Tagung der Alpenkonferenz

Réunion de la Conférence alpine

Sessione della Conferenza delle Alpi

Zasedanje Alpske konference

XVI

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ANLAGE/ANNEXE/ALLEGATO/PRILOGA

5 Activity Report of the Soil Protection Working Group for the period between the XV and XVI meetings of the Alpine Conference

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ACTIVITY REPORT OF THE
Soil Protection Working Group
FOR THE PERIOD BETWEEN THE XV AND XVI MEETINGS OF THE ALPINE CONFERENCE (April 2019 – December 2020)

1. Overview of the mandate or relevant decision of the Alpine Conference

Summary of the main tasks according to the 2019-2020 mandate (for Working Groups) or decision ACXV/A6 of the XV Alpine Conference (for Boards)
The activities foreseen for the Soil Protection Working Group in its first mandate period: 1. Foster exchange and awareness-raising concerning soil protection also by close cooperation with existing networks on soil protection with focus on Alpine soils and especially on vulnerable soils like wetlands and peatlands. 2. Facilitate the implementation of Articles 20 (establishment of harmonized databases) and 21 (establishment of permanent monitoring areas and coordination of environmental monitoring) of the Soil Conservation Protocol. 3. Address the interlinkages between qualitative and quantitative aspects of soil protection. 4. Report on challenges and solutions towards a more economical and prudent use of soils in the Alps. 5. Support of the Alpine Soil Partnership (Network for Soil Protection). The Soil Protection Working Group was chaired by Germany.

2. Meetings

Summary of the meetings (date, place, main topics and outcomes)
The Soil Protection Working Group met five times during the mandate period. In these meetings, all topics foreseen by the mandate were tackled. • 1st meeting: 18 – 19 June 2019, Munich (Germany). The focus topic was the definition of the work plan: Alpine Soil Partnership; start of a stock-taking of current soil relevant networks and projects; option of collecting soil awareness raising activities in the perimeter of the AC; idea of Alpine Soil Film Tour; soil functions assessment; first

exchange on permanent soil monitoring areas; collection of important topics, which should be address regarding interlinkages between qualitative and quantitative aspects of soil protection.

- 2nd meeting: 16 – 17 October 2019, Innsbruck (Austria). Topics: Exchange with PLANALP and the Youth Parliament to the Alpine Convention (YPAC); workshop with ACB for developing soil implementation pathways; overview of institutions, partnerships, networks and projects; development of Alpine Soil Film Tour concept; defining process for developing the report on economical and prudent use of soils in the Alps; second exchange on permanent soil monitoring areas based on submitted questionnaires; discussion on difficulties regarding soil data harmonization; first exchange on agriculturally used moorlands. The meeting took place back-to-back to the final conference of the Links4Soils project and the Austrian Soil Forum including a joint lunch to foster exchange between the Group and actors like the Alpine Soil Partnership.
- 3rd meeting: 22 April 2020, virtual (originally planned for Bolzano/ Bozen (Italy)). Topics: update on Alpine Soil Partnership; presentation of Links4Soils results of the survey on the implementation status of the Soil Conservation Protocol of the Alpine Convention; update on Alpine Soil Film Tour; update on process to develop the report on economical and prudent use of soils in the Alps with focus on data availability; brief exchange on permanent soil monitoring areas based on submitted 1st and 2nd questionnaires; discussion that LUCAS Soil should play a significant role regarding a harmonized database in the Alps and presentation of former Interreg Alpine Space Project "Monitoring Network in the Alpine Region for Persistent and other Organic Pollutants"; outcomes of workshop on European peatland strategies and current work on peatlands of the project Impuls4Action; definition of proposals of concrete priority measures for the French Presidency.
- 4th meeting: 21 - 22 July 2020, virtual. Topics: update on the Alpine Soil Partnership; concluding the stock-taking of institutions, projects and networks; soil function maps for soil awareness raising; update on Alpine Soil Film Tour; exchange on first draft version of the report "economical and prudent use of soil in the Alps"; discussion on stock-taking of permanent soil monitoring areas; exchange with JRC on LUCAS Soil and the issue of harmonizing and availability of national/regional soil data; exchange on soil excavation material; strategies on the implementation of the Sustainable Development Goals (SDGs) regarding soil; peatlands in the Alps; future mandate.

- 5th meeting: 07 October 2020, virtual. Topics: update on Alpine Soil Partnership; update on new work program of EUSALP AG 6; update on planed mandate for a Working Group on Spatial Planning of the Alpine Convention; update Alpine Soil Film Tour; finalizing report on economical and prudent use of soil in the Alps; finalizing stock-taking of permanent soil monitoring areas; presentation of LUCASSA and further exchange on LUCAS Soil; exchange on agriculturally used peatlands.

3. Activities carried out

Synthetic report on activities carried out (including outreach and communication activities)
• Establishment of the Soil Protection Working Group (composed of representatives of the Alpine States and observers). • **Exchanges** with PLANALP, members of the YPAC and a workshop on developing implementation pathways for reaching the Alpine Climate Target System 2050 in the field of soil protection took place during the 2nd meeting. Furthermore the 2nd meeting was organized back-to-back to the Alpine Soil Forum to foster exchange with Links4Soils, the Alpine Soil Partnership and the Austrian Soil Forum. Further exchanges took place regarding a workshop on European peatland strategies, with Impuls4Action, with the office LAND-PLAN, EUSALP AG 6 and a spatial planning expert regarding a possible future spatial planning working group of the Alpine Convention. With focus on soil data harmonization and soil monitoring sites an active cooperation with the Joint Research Center of the European Commission (JRC) was started. Furthermore, information about relevant meetings and conferences in connection to soil topics in the Alps (e.g. EUSALP AG 6 final conference, ELSA annual conference, Eurosoil conference) were shared during meetings and as written information. A stock-taking of institutions, projects and networks, with whom it is relevant to exchange regarding soil protection and in the Alps was done. • The concept of an Alpine Soil Film Tour consisting of movie screening events with accompanying program by e.g. soil scientists of movie authors in the Alpine States was developed in order to reach a broader and younger target group with those soil **awareness-raising** events. Three movies, which had won the award “Best film on the topic of soil” between 2015 and 2019 at the Innsbruck Nature Film Festival, had been chosen and the five film clips on soil in the Alps developed in scope of Links4Soils were added to this list. After a promising start of planning Alpine Soil Film Tour event options in most Alpine States the COVID-19 pandemic limited the activities significantly. Gladly

Alpine Soil Film Tour events might still take place in Innsbruck (Austria) in autumn and in December in Mojstrana (Slovenia) as well as virtually in Berlin (Germany). Furthermore, the importance of soil function maps for awareness raising and to enable well informed decision making was addressed.

- Regarding the **facilitation of the implementation of Articles 20 (establishment of harmonized databases) and 21 (establishment of permanent monitoring areas and coordination of environmental monitoring) of the Soil Conservation Protocol** a stock-taking of soil monitoring mechanisms and areas was undertaken by collecting them by a first questionnaire. On that basis, international monitoring mechanisms, which generate comparable soil data and comprise sites in the Alpine region, were identified and collected by a second questionnaire. The results were analyzed and summarized. Since also on the EU level the harmonization of national or regional soil data was not possible due to differing systems and data gaps, the LUCAS Soil survey coordinated by EUROSTAT and implemented by the JRC, was introduced. Thus, the Alpine EU Member States and in the survey 2015 also Switzerland were covered by the LUCAS Soil survey and should be considered regarding this topic. An active cooperation with the JRC on that topic was started at the 4th meeting of the Working Group.
- Regarding the **interlinkages between qualitative and quantitative aspects of soil protection** some topics were chosen to exchange on, such as soil function assessment, excavation material, peatlands, strategies on the implementation of the Sustainable Development Goals (SDGs) regarding soil.
- Exchange on agriculturally used **peatlands** took place during the 2nd and 5th meeting. Furthermore, in the 3rd and 4th meeting a peatland focus was implied by respectively presentations and discussions of the European peatland strategy workshop outcomes and its implications for the Alpine area, the intermediate results of the Impuls4Action work package on peatlands, the Bavarian Masterplan Peatlands and the Swiss peatland strategy. Lastly also a chapter on wetland, peatland and moor areas was included in the report on economical and prudent use of soils.
- The **report on challenges and solutions towards a more economical and prudent use of soils in the Alps** was jointly developed by the Working Group. As a first step questions were proposed by the members, around which a structure for the report was developed. In the next step the questions were answered by the members and based on those answers and including additional sources the report was drafted and finalized.
- The **Alpine Soil Partnership** (AlpSP, Network for Soil Protection) was discussed at every meeting of the Group. The Group underlined the importance to support the AlpSP

preferably by finding a permanent solution and defined this as a concrete priority measure proposed to the French Presidency of the Alpine Convention. The matter was presented to the 68th and to the 69th meeting of the Permanent Committee. The Chair of the Working Group succeeded to establishing a solution to support a staff member at the Climate Alliance Tyrol as coordination unit for the AlpSP for about 2 years, with financial support of Austria, Germany and Switzerland.

4. Results and outputs

Description of main results and outputs achieved
• **Exchange** fostered with PLANALP, YPAC, ACB, Links4Soils, AlpSP, JRC, office LAND-PLAN, EUSALP AG 6, Impuls4Action, ELSA. Stock-taking of institutions, projects and networks relevant for soil protection in the Alps. • **Awareness-raising** concept "Alpine Soil Film Tour" developed for broad and young target group and probably first three Alpine Soil Film Tour events in Austria, Germany and Slovenia. • Steps for **facilitation the implementation of Articles 20 (establishment of harmonized databases) and 21 (establishment of permanent monitoring areas and coordination of environmental monitoring) of the Soil Conservation Protocol** done by stock-taking of soil monitoring areas in the perimeter of the Alpine Convention, discussions on data harmonization and establishment of a cooperation with the JRC regarding the LUCAS Soil survey. • Selected **interlinkages between qualitative and quantitative aspects of soil protection have been addressed** during the meetings. • Exchange and networking on **wetlands and peatlands** fostered at 4 meetings and probably a project on capacity building, knowledge exchange and networking on peatlands in the Alps developed and starting soon by Germany with partners from the Alps. • The **report on challenges and solutions towards a more economical and prudent use of soils in the Alps** was elaborated. • Active work has been done to **support the Alpine Soil Partnership.**

5. Cooperation

Description of cooperation initiatives and activities with other Alpine Convention Thematic Working Bodies and other relevant bodies and processes (e.g. EUSALP)
• See 3.: activities carried out on exchange, and the attachment "Stock-taking of institutions, projects and networks relevant for soil protection in the Alps"

6. Attachments

List of the documents attached to this report, such as papers proposed for approval by the XVI Alpine Conference (thematic reports, guidelines, statements etc.) and supporting documents (workshop proceedings, survey reports etc.).
1. *Report "Economical and prudent use of soil in the Alps"* 2. *Stock-taking summary of permanent soil monitoring areas in the perimeter of the Alpine Convention* 3. *Cooperation with the JRC regarding the Soil Conservation Protocol Articles 20 and 21: Harmonized Databases and Soil Monitoring* 4. *Stock taking of institutions, projects and networks relevant for soil protection in the Alps*

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Economical and prudent use of soil in the Alps

This report was approved by the Alpine Conference at its XVI meeting, held on 10 December 2020.

The report "*Economical and prudent use of soil in the Alps*" was coordinated by the German Presidency of the Soil Protection Working Group and the Permanent Secretariat of the Alpine Convention and has been drafted by the German Presidency of the Soil Protection Working Group, its members and the Permanent Secretariat.

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Switzerland: Alexis Kessler (Federal Office for Spatial Development)

Observer: Guido Plassmann & Veronika Widmann (ALPARC), Marion Ebster (CIPRA International), Liliana Dagostin (Club Arc Alpin), Nicolas Chesnel (Interreg Alpine Space), Ursula Schüpbach (ISCAR), Maria Schachinger & Elisabeth Sötz (WWF)

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1. Why is it crucial to use our soil economically and prudently?

We need our soil for producing food, for growing forests, for filtering, storing, transforming and purifying water, nutrients and substances, for regulating the water household, for local climate regulation and for global climate regulation by playing a crucial role in the carbon cycle. Biodiversity in soils is the basis for biodiversity above soils. Soils store history: one can find puzzle pieces of natural events, human history and ancient climate changes in soils. We enjoy walking on soil: on mountain pathways, in mountain forests, thorough meadows and yet rarely think about, that it is all there only because of soils. The reason is simple: we often do not think about things we cannot see, and this is valid for soil: it is only recognized, where it lays open.
But it is time for realizing that we need to do more to preserve our soils. This is not only needed for preserving a good quality of our soils, but also common efforts by everyone are necessary to ensure, that enough healthy soils will be left to guarantee that also our children will have enough food, clean water, diverse species of animals and plants around them and will be able to walk through mountain forests, green meadows and along vivid streams.

"A nation that destroys its soil destroys itself."
(Franklin D. Roosevelt, 1937)

Soil is the basis for life on Earth - the living skin of the Earth. In constant interaction between earth, air, water, and living organisms, it is a place for the exchange of matter and energy. It is considered a non-renewable resource because of the long times required for its formation. Soils are at the heart of major environmental issues, such as the availability of quality water, the preservation of biodiversity, food security, natural risks mitigation. Soils can also help against or contribute to climate change, depending on how we treat them.

Soil protection is climate protection and nature protection!

Because of its essential role, soils are subject to multiple land use demands for human activities, which can cause soil degradations, such as soil pollution, soil compaction and the mostly permanent degradation of soils for buildings and infrastructure.

What is special in the Alps?
Looking at landscape and settlement systems in the Alps it is easy to identify patterns: most constructions are located, where it is suitable to build them. Flat areas, which are suitable spaces for settlements and other intensive land uses, are more limited in the mountains then in other regions. At the same time, the identic locations are often those with the most productive soils.
Comparable to the melting Alpine glaciers visualising global climate change, the fast growth of consumed land in many Alpine valleys visualises the rapid loss of soils by human activities.

But it is possible to act! Preserving soil means acting on one of the main challenges, humanity is facing.

2. How is soil "*consumed*"?

The definition of soil consumption and soil sealing is complex and differs in the Alpine Countries. Thus, the Compliance Committee of the Alpine Convention (Compliance Committee of the Alpine Convention 2019) has defined the terms as follows:

- *"**Soil/ land consumption (land take)** means the loss of mainly agricultural and biologically productive soils through building, for example for settlement, traffic and leisure purposes. Approximately 40% of these areas are sealed and thus lose all their biological functions.*
- ***Soil sealing** means covering the ground by an impermeable layer. Thus, the soil is reduced to its function as platform for man-made structures and loses its natural functions. Buildings, but also areas that are covered by concrete, asphalt, or paving stones (pathways, parking lots, driveways, company premises etc.) are considered as completely sealed areas."*

2.1 Main drivers for soil consumption in the perimeter of the Alpine Convention

The need of soil and land from multiple different perspectives makes it an issue on which many players must work together. Thus, there are different drivers of soil and land consumption and they are connected to each other. As non-exhaustive aspects of important drivers for soil consumption in the Alps can be considered:

Residential building and construction

Extensions of settlements are important drivers of land consumption. Urban sprawl, detached housing and a lack of regional and supra-municipal planning coordination and control in spatial planning are drivers of the growing demand for land. The growing number of small households, raising living standards and by this the desire for larger apartments lead to increased living space requirements and to an increasing land consumption. Whereas high land prices can often result in high building density, comparably low land prices can lead to higher land take per person. However, in the densification of urban settlements, care must be taken to ensure sufficient green spaces to adapt to climate change. As another driver of land take can be considered declining stock market returns since investors turn towards the real estate market. Depending on the region different demographic developments with population growth in dynamic regions on the one hand, and on the other population decline in less favoured and peripheral regions need to be considered.

Industrial and commercial and logistics purposes

Growth focused economic development in general is associated with a high demand for limited open spaces. Trade and commerce compete for locations and municipalities for residents. This can result in a high demand for building plots in the outskirts.

Transport infrastructures

Improving road standards and building new roads also presents a constant land demand. Despite generally rising land prices, strong price differences exist between rural and urban areas. Consequently, increasing commuter movements and increasing freight transport lead to an increased need for mobility and transport infrastructure.

Touristic and leisure time facilities

Tourism and leisure time facilities also entail spatial demands. Furthermore, some tourist activities take up large areas, which are only used seasonally. In most Alpine Countries, like in Austria, this applies especially to regions inside of the perimeter of the Alpine Convention since they are strongly influenced by tourism.

Renewable energy

There is a high demand for spaces for photovoltaic, large-scale solar power plants as well as for hydropower reservoirs in order to achieve the climate targets. This objective is in competition with e.g. the conservation of valuable agricultural or natural land and needs to be handled with care.

3. Facts and figures

It is important to know, that even though a definition of soil consumption and soil sealing has been defined by the Compliance Committee of the Alpine Convention in 2019, the issue has been researched for a long time and very different data sets have been developed. Thus, the methods behind data sources and the definitions behind the topic differ significantly between states, regions, municipalities, and even different sectors. It must be considered that against this background the data displayed from the single Alpine States are mostly not directly comparable but can only be considered as tendencies.
There are different programs based on remote sensing to enable gaining data not only for supporting the nations in facing this issue but also to allow a comparison by generating harmonious data. However, the topic of soil consumption and sealing comprises very detailed spatial patterns thus, all approaches entail both, advantages and disadvantages.

The CORINE (Coordination of Information on the Environment) research programme was launched on a proposal from the European Commission in order to collect and bring together data on the state of the environment and natural resources. This database was initiated in 1985 and the datasets from 1990, 2000, 2006, 2012 and 2018 have been completed. The CORINE Land Cover database is based on the interpretation of remotely sensed images whose analysis is cross-referenced with existing maps and aerial photographs. Amongst others the European Environmental Agency (EEA) takes CORINE Land Cover data for informing about land take (EEA 2020a). But "*while the level of detail provided by the CORINE Land Cover project has allowed largescale international comparisons and helped raise awareness of the extent of landscape changes across the EU, it cannot provide a meaningful database for local approaches (Decoville & Schneider 2015). It can also lead to a high error rate in terms of interpretations (Batista et al. 2013). So while it can be useful for general comparisons and observing trends, it is not ideal for measuring the evolution of land take within nations. Any figures based on the data should be considered a conservative estimate.*" (Science for Environment Policy 2016). This is also valid for the specific orographic and land use patterns in the Alps.

The Copernicus mission developed high resolution imperviousness data available for 2006-2015, which can supplement the land take indicator with its information with a higher spatial resolution and a more direct measurement of imperviousness (EEA 2020b). With this high resolution of 20-100m pixel size and the new method this data marks a significant improvement (Copernicus Land Monitoring Service 2020). The data is still not sufficiently exact for the use on a regional or local level, since soil sealing patterns are often smaller than the used resolution of 20-100m. But keeping this in mind, the data allows comparison between the Alpine States.

Table 1 gives an impression of the percentage of sealed area of the total State's territory in 2006 and in 2015. The map in figure 1 displays the average annual change in soil sealing between 2006 – 2015 in the EU. Differences between these data and following national data are caused by different methods, sources, different data acquisition and processing as well as differing definitions of soil consumption and soil sealing as explained above.

State	Share of sealed land of the total State's territory	
	2006	2015
Germany	4,18 %	4,31 %
Slovenia	1,62 %	1,68 %
Austria	1,72 %	1,78 %
Italy	2,66 %	2,74 %
France	2,09 %	2,19 %
Switzerland	2,69 %	2,79 %
Liechtenstein	4,43 %	4,51 %

Table 1: Share of sealed land of the total State's territory. Data source: EEA 2020c.

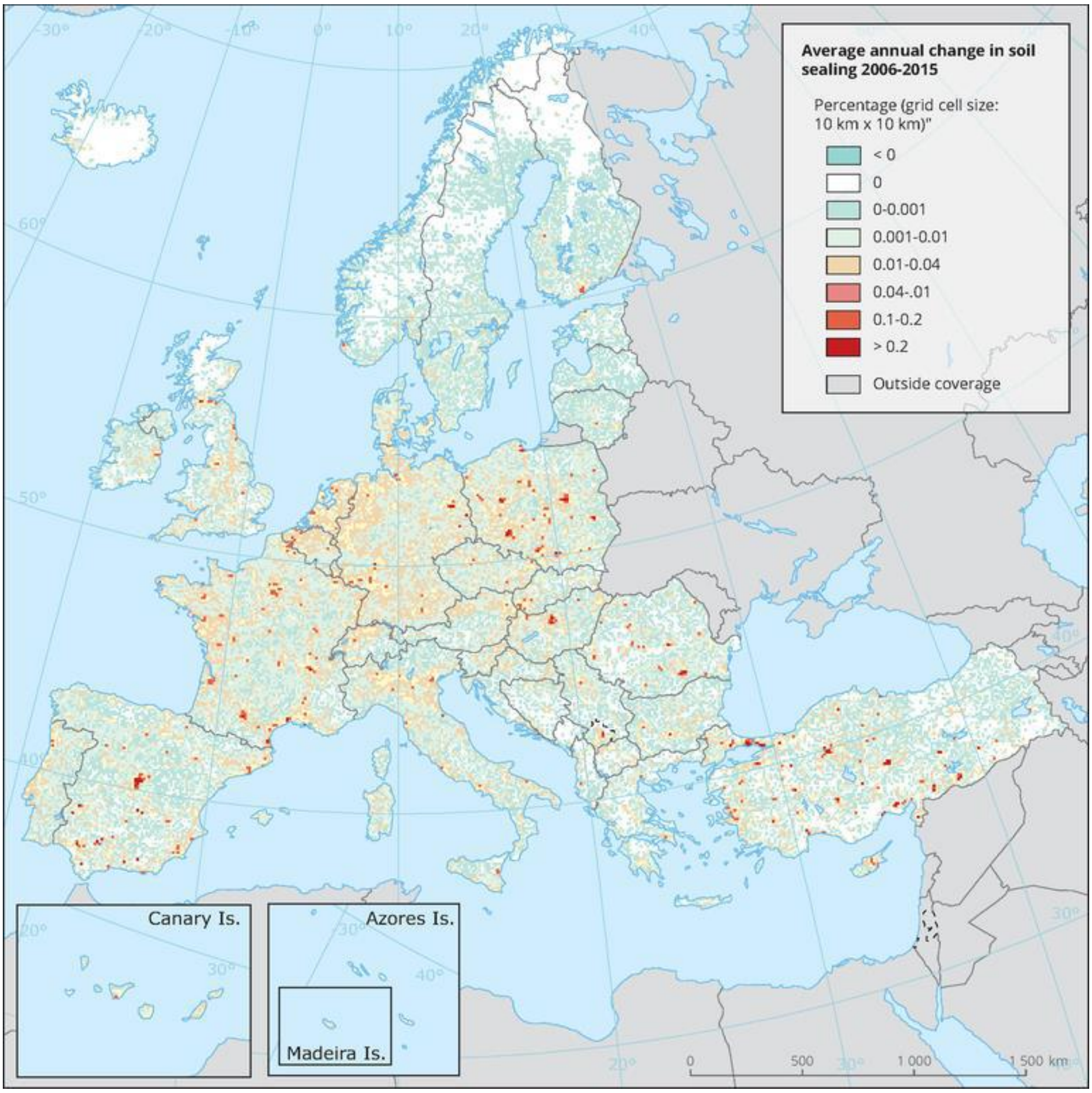

Figure 1: Average annual change in soil sealing in the EU 2006-2015. Source: EEA 2020d.

In total numbers soil consumption in the Alpine area tends to be lower than in surrounding flatter land which can result from a lower share of population and settlements. But at the same time the part of the Alpine area which is suitable for constructions and agricultural use is much less compared to the surrounding flatter areas like figure 2 shows. The soil sealing rates thus need to be contrasted by the area of land, which is suitable to provide a platform for most human activities.

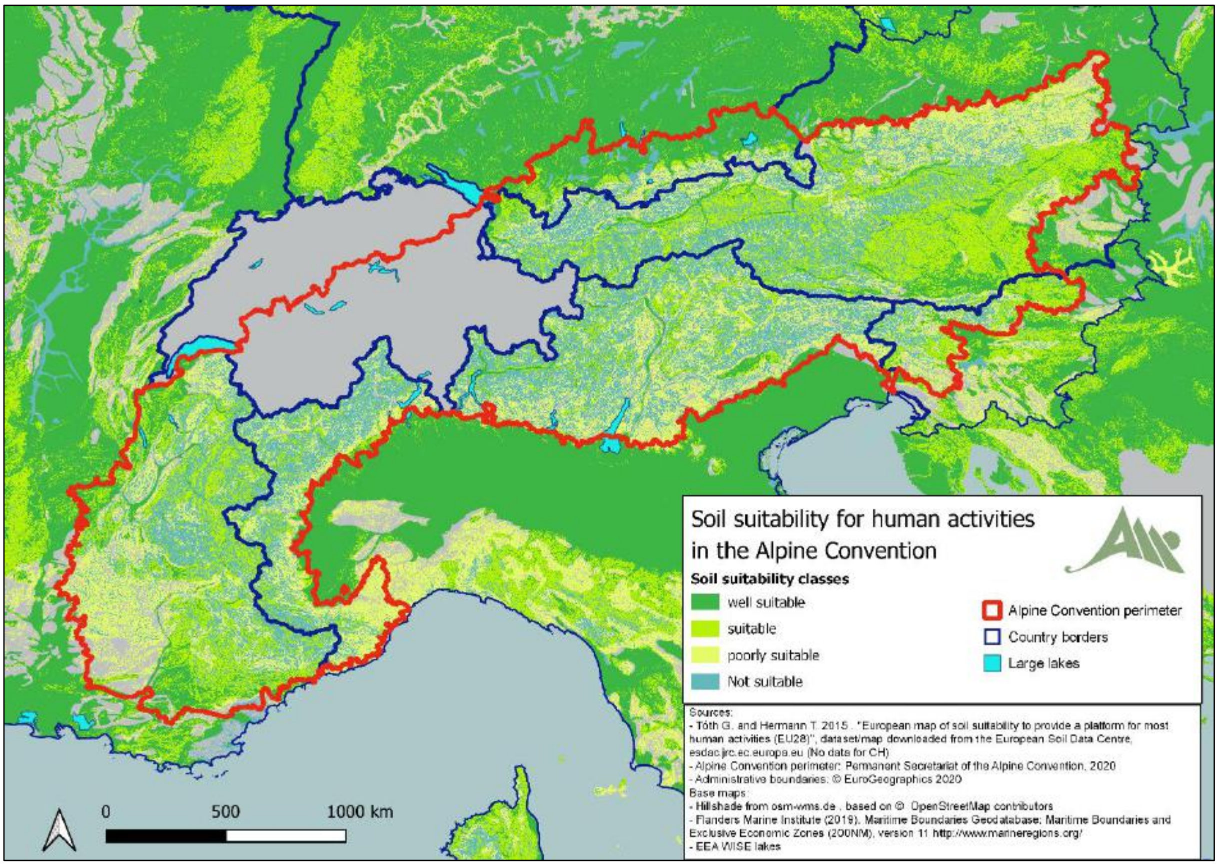

Figure 2: Soil suitability for human activities in the Alpine Convention.

3.1 Figures from the Alpine States

In Austria 5.729 km² soil was consumed (taken land) until 2019, this accounts to ca. 7 % of the Austrian territory and to ca. 18% of the permanent settlement area (Environment Agency Austria 2020). The permanent settlement area in Austria comprises 37% on average, with a wide range from 12% in Tyrol to 74% in Vienna. It should be noted that currently 20% of the permanent settlement area is covered by settlement and traffic areas. In 2011 it was only 15%. Figure 3 compares the shares of different land use categories in Austria, Tyrol, Lower Austria and the part of Lower Austria laying within the Alpine Convention perimeter (ALP). Defined as "*consumed land*" are the categories "*buildings and side areas, industrial and commercial areas, mines, dumps and landfill areas*", "*gardens, leisure areas, cemeteries*" as well as "*traffic areas*". The example of Lower Austria, that lies only partly inside the ALP, visualised that significant land use differences between the whole territory and the ALP territory do exist. With a similar share of "*consumed land*" the agricultural used area is reduced by almost half to 26 %. Differences in land use are even more significant in comparison with Tyrol, which lays completely within the ALP.

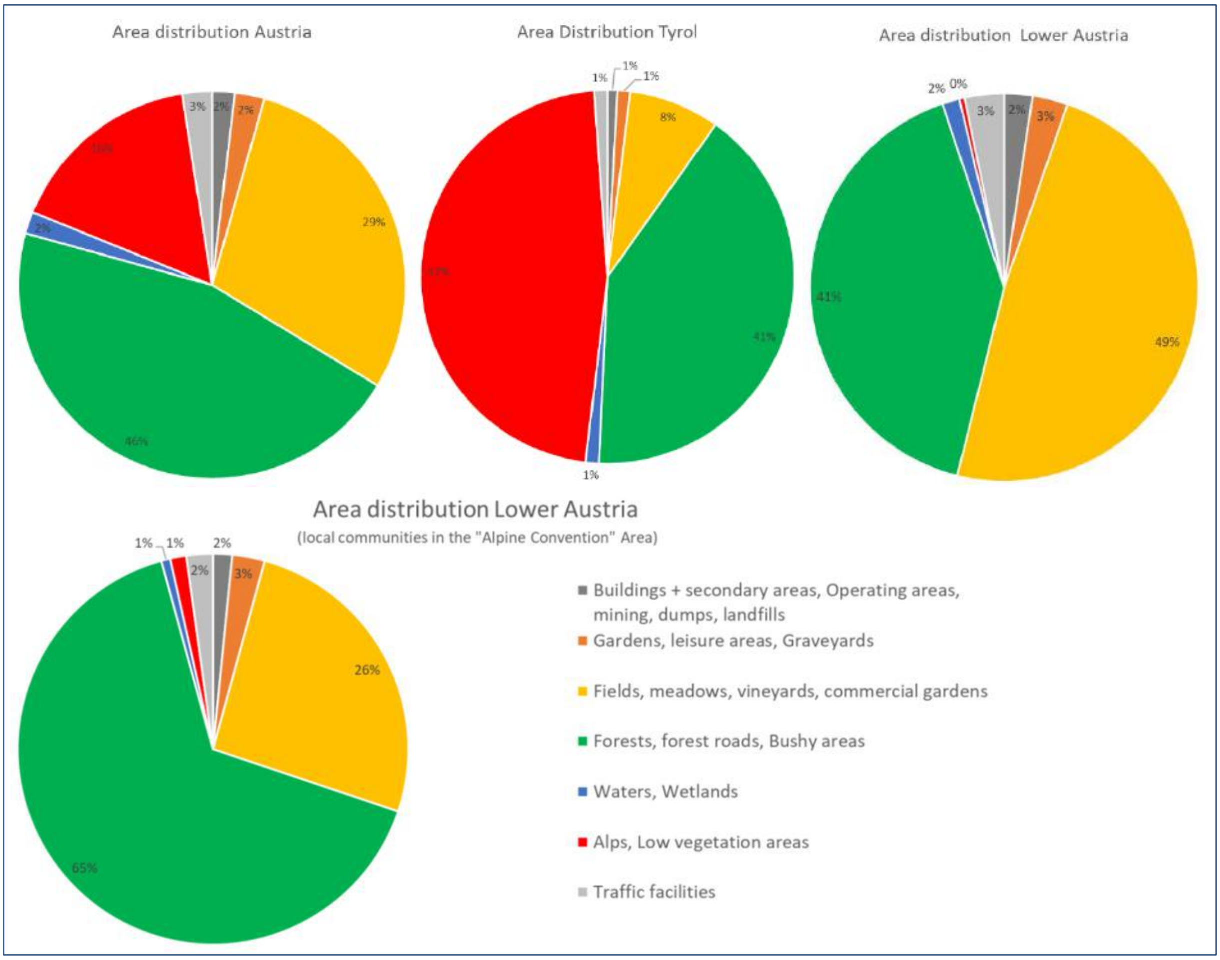

Figure 3: Share of land use categories in Austria, Tyrol, Lower Austria and in the Alpine Convention perimeter of Lower Austria.

Based on the above-mentioned Copernicus high resolution layer imperviousness the ÖROK atlas for spatial observation provides overviews on the soil sealing in Austria. The Alps are highly visible in figure 4, which is displaying the share of sealed areas in 2015 in a 1 km grid. While on first sight the Alpine area looks less affected by sealing a closer look reveals a high percentage of sealing in the Alpine valleys.

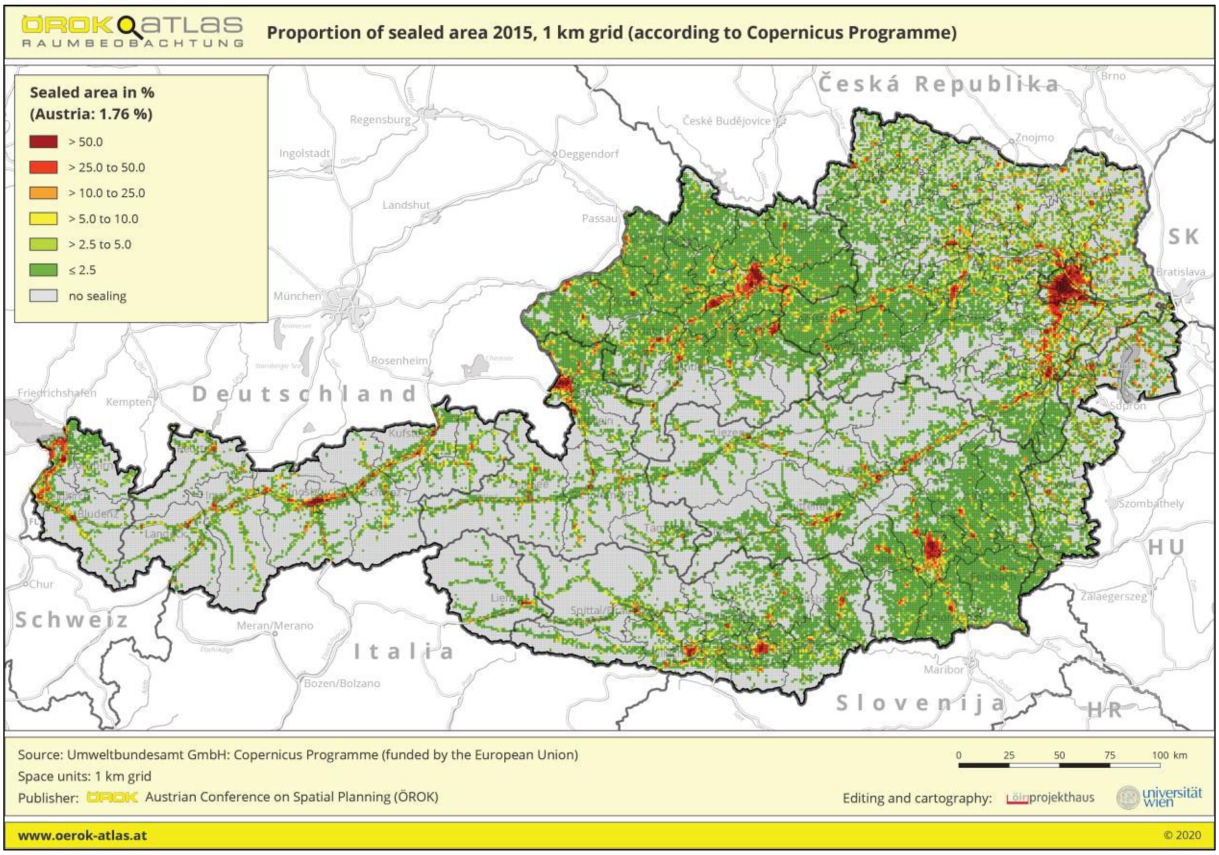

Figure 4: Share of sealed areas 2015 in a 1 km raster (according to the Copernicus High Resolution Layer Imperviousness). Source: ÖROK Atlas 2020.

In Bavaria 10 hectares per day were additionally consumed for settlement and traffic areas in 2018. In the overview in figure 5 a direct comparison between the data before and after 2013 is not possible due to changes in the nationwide uniform statistics of the surveying administrations. The Bavarian State Planning Act plans to introduce a benchmark of a maximum of 5 ha for additional land use for settlement and transport purposes. The area of the Alpine Convention perimeter in Bavaria comprises around 11.127 km² and thus around 15.8% of the total areal extend of Bavaria.

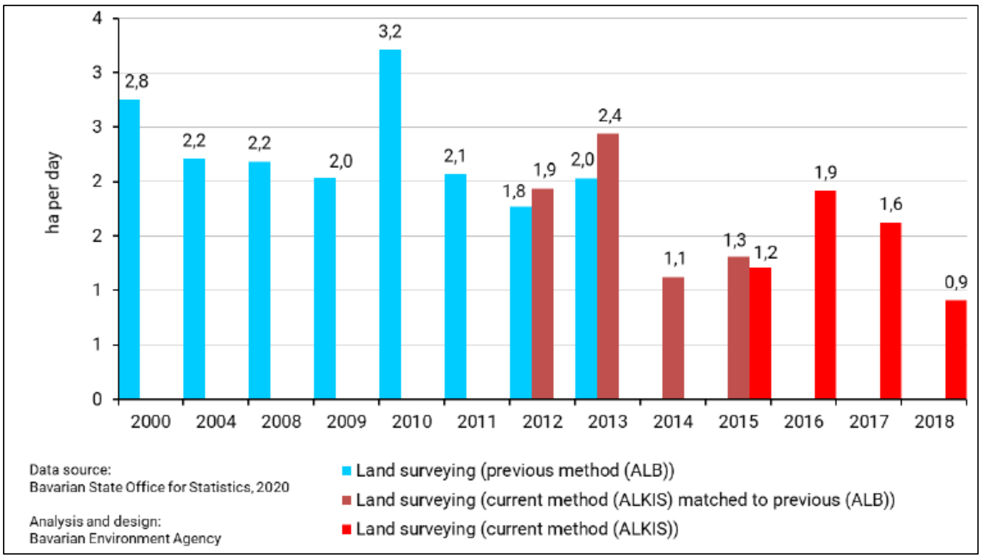

Figure 5: Land consumption in the Bavarian area inside the Alpine Convention perimeter.

Bavaria examined the degree of surface sealing of all designated settlement and traffic areas in the municipalities in detail in 2007 by using satellite images from 2000. This study was then repeated using data from 2015. In 2015 the average degree of surface sealing of designated settlement and traffic areas on the municipal level for the perimeter of the Alpine Convention was around 49.5% and 50.9% for the whole area of Bavaria. The "*Landsat*" images used had a 30 m resolution and were classified with a total accuracy between 70 and 84%. The study considered streets and railroads with a likely width below 30 m with additional vector datasets.

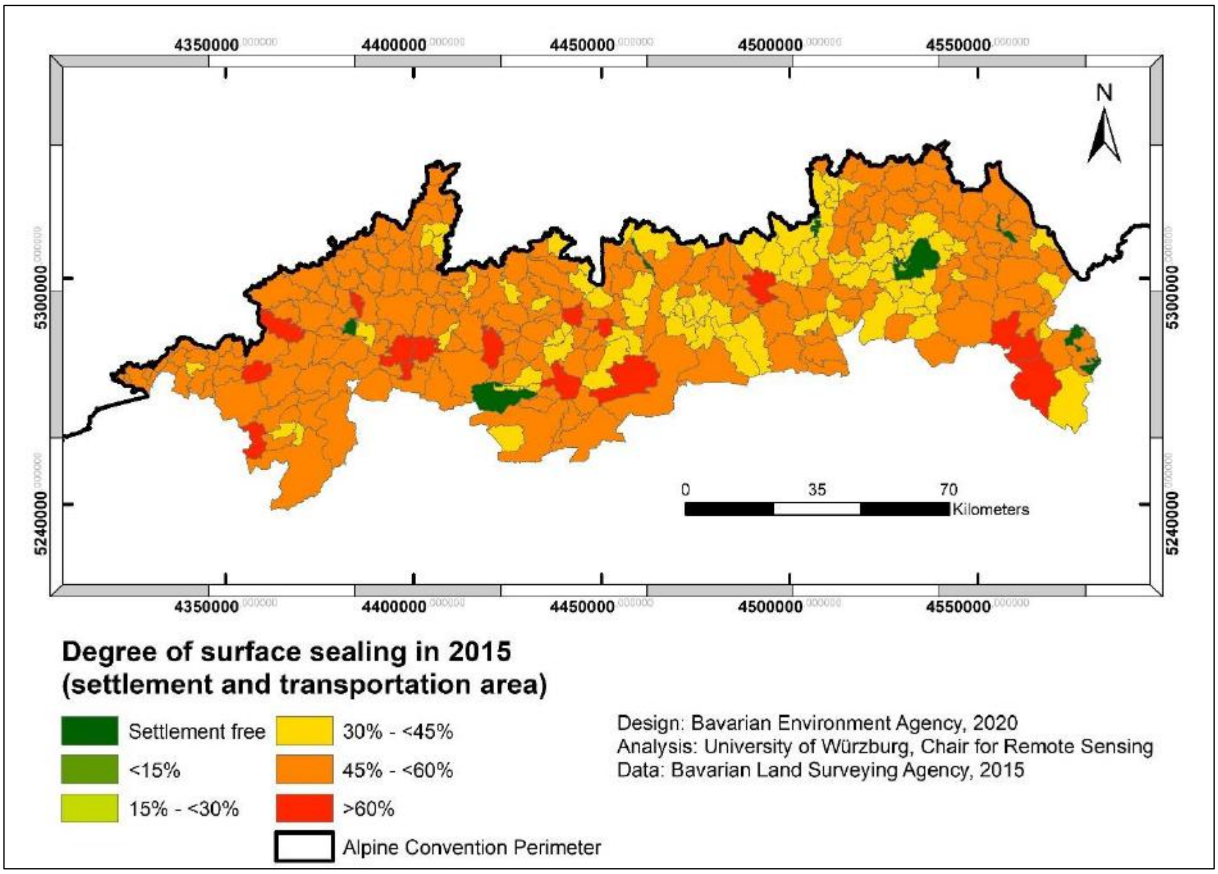

Figure 6: Degree of surface sealing in Bavaria in 2015 (settlement and transportation area).

As mentioned before the type of data source used is significant for being able to display meaningful data on soil consumption. Three main sources of data are available to measure soil uses and artificialisation in France. Each of these sources entails biases for an accurate measurement of artificialisation, defined by non-natural, agricultural and forest areas:

- CORINE Land Cover (CLC) covers the exhaustiveness of the territory, but the results are obtained by extrapolation, and the survey is carried out only once every six years (see also above).
- Teruti-Lucas (TL) is a survey and the results are also obtained by extrapolation from measured points on the territory. It therefore does not provide an accurate measure of artificialisation over the whole territory more than CLC does.
- The land files (LF) do not include land that is not included in the cadastre (such as the public domain, which includes all roads). Conversely, as soon as a plot of land is classified as "*to be built on*", it is counted as artificial, whereas it may remain unbuilt for years or even decades.

As they are not based on the same methods of analysis, particularly in terms of spatial resolution and nomenclature of accounted land, these sources are at the origin of various estimates of the artificialisation processes. Data from land files, recorded at the scale of the cadastral parcel, present the finest level of analysis and therefore allow precise measurement of the dynamics of land use change. The following key data (France Statégie 2019) are comparing these 3 sources and express the extend of differences. This can result in looking e.g. at the increase in artificial surfaces:

- CLC: 16,000 ha / year for 2006-2012,
- TL: 61,200 ha / year between 2006 and 2014,
- LF: 23,000 ha / year between 2006 and 2016.

Only the Teruti-Lucas data allow a long-term analysis of artificialisation and thus of the evolution of land use via this indicator. Since 1981, the increase in artificialized land has averaged around 60.000 hectares per year. Artificialized land has thus increased from 3 million to 5,1 million hectares, which represents a growth of 70%. This represents a much higher growth than that of the population (+19%) in the same period.

Data based on the Teruti-Lucas surveys conducted between 2000 and 2019 on the topic of soil consumption for the French Departments which lay completely or partly inside the French perimeter of the Alpine Convention are given in table 2.

Department inside or partly inside of the AC perimeter & France	Newly artificialized soils 2000-2019 (ha)	Newly artificialized soils 2000-2019 (%)	Sum of artificialized soils 2019 (%)	Artificialized soils difference 2000-2019 (ha/day)	Artificialized soils per inhabitant (m² 2019/inhabitant in 2020)
Drôme	12.706	1,94%	8,93%	1,74	1.100
Isère	9.825	1,25%	9,50%	1,35	600
Savoy	4.481	0,71%	5,11%	0,61	700
Upper Savoy	9.444	1,95%	11,06%	1,29	600
Alpes of Upper Provence	8.033	1,15%	2,87%	1,10	1.200
Upper Alps	3.321	0,58%	2,67%	0,45	1.100
Maritime Alps	7.861	1,83%	9,15%	1,08	400
Var	32.170	5,33%	12,81%	4,40	700
Vaucluse	15.705	4,39%	15,28%	2,15	1.000
Sum Departments	**103.546**	**2,13%**	**8,16%**	**14,17**	**700**
France	1.008.263	1,84%	9,71%	138,04	800

Table 2: Artificialized soils in French departments inside or partly inside of the French AC perimeter and France. Source: Agreste - Statistique Agricole Annuelle (SAA) 2020.

While the share of artificialized soils in 2019 in the departments which lay inside or partly inside of the AC perimeter in not much lower than in the whole French territory, the percentage of additional artificialized soils between 2000 and 2019 was even higher in the Alpine departments than compared to the whole area of France.
According to the land records available since 2006, the increase in artificial land was lower in the timespan 2006-2016, however, still higher than the population growth. In the period 2006-2014 Teruti-Lucas and the land files are consistent in identifying a strong acceleration of artificialisation just before a crisis in 2008 and then returned to a value below the long-term average.

Inside of the perimeter of the Italian Alps lay 1.645 municipalities, 24 provinces and 7 regions, adding up to an area of over 5.200 hectares.
Homogeneous data on land consumption in Italy are processed by the Italian Institute for Environmental Protection and Research (ISPRA), which refers to the category "*artificial land cover*". Some Italian regions also have other data, which refer to the definitions of land consumption introduced by the respective regional laws and mostly concern the consumption on the basis of the municipal plans in force (urbanized surfaces or surfaces that can be urbanized, also classifiable on the basis of the type of residential or other settlement). ISPRA data on land consumption in Italy are available for 2012, 2015, 2016, 2017, 2018 and 2019. For each year they are assessed at municipal, provincial, regional and national level (ISPRA 2020a). The sealed part of land consumption is assessed since 2017 for all new artificial areas. The soil sealing in 2019 was about 23% of total land consumption growth but it should be considered that the 70% which is not sealed yet is classified as building site. It thus can be assumed, that most of it will be sealed in the next years.
The analysis by ISPRA and the Italian National System for the Protection of the Environment (SNPA) is based on the municipal level and considers some indicators for 2012 and 2019. As illustrated in table 3 land consumption between 2012 and 2019 has grown by 2.734 hectares (+1,44%) in the Italian part of the Alpine Convention perimeter. Trentino-Alto Adige/South Tyrol

is the region in which land consumption has increased the most (1.074 ha, +2,54%). The artificial land cover per inhabitant in the Alpine municipalities in Friuli-Venezia Giulia and Liguria are the highest - respectively 735 and 728 m^2 per inhabitant. Considering the whole extend of the Italian Alpine Convention perimeter 2012 - 2019 more than 1 hectare per day was lost.

Region (municipalities in the AC perimeter)	Land consumption growth 2012-2019 (ha)	Artificial land cover of total area 2019 (%)	Land consumption growth 2012-2019 (%)	Land consumption growth 2012-2019 (ha/day)	Land consumption 2019 (m^2 per inhabitant)
Piedmont	426	4,42%	1,00	0,17	502
Aosta Valley	124	2,15%	1,80	0,05	557
Lombardy	333	6,15%	0,76	0,13	345
Trentino-Alto Adige/South Tyrol	1.074	3,19%	2,54	0,42	408
Veneto	566	7,16%	1,70	0,22	491
Friuli-Venezia Giulia	179	5,32%	1,17	0,07	735
Liguria	32	3,52%	0,60	0,01	728
AC perimeter	**2.734**	**4,75%**	**1,44**	**1,07**	**447**

Table 3: Land consumption in the Italian municipalities inside the AC perimeter displayed per Region. Data source: ISPRA - SNPA 2020.

Mountain areas are generally less artificialized than other areas in Italy, where the average artificial land cover of the total area is 7,1%. Considering the map of the land consumption in municipalities in 2019 (figure 7) it is possible to see that the distribution of the artificial areas is concentrated in the South, near Po Valley and in the valleys of Trentino-Alto Adige/South Tyrol.

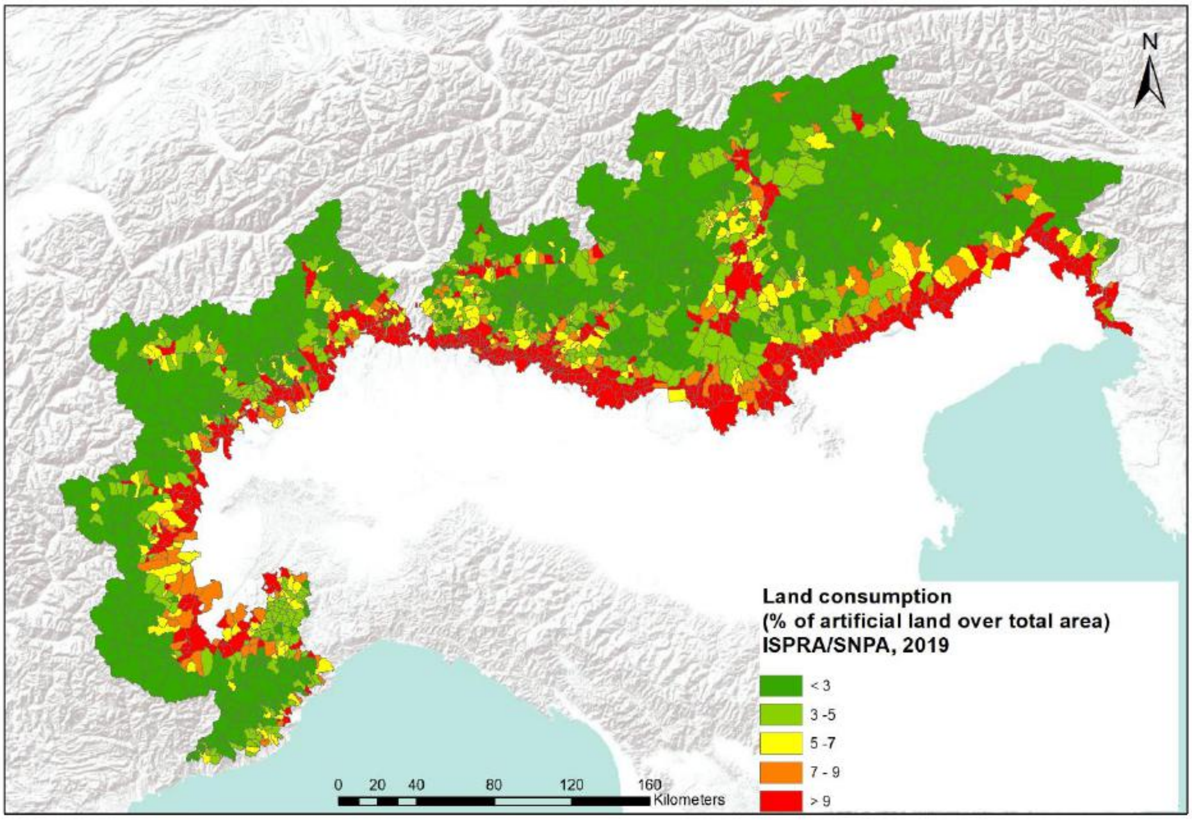

Figure 7: Artificial Land cover in the perimeter of the Alpine Convention in 2019 at municipal level. Source ISPRA - SNPA 2020.

According to the land-use statistic soil consumption in Liechtenstein amounts to 16,8 ha per year in the timeframe between 1984 and 2014. The settlement area made up ca. 11 % of the territory of Liechtenstein in 2014. (Amt für Statistik Fürstentum Liechtenstein 2020). According to an evaluation of the land cover mapping data soil sealing in Liechtenstein amounts to 8,37 ha per year (2015 – 2019).

	1984	1996	2002	2008	2014	2015	2019
Consumed land (in ha)	1.259	1.465	1.578	1.683	1.762		
Land consumption since previous period (in ha)		206	113	105	79		
Settlement area (m²) per inhabitant	471,9	470,4	466,0	472,9	471,6		
Sealed land (in ha)						1.091,87	1.133,72
Land sealing since previous period (in ha)							41,85

Table 4: Land consumption in Liechtenstein. Data source: Amt für Statistik Fürstentum Liechtenstein 2020.

As explained in more detail in a following chapter Slovenia is currently in the process of collecting data on land consumption. There is no specific data yet on land cover and land use for Alpine Convention perimeter in Slovenia, which encompass 62 whole or part municipalities out of 212. However, for the complete territory of Slovenia data is available.
In 2018, more than half of Slovenia's land area was covered by forests (56 % or 5 8% including shrubland), while other mostly natural vegetation makes up 3%. Farmland occupied 34 % of land area, while slightly less than 4 % was artificial land, and less than 1 % covered by water.
In the periods 1996–2000, 2000–2006 and 2006–2012, land cover and land use changes were relatively small (they occurred on 0,12 %, 0,13 % and 0,09 % of the entire territory, respectively). In the latest period 2012–2018 land cover and land use changes slightly increased as they occurred on 0,44 % of the entire territory. Most of the detected changes were related to forest management, resulting from the sleet damage in 2014.

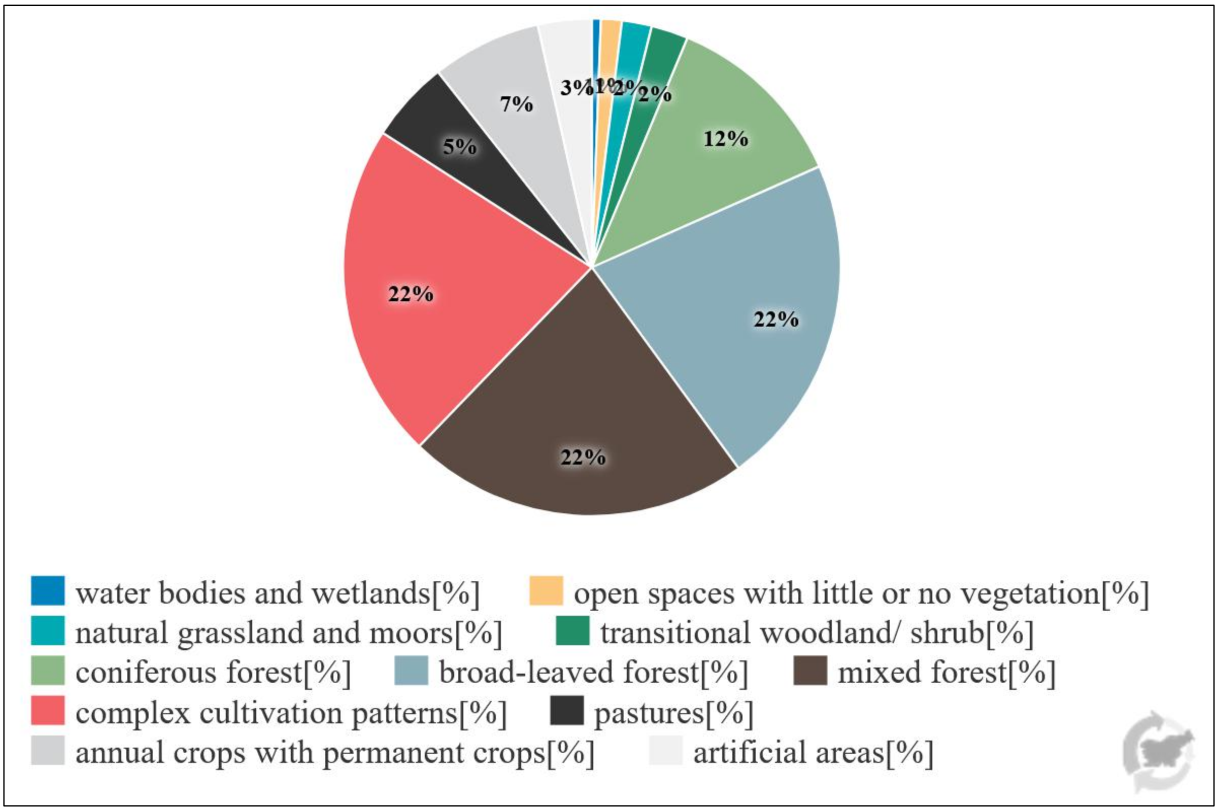

Figure 8: Structure of land cover and land use categories in Slovenia 2018. Source: ARSO OKOLJE Kazalci okolja 2020 and CORINE Land Cover 2018. Ministry of the Environment and Spatial Planning, Slovenian Environment Agency, Surveying and Mapping Authority of the Republic of Slovenia, European Environment Agency (2018).

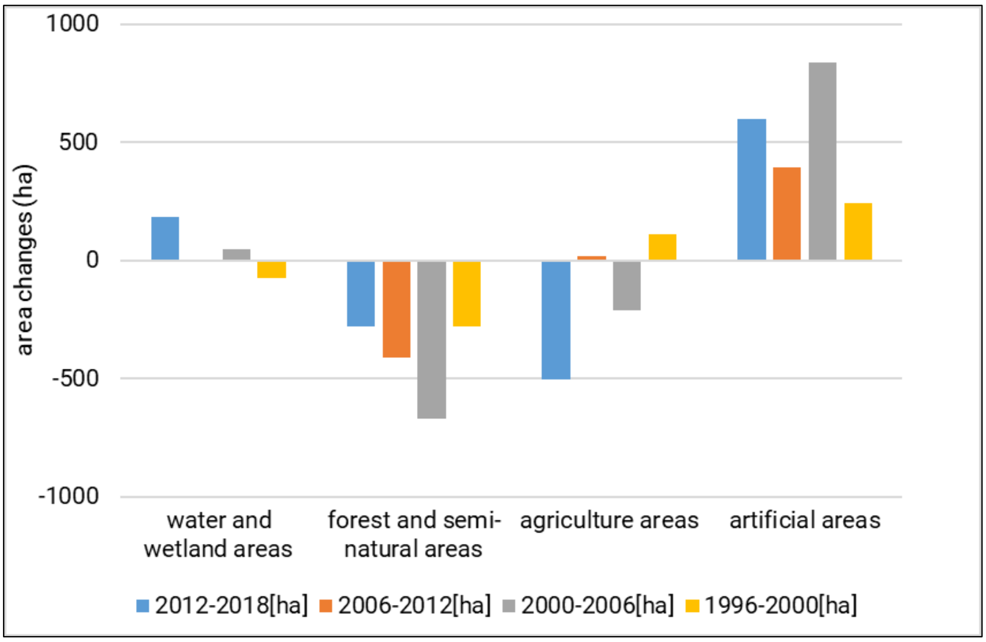

Figure 9: Changes in total area of land cover-land use categories, Slovenina, by period, 1996-2000, 2000-2006, 2006-2012, 2012-2018. Sources ARSO OKOLJE Kazalci okolja 2020 and CORINE Land Cover 2018. Ministry of the Environment and Spatial Planning, Slovenian Environment Agency, Surveying and Mapping Authority of the Republic of Slovenia, European Environment Agency (2018).

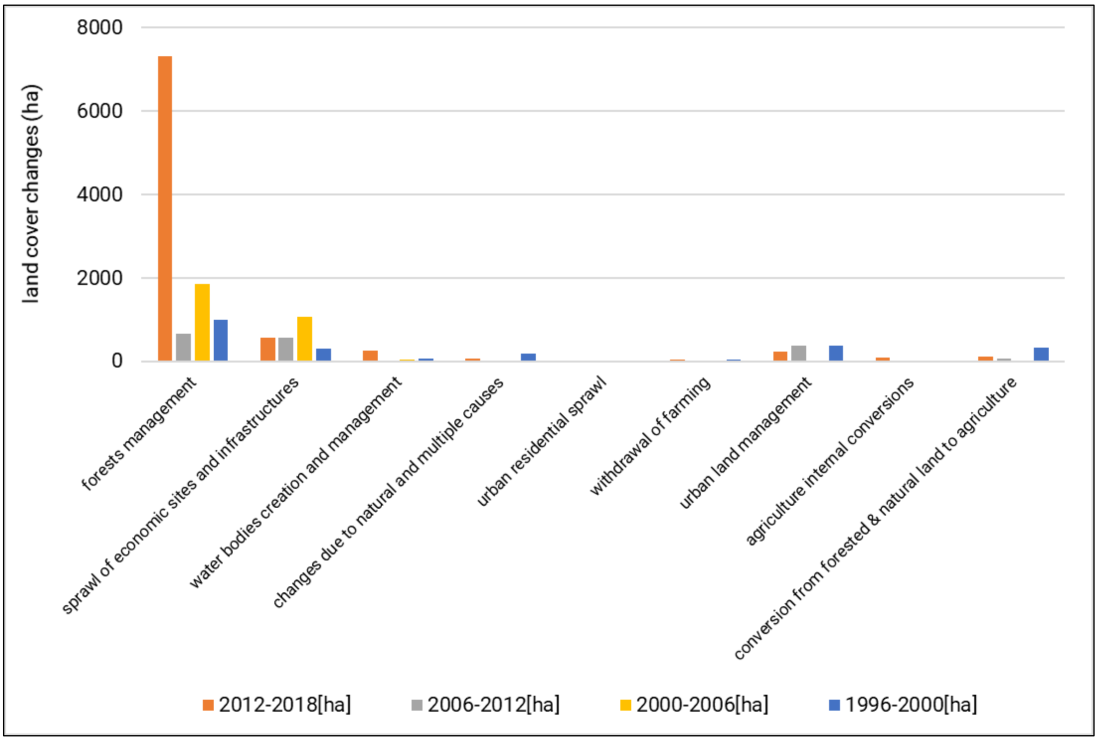

Figure 10: Flows of land cover changes, Slovenia (LEAC, EEA methodology). Sources: ARSO OKOLJE Kazalci okolja 2020 and CORINE Land Cover 2000, 2006, 2012 and 2018; European Environment Agency, Ministry of the Environment and Spatial Planning, Slovenian Environment Agency, Surveying and Mapping Authority of the Republic of Slovenia; European Environment Agency, 2007; European Environment Agency, Slovenian Environment Agency, 2012; calculations Slovenian Environment Agency (SprePok-SI); European Environment Agency, Slovenian Environment Agency, 2018; calculations Geodetic Institute of Slovenia, 2019.

In Switzerland, the data on land consumption is collected in the "*Arealstatistik*", which is conducted during certain time periods. Currently, the data of the newest census is being processed and will be available in 2021. The newest national data are therefore available for the averages of the census period 2004-2009. This means the data per day indicated below are long-term averages. The total size of settlement areas is displayed as consumed land and the total size of sealed areas as sealed soil in table 5.

	1985	2004-2009
Consumed land	249.477 ha	307.898 ha
Average land consumption		6,67 ha/day
Sealed soil	148.742 ha	192.050 ha
Average soil sealing		4,94 ha/day

Table 5: Land consumption in Switzerland. Data source: Bundesamt für Statistik 2020.

3.2 Legally binding quantitative limitations for soil consumption and soil sealing

The need of land from multiple different perspectives makes it an issue on which many players must work together. Even though there are hardly any specific legally binding definite numbers for limiting soil consumption and soil sealing in the Alpine States on the national level, there are several regulations and instruments on different levels and from different fields. There are many regulations which are not directly targeted at soil protection as such but also help to protect the soil, like regulations regarding spatial planning or nature protection. The laws that regulate activities on the soil, are thus plural: spatial development laws (land use, management of its scarcity), civil laws (property rights, easements), rural laws (agricultural exploitation, protection against erosion), health laws (support for measures to protect drinking water catchments).

The in depth review of the Compliance Committee of the Alpine Convention of the subject "*Economical use of soil*" (Compliance Committee of the Alpine Convention 2019) displays this topic and especially the regulations in the Alpine States much more in detail. Regarding the governance in the interface of limiting soil consumption and spatial planning in the Alpine area a study has been carried out in 2018 outlining the different regulations, tools, levels and actors (Zollner, D. et al. 2018).

General guiding principles for the perimeter of the Alpine Convention are set in the Protocol Soil Conservation of the Alpine Convention Article 7:

> *"Economical and Prudent Use of Soils*
> *(1) In drawing up and implementing plans and/or programmes according to article 9 paragraph 3 of the Protocol on Spatial Planning and Sustainable Development, matters regarding soil conservation, especially the economical use of soil and land, shall be taken into consideration.*
> *(2) In order to limit soil sealing and soil consumption, the Contracting Parties shall provide for space-saving construction and an economical use of soil resources. They shall preferably seek*

to keep the development of human settlements within existing boundaries and to limit settlement growth outside these boundaries.
(3) When assessing the spatial and environmental compatibility of large-scale projects in the domains of trade and industry, construction and infrastructure, especially in the transport, energy and tourism sectors, soil conservation and the scarcity of space in the Alpine region shall be taken into account within the framework of the national procedures.
(4) Where natural conditions allow it, disused or impaired soils, especially landfills, slag heaps, infrastructures or ski runs, shall be restored to their original state or shall be recultivated."

As well as in the Protocol Spatial Planning and Sustainable Development of the Alpine Convention article 9 paragraphs 2, 3 and 4:

"Contents of spatial and sustainable development plans and/or programmes
The spatial and sustainable development plans and/or programmes include, at the most appropriate territorial level and taking account of the specific territorial conditions:
2. Rural areas
- *a) reserving lands for agriculture, forestry and pasture farming,*
- *b) defining measures for the maintenance and development of mountain agriculture and forestry,*
- *c) conservation and reclaiming of territories of major ecological and cultural value,*
- *d) determining the areas and installations necessary for leisure activities, complying with other uses of the ground,*
- *e) determining the areas subject to natural hazards, where building of structures and installations should be avoided as much as possible.*

3. Urbanised areas
- *a) proper and contained delimiting of the areas for urbanising, and also measures for ensuring that the areas so defined are actually built upon,*
- *b) reserving the lands necessary for economic and cultural activities, for supply services, and also for leisure activities,*
- *c) determining the areas subject to natural hazards, where building of structures and installations should be avoided as much as possible.*
- *d) conservation and creation of green areas in the town centres and suburban areas for leisure time,*
- *e) limiting of holiday homes,*
- *f) urbanisation directed and concentrated along the routes served by transport infrastructures and/or continuing on from the existing constructions,*
- *g) conservation of the characteristic urban sites,*
- *h) conservation and restoration of the characteristic architectural heritage.*

4. Protection of nature and the landscape
- *a) delimiting of the areas for protecting nature and the landscape, and also for safeguarding the water courses and other vital natural resources,*
- *b) delimiting of tranquil areas and areas in which construction of buildings and infrastructures is restrained or prohibited, as are other damaging activities."*

Additionally, some examples of legally binding quantitative limitations for soil consumption and soil sealing in the Alpine States on different levels and from different fields are shown here.

In Austria municipalities and regional governments can set limits and settlement boundaries in their spatial planning programs. Most Regional State spatial planning programs use tools of spatial planning such as the designation of protected areas, national parks or exemption of agricultural land. But those regulations are only valid on municipal and regional level and might have exceptions contradicting the goal of soil protection. The national "*Environment Impact Assessment Law*" (EIAL) accounts for large-scale infrastructure projects. The leverage for a mandatory EIA is at 10 hectares land consumption and in 5 hectares in sensitive areas.

In Germany, the national Building Code (BauGB § 1a (2)) regulates that land and soil should be handled economically and soil sealing should be limited to the necessary extend. To reduce the additional land use for building purposes, other development opportunities of the municipality must be used, particularly by applying measures for interior development like redevelopment, renovation and densification.

In France, many standards are in place whose purpose is not primarily soil protection but rather to help protect the soil. The most important ones are:

1. The impact study procedure, which precedes development works and projects likely to harm the environment, was instituted by Act No. 76-629 of 10 July 1976. In 1993, the soil component has been added to the impact study procedure.
2. Law n°2000-1208 of 13 December 2000 on Solidarity and Urban Renewal (SRU law), has profoundly modified the urban planning and housing law in France. It introduces several major changes that allow better management of building zones.
3. Law n° 2010-788 of 12 July 2010 specifies that urban planning documents must henceforth set objectives for the protection of agricultural areas and the fight against continuous urbanization.
4. Law n°2016-1087 of 8 August 2016 for the reconquest of biodiversity, nature and landscapes, recognises the protection of soils of general interest, by integrating them into the Nation's common heritage in the environment code.

The local urbanization policy relies on numerous planning instruments, including local inter-municipal urban plans (PLUI), local housing programmes (PLH), urban travel plans (PDU). Territorial Coherence Schemes (SCOT) aim to coordinate these instruments on the scale of a larger area, within the framework of a sustainable planning and development project (PADD). The State ensures legality control via urban planning documents and assists local authorities in drawing them up. In respect with the French regulations, the PLUI defines different zones according to their uses and fixes the conditions and limits of the urbanization. The PLUI builds planning and development projects aimed at making towns and cities more environmentally friendly. The PLUI has the advantage that it can be drawn up on a municipal or even inter-municipal scale. It aims at drawing a vision of the territory for 10 or 15 years. Municipalities and agglomerations will have to make an ecological transition that involves urban reorganization and the consumption of its energies, particularly the use of polluting energy sources in order to limit their CO_2 emissions, stem the problem of soil erosion and reorganize their territorial planning for environmental preservation.

Sectoral policies, which in the past were different and sometimes unconnected, are now being brought in line with each other. The PLUI makes it possible to pool know-how, skills and resources of a larger territory. It makes it possible to organize solidarity between municipalities better, and therefore to develop a more concerted approach to land management and soil protection.

In Italy the fundamental law on land use (D.P.R. n. 380/01) is in place, while a specific law on soil consumption is under preparation. In addition, all regions have their own laws on land use planning. In most of them land consumption is covered with specific limitations and targets for each type of land use. The respective regional laws differ from each other. Some regions, such as Lombardy, Piedmont and Veneto have a specific regulation on land consumption, while for others the matter is contained in land use laws and plans (e.g. Aosta Valley). Furthermore, in many regions, the reduction of land consumption is promoted together with urban regeneration, which is intended to be an alternative to urban sprawl. However, these laws usually do not refer to a single definition of land use and there are also some derogations, which allow for new buildings and urban sprawl.
As very positive feature for soil protection some regional laws and plans refer to quantitative targets for maximum soil consumption and to qualitative aspects of the soil. This is done by attributing scales of values to the soils to guide future planning choices of local administrations, to assess the less critical building locations and also to establish the principle of environmental compensation in case of interventions that generate land consumption. Furthermore, a monitoring system on soil consumption of the urban plans has also been activated in most regions, for example in Lombardy.
Liechtenstein has no legally binding quantitative restriction to limit soil consumption and soil sealing. In case of proven demand, the defined residential zones, which were generously set in the 1970s, can be extended. However, a minimum of 30 percent of each of the eleven municipal areas remains reserved for agriculture (primary production). The communities have developed different approaches to achieve compact settlement structures. There are communities which successfully purchase properties, to be able to exchange these properties in case of submission of building application.

As well in Slovenia there are no legally binding qualitative limitations in spatial planning, but legally binding principles which set a priority to inner development when settlement development is in question. The objectives, basic principles and guidelines are set out in the Spatial Management Act (Law, O.G. 61/17) and Spatial Development Strategy of Slovenia (Ordinance, O.G. 76/04) as well as in the Spatial Order of Slovenia (Decree, O.G. 102/04). The legally binding principles are used in a process of preparation of the municipal spatial plan for assessment weather the municipality’s development needs are justified. If a municipality during the preparation of its spatial plan proposes the extension of the particular settlement area on an agricultural land, the ministry responsible for agriculture can demand the release of an agricultural land, which was designated for urban land use but has not been built on.

In Switzerland the only legally binding quantitative limitation for the consumption of soil is given by the crop rotation sectoral plan. Crop rotation areas cover a large proportion of the soils on Switzerland's central plateau. They comprise crop-sustaining arable land, primarily cropland, and temporary grassland in rotation, as well as crop-sustaining natural grasslands and are secured by measures under spatial planning legislation (Art. 26 para. 1 Spatial Planning Ordinance (SPO)). Revised between 2016 and 2020, the crop rotation area sectoral plan requires each canton to designate a specific quota of land for crop rotation areas (crop-sustaining arable land). It is currently the only spatial planning instrument which references the quality of soils and not simply their land area. Additionally, relevant legal guidelines on national Level can be found in the Federal Act on Spatial Planning (Bundesgesetz über die

Raumplanung (Raumplanungsgesetz, RPG) 22. June 1979 (Current update from 1 January 2019), AS 1979 1573). The law includes the following parts:

"1) The Federal Government, cantons and municipalities ensure that the land is used economically and that the building area is separated from the non-building area.

2)The countryside must be preserved. In particular:

a. sufficient areas of suitable arable land, in particular crop rotation areas, should be reserved for agriculture;

b. settlements, buildings and installations should integrate well into the landscape;

c. lakesides and riverbanks should be kept free and accessible to the public;

d. natural landscapes and recreational areas should be conserved;

e. forests should be able to fulfil their functions.

3) Settlements must be arranged according to the needs of their inhabitants and their expansion must be limited."

A link between quantitative and qualitative soil protection in Switzerland can also be found regarding the recovery of removed topsoils and subsoils in in Article 18 of the Ordinance on the Avoidance and the Disposal of Waste (Verordnung über die Vermeidung und die Entsorgung von Abfällen (VVEA) 4 December 2015 (Current update from 1. April 2020), AS 2015 5699).

3.3 Targets for maximum soil consumption

While the Protocol Soil Conservation of the Alpine Convention sets "*Economical and Prudent Use of Soils*" as binding provision for the perimeter of the Alpine Convention, defined targets are set in some Alpine States as well as on EU and global level.

	Target	Timeframe
Alpine Convention	-	-
Austria	2,5 ha/day (intentional target of Federal Government)	2030
Germany **Bavaria**	30 ha/day 5 ha/day as benchmark	2030 2030
France	zero net artificialisation of soils	2050
Italy **Lombardy** **Piedmont** **Veneto**	 25% reduction of the forecast of land consumption from 2014 45% reduction Max. 3% of existing urbanized area each 5 years 40% reduction of the forecast of land consumption	- 2020 2025 - Since 2011
Liechtenstein	-	-
Slovenia	Reduction of net growth of built-up land for 25% Zero net growth of built-up land	2030 2050
Switzerland	Net zero land take	2050
European Union	No net land take	2050
United Nations	Land Degradation Neutrality	2030

Table 6: Targets for maximum soil consumption.

Soil consumption in Austria should be kept as low as possible and the annual land consumption should be reduced to 9 km² (2,5 hectares per day) by 2030 according to the governmental program 2020 – 2024.

Germany is striving to reduce the use of new land for settlement and transport purposes to 30 hectares per day by 2030 according to the National Sustainability Strategy of the Federal Government. The Bavarian government is committed to the Federal Government's reduction target and plans to introduce a benchmark of 5 ha per day for land use for settlement and transport purposes in the Bavarian State Planning Act. This is part of the Bavarian land-saving initiative, which has been adopted as a comprehensive catalogue of measures in 2019. One of the objectives of the Bavarian Sustainability Strategy is to achieve a significant reduction in land consumption in the long term and to establish a land-cycle economy without further land consumption.

The French biodiversity plan of July 2018 foresees the target to achieve "*zero net artificialisation (ZNA)*" of soils in 2030. The achievement of this goal would require in France a 70% reduction in gross artificialisation and the renaturing of 5.500 hectares of artificial land per year. In parallel, densification in urbanised areas should be encouraged with regulatory or fiscal tools. A first step towards reaching the target has been done by the PLUI initiative.

In Italy, targets for quantitative limitations for soil consumption are currently not established on the national level. The regions are responsible for setting limits and land use is regulated by the local plans, which each municipality must develop. The following Alpine regions have defined a target:

- Lombardy: the 2019 Regional Plan defines on the basis of demographic forecasts compared to forecasts of transformation areas included in the municipal plans in force, identifies the regional threshold for the reduction of soil consumption to 25% for 2020 and 45% for 2025, compared to the forecasts of the municipal plans in force since 2 December 2014 (effective date of Regional Law No. 31 on soil consumption);
- Piedmont: the 2011 Regional Plan defines maximum land consumption thresholds for categories of municipalities, which cannot exceed 3% of the existing urbanized area for each five-year period;
- Veneto: the 2018 Regional Resolution defines a reduction of at least 40% of the forecast of land consumption external to the consolidated urbanization areas of the municipalities.

Furthermore, Italy has, as first EU Member State, set up a national monitoring program integrating several soil related indicators beyond those of the UNCCD in order to assess the achievement of the Sustainable Development Goal 15.3 to reach Land Degradation Neutrality.

No quantitative targets are currently set in Liechtenstein.

Slovenia recently adopted the Environmental Protection Programme 2020-2030 (Resolution, OG No. 31/20) which foresees measures in the field of soil protection like: sustainable management of soil and land as well as the decrease of the net growth of built-up land on 25% by 2030. The document also sets the target of zero net growth of built-up land from 2050 onwards.

In May 2020, the Federal Council adopted the new Soil Strategy for Switzerland. It includes the target of net zero land take until 2050. Building on new ground is still possible. However, if soil functions are lost, they must be compensated by upgrading the soil at another location. Until a Switzerland-wide soil function map is available, soil sealing (according to the BFS areal statistics) is used as indicator.

"*The enormous loss of soil functions and ecosystem services is one of the major environmental challenges Europe is facing. To help address this global problem, the European Commission has proposed in the EU Environment Action Programme to 2020 (7th EAP) to have policies in place by 2020 to achieve 'no net land take' by 2050 and has also set targets for reducing soil erosion and the loss of soil organic matter: "By 2020, EU policies take into account their direct and indirect impact on land use in the EU and globally, and the rate of land* *take is on track with an aim to achieve no net land take by 2050; soil erosion is reduced and the soil organic matter increased, with remedial work on contaminated sites well underway." (COM (2011) 571)*" (Science for Environment Policy 2016).

In scope of the Sustainable Development Goals the global target (15.3) is set to "*combat desertification, restore degraded land and soil, including land affected by desertification, drought and floods, and strive to achieve a land degradation-neutral world*" by 2030 (United Nations 2020).

4. Main challenges regarding an economical and prudent use of soil

Limited space availability against multiple demands

In the Alpine area the permanent settlement space and thus resource land is especially limited. The pressure on those flat or slightly sloped areas, which are favourable for infrastructure is very high. An additional limitation exists due to (hydro-) geological risks in many areas in the Alps. Soils with its many functions and services it provides for the society, e.g. with regard to production, water retention, climate protection., is subject to massive competition from diametrically opposed user interests - such as food production for regional self-sufficiency or retention areas for water balance, space demand for residential and commercial areas as well as touristic and other infrastructure. In the Alpine region, valley floors are a rare commodity and therefore particularly affected. The main challenges regarding an economical and prudent use of soil thus arise from the different claims on the use and the cross-cutting issues that arise with it. Many different strategies address the same area from specific sectoral perspectives which can lead to contradictions and which makes it difficult to find a solution that fits everybody.

Financial/fiscal drivers

Municipalities have an overall interest in supporting the establishment of households and businesses in their territory to maintain its dynamism. Taxes are important sources of funding for local authorities. It is very difficult to measure the specific effects of these tools on the local dynamics of artificialisation of soil. These tax mechanisms were not designed to address the issue of reducing land artificialisation.

Real estate sector

In addition to fiscal instruments, there are housing support policies aimed at supporting the real estate sector, home ownership and urban renewal. These policies play a decisive role in the dynamics of construction and therefore of artificialisation by targeting specific types of housing, particular areas or specific groups of households. A main challenge, e.g. in Liechtenstein, is as well unlocking the real estate assets to better achieve a compact development of settlements.

Infrastructure construction, transport, tourism, commercial areas

European and global value chains link, the Alpine region with the surrounding metropolitan regions and beyond. This flow of goods is associated with additional issues, such as increasing motorised transit traffic. Firms play an essential role in spatial development through dynamics generated by their location and employment. The dynamics of high land prices within cities can lead companies to choose locations in the periphery to benefit from cheaper land. The existence of road infrastructure that makes it easier to move away from the centre can encourage them to locate on the edge of this axis. This is particularly valid for warehouses and logistics platforms. Furthermore, development of large-scale touristic infrastructure projects in Alpine regions like extensions of ski resorts take land in fragile high Alpine areas.

Living stiles & urban sprawl

A challenge is affection for living in the countryside, but close to an urban area. It is a widespread vision to envisage living in a family house, not attached to the other houses. This attitude prevents from implementation of compact settlement policy and fosters building processes in peri-urban areas. The choice of the location for housing is usually based on a combination of the aspects cost, accessibility, comfort and surface area. Moving to the outskirts of towns is generally encouraged by land prices generally decreasing with distance from the centres. This is contrasted by higher transport costs and time for commuting to locations further away from employment areas or places of conviviality. Urban sprawl is supported by changes in household demands and needs. The preference for individual housing is a strong underlying trend. At the same time low costs for commuting and financial support for individual commuting accelerate urban sprawl. Also changes in the household structure explain a part of the dynamics of artificialisation. The average size of households changing towards smaller or even single households due to population ageing, lower fertility, more frequent separations and differing lifestyles amplifies this increase. However, it is necessary to control the building pressure with reference to the respective demographic trends.

Inner development, redevelopment, brownfield management

Better fitting instruments at municipal level could support the spatial planning policy and the general orientation towards inner development and redevelopment e.g. in Slovenia. Inner development and redevelopment are challenges on which most of the Alpine States, many regions and municipalities actively work to face challenges like land consumption. A major challenge to preserve soil, e.g. in Italy, is to reuse soil which is sealed but currently abandoned from economic purposes. Reusing such areas is a main way to effectively reduce artificial land cover growth. Fostering specific economic investments in building renovation is an important approach.

Agricultural practice

In the Alpine regions it is also essential to encourage resilient agriculture, aimed at conserving soil biodiversity and combating surface erosion. But another fact influencing the nature of land use is the agricultural decline in geographical areas with strong orographic and climatic constraints.

Implementation

Even when regulations or targets exists the lack of control and enforcement of instruments can to lead to implementation difficulties. Sufficient tools and staff for supervision of the implementation are necessary for bringing already existing instruments truly into action.

5. Possible solutions

Well elaborated recommendations for effective solutions have been developed by the Compliance Committee of the Alpine Convention and can be fully read in the corresponding publication (Compliance Committee of the Alpine Convention 2019) and urgently recommends:

- *"To strengthen spatial planning on regional and inter-municipal level by setting binding guidelines for municipalities to effectively contain the soil/land consumption.*
- *To set effective quantitative targets of soil/ land consumption on local and regional/ inter-municipal level, also by prioritising the usage by qualitative aspects, such as soil functions."*

5.1 An effective solution for economical and prudent use of soil per Alpine State

Qualitative and quantitative criteria can be applied for developing solutions. Thus, Austria presents one possible solution for each.
Qualitative - Evaluation of Soil Functions in Austria - a way towards better protection and sustainable management of Austrian soils: Across Austria a variety of legal regulations and procedures for data collection are in place regarding the evaluation of soil functions. To rectify these disparities, a new standard "*ÖNORM L 1076*" was published 2013. The ÖNORM L 1067 standards and the relevant guidelines provides transparent information how to evaluate several soil functions relevant in spatial planning. The utilization of the guideline is open to everyone. The only condition for the evaluation is the existence and access to suitable data. The intention is to enable a uniform and transparent approach, which can be used for spatial planning. The guideline should inform stakeholders involved in soil protection as they implement projects across all levels. Ideally high-performance soils should be spared from planning and should be considered in the decision-making processes of spatial planning. Thus, it can significantly contribute to a careful management and protection of the resource soil. Additionally, the environmental value of the soil evaluation outcomes can contribute to preservation of the environmentally most valuable soils from destruction by sealing and construction developments. The evaluation of soil functions is especially important in areas where arable land is a rare resource or where high-performance areas collide with economic and structural interests. Examples of results are available to the public (Austrian Standards 2013, Land Oberösterreich 2020, Land Salzburg 2010, Land Salzburg 2014, Land Salzburg 2020).
Quantitative - Infrastructure cost calculator: Based on examples in other regions, an infrastructure cost calculator was developed in Lower Austria. It estimates necessary investments and follow-up costs for settlement expansions and compares the calculated expenditure for the construction or expansion and for the maintenance of infrastructure with the expected income (Amt der Niederösterreichischen Landesregierung Raumordnung und Gesamtverkehrsangelegenheiten 2020).

The aims of the already mentioned land-saving initiative in Bavaria are to strengthen interior development, to efficiently mobilize vacant and fallow land, promote inter-municipal cooperation, and reduce land consumption in general as well as in particular the rezoning of greenfield land. In that respect Bavaria considers awareness raising and communication as important. For example, an alliance for land saving with partners from the Government, municipalities, society, and economy was established in 2003. Projects and information material have been developed, e.g. making Bavarian best-practice examples with a focus on land-saving and soil-conserving settlement development available to spur knowledge exchange and to share experience between municipalities. Government-supported role models provide an incentive for additional municipalities to follow the path for land saving.
Bavaria provides all municipalities with freely usable tools such as the land management database to facilitate the inventory and management of vacant lots, brownfields, and other interior development potentials. Beyond the inventory, the land management database supports marketing, communication with owners and the determination of demand for residential land. Bavaria also freely offers a "*Follow-up Cost Estimator*" for the municipalities to reveal fiscal unfavourable external developments at an early planning stage. Many cases showed a strong economic incentive to reduce land consumption. Via the funding initiatives "*Inside before Outside*" and "*Unsealing*" the Bavarian Government supports the municipalities financially.

In France one of the currently most efficient solution is based on the development of inter-municipal local urban planning that offers the possibility to develop a real integrated territorial management as explained in more detail in the chapter about legally binding quantitative limitations for soil consumption and soil sealing above.

In Italy, the solutions implemented by the Region Lombardy is particularly significant. The Region approved a specific law (LR 31/2014) and a specific regulation in the Regional Plan (Integration of the PTR approved in 2019) to reduce land consumption and contextually promote urban regeneration (Region Lombardy 2020). In particular, the Region Lombardy has set the target of 25% reduction of land consumption, referring to the planned settlements of the Municipal Plans in force since 2014 and which must be applied in relation to the demographic trend, the quality of soils and regeneration potential existing in the municipalities. At the same time the Region Lombardy has activated a monitoring system for soil consumption and urban regeneration areas, which is constantly updated as part of a collaboration with all municipalities, provinces and the Metropolitan City of Milan. The main contents of the Lombardy regional project are:
The Regional Law 31/2014 (in force since December 2, 2014) has the aim of "*concretizing the goal envisaged by the European Commission to reach a net occupation of land equal to zero by 2050 on the territory of Lombardy*" and introduces new provisions aimed at limiting land take and to promote urban and territorial regeneration, in all territorial plans. Since the approval of the law, the municipalities can no longer approve new forecasts of land take, but they can approve variations of the plans ensuring an ecological balance of the soil consumption not exceeding zero. The law introduces the definition of land consumption and provides the Regional Territorial Plan (PTR) to determine the criteria to be applied in the local plans.
The PTR integrated in 2019 as required by law, contains the criteria and identifies 33 homogeneous territorial areas (Ato), which represent the most appropriate supra-municipal

reference scale for assessing land consumption. The Plan introduces a plurality of actions aimed at obtaining a reduction of soil consumption, both quantitatively and qualitatively by safeguarding the most critical and highest quality soils. It is also effective in terms of rationality and efficiency of the settlement structure.
With reference to the UN Agenda 2030, estimates of the need for new settlements must be based on demographic forecasts and compared with the planned land take in the municipal plans in force. Based on these quantities, as well as in consideration of the regeneration potential existing in the territory, the Plan establishes the regional threshold for the reduction of soil consumption of 25% for 2020 and of 45% for 2025. Furthermore, the Plan defines scales of soil value referring to its agricultural, pedological, naturalistic and landscape peculiarities, to guide future planning choices of local administrations. Finally, the Plan identifies densely urbanized territories where regeneration plays a decisive role for the reduction of soil consumption and the reorganization of the settlement structure on a territorial and urban scale.
By two measures of the Regional Law 31/2014 the first tools for the detection and monitoring of soil consumption and urban regeneration areas were activated. During 2018 and 2019 the data was collected and the completion of the municipal data on land take is prepared in a first regional monitoring report in 2020.

With spatial planning instruments, which are anchored in the national building law, the communities in Liechtenstein can achieve higher density in certain central areas of crucial development zones. In this densifying perimeter it is allowed to build higher and closer than the law permits otherwise, if open spaces, pathways, children's playgrounds etc. for public good are installed in this perimeter.

The most effective measure, that protects soil from being sealed in Slovenia, is the spatial planning system. When preparing their spatial planning documents, municipalities must consider the objectives and basic principles set out in the Spatial Management Act (Law, O.G. 61/17) and Spatial Development Strategy of Slovenia (Ordinance, O.G. 76/04) as well as in the Spatial Order of Slovenia (Decree, O.G. 102/04). In the process of approving municipal spatial plans, the Ministry of Environment and Spatial Planning verifies the fulfilment of the adopted objectives and principles. In the case of non-compliance, the Ministry refuses that the municipality adopts a spatial plan. In most cases the municipalities follow the opinion of the Ministry and change the document until they obtain the positive approval from the Ministry.

The sectoral plan for crop rotation areas (FFF) is a good example from Switzerland. Special protection regulations apply in Switzerland for the best agricultural land. The aim of the sectoral plan for crop rotation areas is to maintain at least 438.460 hectare of the best agricultural land. Each canton has to secure a quota, which was established by the Federal Council in 1992. The FFF account for around 40 % of the total agricultural area in Switzerland. The utilised agricultural area covers just over 1.000.000 hectare.

5.2 A glance of soil awareness activities in the Alps

The Interreg Alpine Space project Links4Soils (project partners from Austria, France, Germany, Italy and Slovenia) fostered the international cooperation for soil protection in the Alpine area. The Alpine Soil Forum on 14-16 October 2019 in Innsbruck, Austria, marked a highlight and ending point of the project Links4Soils. The transnational event, happening in English, German and Italian showed and discussed the results of Links4Soils and opened the exchange on sustainable soil management in the Alpine area. The event consisted of an indoor conference day including a poster exhibition and a marketplace of ideas followed by an informal exchange round on soil-relevant happenings and an excursion showing the influence of land use management practices on soils. The project came to an end, but the Alpine Soil Partnership was established. It is a network open to everyone interested in soil in the Alps. Sort videos were produces to convey information and messages about soil in the Alps (The Alpine Soils Platform).

In the Bavarian Alpine area, educational soil trails are installed in two districts. In addition, the house of the mountains, which is a museum including the national park centre and environmental education, was built in Berchtesgaden.

In Italy the National Environmental Protection System is carrying out the land cover and consumption monitoring including the production of detailed maps and indicators updated annually since 2012. In 2019 ISPRA proposed to establish regional Observatories with the participation of regional authorities and environmental protection agencies, together with ISPRA. The observatories are already contributing to the report in 2020 to integrate the national point of view with local requirements and needs.
Another important initiative was promoted in 2019 by some Italian regions (e.g. Lombardy, Aosta Valley, Piedmont, Veneto, Liguria, Trentino), which have set up an interregional working group aimed at identifying shared strategies for land use planning, with particular attention to the issues of reducing land consumption and supporting urban regeneration.

Every year the Liechtenstein Office of Environment organises the production of the environment calendar (*Umweltkalender*). Within this project, pupils in primary school illustrate a calendar, which addresses environmental issues. The text modules are provided by experts. In the year 2020, the calendar focuses on agriculture. The importance of sufficient areas with fertile soil for food production is highlighted in this context.

Slovenia hosted the 13th Youth Parliament to the Alpine Convention in Maribor from 19-24 March 2018 (Youth Parliament to the Alpine Convention 2018). The umbrella topic "*Preservation of soil*" was discussed between students, politicians and experts. You can read the resolutions, which the pupils adopted on economical use of soil in the next chapter.
On the national level Slovenia prepared guidance for building plots regulation based on the "*In depth review of the Compliance Committee of the Alpine Convention of the subject Economical use of soil*" (Compliance Committee of the Alpine Convention 2019). The guidance provides some general approaches for the organisation of the building plots, lists the general objectives of building plot organisation and explains the division of the building plot into two main categories (sealed and unsealed surface) and their sub-categories.

Furthermore, posters on soil erosion have been prepared by Agricultural Institute of Slovenia for the occasion of the World Soil Day and have been presented to the Slovenian Soil Partnership.

The Swiss project "*Sounding Soil*" is another good example, on how to raise awareness on the important role of our soils in an innovative form. Sounding Soil is an inter and trans-disciplinary research project to increase our understanding of soil ecosystems. More than 20 soil areas in Switzerland have been recorded, including intensively and extensively used agriculture land, Alpine meadows and woodland soils. The sound recordings include the animals that live in the soil, such as springtails. From 29 October until 25 November 2018 "*Sounding Soil*" was presented to the public in the Paul Klee Centre in Bern for the first time. The installation was at the Zurich University of the Arts ZHdK from December 2018 to mid-March 2019. Locations across Switzerland will follow in the future.

5.3 Voices of the next generation

Like the issue of climate change, soil consumption is a highly relevant topic for future generations, since degraded soil can mostly not be restored in timespans of a human life. The Youth Parliament to the Alpine Convention, consisting of pupils from Austria, France, Germany, Italy, Liechtenstein, Slovenia and Switzerland, has intensively dealt with the issue and searched for "*soilutions*" in 2018 and ask actively for their demands to be taken seriously by decision makers. 5 of the 10 demands give possible solutions regarding economical use of soil in the Alpine area:

Resolution 2: Not more, but better – *Environmentally friendly tourism and ways to encourage and increase it in the Alpine region*

Considering the huge amount of new, but unused infrastructure and the building of illegal and nature-harming paths built by dissatisfied vacationers, which is something that damages the soil terribly, we propose to upgrade already existing structures utilizing sustainable materials when possible. With local organisations that determine and draw attention to the demands of special-interest groups, the local government will act upon those demands, selecting what to improve first. Building unnecessary new infrastructure will then be avoided in favour of a more environmentally friendly solution. This will preserve the soil, which will not risk being destroyed, and will improve tourism, making it a better and more sustainable experience.

Resolution 3: Up in the sky - *Companies and the soil that is wasted by their parking lots*

Seen that, for example, around 5 % of Austria is used for roads and parking lots and that 0.3 % of the agricultural space in Europe is used every year to build infrastructure, we think that this is a huge waste of space. We are convinced that a lot of soil could be saved and used in a more efficient way. New parking lots should be built vertically, not horizontally. Newly-built shops or companies should build multi-storey, over ground parking lots to preserve the soil. The national government should define the laws that regulate this process, but the regional government should efficiently apply and control it. This proposal has already been implemented in urban areas in Austria, but in rural areas this is not applied enough yet. To help companies build this kind of infrastructure, they will be subsidized. This way, the environment will be protected and more soil will be saved.

Resolution 4: Fighting soil sealing - *Minimalizing soil sealing and giving alternatives, e.g. to use pervious sealing and to regress and rehabilitate unnecessarily impermeable areas*

The main concern is that every year, more than 1000 km² gets sealed and the soil loses its basic functions, like water purification and flood regulation. Due to urbanization, asphalt and concrete are used to seal the soil to make life more comfortable, yet many areas were sealed where it would not be needed. Therefore, we strongly encourage to regress and rehabilitate those areas by removing the useless asphalt. In public areas, the city council would decide where to remove it, while in private areas, the choice of making an untaxed removal is given to the owner. Furthermore, for new or renewed sealed areas, we promote the use of pervious paving, which allows the soil to interact with the nature above. This would be introduced in pedestrian areas and parking places. Two different examples are the "*Climate Tile*" in Copenhagen, which is used on sidewalks, and the use of pervious paving for parking places in Valpellice, Italy.

Resolution 5: Minimizing Urban Sprawl - *Limiting the extension of urban areas*

The increasing number of city residents, resulting in urbanization, causes the growth of urban sprawl. We cannot stop city growth, but we can try to minimize agglomeration. The committee suggests creating green belts as an option for cities to plan their expansion and to have a clear border between the city and the rural areas as a long-term solution. They also suggest supporting innovation and increasing density and efficiency. Including agricultural land, forest and leisure areas, the green belt would provide food security, decrease air pollution and be a social meeting point. For instance, the city of Portland has designed a virtual line around the city based on predictions and plans of how the city will grow. The line separates rural areas from the city. It is a dynamic process, meaning that they revaluate the line every time the city reaches that border. We are combining that system with London's green belt system that surrounds the city. Moreover, we propose the reuse of old and abandoned buildings. Thus, existing resources would be used efficiently and less soil would be sealed.

Resolution 6: Breathing Buildings - *Green spaces in urban areas to act on the problem of degraded soil in cities due to unsustainable spatial planning*

Urban gardening combined with efficient spatial planning facilitates soil protection and a higher quality of life. We propose the diffusion of roof gardening to maximize limited space, especially on flat roofed buildings such as supermarkets. This type of urban gardening leads to many benefits: The presence of plants enables the regulation of pollution. Additionally, the vegetation absorbs water and lowers the heat in the city. This solution manages to make our cities healthier and even more appealing to live in and strengthens the connection between city residents and nature.

6. Spotlight on soil & climate protection

Soil protection is climate protection. Soils store more organic carbon than the biosphere and atmosphere combined. But at the same time soils are highly vulnerable to climate change and land use pressures. Depending on their use, soils do not only release carbon dioxide but are also able to bind it. Therefore, especially carbon rich soils are interesting for climate adaptation and mitigation. Those are particularly soils, which contain a high amount of humus and peatlands. The Alpine Climate Target system 2050 defines thus the need to support preservation and sequestration of carbon in soil and to set-up a common framework for minimising land-take (Alpine Climate 2050).

6.1 Humus – carbon stocks in soil

The humus content refers to the content of organic carbon in soil and is thus a relevant indicator when looking at climate change. Besides soil consumption and soil sealing, also the impact of climate change will have an influence on the humus content of the arable soils.
Comparable humus data covering the Alpine Convention perimeter in the last years do not exist yet. Data about the humus content development is currently not available in Liechtenstein and Slovenia.
Also in Switzerland not enough soil information is available to provide comprehensive reliable statements on the development of the organic matter content in mineral soils. In mineral arable soils organic carbon declined within the last hundred years. However, the contents seem to have stabilized since the 1990s. In agriculturally used former peatland soils the organic matter decreases continuously (Schweizer Bundesamt für Umwelt 2017).

The forests and grassland of the mountainous areas in Austria hold the highest carbon concentrations. Therefore, the highest potential for improvement are within the arable fields, which mainly lie outside the Alpine Convention perimeter. In this context the evaluation report concerning the impact of several measures for arable land of the Austrian Environmental Programme shows that due to the broad acceptance from the Austrian farmers in participating in the different measures of the programme like greening, organic farming etc. an increase of the humus content in Austrian arable soils was achieved compared to the last period again (Bundesanstalt für Agrarwirtschaft und Bergbauernfragen, Österreich 2019). The humus content of most of the arable soils in Austria lies meanwhile within the optimum range. The evaluations are based on the results of various soil samples, but they cannot be analysed and presented on municipal level. An overview of humus contents in Austria's topsoils is displayed in the figure 11.

Within the ongoing research project "*CASAS*", which is funded by the Austrian Climate Research Programme, several soil research institutes try to find an approach concerning possible soil organic carbon storage capacities in Austrian agricultural soils. It stays important to undertake efforts to maintain or where possible increase the humus content.

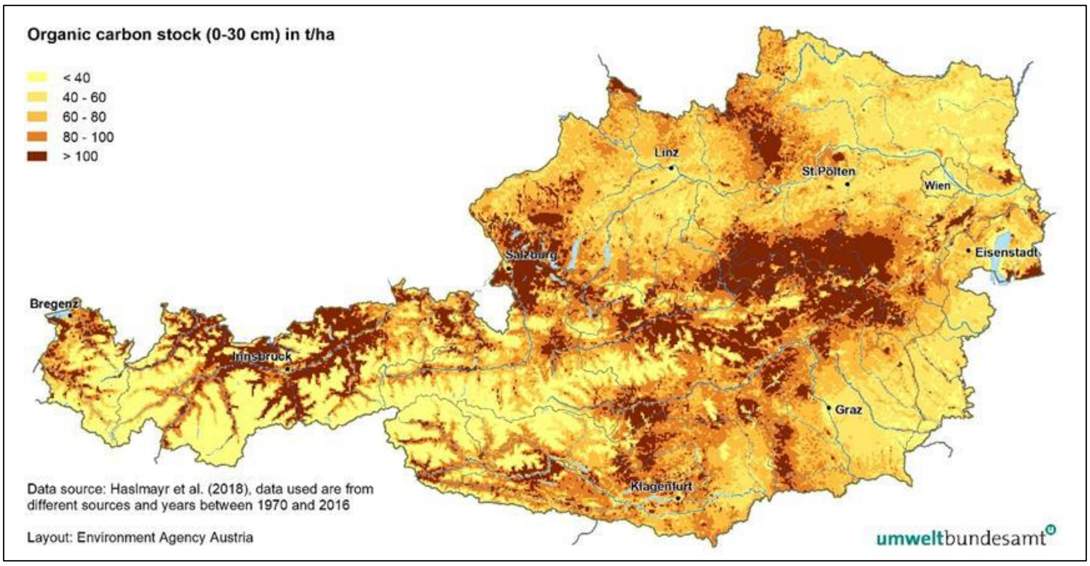

Figure 11: Organic carbon stock in Austrian topsoils (0-30 cm) in tonne per hectare. Source: Haslmayr et al. 2018.

A map of humus contents in Bavaria is currently being developed and will be completed soon. Experience has shown that "*Tangelhumus*," (humus of conifers) is accumulated in the Bavarian Alps.

A reference study covering the entire Italian Alpine Convention perimeter is currently not available, however, it is interesting to look at the project SIAS (Sviluppo di indicatori Ambientali sul suolo in Italia/ Development of Soil Indicators in Italy) (Joint Research Centre – European Soil Data Centre 2020, Giandon P. et al. 2010). The project is assessing soil carbon stocks and especially humus. It was a pilot project aiming at developing environmental soil indicators set up by the ISPRA-Institute and has produced an assessment of soil organic carbon stock of the mineral layers of topsoil (0-30cm) for 17 of the 20 Italian regions. Figure 12 displays the assessment for regions in northern Italy.

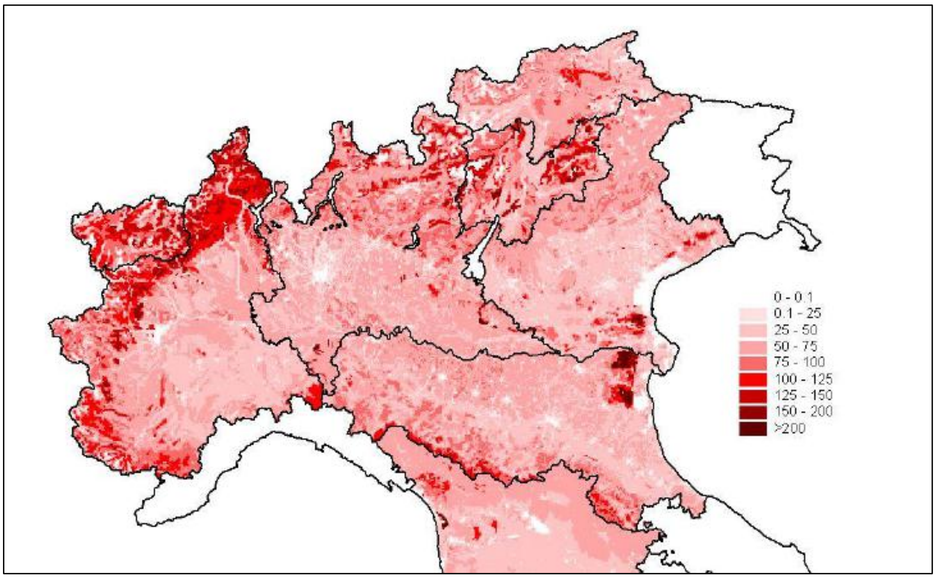

Figure 12: North Italy Soil Organic Carbon stock in t/ha of mineral topsoil layers (0-30cm), humus and litter layers excluded. Source: Joint Research Centre – European Soil Data Centre 2020.

6.2 Wetland, peatland, and moor areas

"*Wet peatlands offer attractive nature-based solutions for various environmental challenges, including climate change mitigation, water regulation and biodiversity conservation. Yet, they are largely threatened or degraded in many European countries. More than 80% of peatlands in the Alpine region are located on the axis Lyons – Salzburg. In addition, smaller peatland clusters and corridors occur in Slovenia and Carinthia, parts of the Central Alps and the Italian High Alps. Many of them are small mountain peatlands that differ fundamentally from larger lowland fen areas in their geomorphology and ecology as well as their land use. With regard to small mountain peatlands, due to their limited potential for carbon sequestration, they are at risk of being overlooked. However, they deserve recognition as important habitats for rare plant and animal species as well as for their crucial role for water management in rivers' upstream catchment areas.*" (German Federal Agency for Nature Conservation et al. 2020).

The guiding principle for conservation of soils in wetlands and moors in the perimeter of the Alpine Convention is laid down in Article 9 of the Protocol Soil Conservation of the Alpine Convention.

> **Conservation of Soils in Wetlands and Moors**
> (1) The Contracting Parties undertake to preserve high moors and lowland moors. To achieve this objective, the use of peat shall be discontinued completely in the medium term.
> (2) Drainage schemes in wetlands and moors shall be limited to the upkeep of existing networks unless there are sound reasons for exceptions. Remedial measures shall be promoted to minimise the environmental impact of existing drainage systems.
> (3) On principle, moor soils shall not be utilised or, when used for agricultural purposes, shall be managed so that their characteristic features remain intact.

Different definitions and differing approaches of mapping also exist regarding peatlands. In scope of the project Impuls4Action, which is running for the timespan August 2019 to January 2021 and is co-financed by the European Regional Development Fund, a master thesis was written with the aim of collecting and combining datasets on peatlands in the Alpine area. The resulting overview of peatlands in the Alps (figure 13) consists of a combination of 76 peatland related datasets. The brown signature shows the identified peatlands. The chosen perimeter represents the maximum extend of the Riss glaciation (Reichart, A. F. 2020), since this glaciation had the largest extend around the Alpine area and thus a significant natural influence on the development of hydrological system. It can however not be regarded as a map of all peatlands in the Alps, since there should be data on additional peatlands and not all peatlands in the Alps have been mapped yet.

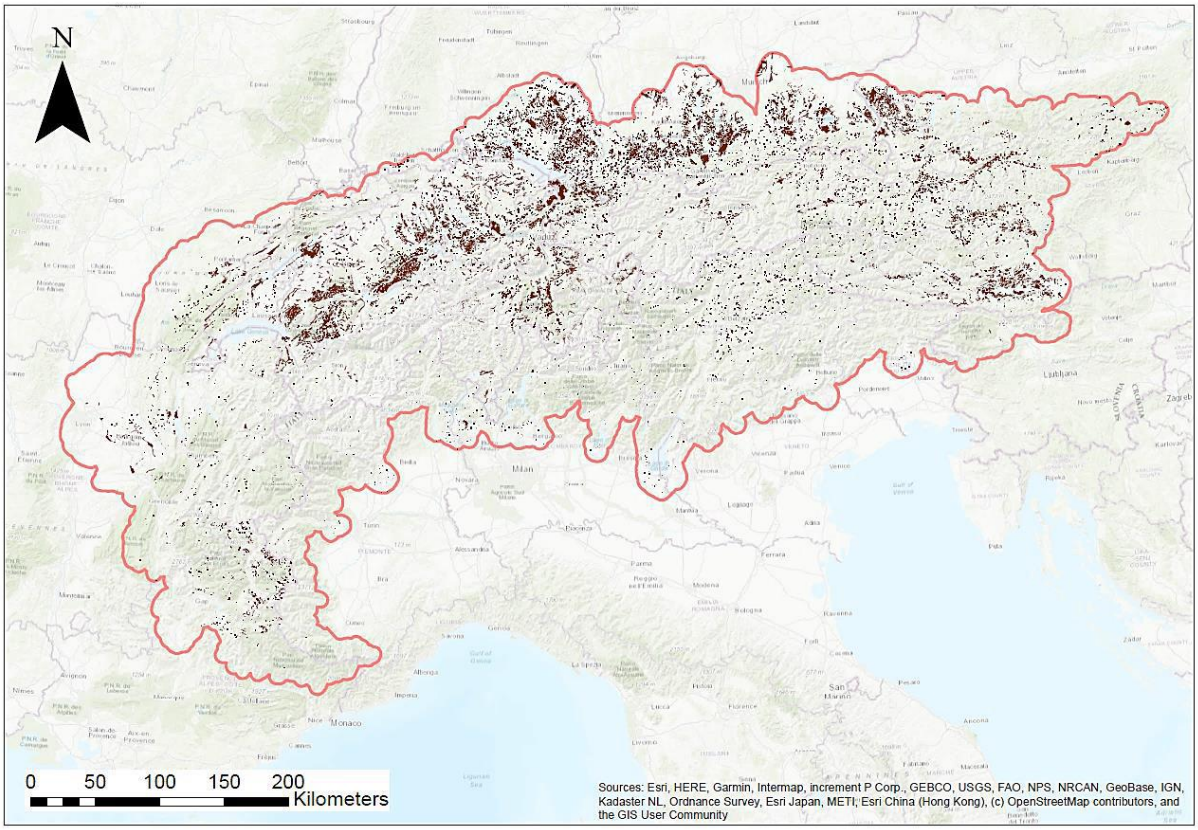

Figure 13: Map of peatlands, based on 76 datasets, in the Alps in the perimeter of the maximum extend of the Riss glaciation. Source: Reichart, A. F. (2020).

Rewetting in Austria mainly occurs as compensation measures according to procedures of environmental impact assessments. Concrete numbers or data on the extent is not available for Austria yet. But the Austrian Environmental Agency provides a compilation of wetlands focusing on Ramsar areas and on wetlands in general (Umweltbundesamt Österreich 2020). Table 7 shows an overview regarding peatland protection and rewetted areas in the last years in the perimeter of the Alpine Convention in Austria without the claim of exhaustiveness.

To develop a national peatland strategy, a working group has been established in scope of the national Ramsar committee. The working group comprises designated members from the federal states. The goal is to present the national peatland strategy, including action plans for the regions, on World Wetlands Day in February 2022.

Region	Amount of rewetted areas	Area in ha	Strategy in place
Tyrol	8	20,7	yes
Vorarlberg	4	48,5	yes
Styria	8	21,7	yes
Carinthia	4	21,0	yes
Salzburg	6	62,5	yes
Upper Austria	12	47,5	yes
Lower Austria	1	9,0	yes
Burgenland	0	0,0	no

Table 7: Peatland protection - Rewetted areas in the perimeter of the Alpine Convention.

In the Bavarian area of 740 km² of superficially developed fens and peat bogs existed in the Alpine Convention perimeter in 2016. Some rewetting activities in the Bavarian Alps are summarized in *Bund Naturschutz* (n.d.). Furthermore, a Bavarian-wide map on a scale of 1: 25.000 showing the distribution of hydromorphic organic soils has been created (Bayerisches Landesamt für Umwelt 2020). Figure 14 shows their identified occurrence in the Bavarian perimeter of the Alpine Convention.

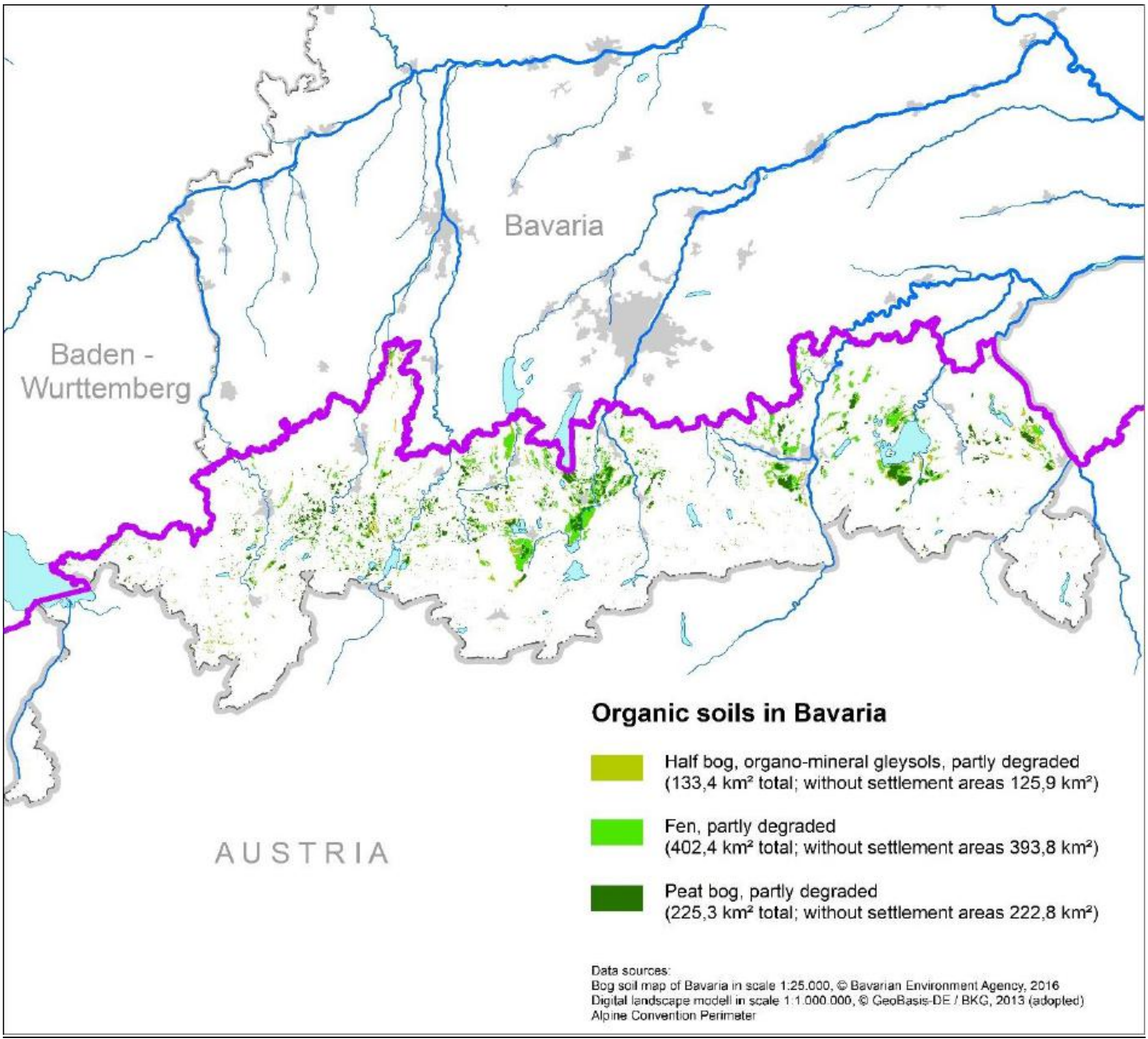

Figure 14: Organic soils in Bavaria.

Wetlands in Italy covered approximately 913.254 hectares in 2011. The data is collected in the Italian wetland inventory (ISPRA 2020b, ISPRA 2020c, D'Antoni et al. 2011), which was elaborated in 2011 by ISPRA, the Ministry of the Environment, Land and Sea, and ARPA Toscana and it is based on "*Pan Mediterranean Wetland Inventory*" (PMWI) MedWet. Unfortunately, the collection criteria were not always homogeneous between the regions. Moreover, it is not possible to reliably separate the information regarding the type of wetlands, such as peat, bogs or lakes.

Wetlands make up ca. 3,02% of the total land area in Italy, while 0,32% of the total land area of Italy are wetlands located in the perimeter of the Alpine Convention. Table 8 shows the number of wetland sites within the perimeter of the Alpine Convention and their areal extend. The numbers are displayed for the Italian Regions, which lay completely or partly in the perimeter of the Alpine Convention. Almost 24% of the wetland areas in those regions lay inside of the Alpine Convention perimeter.

	Wetlands within the Alpine Convention perimeter		Wetlands in the region	Share of wetlands inside the Alpine Convention perimeter
Region	Number of sites	Area (ha)	Area (ha)	%
Friuli Venezia Giulia	1	2.466	32.760	7,5%
Liguria	2	45	5.895	0,8%
Lombardy	3	11.461	29.058	39,4%
Piedmont	3305	21.123	145.534	14,5%
Autonomous Province of Bolzano/Bozen	17	919	919	100,0%
Autonomous Province of Trento	38	34.175	34.175	100,0%
Aosta Valley	7	50	50	100,0%
Veneto	6	25.125	153.776	16,3%
Total	**3385**	**95.804**	**402.167**	**23,8%**

Table 8: Wetlands in the Italian Alpine Regions.

About 1.250 hectares of wetland exist in Liechtenstein. 980 hectares of agricultural land is drained and 170 hectares are inventoried and protected. No areas were rewetted in the last 20 years.

In Slovenia some areas of wetland, moor and peatland are protected as national designated areas according to the Nature Conservation Act. Those are for example regional parks – i.e. Cerkniško jezero Lake; landscape parks – i.e. Ljubljana Barje Moor. Habitat types from Annex II of the Habitat Directive are included in the Natura 2000 network and three areas are designated as Ramsar sites: the Škocjanske jame Caves (underground Ramsar location), lake Ceknica and Sečovlje salina. They are also part of the NATURA 2000 network.
In 2000 a wetland inventory based on the Ramsar classification system was prepared and published, summing up ca. 35.650 hectares of wetland areas including over 8.200 hectares of Ramsar areas in the whole territory of Slovenia (Beltram, G. 2003, Ramsar Convention Secretariat 2020).

In Switzerland 1.924 hectares of high moors and transitional mires, as well as 19.223 hectares of lowland moors and 87.404 hectares of peatland areas were inventoried in 2017.

7. Monitoring soil consumption

Various actors monitor soil sealing and soil consumption in Austria, like the Austrian Environmental Agency or the ÖROK Atlas. Based on these data, further in-depth evaluations for the individual federal states or their municipalities in the perimeter of the Alpine Convention are possible (ÖROK Atlas 2020).

In Bavaria land consumption is annually monitored by the Bavarian State Office for Statistics and measured by the Bavarian Land Surveying Agency. The cadastral delineation of sealed surfaces is supported by aerial photos to delineate actual land use and land cover classes (Bayerisches Landesamt für Statistik 2020). However, unsealed land within settlement and traffic areas such as green spaces or gardens is included in the land consumption rate. Soil sealing has been monitored for settlement and transportation areas for the years 2000 and 2015 with semi-automatic remote sensing methods that combine aerial photos, satellite images, and cadastral data.

Land consumption monitoring in Italy is in progress. The National System for Environmental Protection (SNPA) oversees this task, as required by law (L. 132/2016). SNPA is composed of the National Institute for Environmental Protection and Research (ISPRA) and the Regional/Provincial Environmental Protection Agencies (ARPA-APPA). Since 2015 the monitoring system gives yearly updated data on land consumption, soil sealing and urban development, through thematic maps and specific indicators. Earth observation is used to classify land cover, land use and land consumption. The land consumption map is the result of the monitoring system, which is based on semi-automatic classification of Sentinel-1 and Sentinel-2 images followed by photointerpretation of high-resolution images. The map has a 10 m resolution and is classified in three hierarchical levels to get information about: consumed/non consumed land; sealed or permanent/non permanent consumed land; type of artificial land cover, such as buildings or road network.

Soil consumption in Liechtenstein is monitored by the nationwide land-use statistics, which is conducted every 6 years following the procedure of Switzerland. Soil sealing can be monitored by evaluating the available land cover mapping data of Liechtenstein.

Data on the annual growth rate of built-up land ("*land consumption rate*" as relative figures) and data on land consumption (absolute figures) in Slovenia are currently not available yet. But the calculation of the increase in built-up areas will be possible after the establishment of the built-up areas register, which is in the process of establishment. Currently Slovenia is in a phase of data acquisition. Data on build-up areas will be available for the whole Slovenian territory after 30 June 2021. Data on infrastructure will be added afterwards. Data for the areas of Slovenia where the survey has already been carried out are already available (Republika Slovenija, Ministrstvo za okolje in prostor 2020).

The area statistics "*Arealstatistik*" gives a comprehensive overview of soil consumption in Switzerland on national scale. The survey of the area statistics is based on digital aerial photographs and image strips taken by the Swiss Federal Office of Topography in the timeframes 1979-1985, 1992-1997, 2004-2009 and 2013-2018. A sampling grid of 100 metres mesh size is applied to the areal images. Its intersections form the sample points at which land use and land cover are interpreted based on the category catalogue of the area statistics. The interpretation of the aerial photographs takes place on a screen or other system that enables three-dimensional, stereoscopic image viewing. In this way, slope inclinations, depressions and terrain breaks can also be detected and the height of trees and buildings can be estimated. Limitations of this process arise by the time it requires. However, the land use/cover statistics produced by the Federal Office for Statistics for the whole territory of Switzerland is foreseen to be continued from 2019 on as a rolling survey with a periodicity shortened to 6 year (Bundesamt für Statistik Schweiz 2019). Partially or entirely automated methods are envisioned to support and reduce the high workload of the interpretation task.

8. Soils for food: How to safeguard agricultural production areas?

Two areas of action are required: The agricultural land must be protected from further land take and the sustainable management by farmers must be guaranteed. Austria gives two examples how the two tasks are implemented.
Agricultural precaution areas: On basis of the Tyrolean spatial planning law 2016, agricultural precaution areas are issued by order of regional spatial planning programmes. Such designation banns the dedication of fields for settlement activities. A link to other open space categories like ecologically important areas can be drawn (Land Tirol 2020).
Mountain farmers in Austria: The mountain farms are assigned to four levels of difficulty depending on their altitude, terrain and transport connections. The respective subsidies build up a basic income for the majoritarian small and family farms, compensates the high ratio of manual work and guaranties local food production. Livestock farming in the Alpine mountain regions by 52.891 farms or more than 92% of all mountain farmers is of outstanding importance for the preservation and management of grassland and the associated cultural landscape.

In Bavaria, the State Development Program is the basis for spatial development. Amongst others it defines for the Alpine area that forests and their protective function as well as the care for the cultural landscape by farming and forestry must be secured. Alpine pastures worth preserving shall be redeveloped and made accessible as far as it is ecologically reasonable.
The spatial development of the Bavarian Alps is regulated by the "*Alpenplan*" (=Alpine plan), in which the Bavarian Alpine area is categorized in the three different zones (A, B and C). Different regulations for spatial development and protection apply in the respective zones. Whereas most development projects are possible in zone A, conducting transportation projects is only permitted in zone C, as far as necessary for maintaining the cultural landscape, thus for traditional agriculture and forestry.
Furthermore, Bavaria supports the upkeeping of the cultivation of Alpine pastures by many support measures. Additionally, mountain farmers are supported by investment support programs and by special training opportunities. Hence the extent of mountain pastures (39.000 hectares) and the number of mountain pasture farms (1.400) is stabile in Bavaria.

In Italy, agricultural areas are specifically designated and bound for this use. There are also other ways which can safeguard agricultural production. For example, the regulation on the origin of products, which is based on a control and certification system, which guarantees the enhancement of the products and safeguards the production chain. Furthermore, the Ministry of Agricultural, Food and Forestry Policies fixes strategic priorities based on Common Agricultural Policy (CAP) and developed the PSR (Rural Development Programme) and the PSN (National Strategic Plan). The main goals for the PSR consider the sustainable management of natural resources, climate action and the development of rural areas. Protected areas, where land use for innovative agriculture, soil protection and green economy can be developed, are able to play a significant role, as well on the Alpine level. To improve the protection of agricultural areas it is also appropriate to define policies and actions to reduce land consumption, which also introduce qualitative criteria for assessing soils with reference to the agricultural productivity, pedological, natural and landscape value in addition to quantitative criteria, like e.g. the Region Lombardy - 2019 Plan.

In Liechtenstein, areas preserved for agricultural production are designated and protected by law. However, the sustainability of agricultural production on certain drained organic soil is questionable. Therefore, data is needed to predict the development of these drained soils under the current and an adapted agricultural production. Technical solutions to maintain the fertility of specific sites should also take place. If there is no reasonable solution to preserve certain drained sites for agricultural use on a long-term basis, rewetting is worth considering. For these questions, no time schedule is defined. Currently, as a first step a targeted-oriented improvement of the existing soil data is considered.

In Slovenia agricultural land will be protected as areas of permanently protected farmland. The determination of the farmland to be permanently protected is currently in the process coordinated by the Ministry of Agriculture, Forestry and Food. It will take several years, as it will have to be determined in 212 municipalities. The process of preparation and adoption of the spatial plan depends on the respective municipalities. It is estimated that around 350.000 hectares of permanently protected farmland will be designated in Slovenia. Once designated in a spatial plan, those areas cannot be changed for a timespan of at least 10 years from the entry into force of the municipal spatial plan.

In addition to the before mentioned sectoral plan for crop rotation areas in Switzerland, the new Soil Strategy of Switzerland includes strategic recommendations referring also to agricultural production areas such as: to avoid permanent compaction of agricultural soils, impairment of soil functions through erosion on agricultural land, impairment of water bodies and near-natural habitats and infrastructure by washed away soil material from agricultural land and permanent loss of soil biodiversity and activity due to agricultural use. Also, the loss of soil organic matter as a result of agricultural use of mineral soils has to be compensated and the loss of soil organic matter due to agricultural use has to be minimized. As well a substantial reduction of the risk to humans, animals, plants and water bodies as a result of pollutant and foreign substance inputs like pesticides, fertilisers and other means of production should be reached. The content of the strategy works as an orientation framework for future decisions of the cantons and the federation. Timeframes depend on the respective canton and region.

9. Outlook

Municipalities are at the core of implementing economical and prudent use of soil. Those who show how a sustainable areal development is possible and positive on the long term, need to be regarded as good examples. As the report has shown, the topic of an urgently needed economical and prudent use of soil in the Alps is on the agenda in the Alpine Countries. In scope of the Alpine Convention the Working Group Soil Protection will continue its work for the protection and sustainable development regarding soil in the Alps. The Alpine Climate Board has established implementation pathways towards a climate neutral and climate resilient Alpine area by 2050; one of them focusing on minimising land take and soil sealing. Protection and sustainable management of soil in the Alps will also be supported by the Alpine Soil Partnership, which comprises soil experts, practitioners and people who are interested in soil protection in the Alps. Furthermore, the EU Strategy for the Alpine Area (EUSALP) has adopted the declaration "*Sustainable Land Use and Soil Protection –Joining Forces for Nature, People and the Economy*". Finally, efforts towards a more sustainable use of soil are undertaken on the European- and global level, like in the framework of the European Green Deal and the Sustainable Development Goals.

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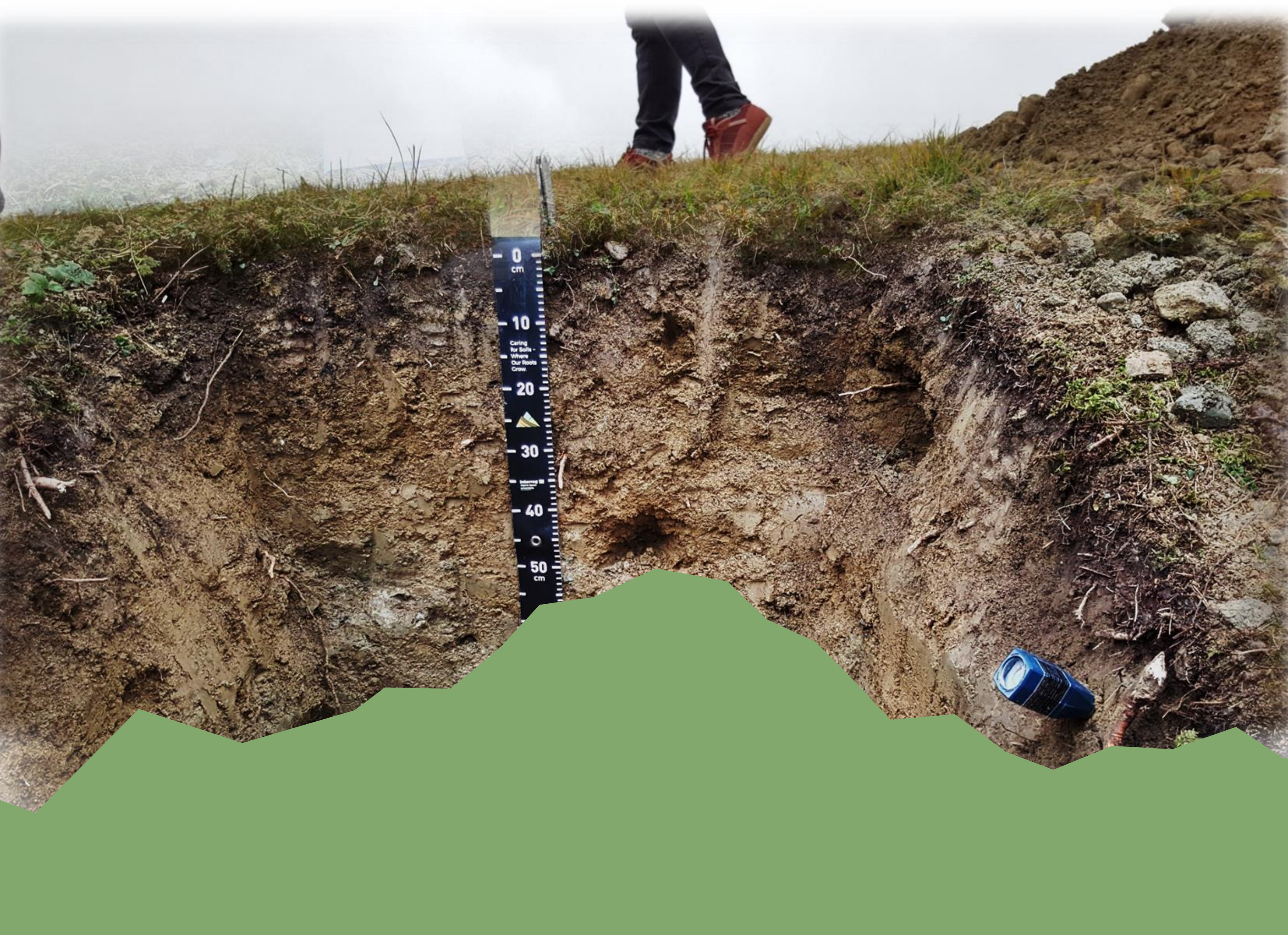
Soil Protection Working Group

Stock-taking summary of permanent soil monitoring areas in the perimeter of the Alpine Convention



This stock-taking summary of permanent soil monitoring areas in the perimeter of the Alpine Convention was approved by the Alpine Conference at its XVI meeting, held on 10 December 2020.

The stock-taking summary of permanent soil monitoring areas in the perimeter of the Alpine Convention was coordinated by the German Presidency of the Soil Protection Working Group and the Permanent Secretariat of the Alpine Convention and has been drafted based on material delivered by the members of the Soil Protection Working Group.

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Content

Annex to the stock-taking summary

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1. Introduction

The task to facilitate the implementation of Articles 20 (establishment of harmonized databases) and 21 (establishment of permanent monitoring areas and coordination of environmental monitoring) of the Soil Conservation Protocol of the Alpine Convention was mandated to the newly established Soil Protection Working Group of the Alpine Convention in its first mandate (2019-2020). The Soil Conservation Protocol has been signed by all Contracting Parties of the Alpine Convention and it has been ratified by Austria, France, Germany, Italy, Liechtenstein, Monaco, Slovenia and the European Union, where it thus entered into force. The Articles 20 and 21 state:

> *"Article 20: Establishment of Harmonised Databases*
> *(1) The Contracting Parties agree to create comparable databases (soil parameters, sampling, analysis, evaluation) within the framework of the Alpine monitoring and information system, and to establish possibilities for data exchange.*
> *(2) The Contracting Parties shall reach agreement about soil-endangering substances which require priority treatment, and they shall strive for comparable evaluation parameters.*
> *(3) The Contracting Parties shall strive to establish representative records of the condition of Alpine soils taking into account the geological and hydrogeological situation, on the basis of identical evaluation systems and harmonised methods.*
>
> *Article 21: Establishment of Permanent Monitoring Areas and Coordination of Environmental Monitoring*
> *(1) The Contracting Parties undertake to establish permanent monitoring areas in the Alpine region and to integrate them in an Alpine-wide soil monitoring network.*
> *(2) The Contracting Parties agree to coordinate their national soil monitoring programmes with the environmental monitoring programmes for air, water, flora and fauna.*
> *(3) Within the framework of their monitoring programmes, the Contracting Parties shall establish soil sample databases according to comparable parameters."*

It was discussed by the Soil Protection Working Group of the Alpine Convention, that reaching data comparability between the Alpine States is a challenging task and can neither be accomplished easily nor quickly. Harmonization of soil data is a difficult issue, which has already been discussed for many years prior to the establishment of the Soil Protection Working Group of the Alpine Convention. It is already difficult, and not achieved in every State to have one standardized national soil monitoring system in place. Generally, soil monitoring is done in different systems in very heterogeneous ways.
In 1994 the subgroup on "*permanent soil monitoring sites*" of the joint working group on soil protection of the Arge Alp, Arge Alpen-Adria and Arge Donau had prepared a report in German language on permanent soil monitoring sites, including a recommendation to set up sites and monitor them in a coordinated way (Arge Alp, Arge Alpen-Adria and Arge Donau 1994). Sites in Tyrol, Salzburg, Switzerland as well as all agricultural and special monitoring sites in Bavaria are set up based on those common recommendations from 1994. However, the recommendations were considered, but have not been implemented in all regions and not been comprehensively coordinated.
Another good example of a joint approach for soil monitoring and creating harmonized data in the Alpine area is the Interreg Alpine Space project "*MonarPOP - Monitoring Network in the Alpine Region for Persistent and other Organic Pollutants*", which was undertaken 2005 – 2007

and continued until 2010 (Austrian Federal Ministry of Agriculture, Forestry, Environment and Water Management 2008). The project underlined how working together internationally can be of significant added value regarding this issue, while a long-term approach would be necessary. Austria, Germany, Italy, Slovenia and Switzerland were involved in the project. In Austria, the project is currently continued from 2017 to 2020 under the title AustroPOPs.
Since also on the EU level the harmonization of national or regional soil data was not possible due to largely differing systems and data gaps, the LUCAS Soil survey coordinated by EUROSTAT and implemented by the JRC, was introduced in 2006. Thus, the Alpine EU member states - and in the survey of 2015 also Switzerland - are covered by the LUCAS Soil survey. Consequently, this European survey should be considered or even play a significant role regarding this topic.

To firstly start generating an overview of the currents state of soil monitoring in the perimeter of the Alpine Convention, the Group undertook a stock-taking of soil monitoring mechanisms and areas by collecting information about those instruments from the Alpine States by a first questionnaire.
On that basis, international monitoring instruments were identified for which soil in areas in the Alpine region are surveyed and for which thus comparable soil data is generated. Corresponding further information was collected from the Contracting Parties by a second questionnaire.
This stock-taking summary gives an overview of the delivered material and further discussions which took place during the mandate period. There is no claim for completeness of monitoring instruments and areas.
The document is followed by the original materials delivered by the Contracting Parties of the Alpine Convention that were prepared as answers for the two questionnaires as a separate annex.

2. Overview of national and regional monitoring instruments

As a starting point the Group agreed that the Contracting Parties prepare written overviews of their respective permanent monitoring instruments, which comprise locations inside the Alpine Convention perimeter. A questionnaire was developed by the Chair and circulated to the Working Group. It contained questions regarding

- the type of instrument,
- the monitoring mechanism,
- it's policy status,
- coverage in territory and land cover classes,
- the responsible administrations,
- topics addressed (soil threads, functions, parameter groups),
- site locations, as well as
- the availability of the generated data and
- in which international framework the sites are included if this applied.

Answers were delivered by Austria, France, Germany, Italy, Liechtenstein, Slovenia and Switzerland. The titles of the monitoring instruments are displayed in table 1, whereas the compiled answers can be found as annex to this stock-taking summary. In total 46 answers to the first questionnaire were submitted of which 45 contain monitoring areas in the perimeter of the Alpine Convention. All Contracting Parties were asked at the 4th meeting of the Working Group to check, if a national or regional monitoring mechanisms is missing, which should be still included.

Name of instrument	In place since	Category space (I=Internat.), (N= National), (R= Regional), (L=Local)	Category QQ (A=qualitative), (B=quantitative), (O=other)
Austria			
LTER Zöbelboden	1992	I	A
Agricultural Soil Protection Program of Styria	1986	R	A
(Permanent) Soil Monitoring Salzburg	1996	R	A
(Permanent) Soil Monitoring Salzburg - Land Consumption	in pipeline	R	B
Soil Inventory Salzburg	1988	R	A
Permanent Soil Monitoring Program of Tyrol	1998	R	A
Soil Inventory Tyrol	1986	R	A
Forest Soil Monitoring ICP Forests Program Level I & II	1988	I/N	A
Land Use and Soil Consumption Monitoring Tyrol	in pipeline	R	B
Repeated Sampling of Soil Mapping Profile Locations, Lower Austria		R	A
Expandible Soil Database for Soil Physical Parameters (mainly: Lower Austria, Upper Austria, Styria)		R/N	A
Permanent Monitoring Sites in Lower Austria	1996	R	A
Hydrological Open-Air Laboratory Petzenkirchen, Lower Austria, 66ha catchment		R/N/I	A
Soil Inventory of Upper Austria	1990-93	R	A

Name of instrument	In place since	Category space (I=Internat.), (N= National), (R= Regional), (L=Local)	Category QQ (A=qualitative), (B=quantitative), (O=other)
Cooperative, Long-term Ecosystem Monitoring Across the Alps: Austrian Hohe Tauern National Park, South-Tyrol and the Swiss Central Alps, AT, IT, CH, LTER Sites in CH and IT	2017	I	A
France			
Spatiotemporal Observatory of Biodiversity and Ecosystem Functioning of Mountains' Socio-ecosystems	2016	R/N/I	A
French Soil Quality Monitoring Network	2000	N	A
Long-term Monitoring of the Forest Ecosystems - Air pollution impacts on soil/forests (ICP Forests Program)	1992	I	A
Germany			
Bavarian Soil Monitoring	1986	R	A
Italy			
Links4Soils - Outcomes for Aosta Valley - Soil Mapping (vulnerability assessment & erosion prevention)	in pipeline	R	O
Carbon Fluxes Observation	2008	L/I	A
Regulation (EC) No 1221/2009 – EMAS III, Environmental Management System (EMS) – Nature Park Mont Avic, Aosta Valley: Transhumance Monitoring of Cattle in the Mountain Pastures	2003	I	O
Soil Erosion in Sloping Vineyards	2014	R/I	O
Italian Land Use Inventory (IUTI)	1990	N	B
Lombardy Geological Monitoring Centre, Warning System for large Landslides	1987	R	B
Soil Quality Monitoring in Lombardy (focus on SOC)	2010	R	A
Soil and Cropping System Monitoring Established in Lombardy to implement the Nitrates Directive	2005	R	A

Name of instrument	In place since	Category space (I=Internat.), (N= National), (R= Regional), (L=Local)	Category QQ (A=qualitative), (B=quantitative), (O=other)
Italy (continued)			
Environmental Monitoring Project in Lombardy Region (Soil Project): Fact-finding Survey of the Quality and State of Health of Lombardy Soils	2015	R	A
Aosta Valley Landslide Monitoring System	1996	R	B
RERCOMF - Regional Network for Landslide Movement Control (Piemonte)	1994	R	B
Environmental Soil Quality Monitoring Network (Piemonte)	2005	R	A
Long-term Thermosensitive Species Monitoring in Periglacial Soil of Northern Piemonte: Monte Rosa, Valley Formazza	first tests since 2006	Sub-R	A
Permafrost Long-term Monitoring Network in Piedmont's Alps (started by ASP PermaNET 2008-11)	2009	R	A
Pedoclimatic Characterization and Production Performance of 4 Truffles of Tuber Magnatum (Piemonte)	2010	SR	O
ARPA-Veneto – Organic Compound Monitoring Scheme		R	A
ARPA-Veneto – Heavy Metals Monitoring Scheme	the 90th	R	A
ARPA-Veneto – Soil Biological Quality	2018	R	A
ARPA- Friuli Venezia Giulia – Organic and Inorganic Substances Monitoring Scheme	Started in 2016	R	A
ARPA Friuli Venezia Giulia – Soil Biological Quality	2018	R	A
Liechtenstein			
Soil Monitoring Network - Principality of Liechtenstein	1994	N	A
Slovenia			
NEC directive Monitoring of Negative Impacts of Air Pollution on Ecosystem	in pipeline	I	A

Name of instrument	In place since	Category space (I=Internat.), (N= National), (R= Regional), (L=Local)	Category QQ (A=qualitative), (B=quantitative), (O=other)
Slovenia (continued)			
ICP Forests Level II Intensive Monitoring of Forest Ecosystem	2003	I	A
ICP Forests Level I 16 x 16km Transnational Grid throughout Europe	1995	I	A
8 × 8 km Grid for Greenhouse Gas Sink Assessment: Land Use Change & Forestry - Spatial Planning for Reporting on LULUCF	2010	N	A
Switzerland			
Swiss National Soil Monitoring Network (NABO)	1985	N	A

Table 1: Overview of all submitted monitoring mechanisms on questionnaire permanent monitoring sites.

A high amount of monitoring sites in the Alpine States, which are not part of an international monitoring system, exist. However, the monitoring mechanisms, topics and delivered data are heterogeneously, which allows only few generalized statements. Thus, the answers on the first questionnaire have been summarized and the most comparable monitoring systems were compiled in order to generate a dataset which allows some general statements, such as regarding parameter groups which are monitored in all or most of the Alpine States.

2.1 Qualitative soil monitoring instruments

To allow some statements, which are more generalized, monitoring systems were selected, which are:

- already in place,
- examine qualitative soil aspects and
- cover a national-wide area or complete region.
- All international mechanisms, such as NEC, ICP Forests or LTER were excluded to avoid doubling. Those will be part of the next chapter.
- Also projects as well as monitoring of erosion and permafrost monitoring are not included in the following overview, since they were only delivered by one Contracting Party and thus no international comparison can be made.

The following analysis comprises 24 monitoring instruments, of which nine are from Austria, two from France, nine from Italy, one from Germany, Liechtenstein, Slovenia and Switzerland respectively. The main reason for the high number of instruments in Austria and Italy is the

Regional organisation of soil monitoring. This applies also for Germany, but only one German Federal State comprises a part of the Alpine Convention perimeter.

It must be considered that the intervals of monitoring the respective sites differ significantly between the monitoring systems. Furthermore, some instruments are inventories, which examine a soil site once or might have single repetitions. However, the choice of sites as well as the interval of resampling depends largely on the requirements, questions which should be answered and available resources.

Figure 1 gives an overview of the percentage of the instruments that examine certain parameter groups. It is obvious, that all qualitative soil monitoring schemes cover site characteristics. While soil chemistry and specifically soil carbon is also covered by a very high percentage of the surveys, soil biodiversity and climate parameters are included in a lower percentage of instruments. Main- and subcategories of parameter groups could be chosen in the questionnaire. The main category "*climate parameters*" had the subcategory "*soil temperature*" and the main category "*soil chemistry*" had the subcategories "*ph-value*", "*heavy metal concentrations*" and "*organic compounds*". In figure 1 subcategories are displayed with a lighter colour than the main categories.

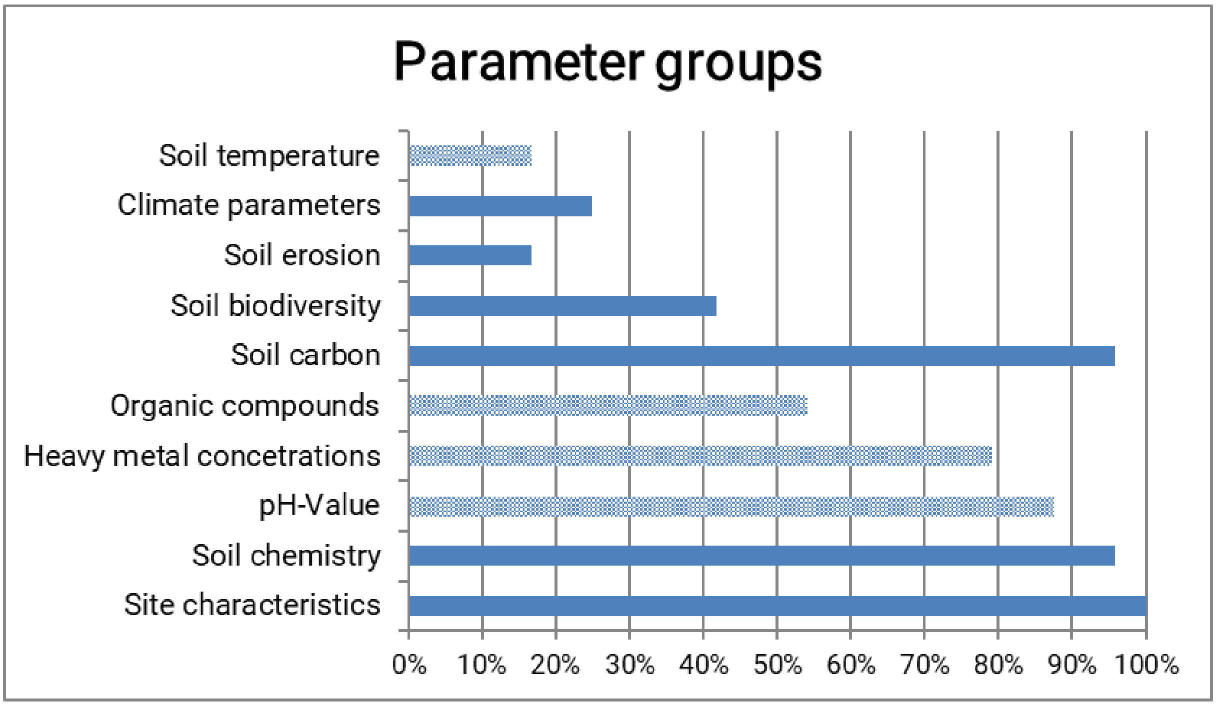

Figure 1: Percentage of parameter groups covered by selected monitoring mechanisms.

While figure 1 can give a good first insight, it must be considered, that the Alpine States are represented unequally, as the numbers of instruments per country differ (see above). Figure 2 displays this difference in showing the land cover classes addressed by the instruments firstly in total numbers and secondly per percentage of the respective Alpine State's instruments.

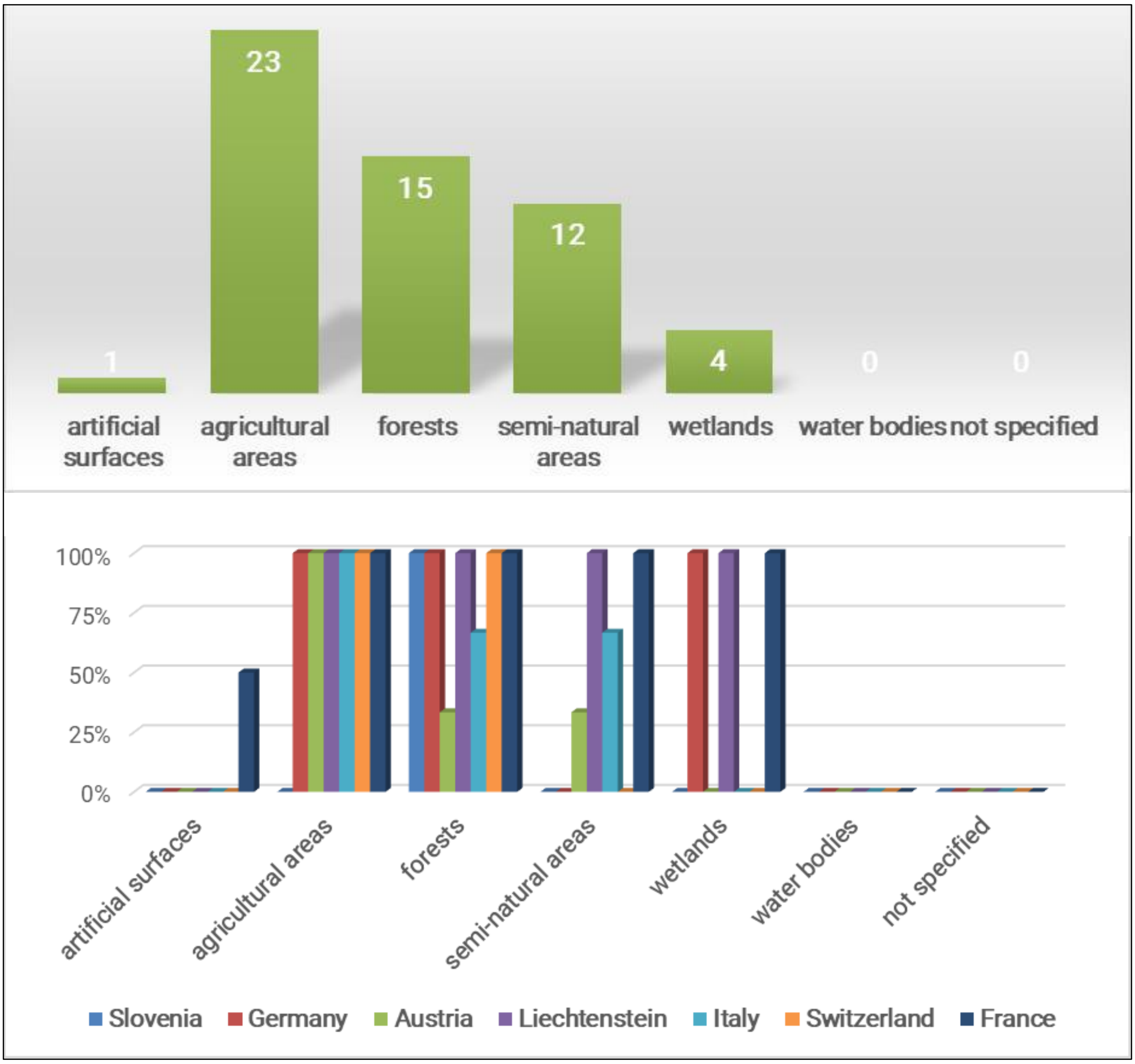

Figure 2: Land cover classes addressed by instrument in total numbers and in % of the State's instruments (Austria: 9, France: 2, Italy: 9, Germany: 1, Liechtenstein: 1, Slovenia: 1, Switzerland: 1).

Consequently, this more precise processing needed to be applied also for other key issues, such as,

- which parameter groups are examined (figure 3),
- which soil functions (figure 4) and
- which soil threads are addressed (figure 5)

in all or many Alpine States by national or regional-wide monitoring systems.

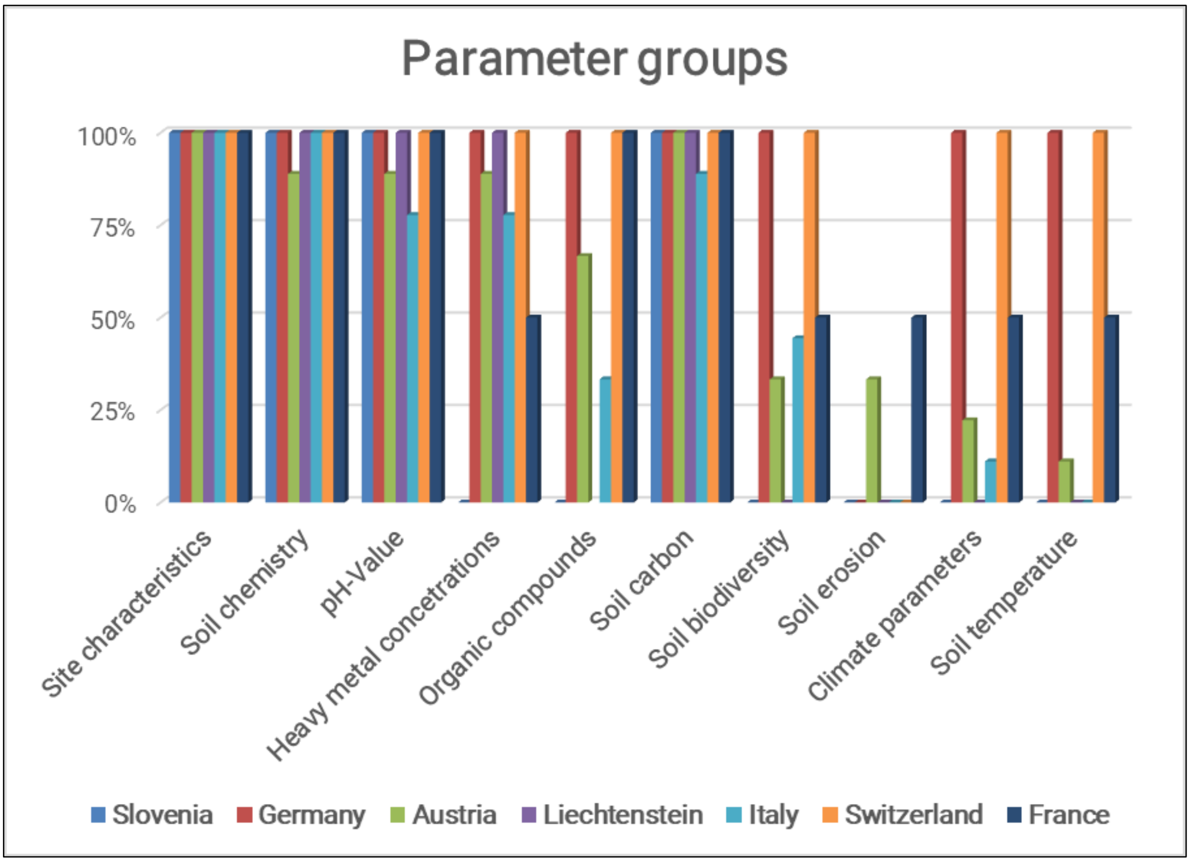

Figure 3: Parameter groups covered by instrument in % of the State's instruments (Austria: 9, France: 2, Italy: 9, Germany: 1, Liechtenstein: 1, Slovenia: 1, Switzerland: 1).

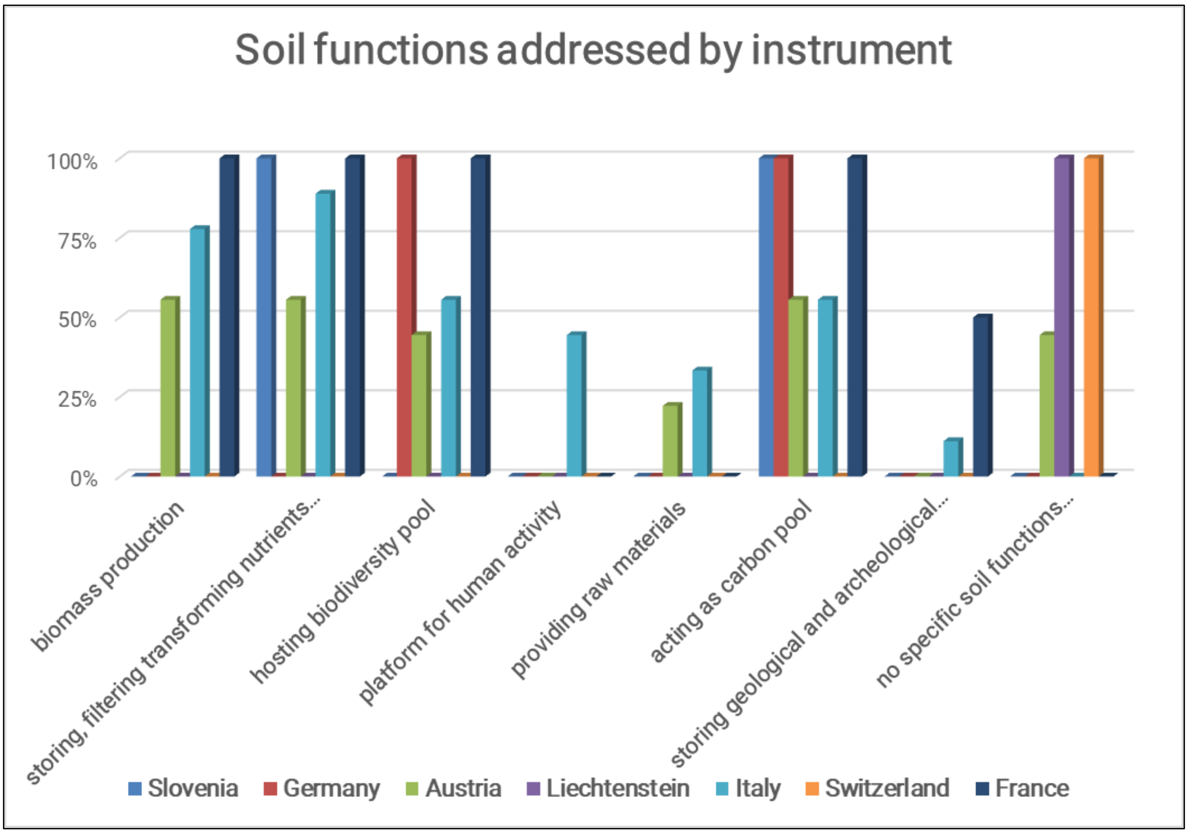

Figure 4: Soil functions addressed by instrument in % of the State's instruments (Austria: 9, France: 2, Italy: 9, Germany: 1, Liechtenstein: 1, Slovenia: 1, Switzerland: 1).

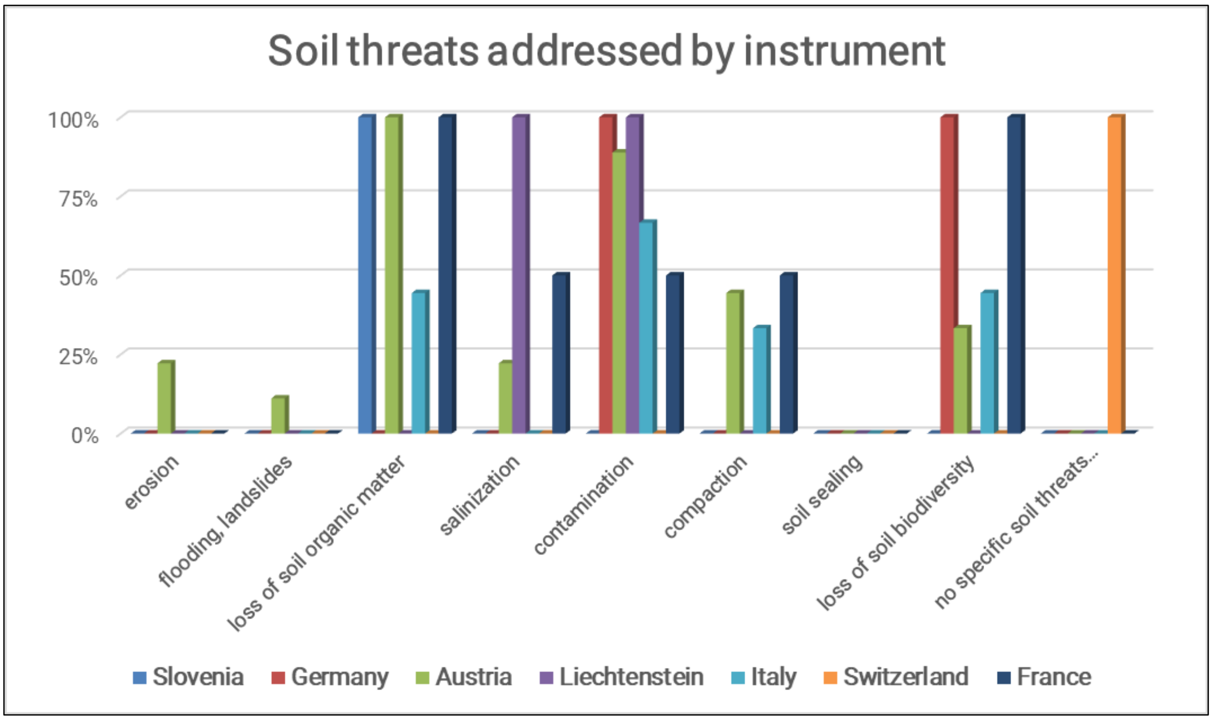

Figure 5: Soil threats addressed by instrument (Austria: 9, France: 2, Italy: 9, Germany: 1, Liechtenstein: 1, Slovenia: 1, Switzerland: 1).

2.2 An example per Alpine State

To give an insight into the monitoring instruments submitted in the first questionnaires, one example per Alpine State is briefly displayed here. The full questionnaires, comprising more details of all instruments can be found in the annex.

In Austria, the soil monitoring is organized on the regional level. Thus, an example is given here from Tyrol since the Region's area lays completely inside of the perimeter of the Alpine Convention.
The establishment of the Permanent Soil Monitoring Program of Tyrol serves the long-term monitoring of soil conditions and thus to a sustainable soil protection. It is planned for 70 years. Five sites, with each one plot under agricultural and silvicultural management, following different pollution scenarios and evenly distributed were set up. The soils are sampled and analysed every ten years to detect changing conditions and to allow taking measures for soil protection. The advantage is that targeted questions can be answered in a few informative and representative locations.
In addition to the permanent monitoring, a soil inventory has been done to assess the state of the soil condition, especially regarding heavy metal pollution. The investigations were based on the Austria-wide recommendation of the Austrian Soil Science Society. Monitoring points in a 4 x 4 km grid have been set. 658 sites were sampled between 1986 to 1987 and 107 sites resampled in 1993 (figure 6).

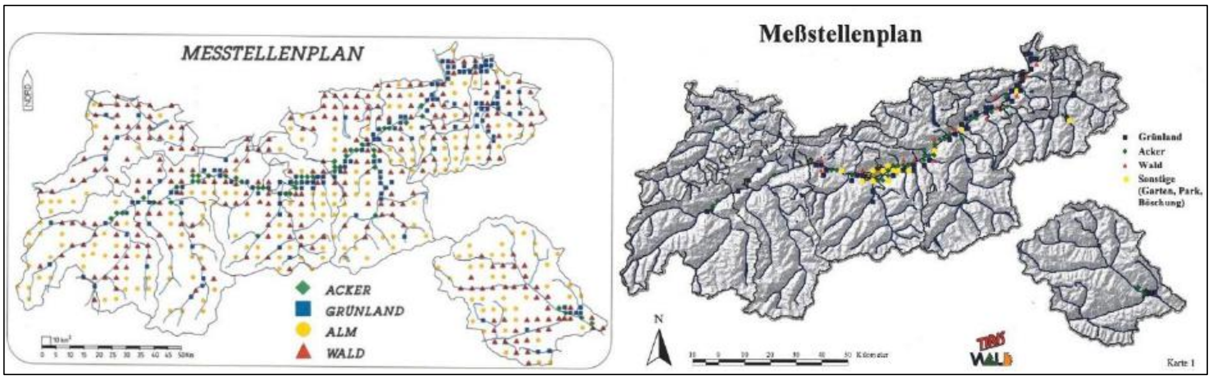

Figure 6: Plan of sampling sites of the Tyrol soil inventory, on the left: 1986-1987, on the right: 1993.

The French National Soil Quality Monitoring Network (RMQS) is a soil monitoring network based on a 16 x 16 km regular grid across the 550.000 km^2 of France. In continental France, it includes 2.173 monitoring sites, each located at the centre of a 16 x 16 km cell. For each, the soil profile, site environment, climatic factors, location, vegetation and land management have been described. Composite soil samples are collected up to 1 m depth, if possible. All samples are stored at INRA-Orleans in the European soil samples conservatory and data collected are available in the DONESOL database. The first campaign started in 2000 and ended in 2009 in continental France. The second campaign is ongoing. 158 sites are in the perimeter of the Alpine Convention (figure 7).

Next to the National Soil Monitoring, France has another system in place, which is especially relevant for the Alpine area: the Spatiotemporal observatory of biodiversity and ecosystem functioning of mountains' socio-ecosystems. It included 24 lines stretching over 600 to 1.200 meters of elevation. Each line contains ca. 6 plots.

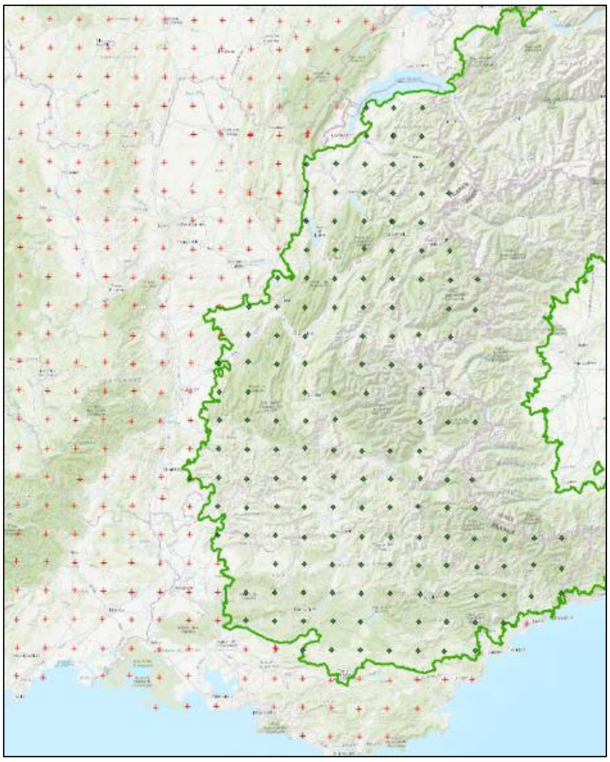
Figure 7: Locations in the Alpine Convention perimeter of the French National Soil Quality Monitoring Network.

Since 1986 the Bavarian Soil Monitoring assesses soil characteristic values at selected dates. This allows to compare the physical and chemical state of the soil and to detect trends of soil quality over extended periods of time. The Bavarian Environment Agency oversees protected areas and special sites; the agricultural areas are monitored by the Bavarian State Research Centre for Agriculture and the forest areas by the Bavarian State Institute of Forestry. The soil monitoring provides supportive data for political strategies and programs of the respective regional ministries, such as the Bavarian State Ministry of the Environment and Consumer Protection or the Bavarian State Ministry of Nutrition, Agriculture and Forestry. It comprises about 50 sites in perimeter in the land cover classes forest, agricultural areas and wetlands. The Bavarian soil monitoring is associated with the Bavarian Soil Protection Law and the Bavarian Soil Protection Program. The monitoring sites are displayed in figure 8.

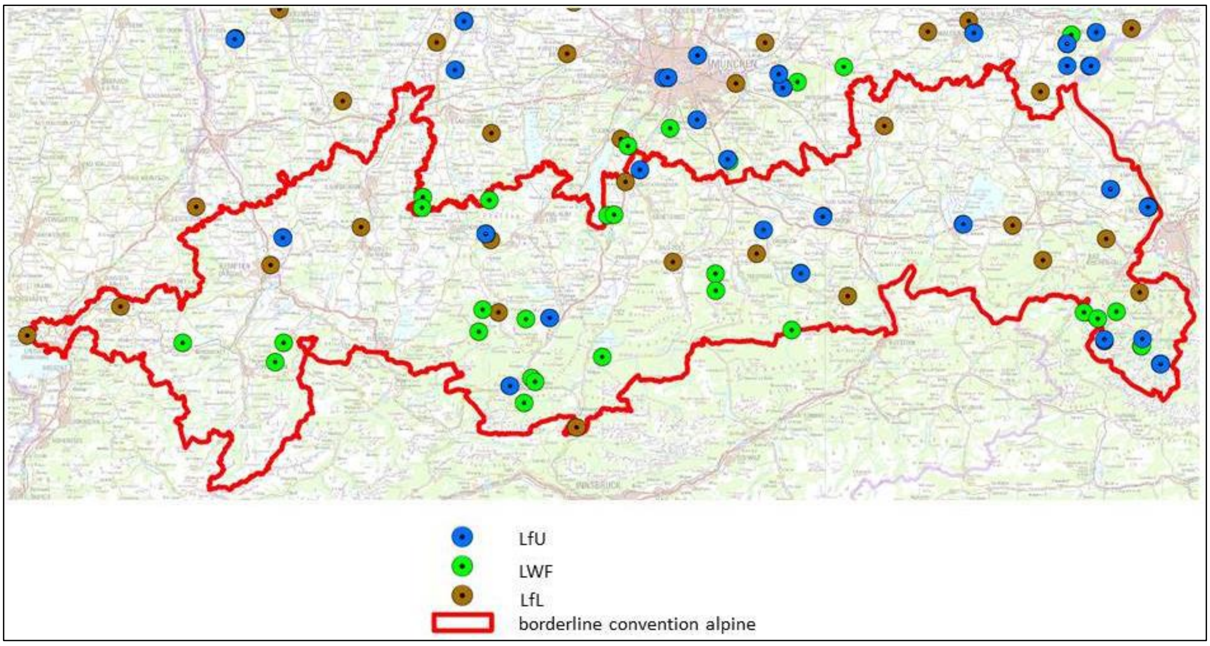

Figure 8: Bavarian Soil Monitoring. LfU = Bavarian Environment Agency, LWF = Bavarian State Institute of Forestry, LfL = Bavarian State Research Centre for Agriculture.

In Italy soil monitoring is organized on the regional level. Thus, many different monitoring programs and systems exist in Italy. Consequently, also for Italy one of the regional monitoring systems was chosen to present it here as an example.

The Environmental Soil Quality Monitoring Network of Piemonte is designed to provide homogeneous and validated data regarding the main contaminants. It is used as scientific reference support in activities related to the evaluation of soil quality and the application of the regulations concerning environmental contamination. The soil monitoring is carried out in monitoring stations distributed throughout the territory of the Region (figure 9), in correspondence with the vertices of a systematic network expanded with subsequent levels of depth. Soil sampling is carried out at fixed depths and for each sample taken, more than 70 contaminants are analysed, such as heavy metals, polycyclic aromatic hydrocarbons (PAHs) polychlorinated biphenyls (PCB), dioxins (PCDD) and furans (PCDF), for which limits are fixed by the Legislative Decree 152/06, in addition non-regulated heavy metals and rare earths.

Resampling is taking place at least every 10 years. The soils of 600 monitoring stations from the whole territory of Piemonte in the systematic grid have been sampled and analysed:

- 9 x 9 km grid: for the soils in the Alpine and hilly areas,
- 4,5 x 4,5 km grid: for the soils in the plain,
- 3 x 3 km or 1,5 x 1,5 km grid for areas characterized by problems related to widespread soil contamination.

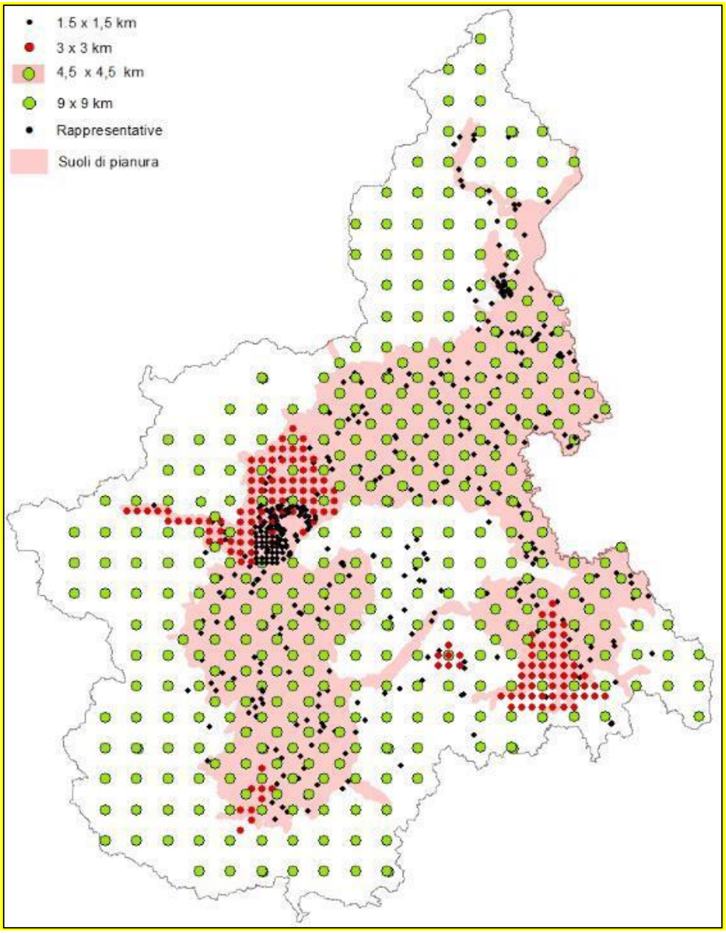

Figure 9: Locations of the stations of the Environmental Soil Quality Monitoring Network of Piemonte (data updated in December 2019).

The introduction of the Soil Monitoring Network of the Principality of Liechtenstein is based on the environment protection law. The task of the soil monitoring network is to record the contamination of soil pollutants as well as soil fertility in general. Repeated sampling of the same sites is intended to identify the longer-term development of pollutant loads. In the years 1994-1996 topsoil samples were collected at 37 locations, which are distributed over the whole nation in a grid of 2 x 2 km (figure 10). The sampled areas are currently used as forest, alpine pasture, grassland or arable land. Resampling took place at locations with critical loads of pollutants.

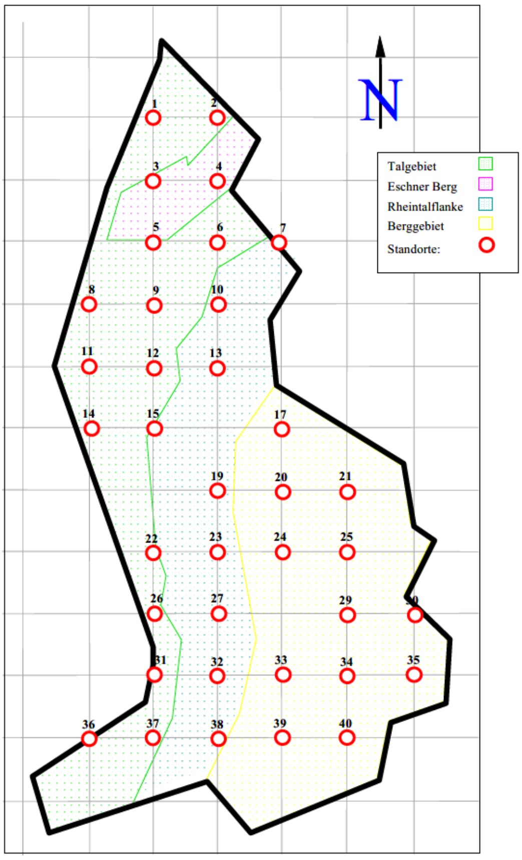

Figure 10: Soil monitoring grid of the Principality of Liechtenstein in 1995.

Slovenia has amongst other monitoring mechanisms for international instruments, the 8 x 8 km grid of plots in place. The main task of this instrument, on demand of the Ministry of the Environment and Spatial Planning, is carrying out activities related to greenhouse gas sink assessments needed for the regulation on the inclusion of greenhouse gas emissions and removals from land use, land use change and forestry (LULUCF). About 58 monitoring plots are located inside of the Alpine Convention perimeter as displayed in figure 11.
In addition, Slovenia is preparing the monitoring of negative impacts of air pollution on ecosystems for the NEC Directive.

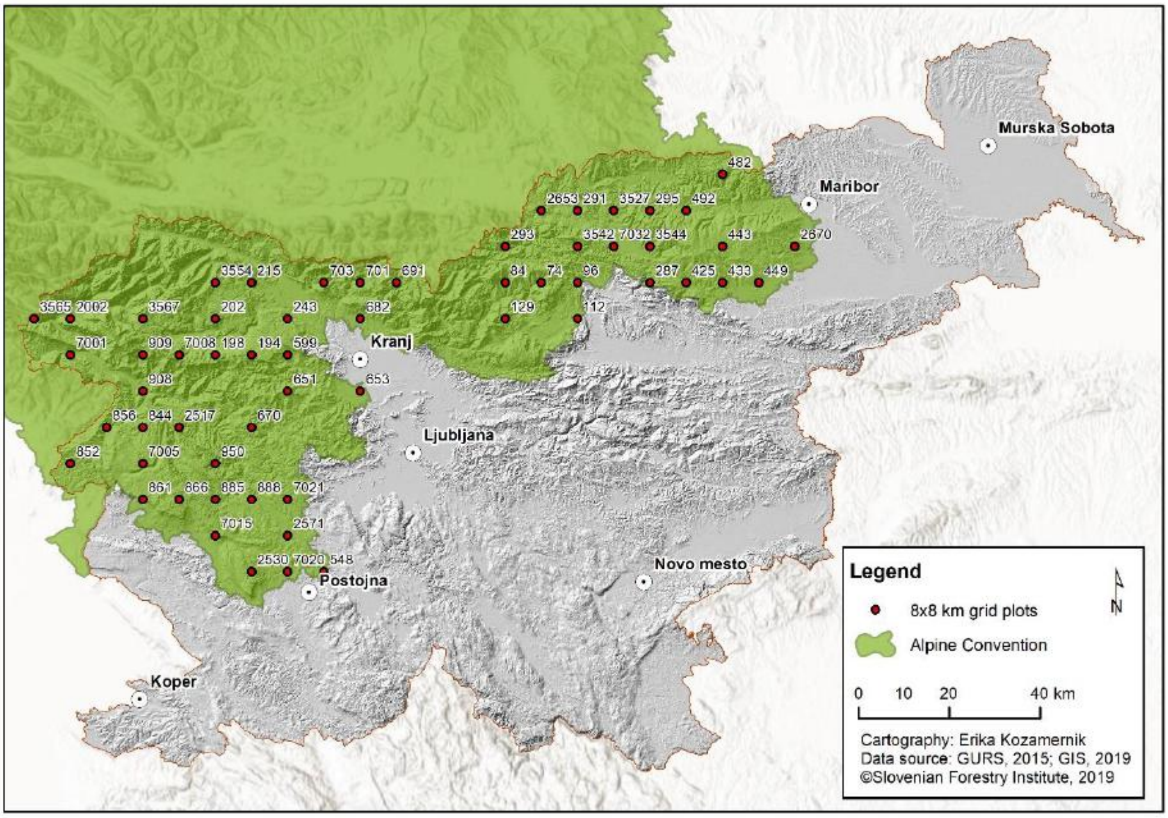

Figure 11: 8 x 8 km grid of plots in Slovenia for soil monitoring for LULUCF.

The Swiss National Soil Monitoring Network (NABO) records and documents the temporal development of the quality of Swiss soils based on chemical, physical and biological soil properties since 1985. The tasks also include early detection and forecasting of changes. For this purpose, a long-term monitoring system is operated, that monitors soils under their normal management. The monitoring network of around 110 sites spread across Switzerland is sampled regularly (figure 12). In addition, annually management and land use data are collected at selected sites. Also, NABO conducts supplementary studies on current issues. The selected NABO sites represent a combination of land use, soil type, geology, altitude and other site properties that are typical for Switzerland. Approximately two thirds are agricultural sites (arable land, permanent grassland, special crops) and one third is located in forests. Soil samples are collected at least every 5 years. Consequently, consistent time series over more than 30 years are available.
NABO carries out an additional indirect monitoring. Data on agricultural use will be collected for selected sites and material balances derived. Substance balancing helps to identify undesirable developments in the soil at an early stage and enables forecasts and scenarios to be drawn up. This modelling instrument serves as a precautionary tool in soil protection.
As a service, NABO offers consultation services for a diverse clientele with various needs. These services include developing recommendations for cantonal authorities, addressing specific soil-related questions of federal offices and offering technical advice to private clients. In addition, NABO regularly performs proficiency testing. These evaluations are commissioned by the federal government and conducted for interested laboratories to ensure data quality.

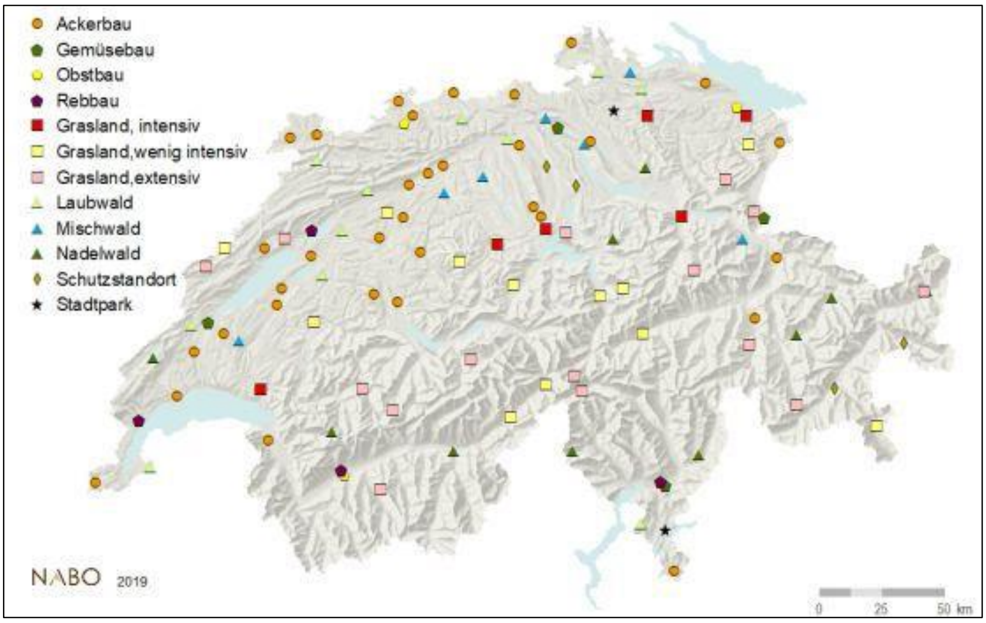

Figure 12: Swiss National Soil Monitoring Network (NABO), 2019. Source: Agroscope 2020.

3. Overview of sites for international monitoring instruments

As outlined above, harmonization of data generated by the largely differing monitoring systems in the Alpine States is hardly possible. Thus, it is important to take existing international monitoring systems into consideration, since in scope of those systems soil is already examined in an internationally comparable way. Consequently, the "*Questionnaire permanent monitoring sites for international monitoring mechanisms*", asking for soil monitoring sites in the perimeter of the Alpine Convention of previously identified international instruments - NEC directive, ICP Forests (Level I and II), LTER as well as LULUCF - was distributed and filled in by Austria, France, Germany, Italy, Liechtenstein, Slovenia and Switzerland.

The European soil monitoring LUCAS (Land Use/Cover Area frame statistical Survey) Soil, which also comprises locations inside the perimeter of the Alpine Convention is also an important instrument, which needs to be considered in this scope.

Sites, which are monitored for LULUCF (Regulation on the inclusion of greenhouse gas emissions and removals from land use, land use change and forestry) have also been demanded, but the answers underlined that this reporting mechanism can be disregarded for the purpose of this stock-taking, since there are no separate monitoring sites in some Alpine Countries and the reporting does not apply to Switzerland and Liechtenstein.

After presenting a summary at the 4th meeting of the Working Group the Contraction Parties have been asked for feedback regarding all open points. The Contracting Parties have been additionally asked to deliver, where possible, the coordinates and names of the sites, which are part of the monitoring for the NEC directive, ICP Forests (Level I and II) as well as LTER to avoid doubling and to prepare a correct overview. Since this was only partly possible in the short timeframe the displayed summary needs to be regarded as an initial overview, which should be updated in the future. Table 2 gives an overview on the current state of knowledge regarding the number of sites in the perimeter of the Alpine Convention, on which soil is monitored for the respective international instruments.

		Austria	France	Germany	Italy	Liechten-stein	Slovenia	Switzerland	AC perimeter	EU
LUCAS Soil survey	Sites in survey 2015	363	183	54	290	x	61	58	1.009	over 250.000 sample points, 2015 also altitudes above 1.000 m
	In place since	2009	2009	2009	2009		2009	once 2015	2009/2015	2009-2012, 2015, 2018 next 2022, 2026
ICP Forests Level II	Sites	13 (5 core areas) (6 also part of LTER)	9	2	10	x	3 2 identic with NEC sites	12	49 + x	around 500 plots
	In place since	1988	1992	1991/1995	1995	x	2003			program launched in 1985
ICP Forests Level I	Sites	114	47	8 x 8 km grid	15 x 18 km grid (260 in Italy)	x	14	12	187 + x	16 x 16 km grid
	In place since	1987-1990 + 2006-2007	1988	1986 (next 2022-2024)	1995	x	1995			1986-1996 + 2004-2008
LTER	Sites	30	25	1	16	x	4	12	88	25 national LTER networks
	In place since	2001	2015	2004	2008	x	2003			LTER Europe since 2003
NEC directive	Sites	15 (5 identic with ICP Forest) sites, 3 identic with LTER sites)	6 (of 2 French national observatories. Air pollution monitoring plost should be added)	ICP and other preexisting monitoring sites used for monitoring	4 (identic with ICP Level II sites)	x	3	*5*	33 + x	
	In place since	4-year interval for reporting data starting with 2019	To be implemented or reinforced over the period 2017-2021		sites identified since 2018	x	in preparation	*NABEL*		starting in 2019: 4-year interval for reporting data

Table 2: Overview of number of soil monitoring sites from international instruments in the perimeter of the Alpine Convention: current state of knowledge. The NEC Directive does not apply for Switzerland, but a comparable target is monitored by the Swiss National Air Pollution Monitoring Network (NABEL).

3.1 LUCAS Soil

The LUCAS (Land Use/Cover Area frame statistical Survey) Soil was developed in 2006 for the purpose of generating harmonized and thus comparable soil data for the EU (Joint Research Centre – European Soil Data Centre 2020), because the availability of soil data in the Member States and in their regions is very heterogeneously and the existing soil data is not comparable and thus cannot be harmonized. It is aimed at answering to policy needs of the EU and the Member States, such as regarding nature protection, climate change and agriculture. Soil data is becoming even more important in light of the EU Green Deal (Biodiversity Strategy, zero pollution, Farm2Fork Strategy, Circular Economy, climate law) and the Sustainable Development Goals. Eurostat coordinates the LUCAS Soil survey, while the implementation and development is done by the Joint Research Centre of the European Commission (JRC).

The soil surveys were continuously further developed in the extend of sample sites as well as in parameters covered, from the first survey in 2006 to the replications in 2009, 2012, 2015 and 2018. From now on the sampling interval will be extended to every four years. A core of sampling points always stays identical, while the majority of points change for each survey. For the Alpine area, the surveys from 2015 onwards are the most relevant once, since also sites on a higher elevation than 1.000 m over sea level were covered and additionally Switzerland was included. Figure 13 shows the locations inside of the perimeter of the Alpine Convention, which were sampled in scope of the LUCAS Soil survey 2015 including the sites in Switzerland.

Thus, this survey needs to be considered or even play a significant role regarding the issue of establishing a harmonized soil database for the Alpine region. Consequently, the soil monitoring sites in the perimeter of the Alpine Convention, which the survey comprises need to be included in this overview.

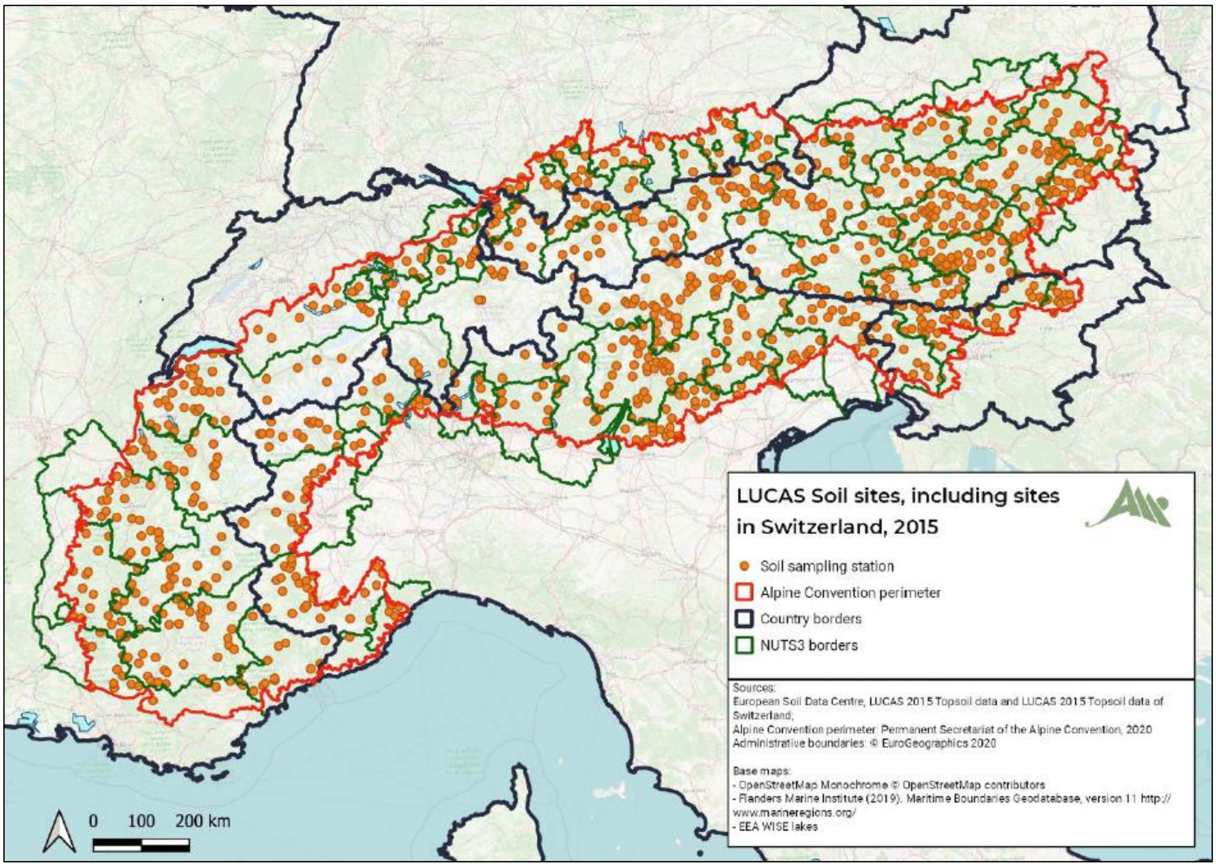

Figure 13: LUCAS Soil survey 2015 sampling sites and corresponding sampling sites in Switzerland 2015.

A cooperation with the JRC was started at the 4th meeting of the Soil Protection Working Group of the Alpine Convention. Currently the next LUCAS Soil survey is being prepared for the sampling phase from March to September 2022. While the first part of the surveys is always based on photointerpretation, the soil sampling is raised from 25.000 to 41.000 points. The samples will also be taken from deeper horizons (down to 30 cm). In addition, it is foreseen to expand on investigating soil biodiversity, sulphur, more cations and to research heavy metals again more extensively in the upcoming survey. While carbon content and organic soils were already a topic in the 2018 survey, a soil carbon indicator is currently further developed for reporting e.g. for the new CAP (EU Common Agricultural Policy). The Soil Protection Working Group of the Alpine Convention will prepare a proposal for the next survey for adjusting the locations in the Alpine region in order to record the state of the soils in the Alpine region in a representative way, taking into account the geological and hydrogeological situation, using the same evaluation bases and harmonised methods (Protocol on Soil Protection of the Alpine Convention Article 20 (3)).

3.2 ICP Forests

The ICP Forests Programme is the International Cooperative Programme on Assessment and Monitoring of Air Pollution Effects on Forests. In total 40 European countries as well as Canada and the United States of America are taking part in the ICP Forests Programme. Austria, Germany, France, Italy, Liechtenstein, Slovenia and Switzerland are participating.

ICP Forests was launched in 1985 under the Convention on Long-range Transboundary Air Pollution (Air Convention, formerly CLRTAP) of the United Nations Economic Commission for Europe (UNECE). A Task Force is the highest body of ICP Forests, and it represents all participating countries. National experts are organized in Expert Panels and Working Groups, which ensure the continuous development and harmonization of the monitoring methods and contribute to data evaluations. Different aspects are monitored, while samples for soil conditions are taken ca. every 10 years.

ICP Forests monitors forest condition in Europe on two monitoring intensity levels:

- The Level I monitoring is based on around 7.500 observation plots on a systematic transnational grid of 16 x 16 km throughout Europe and beyond to gain insight into the geographic and temporal variations in forest conditions. Figure 14 displays the spatial distribution of Level I plots in Europe in 2011classified by forest types. The network is subject of changes thus the distribution of plots (Level I and II) has slightly changed since then (Michel et. al 2018, 2019).
- The Level II intensive monitoring comprises around 500 plots in selected forest ecosystems with the aim of clarifying cause-effect relationships, to research the interaction between air pollution, climate change and forest ecosystems. At the current state of knowledge 39 plots are in the perimeter of the Alpine Convention.

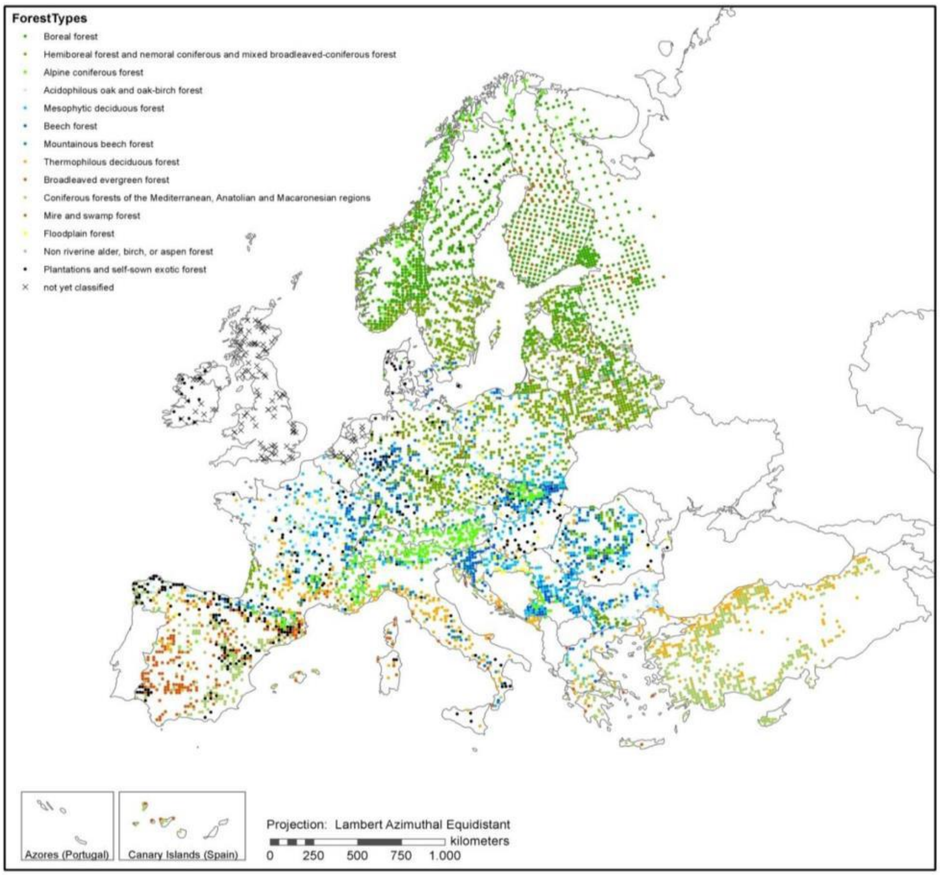

Figure 14: Spatial distribution of the ICP Forests Level I plots assessed in 2011, displayed according to respective forest types. Source: Lorenz et. al 2012.

3.3 LTER

Through research and long-term observation of representative sites around the globe, Long-Term Ecosystem Research (LTER) enhances our understanding of the structure and functions of ecosystems, which provide essential services to people (eLTER 2020). The LTER network was founded in 1980 by the United States National Science Foundation. eLTER was launched in Europe in 2003 as the umbrella network for Long-Term Ecosystem Research in Europe. Its members are national networks of LTER areas, which differ in their respective structures. Several permanent monitoring sites are located in mountain regions, where several biotic (e.g. plant phenology, plant composition, soil microbial biomass) and abiotic factors (e.g. air temperature, soil temperature, snow cover duration) are recorded. There are different classes of LTER sites:

- Master LTER sites,
- Regular LTER sites,
- Emerging LTER sites (new sites) and
- Extensive LTER sites.

At the current state of knowledge about 88 plots are in the perimeter of the Alpine Convention (see table 2). Figure 15 gives a general orientation of LTER sites in the perimeter. The locations are based on the information provided by the DEIMS-SDR (Dynamic Ecological Information Management System - Site and dataset registry). It displays only accredited LTER Europe sites, which differs slightly from LTER sites participating in the program, that were reported by the Contracting Parties.

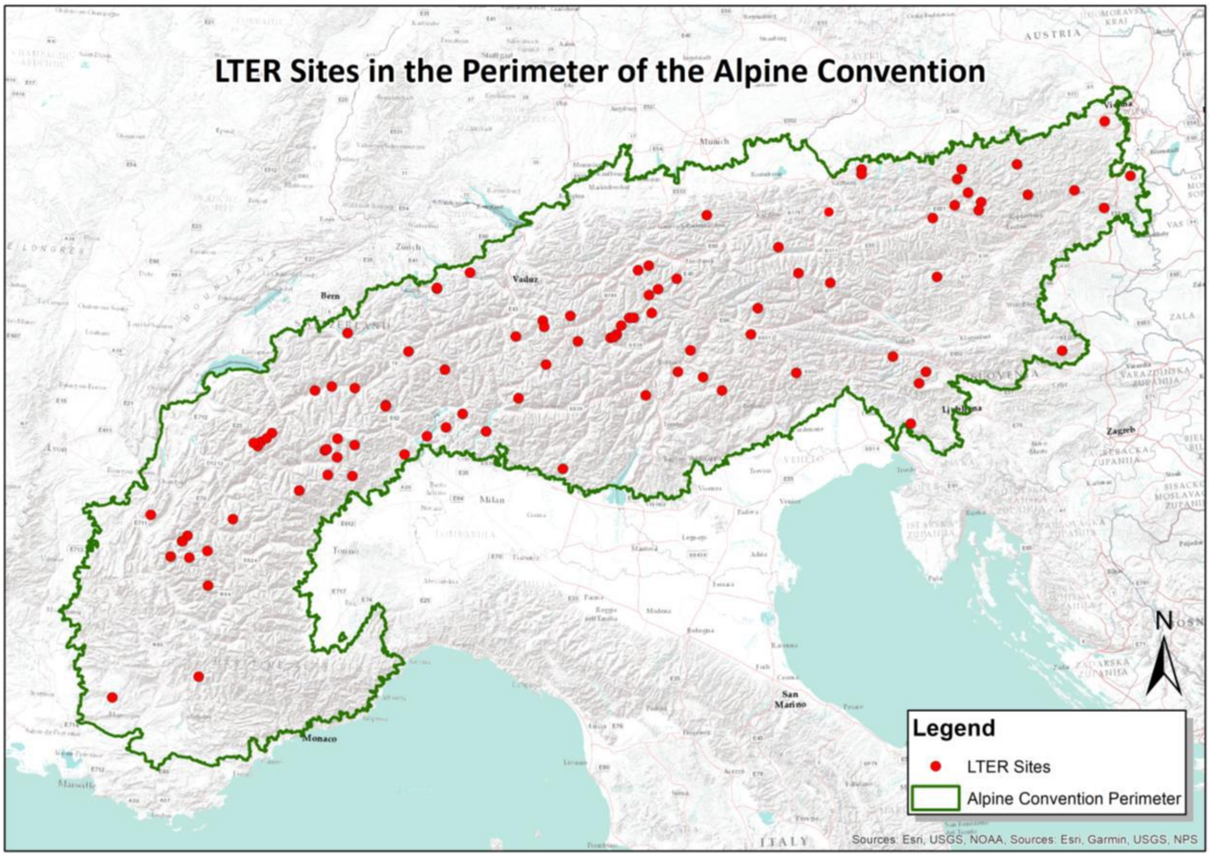

Figure 15: LTER sites in the perimeter of the Alpine Convention. Data source: DEIMS-SDR 2020.

The operators of the Austrian LTER sites, came together under the umbrella of "*LTER-Austria*". LTER in Austria provides an excellent link between environmental research and environmental monitoring, which is reflected in the reciprocal and highly synergistic utilization of the sites in both sectors. There are close connections to inter- and transdisciplinary sustainability research, to applied research, and to questions of sustainable regional development.

eLTER-France is organized in Workshop Zone Networks (RZA= Réseau des Zones Ateliers). The RZAs focus on functional units such as a river and its catchment area, landscapes - agricultural or urban - and biodiversity. They investigate ecosystems (marine, mountain, agricultural, fluvial, etc.). In the RZA observation, experimentation and analysis consider human practices in these environments and ecological functionalities such as ecosystem services. The RZAs are in direct contact with the stakeholders in the area, particularly regarding questions raised by managers, politicians and associations. Two LTER RZAs in France are part of the Alpine area: Zone Atelier Alpes and the research infrastructure OZCAR, both containing several sites. In addition, it is possible, that single sites of other RZA stretch into the Alpine perimeter.

The German LTER network "*LTER-D*" was founded in 2004. It comprises about 30 LTER areas. A LTER site in the perimeter of the Alpine Convention in the Berchtesgaden National Park.

LTER-Italy (ILTER) was founded in 1993, to meet the growing need for global communication and collaboration among long-term ecological researchers and to capture ecological phenomena in the context of global change. LTER-Italy is also one of the key nodes of the E-infrastructure for Biodiversity and Ecosystem Research LifeWatch (LifeWatch ERIC 2020).

LTER Slovenia is a network of eight institutions engaged in a long-term, site-based ecological and socioeconomic research since 2003. LTER Slovenia geographically covers a wide spectrum of monitoring sites, which are: two cave systems, 11 forest platforms, two lakes and one marine site. Depending on the physical characteristics of the LTER site, several ecological and biodiversity data are measured. Parameters are monitored in the air, water, soil, and vegetation. Four LTER areas are in the perimeter of the Alpine Convention.

In Switzerland, the identic sites are part in the LTER network as in the ICP Forests Program. It is covered by the Swiss national program "*Long-term Forest Ecosystem Research*" (LWF) which follows multiple objectives on 19 monitoring sites of which 12 are inside the perimeter of the Alpine Convention.

3.4 NEC

The NEC Directive (National Emission Ceilings Directive) entered into force on 31 December 2016. According to Article 9 of the NEC Directive, monitoring of impacts of air pollution on ecosystems must be ensured. The Clean Air Programme for Europe includes, in addition to its target for reduction of health impacts across the Union, a target for a reduction by 35 % of the ecosystem area subjected to eutrophication by 2030, compared with 2005. In order to have the data to assess this target, Member States must report monitoring data in a 4-year interval, starting with 2019.

The intention is to reinforce the ecosystem monitoring network to determine the state of terrestrial and freshwaters ecosystems in a long-term perspective with respect to the impacts of SOX, NOX, NH3, and ground level ozone and to enable prediction of changes. Thus, the objectives of the monitoring are to improve information on the impacts of air pollution, including the recovery time needed when the impacts are reduced, as well as to review critical loads and levels. The air pollution impacts of main interest for the ecosystem monitoring are acidification, eutrophication and ozone damage. While the impacts of other pollutants (e.g. metals) are also of concern, the first phase of monitoring focuses on these three issues.

In Italy "four sites sensitive to both acidification and nitrogen deposition where long-term data are collected (ICP Waters/LTER) were identified for water bodies monitoring, all of them located in the north alpine region, because this is considered a pristine area in Italy not affected by other anthropogenic sources of air pollution, where the contribution of transboundary air pollution can be distinguished from other pressures" (De Marco et al. 2019).

The NEC Directive does not apply for Switzerland. However, Switzerland has set a target similar to the targets of the NEC Directive. It aims at reducing the VOC (volatile organic compounds)-emissions by 30% until 2030, taking the year 2005 as the starting point. The Swiss National Air Pollution Monitoring Network (NABEL) is thus also listed in the table 2.

In Liechtenstein air quality and compliance with threshold values for human health and environmental protection is monitored in cooperation with the monitoring network of east Switzerland "*OSTLUFT*". Threshold emission values for human health and environmental protection and emission limits for energy production, industry, agriculture, traffic, combustion and power fuel, and domestic heating are defined in the national clean air act and further developed in the national air quality action plan.

4. Conclusions and further steps

The stock-taking of soil monitoring areas in the perimeter of the Alpine Convention as well as the stared discussions on data harmonization and the establishment of a cooperation with the JRC regarding the LUCAS Soil survey represent first steps in facilitating the implementation of Articles 20 (establishment of harmonized databases) and 21 (establishment of permanent monitoring areas and coordination of environmental monitoring) of the Soil Conservation Protocol of the Alpine Convention.

Further steps are necessary to build up on the started process. This applies especially to the continuation of the started cooperation regarding the European soil survey as well as the need to establish a medium- or long-term concept towards coordinated permanent soil monitoring areas and comparable soil databases for the Alpine area.

Furthermore, the assessment of soil functions of agricultural soils has been addressed and discussed by the Soil Protection Working Group at several meetings. The resulting soil function maps have proven to be a good and important tool for evidence based spatial planning decision, for enabling planers and decision makers to save the most valuable soils. Supporting Alpine regions in establishing such soil function maps and developing Alpine wide comparable soil function maps, would be important steps for soil protection in the Alps and a specific case of implementing article 20(1) of the Soil Conservation Protocol.

Sources and further information

Websites

Alpine Convention (Framework Convention): https://www.alpconv.org/en/home/convention/framework-convention/

Protocols and declarations of the Alpine Convention: https://www.alpconv.org/en/home/convention/protocols-declarations/

In scope of the Interreg Alpine Space project Links4Soils the **Alpine Soil Web GIS** has been established. It gives access to freely available regional, national and trans-border Alpine soil data collected within the Links4Soils project: https://alpinesoils.eu/soil-info/

Literature

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Austrian Federal Ministry of Agriculture, Forestry, Environment and Water Management (eds.) (2008): MONARPOP Monitoring Network in the Alpine Region for persistent and other organic pollutants. Online: http://www.monarpop.at/, 24.09.2020.

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eLTER (2020): LTER-Europe. Online: https://www.lter-europe.net/lter-europe, 02.10.2020.

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Michel, A., Seidling, W., Prescher, A-K. (eds.) (2018) Forest Condition in Europe: 2018 Technical Report of ICP Forests. Report under the UNECE Convention on Long-range Transboundary Air Pollution (Air Convention). Online: http://www.bfw.ac.at/webshop/index.php?id_product=400&controller=product, 02.10.2020.

Michel, A., Prescher, A-K., Schwärzel, K. (eds.) (2019) Forest Condition in Europe: 2019 Technical Report of ICP Forests. Report under the UNECE Convention on Long-range Transboundary Air Pollution (Air Convention). BFW-Dokumentation 27/2019. Vienna: BFW Austrian Research Centre for Forests. Online: https://www.researchgate.net/publication/340478474_Forest_Condition_in_Europe_2019_Technical_Report_of_ICP_Forests_Report_under_the_UNECE_Convention_on_Long-Range_Transboundary_Air_Pollution_Air_Convention, 02.10.2020.

ALPENKONVENTION
CONVENTION ALPINE
ALPSKA KONVENCIJA
CONVENZIONE DELLE ALPI

alpenkonvention • convention alpine
convenzione delle alpi • alpska konvencija

Soil Protection Working Group

Questionnaire permanent monitoring sites

Content by country in alphabetical order

PDF page number

alpenkonvention • convention alpine
convenzione delle alpi • alpska konvencija

Soil Protection Working Group
Questionnaire permanent monitoring sites

Please send your feedback ***by FR, 13.09.2019*** *to vera.bornemann@alpconv.org to allow us to prepare an overview of the results for the 2nd meeting of the working group.*
When filling out this document, please do not use footnotes. If you would like to make comments, use the Comments section at the end. Please delete this instruction text and the other instructions in the document. Just keep the answers. Please copy the questionnaire as many times as needed starting with a new page for every monitoring scheme, or use separate document for every monitoring scheme you will send in.

AT – LTER Zöbelboden

National Name: Erhebungen zur langfristigen Ökosystem-Beobachtung, Zöbelboden

1. Brief description of the instrument

The Zöbelboden was established in 1992 as the only Integrated Monitoring station in Austria under the UN Convention on long-range transboundary air pollution (CLRTAP). In 2006 it became part of LTER Austria. The Zöbelboden covers a small forested catchment (90 ha) of a karstic mountain range (500 to 950 m above sea level) in the Kalkalpen national park. Monitoring and research is focussing on air pollution effects on forested catchments and its interaction with climate change. The Zöbelboden represents one of the best known karst catchments in Europe with long-term data series of the major components of its ecosystems. The Zöbelboden is managed by the Umweltbundesamt GmbH. Sampling of chemical specimen is done by local staff. Chemical analyses are carried out by the laboratory of the Umweltbundesamt in Vienna (https://deims.org/8eda49e9-1f4e-4f3e-b58e-e0bb25dc32a6).

2. Institution(s) responsible for the implementation and/or evaluation of the policy instrument

Umweltbundesamt GmbH www.umweltbundesamt.at

3. Type of instrument

- international monitoring systems,
- national monitoring systems,

- instrument with direct impact on soil.

4. Status of policy instrument

- In place (1989),

5. Territorial coverage

- international,

6. Sectoral coverage

- forestry,

7. Soil threats addressed by instrument

- contamination,
- loss of soil biodiversity,

8. Soil functions addressed by instrument

- storing, filtering, transforming nutrients or water,
- hosting biodiversity pool,
- acting as carbon pool,

9. Land cover classes addressed by the instrument

- forests,

10. Monitoring sites

GIS layer to be found here: https://deims.org/8eda49e9-1f4e-4f3e-b58e-e0bb25dc32a6

11. Parameter groups

- Site characteristics (soil type etc.)
- Soil chemistry
  - pH-value
  - Heavy metal concentrations
  - Organic compounds
- Soil carbon
- Soil biodiversity
- Climate parameters
  - Soil temperature
  - Soil water content

12. Data availability

The data is or will soon be available without any restrictions here: https://deims.org/8eda49e9-1f4e-4f3e-b58e-e0bb25dc32a6

13. Monitoring mechanisms

LTER Zöbelboden is a small, well definable catchment of 90 ha in the National Park Kalkalpen in Austria. Material inputs, pollutants and nutrients via air and precipitation are measured as well as their effects on the ecosystem. Their behaviour within the ecosystem is studied in a comprehensive manner and effects are determined. With standardized methods the long-term trends of ecosystem water and element fluxes are studied. Outputs through surface waters and into groundwater are part of this work as are trends in biodiversity and effects of climate change. The the long-term data is used in the UNECE CLRTAP effects monitoring networks, in EMEP, and the national air pollution monitoring. LTER Zöbelboden is an important site within the Austrian LTER network so that many research institutions use the site in their projects.

Meteorological and air pollution monitoring is carried out at a clearing area (EMEP station; includes measurement of fog deposition) and on a tower (45 m height). Three intensive plots exist for the detailed measurement of element fluxes through the main forest types (bi-weekly to monthly analyses of deposition and soil water). Catchment runoff chemistry is measured at the main spring with a measuring weir (weekly analyses) and through irregular sampling at all other springs. Additional karst-hydrological measurements are in place in the main rivers surrounding the mountain range. On 64 permanent plots (regular 100 m grid) forest tree monitoring, ground vegetation and soil sampling is carried out (5 to 10 year interval). Additional permanent plots exist for forest floor vegetation, lichens, bryophytes and birds (3 to 10 year interval). The main stations (EMEP station, intensive plots, the hut) can be reached via a forest road with all year access (once a week in winter).The station has full power supply, a radio transfer of the data within the site and remote online access to the major devices.

For a full parameter list please go to **https://deims.org/8eda49e9-1f4e-4f3e-b58e-e0bb25dc32a6**

14. Other available information

Integrated Monitoring Manual: **https://www.syke.fi/en-US/Research__Development/Ecosystem_services/Monitoring/Integrated_Monitoring/Manual_for_Integrated_Monitoring**

Auswertung der Bodeninventurdaten Zöbelboden: **https://www.umweltbundesamt.at/umweltsituation/oekosystemareumweltkontrolle/oekosystem_monitoring/ergebnisse_lter/bodenchemie/**

Comments by the assessor:

AT –Agricultural soil protection program of Styria

National Name: Steiermärkisches landwirtschaftliches Bodenschutzprogramm.

1. Brief description of the instrument

Das Steiermärkische landwirtschaftliche Bodenschutzgesetz (LGBl. Nr. 66/1987) und die Bodenschutzprogrammverordnung (LGBl. Nr. 87/1987) sehen vor, dass in der Steiermark zur Beurteilung des durch Schadstoffeintrag, Erosion und Verdichtung gegebenen Belastungsgrades landwirtschaftlicher Böden ein geeignetes ständiges Netz von Untersuchungsstellen geschaffen und dort laufend Zustandskontrollen durchgeführt werden.

2. Institution(s) responsible for the implementation and/or evaluation of the policy instrument

Amt der Steiermärkischen Landesregierung, A10, Referat Boden- und Pflanzenanalytik

3. Type of instrument

- regional monitoring systems,

4. Status of policy instrument

- since 1986

5. Territorial coverage

- regional (federal state),

6. Sectoral coverage

- agriculture,

7. Soil threats addressed by instrument

- erosion,
- loss of soil organic matter,
- contamination,
- compaction,

8. Soil functions addressed by instrument

- no specific soil functions mentioned.

9. Land cover classes addressed by the instrument

- agricultural areas,

10. Monitoring sites

11. Parameter groups

- Site characteristics (soil type etc.)
- Soil chemistry
  - pH-value
  - Heavy metal concentrations
  - Organic compounds
- Soil carbon
- Soil erosion

12. Data availability

Daten im LUIS (Landesumweltinformationsystem) bzw. GIS einsehbar.

13. Monitoring mechanisms

- Vollzug des Steiermärkischen Bodenschutzgesetzes und der anhängenden Bodenschutzprogrammverordnung.

14. Other available information

Bodenschutzberichte

Comments by the assessor: -

AT –- (permanent) soil monitoring Salzburg

National Name: Bodendauerbeobachtung (BDF) Salzburg

1. Brief description of the instrument

The Salzburg Soil Protection Act provides for the establishment of soil observation areas in § 15. The overarching goals of soil monitoring are for example: Recording the current properties and loads of selected soils as a continuation of the soil inventory, Long-term determination of soil changes, Derivation of the sensitivity of soils to different factors, Comparative assessment (pollution and clean air area).
8 monitoring areas have been set up since 1996.
The scope includes anorganic and organic parameters and pollutants, soil physical and soil biological parameters and radionuclides

2. Institution(s) responsible for the implementation and/or evaluation of the policy instrument

Government of the Land Salzburg
https://www.salzburg.gv.at/themen/aw/landwirtschaft/boden

3. Type of instrument

- regional monitoring systems,
- instrument with direct impact on soil.

4. Status of policy instrument

- In place since 1996

5. Territorial coverage

- regional (federal state or non-federal state),

6. Sectoral coverage

- agriculture

7. Soil threats addressed by instrument

- loss of soil organic matter,
- contamination,
- compaction,
- loss of soil biodiversity,

8. Soil functions addressed by instrument

- biomass production,
- storing, filtering, transforming nutrients or water,
- hosting biodiversity pool,

- acting as carbon pool,

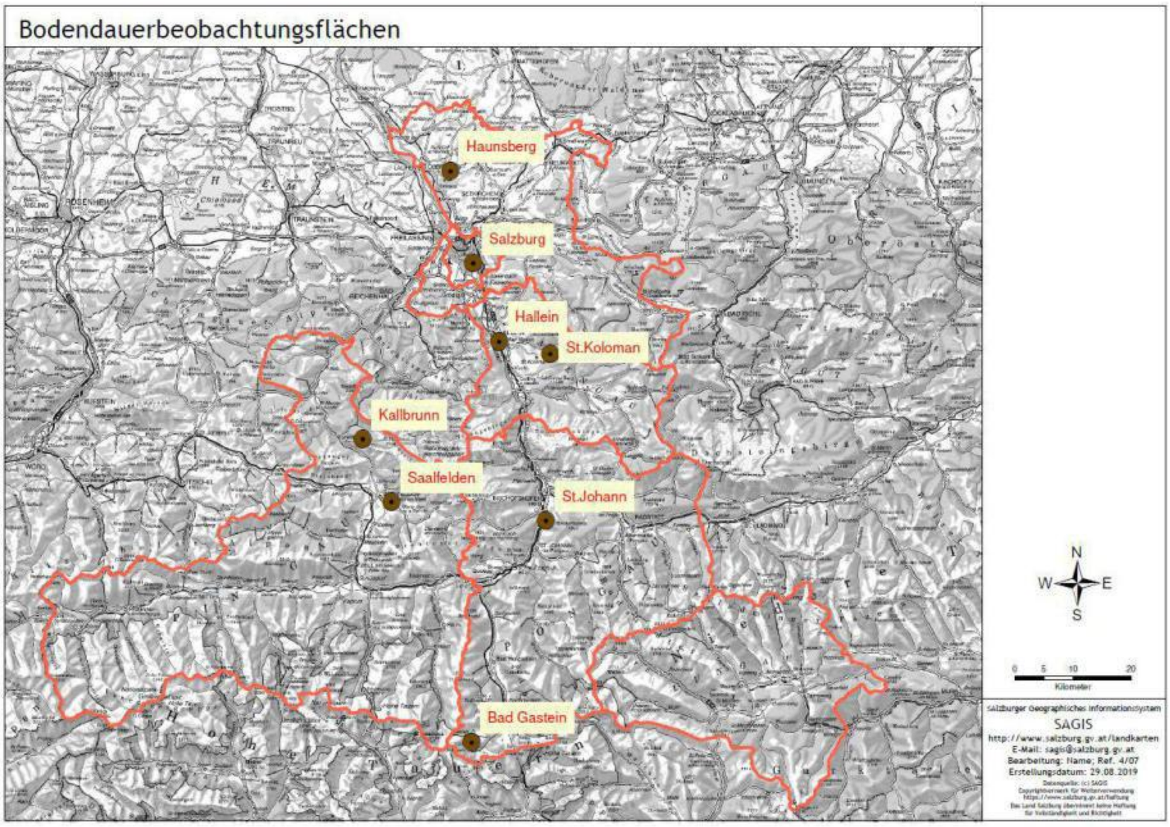
9. Land cover classes addressed by the instrument

- agricultural areas,
- semi-natural areas,

10. Monitoring sites

Please list here the monitoring sites, which are in the perimeter of the Alpine Convention. List the locations, site characteristics and other relevant information as exact as possible in writing. Please include cartographic overview(s), if available.

❶ Hallein (Wechselgrünland, kalkhaltiger grauer Auboden, Industriestandort)
❷ St. Koloman (Grünland, Braunlehm, Hintergrund)
❸ Saalfelden (Grünland, entkalkte Lockersediment-Braunerde, Hintergrund)
❹ Salzburg Stadt (Acker, kalkhaltiger grauer Auboden, städtisches Gebiet)
❺ St. Johann (Grünland, kalkfreie Lockersediment-Braunerde, Vorbelastung Bergbau)
❻ Weißbach/Kallbrunnalm (Almfläche kalkalpin, stark versauert)
❼ Nußdorf/Haunsberg (Grünland, Lockersedimentbraunerde, Staulage)
❽ Bad Gastein (Almfläche, zentralalpin, Vorbelastung Bergbau)

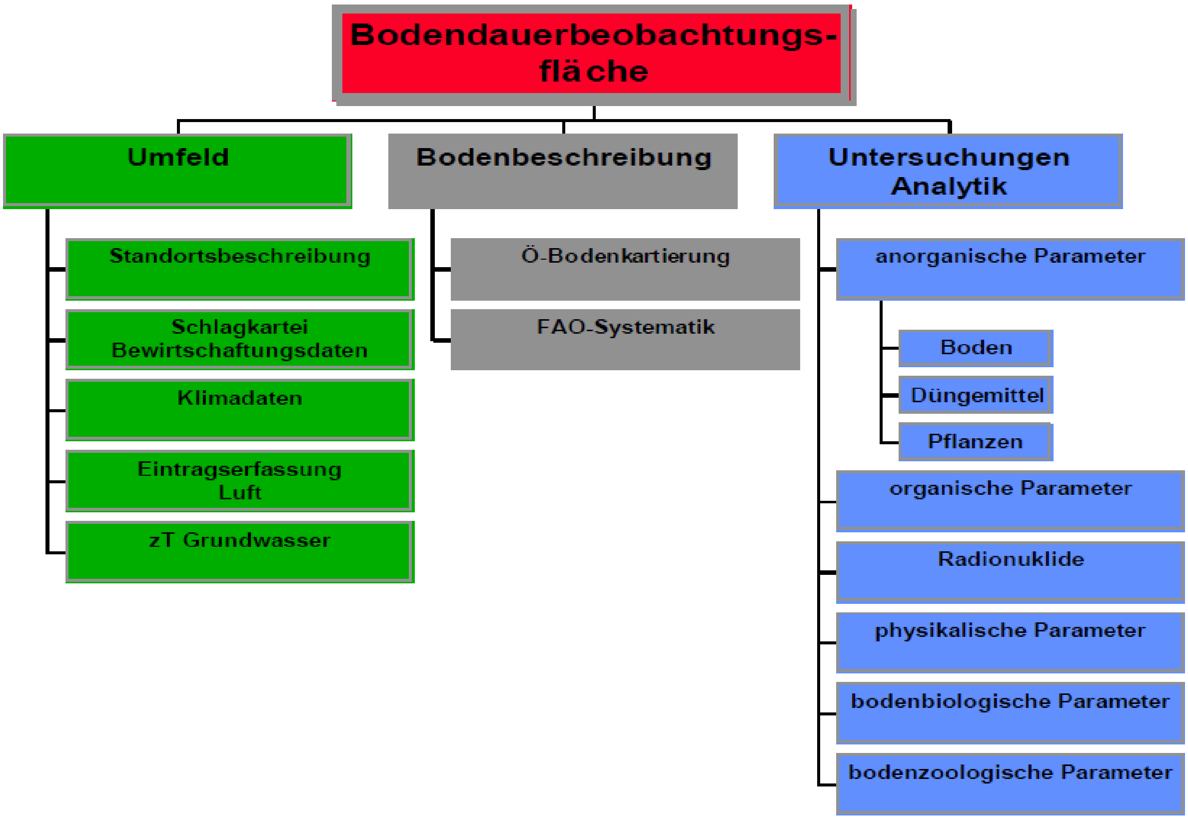


11. Parameter groups

- Site characteristics (soil type etc.)
- Soil chemistry

- pH-value
- Heavy metal concentrations
- Organic compounds

- Soil carbon
- Soil biodiversity
- Climate parameters



12. Data availability

data are restricted, meta-information available, INSPIRE yes

13. Monitoring mechanisms

13. Other available information

https://www.salzburg.gv.at/agrarwald_/Documents/bodenschutzbericht_endversion_fuer_internet.pdf page 34 – 42

Comments by the assessor:

AT –- (permanent) soil monitoring Salzburg

National Name: Monitoring Bodenverbrauch Salzburg

1. Brief description of the instrument

To minimize the land consumption is in Salzburg is of great public and political interest, because the area of permanent settlement is only about 20 %.

In 2019 has set up a project to establish the real land consumption in Salzburg. The basis for the project are satellite pictures and special evaluation methods. After the basic surveys is the plan to repeat the evaluation every five or ten years to show the change process and to take measures for reducing land consumption. The decision about the repeat is not yet decided.

The first statistical evaluations are expected in spring 2020.

2. Institution(s) responsible for the implementation and/or evaluation of the policy instrument

Government of the Land Salzburg
https://www.salzburg.gv.at/themen/aw/landwirtschaft/boden

3. Type of instrument

- regional monitoring systems

4. Status of policy instrument

- in pipeline

5. Territorial coverage

- regional (federal state or non-federal state),

6. Sectoral coverage

- cross sectoral

7. Soil threats addressed by instrument

- soil sealing

8. Soil functions addressed by instrument

- platform for human activity

9. Land cover classes addressed by the instrument

- artificial surfaces
- agricultural areas
- forests

10. Monitoring sites

The project starts in 2019 and there are any results yet. The plan is, to realize the project for all areas in Salzburg.

11. Parameter groups

- Site characteristics

12. Data availability

The plan is, that meta-information is available and it should be in line with inspire.

13. Monitoring mechanisms

13. Other available information

Comments by the assessor:

AT –- Soil inventory Salzburg

National Name: Bodenzustandsinventur (BZI) Salzburg

1. Brief description of the instrument

The aim of the soil inventory is (was) the detection and assessment of the soil condition, especially with regard to heavy metal pollution.

The investigations were based on the Austria-wide recommendation of the Austrian Soil Science Society.

462 monitoring points in a 4 x 4 km grid have been set in the year 1988 to 1990.

2. Institution(s) responsible for the implementation and/or evaluation of the policy instrument

Government of the land Salzburg
https://www.salzburg.gv.at/themen/aw/landwirtschaft/boden

3. Type of instrument

- national monitoring system
- regional monitoring systems,
- instrument with direct impact on soil.

4. Status of policy instrument

- In place since 1988

5. Territorial coverage

- regional (federal state or non-federal state),

6. Sectoral coverage

- agriculture
- forestry

7. Soil threats addressed by instrument

- loss of soil organic matter,
- contamination,

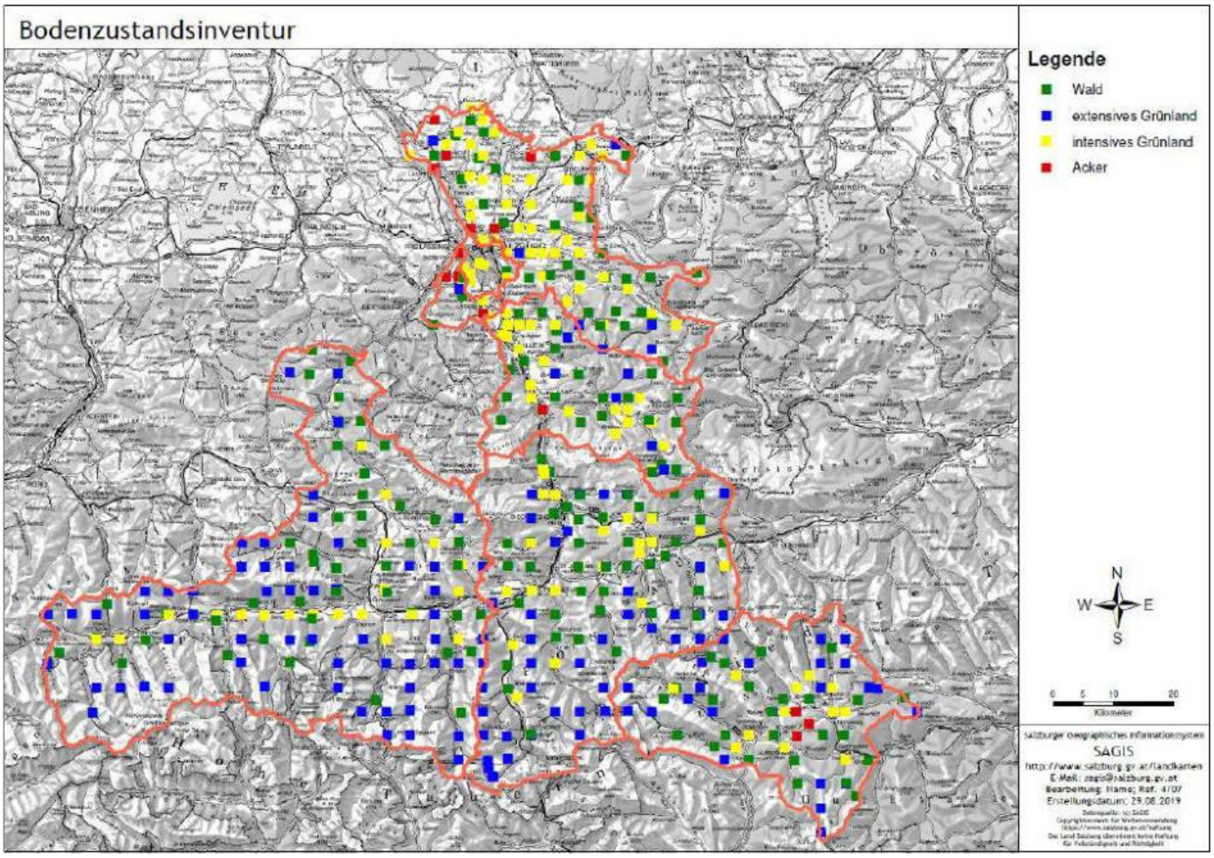
8. Soil functions addressed by instrument

- biomass production,
- storing, filtering, transforming nutrients or water,
- acting as carbon pool,

9. Land cover classes addressed by the instrument

- agricultural areas,
- semi-natural areas,
- forests,

10. Monitoring sites



11. Parameter groups

- Site characteristics (soil type etc.)
- Soil chemistry
  - pH-value
  - Heavy metal concentrations
  - Organic compounds
- Soil carbon

12. Data availability

data are free available, meta-information available, INSPIRE yes

https://www.salzburg.gv.at/sagisonline_boden

13. Monitoring mechanisms

14. Other available information

https://www.salzburg.gv.at/agrarwald_/Documents/bodenschutzbericht_endversion_fuer_internet.pdf page 34 – 42

Comments by the assessor:

AT – Permanent Soil Monitoring Program of Tyrol

National Name: Bodendauerbeobachtungsprogramm für Tirol

1. Brief description of the instrument

The establishment of permanent soil observation plots serves the long-term monitoring (planned for 70 years) of soil conditions and thus a sustainable soil protection. Five sites, with one plot under agricultural and silvicultural management each, following different pollution scenarios and evenly distributed were set up. The soils are sampled and analysed every ten years to detect changing conditions and to allow taking measures for soil protection. The advantage is that targeted questions can be answered in a few informative and representative locations.

2. Institution(s) responsible for the implementation and/or evaluation of the policy instrument

Office of the regional parliament of Tyrol, department of agricultural education, hunting and fishery AND department of forest protection

3. Type of instrument

- regional monitoring system

4. Status of policy instrument

- In place since 1998

5. Territorial coverage

- regional (federal state),

6. Sectoral coverage

- agriculture
- forestry

7. Soil threats addressed by instrument

- loss of soil organic matter
- contamination
- compaction
- loss of soil biodiversity

8. Soil functions addressed by instrument

- no specific soil functions mentioned.

9. Land cover classes addressed by the instrument

- agricultural areas
- forests

10. Monitoring sites

All five sites (ten plots) are within the perimeter of the Alpine Convention.

The sites are close to the following settlements:

- Achenkirch
- Brixlegg
- Navis
- Lienz
- Reutte

11. Parameter groups

- Site characteristics (soil type etc.)
- Soil chemistry
    - pH-value
    - Heavy metal concentrations
    - Organic compounds (dioxins, furans, PAHs, organochlorine pesticides, general pesticides)
- Soil carbon
- Soil microbiology

12. Data availability

The meta-data is soon available via BORIS (SOIL Information System in Austria https://www.umweltbundesamt.at/umweltsituation/boden/boris/boris_datenzugang/) and with some restrictions also the raw date can be accessed. Yes, it is than in line with INSPIRE.

13. Monitoring mechanisms

14. Other available information

Comments by the assessor:

AT – Soil inventory, Tyrol

National Name: Bodenzustandsinventur Tirol

1. Brief description of the instrument

The aim of the soil inventory is (was) the detection and assessment of the soil condition, especially with regard to heavy metal pollution.

The investigations were based on the Austria-wide recommendation of the Austrian Soil Science Society.

Monitoring points in a 4 x 4 km grid have been set. 658 sites were sampled 1986/1987 and 107 sites 1993.

2. Institution(s) responsible for the implementation and/or evaluation of the policy instrument

Office of the Regional Parliament of Tyrol, department of agricultural education, hunting and fishery AND department of forest protection AND Institute of radio-chemistry of the University of Innsbruck

3. Type of instrument

- regional monitoring system

4. Status of policy instrument

- In place (reports 1988 and 1996)

5. Territorial coverage

- regional (federal state)

6. Sectoral coverage

- agriculture
- forestry

7. Soil threats addressed by instrument

- loss of soil organic matter
- contamination

8. Soil functions addressed by instrument

- no specific soil functions mentioned.

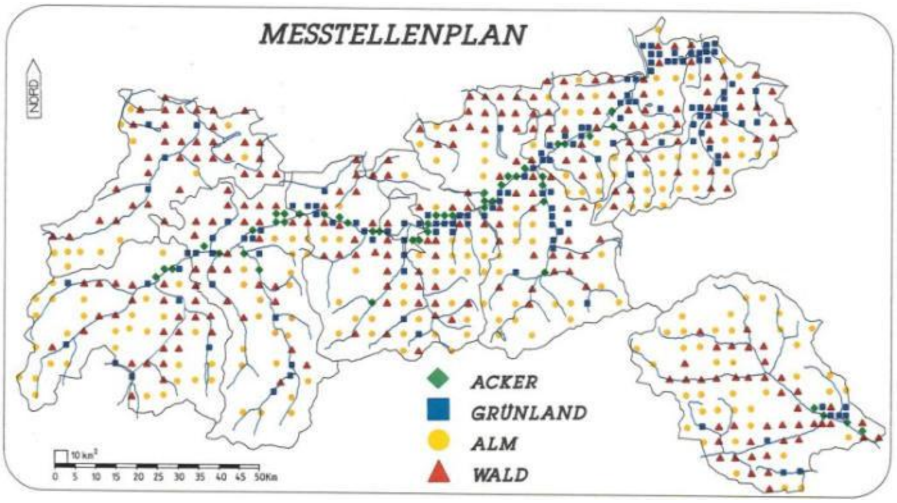
9. Land cover classes addressed by the instrument

- agricultural areas
- forests

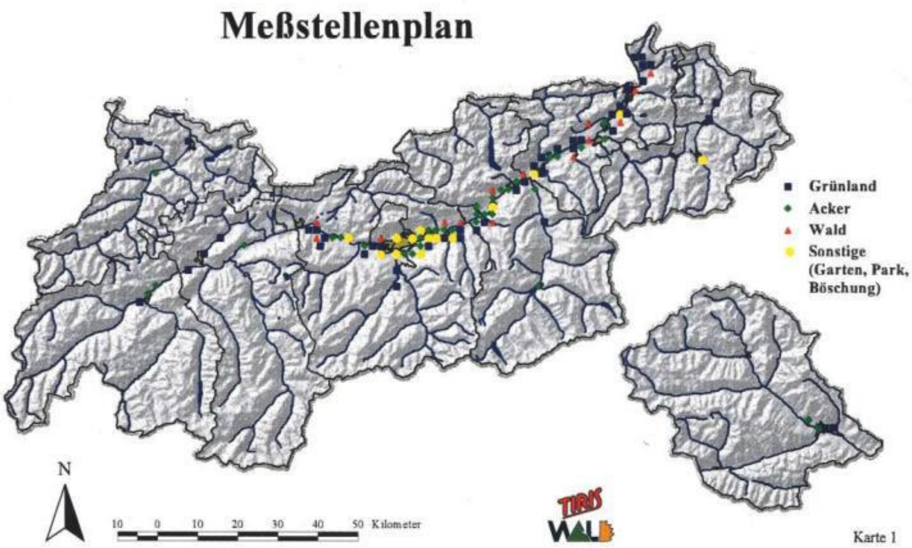
10. Monitoring sites

All sites are within the perimeter of the Alpine Convention.

263 forest, 209 alpine meadow, 139 meadow and 47 arable field sites were sampled in the years 1986 and 1987.
During the first replication 15 forest, 45 meadow, 33 arable field and 14 urban (gardens, parks...) sites were sampled in 1993.



Monitoring sites 1986/87



Monitoring sites 1993

11. Parameter groups

- Site characteristics (soil type etc.)
- Soil chemistry
    - pH-value
    - Heavy metal concentrations
    - Nutrients
- Soil carbon
- Radio nucleids

12. Data availability

The meta-data is available via BORIS (SOIL Information System in Austria) and with some restrictions also the raw date can be accessed. Yes, it is than in line with INSPIRE.

13. Monitoring mechanisms

14. Other available information

Amt der Tiroler Landesregierung (1988): Bericht über den Zustand der Tiroler Böden. Innsbruck, 197 Seiten

Amt der Tiroler Landesregierung (1996): Bericht über den Zustand der Tiroler Böden 1996 – 1. Wiederholungsbeprobung. Innsbruck, 63 Seiten

Summary concerning forest soil is available via:
https://www.tirol.gv.at/umwelt/wald/zustand/waldboden/

Comments by the assessor:

AT – Forest Soil Monitoring

National Name: Waldbodenmonitoring

1. Brief description of the instrument

Forest monitoring in Austria has been carried out by the Austrian Research Centre for Forests (BFW) on two levels since 1988: on the one hand on monitoring plots distributed over the whole of Austria (Level I) and on the other on intensive observation areas (Level II), selected in 1995 from the Level I network.

These activities were initiated by the international cooperation program ICP-Forests of UNECE and are harmonized throughout Europe.

Currently, the BFW is continuing a slightly reduced program to ensure the preservation of the valuable time series of the intensive monitoring plots on the forest and environmental situation in Austria.

2. Institution(s) responsible for the implementation and/or evaluation of the policy instrument

Austrian Research Centre for Forests (BFW)

3. Type of instrument

- international monitoring systems
- national monitoring systems

4. Status of policy instrument

- In place (since 1988)

5. Territorial coverage

- international,
- national (MS level)

6. Sectoral coverage

- forestry

7. Soil threats addressed by instrument

- loss of soil organic matter
- contamination
- compaction

8. Soil functions addressed by instrument

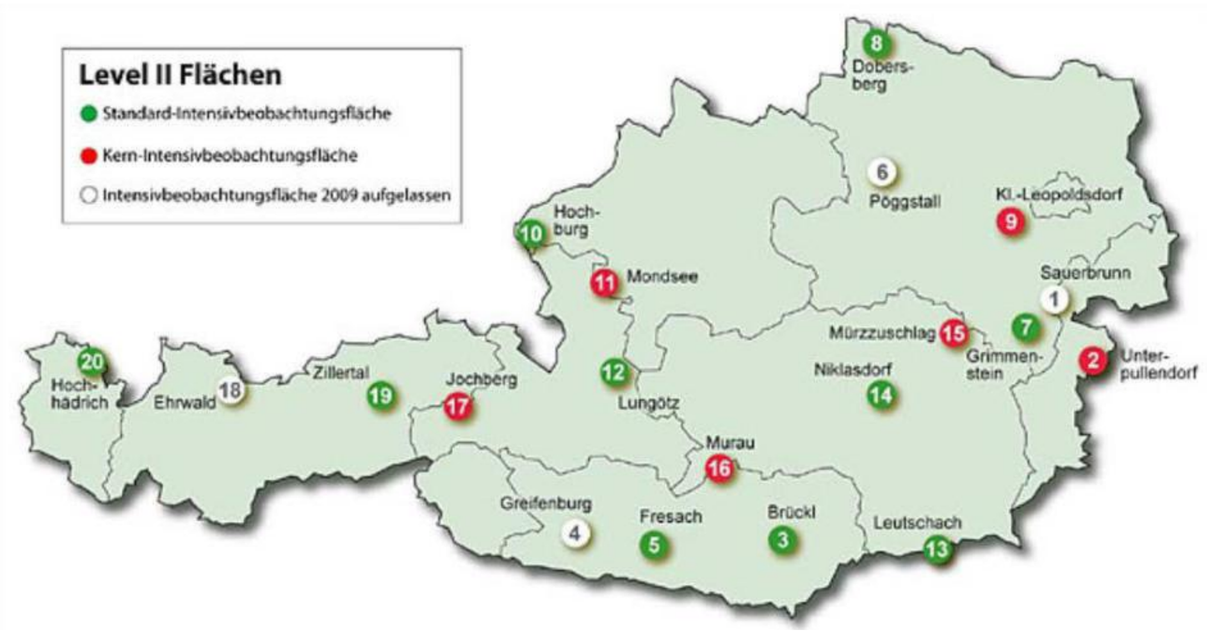
- biomass production
- storing, filtering, transforming nutrients or water
- hosting biodiversity pool
- providing raw materials
- acting as carbon pool

9. Land cover classes addressed by the instrument

- forests

10. Monitoring sites

Except sites (2) Unterpullendorf, (6) Pöggstall, (8) Dobersberg and (10) Hochburg all others are within the perimeter of the Alpine Convention.



11. Parameter groups

- Site characteristics (soil type etc.)
- Soil chemistry
    - pH-value
    - nutrients
    - heavy metals
    - base saturation,cation exchange capacity
- bulk density
- Climate parameters
    - Soil temperature, Soil moisture,

12. Data availability

Selected audited Data and meta-data are available via the INSPIRE data portal. Selected climate parameters are available online via *https://bfw.ac.at/rz/bfwcms2.web?dok=8657* (Waldökodaten).

13. Monitoring mechanisms

Beside soil parameters several environmental compartments are analysed: deposition, air pollutants, needle element contents, litter, climate, tree growth.

14. Other available information

https://bfw.ac.at/rz/bfwcms.web?dok=881

https://bfw.ac.at/lims/level2.daten?kind_in=1

http://icp-forests.net/page/icp-forests-executive-report

Comments by the assessor:

AT land use and soil consumption measuring

National Name: Bericht über Widmungsbilanz und Bodenverbrauch an den Landtag

1. Brief description of the instrument

Every two years a monitoring report of the growth of building land and the loss of soil in Tyrol shall be presented to the Tiroler Landtag (provincial parliament)

2. Institution(s) responsible for the implementation and/or evaluation of the policy instrument

provincial government (Tiroler Landesregierung)

3. Type of instrument

- regional monitoring system

4. Status of policy instrument

- in pipeline

5. Territorial coverage

- regional (federal state)

6. Sectoral coverage

- cross sectoral

7. Soil threats addressed by instrument

- loss of soil organic matter,
- compaction
- soil sealing
- loss of soil biodiversity,

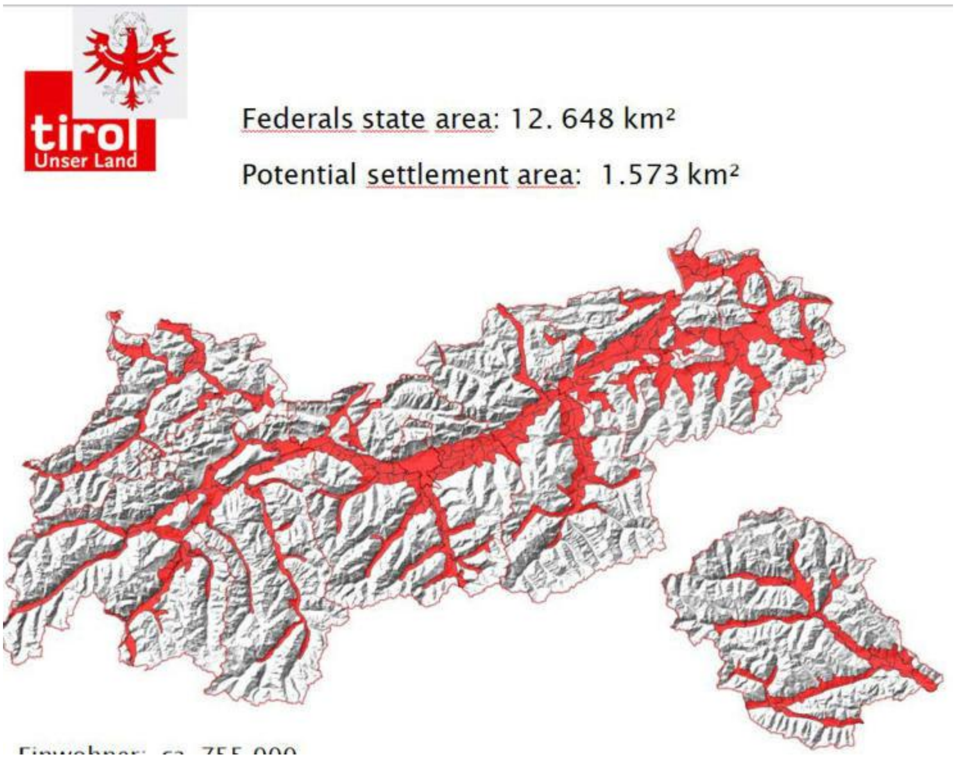
8. Soil functions addressed by instrument

- no specific soil functions mentioned.

9. Land cover classes addressed by the instrument

- no specific land cover classes are mentioned/inferred.

10. Monitoring sites



area of the federal state of Tyrol, focus: Settlement area

11. Parameter groups

- Site characteristics (building and sealed area)

12. Data availability

not decided yet

13. Monitoring mechanisms

The monitoring will be based on different types of geodata (airborne and satellite remote sensing, digital land use data)

14. Other available information

-

Comments by the assessor:

The establishing of this land use and soil consumption monitoring programme is laid down in the current Tyrolean government programme 2018 – 2023.

AT-NOE – Repeated Sampling of Soil Mapping Profile Locations

National Name: Wiederholungsbeprobungen von Profilstellen der Österreichischen Bodenkartierung

1. Brief description of the instrument

Soil profile locations of the Austrian Soil Map for which archived soil material is available (about 600 locations) have been re-sampled in the period 2016-2019. The initial sampling took place between about 20-40 years ago. The instrument aims at monitoring temporal changes and the actual status of nutrients (in particular P, Si, total N), pollutants, soil acidity (pH) and organic carbon.

2. Institution(s) responsible for the implementation and/or evaluation of the policy instrument

Universität für Bodenkultur Wien, Institute of Soil Research (www.boku.ac.at)

Agrarbezirksbehörde Niederösterreich

3. Type of instrument

- regional monitoring systems (can be potentially extended to national scale)

4. Status of policy instrument

- In place (indicate how long),

5. Territorial coverage

- regional (federal state of Lower Austria),

6. Sectoral coverage

- agriculture

7. Soil threats addressed by instrument

- loss of soil organic matter,
- salinization,
- contamination

8. Soil functions addressed by instrument

- biomass production,
- storing, filtering, transforming nutrients or water,
- hosting biodiversity pool,
- providing raw materials,

- acting as carbon pool

9. Land cover classes addressed by the instrument

- agricultural areas,

10. Monitoring sites

Detailed information on the ~600 monitoring sites is currently collected and will be fully available by 2021.

11. Parameter groups

- Site characteristics (soil type and all detailed site information and soil description available from ebod)
- Soil chemistry
    - pH-value
    - Available nutrients (Si, P, K)
    - Total carbon and nitrogen
    - Lime content
    - Heavy metal concentrations (not yet but planned)
- Soil organic carbon

12. Data availability

Data will be made available upon completion of the programme in 2021.

13. Monitoring mechanisms

14. Other available information

Comments by the assessor:

AT-NOE –Expandible soil database for soil physical parameters

National Name: Bodenphysikalische Datenbank

1. Brief description of the instrument

Expandible soil database for soil physical parameters encompasses more than 1000 sites, predominantly in Lower Austria, Upper Austria and Styria. The data base includes the following parameters, e.g. pF, soil texture, organic carbon, saturated hydraulic conductivity, unsaturated hydraulic conductivity, bulk density, aggregate stability, particle density. A layer of the sites and the respective results on the website www.ebod.at or www.bodenkarte.at is in preparation.

2. Institution(s) responsible for the implementation and/or evaluation of the policy instrument

Federal Agency for Water Management, Petzenkirchen / Bundesamt für Wasserwirtschaft

3. Type of instrument

- national monitoring systems,
- regional monitoring systems,

4. Status of policy instrument

- In place (indicate how long),

5. Territorial coverage

- national (MS level),
- regional (federal state or non-federal state),

6. Sectoral coverage

- agriculture

7. Soil threats addressed by instrument

- erosion,
- flooding landslides,
- loss of soil organic matter,
- compaction,
- loss of soil biodiversity,

8. Soil functions addressed by instrument

- biomass production,

- storing, filtering, transforming nutrients or water,
- hosting biodiversity pool,
- providing raw materials,
- acting as carbon pool,

9. Land cover classes addressed by the instrument

- agricultural areas,

10. Monitoring sites

More than 1000 sites, predominantly in Lower Austria, Upper Austria and Styria. A layer of the sites and the respective results on the website www.ebod.at or www.bodenkarte.at is in preparation.

11. Parameter groups

- Soil carbon
- Soil biodiversity
- Soil erosion
- Climate parameters
    - Soil temperature

AT-NOE – Permanent Monitoring Sites

National Name: Bodendauerbeobachtungsflächen

1. Brief description of the instrument

The permanent monitoring scheme according to the methodology of Blum et al. (1996) has been implemented to monitor the initial status of soil properties with the opportunity to repeat the sampling in appropriate intervals (typically >20 years) in a statistically sound manner. Briefly, each monitoring site comprises of a square grid of 64 individual sampling points at the nods with 4 m distance between the nods. For repeated sampling the grid is shifted several times by moving the nods in both directions by 0.5 m to avoid sampling of previously disturbed soil material.
The individual samples are partitioned in 4 subsets using permutation to obtain 4 composite samples that can be analyzed separately. Data obtained can be used to calculate means and standard deviations to provide information about the plot-internal variability. This is important to evaluate significance of differences in repeated sampling over time. Sieved samples are archived.

2. Institution(s) responsible for the implementation and/or evaluation of the policy instrument

Universität für Bodenkultur Wien, Institute of Soil Research (www.boku.ac.at)

Agrarbezirksbehörde Niederösterreich

3. Type of instrument

- national monitoring systems (as part of)
- regional monitoring systems

4. Status of policy instrument

- In place (since 1998)

5. Territorial coverage

- regional (federal state or non-federal state)

6. Sectoral coverage

- agriculture

7. Soil threats addressed by instrument

- loss of soil organic matter
- (salinization)
- contamination

8. Soil functions addressed by instrument

- no specific soil functions mentioned.

9. Land cover classes addressed by the instrument

- agricultural areas

10. Monitoring sites

30 sites

11. Parameter groups

- Site characteristics (soil type)
- Soil chemistry
    - pH-value
    - Heavy metal concentrations
    - Organic compounds
- Soil carbon
- Soil erosion

12. Data availability

Data availability is currently restricted

13. Monitoring mechanisms

14. Other available information

Comments by the assessor:

AT – NOE Hydrological Open Air Laboratory Petzenkirchen

National Name: Hydrological Open Air Laboratory Petzenkirchen

1. Brief description of the instrument

The Hydrological Open Air Laboratory (HOAL) in Petzenkirchen, Lower Austria, is a 66 ha research catchment that has been established to advance the understanding of water related flow and transport processes in the landscape, involving sediments, nutrients and microbes.
http://hoal.hydrology.at/index.php?id=2

2. Institution(s) responsible for the implementation and/or evaluation of the policy instrument

Federal Agency for Water Management, Petzenkirchen

3. Type of instrument

- international monitoring systems,
- national monitoring systems,
- regional monitoring systems,
- instrument with direct impact on soil.

4. Status of policy instrument

- In place (indicate how long),

5. Territorial coverage

- international,
- national (MS level),
- regional (federal state or non-federal state),
- sub-regional.

6. Sectoral coverage

- agriculture,

7. Soil threats addressed by instrument

- erosion,
- flooding landslides,
- loss of soil organic matter,
- compaction,
- loss of soil biodiversity,

8. Soil functions addressed by instrument

- biomass production,
- storing, filtering, transforming nutrients or water,
- hosting biodiversity pool,
- platform for human activity,
- acting as carbon pool,

9. Land cover classes addressed by the instrument

- agricultural areas,
- water bodies,

10. Monitoring sites

The Hydrological Open Air Laboratory (HOAL) in Petzenkirchen, Lower Austria, is a 66 ha research catchment that has been established to advance the understanding of water related flow and transport processes in the landscape, involving sediments, nutrients and microbes.
http://hoal.hydrology.at/index.php?id=2

11. Parameter groups

- Site characteristics (soil type etc.)
- Soil chemistry
  - pH-value
  - Heavy metal concentrations
  - Organic compounds
- Soil carbon
- Soil biodiversity
- Soil erosion
- Climate parameters
  - Soil temperature

AT – Soil Inventory of Upper Austria

National Name: Bodenzustandsinventur (BZI)

1. Brief description of the instrument

The aim of the soil inventory is the detection and assessment of the soil condition.
The Upper Austrian Soil Protection Act provides for the establishment of the soil inventory.
The investigations are based on the Austria-wide recommendation of the Austrian Soil Science Society.
880 monitoring sites have been set in the years 1990 to 1993 in Upper Austria according to a defined grid. Repetition currently in progress.

2. Institution(s) responsible for the implementation and/or evaluation of the policy instrument

Government of Upper Austria

3. Type of instrument

- regional monitoring systems,
- instrument with direct impact on soil.

4. Status of policy instrument

- In place (since 1990)

5. Territorial coverage

- regional (federal state or non-federal state)

6. Sectoral coverage

- agriculture

7. Soil threats addressed by instrument

- loss of soil organic matter,
- contamination,

8. Soil functions addressed by instrument

- biomass production,
- storing, filtering, transforming nutrients or water,
- hosting biodiversity pool,
- acting as carbon pool,

9. Land cover classes addressed by the instrument

- agricultural areas
- semi-natural areas

10. Monitoring sites

The monitoring sites located in the Southern districts of Upper Austria are partly within the perimeter of the Alpine Convention.

11. Parameter groups

- Site characteristics (soil type etc.)
- Soil chemistry
    - pH-value
    - Heavy metal concentrations
    - Organic compounds
- Soil carbon

12. Data availability

Data available in the BORIS Soil Information System for Austria. INSPIRE: yes.

https://www.umweltbundesamt.at/boris

13. Monitoring mechanisms

14. Other available information

www.land-oberoesterreich.gv.at

Comments by the assessor:

AT, IT, CH – Comparative, long-term ecosystem monitoring across the Alps: Austrian Hohe Tauern National Park, South-Tyrol and the Swiss central Alps

National Name: Interdisziplinäres, integratives Monitoring- und Forschungsprogramm zur langfristigen, systematischen Ökosystembeobachtung im Nationalpark Hohe Tauern Österreich), im Matschertal (Südtirol) und am Furkapass (Schweiz)

1. Brief description of the instrument

To assess potential impacts of on-going environmental change on alpine biota, a long-term ecological monitoring program was launched in the Alps. Plant, invertebrate and microbial responses will be assessed across sharp snow-melt gradients several hundred meters above tree line in five study regions. The dominant vegetation under favourable growth conditions at all these sites is a *Carex curvula* heathland (the optimum reference along the snow melt gradients), with often only a few or no flowering plant species left at the centre of such snow-beds ('pessimal' end of the gradient).

The data collected as part of this new monitoring program include (a) environmental conditions (temperature in the top soil near the meristems of all graminoids and many herb taxa), snow duration, soil physical parameters (water content – what potential responses, grain size distribution, pH and basic soil chemistry including ^{15}N signals in the soil organic fraction), (b) plant and soil animal (Oribatid mites and Collembola) species identity and abundance, (c) soil microbe spectra (molecular techniques), (d) wild animal presence (ungulates, predators; using automatic cameras).

2. Institution(s) responsible for the implementation and/or evaluation of the policy instrument

Nationalpark Hohe Tauern www.hohetauern.at

3. Type of instrument

- international monitoring systems

4. Status of policy instrument

- In place (since 2017)

5. Territorial coverage

- international

6. Sectoral coverage

- Sites across the Alps. Locations are ca. 150 to 450 m above the regional climatic treeline

7. Soil threats addressed by instrument

- No specific soil threats are mentioned.

8. Soil functions addressed by instrument

- hosting biodiversity pool

9. Land cover classes addressed by the instrument

- natural areas (gradients from snow-beds to *Carex curvula* heathland)

10. Monitoring sites

Monitoring sites were established in 2016 in the Hohe Tauern National Park, north and south of the main divide of the Alps, in Carinthia (Seebachtal 2300 m, Ankogel), Tyrol (Innergschlöss near Matrei, 2350 m), and Salzburg (Untersulzbachtal, 2380 m), with additional sites in northern Italy (Oberettes 2690 m, Matschertal, Ötztal-Alps) and in the Swiss central Alps (near Furka Pass 2460 m).

Source: Google Earth, from Newesely et al. 2019)

11. Parameter groups

- Site characteristics (vegetation, soil type etc.)
- Soil chemistry
    - pH-value
- Soil carbon
- Soil biodiversity
- Climate parameters
    - Soil temperature

12. Data availability

http://www.parcs.at/npht/mmd_fullentry.php?docu_id=36449

13. Monitoring mechanisms

Investigated parameters include:

- Site climate conditions, soil physics, soil chemistry, productivity
- Botanical-Vegetation Studies
- Soil mesofauna
- Culture-dependent analysis of the bacterial soil composition
- Hydrological, chemical and biological signals in micro-catchments
- Herbivores
- Cryosphere: glaciers, hydroclimate, permafrost, geomorphodynamics
- Zooplankton communities and abiotic parameters of high alpine

14. Other available information

http://parcs.at/npht/mmd_fullentry.php?docu_id=36449

Eintrag Nr. 36449 - Mehrjaehriges Monitoring- und Forschungsprogramm - Pilotprojekt

Comments by the assessor:

In Austria, the program is supported by a starting grant of the European Union and the Austrian Federal Department for Agriculture, Forestry, Environment and Water (Rural Development 2014-2020) provided through the 'Secretariat of the Hohe Tauern Nationalpark'. The Hohe Tauern Nationalpark services of Salzburg, Carinthia and Tyrol provide logistic support. The Swiss contribution is supported by the Alpine Research and Education station Furka (ALPFOR), and the Italian contribution is supported by the Autonomous Province of Bolzano/Bozen – South Tyrol. The Italian site is part of the LTSER platform Matsch|Mazia. The Swiss and Italian sites, belong to the national and international Long-Term Ecological Research Networks (LTER-Italy, LTER-Europe and ILTER).
Members of the monitoring consortium :
Christian Körner (Univ. Basel), Ulrike Tappeiner, Christian Newesely, Erwin (Universität Innsbruck), Thomas Eberl, Roland Kaiser (Fa. Ennacon KG, Salzburg), Martin Grube, Fernando Fernandez Mendoza (Universität Graz), Klaus Hackländer, Andreas Daim (Universität f. Bodenkultur Wien), Gerhard Lieb (Universität Graz) Helmut Wittmann (Haus der Natur, Salzburg)

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Questionnaire permanent monitoring sites

FR – ORCHAMP: Spatio-temporal observatory of biodiversity and ecosystem functioning of mountains' socio-ecosystems

National Name: ORCHAMP, Observatoire spatio-temporel de la biodiversité et du fonctionnement des socio-Écosystèmes de montagne

1. Brief description of the instrument

ORCHAMP is a long-term observatory of mountain ecosystems aiming to observe, understand and model biodiversity and ecosystem functioning over space and time. It relies on the active involvement of local actors, managers and researchers with the objective of a better safeguard of biodiversity's contribution to human society.

ORCHAMP is built around multiple elevational gradients (1000-1200m of elevation length) representative of the pedo-climatic space of the French Alps. Each gradient is made of 5 to 8 permanent plots distributed regularly each 200 m of altitude, from down the valley to the top. They are re-sampled on average every 5 years using a rotating sampling scheme. Measures include physical properties (soil temperature, physicochemical, and pedology), biodiversity estimates (botanical surveys, multi-trophic biodiversity using soil environmental DNA, dead wood in forests), ecosystem functions (productivity, enzymatic activities, soil organic matter) and human uses.

Data are open-access and synthetize following GEOBON recommendations on Essential Biodiversity Variables.

2. Institution(s) responsible for the implementation and/or evaluation of the policy instrument

ORCHAMP is a consortium gathering a large range of actors: national and regional park managers, botanical conservatory experts, natural area conservatory managers, researchers from university and research institutions. The project is led by the LECA (Laboratoire d'Écologie Alpine - https://leca.osug.fr/), located in Grenoble.

The soil protocol is implemented by the LECA for the biodiversity, ecosystem functioning and physico-chemical parts and by EDYTEM (Environnements, DYnamiques et TErritoires de la Montagne - http://edytem.univ-savoie.fr/) for the pedological part.

The forest protocols are implemented by IRSTEA (https://www.irstea.fr/en/grenoble).

Other academic institutions and all stakeholders are listed in the project website: https://orchamp.osug.fr/home

3. Type of instrument

- international monitoring systems,
- national monitoring systems,
- regional monitoring systems,

4. Status of policy instrument

- In place, since 2016

5. Territorial coverage

- regional (federal state or non-federal state),
- sub-regional.

6. Sectoral coverage

Sectors:

- agriculture,
- forestry,
- cross sectoral.

7. Soil threats addressed by instrument

- loss of soil organic matter,
- loss of soil biodiversity,

8. Soil functions addressed by instrument

- biomass production,
- storing, filtering, transforming nutrients or water,
- hosting biodiversity pool,
- acting as carbon pool,
- storing geological and archeological heritage,

9. Land cover classes addressed by the instrument

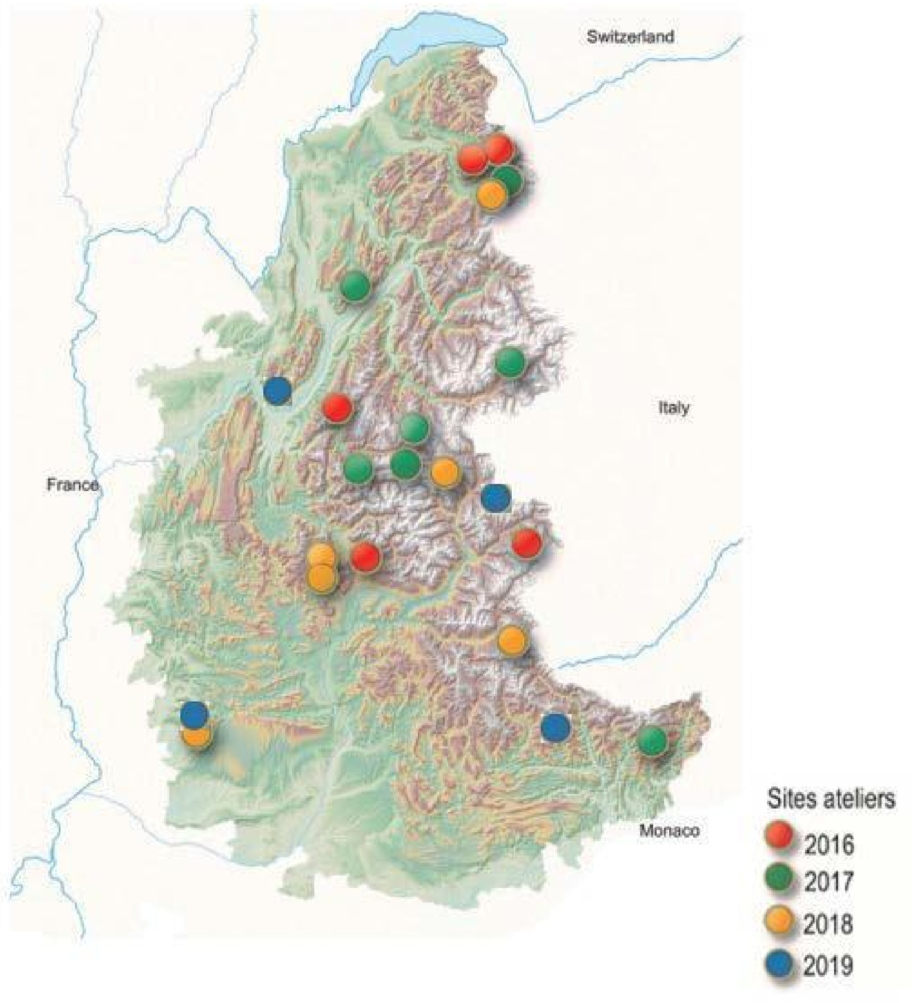
- agricultural areas,
- forests,

- semi-natural areas,
- wetlands,

10. Monitoring sites

Site Name	Number of permanents plots	Minimum altitude	Maximum altitude
Anterne	6	1400	2370
Loriaz	6	1370	2330
Chamrousse	6	1250	2180
Ristolas	6	1870	2850
Chaillol	6	2150	3160
Armenaz	4	1520	2140
Pecolz	4	962	1578
Argentière	6	1420	2400
Vanoise	8	1400	2780
Valloire	5	1860	2710
Lautaret	5	1920	2700
Lauvitel	7	1070	2150
Caramagne	6	1430	2480
Bonette	6	1900	2650
Devoluy Nord	7	1500	2670
Dévoluy Sud	7	1500	2670
Névache	5	2010	2700
Plan de l'aigille	5	1700	2450
Ventoux Sud	6	660	1645
Ventoux Nord	6	900	1660
Rachais	4	330	950
Chamechaude	5	1250	2060
Mounier	6	1810	2720
Cervières	6	1860	2310

ORCHAMP Observatory sites with their date for implementation



11. Parameter groups

- Site characteristics (soil type etc.)
- Soil chemistry
  - pH-value
  - Organic compounds
- Soil carbon
- Soil biodiversity
- Soil erosion
- Climate parameters
  - Soil temperature

12. Data availability

A dedicated database gathers the data from each protocol, parts of this data are downloadable on the project website: https://orchamp.osug.fr/home, the rest of the data are accessible on request.

Meta-data are available on a GeoNetwork shared by the LECA and EDYTEM: http://leca-bdgis.u-ga.fr/geonetwork/srv/fre/catalog.search#/home

13. Monitoring mechanisms

The protocols for **"superficial layer"** allow the evaluation of the soil multi-trophic biodiversity and functioning.
Sampling and analyses are performed every 5-years in average in September, at two depth 0-10cm and 10-20cm. For each sample, physicochemical parameters (pH, SOM, %C, %N) and extracellular enzymatic activities are quantified as well as total biodiversity using environmental DNA. For the latter, eight different markers are used to represent the total biodiversity of the soil. Three have been designed to amplify the three super-kingdoms of life: Eukaryota, Bacteria and Archaea. The other markers zoom into the Eukaryota diversity by targeting fungi, vascular plants, olligogeths, springtails, arthropods and insects.

The protocol for **"deep soil"** is a description of the soil profile from the surface to the bedrock, and a physicochemical analysis of the soil components to evaluate alteration/erosion.
Sampling is done once only due to a slow evolution of the soil composition in depth.
The protocols are an adaptation of the French national protocol for the soil called RMQS.

This description is only concerning the mandatory protocol, few others additional parameters are measured only in some sites (litter decomposition, soil organic matter characterisation, pedoantracology …)

13. Other available information

More information are available on ORCHAMP website https://orchamp.osug.fr/home, or on request at orchamp@univ-grenoble-alpes.fr.

Comments by the assessor:

Contacts:
Project leader: Wilfried THUILLER, LECA (Wilfried.THUILLER@univ-grenoble-alpes.fr)
Project manager: Amelie SAILLARD, LECA (Amelie.SAILLARD@univ-grenoble-alpes.fr)
Soil survey leader: Jérôme Poulenard, EDYTEM (jerome.poulenard@univ-smb.fr)

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Soil Protection Working Group

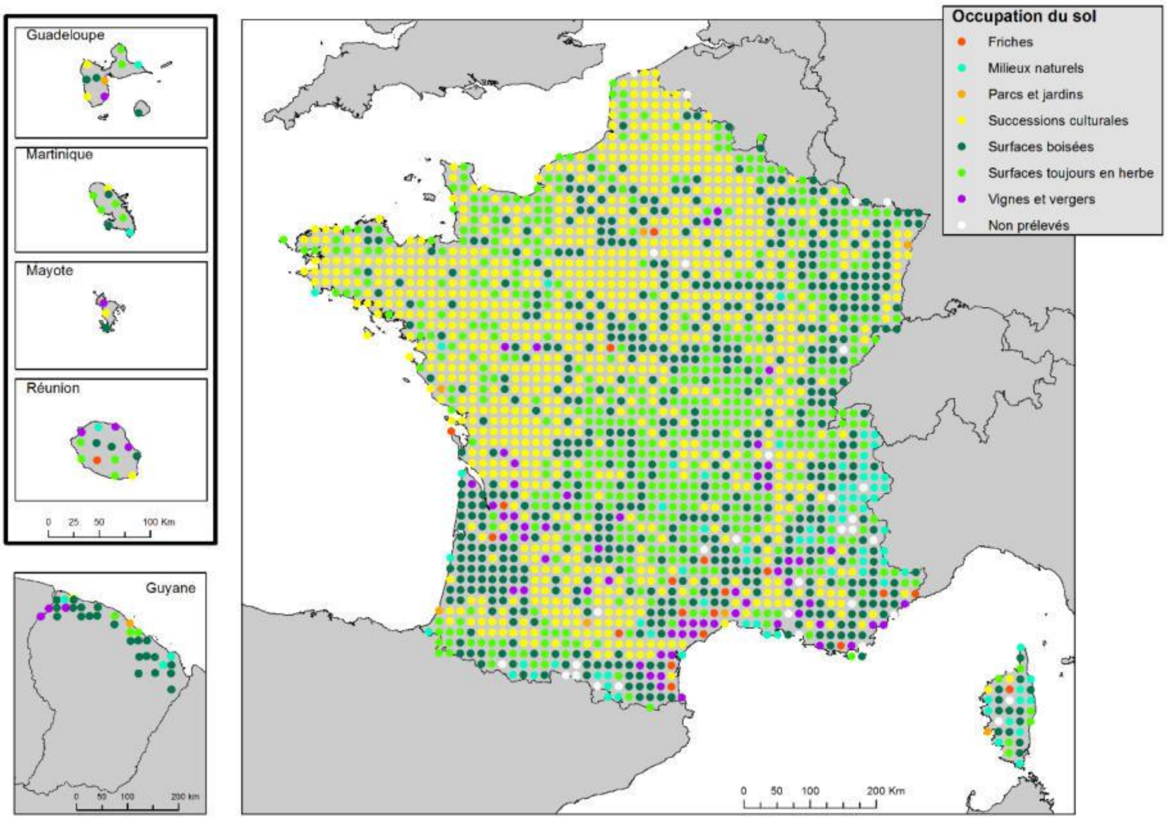
Questionnaire permanent monitoring sites

FR – RMQS

National Name: F- RMQS (Réseau de Mesures de la Qualité des Sols) - French Soil Quality Monitoring Network

1. Brief description of the instrument

RMQS is a soil monitoring network based on a 16 km regular grid across the 550,000 km2 of France. French overseas territories are also concerned. In continental France, it includes 2,173 monitoring sites, each located at the centre of a 16 x 16 km cell, for which the soil profile, site environment, climatic factors, location, vegetation and land management have been described. Composite soil samples are collected up to 1 m depth if possible. All samples are stored at INRA-Orleans in the European soil samples conservatory and data collected are available in the DONESOL database. The first campaign started in 2000 and ended in 2009 in continental France. The second campaign in ongoing.



2. Institution(s) responsible for the implementation and/or evaluation of the policy instrument

Soil sampling, physico-chemical and biological analyses of RMQS are supported by a French Scientific Group of Interest on soils: the **"GIS Sol" (www.gissol.fr),** involving the French Ministry for an Ecological and Solidary Transition (MTES), the French Ministry of Agriculture and Food (MAA), the French Agency for Biodiversity (AFB), the French Institute for Forest and Geographical Information (IGN), the Environment and Energy Management Agency (ADEME), the French Institute for Research and Development (IRD) and the National Institute for Agronomic Research (INRA). INRA InfoSol in Orléans is responsible for the coordination of the overall programme.

3. Type of instrument

- National monitoring systems

4. Status of policy instrument

- In place since 2000

5. Territorial coverage

- National (MS level)

6. Sectoral coverage

Here we want to identify the sectors that the monitoring scheme covers. There may be monitoring schemes, which cover a range of sectors or are on purpose cross-sectoral. However, some may target only one or two sectors. The sectoral coverage also gives us an indication of what types of drivers behind soil degradation the instrument is likely to address. The section on territorial and sectoral coverage will also help to discern whether the spatial and sectoral coverage of the instrument is limited compared to its potential.

Sectors:

- agriculture,
- forestry,
- infrastructure,
- cross sectoral.

7. Soil threats addressed by instrument

The European Soil Thematic Strategy identifies 8 soil threats. These include: erosion, flooding and landslides, loss of soil organic matter, salinization, contamination, compaction, soil sealing and loss of soil biodiversity.

Which threats are addressed **explicitly**, i.e. the monitoring scheme explicitly aims to address the threat (this is stated in its scope, objectives, or the activities and mechanisms it includes)?

- loss of soil organic matter,
- salinization,
- contamination,
- compaction (partly, linked to changes in bulk density),
- loss of soil biodiversity (partly),

8. Soil functions addressed by instrument

- biomass production,
- storing, filtering, transforming nutrients or water,
- hosting biodiversity pool,
- acting as carbon pool,

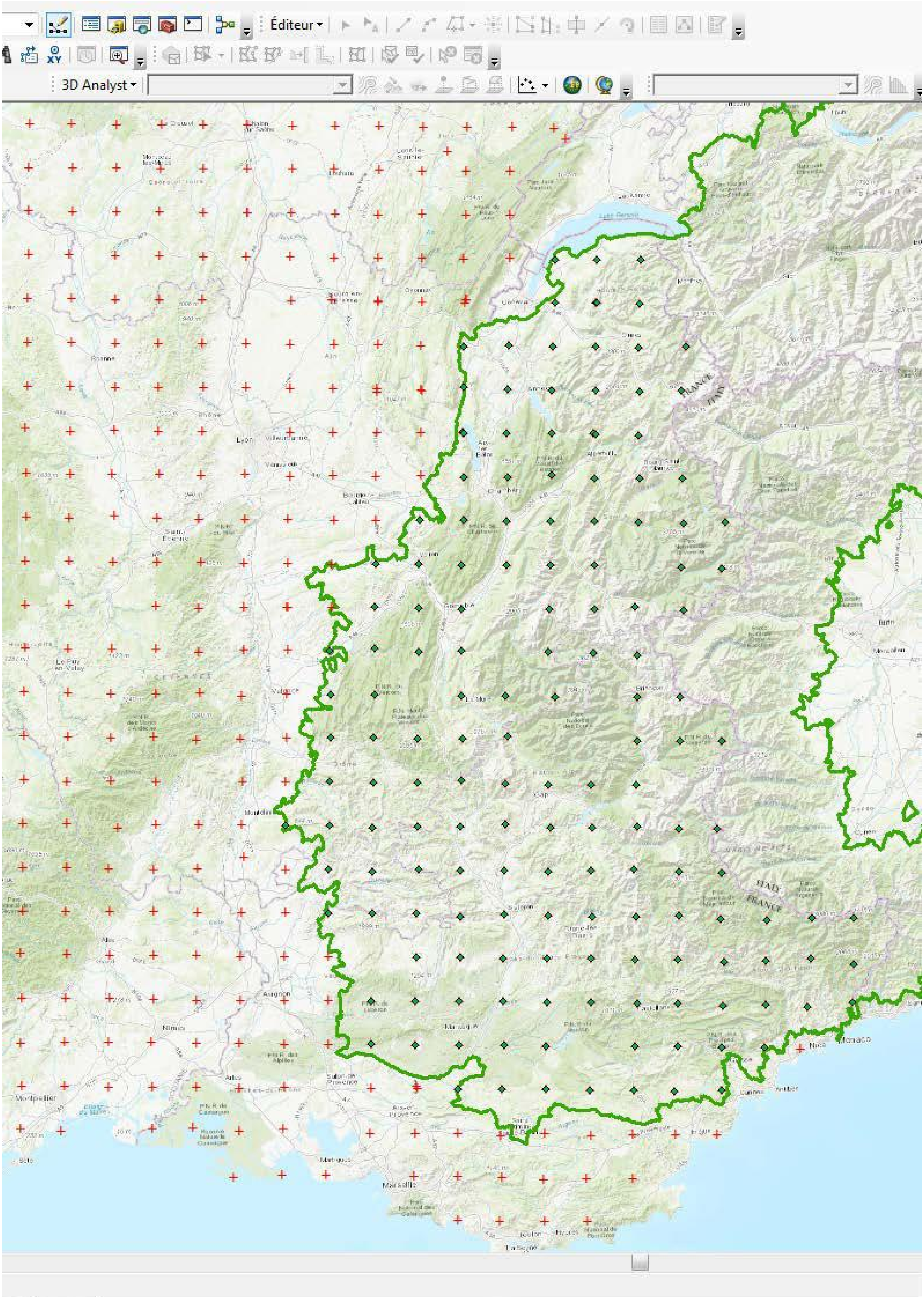
9. Land cover classes addressed by the instrument

- artificial surfaces (urban soils),
- agricultural areas,
- forests,

- semi-natural areas,
- wetlands,

10. Monitoring sites

We have 158 monitoring sites in the area (see figure below).


Éditeur
3D Analyst

11. Parameter groups

- Site characteristics (soil type etc.)
- Soil chemistry
  - pH-value
  - Heavy metal concentrations
  - Organic compounds
  - Other soil variables (nitrogen, phosphorus, particle size distribution, CEC and exchangeable cations, major elements, boron, $CaCO_3$, etc.)
- Soil carbon
- Soil physical parameters (bulk density, soil water retention)
- Soil management and practices data
- Soil biodiversity (soil microbiology)

12. Data availability

Are data free available or restricted? Is meta-information available? Is it in line with INSPIRE?

Partly: exact coordinates of the sampling point are not available.

Data available at: https:\\data.inra.fr and https://agroenvgeo.data.inra.fr

13. Monitoring mechanisms

Since you are filling out information for monitoring schemes as such, you can provide here more detail on the monitoring scheme itself (going beyond the text that you provided above in section 1 'brief description of the instrument'). I.e.:

- What types of monitoring is included; what parameters (broad categories are sufficient) are measured and for what purpose, with what frequency?

  Soil parameters (chemical, physical and biological) are measured every 15 years for long-term monitoring soil quality.

14. Other available information

Other links to information that is relevant and useful to illustrate the monitoring scheme and its implementation. This could include, for example, guidance documents.

Web site: **https://www.gissol.fr/le-gis/programmes/rmqs-34**
Guidance document in French: **http://147.100.179.105/gissol/wp-content/uploads/2018/03/Manuel_V_Num2.pdf**

Contacts: Antonio Bispo (antonio.bispo@inra.fr) and Claudy Jolivet (claudy.jolivet@inra.fr)

Comments by the assessor:

Here you can provide any additional comments that you might have, for example:

- If you didn't think that the closed-ended questions (those with a list of answers) included the appropriate answer for the monitoring scheme in question
- If you would like to point out a specific characteristic of the instrument that is not included in the above headings.
- If you were uncertain about a particular answer, and you would like to add a comment about it
- If, for example, the instrument is very important for a particular soil threat / function even though it only deals with it implicitly, you can also comment here.
- Any other comment that you would like to make about availability of information, the nature of the instrument or anything else to communicate to the study team

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Questionnaire permanent monitoring sites

FR-RENECOFOR

National Name: RENECOFOR (REseau National de suivi à long terme des ECOsystèmes FORestiers)

1. Brief description of the instrument

RENECOFOR is the French network for the long-term intensive monitoring of forest ecosystems. It is part of the International Co-operative Programme on Assessment and Monitoring of Air Pollution Effects on Forests (ICP Forests Level II) under the UNECE Air Convention. It comprises 102 2-ha permanent plots, covering a wide range of ecological conditions throughout France, and on which multiple parameters have been monitored with regard to the trees, to the soil, to the atmosphere, and to species diversity. It was created in response to the S1 resolution of the Ministerial Conference on the Protection of Forests in Europe (Strasbourg, 1990) and to successive EU rules for forest monitoring. Since 2018, it has contributed to the monitoring of ecosystem impacts of air pollution, as reported by France to EU “NEC” Directive n°2016/2284. RENECOFOR’s repeated measurements of soil carbon stocks were also useful to the national inventory of greenhouse gas emissions under the UNFCCC and the Kyoto Protocol.

2. Institution(s) responsible for the implementation and/or evaluation of the policy instrument

RENECOFOR is coordinated by the French National Forest Office (ONF).

Link to RENECOFOR’s webpages: http://www1.onf.fr/renecofor

3. Type of instrument

- international monitoring systems,

4. Status of policy instrument

- In place since 1992

5. Territorial coverage

- international,
- national (MS level),

6. Sectoral coverage

- forestry,

7. Soil threats addressed by instrument

- loss of soil organic matter,

8. Soil functions addressed by instrument

- biomass production,
- storing, filtering, transforming nutrients or water,
- hosting biodiversity pool,
- acting as carbon pool,

9. Land cover classes addressed by the instrument

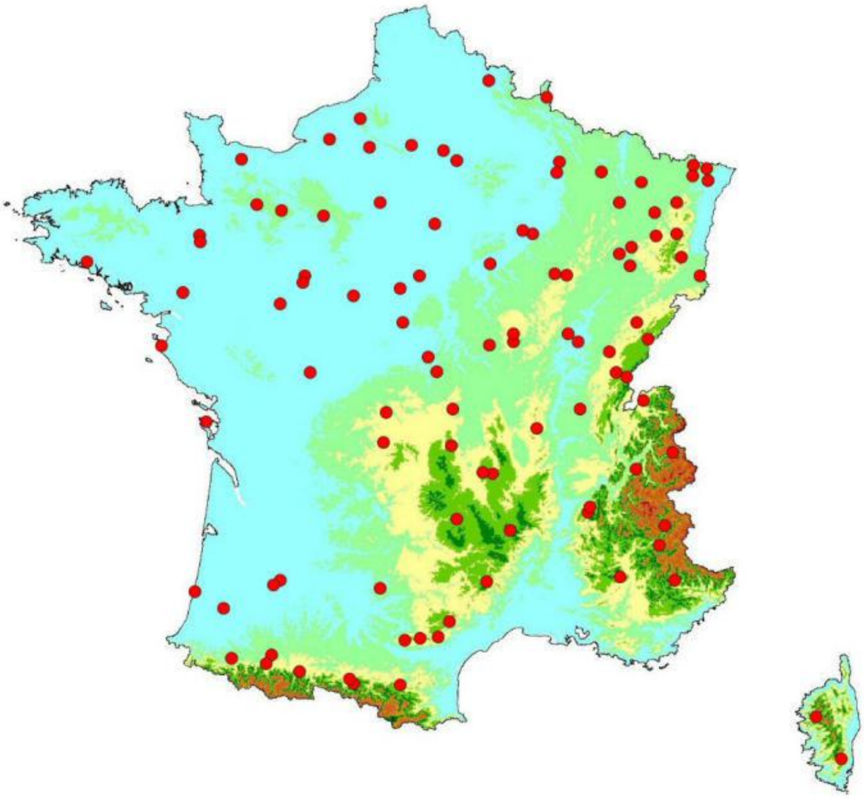
- forests,

10. Monitoring sites

List of the sites within the perimeter of the Alpine Convention:

Code	Plot level	Main tree species	Municipality	Latitude	Longitude	Altitude (m)
EPC 73	B	Picea abies	Bourg-Saint-Maurice	45°35'12'' N	6°47'23'' E	1700
EPC 74	A2	Picea abies	Saint-Cergues	46°13'42'' N	6°20'58'' E	1200
HET 04	A1	Fagus sylvatica	Noyers sur Jabron	44°07'52'' N	5°48'00'' E	1300
HET 26	A1	Fagus sylvatica	Bouvante	44°55'04'' N	5°17'46'' E	1320
MEL 05	B	Larix decidua	Champcella	44°42'18'' N	6°33'42'' E	1850
PS 04	B	Pinus sylvestris	Le Fugeret	44°01'30'' N	6°40'16'' E	1670
SP 05	A3	Abies alba	Crots	44°29'25'' N	6°27'33'' E	1360
SP 26	B	Abies alba	Bouvante	44°56'53'' N	5°19'50'' E	1150
SP 38	A3	Abies alba	La Chapelle du Bard	45°25'17'' N	6°07'53'' E	1100

Map of the whole RENECOFOR network:



11. Parameter groups

- Site characteristics (soil type etc.)
- Soil chemistry
    - pH-value
    - Heavy metal concentrations
    - Organic compounds
- Soil carbon
- Climate parameters

12. Data availability

Data are consistently stored in database and available on request, at both national and international levels.

13. Monitoring mechanisms

RENECOFOR is integrated to ICP Forests Level II so that the collected data are comparable with those from all other member states and for all surveys. The comparability of the data relies on the outstanding effort made to ensure data quality at both national and international levels: detailed and continuously updated manuals, intercalibration courses regularly organized in the field as well as control tests in labs, data stored in consistent and maintained databases.

List of surveys, depending on RENECOFOR plot level:

		Plot level			
Ecosystem component	Survey	A3 (14 sites)	A2 (13 sites)	A1 et B (75 sites)	Frequency
Trees	Stand growth survey	X	X	X	Every 5 years
Trees	Tree growth survey (with girth bands)	X	X	X	Every year
Trees	Phenology	X	X	X	Every year
Trees	Crown condition	X	X	X	Every year
Trees	Foliar nutrition	X	X	X	Every 2 years
Trees	Litterfall	X			Monthly
Diversity	Ground vegetation	X	X	X	Every 5 years
Atmosphere	Meteo station	X			Hourly
Atmosphere	Ozone concentrations and ozone-induced symptoms	X			Every year for 5 years every 10 years
Atmosphere	Bulk deposition (in open-field area)	X	X		Every 4 weeks
Atmosphere	Throughfall deposition	X			Every 4 weeks
Soil	Soil solution	X			Every 4 weeks
Soil	Solid soil analysis (C, acidity, nutrients)	X	X	X	Every 15 years

13. Other available information

Link to RENECOFOR's webpages: http://www1.onf.fr/renecofor

Link to ICP Forests' webpages: http://icp-forests.net/

Comments by the assessor:

Many forest soils and ecosystems are also under the threat of acidification and eutrophication. Even if international commitments successfully decreased the atmospheric emission of acid and N pollutants in Europe, the deposition of such compounds still exceeds the critical loads for acidification and/or eutrophication for sensitive soils and ecosystems. ICP Forests and RENECOFOR have provided useful data to evaluate the impacts of air pollution on ecosystem parameters such as soil acidity and nutrient content, tree nutrition and vitality, and ground vegetation composition.

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Soil Protection Working Group
Questionnaire permanent monitoring sites

DE – Bavarian Soil Monitoring

National Name: Bayerische Bodendauerbeobachtung

1. Brief description of the instrument

Since 1986 the soil monitoring network assesses soil characteristic values at selected dates. This allows to compare the physico-chemical state of the soil and to detect trends of soil quality over extended periods of time. The Bavarian Environment Agency (LfU) is in charge of protected areas and special sites; the agricultural areas are monitored by the Bavarian State Research Center for Agriculture (LfL) and the forest areas by the Bavarian State Institute of Forestry (LWF), respectively. Soil monitoring provides supportive data for political strategies and programs of the respective regional ministries (Bavarian State Ministry of the Environment and Consumer Protection, StMUV; Bavarian State Ministry of Nutrition, Agriculture and Forestry, StMELF).

2. Institution(s) responsible for the implementation and/or evaluation of the policy instrument

Bavarian Environment Agency (LfU): protected areas and special sites (https://www.lfu.bayern.de/boden/bodendauerbeobachtung/index.htm)

Bavarian State Research Center for Agriculture (LfL): agricultural areas (https://www.lfl.bayern.de/iab/boden/031470/index.php)

Bavarian State Institute of Forestry (LWF): forest areas (http://www.lwf.bayern.de/boden-klima/bodeninventur/index.php)

3. Type of instrument

- regional monitoring system

4. Status of policy instrument

- in place (since 1986)

5. Territorial coverage

- regional (federal state)

6. Sectoral coverage

- agriculture
- forestry
- cross sectoral

7. Soil threats addressed by instrument

- contamination
- loss of soil biodiversity

8. Soil functions addressed by instrument

- hosting biodiversity pool
- acting as carbon pool

9. Land cover classes addressed by the instrument

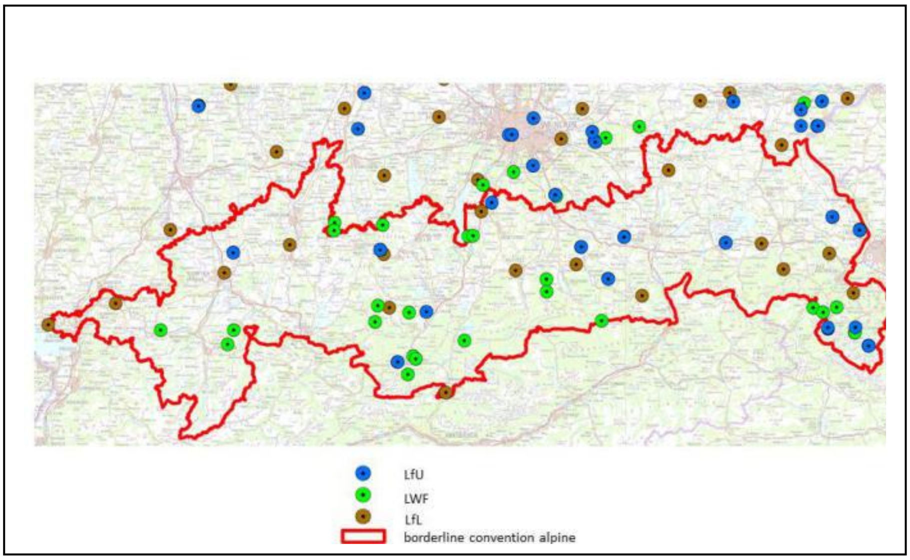
- agricultural areas
- forests
- wetlands

10. Monitoring sites of LfL, LWF and LfU

Institute	Municipality	Landuse	Years of sampling
LfU	Egling	Coniferous forest	1987
LfU	Ramsau	Pasture	1987, 2013, 2016, 2019
LfU	Freilassing	Deciduous forest	1986, 1990, 2013, 2016
LfU	Schönau	Pasture	1987, 2010, 2013, 2016, 2019
LfU	Eschenlohe	Peat bog	1987
LfU	Garmisch-Partenkirchen	Pasture	1987
LfU	Miesbach	Grassland	1987
LfU	Fischbachau	Coniferous forest	1990
LfU	Haldenwang	Coniferous forest	1987
LfU	Bad Aibling	Grassland	1987
LfU	Bernau	Peat bog	1986

LfU	Petting	Peat bog	1986, 2010
LfU	Peiting	Grassland	1987, 2010, 2013, 2016
LfL	Bayrischzell	Grassland	1986-2004
LfL	Ruhpolding	Grassland	1986-2005
LfL	Bad Reichenhall	Grassland	1986-2005
LfL	Berchtesgaden West	Grassland	1986-2004
LfL	Peiting	Grassland	1986-2004
LfL	Wangen im Allgäu Ost	Grassland	1986-2005
LfL	Tegernsee	Grassland	1985-2005
LfL	Traunstein	field	1986-2004, 2006
LfL	Mittenwald	Grassland	1986-2005
LfL	Bad Tölz	Grassland	1986-2005
LfL	Starnberg Süd	field	1986-2004, 2006
LfL	Wildpoldsried	Grassland	1986-2004
LfL	Unterammergau	Grassland	1986-2005
LfL	Wasserburg a.Inn	Grassland	1986-2004, 2006
LfL	Kressbronn am Bodensee	special use	1986-2004, 2006
LfL	Kaufbeuren	Grassland	1986-2005
LWF	Oberstaufen	forest	1988
LWF	Königssee 1	forest	1995
LWF	Tegernsee	forest	1996
LWF	Hindelang	forest	1995
LWF	Garmisch-Partenkirchen	forest	1987
LWF	Josefsthal	forest	1987
LWF	Hindelang	forest	1988
LWF	Rottach-Egern	forest	1987
LWF	Oberammergau	forest	1987
LWF	Bad Bayersoien	forest	1987
LWF	Unterammergau	forest	1986
LWF	Königssee 2	forest	1990
LWF	Bad Bayersoien	forest	1987
LWF	Schneizlreuth	forest	1988
LWF	Vorderriß	forest	1987
LWF	Berchtesgaden West	forest	1988
LWF	Königsdorf 1	forest	1986
LWF	Königsdorf 2	forest	1986
LWF	Oberammergau	forest	1987
LWF	Schongau	forest	1989
LWF	Schneizlreuth	forest	1991

Soil monitoring sites of LfL, LWF and LfU in the area of convention alpine



11. Parameter groups

- Site characteristics (soil type etc.)
- Soil chemistry
    - pH-value
    - Heavy metal concentrations
    - Organic compounds
- Soil carbon
- Soil biodiversity (earthworms)
- Climate parameters on three sites of LfU
    - Soil temperature
    - Soil moisture

12. Data availability

Data are freely available. However, they are subject to a statement of the commitment of data use and therefore have to be requested in written form.

13. Monitoring mechanisms

The Bavarian soil monitoring is associated with the Bavarian Soil Protection Law (BayBodSchG, Art. 8) and the Bavarian Soil Protection Program (Bayerisches Bodenschutzprogramm, 3.4). Further information is provided in the table above (s. point 10).

13. Other available information

https://www.lfu.bayern.de/boden/bodendauerbeobachtung/fachtagung/index.htm
https://www.lfl.bayern.de/publikationen/schriftenreihe/040862/

Comments by the assessor:

- Three LfU-sites (Gotzenalm, Wimbachgries, Hirschbichl – all in the region of the Berchtesgadener Land) of the LfU-program is equipped with soil moisture and soil temperature sensors.
- As explained in more detail on the mentioned homepages, the normal soil monitoring procedure includes destructive soil sampling. Thus, some of the soil monitoring plots will be "exhausted" after a certain amount of replicative samplings and will be abandoned.
- The LfL is observing earthworms as bionidicators on all sites, the LfU only on four sites.

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Soil Protection Working Group

Questionnaire permanent monitoring sites

IT –Links4Soils Interreg Alpine Space Project – Outcomes for Aosta Valley – Soil mapping

National Name: Links4Soils Interreg Alpine Space Project – Produzione di cartografie del suolo della Valle d'Aosta

1. Brief description of the instrument

Links4soil Project - expected findings of Aosta Valley are:
Soil Map and a vulnerability soil erosion map,
Production of protocol of good practices to prevent soil erosion in the alpine context.

2. Institution(s) responsible for the implementation and/or evaluation of the policy instrument

Autonomous region of Aosta Valley/Regione autonoma Valle d'Aosta – Dipartimento programmazione, risorse idriche, territorio http.//www.regione.vda.it

DISAFA – University of Torino
http://www.disafa.unito.it/do/home.pl/View?doc=offerta_formativa_DISAFA.html

https://www.alpine-space.eu/projects/links4soils/en/home

3. Type of instrument

- regional monitoring systems,

4. Status of policy instrument

- in pipeline,

5. Territorial coverage

- regional (non-federal state),

6. Sectoral coverage

- agriculture,
- forestry,
- infrastructure,
- cross sectoral.

7. Soil threats addressed by instrument

- erosion,
- flooding landslides,
- loss of soil organic matter,
- compaction,
- soil sealing,
- loss of soil biodiversity,

8. Soil functions addressed by instrument

- no specific soil functions mentioned.

9. Land cover classes addressed by the instrument

- artificial surfaces,
- agricultural areas,
- forests,
- semi-natural areas,
- wetlands,
- water bodies,

10. Monitoring sites

The whole regional territory is concerned

11. Parameter groups

- Site characteristics (soil type etc.)
- Soil chemistry
    - pH-value
    - Heavy metal concentrations
    - Organic compounds
- Soil carbon
- Soil biodiversity
- Soil erosion
- Climate parameters
    - Soil temperature

12. Data availability

Data available

Meta-information available

13. Monitoring mechanisms

Under definition

13. Other available information

https://www.alpine-space.eu/projects/links4soils/en/home
https://alpinesoils.eu/
https://it.alpinesoils.eu/

Comments by the assessor:

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Questionnaire permanent monitoring sites

Country Prefix – Name of the monitoring scheme

National Name:

1. Brief description of the instrument

The monitoring approach is based on carbon fluxes observational sites. The main scope of the observational sites is the measure of CO_2 and water fluxes between the vegetation and the atmosphere, but monitoring activities are highly intertwined with soil processes and evolution.

2. Institution(s) responsible for the implementation and/or evaluation of the policy instrument

Environmental Protection Agency of Aosta Valley (www.arpa.vda.it/climatechange)

3. Type of instrument

international monitoring systems,

4. Status of policy instrument

- In place (2008-on going)

5. Territorial coverage

- sub-regional.

6. Sectoral coverage

- agriculture,
- forestry,
- cross sectoral.

7. Soil threats addressed by instrument

- loss of soil organic matter,

8. Soil functions addressed by instrument

- biomass production,
- storing, filtering, transforming nutrients or water,
- hosting biodiversity pool,
- acting as carbon pool,

9. Land cover classes addressed by the instrument

- agricultural areas,
- forests,
- semi-natural areas,

10. Monitoring sites

IT-Tor

The site is located in the northwestern Italian Alps (Aosta Valley, IT) at an altitude of 2160 m a.s.l. (45°50’40’’N, 7°34’41’’E). The area is a subalpine unmanaged grassland. Dominant vegetation consists of Nardus stricta L., Festuca nigrescens All., Arnica montana L., Carex semper- virens Vill., Geum montanum L., Anthoxanthum alpinum L., Potentilla aurea L., Trifolium alpinum L.. The terrain slopes gently and the soil is classified as Cambisol (FAO/ISRIC/ISS). The site is characterized by an intra-alpine semi-continental climate, with mean annual temperature of 3.1°C and mean annual precipitation of about 880 mm. On average, from the end of October to late May, the site is covered by a thick snow cover (90–120 cm) which limits the growing period to an average of five months. Further information regarding the site can be found in . Continuous CO2 and water fluxes measures (eddy covariance method), meteorological, phenological and proximal sensing observations are carried out since 2008. Beside LTER network, the experimental site belongs also to the to the ICOS (IT-Tor **https://www.icos-ri.eu/**) and Phenocam (Torgnon-nd, https://phenocam.sr.unh.edu/webcam/) networks.

IT-Trf

The European larch forest is located at 2100 m asl (45.82387N, 7.55459E), close to the village of Torgnon (AO). The site is one of the most widely distributed ecosystems in the Aosta Valley and the Alps. The stand is composed by European larch (Larix decidua Mill.) as the dominant species and by sporadic spruce (Picea abies) individuals. The forest is quite open, allowing the growth of vigorous understory vegetation, composed mainly by shrubs, such as Rhododendron Ferrugineum, Juniperus communis, and Vaccinium spp. and grasses such as Arnica montana and Poa alpina. Mean tree height is 10 m and mean tree age is 120 years. The climate is characterised by a mean annual temperature of +2.31°C and a mean annual precipitation of 880 mm. On average from November to late May the ground is covered by snow with an average of 0.70 m and a maximum of 1.95 reached in winter 2018. At the site, different observations are carried on in order to evaluate the climate change impacts on the structure and function of the ecosystem. In 2005 direct observations of the main phenological events have been started at the site, while since 2010 eddy covariance measurements of CO_2 fluxes are carried on. Monitoring of phenology is also carried on by means of digital cameras installed on the top of the eddy covariance tower and since 2015 measurements of the sap flow in trunks are available. Beside LTER network, the site belongs also to the to the Fluxnet and Phenocam networks

11. Parameter groups

- Site characteristics (soil type etc.)
- Soil chemistry
    - pH-value
    - Organic compounds
- Soil carbon
- Climate parameters
    - Soil temperature

12. Data availability

Are data free available or restricted: FREE

Is meta-information available? YES

Is it in line with INSPIRE? NO

13. Monitoring mechanisms

13. Other available information

http://www.arpa.vda.it/it/effetti-sul-territorio-dei-cambiamenti-climatici/pubblicazioni/articoli

Comments by the assessor:

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Soil Protection Working Group

Questionnaire permanent monitoring sites

IT – GLACIER-RELATED RISK MONITORING PLAN

National Name: Monitoraggio rischi glaciali e periglaciali

1. Brief description of the instrument

Because many different potentially hazardous glaciers are located in the surroundings of populated areas or near major infrastructure, the Autonomous Region of Aosta Valley has devised a regional glacial risk monitoring plan together with the Fondazione Montagna Sicura.
This gives them an overview of the regional risk situation. Every potentially hazardous glacier has a detailed folder linked to the GIS database containing historical material, updated photographs etc. Whenever any of the existing or new potential risk situations seem to require further investigation, field surveys take place and the respective phenomena can start to be monitored in precise spots.

2. Institution(s) responsible for the implementation and/or evaluation of the policy instrument

Fondazione Montagna Sicura (http://www.fondazionemontagnasicura.org)

Snow & Avalanches Regional Bureau Management_ Autonomous region of Aosta Valley/Regione autonoma Valle d'Aosta (Ufficio Valanghe – http://ww.regione.vda.it)

3. Type of instrument

- international monitoring systems
- regional monitoring systems

4. Status of policy instrument

- In place (from 2012 to today),

5. Territorial coverage

- regional (non-federal state),

6. Sectoral coverage

- cross sectoral.

7. Soil threats addressed by instrument

- No specific soil threats are mentioned.

8. Soil functions addressed by instrument

- storing, filtering, transforming nutrients or water,
- providing raw materials,
- storing geological and archeological heritage.

9. Land cover classes addressed by the instrument

- water bodies,

10. Monitoring sites

The monitoring plan is primarily based on the 184 glaciers of Aosta Valley.

11. Parameter groups

- Site characteristics (soil type etc.)
- Soil erosion

12. Data availability

The gathered data are restricted and available only for the Aosta Valley Autonomous Region.

13. Monitoring mechanisms

The monitoring plan is primarily based on the GIS database of the glaciers of Aosta Valley. A series of potentially hazardous glaciers has been identified in a study of historical glacial hazardous events. Part of this study was carried out on the entire Alpine territory, thanks to the Glaciorisk project. The database has been completed with additional local research and is updated annually. Every year, local stakeholders such as Alpine guides and refuge owners report new glacial lakes, serac falls and other hazardous events. FMS then has the responsibility to verify the risk level of these events. At the end of every summer, technicians from the FMS glacier office perform a helicopter flight with a precise flight plan covering all of the 184 glaciers of the region. During the flight, photographs of all Aosta Valley glaciers are taken. This gives them an overview of the regional risk situation.

13. Other available information

http://app.fondazionemontagnasicura.org/multimedia/crgv/

Comments by the assessor:

The population is encouraged to report any relevant observations. As of now, the GIS database contains 26 potentially hazardous glaciers. On three of them, special monitoring actions have been activated (Whymper Serac/Grandes Jorasses, Planpincieux Glacier tongue, and the Brenva glacier and rock face).

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Questionnaire permanent monitoring sites

IT – Regulation (EC) No 1221/2009 – EMAS III, Environmental Management System (EMS) – Parco Naturale Mont Avic, Valle d'Aosta

National name: Regolamento CE 1221/2009 – EMAS III. Sistema di Gestione Ambientale – Parco Naturale Mont Avic, Valle d'Aosta

1. Brief description of the instrument

EMS - Procedure 446-02 - Alpine pastures and pastures. Monitoring of the transhumance of the cattle in the mountain pastures through field surveys carried out by the Park staff.

2. Institution(s) responsible for the implementation and/or evaluation of the policy instrument

Implementation: Parco Naturale Mont Avic (https://www.montavic.it/)

Evaluation: accredited certification body (it changes over time, currently RINA spa - https://www.rina.org) [ISPRA validate only the Environmental Statements and not the single procedures]

3. Type of instrument

- international monitoring system

4. Status of policy instrument

- In place (from 2003-today)

5. Territorial coverage

- sub-regional.

6. Sectoral coverage

- agriculture,

7. Soil threats addressed by instrument

- No specific soil threats are mentioned.

8. Soil functions addressed by instrument

- no specific soil functions mentioned.

9. Land cover classes addressed by the instrument

- agricultural areas,
- forests,
- semi-natural areas,

10. Monitoring sites

Parco Naturale Mont Avic (see www.montavic.it)

11. Parameter groups

12. Data availability

Meta-information available (Environmental Statements, subsequent editions from 2003 to the present)

(The detailed data must be treated with reference to the privacy regulation)

13. Monitoring mechanisms

Grazing activity (number of animals for each category of the cattle transhumance on each pasture sector, indicating the period of pasture)

13. Other available information

Comments by the assessor:

About question 2: The procedure is managed under an EMS in accordance to the EMAS regulation; the methodology is chosen independently by the organization and therefore it is not intended as an internationally shared protocol.

About question 7: Implicitly, the monitoring system could be used to assess the following threats:

- erosion,
- compaction,
- loss of soil biodiversity.

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Soil Protection Working Group

Questionnaire permanent monitoring sites

Please send your feedback ***by FR, 13.09.2019*** *to vera.bornemann@alpconv.org to allow us to prepare an overview of the results for the 2nd meeting of the working group.*
When filling out this document, please do not use footnotes. If you would like to make comments, use the Comments section at the end. Please delete this instruction text and the other instructions in the document. Just keep the answers. Please copy the questionnaire as many times as needed starting with a new page for every monitoring scheme, or use separate document for every monitoring scheme you will send in.

IT – Soil erosion in sloping vineyards

National Name: Erosione del suolo su vigneti in forte pendenza

1. Brief description of the instrument

The University of Torino, DISAFA (Department of Agricultural, orest and Food Sciences) is carrying on an experiment on soil erosion in a vineyard managed by Institut Agricole Régional in Aosta (IT). The experiment, currently part of the Links4Soil Interreg Project (https://www.alpine-space.eu/projects/links4soils/en/home), aims at defining best practices for different land use and management types. The effects of weed killing vs permanent grassing on soil erosion are being studied in a sloping mountain vineyard (40% slope) located in Aosta (N-W Italy). Eighteen tanks for the collection of sediments and runoff were set at the end of the rows. The amount of runoff, the erosion rate and the properties of eroded soil (nutrients, texture) are recorded after each rainfall event occurring from April to November. The expected outcomes are: 1) better understanding the effect of different management types on soil erosion; 2) assessing the effects of soil management on the ecosystem services provided; 3) recommending best practices in order to mitigate soil degradation. In addition, the experiment will help assessing threshold for erosive rainfall events in the study area.

2. Institution(s) responsible for the implementation and/or evaluation of the policy instrument

IAR – Institut Agricole Régional http://www.iaraosta.isiportal.com/

DISAFA – University of Torino
http://www.disafa.unito.it/do/home.pl/View?doc=offerta_formativa_DISAFA.html

https://www.alpine-space.eu/projects/links4soils/en/home

3. Type of instrument

- international monitoring systems;
- regional monitoring systems.

4. Status of policy instrument

- In place since 2014

5. Territorial coverage

- sub-regional.

6. Sectoral coverage

Sectors:

- agriculture.

7. Soil threats addressed by instrument

- erosion,
- loss of soil organic matter.

8. Soil functions addressed by instrument

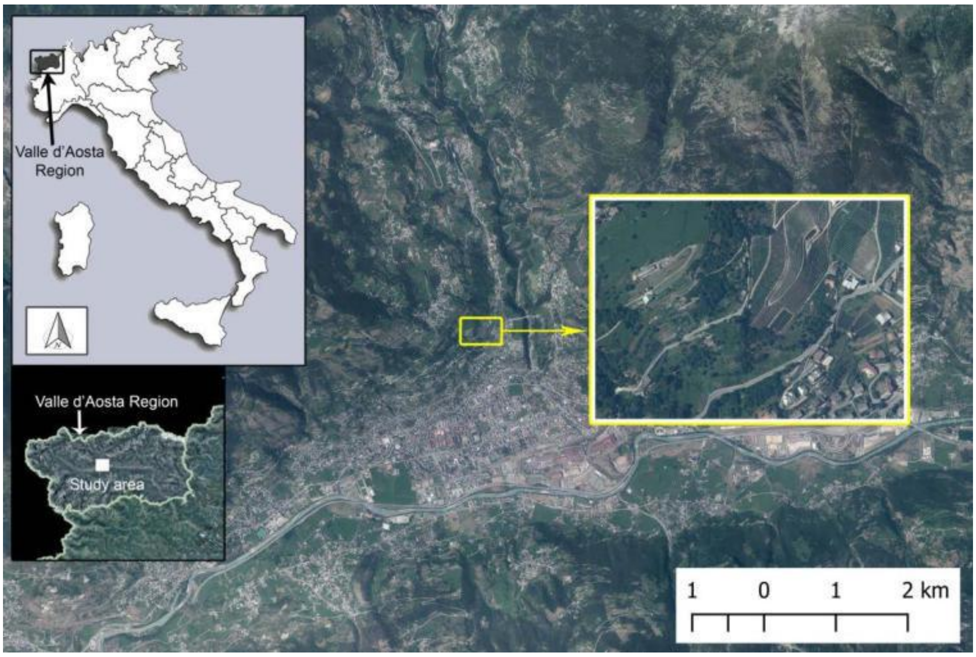
- biomass production,
- storing, filtering, transforming nutrients or water.
- hosting biodiversity pool,
- platform for human activity.

9. Land cover classes addressed by the instrument

- agricultural areas

10. Monitoring sites

Moncenis, in the municipality of Aosta, Valle d'Aosta region, North-West Italy.
Latitude, Longitude: 45.7491, 7.3143.



11. Parameter groups

- Site characteristics (soil type etc.) : soil type, slope%, Soil chemistry and physics
  - pH
  - C and N contents Wet aggregate stability (topsoil)
  - Liquid and plastic limit (topsoil)
- Soil erosion (run-off, sediment release, erosion rate)
- Air temperature, RH, Wind speed and direction, rainfall and rain rate

12. Data availability

The results will be available on a report on the project website,

13. Monitoring mechanisms

- Soil erosion is affecting large areas worldwide, especially on steep slopes where soil development is limited and the soil formation rate is particularly low. In Aosta Valley, according to CERVIM (2016), vineyards cover 522 Ha. Around 60% of this surface lays on difficult terrains for different reasons, such as relatively high altitude (>500 m asl), slope exceeding 30%, and presence of man-made terraces that can help reducing erosion but also limit access and mechanization. Row orientation (up and down or orthogonal to the slope by earth embankments) and soil management (grass cover or bare soil), as well as tractor passages can greatly influence soil erosion and runoff. Runoff and soil sediments are collected at the end of the inter-rows. Runoff volumes are measured after every important precipitation event (from April 1st to October 30th). Soil erosion is estimated and soil sediments are sampled and analysed after every relevant erosion event and/or at the end of the season. The experimental design is a RCBD with 3 replicates and 3 treatments (complete grass cover, bare soil, grass buffer strip). Each experimental plot is made of two subplots (two adjacent inter-rows), one being subject to tractor passage several times per season, the other undisturbed.

13. Other available information

A video on the experimental site management will be available soon on the Links4Soil website (https://www.alpine-space.eu/projects/links4soils/en/home)

http://www.cervim.org/v.aspx
Two abstracts presented at the CERVIM 2017 Congress (pages 175-176 and 178)

Comments by the assessor:

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Soil Protection Working Group

Questionnaire permanent monitoring sites

IT – Italian Land Use Inventory

Inventario dell'Uso delle Terre d'Italia- IUTI

1. Brief description of the instrument

The Italian Land Use Inventory (IUTI) is a point sampling based inventory. It was originally conceived as a key instrument of the National Registry for forest carbon sinks by the Italian Ministry of Environment and then updated by University of Molise and ISPRA. IUTI has monitored the land use and land use changes in the last three decades over the country at the years 1990, 2000, 2008, 2013, 2017, adopting a tessellated stratified sampling scheme with about 1.206.000 million sample points on aerial orthophotos using six GPG-LULUCF categories of the IPCC, divided into 15 subclasses. These sample points show the heavy changes affecting surface and distribution of the various land use classes over time. Many implementation and cross analysis have been carried out using IUTI to extend land use monitoring to specific landscape features (e.g., trees outside forests, clearings, urban greenspaces) and to assess land use change impacts on ecosystems.

2. Institution(s) responsible for the implementation and/or evaluation of the policy instrument

Ministry of the Environment, Land and Sea, University of Molise and ISPRA

3. Type of instrument

- national monitoring systems

4. Status of policy instrument

- In place (since 1990),

5. Territorial coverage

- national (MS level),

6. Sectoral coverage

- cross sectoral.

7. Soil threats addressed by instrument

- soil sealing

8. Soil functions addressed by instrument

- acting as carbon pool

9. Land cover classes addressed by the instrument

- artificial surfaces,
- agricultural areas,
- forests,
- semi-natural areas,
- wetlands,
- water bodies,

10. Monitoring sites

IUTI is composed by 1.206.000 random sampling points covering the whole national territory. Land use classes was assigned through visual photointerpretation of a time-series of digital aerial orthophotosbased on the dominant land use in a 0.5 ha range around the sampling points. The whole set of sampling points can be modified according to specific territorial analysis (i.e., subsampling schemes for the Alpine Convention territory)

11. Parameter groups

- Land use

12. Data availability

To be verified

13. Monitoring mechanisms

IUTI was originally conceived and implemented as a key instrument of the National Registry for forest carbon sinks, through the analysis of land use and land cover changes and their impacts on carbon storage. However, its sampling scheme combined with the possibility to be integrated with other cartographic and inventory information allowed to further extend its range of implementation to specific issues as already done by LUCAS at EU scale.

The possibility to integrate cartographic and inventory approaches, allowed to extend its range of activities beyond the land use and land cover changes monitoring. It is indeed now possible to use IUTI as a base for environmental impact assessment analysis related to such landscape changes (e.g., impacts on carbon storage and sequestration, crop production, timber production, land capability etc.). All the implementation can both cover the whole national territory as well as its smaller portions (e.g., province, region).

13. Other available information

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Marchetti M., Santopuoli G., Vizzarri M., Di Cirstofaro M., Lasserre B., Lombardi F., Giancola C., Perone A., Simpatico A., Sallustio L. (2018). Behind forest cover changes: is natural regrowth supporting landscape restoration? Findings from Central Italy. Plant Biosystems - An International Journal Dealing with all Aspects of Plant Biology: Official Journal of the Società Botanica Italiana, 152(3), 524-535, DOI: https://doi.org/10.1080/11263504.2018.1435585

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Sallustio L.,Simpatico A., Munafò M., Giancola C., Tognetti R., Vizzarri M., Marchetti M. (2015). Recent trends in forest cover changes: only positive implications? L'Italia Forestale e Montana, 70 (4): 273-294. doi: http://dx.doi.org/10.4129/ifm.2015.40.03

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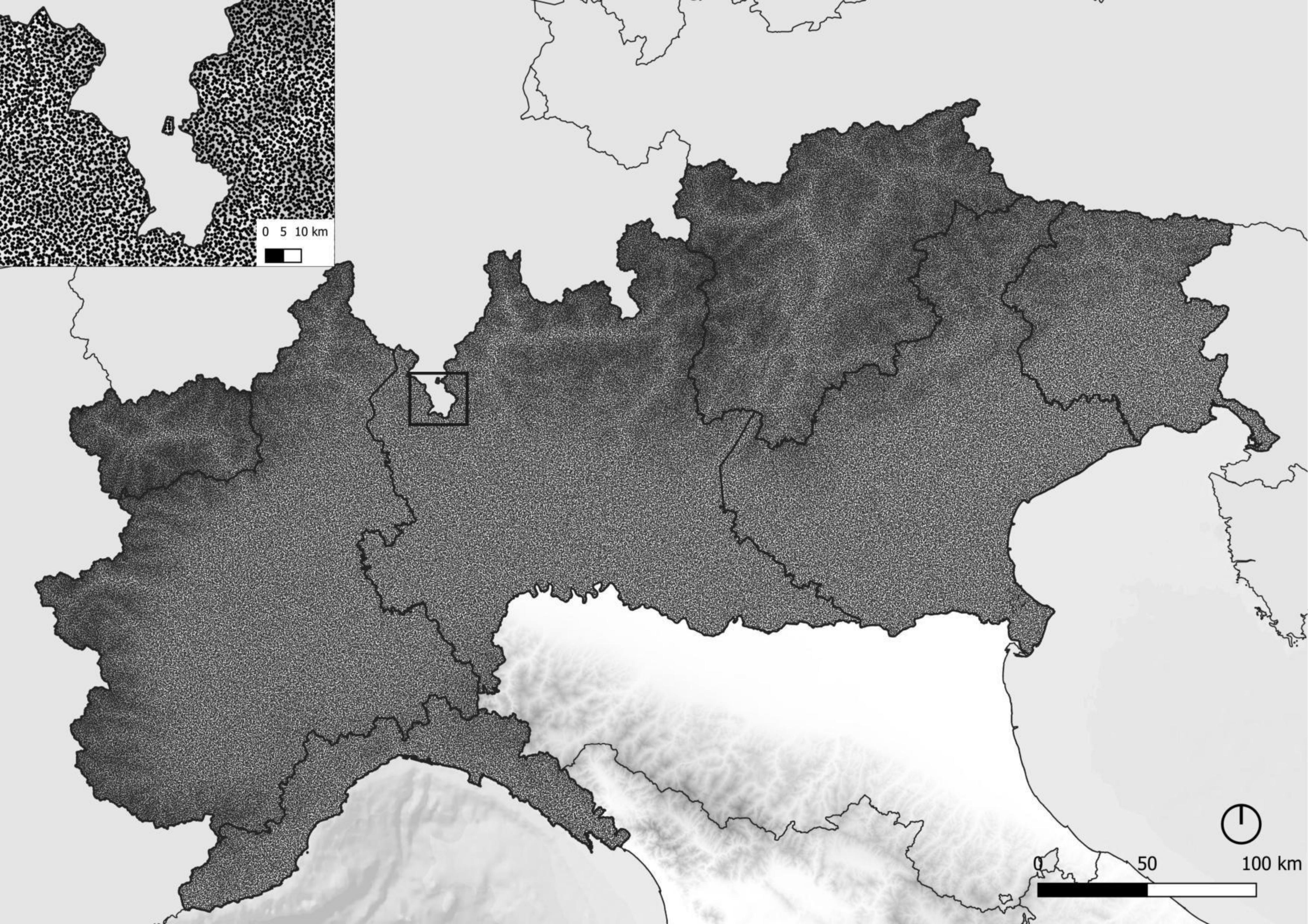
Comments by the assessor:


0 5 10 km
0 50 100 km

Soil Protection Working Group

Questionnaire permanent monitoring sites

IT - ARPA CMG - Lombardy Environmental Protection Agency - Geological Monitoring Center

CMG – Centro Monitoraggio Geologico della Lombardia

1. Brief description of the instrument

Arpa Lombardia manages the Geological Monitoring Center of Lombardy, where a systematic geological monitoring activity began following the flood of Valtellina (July 1987) with the construction and activation of the first control networks on the landslides of Val Pola (1987), Val Torreggio (1988) and in the Campo Franscia area (1988). Since then, the Geological Monitoring Center (CMG) established by the Lombardy Region has been active and subsequently transferred to ARPA Lombardia (April 2003). The Lombard warning system for large landslides is focused on CMG.

The network is equipped with surface type measuring points (strain gauges, crack meters, distometers, wall inclinometers), in the hole (inclinometer tubes / probes, multibase extensometers, piezometric tubes / probes, inclinometer chain, multi-parameter DMS, "TDR" cables) , Interferometry radar (ground and satellite), Topographic (Total station, GPS antennas) and Pluvio-Meteorological (Rain gauge, Snow meter, Thermometer, Barometer, Anemometer, Hydrometer, Hygrometer, Albedometer).

Landslides monitored: 44

Landslides with real-time data transmission: 33

Landslides for alert purposes: 28

Inclinometric measurements: about 15.000 meters per year

Dystometric measurements: over 2.000 readings per year

Piezometric measurements: over 160 measurements per year

Topographic and GPS campaigns: 48 + 41 campaigns per year

automatic acquisition sensors: 1088

Data acquisition and transmission stations: 137

Geotechnical data: approximately 12.006.038 data / year

Hydrometeorological data: approximately 8.462.160 data / year

Total data acquired every year in automatic mode: about 20.468.198

2. Institution(s) responsible for the implementation and/or evaluation of the policy instrument

ARPA Lombardia – Agenzia Regionale per la Protezione ambientale della Regione Lombardia (www.arpalombardia.it) - [The Environmental Protection Agency of the Lombardy Region]

Regione Lombardia (www.regione.lombardia.it) [Lombardy Region]

3. Type of instrument

- regional monitoring systems,

4. Status of policy instrument

- In place (since 1987)

5. Territorial coverage

- regional (non-federal state),

6. Sectoral coverage

- cross sectoral

7. Soil threats addressed by instrument

- landslides, flooding

8. Soil functions addressed by instrument

- no specific soil functions mentioned.

9. Land cover classes addressed by the instrument

- artificial surfaces,
- agricultural areas,
- forests,
- semi-natural areas,

10. Monitoring sites

https://www.arpalombardia.it/Pages/Monitoraggio-Geologico/Le-aree-monitorate.aspx

11. Parameter groups

  - other

12. Data availability

The locations and characteristics of the instruments are available on the website. The data deriving from the instrumental monitoring are available on request or on the site with restricted access.

13. Monitoring mechanisms

The network is extensive and includes depth and surface control tools such as inclinometer tubes / probes, multi-base strain gauges, piezometric tubes / probes, inclinometer chain, DMS multiparameter, "TDR" cables, ground and satellite radar interferometry, total station, GPS antennas, Rain gauge, Snow meter, Thermometer, Barometer, Anemometer, Hydrometer, Hygrometer, Albedometer which allow to know the evolution of landslide movements over time.
The number of sites to be monitored varies according to the indications of the Lombardy Region, while the number of tools to be installed derives from the analyzes and studies on the phenomena observed, which are translated by the Geological Technicians of the Center into specific projects, where the methods are also indicated. (automatic or manual) and the timing of acquisition of sensor data.

14. Other available information

The website https://www.arpalombardia.it/Pages/Monitoraggio-Geologico/Le-aree-monitorate.aspx presents for each failure at least the following information:
name and description of the failure, municipality in which it exists, year from which it is monitored, method of data acquisition, number and type of data transmission systems, list of instruments installed with automatic detection and manual detection, number and type of campaigns measurement expected in the year, number of data acquired in a year, image with location of sensors, CTRL map of classification, some images of failure and sensors.

Comments by the assessor:

alpenkonvention • convention alpine
convenzione delle alpi • alpska konvencija

Soil Protection Working Group

Questionnaire permanent monitoring sites

IT – Soil Quality Monitoring in Lombardy (North Italy)

National Name: Monitoraggio delle qualità dei suoli agricoli della Lombardia.

1. Brief description of the instrument

Monitoring is based on the detection of a large set of environmental and agronomic indicators related to soil qualities/properties and soil management practices. Data are gathered from sites representative of the pedoclimatic conditions and cropping systems that characterize the Lombardy Po plain. Monitoring activity is carried out in the framework of projects financed under successive projects financed by both EU programs (e.g. LIFE) and Regional decisions. Results are expected to contribute to the application of climatic and agro-environmental policies at regional level, with respect in particular to the Rural Development Plans and the mitigation/adaptation to climate change strategies (ref.: Agenda 2030 goals; Paris Commitment). To this purpose, the monitoring is mainly focused on SOC (Soil Organic Carbon), diversification of cropping systems, edaphic biodiversity, water, energy and fossil fuel consumption. More information available on www.lifehelpsoil.eu

2. Institution(s) responsible for the implementation and/or evaluation of the policy instrument

ERSAF – Ente Regionale per I Servizi all'Agricoltura e alle Foreste

Via Pola 12, 20124 Milano (Italy) – www.ersaf.lombardia.it

3. Type of instrument

- regional monitoring systems,

4. Status of policy instrument

- In place (since 2010, under successive projects),

5. Territorial coverage

- regional (federal state or non-federal state),

6. Sectoral coverage

Sectors:

- agriculture,

7. Soil threats addressed by instrument

- loss of soil organic matter,
- compaction,
- loss of soil biodiversity,

8. Soil functions addressed by instrument

- biomass production,
- hosting biodiversity pool,
- acting as carbon pool,

9. Land cover classes addressed by the instrument

- agricultural areas,

10. Monitoring sites

Monitoring sites are located on the Lombardy plain, within normal farms. Main soil types are Cambisols, Luvisols and Vertisols. Cropping systems mainly include the cultivation of cereals, maize, soybean, forage crops and rice.

11. Parameter groups

- Site characteristics (soil type etc.)
- Soil chemistry
    - pH-value
    - Heavy metal concentrations
- Soil carbon
- Soil biodiversity

12. Data availability

Data are available and published within the final report of the projects that included the monitoring activity mentioned. Also meta-information is provided there. It is in line with INSPIRE (as I know).

13. Monitoring mechanisms

Monitoring is addressed in particular to assess the SOC stock occurring in the agricultural soils and its variation over the time, under different tillage management practices (conventional/ploughed, minimum tillage, no tillage) and crop rotations (including and not including cover crops). Data collected are integrated with a modelling approach to simulate the SOC increasing/decreasing rate. Monitoring of edaphic biodiversity is based on the QBS-ar index and the detection of earthworms occurrence in the topsoil. According to local conditions and environmental problems occurring in specific areas also the soil content of heavy metals, nutrients and soluble salts as well of soil structure stability are detected. In any case scientific methods are applied for both soil sampling, field measurements and laboratory analysis.

13. Other available information

www.lifehelpsoil.eu
www.ersaf.lombardia.it
"AgroEnvironmental aspects of conservation agriculture compared to conventional systems: a 3-years experience on 20 farms in the Po Valley (Northern Italy)", in Agricultural Systems n. 168 (2019), 73-87, Elsevier The Netherlands;
"Soil carbon sequestration and biological activity in Conservation Agriculture systems in North Italy", in Atti (MTA CAES Geoghraphical Institute Budapest, 2016: ISBN 978-963-9545-50-2) "International Conference on Conservation Agriculture and Sustainable Land Use", Budapest (Ungheria), 31 maggio – 2 giugno 2016;
"Il ruolo dell'agricoltura conservativa nel bilancio del carbonio – AgriCO$_2$ltura", Quaderni della Ricerca n. 153, 137 pp. Regione Lombardia, giugno 2013 – coordinamento di progetto e autore capitoli 2.1 e 3.1;
"Soilqualimon – Sistema di monitoraggio della qualità dei suoli di Lombardia", Quaderni della Ricerca n.110 su CD Rom, Regione Lombardia, maggio 2010;

Comments by the assessor:

alpenkonvention • convention alpine
convenzione delle alpi • alpska konvencija

Soil Protection Working Group

Questionnaire permanent monitoring sites

IT – ARMOSA – Soil and cropping system monitoring established in Lombardy to implement the Nitrates Directive

National Name: ARMOSA – rete di monitoraggio dei suoli e dei sistemi agricoli nell'ambito dell'applicazione della Direttiva Nitrati in Lombardia

1. Brief description of the instrument

Monitoring is based on 6-8 permanent sites representative of pedoclimatic conditions and fertilization practices normally adopted by farms, both zootechnic and cereal farms, in Lombardy. Monitoring activity concerns the content and dynamic of nutrients – nitrogen/nitrates and phosphorous – through the soil, from the surface down to 90 cm. Soil sampling and analysis are carried out every 15-30 days in each site according to the crop growing season; soil water content is detected in continuum by soil probes connected to a data-logger. The ARMOSA monitoring system has been identified by Lombardy Region in order to comply with the requirements laid down by the EU Nitrates Directive (91/676/CEE) and regulation taken at national and regional level.

2. Institution(s) responsible for the implementation and/or evaluation of the policy instrument

ERSAF – Ente Regionale per I Servizi all'Agricoltura e alle Foreste

Via Pola 12, 20124 Milano (Italy) – www.ersaf.lombardia.it

3. Type of instrument

- regional monitoring systems,

4. Status of policy instrument

- In place (since 2005)

5. Territorial coverage

- regional (federal state or non-federal state),

6. Sectoral coverage

Sectors:

- agriculture,

7. Soil threats addressed by instrument

- contamination,

8. Soil functions addressed by instrument

- biomass production,
- storing, filtering, transforming nutrients or water,

9. Land cover classes addressed by the instrument

- agricultural areas,

10. Monitoring sites

Monitoring sites are located on the Lombardy plain, within normal farms. Main soil types are Cambisols, Luvisols and Vertisols. Cropping systems mainly include the cultivation of cereals, maize, soybean, forage crops and rice. Fertilisation practices monitored include the distribution of livestock manure, digestate and mineral fertilizers.

11. Parameter groups

- Site characteristics (soil type etc.)
- Soil chemistry
    - Nutrient content (nitrates and phosphates)
    - Heavy metal concentrations
- Soil carbon
- Climate parameters
    - Soil water content

12. Data availability

Data are processed yearly and published on the website of ERSAF and Lombardy Region (Agriculture). Moreover, data are delivered to the national authorities (Minister of Environment) for reporting aims of Nitrates Directive implementation to the European Commission.

13. Monitoring mechanisms

The ARMOSA monitoring system is complementary to that is provided by the Regional Environmental Agency (ARPA) with respect to the quality of surface and groundwater. At the beginning ARMOSA was a project aimed at collecting measured data to develop and validate a deterministic model – also called ARMOSA – addressed to simulate the environmental fate of nitrogen compounds in the soil-plant-atmosphere system (e.g.: nitrates leaching, ammonia and N_20 volatilization). The model has been used, and is still used, to assess the impact of current and improved fertilization practices on the environment (water and air quality). To this purpose, the monitoring activity also includes data recording of nitrogen supplied to crops with manure and fertilizers, nitrogen uptake by plants and crops yields and management practices adopted by farmers.

From 2011 ARMOSA sites have taken officially on the role of soil and cropping system monitoring in the frame of the Nitrates Directive implementation in Lombardy. Nowadays it is under consideration the revision of the monitoring network, in order to set out a more targeted approach able to reduce costs, limiting the number of indicators/parameters monitored, and increase the number of monitoring sites.

13. Other available information

www.ersaf.lombardia.it

www.regione.lombardia.it (Agricoltura)

"The ARMOSA simulation crop model: overall features, calibration and validation results", in Italian Journal of Agrometeorology n. 3/2013, pp 23-38;

"Crop rotation, fertilizer types and application timing affecting nitrose leaching in nitrate vulnerable zones in Po Valley", in Italian Journal of Agrometeorology n. 2/2013, pp 39-50;

"Nitrate leaching under maize cropping systems in Po Valley (Italy)", in Agriculture, Ecosystems and Environment 147(2012) pp. 57-65, online dal 6 luglio 2011;

Comments by the assessor:

Soil Protection Working Group

Questionnaire permanent monitoring sites

IT – Environmental Monitoring Project throughout the Lombardy Region (Soil Project): fact-finding survey of the quality and state of health of Lombardy soils

Progetto di Monitoraggio Ambientale su tutto il Territorio della Regione Lombardia (Progetto Soil): Indagine conoscitiva della qualità e dello stato di salute dei suoli lombardi

1. Brief description of the instrument

The Lombardy Region funded the ISPRA JRC for the "Environmental Monitoring Project for the whole territory of the Lombardy Region (Soil Project): a survey on the quality and state of health of Lombardy soils", the report of which was published in 2015 on the website of the EU Commission:

https://ec.europa.eu/jrc/en/publication/progetto-di-monitoraggio-ambientale-su-tutto-il-territorio-della-regione-lombardia-progetto-soil

In this project, a monitoring network was defined on the entire regional territory, referring to the Lucas network.

The aim of the project was to carry out a screening of the health and quality of the agricultural soils of the Lombardy Region, through a multidisciplinary chemical, physical and biological approach, through which to obtain the so-called "zero point".

The project was divided into two phases: the first general screening in which 156 soil samples were collected and analyzed, taking mainly into consideration the soil used for agricultural activity; the second phase took into consideration seven areas where there is a known or at least suspect critical situation.

However, no replicas of the project are foreseen (to date an update of the work is not expected).

2. Institution(s) responsible for the implementation and/or evaluation of the policy instrument

Lombardy Region and ISPRA

3. Type of instrument

- regional monitoring systems

4. Status of policy instrument

- In place (2015),

5. Territorial coverage

- regional,

6. Sectoral coverage

- agriculture.

7. Soil threats addressed by instrument

- no specific soil threats are mentioned.

8. Soil functions addressed by instrument

- no specific soil threats are mentioned.

9. Land cover classes addressed by the instrument

- agricultural areas,

10. Monitoring sites

The project was divided into two phases: the first general screening in which 156 soil samples were collected and analyzed, taking mainly into consideration the soil used for agricultural activity; the second phase took into consideration seven areas where there is a known or at least suspect critical situation.

11. Parameter groups

- Land use

12. Data availability

To be verified

13. Monitoring mechanisms

No replicas of the project are foreseen (to date an update of the work is not expected).

13. Other available information

The Soil Project Report was published in 2015 on the EU Commission website:

https://ec.europa.eu/jrc/en/publication/progetto-di-monitoraggio-ambientale-su-tutto-il-territorio-della-regione-lombardia-progetto-soil

Comments by the assessor:

alpenkonvention • convention alpine
convenzione delle alpi • alpska konvencija

Soil Protection Working Group

Questionnaire permanent monitoring sites

IT - AOSTA VALLEY LANDSLIDE MONITORING SYSTEM Valle d'Aosta Autonomous Region

SISTEMA REGIONALE DI MONITORAGGIO DEI FENOMENI FRANOSI DELLA REGIONE AUTONOMA VALLE D'AOSTA

1. Brief description of the instrument

The Aosta Valley (Valle d'Aosta) Autonomous Region is the smallest region in Italy, with an area of 3262 km^2. Its territory is located in the highest part of the Alpine chain, thus the relief energy is very high, in fact the altitudes are between 4810 m a.s.l. (the peak of Mont Blanc) and 350 m a.s.l. in the lower part of the Dora Baltea Valley.
These morphological conditions, combined with complex orogenic tectonics, marked by a still active geodynamics, are the main boundary conditions that mark a territory with more than 4000 landslides of various types and sizes;
In the mid-1990s, the first clusters of a regional monitoring network of landslides were built.
After the October 2000 flood, four other large landslides were activated, located in different geological and litho-stratigraphic contexts of the Region.
The volumes of material potentially mobilized varies from $1.2 * 10^6$ m^3 to $5 * 10^6$ m^3.
The targets threatened by landslides vary from residential areas to infrastructures (railways, roads, highways) and rivers. For all these landslides the scenario of total collapse involves the damming of a stream of water with the resulting dam-break, thus producing an indirect threat to the targets downstream of the landslide accumulation zone.

2. Institution(s) responsible for the implementation and/or evaluation of the policy instrument

- regional monitoring systems,

3. Type of instrument

- regional monitoring systems

4. Status of policy instrument

- In place (since 1996),

5. Territorial coverage

- regional (non-federal state),

6. Sectoral coverage

- cross sectoral

7. Soil threats addressed by instrument

- flooding landslides,

8. Soil functions addressed by instrument

- no specific soil functions mentioned.

9. Land cover classes addressed by the instrument

- artificial surfaces;
- agricultural areas;
- forests;
- semi-natural areas;
- water bodies.

10. Monitoring sites

The regional landslide monitoring system perform for the control of the landslide hazard on the regional territory, and is articulated into three levels:

1) 1) First level network: it is a monitoring network with *knowledge monitoring* purposes and covers the entire regional territory through the PS Monitoring satellite interferometry technology whose products (ground motion anomaly maps) are processed by the automated ARTEMIS (**A**dvanced **R**egional **TE**rrain **M**otion **I**nSAR **S**creening system) territorial screening procedure, implemented by the regional geological survey. The purpose is to detect new sites to be included in the level 2 or level 3 networks;
2) Second level network: it is a monitoring network with 10 punctual sites for *control monitoring* purposes. It is based on “contact” or “remote” site instrumentation and discontinuous measurements.

3) Third level network: is the continuous monitoring network for emergency monitoring and early warning purposes. It includes 6 sites affected by landslides with volumes higher than 10^6 m3, and foresees the activation of civil protection plans.

The list of the sites belonging to the third level network is available at the following link:
https://www.regione.vda.it/territorio/territorio/rischiidrogeologici/conoscere_territorio_e_rischi/monitoraggio_frane_i.aspx

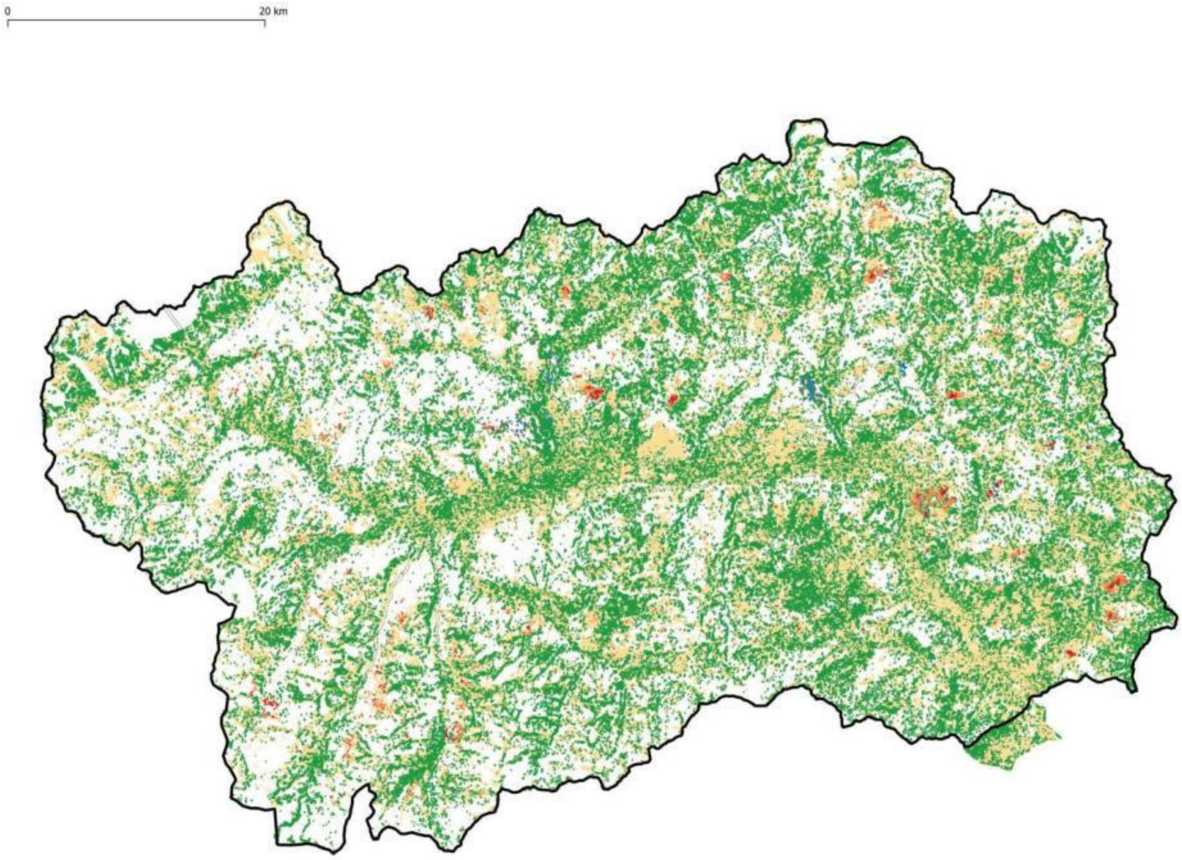


Figura 1 - Layout of the PS InSAR Coverage (Sentinel1 SAR), providing the coverage of the level 1 network

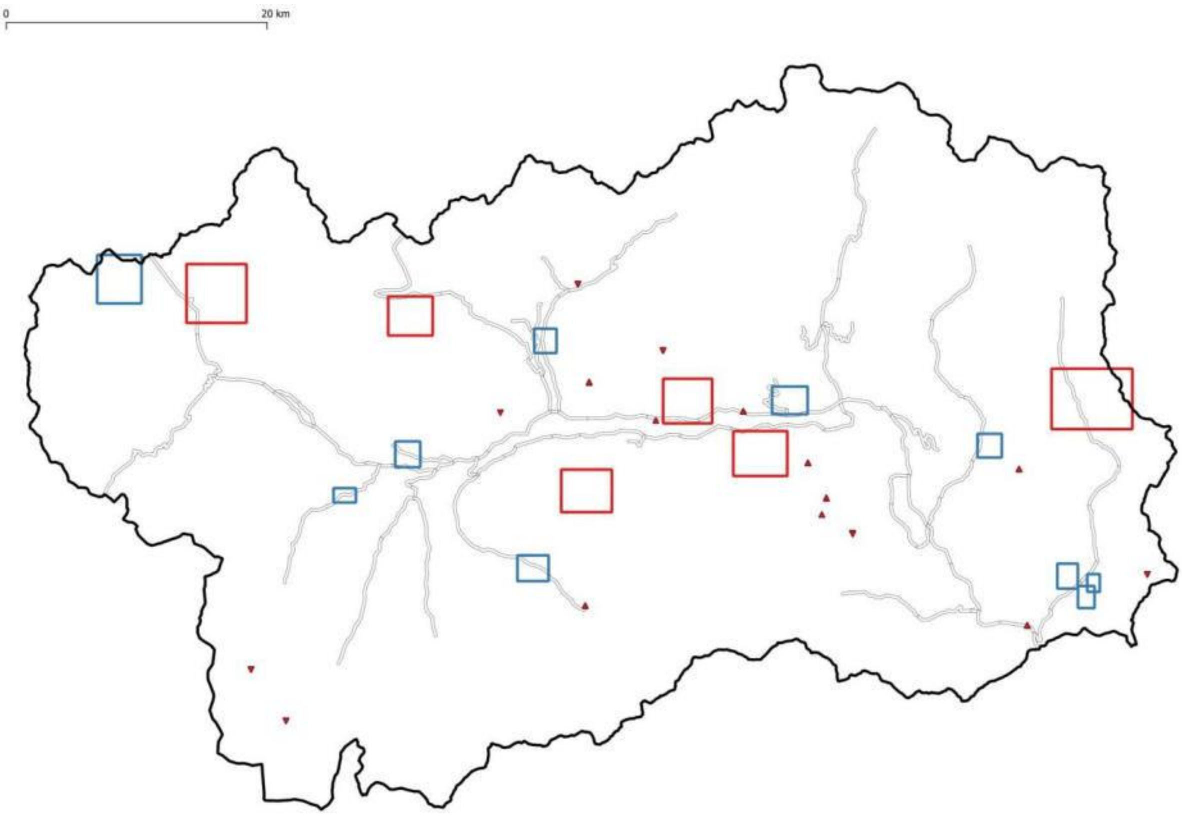


Figure 2 - Layout of the second level network sites (blue rectangles) and of the third level network sites (red rectangles)

11. Parameter groups

- Others
- Climate parameters

12. Data availability

Under the Italian legislative framework, the monitoring data are fully available to all institutions and stakeholders on-demand. Public dissemination is made with periodical reports on the above-mentioned website and, for the most relevant phenomena, (third lever network) monthly bulletins are issued. A public dissemination platform WEBGIS based is under development.

13. Monitoring mechanisms

The Regional monitoring system is made by both extensive and punctual networks. The extensive network include the PSinSAR coverage for PS Monitoring activity.
The Punctual networks, both continuous or discontinuous monitoring, include several types of instruments such as:

- Strain gauges and extensometers;
- Piezometers;

- Multi parametric groundprobes (Differential Monitoring of Stability-DMS);
- Ground Based Interferometric radars Gb-InSAR;
- Robotized Total Stations RTS;
- GNSS-DGPS;
- Meteorological instruments(rain gauges, nivometers, etc.);
- Manual inclinometers;
- Computer vision, both visible and IR wavelengths;

The data collected by the monitoring system are transmitted by the civil protection radio network, or by mobile data network: the choice of the type of data network is strongly conditioned by the orography.
All data are collected at the control center located at the regional geological survey venue in Quart (AO), where an "expert-system" software, processes them and sends SMS alerts to the on-duty personnel and to the Civil Protection Operations Centre when the instrument limits have passed.
The subsequent interpretation of the data aims to detect instrumental anomalies and to validate warnings if necessary. Once an instrumental warning is validated, an alert is sent to the civil protection authorities (Early Warning or Alarm), which activate the civil protection plans.

13. Other available information

The data are classified with the peer-reviewed standard of the “Operative monographies” (Giordan et al., 2018)

Comments by the assessor:

Soil Protection Working Group

Questionnaire permanent monitoring sites

IT - RERCOMF Rercomf - Regional Network for Landslide Movement Control

Rercomf – Rete Regionale Controllo Movimenti Franosi

1. Brief description of the instrument

Arpa Piemonte manages the Regional Landslide Movement Control Network (ReRCoMF), born in the mid-90s and extended, with about 240 monitoring sites, to the entire regional territory. The network includes instrumental control systems installed by municipal and provincial administrations, mountain communities or other bodies and aims to monitor the movement of slow-moving landslides over time.
The network is extensive and the number of sites varies according to new installations, usually as a result of funding from the Piedmont Region. The network is equipped with surface type measuring points (topographic cornerstones, on which the Agency takes readings with total station or with GPS antennas) and deep type (mainly inclinometers and piezometers).
As required by institutional procedures, the instrumental results of the periodic measurement campaigns carried out by Arpa are provided to the municipal administrations in specific technical reports.
The technical and procedural aspects of the Agency's activities in the field of RerCoMF management are specified in the "Disciplinary for the development, management and dissemination of data on monitoring systems on landslides in the regional territory for the purpose of territorial prevention and civil protection ", approved with DGR 16 April 2012, n.18-3690.

2. Institution(s) responsible for the implementation and/or evaluation of the policy instrument

ARPA Piemonte – Agenzia Regionale per la Protezione ambientale della Regione Piemonte (www.arpa.piemonte.it) - [The Environmental Protection Agency of the Piemonte Region]

Regione Piemonte (www.regione.piemonte.it) [Piemonte Region]

3. Type of instrument

- regional monitoring systems,

4. Status of policy instrument

- In place (since 1994)

5. Territorial coverage

- regional (non-federal state),

6. Sectoral coverage

- cross sectoral

7. Soil threats addressed by instrument

- flooding landslides

8. Soil functions addressed by instrument

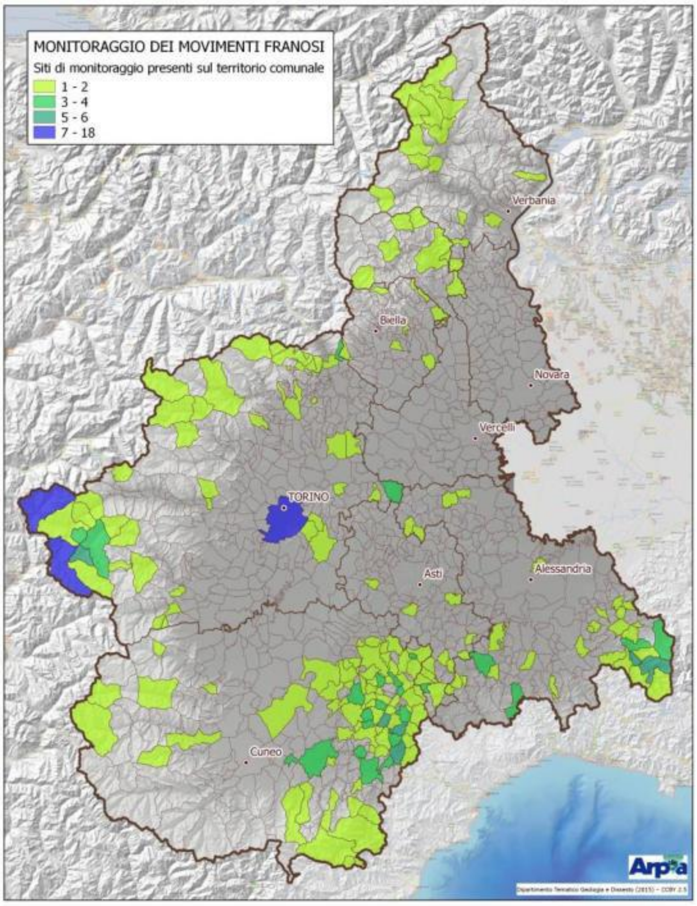
- no specific soil functions mentioned.

9. Land cover classes addressed by the instrument

- artificial surfaces,
- agricultural areas,
- forests,
- semi-natural areas,

10. Monitoring sites

The list of sites active in the monitoring network can be consulted at the following link: https://www.arpa.piemonte.it/approfondimenti/temi-ambientali/geologia-e-dissesto/fenomenifranosi/rercomf-1/disciplinare-monitoraggio-frane-1/allegato-2
Multiple monitoring sites can affect the same municipal area as explained in the following cartography



11. Parameter groups

- other

12. Data availability

The data are metadocumented and follow the INSPIRE directive. The locations and characteristics of the tools are available on geoportal. The data deriving from monitoring are available on request, as Arpa Piemonte is only the manager and not the owner of the data.
https://webgis.arpa.piemonte.it/geoportale/
As for the municipal administrations, owners of the instrumentation making up the network, the data are available on a dedicated site with restricted access.

13. Monitoring mechanisms

The network is extensive and includes depth and surface control instruments such as inclinometers, strain gauges, piezometers, distance bases, topographic cornerstones, multiparamentric columns, which allow to know the evolution of landslide movements over time.

The number of sites and instruments varies according to new installations, normally following funding from the Piedmont Region and the measurement frequencies are variable: quarterly, quarterly, half-yearly, annual or biennial.

14. Other available information

The Regional Landslide Movement Control Network (ReRCoMF) service is available on the Arpa Geoportal (ReRCoMF) which presents the location of the instruments distinguished by type, the master data, the functionality, the managing body, the technical characteristics of the installation and, where available, a photograph of the monitored site.
https://webgis.arpa.piemonte.it/geoportale/

On the institutional site of ARPA Piemonte, the page dedicated to the Rercomf network can be consulted at the following link:
https://www.arpa.piemonte.it/approfondimenti/temi-ambientali/geologia-e-dissesto/fenomenifranosi/rercomf-1/rercomf

Also on the institutional website, a descriptive poster of the network can be consulted
https://www.arpa.piemonte.it/approfondimenti/temi-ambientali/geologia-e-dissesto/immagini/poster_rercomf
An educational video created specifically for the public that can be viewed at the link below is also available on the Youtube platform
https://youtu.be/2OKJc_fuGlc

Comments by the assessor:

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Soil Protection Working Group

Questionnaire permanent monitoring sites

IT - Environmental Soil Quality Monitoring Network

Rete di monitoraggio ambientale dei Suoli del Piemonte

1. Brief description of the instrument

Arpa Piemonte creates a monitoring system for soils in the Piedmont area, designed to provide homogeneous and validated data relating to the main contaminants, to be used as scientific reference support in activities related to the evaluation of soil quality and the application of the regulations concerning the environmental contamination.

Soil monitoring is carried out in monitoring stations distributed throughout the regional territory, in correspondence with the vertices of a systematic network expanded with subsequent levels of depth.

Soil sampling is carried out at fixed depths and for each sample taken, more than 70 contaminants are analyzed between heavy metals, polycyclic aromatic hydrocarbons (PAHs) polychlorinated biphenyls (PCB), dioxins (PCDD) and furans (PCDF) for which values are fixed limit from Legislative Decree 152/06, in addition to non-regulated heavy metals and rare earths.

2. Institution(s) responsible for the implementation and/or evaluation of the policy instrument

ARPA Piemonte – Agenzia Regionale per la Protezione ambientale della Regione Piemonte (www.arpa.piemonte.it) - [The Environmental Protection Agency of the Piemonte Region]

3. Type of instrument

- regional monitoring systems,

4. Status of policy instrument

- In place (dal 2005 – in progress),

5. Territorial coverage

- regional (non-federal state),

6. Sectoral coverage

Sectors:

- agriculture,
- forestry

7. Soil threats addressed by instrument.

- contamination,

8. Soil functions addressed by instrument ???

- storing, filtering, transforming nutrients or water,
- hosting biodiversity pool,
- platform for human activity,
- storing geological and archeological heritage,
- no specific soil functions mentioned.

9. Land cover classes addressed by the instrument

- agricultural areas,
- forests,
- semi-natural areas,

10. Monitoring sites

Soil monitoring is carried out at monitoring stations distributed throughout the regional territory.

At present the soils of 600 monitoring stations on systematic mesh have been sampled and analyzed

• 9x9 km: for the soils of the Alpine and hilly areas,

• 4,5x4,5 km: for the soils of the plain

• 3x3 km or 1,5x1,5 km for areas characterized by particular problems related to widespread soil contamination.

The data of the systematic network are integrated with analysis of monitoring stations (currently 400), carried out in the context of other projects carried out by Arpa and sampled and analyzed with the same procedures.

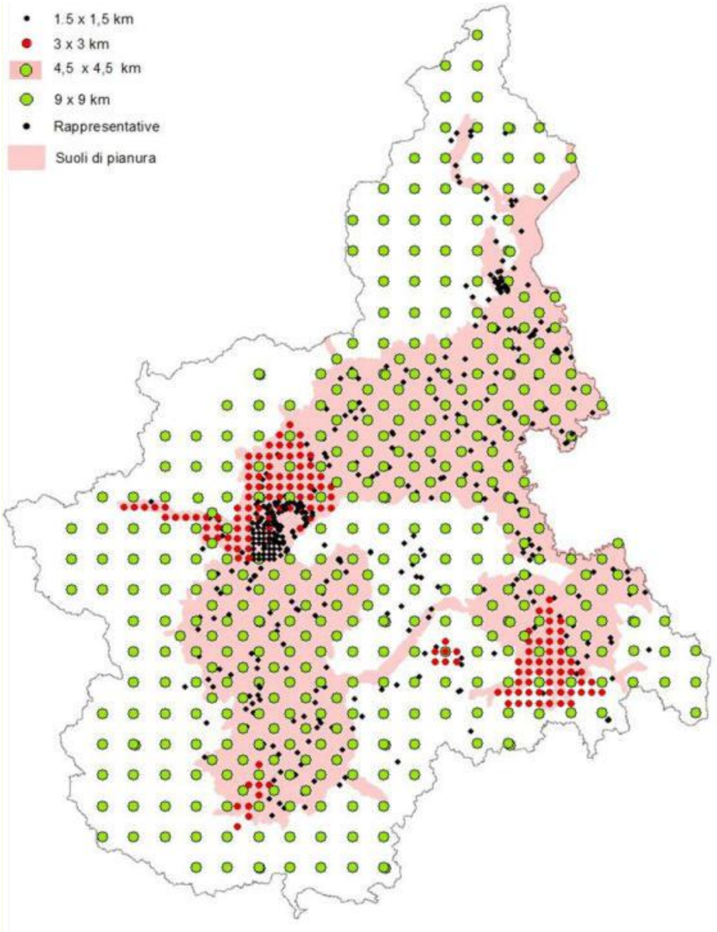

Figure - Location of the stations of the Piedmont Soil Environmental Monitoring Network (data updated in December 2019).

11. Parameter groups

- Site characteristics (soil type etc.)
- Soil chemistry
    - Heavy metal concentrations
    - Organic compounds

12. Data availability

The data are disclosed grouped by homogeneous areas of concentration and critical areas of the individual contaminants, obtained through predictive geostatistical models.

13. Monitoring mechanisms

For each sample, contaminants are analyzed for which limit values are set by Legislative Decree 152/06 for sites for public, private and residential green use:

- heavy metals and non-metals (Antimony - Sb, Arsenic - As, Beryllium - Be, Cadmium - Cd, Cobalt - Co, Chrome - Cr, Mercury - Hg, Nickel - Ni, Lead - Pb, Copper - Cu, Selenium - Se, Tin - Sn, Thallium - Tl, Vanadium - V and Zinc - Zn). Extraction in aqua regia and analysis with ICP-MS (Agilent, 7500CE).
- polycyclic aromatic hydrocarbons (IPA - 16 compounds). Extraction through ASE 200 Accelerated Solvent Extractor (Dionex, Sunnyvale, CA, USA). with dichloromethane.
- dioxins and furans (PCDD / DF - 17 congeners). Extraction through ASE 200 Accelerated Solvent Extractor (Dionex, Sunnyvale, CA, USA) with toluene.
- polychlorinated biphenyls (PCB - 30 congeners). Extraction through ASE 200 Accelerated Solvent Extractor (Dionex, Sunnyvale, CA, USA) with toluene.

The following are also analyzed:

- lantanoids or "rare earths" not regulated by Legislative Decree 152/06, but of considerable interest for the assessment of widespread soil contamination: (Cerium - Ce, Dysprosium - Dy, Erbium - Er, Europio - Eu, Gadolinium - Gd, Holmium - Ho, Lanthanum - La, Neodymium - Nd, Praseodymium - Pr, Samario - Sm, Tullio - Tm, Yttrium - Y, and Ytterbium - Yb). Extraction in aqua regia and analysis with ICP-MS (Agilent, 7500CE).
- inorganic compounds not regulated by Legislative Decree 152/06 but necessary for the interpretation of numerous contamination phenomena. Extraction in aqua regia and analysis with ICP-MS (Agilent, 7500CE).

Sampling frequency at least 10 years.

Laboratory analytical determinations carried out on the particle size of less than 2 mm. The concentration of the sample refers to the totality of the dry materials of only the fraction of less than 2 mm without including the fraction of the skeleton 2 cm - 2 mm.

The systematic mesh sampling scheme integrated on successive levels of in-depth analysis was designed to have the highest level of harmonization with other soil monitoring projects carried out at national and European level. In particular, the sampling scheme originated from the points of the systematic network 18 x 18 km of the LUCAS project (European Community, 2003).

13. Other available information

ARPA Piemonte website - The soil environmental monitoring network:
https://www.arpa.piemonte.it/approfondimenti/temi-ambientali/suolo/suolo_rete_monitoraggio

Regional RSA website:
http://relazione.ambiente.piemonte.it/2019/it/territorio/stato/suolo-contaminazione

Publications in ISI scientific journals
Soil quality and landscape metrics as driving factors in a multi-criteria GIS procedure for peri-urban land use planning Urban Forestry & Urban Greening 01/2016; in press. DOI:10.1016/j.ufug.2015.07.004 (*Enrico Borgogno-Mondino*, Gabriele Fabietti, *Franco Ajmone-Marsan*, 2016)

Earth walls as repositories of background levels of soil metal contaminants. Environmental earth sciences 01/2013. (Valter Boero, Gabriele Fabietti, Franco Ajmone-Marsan, 2013).

An appraisal of soil diffuse contamination in an industrial district in northern Italy. Chemosphere 05/2012 (Mattia Biasioli, Gabriele Fabietti, Renzo Barberis e Franco Ajmone Marsan, 2012).

Soil Contamination by Organic and Inorganic Pollutants at the Regional Scale: the Case of Piedmont, Italy. Journal of Soils and Sediments 10 (2), 290-300. (Gabriele Fabietti, Mattia Biasioli, Renzo Barberis e Franco Ajmone Marsan, 2010).

Comments by the assessor:

The use of data from the Soil Environmental Monitoring Network allows to evaluate the presence, origin and intensity of the main forms of widespread contamination of soils in the Piedmont area.
The results of the calculations made it possible to identify two main groups of contaminants that present critical issues in the soils of the Piedmont territory.
A first group is represented by heavy metals and non-metals (Chromium, Nickel, Cobalt, Arsenic, Vanadium and Beryllium) which present critical areas whose origin is mainly due to the chemical composition of the starting material from which the soil originated.
A second group of contaminants is composed of heavy metals (Lead, Copper, Zinc, Antimony, Tin) with critical areas whose origin is attributable in part to the chemical composition of the starting material from which the soil originated and in part to more or less intense phenomena of surface deposition deriving from diffuse anthropogenic contamination.
The results obtained fill a historical lack of data and scientific documentation relating to the characterization and quantification of the widespread contamination of soils in the Piedmont area.
In particular, the data provided represent a fundamental scientific reference support for all activities related to the assessment of the quality of lowland, hilly and alpine soils, the assessment of the quality of the environment in general and territorial planning on a large scale.
The contribution of the monitoring network is also of fundamental importance in the context of investigative activities related to the application of soil regulations, such as Legislative Decree 152/06 and Ministerial Decree August 10, 2012 n. 161.

Soil Protection Working Group

Questionnaire permanent monitoring sites

IT –Long-term thermosensitive species monitoring in periglacial soil of Northern Piemonte: Monte Rosa, Val Formazza

National Name: Rete piemontese di monitoraggio delle specie termosensibili in suoli periglaciali

1. Brief description of the instrument

To assess potential impacts of climate change on alpine biota of periglacial soils, a long-term ecological monitoring program was launched in Northern Piemonte.

Plant and Soil mesofauna invertebrates in Nature 2000 habitat of *Carex curvula* heathland and Communities of siliceous scree will be assessed in two study regions near long-term Permafrost Monitoring stations, across altitudinal gradients on more or less moving "cryoclastic systems" with variable granulometry.

The data collected as part of this new monitoring program include environmental conditions temperature in the top soil, meteorological parameters and phenological data of the few flowering plant species.

2. Institution(s) responsible for the implementation and/or evaluation of the policy instrument

ARPA Piemonte – Agenzia Regionale per laPortezione ambientale della Regione Piemonte (www.arpa.piemonte.it)

3. Type of instrument

- regional monitoring systems,

4. Status of policy instrument

- In pipeline (first tests since 2016)

5. Territorial coverage

- regional (non-federal state),

6. Sectoral coverage

Sites are in snow level and periglacial soils of Pennine and Lepontine Alps sector in Northern Piemonte, across a transect from ca. 2600 mt to 3000 mt.

7. Soil threats addressed by instrument

- Erosion (melting of Permafrost)
- Loss of soil organic matter

8. Soil functions addressed by instrument

- hosting biodiversity pool
- acting as carbon pool

9. Land cover classes addressed by the instrument

- natural areas

10. Monitoring sites

Monitoring sites were established in 2016 in the Alta Valsesia Park (Nature 2000 Special Area of Conservation “Monte Rosa”) and in Sabbioni Glacial area in high Val Formazza (Nature 2000 Special Protection Area “ Alta Val Formazza”). In Monte Rosa the site is located at 3000 m (Passo dei Salati), in Sabbioni Glacial area at 2600 mt (Hosand Glacier)

11. Parameter groups

- Soil biodiversity
- Climate parameters
- Soil temperature

12. Data availability

Currently not avilable on line

13. Monitoring mechanisms

Investigated parameters include:

- Site climate conditions, soil temperature
- Botanical-Vegetation Studies (phitosociological and phenological sampling)
- Soil mesofauna
- Cryosphere: permafrost, geomorphodynamics

14. Other available information

“Clima e biodiversità. Esperienze di monitoraggio in ambiente alpino”
http://www.arpa.piemonte.it/pubblicazioni-2/pubblicazioni-anno-2012/clima-e-biodiversita

“Monitoraggio della biodiversità in ambito alpino: strategie e prospettive di armonizzazione”
2° Report of SAPA Network-System of the Italian Alpine Protected Areas, 2019, pp.149-151
http://www.areeprotette-sapa.it/wp-content/uploads/2019/10/2%C2%B0-REPORT-RETE-SAPA.pdf

Comments by the assessor:

The program is supported in Monte Rosa, by Alta Valsesia regional Park and is in collaboration with “Alpine Soil and Snow Laboratory” of University of Torino (DISAFA) which is settled nearby in the Mosso Research Centre.
ARPA Piemonte also manage in this area a set of 3 meteorological survey system across a gradient from   1500 to 4400 mt on Mount Rosa.

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Soil Protection Working Group

Questionnaire permanent monitoring sites

IT – Permafrost long-term monitoring network in Piedmont Alps

National Name: Rete piemontese di monitoraggio del permafrost e della temperatura superficiale del terreno (*GST – Ground Surface Temperature*)

1. Brief description of the instrument

To assess potential impacts of climate change on bedrock, debris and soils, a long-term permafrost monitoring network has been established in Piedmont Alps, thanks to a European Alpine Space Project "PermaNET – permafrost long-term monitoring network" (2008-2011). Starting from this project, many activities on thermal monitoring of the ground have been implemented by Arpa PIemonte until nowadays. The permafrost monitoring is characterised by chains of thermal sensor in vertical boreholes (5 to 100 m deep), GST monitoring is characterised by thermal sensors put in the ground, water or ice (2 to 100 cm deep).
The main goals of this monitoring in Piedmont Alps, are:

- to evaluate the thermal effect on the ground in the periglacial environment of the atmospheric variations in relation to climate change;
- to analyse relationships between permafrost degradation and slope instability, for land/infrastructures and natural risks (floods, landslides and debris flows) management in high mountain areas;
- to study the soil and biodiversity evolution in deglaciated and periglacial areas;
- to assess the water quantity and quality in high mountain catchments, interested by permafrost degradation and melting ice from permafrost

2. Institution(s) responsible for the implementation and/or evaluation of the policy instrument

ARPA Piemonte – Agenzia Regionale per la Protezione Ambientale della Regione Piemonte (www.arpa.piemonte.it) [*Regional Agency for Environmental Protection of Piemonte*]

3. Type of instrument

- regional monitoring systems (harmonized with the International monitoring network)

4. Status of policy instrument

- in place (since 2009, implemented year by year)
- in pipeline (since 2009, implemented year by year)

5. Territorial coverage

- regional (non-federal state)

6. Sectoral coverage

- cross sectoral (natural risks, water and land/infrastructures management, soil and biodiversity evaluation, assessment of climate change effects on alpine cryosphere)

7. Soil threats addressed by instrument

- erosion (thawing permafrost)
- landslides (thawing permafrost)
- contamination (by water from ice melting in permafrost)
- loss of soil organic matter (due to thermal disequilibrium)
- loss of soil biodiversity (due to thermal disequilibrium)

8. Soil functions addressed by instrument

- storing, filtering, transforming nutrients or water
- hosting biodiversity pool
- platform for human activity
- storing geological and archaeological heritage

9. Land cover classes addressed by the instrument

- natural and semi-natural areas
- wetlands
- water bodies

10. Monitoring sites

Permafrost monitoring stations have been installed in 5 points of Piedmont Alps (2 in Southern Cottian Alps, at an altitude of 2500 and 2870 m asl respectively; 1 in Northern Cottian Alps, at 2985 m asl of altitude; 2 in Pennine Alps, at an altitude of 2870 and 3020 m asl respectively).
GST monitoring sites have been installed in the whole Piedmont Alps, from Ligurian to Lepontine Alps, from 1900 m to over 3500 m asl of altitude, in several geologic-geomorphologic contests (debris, rocks, soils, grasslands, caves, rock-walls, etc.).

Map of monitoring sites to be found here:

- http://www.arpa.piemonte.it/approfondimenti/temi-ambientali/geologia-e-dissesto/bancadatiged/criosfera-e-permafrost

11. Parameter groups

In all sites:

- Site characteristics (soil type, etc.)
- Climate parameters
    - Soil temperature

In some cases (integrating multi-sectoral activities):

- Soil chemistry
  - pH-value
  - Heavy metal concentrations
  - Organic compounds
- Soil carbon
- Soil biodiversity
- Soil erosion

12. Data availability

Free and validated data/graphics are available here:

- http://www.arpa.piemonte.it/approfondimenti/temi-ambientali/geologia-e-dissesto/permafrost/monitoraggio-permafrost

Further information and other not yet published data are available on-demande (by e-mail to: geologico@arpa.piemonte.it)

13. Monitoring mechanisms

The permafrost and GST monitoring is a thermal monitoring of geo-materials (soil, debris and rock). In order to evaluate the climate change effect on the thermal equilibrium of the ground, a meteorological-climate monitoring is always associated. In some specific sites, other monitoring activities, studies and analyses are carried on in order to evaluate the relationships among permafrost degradation and natural risks, water quality, ecosystems and soils conditions, and cryosphere evolution. So, in these specific cases, the thermal monitoring of geo-materials is associated to botanical-vegetation studies (phito-sociological and phenological sampling), soil meso-fauna analysis, geotechnical monitoring, water-snow-ice quantity/quality monitoring, periglacial processes monitoring (thermal state and morpho-dynamics).

14. Other available information

Other information on the permafrost-GST monitoring and related activities are available on the Annual Regional Report on Environment, published yearly by Arpa Piemonte and Regione Piemonte with specific focus (in Italian):

- relazione.ambiente.piemonte.it/2016/it/clima/impatti/permafrost
- relazione.ambiente.piemonte.it/2017/it/clima/impatti/permafrost
- relazione.ambiente.piemonte.it/2018/it/clima/impatti/permafrost
- relazione.ambiente.piemonte.it/2019/it/clima/impatti/permafrost

Some information about this topic in English are available here:

- http://www.arpa.piemonte.it/approfondimenti/temi-ambientali/geologia-e-dissesto/progetti-geologia-e-dissesto/ENprevriskhautemontagne201d
- https://youtu.be/bzXve9BI5jY

Comments by the assessor:

Due to inter-sectorial approach linked to the permafrost and thermal ground monitoring, several Institutions supported the activities and most of them are carried on with their collaboration.
In the Monte Rosa area, the soil and biodiversity evaluation is supported by Alta Valsesia regional Park and is implemented in collaboration with “Alpine Soil and Snow Laboratory” of University of Torino (DISAFA) which is settled nearby in the Mosso Research Centre (2850 m asl of altitude). In the same area, the analysis of the relationships between permafrost and infrastructures is supported by Monterosa 2000 srl (manager of cable ways and sky resort).
Geomorphologic dynamic in periglacial areas is monitored in collaboration with Universities of Pisa (Earth Science Dept.) and of Insubria (Theoretical and Applied Sciences Dept.), and with Arpa of the Regione Valle d’Aosta.
The water quality and its relationship with permafrost degradation are analysed in collaboration with CNR-IRSA (Institute for Water Researches) of Verbania and in the framework of a European project Italy-Switzerland “ReservAQUA” started in 2019 ant still ongoing.
The ice cave monitoring is carried on in collaboration with Paleo-Lab of Polytechnics of Torino, with de DIATI (Engineering of Environment, Land and Infrastructures Dept.) of Polytechnics of Torino, and with University of Milano Bicocca (EuroCold Lab).

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Soil Protection Working Group

Questionnaire permanent monitoring sites

IT – Tetto Frati Long-term Experiment

National Name: Prova storica di Tetto Frati

1. Brief description of the instrument

The experimental platform compares 38 different cropping systems, all typical of the Northwestern Po plain dairy farms. Four rotations (maize for grain with crop residue return, entirely harvested maize for silage, Italian ryegrass-maize for silage double cropping, maize for silage-grass meadow 6 years rotation) are compared at 9 fertilisation types and levels (0, 100, 170, 250 and 350 kg ha^{-1} of N as urea, 170 and 250 kg $ha^{-1}$of N as farmyard manure, 170 and 250 kg $ha^{-1}$of N as bovine liquid manure, plus two systems at a single N rate of 170 kg ha^{-1}, maize for silage-lucerne meadow 6 years rotation and permanent meadow).
Plots are 75 m3, organized in a randomized block design. The experiment was started in 1992 and treatments have been modified only slightly since then. It is focused on studying environmental effects of fertilization under the Nitrates Directive and Derogation schemes, but also long-term SOM evolution and the C and N interaction.

2. Institution(s) responsible for the implementation and/or evaluation of the policy instrument

The platform is managed by the University of Torino, Italy, Dept. of Agricultural, Forest and Food Sciences (www.disafa.unito.it).

Responsible persons: Laura Zavattaro (laura.zavattaro@unito.it) and Carlo Grignani (carlo.grignani@unito.it)

3. Type of instrument

- international monitoring systems,
- national monitoring systems,
- regional monitoring systems,

The platform was included in European projects (ExpeEr, Catch-C), national projects (IC-FAR) and regional projects (several, currently one aimed at monitoring the Derogation to the Nitrates Directive fertilisation scheme)

4. Status of policy instrument

- In place since 1992

5. Territorial coverage

- national (MS level),
- regional (federal state or non-federal state),
- The site is representative of the conditions of the Po plain

6. Sectoral coverage

- agriculture,

7. Soil threats addressed by instrument

The European Soil Thematic Strategy identifies 8 soil threats. These include: erosion, flooding and landslides, loss of soil organic matter, salinization, contamination, compaction, soil sealing and loss of soil biodiversity. Please keep the answers as they are – i.e. don't add or rewrite the answers.

Which threats are addressed **explicitly**, i.e. the monitoring scheme explicitly aims to address the threat (this is stated in its scope, objectives, or the activities and mechanisms it includes)? DELETE answers that are not relevant.

- loss of soil organic matter,
- contamination, → excessive N and P fertilisation in particular
- loss of soil biodiversity,
- No specific soil threats are mentioned.

8. Soil functions addressed by instrument

Which soil functions does the monitoring scheme address – i.e. provide support for, either explicitly or implicitly. (Explicitly means that addressing the soil function is stated in its scope, objectives, or the activities and mechanisms it includes; implicitly means that the instrument may have implications for the soil function, but this is not explicitly stated in the text). DELETE answers that are not relevant.

- biomass production, → EXPLICITLY
- storing, filtering, transforming nutrients or water, → EXPLICITLY
- hosting biodiversity pool, → IMPLICITLY
- providing raw materials, → IMPLICITLY, if biomass is used to produce energy instead of as feed

- acting as carbon pool, → EXPLICITLY

9. Land cover classes addressed by the instrument

Here we identify what types of land covers are affected by the instrument. These are Corine land cover classes. The land uses in the monitoring might not correspond directly to these broad classes. DELETE not relevant ones.

- agricultural areas,
- semi-natural areas,

10. Monitoring sites

Tetto Frati, Carmagnola, Regione Piemonte, Italy

Latitude 44° 53’ N, longitude 7° 41’ E, altitude 232 m a.s.l.

11. Parameter groups

- Site characteristics (soil type etc.) → Typic Ustifluvent, loam, calcareous
- Soil chemistry
  - pH-value → 8.1
  - Heavy metal concentrations
  - Organic compounds
- Soil carbon → monitored every 3 years 0-100 cm
- Soil biodiversity
- Soil erosion → not relevant
- Climate parameters → monitored
  - Soil temperature → monitored

12. Data availability

Data are available upon request. Meta-information is available. It is not yet in line with INSPIRE

13. Monitoring mechanisms

Yield, NPK content of yield and fertilisation are measured every year at all plots. The SOM content is measured at all plots every 3 years in the 0-30, 30-60 and 60-90 cm layers. Soil mineral N content is measured twice a year in a subset of 22 treatments since 2011. Data from previous sampling campaigns are also available.
The site was part of the networks set by the project ExpeER at a EU level, and if IC-FAR at a national level. It has been proposed for several Infrastructure EU project (not funded).

13. Other available information

Grignani C., Zavattaro L.*, Sacco D., Monaco S., 2007. Production, Nitrogen and Carbon balance of maize-based forage systems. European Journal of Agronomy 26: 442-453. DOI 10.1016/j.eja.2007.01.005

Bertora C.*, Zavattaro L., Sacco D., Monaco S., Grignani C., 2009. Soil organic matter dynamics and losses in manured maize-based forage systems. Eur. J. Agron. 30 (3): 177-186. DOI 10.1016/j.eja.2008.09.006

Borda T.*, Celi L., Zavattaro L., Sacco D., Barberis E., 2011. Effect of agronomic management on risk of suspended solids and phosphorus losses from soil to waters. J. Soil Sediment 11: 440-451. DOI 10.1007/s11368-010-0327-y

Zavattaro L.*, Monaco, S., Sacco D., Grignani C., 2012. Options to reduce N loss from maize in intensive cropping systems in Northern Italy. Agric. Ecosys. Environ. 147: 24-35. DOI 10.1016/j.agee.2011.05.020

Zavattaro L.*, Assandri D., Grignani C., 2016. Achieving legislation requirements with different nitrogen fertilization strategies: results from a long term experiment. Eur. J. Agron. 77: 199-208. DOI 10.1016/j.eja.2016.02.004

Sandén T.*, Zavattaro L., Spiegel H., Grignani C., Sandén H., Baumgarten A., Tiirola M., Mikkonen A., 2019. Out of sight: Profiling soil characteristics, nutrients and bacterial communities affected by organic amendments down to one meter in a long-term maize experiment. Appl. Soil Ecol. 134: 54-63. DOI 10.1016/j.apsoil.2018.10.017

Xu H.*, Vandecasteele B., Zavattaro L., Sacco D., Wendland M., Boeckx P, Haesaert G., Sleutel S., 2019. Maize root-derived C in soil and the role of physical protection on its relative stability over shoot-derived C. Eur. J. Soil Sci. 70(5): 935-946. DOI 10.1111/ejss.12792

Harrison M.*, Zavattaro L., Roggero P.P., 2019. Simple, efficient and robust techniques for automatic multi-objective function parameterisation: case studies of local and global optimisation using APSIM. Environ. Modell. Softw. 117: 109-133. DOI 10.1016/j.envsoft.2019.03.010

Comments by the assessor:

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Soil Protection Working Group

Questionnaire permanent monitoring sites

IT- regione Piemonte-I.P.L.A.s.p.a.: RETE DI MONITORAGGIO PEDOCLIMATICA DEL TARTUFO BIANCO IN PIEMONTE

1. Brief description of the instrument

Pedoclimatic characterization and production performance of 4 truffles of Tuber magnatum typical of the Piedmont hills, on the basis of a multi-annual monitoring. The comparison of the collected and processed data provides a useful framework to better understand how the variation of the main physical and chemical parameters of the soil of the investigated ecosystems, in relation to the hypotheses of climate change, can influence the truffle fructification.

2. Institution(s) responsible for the implementation and/or evaluation of the policy instrument

I.P.L.A. spa - www.ipla.org

3. Type of instrument

- regional monitoring systems,
- instrument with direct impact on soil.

4. Status of policy instrument

- In place (10 yrs),

5. Territorial coverage

- sub-regional.

6. Sectoral coverage

Sectors:

- agriculture,
- forestry,

7. Soil threats addressed by instrument

- loss of soil biodiversity,

8. Soil functions addressed by instrument

- storing, filtering, transforming nutrients or water,
- hosting biodiversity pool,

9. Land cover classes addressed by the instrument

- agricultural areas,
- forests,

10. Monitoring sites

The monitoring sites (Mombercelli, Viarigi, Ceva, Aramengo) are located in the southern portion of the AC perimeter in the Langhe subregion originated by sediments from an ancient sea basin, the Piedmontese Tertiary Basin, which were later raised by a sudden tectonic movement that brought them to current levels. Within this broad area are mainly Marls, Sands or Sandstones.

11. Parameter groups

- Site characteristics (soil type etc.)
- Soil chemistry
    - pH-value
- Soil carbon
- Soil biodiversity
- Soil erosion
- Climate parameters
    - Soil temperature

12. Data availability

Are data free available or restricted? Restricted

Is meta-information available? No

Is it in line with INSPIRE? No

13. Monitoring mechanisms

- What types of monitoring is included; what parameters (broad categories are sufficient) are measured and for what purpose, with what frequency?

  The monitoring provides data on hourly rate used to calculate the soil water balance and soil temperature and humidity records which are related to ecosystem soil parameters and truffle ecology and production.

- Any other aspects of the monitoring scheme that you think are very important to understand its relevance for soil protection, for example, if the scheme helps to establish harmonised monitoring data at international or national level, or on the other hand if it is a private initiative, what its limitations might be, or if it could be expanded to cover a wider area:

  The monitored data are a ten years record set which allows evaluation on climate change based on variation of soil water balance, soil temperature and soil humidity, besides all the other climatic data (air temperature, rainfall, radiation, ecc.). The monitored area could be expanded in order to realize a territorial spatialization, at least of the Langhe subregion.

13. Other available information

The complete report (in italian)of ten years monitoring is property of the Forestry Dept. of the Piedmont Region which must authorize its use and spreading.

A scientific paper (in english) is in course of publication under the following title:

Influence of pedoclimatic factors on the fructification of Tuber magnatum Pico in four Piedmontese truffles (Fabio Petrella, Cristina Grieco, Mario Palenzona) - International Journal of Scientific Research in Research Paper . Multidisciplinary Studies, E-ISSN: 2454-9312, Vol., Issue., pp., (2020) P-ISSN: 2454-6143

Comments by the assessor:

The broad data set of 10 years record and all the elaboration done till now need to be implemented on the following levels:

- increase of number of monitoring sites on a subregional scale
- spread of results by on-line and download facilities
- use of results to wider purposes such as evaluation of climate change consequences on soil biodiversity and water balance.

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Soil Protection Working Group

Questionnaire permanent monitoring sites

IT – ARPA-Veneto – ORGANIC COMPOUND MONITORING SCHEME

ARPAV-organici

1. Brief description of the instrument

It is a program aimed at monitoring organic compounds, together with heavy metals, to assess diffuse contamination status of soil, together with information on impact of potential pressures in order to to gather information on trends.

2. Institution(s) responsible for the implementation and/or evaluation of the policy instrument

The Environmental Protection Agency of the Veneto Region (ARPAV https://www.arpa.veneto.it/) is the only institution responsible for the monitoring. There is no regulation at national or regional level, monitoring is carried out on ARPAV initiative.

3. Type of instrument

- regional monitoring systems

4. Status of policy instrument

No policy at national or regional level

5. Territorial coverage

- regional (federal state or non-federal state)

6. Sectoral coverage

Sectors:

- cross sectoral.

7. Soil threats addressed by instrument

- contamination

8. Soil functions addressed by instrument

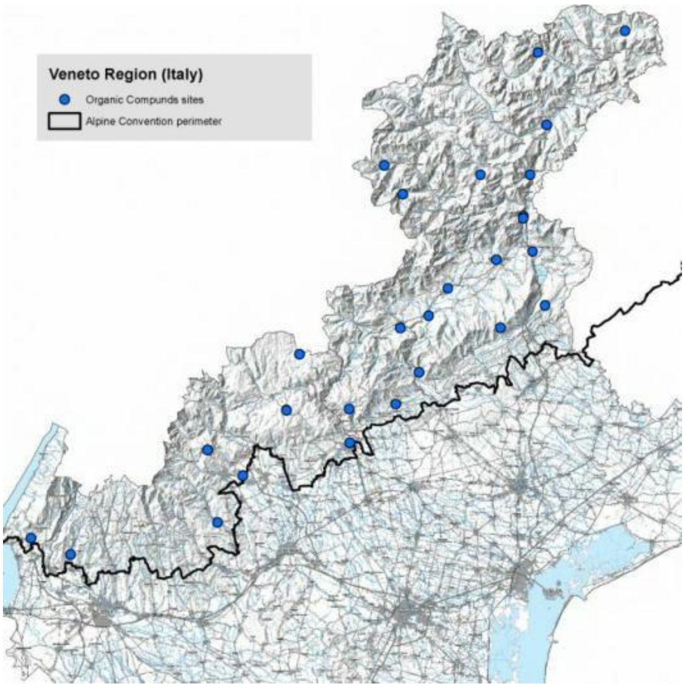
- biomass production,
- storing, filtering, transforming nutrients or water,
- platform for human activity,
- providing raw materials,

9. Land cover classes addressed by the instrument

- agricultural areas,
- forests,
- semi-natural areas,

10. Monitoring sites

Monitoring is worked out on 26 sites within the Alpine Convention territory, positioned not regularly in mountain areas (approximately one site every 20kmx20km).
An overview of sites is available on the map.



11. Parameter groups

- Site characteristics (soil type etc.)
- Soil chemistry
  - pH-value
  - Heavy metal concentrations
  - Organic compounds
- Soil carbon

12. Data availability

Site data are restricted. Report on results is available in the web. Meta information is available. Not in line with INSPIRE (national projection system).

13. Monitoring mechanisms

Organic compound monitoring has started in 2010 and the aim is to assess diffuse contamination status of soil and to collect information on impact of potential pressures, monitoring their trends over time.
Sampling: planned every 10 years.
Parameters: Dioxins, Furans (PCDD/Fs), PCBs, PAHs, together with heavy metals (Sb, As, Be, Cd, Co, Cr, Hg, Ni, Pb, Cu, Se, Sn, V, Zn).
Since no regulation at national or regional level exists and monitoring is worked out as a Regional Environmental Protection Agency initiative, there are no prefixed schemes and no harmonising with other regional initiatives.

13. Other available information

Report on organic compounds at:
https://www.arpa.veneto.it/temi-ambientali/suolo/file-e-allegati/documenti/rete-di-monitoraggio/Microinquinanti_organici_suoli_2010-2016.pdf

Comments by the assessor:

Need for assessment of heavy metal background values is due to national legislation on reuse of excavated soils and rocks: National Environmental Code of 2006 (DL n. 152/2006) and Presidential Decree DPR 120/2017. No other legal obligation exists at national/regional level to set up a soil monitoring program.

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Soil Protection Working Group

Questionnaire permanent monitoring sites

IT – ARPA-Veneto – Heavy Metals monitoring scheme

ARPAV-metalli

1. Brief description of the instrument

It is a study aimed at determining heavy metal background values, mainly analyzing soil samples collected, not on a regular grid, by soil surveys carried out on the whole regional territory.

2. Institution(s) responsible for the implementation and/or evaluation of the policy instrument

The Environmental Protection Agency of the Veneto Region (ARPAV https://www.arpa.veneto.it/) is the only institution responsible for the monitoring. There is no regulation at national or regional level, monitoring is carried out on ARPAV initiative.

3. Type of instrument

- regional monitoring systems,

4. Status of policy instrument

No policy at national or regional level

5. Territorial coverage

- regional (federal state or non-federal state)

6. Sectoral coverage

Sectors:

- cross sectoral.

7. Soil threats addressed by instrument

- contamination,

8. Soil functions addressed by instrument

- biomass production,
- storing, filtering, transforming nutrients or water,
- platform for human activity,
- providing raw materials,

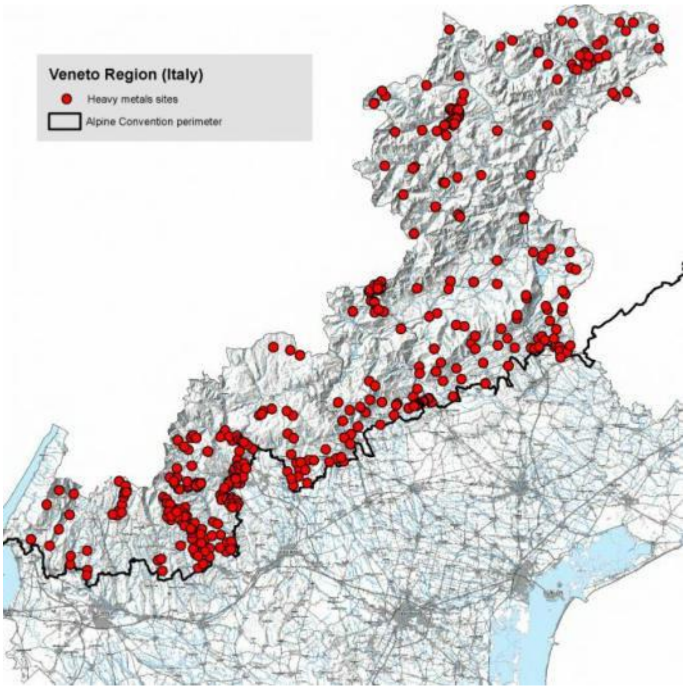
9. Land cover classes addressed by the instrument

- agricultural areas,
- forests,
- semi-natural areas,

10. Monitoring sites

Sites were selected among those described and sampled within soil surveys at 1:250,000 and 1:50,000 scale (more than 3,500 soil profiles widespread on the whole regional territory). Among these, approximately 400 sites, are within the Alpine Convention territory. Sites are not set on a regular grid, but they were chosen as representatives of described soil types, aiming at determining their heavy metal background values.

An overview of sites is available on the map.



11. Parameter groups

- Site characteristics (soil type etc.)
- Soil chemistry
  - pH-value
  - Heavy metal concentrations
- Soil carbon

12. Data availability

Site data are restricted, but areal data are available. Report available in the web. Meta information is available. Not in line with INSPIRE (national projection system).

13. Monitoring mechanisms

Within the Alpine Convention territory approximately 400 sites have been analyzed, selected among described soil profiles (in the whole region more than 3.000 soil profiles); they were selected as representative of main soil types and are aimed at determining heavy metal background values, useful for remediation and for reuse of excavated soil.
Soil profiles have been sampled since years ‘90s within soil survey regional programs. Sites are not planned to be resampled.
Parameters: Sb, As, Be, Cd, Co, Cr, Hg, Ni, Pb, Cu, Se, Sn, V, Zn.

13. Other available information

Map of background values for heavy metals are available at geoportal:
http://geomap.arpa.veneto.it/layers/geonode%3Ametmetalloidi

Report on heavy metals background values:
https://www.arpa.veneto.it/arpavinforma/pubblicazioni/metalli-e-metalloidi-nei-suoli-del-veneto-definizione-dei-valori-di-fondo.-edizione-2019

Comments by the assessor:

Need for assessment of heavy metal background values is due to national legislation on reuse of excavated soils and rocks: National Environmental Code of 2006 (DL n. 152/2006) and Presidential Decree DPR 120/2017. No other legal obligation exists at national/regional level to set up a soil monitoring program.

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Soil Protection Working Group

Questionnaire permanent monitoring sites

IT – ARPA-Veneto – Soil Biological Quality

ARPAV-QBS – Qualità Biologica del Suolo

1. Brief description of the instrument

The program is aimed at monitoring biological quality of soil by detecting microarthropods presence and their edaphic forms, following a methodology that leads to assess a soil biological quality index named QBS-ar.

2. Institution(s) responsible for the implementation and/or evaluation of the policy instrument

The Environmental Protection Agency of the Veneto Region (ARPAV https://www.arpa.veneto.it/) is the only institution responsible for the monitoring. There is no regulation at national or regional level, monitoring is carried out on ARPAV initiative.

3. Type of instrument

- regional monitoring systems,

4. Status of policy instrument

No policy at national or regional level

5. Territorial coverage

- regional (federal state or non-federal state),

6. Sectoral coverage

Sectors:

- cross sectoral.

7. Soil threats addressed by instrument

- loss of soil biodiversity,
- loss of soil organic matter,
- compaction,

8. Soil functions addressed by instrument

- biomass production,
- storing, filtering, transforming nutrients or water,
- hosting biodiversity pool,
- acting as carbon pool,

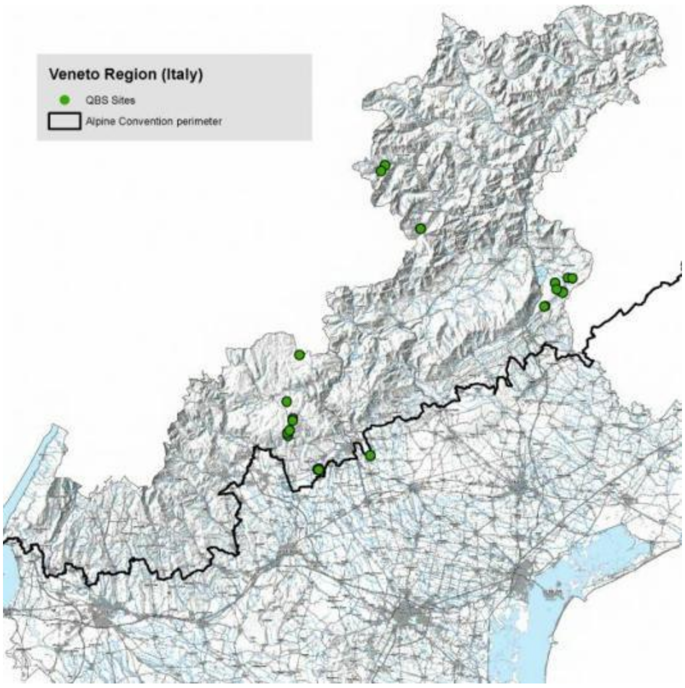
9. Land cover classes addressed by the instrument

- agricultural areas,
- forests,
- semi-natural areas,

10. Monitoring sites

Approximately 16 sites within the Alpine Convention territory, not on a regular grid, selected on the basis of great group of soil types, land use and lithology.

An overview of sites is available on the map.



11. Parameter groups

- Site characteristics (soil type etc.)
- Soil chemistry
  - pH-value
- Soil carbon
- Soil biodiversity

12. Data availability

Site data are restricted. Report on results is available on the web. Meta information is available. Not in line with INSPIRE (national projection system).

13. Monitoring mechanisms

Approximately 16 sites within the Alpine Convention territory.
Sampled yearly since 2018.
Parameters: pH, SOC, carbonates, soil texture and bulk density are measured.
QBS-ar is a methodology applied in different regions in Italy and there's a national working group for metodology harmonizing although there is no harmonized scheme among them up to now.

13. Other available information

Report on biological quality index of soils in the Veneto Region:

https://www.arpa.veneto.it/temi-ambientali/suolo/file-e-allegati/documenti/rete-di-monitoraggio/MONITORAGGIO_QBS_RISULTATI_ARPAV_2019.pdf

QBS-ar methodology description:
https://www.sciencedirect.com/science/article/abs/pii/S1470160X17307422

Comments by the assessor:

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Soil Protection Working Group

Questionnaire permanent monitoring sites

IT – ARPA- FRIULI VG – ORGANIC AND INORGANIC SUBSTANCES MONITORING SCHEME

ARPA FVG – “*indagine per la valutazione dei valori di riferimento per una o più sostanze nei suoli regionali*”

1. Brief description of the instrument

a) aim and scope of the scheme:
monitoring of inorganic and organic sustances in soils. Assessment of the background content (concentration) and values in regional soils. Possible repetition of the checks over time to evaluate the trends of the contents detected;
b) links to policy objectives and other policy instruments
National Environmental Laws of 2006 (DLgs n. 152/2006) and Presidential Decree DPR 120/2017;
c) parameters of interest of the scheme
the scheme (substantially) focuses on heavy metals (inorganic substances) and Persistent Organic Pollutants - POP’s (organic substances);

2. Institution(s) responsible for the implementation and/or evaluation of the policy instrument

The environmental protection agency of the Friuli VG Region (ARPA FVG https://www.arpa.fvg.it/) is the institution responsible for the monitoring scheme. Soil monitoring is currently not required by any national or regional regulation

However, all activities of ARPA FVG are shared with the Friuli VG Region – Direzione Centrale Difesa dell'Ambiente, Energia e Sviluppo Sostenibile (https://www.regione.fvg.it/rafvg/cms/RAFVG/ambiente-territorio/).

3. Type of instrument

regional monitoring systems,

4. Status of policy instrument

No policy instrument at the moment

5. Territorial coverage

regional

6. Sectoral coverage

cross sectoral

7. Soil threats addressed by instrument

contamination,

8. Soil functions addressed by instrument

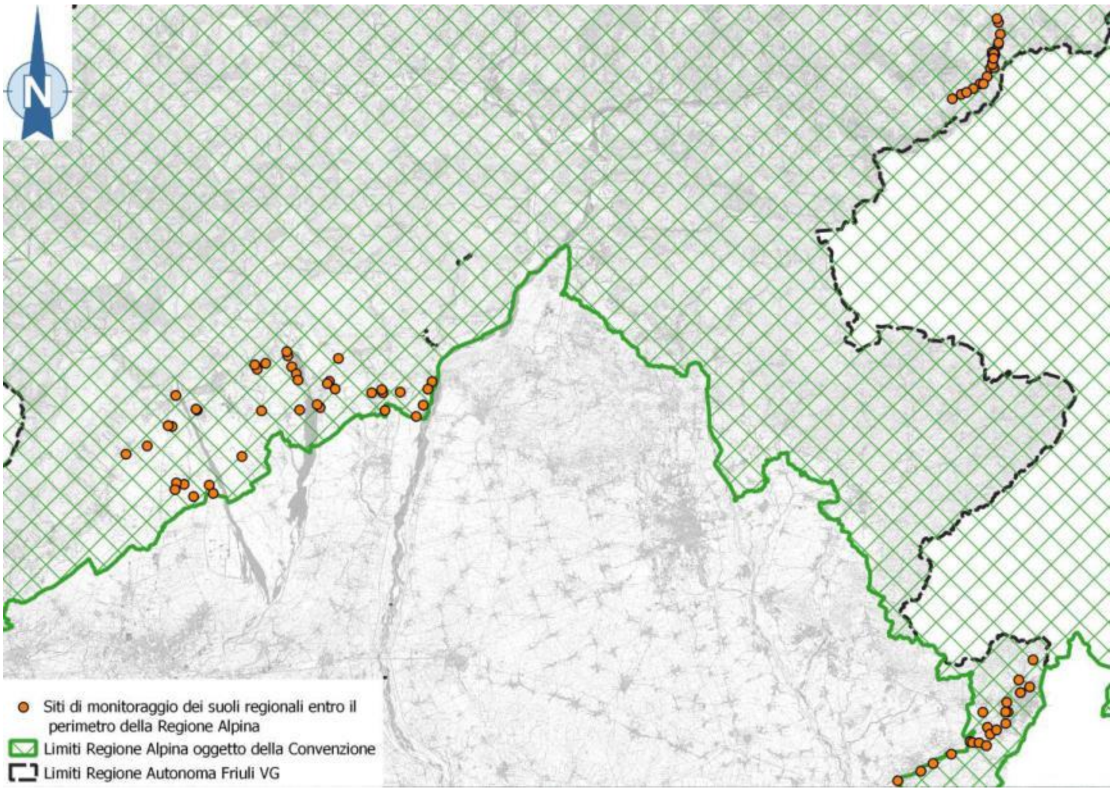
- storing, filtering, transforming nutrients or water,
- platform for human activity,
- providing raw materials,
- acting as carbon pool,

9. Land cover classes addressed by the instrument

- agricultural areas,
- forests,
- semi-natural areas.

10. Monitoring sites

Monitoring is carried out in correspondence of sites located mainly in the regional plain (now about 350 monitoring sites). Surveys were not carried out on all monitoring sites. Further monitoring sites will concern other parts of the regional territory. The assessment of the quality of regional soils is ongoing. Monitoring sites were chosen as representatives of described soil types. Monitoring sites were chosen in correspondence with public property areas. Monitoring sites are not arranged on a regular grid.
Currently there are about 80 sites among them located in the Alpine Convention territory. The current monitoring sites are shown on the next map.



11. Parameter groups

- Site characteristics (soil type etc.)
- Soil chemistry
  - pH-value
  - Heavy metal concentrations
  - Organic compounds
- Soil carbon

12. Data availability

Site data and Report are not avalaible on the web. Meta-information is currently not available. Not in in line with INSPIRE.

13. Monitoring mechanisms

Inorganic substances monitoring has started in 2016. The monitoring aims to assess the state of diffuse soil contamination and to collect information on impact of potential pressures.
Measured parameters are: Sb, As, Be, Cd, Co, Cr, Hg, Ni, Pb, Cu, Se, Sn, Tl, V, Zn, Al, Fe, Mn.
At some of the selected monitoring sites: Dioxins, Furans (PCDD/Fs), PCBs, PAHs
According to the needs and indications, (at least) some monitoring sites may be resampled.

The scheme can establish harmonised monitoring data (at least) at national level; the monitoring scheme aims to affect the entire regional territory.

13. Other available information

No link(s) to publications and to the websites which describe the monitoring mechanism. No Other links to information that is relevant and useful to illustrate the monitoring scheme and its implementation.

Comments by the assessor:

Closed-ended questions do not always include an appropriate answer.

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Soil Protection Working Group

Questionnaire permanent monitoring sites

IT – ARPA FVG – Soil Biological Quality

ARPA FVG – QBSar (Soil Biological Quality arthropod)

1. Brief description of the instrument

Pilot study on the biological quality of the soil using the QBS method. The study was aimed at verifying the biological response of the soils in areas with different intended uses envisaged in the PRGC, by monitoring the edaphic microarthropod communities. The areas of interest included SIC, ZPS, nature reserves, uncultivated areas, pastures located throughout the regional territory, including the Alpine area of Friuli Venezia Giulia Region.

2. Institution(s) responsible for the implementation and/or evaluation of the policy instrument

The Environmental Protection Agency of the Friuli Venezia Giulia Region (ARPA FVG https://www.arpa.fvg.it/) is the only institution responsible for the monitoring. There is no regulation at national or regional level, monitoring is carried out on ARPA FVG initiative.

3. Type of instrument

Please choose the type of monitoring scheme, DELETE those which do not apply.

- national monitoring systems.

4. Status of policy instrument

- in pipeline at national level.

5. Territorial coverage

- regional (federal state or non-federal state).

6. Sectoral coverage

Sectors:

- cross sectoral.

7. Soil threats addressed by instrument

- loss of soil organic matter,
- loss of soil biodiversity,
- compaction.

8. Soil functions addressed by instrument

- biomass production,
- storing, filtering, transforming nutrients or water,
- hosting biodiversity pool,
- storing geological and archeological heritage.

9. Land cover classes addressed by the instrument

- agricultural areas,
- forests,
- semi-natural areas.

10. Monitoring sites

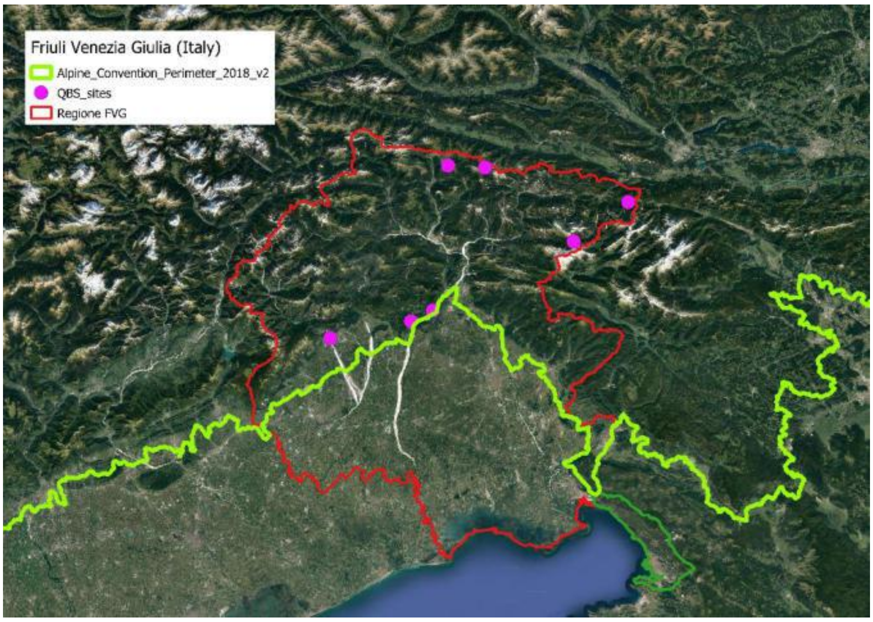
Within the perimeter of the Alpine Convention, there are about 7 monitoring sites selected on the basis of soil lithology, protected areas and land use in public areas.

Some information is given in the following table:

Site	Comune	Stratigraphic lithology unit	Land use and area procteted	WGS84/UTM zone 33N x	WGS84/UTM zone 33N y
PA001	Paularo	Storage of mixed platforms	moorland	361098	5158444
FU001	Tarvisio	Morainic deposits of the mountain sector and the morainic	moorland	398471	5149438

		amphitheatre of the Tagliamento			
SRIF	Maniago	Alluvial sediments of the mountain, plain and coastal sectors	Steady meadows	320684	5113878
LDM2	Ligosullo	Deposits of alluvial conoids passing through alluvial plain with local sabkha conditions	Alpine, ZPS	351426	5158979
PINZ	Pinzano al Tagliamento	Epibatial, deltitic and alluvial conoid deposits with lake episodes	pedemontana	341730	5118277
QB008	Forgaria nel Friuli	Recent and current ground debris	Natural reserve	347478	5118277
QB009	Chiusaforte	Morainic deposits of the mountain sector and the morainic amphitheatre of the Tagliamento	Alpine, Special protection area containing a Site of Community interest	384225	5139144

An overview of the sites is available on the map.



Will be implemented the number of monitoring sites within the perimeter of the Alpine Convention.

11. Parameter groups

- Site characteristics (soil type etc.)

- Soil chemistry
    - pH-value
- Soil biodiversity
- Climate parameters
    - Soil temperature

12. Data availability

The data are restricted. Meta information is available. It is not in line with INSPIRE.

13. Monitoring mechanisms

Among the objectives of the agency ARPA FVG is included the monitoring of soil biodiversity through the application of the QBSar method devised by Vittorio parisi (and published in 2001) for the assessment of soil biological quality in relation to the level of soil adaptation of the micro arthropod community (ar). The monitoring phase of the 7 sites started between 2018 and 2019. A monitoring frequency is expected every two years. In summary, the method includes the following steps:

- Sampling;
- Measurement of pH and soil temperature, determination of texture and bulk density;
- Extraction of arthropods;
- Determination of biological forms (FB);
- Calculation of the QBSar Index.

The method is currently not governed. It is applied by different regions on a voluntary basis. ARPA FVG is part of the national reference working group for the applications and evolution of the Biological Soil Quality Index (QBS-ar). The method has been widely applied at national level and is also attracting increasing interest at international level.

13. Other available information

Website of ARPA FVG about soil's biodiversity is under working. The only document currently available is the following:
http://www.arpa.fvg.it/export/sites/default/tema/suolo/Allegati/poster-siss-modalit-compatibilit.pdf

QBS-ar methodology description:
https://www.sciencedirect.com/science/article/abs/pii/S1470160X17307422

Comments by the assessor:

Soil Protection Working Group

Questionnaire permanent monitoring sites

FL – Soil Monitoring Network - Principality of Liechtenstein

National Name: Bodenmessnetz – Fürstentum Liechtenstein

1. Brief description of the instrument

The introduction of the Soil Monitoring Network is based on the environment protection law. The task of the soil monitoring network is to record the contamination of soil pollutants as well as soil fertility in general. Repeated sampling of the same sites is intended to identify the longer-term development of pollutant loads.
In the years 1994-96 topsoil samples were collected at 37 locations, which are distributed over the whole nation in a grid of 2 x 2 km. The sampled areas are currently used as forest, alpine pasture, grassland or arable land. Resampling took place at locations with critical loads of pollutants.

2. Institution(s) responsible for the implementation and/or evaluation of the policy instrument

The Office for Environment is responsible for the implementation and/or evaluation of the monitoring scheme (https://www.llv.li/inhalt/12298/amtsstellen/amt-fur-umwelt)

3. Type of instrument

The Soil Monitoring Network is a national monitoring system.

4. Status of policy instrument

The Soil Monitoring Network is in place since 1994.

5. Territorial coverage

The grid of the Soil Monitoring Network covers the whole nation.

6. Sectoral coverage

The Soil Monitoring Network covers the sectors agriculture and forestry.

7. Soil threats addressed by instrument

The Soil Monitoring Network addresses:

* contamination

8. Soil functions addressed by instrument

The Soil Monitoring Network addresses:

* no specific soil functions mentioned.

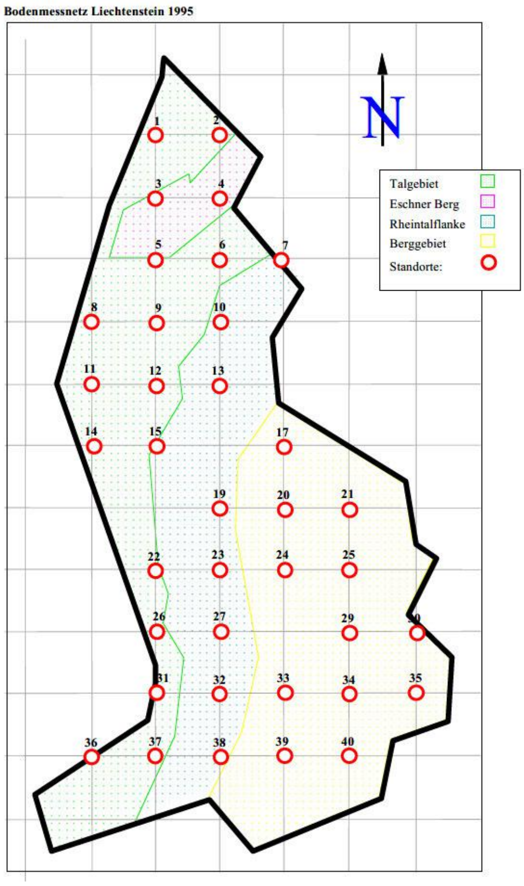
9. Land cover classes addressed by the instrument

The Soil Monitoring Network addresses:

* agricultural areas,
* forests,
* semi-natural areas,
* wetlands

10. Monitoring sites

All the monitoring sites are situated within the perimeter of the Alpine convention. They are distributed in a grid of 2 x 2 km and cover the whole nation. Therefore, the monitoring sites cover agricultural and forest areas in the lowlands, mountain area as well as in alpine regions.



11. Parameter groups

- Site characteristics (granulation)
- Soil chemistry
    - Heavy metal contamination (Cu, Ni, Cd, Zn, Pb, Hg, Co, F)
    - pH-Value
    - Soil salinity
- Soil carbon
- Phosphorous content
- Nitrogen content
- FeOxid (amorph)
- AlOxid (amorph)
- Cation exchange capacity (CEC)

12. Data availability

On request, data are freely available including meta-information. Currently, the available data is not in line with Inspire.

13. Monitoring mechanisms

After the initial sampling resampling took place just at locations with critical loads of heavy metals. The resampling was conducted to gain additional information about the source of contamination. According to the current state of knowledge, it is expected that no further systematic increase in heavy metal contamination is taking place. Thus, further sampling is planned in long term intervals.

There are indications that there are additional pollutants which should be integrated in the soil monitoring. Therefore, the office of environment is evaluating how to further develop the existing monitoring tool.

13. Other available information

There is no additional information available.

Soil Protection Working Group

Questionnaire permanent monitoring sites

Please send your feedback ***by FR, 13.09.2019*** *to vera.bornemann@alpconv.org to allow us to prepare an overview of the results for the 2nd meeting of the working group.*
When filling out this document, please do not use footnotes. If you would like to make comments, use the Comments section at the end. Please delete this instruction text and the other instructions in the document. Just keep the answers. Please copy the questionnaire as many times as needed starting with a new page for every monitoring scheme, or use separate document for every monitoring scheme you will send in.

SI – Monitoring of Negative Impacts of Air Pollution on Ecosystems - NEC Directive

National Name: Monitoring negativnih vplivov onesnaženega zraka na ekosisteme (not yet an official name)

1. Brief description of the instrument

According to Article 9 of NEC Directive 2016/2884 monitoring of impacts of air pollution on ecosystems has to be ensured. The aim of Directive is to improve human health and the condition of ecosystems across the EU. The intention is to reinforce the ecosystem monitoring network needed to determine the state of, and predict changes in, terrestrial and freshwaters ecosystems in a long-term perspective with respect to the impacts of SO_X, NO_X, NH_3, and ground level ozone (acidification, eutrophication, ozone damage or changes on biodiversity). Thus, the objective of the monitoring is to improve information on the impacts of air pollution, including the extent of any impacts and the recovery time when the impacts are reduced, and to contribute to review of critical loads and levels. The air pollution impacts of interest for the ecosystem monitoring are: acidification, eutrophication and ozone damage. While the impacts of other pollutants (e.g. metals) are also of concern, a staged approach is suggested and it is proposed that the first phase of monitoring focus on these three issues.

2. Institution(s) responsible for the implementation and/or evaluation of the policy instrument

For the implementation and/or evaluation of the monitoring scheme are responsible Ministry of the Environment and Spatial Planning (https://www.gov.si/drzavniorgani/ministrstva/ministrstvo-za-okolje-in-prostor/) and Slovenian Environment Agency (https://www.arso.gov.si/).

3. Type of instrument

- international monitoring systems,
- national monitoring systems,
- instrument with direct impact on soil.

4. Status of policy instrument

- in pipeline.

5. Territorial coverage

- national (MS level).

6. Sectoral coverage

Sectors:

- agriculture,
- forestry,
- cross sectoral.

7. Soil threats addressed by instrument

- contamination,
- loss of soil biodiversity.

8. Soil functions addressed by instrument

- storing, filtering, transforming nutrients or water,
- hosting biodiversity pool,
- no specific soil functions mentioned.

9. Land cover classes addressed by the instrument

- agricultural areas,
- forests,
- semi-natural areas,
- wetlands,
- water bodies.

10. Monitoring sites

There are three monitoring sites in the perimeter of the Alpine Convention:

1. Spodnja Krma (also site in Research of Soil Pollution in Slovenia)

Monitoring site - Spodnja Krma is located in the Krma Valley, at an altitude of 835 m. Longitude and latitude of the site are 46,4080 and 13,9286, respectively. The land use is a grassland. The soil is shallow and very humorous, making it slippery when wet. There is a small chance of wind and water erosion. Potentially, soil can only be threatened by the occurrence of torrential deposits from the eastern slopes. The soil type is rendzina on a moraine. The soil has a well-developed and humus-rich A horizon. The soil pH is slightly alkaline. The cation exchange capacity is high due to the high content of organic matter. The cation exchange capacity is also affected by the presence of carbonates in the soil. The soil is unpolluted. Despite the small total soil depth, the transport of contaminants is expected to be slow due to the high content of organic matter, which acts as a mechanical, physicochemical and biological filter.

2. Pohorje-Tratice (also monitoring site in ICP Forests, see site characteristics in questionnaire permanent monitoring sites for ICP Forests)
3. Trnovski gozd – Fondek (also monitoring site in ICP Forests, see site characteristics in questionnaire permanent monitoring sites for ICP Forests)

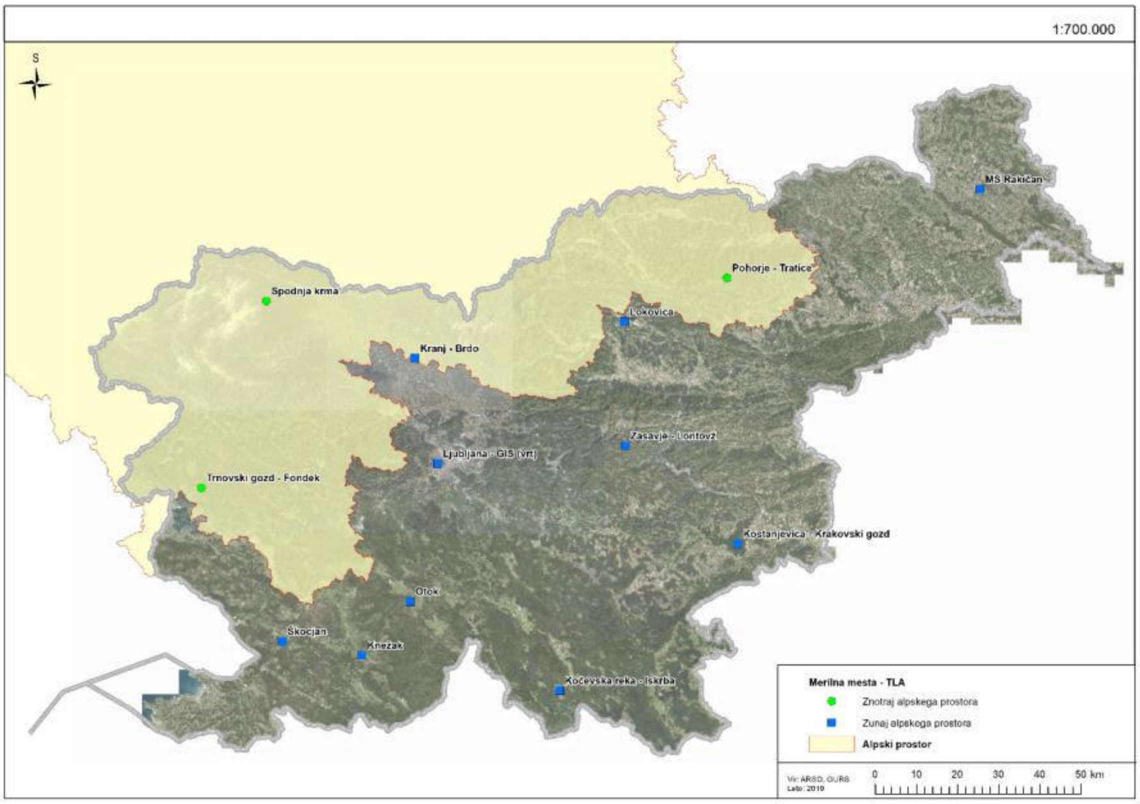


Figure 1: Spatial display of the monitoring sites in the framework of Monitoring of Negative Impacts of Air Pollution on Ecosystems - NEC Directive. The perimeter of the Alpine Convention is marked with yellow and green circle indicates that monitoring site is within this perimeter.

11. Parameter groups

- Site characteristics (soil type etc.)
- Soil chemistry
    - pH-value
    - Heavy metal concentrations
    - Organic compounds
- Soil carbon

12. Data availability

Data and meta-information are partly free available. Some data are in line with INSPIRE.

13. Monitoring mechanisms

The Monitoring of Negative Impacts of Air Pollution on Ecosystems according to Article 9 of NEC Directive 2016/2884 is based on other monitoring systems, survey and research. Thus, its monitoring sites and its soil data are selected from ICP Forest (http://icp-forests.net/) , LUCAS survey (https://esdac.jrc.ec.europa.eu/projects/lucas) and Research of Soil Pollution in Slovenia (https://publications.europa.eu/en/publication-detail/-/publication/538dee5b-dfbf-45d6-bc3c-d4b6fab3110d/prodSystem-cellar/language-en/format-PDF pages 88-95.). Therefore, some harmonisations within monitoring system is still needed.

Only relevant parameters are determent on certain monitoring site. Therefore, it is not necessary that all parameters included in monitoring system are determined at certain monitoring site. As an example, cropland is not relevant for nutrient load but is relevant for ozone damage.
Several parameters are included in the monitoring system, from which some are also related to terrestrial vegetation and freshwater ecosystem. Only soil related parameters are listed below:

- longitude and latitude to identify site location;
- ecosystem type (MAES classification), "Eunis class" Site Status (protected non-protected, unknown), Biogeographic region, elevation, slope, orientation/exposition to describe the site;
- date of profile description, soil type/soil group (WRB), soil qualifieres and specifiers (WRB), soil profile, soil horizon depths, WRB reference, parent material, effective soil depth, number of sampling layers and sampling depths, horizont number and horizont name in order to describe soil profile and soil characteristics;
- C_{tot}, C_{min} (carbonates), C_{org}, N_{tot}, C/N, pH ($CaCl_2$), CEC, Base Saturation, Ca, Mg, K, Na, Mn, P, Al_{tot}, conductivity, NH_4-N, NO_3-N, SO_4-S, DOC in order to determine soil acidity and eutrophication in soild or liquid phase.

Each parameter has its own sampling frequency (from 1 to 10 years).

The scheme helps to establish harmonised monitoring data at international and national level and encourages to coordinate it with other monitoring programmes established pursuant to Union legislation including Directive 2008/50/EC, Directive 2000/60/EC of the European Parliament and of the Council (1) and Council Directive 92/43/EEC (2) and, if appropriate, the LRTAP Convention.

13. Other available information

Ecosystem monitoring under Article 9 and Annex V of Directive 2016/2284(NECD) Draft Guidance - Version 2
https://ec.europa.eu/transparency/regexpert/index.cfm?do=groupDetail.groupDetailDoc&id=35724&no=3

Directive 2016/2284(NECD)
https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32016L2284&from=EN

Comments by the assessor: /

alpenkonvention • convention alpine
convenzione delle alpi • alpska konvencija

Soil Protection Working Group

Questionnaire permanent monitoring sites

SI–ICP Forests Level II

Intensive monitoring of forest ecosystems

1. Brief description of the instrument

The Level II intensive monitoring comprises around 500 plots all over Europe in selected forest ecosystems with the aim to clarify cause-effect relationships. At present 42 countries in Europe and beyond participate in ICP Forests.

Task Force is the highest body of ICP Forests, and it represents all participating countries. National experts are organized in Expert Panels and Working Groups, which ensure the continuous development and harmonization of the monitoring methods and contribute to data evaluations.

2. Institution(s) responsible for the implementation and/or evaluation of the policy instrument

Slovenian Forestry Institute (Gozdarski inštitut Slovenije) http://www.gozdis.si/domov/

3. Type of instrument

- international monitoring systems,
- national monitoring systems,

4. Status of policy instrument

- In place (from 2003 on),

5. Territorial coverage

- international,
- national (MS level),

6. Sectoral coverage

Sectors:

- forestry,

7. Soil threats addressed by instrument

- loss of soil organic matter,
- contamination,

8. Soil functions addressed by instrument

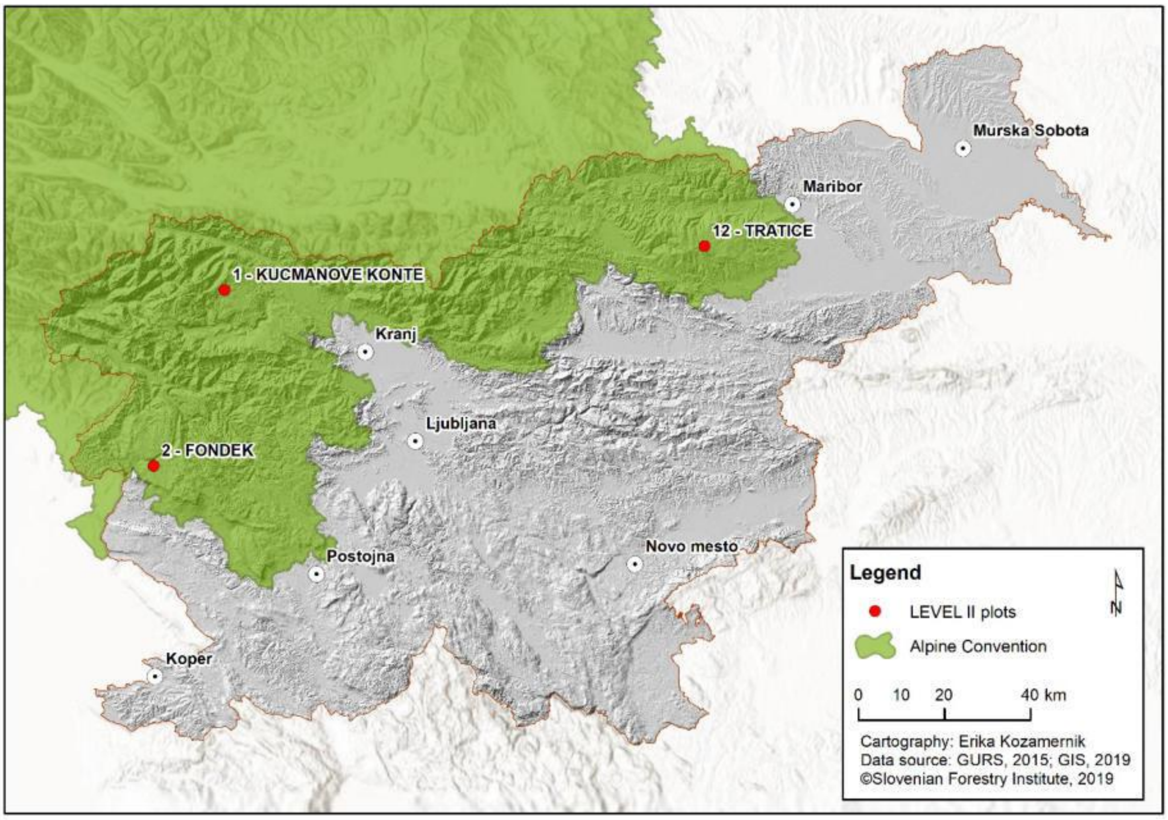
- storing, filtering, transforming nutrients or water,
- hosting biodiversity pool,
- acting as carbon pool,
- no specific soil functions mentioned.

9. Land cover classes addressed by the instrument

- forests,

10. Monitoring sites

No. of the plot	Name	latitude	longitude	m a. s. l.	age	average height	date of establish ement	main tree species	no. of tres	size of the plot (ha)
1	KRUCMANOVE KONTE	+462204	-+135636	1397	130	28	2.7.2003	*Picea abies*	227	0.25
2	FONDEK	+455955	+134416	827	80	17	1.7.2003	*Fagus sylvatica*	108	0.25
12	TRATICE	+462748	+152312	1289	80	26	7.9.2009	*Picea abies & Fagus sylvatica*	107	0.25



11. Parameter groups

- Site characteristics (soil type etc.)
- Soil chemistry
  - pH-value
  - Heavy metal concentrations
- Soil carbon
- Climate parameters

12. Data availability

Data are available via ICP Forests data base (according to ICP Forests data share policy). It is in line with INSPIRE.

13. Monitoring mechanisms

- The monitoring is under the Convention on Long-Range Transboundary Air Pollution (CLRTAP), Working Group on Effects (WGE), Integrated co-operation Programme on Forests (ICP Forests) methodology. Level II (Intensive monitoring) includes: soil survey, soil solution, forest stands (crown condition, damage, growth, yield, nutrient stock), ground vegetation, meteorological data, deposition in the open field and in the forest, ozone injuries and ozone concentration. Each survey has its own sampling frequency. It goes from 14 days (deposition, ozone concentration) to soil survey (10 years or more).

- The methodology of the soil sampling design, soil sampling performance, soil analysis, data providing, data reporting and soil samples storage are full harmonized at international level.

13. Other available information

http://icp-forests.net/
http://icp-forests.net/page/level-ii
http://icp-forests.net/page/icp-forests-manual
http://publications.jrc.ec.europa.eu/repository/bitstream/111111111/15905/1/lbna24729enc.pdf

Comments by the assessor:

In the frame of ICP Forests programme exists the intention to expand the set of soil sampling parameters: e. g. soil biodiversity, plant available phosphorous etc.

SI-ICP Forests Level I

16 × 16 km grid

1. Brief description of the instrument

The Level I monitoring is based on around 6000 observation plots on a systematic transnational grid of 16 x 16 km throughout Europe and beyond to gain insight into the geographic and temporal variations in forest condition. At present 42 countries in Europe and beyond participate in ICP Forests.

Task Force is the highest body of ICP Forests, and it represents all participating countries. National experts are organized in Expert Panels and Working Groups, which ensure the continuous development and harmonization of the monitoring methods and contribute to data evaluations.

The first survey was conducted in 1995/1996 aiming at monitoring traditional pedology parameters, as well as heavy metals. The repetition was made in 2006 in the frame of the BioSoil project.

2. Institution(s) responsible for the implementation and/or evaluation of the policy instrument

Slovenian Forestry Institute (Gozdarski inštitut Slovenije) http://www.gozdis.si/domov/

3. Type of instrument

- international monitoring systems,
- national monitoring systems,

4. Status of policy instrument

- In place (),

5. Territorial coverage

- international,
- national (MS level),

6. Sectoral coverage

Sectors:

- forestry,

7. Soil threats addressed by instrument

- loss of soil organic matter,
- contamination,
- No specific soil threats are mentioned.

8. Soil functions addressed by instrument

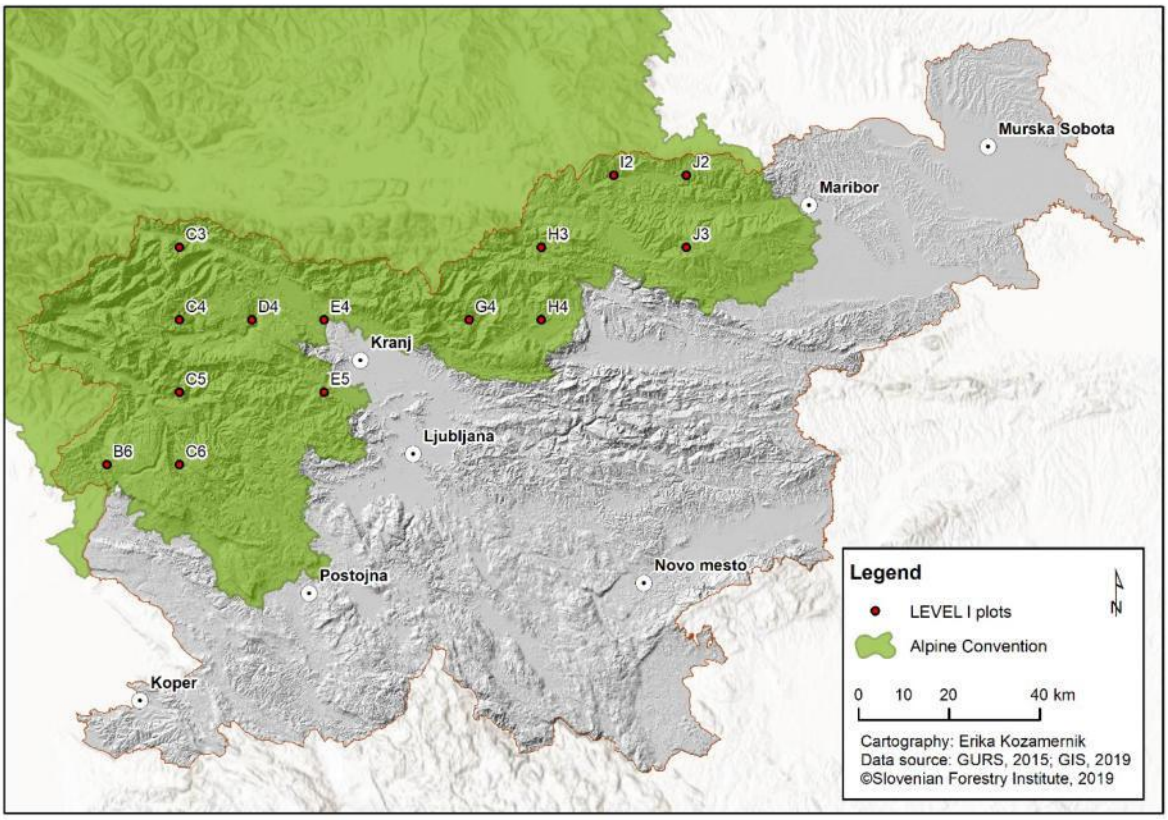
- storing, filtering, transforming nutrients or water,
- acting as carbon pool,

9. Land cover classes addressed by the instrument

- forests,

10. Monitoring sites

Plot code	Latitutde	Longitude	m a. s. l.
G4	+474950	+131000	1150
H4	+490950	+131000	430
D4	+426950	+131000	1020
C4	+410950	+131000	1460
E4	+442950	+131000	510
H3	+490950	+147000	870
I2	+506950	+163000	650
J2	+522950	+163000	535
C6	+410950	+99000	465
C3	+410950	+147000	1150
E5	+442950	+115000	550
C5	+410950	+115000	670
B6	+394950	+99000	505
J3	+522950	+147000	1300



11. Parameter groups

- Site characteristics (soil type etc.)
- Soil chemistry
    - pH-value
    - Heavy metal concentrations
- Soil carbon

12. Data availability

Data are available via ICP Forests data base (according to ICP Forests data share policy). It is in line with INSPIRE.

13. Monitoring mechanisms

- The monitoring is under the Convention on Long-Range Transboundary Air Pollution (CLRTAP), Working Group on Effects (WGE), Integrated co-operation Programme on Forests (ICP Forests) methodology. Level I include: soil survey, forest stands (crown condition, damage). Each survey has its own sampling frequency. It goes from yearly (forest stands conditions) to soil survey (10 years or more; two soil surveys were made in 1995 and 2006).

- The methodology of the soil sampling design, soil sampling performance, soil analysis, data providing, data reporting and soil samples storage are full harmonized at international level.

13. Other available information

http://icp-forests.net/
http://icp-forests.net/page/largescale-forest-condition
http://icp-forests.net/page/icp-forests-manual
http://publications.jrc.ec.europa.eu/repository/bitstream/111111111/15905/1/lbna24729enc.pdf

Comments by the assessor:

SI-8 × 8 km grid (Public Environment Service – Ministry of the Environment and Spatial Planning)

1. Brief description of the instrument

The main task of the instrument, on demand of the Ministry of the Environment and Spatial Planning, is carrying out activities related to greenhouse gas sink assessments for the field “Land use, land use change and forestry” (LULUCF) in accordance with the Rules on monitoring sinks and greenhouse gas emissions from land use, land use change and forestry.

2. Institution(s) responsible for the implementation and/or evaluation of the policy instrument

Slovenian Forestry Institute (Gozdarski inštitut Slovenije) http://www.gozdis.si/domov/

3. Type of instrument

- national monitoring systems,

4. Status of policy instrument

- In place (since 2010),

5. Territorial coverage

- national (MS level),

6. Sectoral coverage

Sectors:

- forestry,

7. Soil threats addressed by instrument

- loss of soil organic matter,
- No specific soil threats are mentioned.

8. Soil functions addressed by instrument

- storing, filtering, transforming nutrients or water,
- acting as carbon pool,

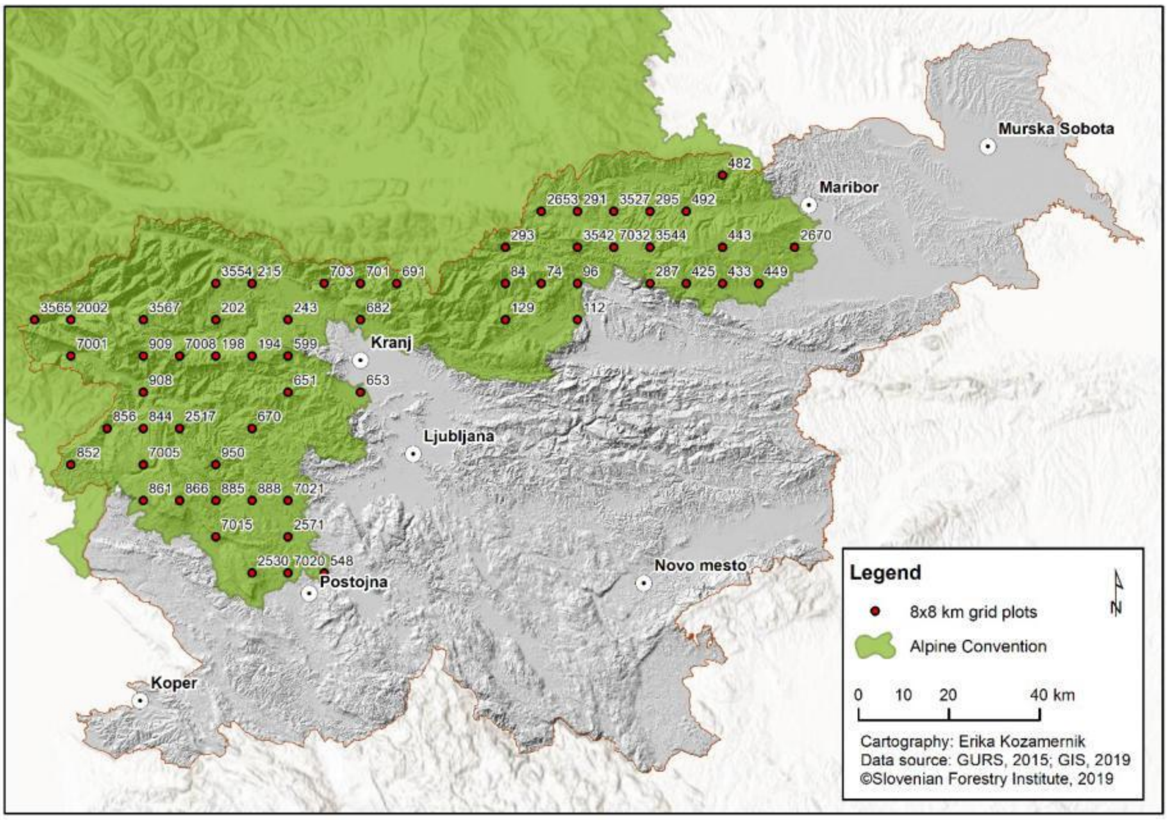
9. Land cover classes addressed by the instrument

- forests,

10. Monitoring sites

Plot code	Latitude	Longitude	m a. s. l.
KPP 74	+490950	+139000	1010
KPP 84	+482950	+139000	870
KPP 96	+498950	+139000	450
KPP 112	+498950	+131000	580
KPP 129	+482950	+131000	780
KPP 194	+426950	+123000	1480
KPP 198	+418950	+123000	1275
KPP 202	+418950	+131000	1375
KPP 215	+426950	+139000	810
KPP 243	+434950	+131000	890
KPP 287	+514950	+139000	810
KPP 291	+498950	+155000	430
KPP 293	+482950	+147000	1260
KPP 295	+514950	+155000	750
KPP 425	+522950	+139000	505
KPP 433	+530950	+139000	620
KPP 443	+530950	+147000	1300
KPP 449	+538950	+139000	400
KPP 482	+530950	+163000	675
KPP 492	+522950	+155000	555
KPP 548	+442950	+75000	590
KPP 599	+434950	+123000	740
KPP 651	+434950	+115000	1085
KPP 653	+450950	+115000	360
KPP 670	+426950	+107000	810
KPP 682	+450950	+131000	580
KPP 691	+458950	+139000	1105
KPP 701	+450950	+139000	1090
KPP 703	+442950	+139000	1030

KPP 844	+402950	+107000	765
KPP 852	+386950	+99000	240
KPP 856	+394950	+107000	320
KPP 861	+402950	+91000	700
KPP 866	+410950	+91000	1095
KPP 885	+418950	+91000	670
KPP 888	+426950	+91000	660
KPP 908	+402950	+115000	230
KPP 909	+402950	+123000	550
KPP 950	+418950	+99000	445
KPP 2002	+386950	+131000	570
KPP 2517	+410950	+107000	430
KPP 2530	+426950	+75000	1070
KPP 2571	+434950	+83000	600
KPP 2653	+490950	+155000	630
KPP 2670	+546950	+147000	450
KPP 3527	+506950	+155000	575
KPP 3542	+498950	+147000	874
KPP 3544	+514950	+147000	876
KPP 3554	+418950	+139000	1846
KPP 3565	+378950	+131000	1000
KPP 3567	+402950	+131000	1750
KPP 7001	+386950	+123000	252
KPP 7008	+410950	+123000	1719
KPP 7015	+418950	+83000	575
KPP 7020	+434950	+75000	538
KPP 7021	+434950	+91000	597
KPP 7032	+506950	+147000	500
KPP 7005	+402950	+99000	790



11. Parameter groups

- Site characteristics (soil type etc.)
- Soil chemistry
    - pH-value
- Soil carbon

12. Data availability

Are data free available or restricted? Is meta-information available? Is it in line with INSPIRE?

Data are incorporated in the NIR report under the UNFCCC and are available upon request.

13. Monitoring mechanisms

- The soil survey and monitoring mechanism is introduced for the purpose of LULUCF.

- The methodology of the soil sampling design was established for national use only. Soil sampling performance, soil analysis and soil samples storage are performed in harmonized way at international level. Data are processed and prepared for LULUCF reporting.

13. Other available information

https://unfccc.int/topics/land-use/workstreams/land-use--land-use-change-and-forestry-lulucf
https://www.gov.si/en/state-authorities/ministries/ministry-of-the-environment-and-spatial-planning/about-us/
http://icp-forests.net/page/icp-forests-manual

Comments by the assessor:

alpenkonvention • convention alpine
convenzione delle alpi • alpska konvencija

Soil Protection Working Group

Questionnaire permanent monitoring sites

CH – Swiss Soil Monitoring Network (NABO)

Nationale Bodenbeobachtung (NABO)

1. Brief description of the instrument

The National Soil Monitoring Network (NABO) records and documents the temporal development of the quality of Swiss soils based on chemical, physical and biological soil properties. Their tasks also include early detection and forecasting of changes. To do so, they operate a long-term monitoring system that monitors soils under their normal management. For this purpose, they regularly sample a monitoring network of around 110 sites spread across Switzerland. They also collect annually management and land use data at selected sites. In addition to the long-term monitoring, NABO conducts supplementary studies on current issues.

As a service, NABO offers consultation services for a diverse clientele with various needs. These services include developing recommendations for cantonal authorities, addressing specific soil-related questions of federal offices and offering technical advice to private clients. In addition, NABO regularly performs proficiency testing. These evaluations are commissioned by the federal government and conducted for interested laboratories to ensure data quality.

2. Institution(s) responsible for the implementation and/or evaluation of the policy instrument

NABO (https://www.agroscope.admin.ch/agroscope/en/home/topics/environment-resources/soil-bodies-water-nutrients/nabo.html)

3. Type of instrument

- national monitoring systems,

4. Status of policy instrument

- In place (since 1985),

5. Territorial coverage

- national (MS level),
- regional (federal state or non-federal state),

6. Sectoral coverage

Here we want to identify the sectors that the monitoring scheme covers. There may be monitoring schemes which cover a range of sectors or are on purpose cross-sectoral. However, some may target only one or two sectors. The sectoral coverage gives us an indication also of what types of drivers behind soil degradation the instrument is likely to address. The section on territorial and sectoral coverage will also help to discern whether the spatial and sectoral coverage of the instrument is limited compared to its potential. DELETE answers which are not relevant and the instructions text:

Sectors:

- cross sectoral.

7. Soil threats addressed by instrument

- No specific soil threats are mentioned.

8. Soil functions addressed by instrument

- no specific soil functions mentioned.

9. Land cover classes addressed by the instrument

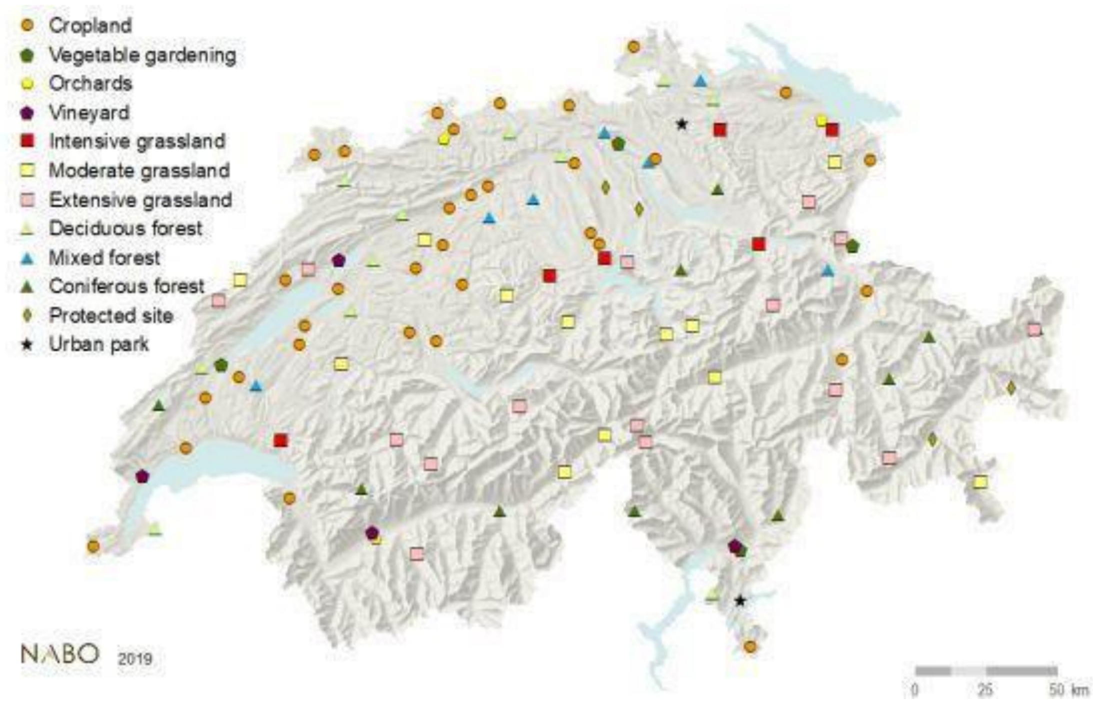
Here we identify what types of land covers are affected by the instrument. These are Corine land cover classes. The land uses in the monitoring might not correspond directly to these broad classes. DELETE not relevant ones.

- no specific land cover classes are mentioned/inferred.

10. Monitoring sites

Please list here the monitoring sites, which are in the perimeter of the Alpine Convention. List the locations, site characteristics and other relevant information as exact as possible in writing. Please include cartographic overview(s), if available.

The Swiss Soil Monitoring Network NABO assesses and documents the soil quality at 111 monitoring sites. The selected NABO sites represent a combination of land use, soil type, geology, altitude and other site properties that are typical of Switzerland. Approximately two thirds are agricultural sites (arable land, permanent grassland, special crops) and one third are located in forests.



11. Parameter groups

- Site characteristics (soil type etc.)
- Soil chemistry
    - pH-value
    - Heavy metal concentrations
    - Organic compounds
- Soil carbon
- Soil biodiversity
- Climate parameters
    - Soil temperature

12. Data availability

Access to the data is restricted, but interested parties can ask for information from the NABODAT information system. The access to all the publications is free.

13. Monitoring mechanisms

At the monitoring site, chemical, physical and biological investigations are conducted. Soil samples are collected at least every 5 years. Consequently, consistent time series over more than 30 years are available.

NABO carries out an additional indirect monitoring. Data on agricultural use will be collected for selected sites and material balances derived. Substance balancing helps to identify undesirable developments in the soil at an early stage and enables forecasts and scenarios to be drawn up. This modelling instrument serves as a precautionary tool in soil protection.

13. Other available information

NABO (https://www.agroscope.admin.ch/agroscope/en/home/topics/environment-resources/soil-bodies-water-nutrients/nabo.html)

Publications (https://www.agroscope.admin.ch/agroscope/en/home/topics/environment-resources/soil-bodies-water-nutrients/nabo/publications.html)

NABODAT Information System (https://www.nabodat.ch/index.php/de/)

Comments by the assessor:

TEMPLATE:

Country Prefix – Name of the monitoring scheme

Please replace the heading ‘country prefix – name of the monitoring scheme’ with the standard country prefix (e.g. DE, AT) and include the English name of the monitoring scheme.

National Name: Include here the name in the respective national language, and delete this instruction text.

1. Brief description of the instrument

Briefly summarize the main content of the monitoring scheme (its aim and scope, links to policy objectives and other policy instruments, which parameters it focuses on, other key information you think is relevant to understand the monitoring scheme)

Please KEEP to around 150 words.

2. Institution(s) responsible for the implementation and/or evaluation of the policy instrument

Which institutions are responsible for the implementation and/or evaluation of the monitoring scheme? Please include the names and link to their home pages, and delete the instructions text.

3. Type of instrument

Please choose the type of monitoring scheme, DELETE those which do not apply.

- international monitoring systems,
- national monitoring systems,
- regional monitoring systems,
- instrument with direct impact on soil.

4. Status of policy instrument

DELETE the answers which do not apply.

- In place (indicate how long),
- in pipeline,
- proposed.

5. Territorial coverage

DELETE not relevant answers.

- international,
- national (MS level),
- regional (federal state or non-federal state),
- sub-regional.

6. Sectoral coverage

Here we want to identify the sectors that the monitoring scheme covers. There may be monitoring schemes which cover a range of sectors or are on purpose cross-sectoral. However, some may target only one or two sectors. The sectoral coverage gives us an indication also of what types of drivers behind soil degradation the instrument is likely to address. The section on territorial and sectoral coverage will also help to discern whether the spatial and sectoral coverage of the instrument is limited compared to its potential. DELETE answers which are not relevant and the instructions text:

Sectors:

- agriculture,
- forestry,
- infrastructure,
- cross sectoral.

7. Soil threats addressed by instrument

The European Soil Thematic Strategy identifies 8 soil threats. These include: erosion, flooding and landslides, loss of soil organic matter, salinization, contamination, compaction, soil sealing and loss of soil biodiversity. Please keep the answers as they are – i.e. don't add or rewrite the answers.

Which threats are addressed **explicitly**, i.e. the monitoring scheme explicitly aims to address the threat (this is stated in its scope, objectives, or the activities and mechanisms it includes)? DELETE answers that are not relevant.

- erosion,
- flooding landslides,
- loss of soil organic matter,
- salinization,
- contamination,
- compaction,
- soil sealing,
- loss of soil biodiversity,
- No specific soil threats are mentioned.

8. Soil functions addressed by instrument

Which soil functions does the monitoring scheme address – i.e. provide support for, either explicitly or implicitly. (Explicitly means that addressing the soil function is stated in its scope, objectives, or the activities and mechanisms it includes; implicitly means that the instrument may have implications for the soil function, but this is not explicitly stated in the text). DELETE answers that are not relevant.

- biomass production,
- storing, filtering, transforming nutrients or water,
- hosting biodiversity pool,
- platform for human activity,
- providing raw materials,
- acting as carbon pool,
- storing geological and archeological heritage,
- no specific soil functions mentioned.

9. Land cover classes addressed by the instrument

Here we identify what types of land covers are affected by the instrument. These are Corine land cover classes. The land uses in the monitoring might not correspond directly to these broad classes. DELETE not relevant ones.

- artificial surfaces,
- agricultural areas,
- forests,
- semi-natural areas,
- wetlands,
- water bodies,
- no specific land cover classes are mentioned/inferred.

10. Monitoring sites

Please list here the monitoring sites, which are in the perimeter of the Alpine Convention. List the locations, site characteristics and other relevant information as exact as possible in writing. Please include cartographic overview(s), if available.

11. Parameter groups

- Site characteristics (soil type etc.)
- Soil chemistry
    - pH-value
    - Heavy metal concentrations
    - Organic compounds
- Soil carbon
- Soil biodiversity
- Soil erosion
- Climate parameters
    - Soil temperature

12. Data availability

Are data free available or restricted? Is meta-information available? Is it in line with INSPIRE?

13. Monitoring mechanisms

This section is included to provide information on monitoring mechanisms associated with different types of policy instruments (e.g. Alpine Convention, environmental or soil protection acts, or water legislation, etc). Since you are filling out information for monitoring schemes as such, you can provide here more detail on the monitoring scheme itself (going beyond the text that you provided above in section 1 'brief description of the instrument'). I.e.:

- What types of monitoring is included; what parameters (broad categories are sufficient) are measured and for what purpose, with what frequency?
- Any other aspects of the monitoring scheme that you think are very important to understand its relevance for soil protection, for example, if the scheme helps to establish harmonised monitoring data at international or national level, or on the other hand if it is a private initiative, what its limitations might be, or if it could be expanded to cover a wider area.

13. Other available information

Provide link(s) to publications and to the websites which describe the monitoring mechanism.
Other links to information that is relevant and useful to illustrate the monitoring scheme and its implementation. This could include, for example, guidance documents.

Comments by the assessor:

Here you can provide any additional comments that you might have, for example:

- If you didn't think that the closed-ended questions (those with a list of answers) included the appropriate answer for the monitoring scheme in question
- If you would like to point out a specific characteristic of the instrument that is not included in the above headings.
- If you were uncertain about a particular answer, and you would like to add a comment about it
- If, for example, the instrument is very important for a particular soil threat / function even though it only deals with it implicitly, you can also comment here.
- Any other comment that you would like to make about availability of information, the nature of the instrument or anything else to communicate to the study team

Soil Protection Working Group

Questionnaire permanent monitoring sites for international monitoring mechanisms

Content by country in alphabetical order

PDF page number

alpenkonvention • convention alpine
convenzione delle alpi • alpska konvencija

Soil Protection Working Group

Questionnaire on permanent monitoring sites for international monitoring mechanisms

AT

1. ICP Forest Programme (International Cooperative Programme on Assessment and Monitoring of Air Pollution Effects on Forests)

The International Co-operative Programme on Assessment and Monitoring of Air Pollution Effects on Forests (ICP Forests) was launched in 1985 under the Convention on Long-range Transboundary Air Pollution (Air Convention, formerly CLRTAP) of the United Nations Economic Commission for Europe (UNECE). ICP Forests monitors forest condition in Europe at two monitoring intensity levels:

The Level I monitoring is based on around 6000 observation plots on a systematic transnational grid of 16 x 16 km throughout Europe and beyond to gain insight into the geographic and temporal variations in forest condition.

The Level II intensive monitoring comprises around 500 plots in selected forest ecosystems with the aim to clarify cause-effect relationships.

At present 42 countries in Europe and beyond participate in ICP Forests.

Homepage: **http://icp-forests.net/**

1.1 Institution(s) responsible for the implementation and/or evaluation of the policy instrument

Bundesforschungszentrum für Wald (Austrian Research Centre for Forests) https://bfw.ac.at/rz/bfwcms.web?dok=1004043 (implementation, scientific evaluation);

BMLRT (Policy)

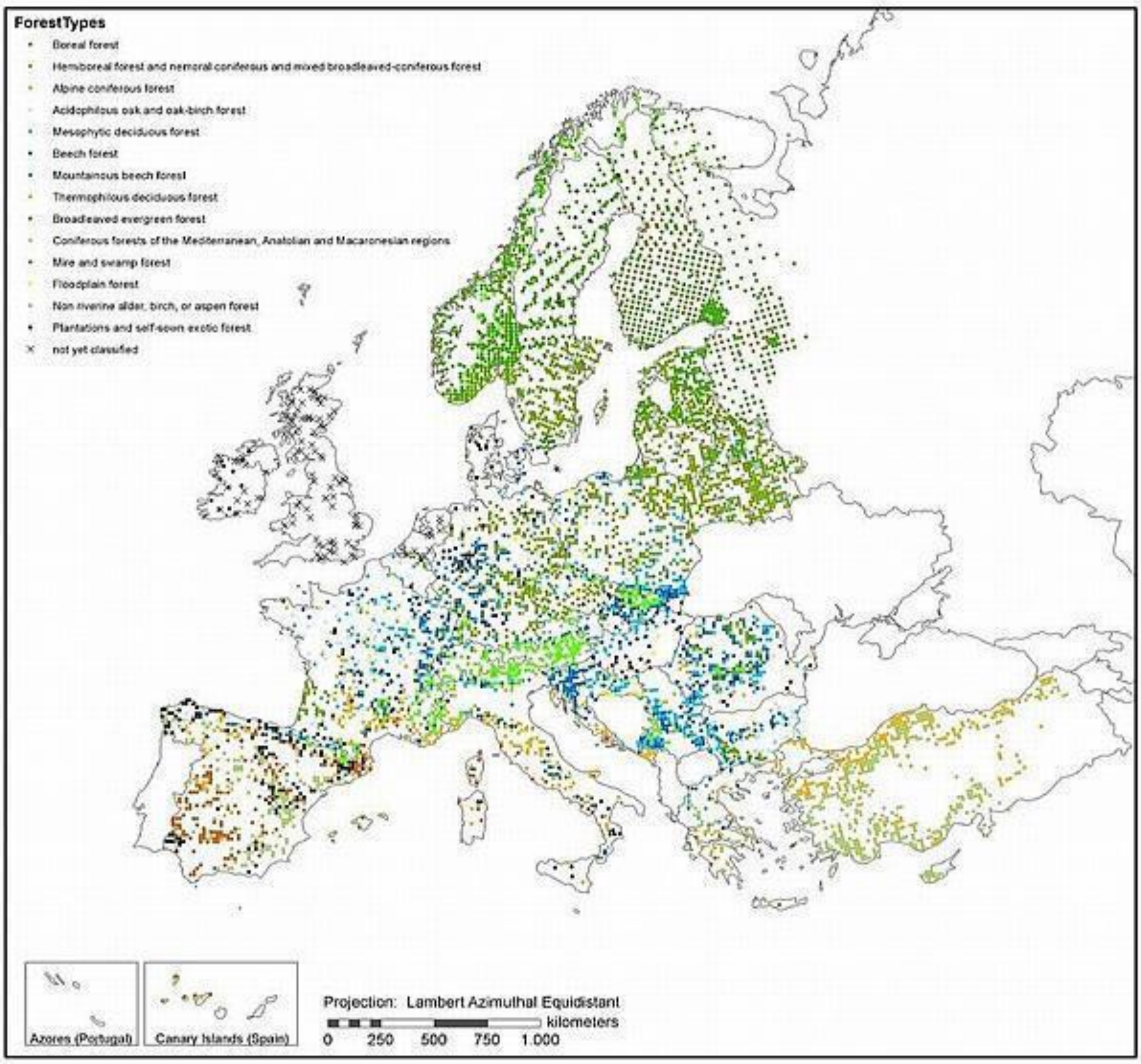
1.2 Level I monitoring sites

At Austrian level I plots two soil surveys were done (1987-1990, WBZI; 2006-2007 BioSoil Project of EU). Further information: https://op.europa.eu/en/publication-detail/-/publication/f61a8e54-5099-466b-90ce-e62a317fba4f/language-en

Plot	Number	Location Name	a.s.l. [m]	projection	easting	northing
101	703	Mattersburg	580	BMN M34	752000	284000
102	704	Rettenbach	520	BMN M34	742000	254000
201	701	Sirnitz Tschiggerhoehe	1180	BMN M31	509000	186000
201	705	Brenteralm	1680	BMN M31	493000	181000
202	704	Strassburg	1160	BMN M31	523000	200000
202	705	Zeltschach	1490	BMN M31	539000	206000
202	706	Metnitz	1260	BMN M31	512000	206000
204	750	Linsendorf	422	BMN M31	537000	159000
205	703	Lölling/ Klippitztörl	1380	BMN M31	550000	200000
205	705	Glantschach	990	BMN M31	520000	181000
206	707	Trebesing	1130	BMN M31	460000	197000
206	709	Kremsbruecke	1570	BMN M31	476000	203000
206	712	Obervellach	1540	BMN M31	432000	197000
206	713	Napplach	1100	BMN M31	443000	192000
207	705	Paternion	1600	BMN M31	460000	170000
207	710	Treffen	1090	BMN M31	487000	170000
208	702	St.Kollmann	550	BMN M31	559000	175000
208	704	Pribelsdorf	460	BMN M31	553000	164000
208	705	Globasnitz	800	BMN M31	556000	156000
301	704	Grosshollenstein	770	BMN M31	556000	294000
301	750	Sattlerhuette	440	BMN M31	559000	313000
302	702	Hernstein	420	BMN M34	736000	306000
307	703	Kleinzell	550	BMN M34	706000	316000
307	710	St. Aegyd	750	BMN M34	692000	302000
307	711	Horasek (Ramsau)	650	BMN M34	715000	318000
308	702	Aschelberg	860	BMN M34	667000	359000
310	704	Warth	500	BMN M34	735000	279000
310	707	Schwarzau Im Gebirge/ Rax	1560	BMN M34	705000	288000
310	709	Puchberg Am Schneeberg	1400	BMN M34	714000	291000
310	710	Aspang-Markt	600	BMN M34	729000	268000
311	703	Kirchberg/ Pielach	660	BMN M34	687000	320000
311	705	Probstwald	370	BMN M34	702000	332000
312	702	Mitterau\Gaming	820	BMN M34	654000	310000
312	704	Gresten	430	BMN M34	651000	318000
312	707	Neuhaus	1050	BMN M34	659000	293000
314	701	Waidmannsfeld	780	BMN M34	719000	302000
315	701	Stangau	510	BMN M34	729000	331000
315	704	Breitenfurt	400	BMN M34	737000	334000
315	705	Gablitz	420	BMN M34	735000	342000

403	708	Oberlangbath	840	BMN M31	482000	296000
403	710	Rettenbach	1260	BMN M31	476000	286000
404	701	Steyrling	870	BMN M31	501000	294000
404	702	Steyrling	680	BMN M31	509000	296000
410	703	Lumpelgraben	640	BMN M31	537000	297000
410	712	Grossraming	540	BMN M31	542000	307000
410	713	Kleinreifling	480	BMN M31	548000	291000
412	703	Mondsee	860	BMN M31	451000	305000
501	703	Abtenau	900	BMN M31	454000	269000
501	704	Russbach	1120	BMN M31	462000	272000
502	701	Weissenbach	880	BMN M31	460000	280000
502	707	Schwaighofen	680	BMN M31	435000	298000
503	704	Hoech	1340	BMN M31	451000	250000
503	706	Neuberg	1590	BMN M31	460000	252000
504	701	Ramingstein	1380	BMN M31	490000	217000
504	704	Muhr	1610	BMN M31	462000	217000
504	750	Mauterndorf	1095	BMN M31	479000	222000
505	702	Saalbach	1200	BMN M31	396000	250000
505	703	Bucheben	1340	BMN M31	424000	222000
505	707	Pichl	1290	BMN M31	410000	236000
505	708	Walchen	1420	BMN M31	399000	241000
505	710	Muehlbach	1450	BMN M31	372000	241000
505	716	Dienten	1490	BMN M31	424000	250000
601	704	Halltal	1300	BMN M34	686000	292000
601	706	Frauenberg	980	BMN M34	679000	254000
601	709	Bruck an der Mur	600	BMN M34	671000	251000
601	711	Foelz	880	BMN M34	666000	268000
601	713	Aschbach	900	BMN M34	669000	287000
602	702	Krumbach	960	BMN M34	657000	174000
604	703	Fressnitz	680	BMN M34	678000	226000
604	708	Laufnitzdorf	670	BMN M34	673000	243000
604	709	Rein	610	BMN M34	670000	224000
606	701	Lavantegg	890	BMN M31	556000	211000
606	705	Unterzeiring	1100	BMN M31	540000	233000
606	709	Pusterwald	1760	BMN M31	526000	247000
606	711	Moederbrugg	1210	BMN M31	537000	241000
609	702	Nicklasdorfgraben	960	BMN M34	662000	249000
609	706	Kraubathgraben	860	BMN M34	646000	244000
609	708	Schattenberg	1100	BMN M31	559000	258000
610	707	Landl	910	BMN M31	561000	277000
610	709	Lassing	1490	BMN M31	520000	263000
610	712	Unterhall	840	BMN M31	534000	277000
610	714	Weng	1100	BMN M31	542000	280000
611	701	Krieglach	720	BMN M34	693000	267000
612	702	Sanktmarein	1350	BMN M31	528000	211000
612	703	Oberwoelz	1330	BMN M31	523000	228000
612	704	Murau	1540	BMN M31	509000	214000
612	705	Rinegg	1460	BMN M31	515000	225000
613	702	Erlsberg	1570	BMN M31	512000	260000

613	703	Donnersbachwald	1460	BMN M31	506000	250000
613	711	Pichl	1510	BMN M31	471000	247000
613	712	Bad Mitterndorf 1	1280	BMN M31	493000	263000
613	714	Bad Mitterndorf 2	1340	BMN M31	498000	274000
614	704	Oswaldgraben	1180	BMN M34	650000	227000
614	706	Pack	960	BMN M34	647000	208000
615	701	Kathrein	730	BMN M34	692000	239000
615	705	Kaltenegg	1220	BMN M34	712000	263000
615	706	Fischbach	1380	BMN M34	696000	258000
702	703	Arzl	1490	BMN M28	183000	227000
704	702	Brixen	1120	BMN M31	366000	258000
705	703	Erl	1045	BMN M31	366000	285000
707	704	Pfaller	1300	BMN M28	169000	240000
709	703	St.Veit Im Defreggental	2080	BMN M31	385000	200000
710	701	Reutte	890	BMN M28	179000	263000
711	702	Kaunertal	1650	BMN M28	181000	208000
712	750	Fieberbrunn	1475	BMN M31	385000	255000
713	702	Gallzein	1630	BMN M28	260000	247000
713	703	Plumsbachtal	1500	BMN M28	245000	260000
713	704	Steinberg	1190	BMN M28	262000	266000
714	701	Obertilliach	1650	BMN M31	394000	175000
717	704	Zirl	940	BMN M28	216000	240000
801	702	Nenzing	1160	BMN M28	101000	224000
801	703	Nueziders	810	BMN M28	109000	227000
802	702	Au	1150	BMN M28	122000	242000
804	701	Fraxern	1420	BMN M28	103000	243000



Currently, due to access restrictions to the office, only this map is available.

1.3 Level II monitoring sites

Bundesforschungszentrum für Wald (Austrian Research Centre for Forests)
https://bfw.ac.at/rz/bfwcms.web?dok=1004043

BMLRT (Policy)

Further information: https://bfw.ac.at/rz/bfwcms.web?dok=881

Monitoring programme, core sites

Tree Crown Condition Assessment	1995	annual
Measurements of Tree Growth	1995	Every 5 years
Chemical Needle/Lea Analysis	1995	annual
Assessment of Ground Vegetation	1996	Every 5 years

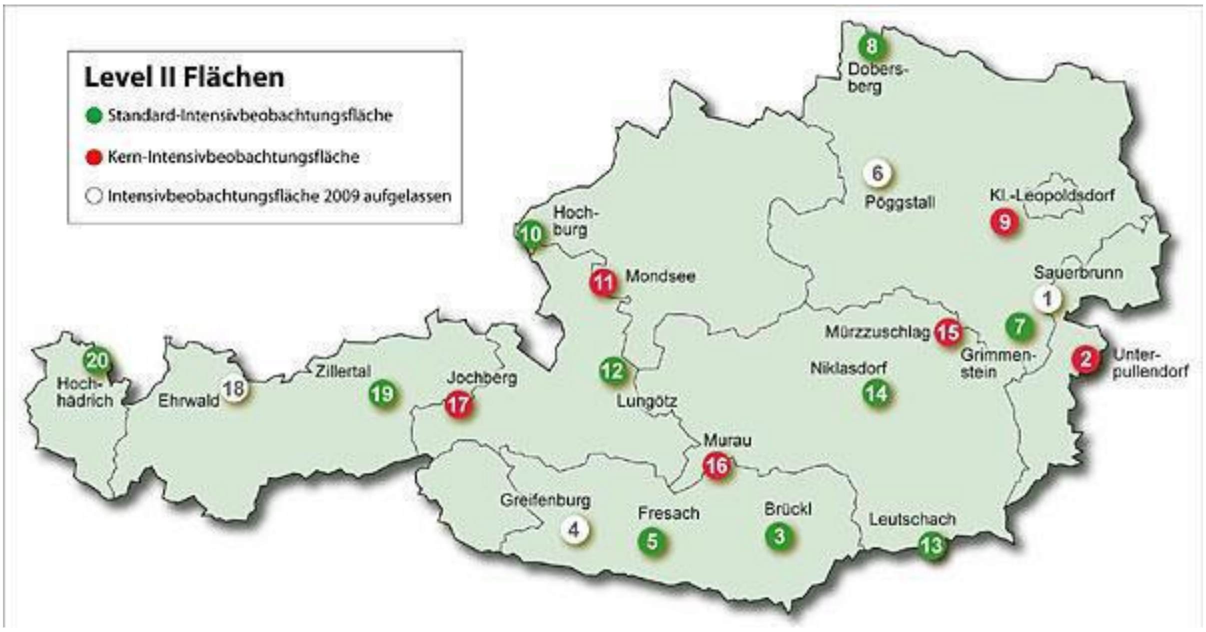
Soil Analysis (Chemical and Physical Parameters)	1996	Every 10 years
Quantitative and Chemical Analysis of Wet Precipitation	1996	Every 14 days
Measurements of Air quality (passive Sampling)	2009	Every 14 days till 2011
Litterfall, chemical analysis of litter	2009	annual
Phänologie - Beobachtung der Vegetationsentwicklung	2009	Every 14 days
Leaf Area Index	2009	annual
Chemical Analysis of Soil Water	2010	Every 14 days
Analysis on nutrients in ground vegetation	2009	singular
Measurement of soil temperature and soil moisture	2009	every15 Minutes
Meteorological measurements	2009	Every 15 Minutes
Automated dendrometer measurements	2009	hourly

Monitoring programme, regular sites

Tree Crown Condition Assessment	1995	annual
Measurements of Tree Growth	1995	Every 5 years
Chemical Needle/Lea Analysis	1995	annual
Assessment of Ground Vegetation	1996	Every 5 years
Soil Analysis (Chemical and Physical Parameters)	1996	Every 10 years
Quantitative and Chemical Analysis of Wet Precipitation	1996	Every 14 days

In bold letters: Core plots, regular letters: regular sites

PlotNbr	Location	a.s.l. [m]	projection	Easting	Northing	Main Tree Species
09	**Klausen-Leopoldsdorf**	**510**	**BMN34**	**729000**	**331000**	**Beech**
11	**Mondsee**	**860**	**BMN31**	**451000**	**305000**	**Spruce**
15	**Mürzzuschlag**	**715**	**BMN34**	**699000**	**277000**	**Spruce**
16	**Murau**	**1540**	**BMN31**	**509000**	**214000**	**Spruce**
17	**Jochberg**	**1050**	**BMN31**	**380000**	**244000**	**Spruce**
3	Brückl	930	BMN31	539000	178000	Spruce
5	Fresach	720	BMN31	476000	175000	Spruce
7	Grimmenstein	500	BMN34	735000	279000	Beech
12	Lungötz	920	BMN31	457000	261000	Spruce
13	Leutschach	670	BMN34	687000	165000	Fir
14	Niklasdorf	960	BMN34	662000	249000	Spruce
19	Zillertal	1490	BMN31	341000	250000	Spruce
20	Hochhäderich	1350	BMN28	124000	261000	Spruce



2. NEC Directive (National Emission Ceilings Directive)

Both Directive 2001/81/EC (the “old NEC-Directive”) and Directive (EU) 2016/2284 (“NEC-Directive”) have the aim to improve not only human health but also the condition of ecosystems across the EU. The Clean Air Programme for Europe includes, in addition to its target for reduction of health impacts across the Union, a target for a reduction by 35 % of the ecosystem area subjected to eutrophication by 2030, compared with 2005. In order to have the data to assess this target, member states report monitoring data in a 4-year interval, starting with 2019. The Austrian reporting regarding ecosystem monitoring under the NEC directive follows the respective guideline (https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=OJ:C:2019:092:TOC).

2.1 Institution(s) responsible for the implementation and/or evaluation of the policy instrument

Umweltbundesamt GmbH, www.umweltbundesamt.at

2.2 Monitoring sites

The Austrian monitoring sites, which are existing ICP Forests, ICP Integrated Monitoring (both CLRTAP) or WFD sites, are located in the alpine and continental biogeographic region. As such, they represent both, the mountainous situation of the Alps as well as lowland areas. The site network is located in areas exposed to high and low deposition. Please note that S deposition has very similar distribution patterns in Austria as has N deposition shown in. The terrestrial forest sites include the main Austrian tree species (*Picea abies, Fagus sylvatica, Quercus sp.*) and soils on siliceous as well as carbonate bedrock. All terrestrial sites are also part of the Austrian LTER network. Non-forest habitats are not yet included but possibilities to do so are explored in the moment. All freshwater sites are epirhithral and metarhithral, oligo- to mesotrophic streams with a nivale or a mixed nival-pluvial runoff regime.

Those sites located within the perimeter of the Alpine Convention are listed in Table 1 (15 sites out of a total of 17 NEC monitoring sites). The reported data is freely available at the EIONET portal: https://www.eionet.europa.eu/.

Table 1. Austrian NEC directive monitoring sites located within the perimeter of the Alpine Convention

Site code national	**Site name**	**Longitude**	**Latitude**	**Ecosystem type (MAES classification)**
ICP_FO_AU09	Klausen-Leopoldsdorf	16.05	48.12	Woodland and forest
ICP_FO_AU11	Mondsee	13.35	47.88	Woodland and forest
ICP_FO_AU15	Mürzzuschlag	15.66	47.63	Woodland and forest
ICP_FO_AU16	Murau	14.11	47.06	Woodland and forest
ICP_FO_AU17	Jochberg	12.41	47.33	Woodland and forest
LTER_EU_AT_003_551	Zöbelgraben	14.4441	47.8422	Rivers and lakes
LTER_EU_AT_003_IP2	Zöbelboden IP2	14.4441	47.8422	Woodland and forest
LTER_EU_AT_003_IP3	Zöbelboden IP3	14.4441	47.8422	Woodland and forest
FW21553436	Innere Wimitz	14.3078684	46.83515	Rivers and lakes
FW30900167	Vordere Tormäuer	15.2030805	47.91275	Rivers and lakes
FW40823016	Großer Bach oh. Anzenbach	14.4556134	47.84903	Rivers and lakes
FW51121257	Fuscherache bei Piffmoos	12.7974613	47.1395	Rivers and lakes
FW60800357	Preszeny-Klause	15.1526525	47.65321	Rivers and lakes
FW71510307	Innervillgraten	12.3378991	46.83012	Rivers and lakes
FW72200807	Scharnitz	11.2859235	47.38018	Rivers and lakes
FW80411046	Frutz, Bad Laterns	9.7872548	47.25813	Rivers and lakes

3. LTER Sites (Long-Term Ecosystem Research in Europe)

The core of the European Research Infrastructure eLTER RI (European Long-Term Ecosystem, Critical Zone and Socio-ecological Research Infrastructure) will be ca. 250 selected sites covering all biogeographical zones in Europe, where biological, biogeochemical, hydrological and socio-ecological data will be collected - according to common standards - and analysed. The operators of the Austrian LTER sites, which are the pool of sites available for eLTER RI, came together under the umbrella of “LTER-Austria”, LTER in Austria provides an excellent link between environmental research and environmental monitoring, which is reflected in the reciprocal and highly synergistic utilization of the sites in both sectors (e.g. UNECE ICP Forests). Further to this, there are close connections to inter- and transdisciplinary sustainability research, to applied research, and to questions of sustainable regional development (e.g. the socio-ecological research platforms “Tyrolian Alps“ and “Eisenwurzen“).

3.1 Institution(s) responsible for the implementation and/or evaluation of the policy instrument

Umweltbundesamt GmbH, www.umweltbundesamt.at

LTER Austria, www.lter-austria.at

3.2 Monitoring sites

A comprehensive description and access to metadata for LTER Austria is available at https://deims.org/network/d45c2690-dbef-4dbc-a742-26ea846edf28

4. LULUCF (Regulation on the inclusion of greenhouse gas emissions and removals from land use, land use change and forestry)

For LULUCF there is no separate Monitoring established in Austria.

Soil Protection Working Group

Questionnaire on permanent monitoring sites for international monitoring mechanisms

FR

1. ICP Forest Programme (International Cooperative Programme on Assessment and Monitoring of Air Pollution Effects on Forests)

The French extensions of the European networks for forest monitoring are the systematic network for forest health monitoring (16 x 16 km) and the RENECOFOR network respectively put into place in 1988/89 and 1992. Today, 25-30 years later, they are still operational and the base of the ICP in France.

RENECOFOR: French National network for long-term monitoring of forest ecosystems.

1.1 Institution(s) responsible for the implementation and/or evaluation of the policy instrument

Created in 1989, the Forest Health Department(DSF) is in charge of health monitoring of French forests in metropolitan France. To ensure the protection and quality of the forests, the DSF's network of foresters monitors the forests, diagnoses silvosanitary problems, and assists and advises managers and owners. It monitors the evolution and impact of forest pests and identifies any emerging problems. The DSF makes 10,000 silvosanitary observations per year. The DSF manages a monitoring, dia gnostic and phytosanitary advisory system for the forest. It relies on a network of more than 230 field foresters known as correspondent observers who work in different organizations (ONF, CNPF or decentralized services of the French Agriculture Ministry).

https://agriculture.gouv.fr/la-sante-des-forets

French Forest National Office

http://www1.onf.fr/renecofor/++oid++b6b/@@display_advise.html

French National Forest Inventory:
https://inventaireforestier.ign.fr/spip.php?rubrique74

1.2 Level I monitoring sites

The sites are based on a 16 km x 16 km systematic grid for the French forest damage systematic monitoring, managed by the DSF

1.3 Level II monitoring sites

Each observation site is 2 hectares in size and is referred to as a "plot". The network is intended to be representative of all major French forest types.

In total (France), the network is made up of 102 plots all located in public forest.Only 9 are located in the perimeter of the AC.The site description are available via the following link: http://www1.onf.fr/renecofor/sommaire/sites

2. NEC Directive (National Emission Ceilings Directive)

At the national level, the main framework document for the fight against air pollution is the air pollution emission prevention plan (PREPA), provided for in Article L. 222-9 of the Environment Code since Law No. 2015-992 of 17 August 2015 relating to the energy transition for green growth25(*).

Adopted in 2017, the PREPA consists of a decree setting the objectives for the reduction of anthropogenic pollutant emissions for the periods 2020-2024, 2025-2029 and from 203026(*), in line with the national objectives set in the aforementioned European "NEC" directive, and a decree determining the actions to be implemented or reinforced over the period 2017-2021, in order to effectively reduce these pollutant emissions.

PREPA's action program comprises 7 components, dedicated to the main emitting sectors as well as to certain cross-cutting themes: "industry", "transport and mobility", "residential-tertiary", "agriculture", "mobilization of local stakeholders", "improvement of knowledge and innovation", "sustainable financing for air quality". Each of these strands is broken down into several strands linked to different actions.

The PREPA must be reassessed every four years and updated within 18 months when the national emissions inventory or national emissions projections indicate that the objectives are not being met or suggest that they are likely to be missed.

2.1 Institution(s) responsible for the implementation and/or evaluation of the policy instrument

Local and regional authorities (implementation)

Direction départementale des territoires (implementation and evaluation)

Regional Directorates for the Environment, Planning and Housing i(mplementation and evaluation)

2.2 Monitoring sites

Impossible to be done due to the high number of sites.

3. LTER Sites (Long-Term Ecosystem Research in Europe)

Briefly summarize the main content of the monitoring scheme (its aim and scope, links to policy objectives and other policy instruments, which parameters it focuses on, other key information you think is relevant to understand the monitoring scheme)

The monitoring scheme varies in each French LTER sites. The bases of the monitoring are depending on the objectives of each Workshop Zones that are basic components of the French LTER. See the WS descriptions below.

3.1 Institution(s) responsible for the implementation and/or evaluation of the policy instrument

In France, it is the "Network of Workshop Zones" built under the aegis of the CNRS (which is the LTER correspondent) and which is also intended to be a Long Term Observation and Experimental System for Environmental Research (SOERE), labelled by the National Research Alliance for the Environment (AllEnvi). This network of workshop zones plays the role of French representative of the international Long Term Ecological Network

NWZ: Network of Workshop Zones

In direct contact with the questions of managers, politicians and associations, they share with the American LTER (Long term ecological research) and the international network (ILTER) a conceptual framework highlighting the integrative and iterative processes of socio-ecological interactions. Their themes focus on resource dynamics (water, biodiversity, etc.), land use change, the effects of climate change and land management.

3.2 Monitoring sites

All of the WZ (13 sites as of January 1, 2015) offer a diversity of contrasting situations from the point of view of environments and social systems. Each of these WZ corresponds to a geographical area on the scale of a territory characterised by a functional unit/ecosystem: watershed, agro-ecosystem, etc.

Rhône Basin Workshop Zone (ZABR)

The ZABR addresses, through different disciplines, the interactions between the river and perifluvial environment of the Rhône and the societies that develop in the catchment area.

Geographical area: Rhone catchment area

Website: http://www.zabr.org

Contact: Pierre MARMONIER, UMR 5023 Laboratoire d'Ecologie des Hydrosystèmes naturels et anthropisés and Bernard MONTUELLE, UMR CAARTEL

Moselle Basin Workshop Zone (ZAM)

The main objective of the ZAM is to acquire knowledge in order to help control the impact of human activities on the quality of water resources in Lorraine, in the Moselle catchment area.

Geographical area: Moselle catchment area

Website: http://www.ensic.inpl-nancy.fr/Zam

Contact: Emmanuelle MONTARGES-PELLETIER UMR 7360 Interdisciplinary Laboratory of Continental Environments , Marc BENOIT UR 55 ASTER , Jean-François MUNOZ, ANSES-Laboratoire d'Hydrologie de Nancy and Christophe MERLIN, UMR 7564 LCPME

Alps Workshop Zone (AWZ)

The AWZ studies the coupled dynamics of alpine ecosystems, their uses and climate on two sites that are contrasted by their natural and human conditions: the Vercors and the Oisans.

Geographical area: Alps (Vercors and Oisans)

Website: http://www.za-alpes.org

Contact: Philippe CHOLER, UMR 5553 Laboratoire d'écologie alpine (LECA) and Thomas SPIEGELBERGER, INRAE UR LESSEM

Urban Environmental Workshop Zone Strasbourg (ZAEU)

The ZAEU is an environmental observation system for urban areas in conjunction with local authorities, carrying out actions to structure research on complex issues related to natural processes and social dynamics.

Geographical area: Alsace (Bas-Rhin)

Contact: Christiane WEBER, ERL 7230 LIVE

Zone Atelier Arc Jurassien (ZAAJ)

Jura Arc Workshop Zone (ZAAJ)

The ZAAJ federates a research network on the interactions between environment, society and the dynamics of the socio-ecological systems of the Jura arc. It is particularly interested in the impacts of past and present changes in climate and landscape on populations and communities, and the relationships between environment, ecology and health.

Geographical area: Jura Arc

Website: http://zaaj.univ-fcomte.fr

Contact : Patrick GIRAUDOUX, UMR 6249 Chrono-environnement

4. LULUCF (Regulation on the inclusion of greenhouse gas emissions and removals from land use, land use change and forestry)

National plans implemented within the framework of agro-ecological policies

- Agroecological project (diversification of crop rotation, agroforestry, tillage, reduction of mineral fertilization, etc.)
- Organic Ambition Programme, support for organic farming (direct impact LULUCF limited, but mitigation of global emissions from the sector).
- Plant protein plan, development of plant crops rich in plant protein (direct impact LULUCF limited, but mitigation of global emissions from the agricultural sector)
- Provisions for controlling soil artificialisation (ALUR and LAAF laws): preservation of agricultural soils and of the storage potential for carbon
- Agroforestry development plan

National plans implemented within the framework of forest and forestry policies : Most of the policies and measures implemented and programmed for the forest-based sector have combined effects on several levers, the most important ones:

- increase the substitution of energy-intensive products by wood or wood-based products
- accentuate the substitution of fossil fuels by wood energy
- improve the production potential of the upstream forestry sector to enable it to meet the increased demand for wood.
- promote the storage of carbon in wood products, by encouraging their reuse
- increase the productive capacity of the forest and its function as a "carbon pump"
- support and develop intangible investments (studies, research)

Strategic advances are expected from the world of research to develop economic tools that will enable:

- account for and value the environmental and social services provided by agriculture and forestry,
- to take better account of the carbon content of agricultural/forest production (through life cycle analyses, in particular),
- respond to the complexity of measuring emissions (given the many biological and cultural phenomena involved),
- and to meet the need for inventories and appropriate monitoring systems.

4.1 Institution(s) responsible for the implementation and/or evaluation of the policy instrument

French Environment Ministry and French Agriculture Ministry.

Citepa contributes to the fight against atmospheric pollution and climate change by calculating, interpreting and disseminating information on reliable emission data for decision-makers and specialists in France and abroad. As a non-profit organisation and State operator for the French Environment Ministry, the Citepa meets reporting requirements for air pollutants and greenhouse gas emissions from France in different inventory formats, such as UNFCCC, EMEP, Kyoto Protocol and UNECE inventories. Our inventory reports contribute to the transparency of the effects of climate and air quality policies and measures on emissions, and assist public decision-making. It strengthens the capacities of French or foreign States, regions, cities and companies to develop and report their efforts in terms of greenhouse gas emissions and air pollutants, as well as adaptation to climate change.

https://www.citepa.org/en/data/

The French National Geographic Institute contributes to the LULUCF as an operator of the French Agriculture Ministry, more precisely on the forestry topics (the NGI includes the Forest National Inventory).

4.2 Monitoring sites

They are no real monitoring site. The LULUCF evaluation is based on the use of the Forest National Inventory (without permanent plots), of the data of agricultural statistics department, and of all the available data dealing with this thematic (e.g. Air pollution sensor disseminated along roads and in the cities).

alpenkonvention • convention alpine
convenzione delle alpi • alpska konvencija

Soil Protection Working Group

Questionnaire on permanent monitoring sites for international monitoring mechanisms

DE

1. ICP Forest Programme (International Cooperative Programme on Assessment and Monitoring of Air Pollution Effects on Forests)

Concept, scheme, parameters and metadata as well as data requests see:
ICP Forests
All countries in the alpine region participate

1.1 Institution(s) responsible for the implementation and/or evaluation of the policy instrument

International:

UN/ECE-ICP Forests (intern.): ICP Forests

ICP-Data Service: Thünen-Institut: ICP Forests

National:

BMELF (NFC of ICP Forestst,Germany): BMEL - Das forstliche Umweltmonitoring

National Data Service:

Thünen-Institut: ICP Forests

Thünen-Institut: Bodenschutz und Waldzustand

Federal:

Klima- und Ressourcenschutz in Bayern - StMELF

Federal Data Service -Implementation and Monitoring (Bavarian State Institute of Forestry, Department 2 Soil and Climate):

Umweltmonitoring

Bodeninventur und Bodendauerbeobachtung

1.2 Level I monitoring sites

International:

ICP Forests: see 1.1

EU:

Periodical assessment of forest soils 16x16 km grid according to ICP Forests: (first soil survey (Biosoil), under Forest Focus Convention (EU); no repetition up to now.

https://publications.jrc.ec.europa.eu/repository/bitstream/111111111/15905/1/lbna24729enc.pdf

Data and Metadata:

Validated soil data and metadata provided to the JRC are integrated into the Soil Profile Analytical Data Base of Europe, which is part of the European Soil Data Centre.

https://data.europa.eu/euodp/en/home

https://esdac.jrc.ec.europa.eu/

National:

Level I is a subsample of National Soil Inventory (BZE) 8x8 km grid. Third soil inventory in preparation 2022-2024

Data and Metadata, Maps: see 1.1

Federal:

Level I is a subsample of National Soil Inventory (BZE) 8x8 km grid. Third soil inventory in preparation 2022-2024

Data and Metadata, Maps: see 1.1

1.3 Level II (?) monitoring sites

Responsability and data of all regional scales see: 1.1

2. NEC Directive (National Emission Ceilings Directive)

National:

Implementation BMU, Umweltbundesamt

Nationales Luftreinhalteprogramm der Bundesrepublik Deutschland 2019 | Umweltbundesamt

Monitoringdata are used for national reporting obligations see 1.1

2.1 Institution(s) responsible for the implementation and/or evaluation of the policy instrument

See 1.1

2.2 Monitoring sites

see 1.2 and 1.3

3. LTER Sites (Long-Term Ecosystem Research in Europe)

International:

Sites & platforms — LTER in Europe

Initiative to connect monitoring sites,still in progress. Some ICP Forests Level II Sites are just integrated.

3.1 Institution(s) responsible for the implementation and/or evaluation of the policy instrument

Subset of Forest Monitoring Level II:

See national and federal responsibility 1.1

BMEL (Germany), LWF (Bavaria- not yet included)

3.2 Monitoring sites

No Federal site integrated till now.

4. LULUCF (Regulation on the inclusion of greenhouse gas emissions and removals from land use, land use change and forestry)

No Information

Soil Protection Working Group

Questionnaire on permanent monitoring sites for international monitoring mechanisms

1. ICP Forest Programme (International Cooperative Programme on Assessment and Monitoring of Air Pollution Effects on Forests)

IT – ICP Forest Programme - CON.ECO.FOR. (Controllo ecosistemi forestali)

Italy actively participates in the implementation of the ICP Forest Programme since its inception through the activation on its territory of the large-scale Level I monitoring programme and with the intensive and continuous Level II monitoring programme of forest ecosystems.
In particular, the Level II network, based on the intensive monitoring areas where most research takes place, is used to understand the interaction between air pollution, climate change and forest ecosystems. These monitoring areas are representative of the main Italian forest types (beech forest, spruce forest, Turkey oak forest, holm oak forest, plain forests, etc.), of which 24 are located in Italian mountain territory, among 700 and 1900 m altitude, and of these 10 fall within the perimeter of the Alpine Convention.
This monitoring programme is implemented within the CON.ECO.FOR network (National Network for the Control of Forest Ecosystems), established since 1995.
The detection and monitoring of natural phenomena related to the forest ecosystem are, by law, under the jurisdiction of the Carabinieri Corp (d.lgs 177/2016).

1.1 Institution(s) responsible for the implementation and/or evaluation of the policy instrument

The institution responsible of the forest monitoring national programme is Carabinieri Corp, Forestry specialty since 2016.

The field work for both networks –Level I and Level II - is carried out in the Regions with ordinary statute by CON.ECO.FOR qualified detectors of the Carabinieri Corp - Forestry specialty and, in the Autonomous Provinces and Regions, by surveyors of the Regional/Provincial Forest Corps. The data and information collected are transmitted and processed by a team of researchers from the main national research centers in the forestry sector: the National Research Center (Centro Nazionale delle Ricerche - CNR); the Universities of Florence and Camerino; the Council for Agricultural Research and Analysis of the Agricultural Economy (Consiglio per la ricerca in agricoltura e l'analisi dell'economia agraria - CREA).

The data processed by the monitoring activities are integrated into the European databases of the ICP-Forest and ICP-IM programmes of which the Studies and Projects Office of the Carabinieri Command for the Protection of Biodiversity and Parks (CUFA - Command for Forestry, Environmental and Agri-food Units) is *National Focal Center* for Italy.
(https://www.carabinieri.it/arma/oggi/organizzazione/organizzazione-per-la-tutela-forestale-ambientale-e-agroalimentare**)**.

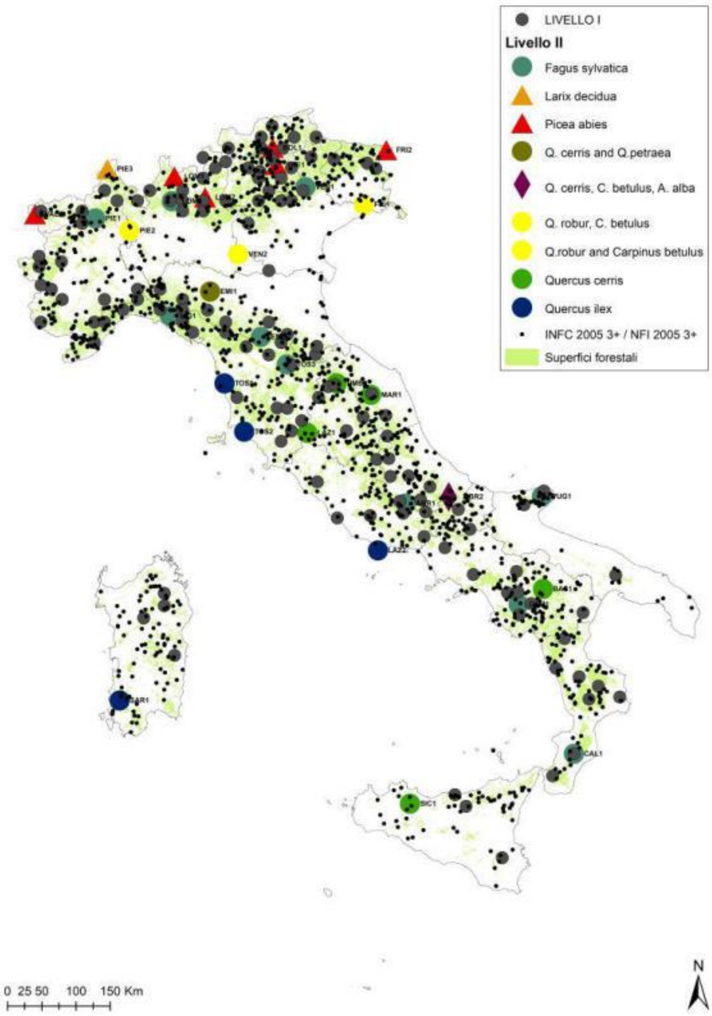
References

Papitto G., Cindolo C., Cocciufa C., Brunialti G., Frati L., Pollastrini M., Bussotti F. (a cura di), 2018. Lo stato di salute delle foreste italiane (1997 – 2017). 20 anni di monitoraggio della condizione delle chiome degli alberi. Pubblicato da Arma dei Carabinieri, Comando Unità Forestali Ambientali e Agroalimentari. Roma. Pag.205

Life+ SMART4Action – Sustainable Monitoring And Reporting To Inform Forest and Environmental Awareness and Protection. Life 13ENV/IT/000813, Final Report (2018).

1.2 Level I monitoring sites

Level I of the monitoring national network is made up of about 260 sites distributed on the national territory on the basis of a 15 x 18 km grid used as an early warning system for damage to the forest heritage. For distribution of level I monitoring sites, see the attached map.



From Life+ SMART4ACTION – Final Report 31/12/2018

1.3 Level II monitoring sites

Level II monitoring sites is composed by 31 square permanent areas, 50 m on each side, within the main types of forest ecosystems. At test areas, chemical-physical and biological measurements are carried out to study the health status of the woods through the analysis of: biodiversity, chemical composition of the leaves, tree growth, crown conditions, air composition, precipitation and liquids present in the soil. The Level II monitoring sites included in the Italian perimeter of the Alpine Convention are 10, as can be seen in the attached map.

At the end of 2018, the Life+ project Smart4Action (Sustainable Monitoring And Reporting To Inform Forest and Environmental Awareness and Protection) was completed. The project was coordinated by the Carabinieri Corps (CUFA) with support of the National Research Center, the University of Florence, the Council for Agricultural Research and Analysis of the Agricultural Economy (CREA). The project aimed at restructuring forest monitoring networks in order to reduce management costs, while continuing to guarantee the scientific correctness of the data collected. Furthermore, the project introduced citizens to sharing information on forests, through a "citizen-science" action. Therefore, at the end of the project some proposals were formulated to reduce the number of monitoring sites of both Level I and Level II or their sampling parameters.

The attached table shows a extract of the proposed reduction of the parameters to be monitored for the 10 monitoring sites of the Alpine Convention area formulated by Smart4Action Life Project at the end of 2018 . (TAB 1)

2. NEC Directive (National Emission Ceilings Directive)

IT – NEC Network (Rete NEC)

The information relating to the Italian NECD monitoring network was mostly taken from:

De Marco A., Proietti C. et al., 2019. *Impacts of air pollution on human and ecosystem health, and implications for the National Emission Ceilings Directives: Insights from Italy*. Environmental International 125. 320-333. **https://doi.org/10.1016/j.envint.2019.01.064**

Papitto G., Cindolo C., Cocciufa C., Brunialti G., Frati L., Pollastrini M., Bussotti F. (a cura di), 2018. *Lo stato di salute delle foreste italiane (1997 – 2017). 20 anni di monitoraggio della condizione delle chiome degli alberi.* Pubblicato da Arma dei Carabinieri, Comando Unità Forestali Ambientali e Agroalimentari. Roma. Pag.205.

The NEC Directive entered into force on 31th December 2016 and was implemented in Italy with the Legislative Decree 30 May 2018, n. 81. The decree for the definition of the operational aspects of the Directive and especially for the implementation of ecosystem monitoring network was issued by the Ministry of the Environment and Protection of the Territory and the Sea on 26th November 2018.

It is therefore possible to carry out the obligations required by the Directive using the manuals of the LRTAP Convention, the parameters and indicators of the ICP Forests and therefore of the ICP Forests - CON.ECO.FOR areas. Level II.
Italy is therefore activating the NEC network to monitor the impacts of atmospheric pollutants on ecosystems (terrestrial and freshwaters); as far as forests are concerned, monitoring is based on 6 areas ICP Forests - CON.ECO.FOR. Level II.

2.1 Institution(s) responsible for the implementation and/or evaluation of the policy instrument

In Italy, the Ministry for Environment, Land and Sea – General Directorate for Waste and Pollution (Division on Air, noise and electromagnetic pollution), is responsible for the NECD enforcement and for setting a National Network to monitor air pollution impacts in collaboration with research institutions and local administrations.
CUFA (Carabinieri Corp - Command for Forestry, Environmental and Agri-food Units) was called by the Ministry of Environment to provide ICP Forests field infrastructures and monitor indicators requested by the Directive. An agreement with the Ministry of Environment was signed (on December 2018) to implement a NEC Network ITALY.

2.2 Monitoring sites

The monitoring sites of terrestrial ecosystems identified by the Ministerial Decree 26 november 2018 (*DM 26 novembre 2018, Siti e criteri per l'esecuzione del monitoraggio degli impatti dell'inquinamento atmosferico sugli ecosistemi*) and falling within the Italian perimeter of the Alpine Convention have been selected below.

NECD Terrestrial Ecosystem Monitoring sites within the Italian perimeter of the Alpine Convention				
NEC Italian monitoring sites	INTERREG1	**PIE1 (CON.ECO.FOR)**	**TRE1 (CON.ECO.FOR)**	**VEN1 (CON.ECO.FOR)**
Categories of physical and chemical parameters to be monitored	Demonte/ Valloriate	Val Sessera	Passo Lavazè	Pian di Cansiglio
Solid phase		**x**		**x**
Liquid phase		**x**		**x**
Ozone and meteorology	**x**	**x**	**x**	**x**

You can see the location of the sites identified by Ministerial Decree for the NEC Directive implementation in Italy in De Marco A., Proietti C. et al., 2019, fig. 6, page 329, where 4 forest sites and 4 freshwater sites are included in the Italian perimeter of the Alpine Convention.

"The monitoring network identified for Italy contains sites distributed over the territory and will produce a high number of monitored parameters. The numbers of sites selected is not high, but the parameters monitored are in strict agreement with the list provided by the NECD. In detail, four sites sensitive to both acidification and nitrogen deposition where long-term data are collected

(ICP Waters/LTER) were identified for water bodies monitoring, all of them located in the north alpine region, because this is considered a pristine area in Italy not affected by other anthropogenic sources of air pollution, where the contribution of transboundary air pollution can be distinguished from other pressures; 6 sites for terrestrial ecosystem monitoring (ICP Forests), for both liquid and solid phases monitoring, distributed on a north to south gradient (4 sites for a latitudinal transect of Fagus sylvatica and the other two sites in the Mediterranean area characterized by Quercus petrea and Quercus cerris); 11 sites for ozone and meteorology (LIFE/INTERREG/ICP Forests), distributed in consideration of the different biogeographic areas and habitat distribution (in addition of the species listed before for terrestrial ecosystem, three typical Mediterranean species: Phyllirea latifolia, Pinus pinea and Quercus ilex)." (De Marco A., Proietti C. et al., 2019).

3. LTER Sites (Long-Term Ecosystem Research in Europe)

The vast majority of studies in the ecological literature last less than three years, and only 10% of studies capture unusual events. Through research and long-term observation of representative sites around the globe, Long-Term Ecosystem Research (LTER) enhances our understanding of the structure and functions of ecosystems, which provide essential services to people. In 1980, the United States National Science Foundation (NSF) initiated the US Long Term Ecological Research Network (US LTER) Network. The International Long Term Ecological Research Network (ILTER) was founded in 1993, to meet the growing need for global communication and collaboration among long-term ecological researchers and to capture ecological phenomena in the context of global change. LTER Europe (https://www.lter-europe.net/lter-europe) was launched in 2003 as the umbrella network for LTER in Europe. Its members are national networks operating a wide range of research and monitoring sites as well as larger platforms for socio-ecological research. Several permanent monitoring sites are located in the mountain regions, where several biotic (e.g. plant phenology, plant composition, soil microbial biomass) and abiotic factors (e.g. air temperature, soil temperature, snow cover duration) are recorded. LTER-Italy is one of the twenty-five national networks that make up the LTER-Europe Network (LTER-Europe; **www.lter-europe.net**) and it pertains to the LTER International Network (ILTER; **www.ilternet.edu/**), globally distributed.

LTER-Italy is also one of the key nodes of the E-infrastructure for Biodiversity and Ecosystem Research LifeWatch (LifeWatchItaly; www.servicecentrelifewatch.eu/home).

3.1 Institution(s) responsible for the implementation and/or evaluation of the policy instrument

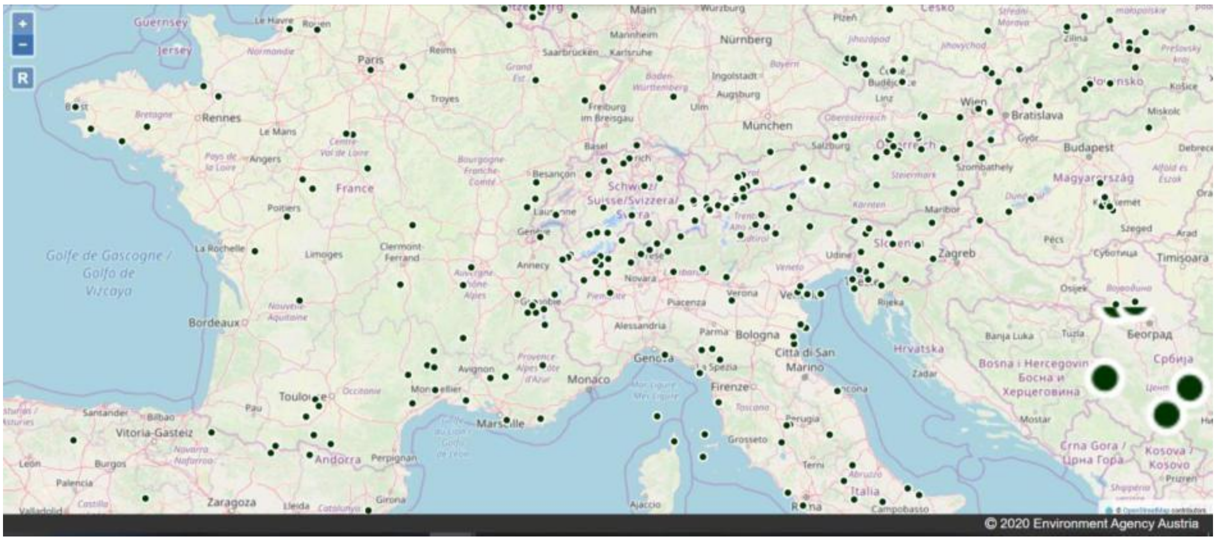
LTER-Italy is one of the twenty-five national networks that make up the LTER-Europe Network (LTER-Europe; www.lter-europe.net) and it pertains to the LTER International Network (ILTER; www.ilternet.edu/). Each network is separately governed through scientific institutions (e.g. Universities, National Research Councils), but, through their involvement in LTER-Europe, they strive to work together.

The bodies of LTER-Europe are: (information from: https://www.lter-europe.net/lter-europe/about/organisation/formalisation-and-bodies):

1. Chair and Vice-chair
2. Executive Committee (EC), consisting of chair, vice chair, expert panel leads
3. Co-ordinating Committee (CC), consisting of representatives of the formal national LTER networks
4. National Networks Representatives Conference (NNRC), consisting of representatives of formal and emerging national networks.
5. Scientific Site Co-ordinators Conference (SSCC), consisting of all scientific LTER Site co-ordinators and LTSER Platform managers
6. Expert panels (EP) on:
   - Science Strategy
   - Information Management
   - Long-Term Socio-Ecological Research Platforms
   - Site Management
   - Harmonization and Standardization
   - Communication
   - Technology

3.2 Monitoring sites

DEIMS-SDR (Dynamic Ecological Information Management System - Site and dataset registry) is an LTER information management system that allows you to discover long-term ecosystem research sites around the globe, along with the data gathered at those sites and the people and networks associated with them. DEIMS-SDR describes a wide range of sites, providing a wealth of information, including each site’s location, ecosystems, facilities, parameters measured and research themes. It is also possible to access a growing number of datasets and data products associated with the sites.
In the figure below a screenshot from the DEIMS web site shows the LTER research sites in Europe, with a focus on the Alpine Convention area. These sites include terrestrial and freshwater sites.



LTER Italy (http://www.lteritalia.it/), for example, included 25 macro-sites (Each macro-site, representative of terrestrial, freshwater and marine ecosystems, includes different research sites), among them 4 terrestrial macro-sites are located in the Alps, including 16 research sites. In the table below are reported the main characteristics of the 4 macro-sites and related research sites, with a focus on the soil parameters measured in the sites.

Macro-sites (parent sites)	Research sites	Location	Main Institutions	Main Soil Parameters
IT 02 Foreste delle Alpi	Renon BOL1	Provincia Autonoma Bolzano	CONECOFOR	Soil and soil solution chemistry
	Passo Lavazè TRE1	Provincia Autonoma Trento	CONECOFOR	Soil and soil solution chemistry
	Tarvisio FRI2	Friuli Venezia Giulia	CONECOFOR	Soil and soil solution chemistry
	Valbona	Provincia Autonoma Trento	Università di Torino	
	Val Masino LOM1	Lombardia	CONECOFOR	Soil and soil solution chemistry
IT 19 Alpi Nord Occidentali	Mosso	Piemonte/Valle d'Aosta	Università di Torino	Soil temperature, soil C and N cycling, paleosols
	Tronchaney	Valle d'Aosta	ARPA – Valle d'Aosta	Soil temperature, gas fluxes
	Tellinod	Valle d'Aosta	ARPA – Valle d'Aosta	Soil temperature, gas fluxes
	Mont Avic	Valle d'Aosta	ARPA – Valle d'Aosta	Soil temperature, organic matter mineralization rates
	Cime Bianche	Valle d'Aosta	ARPA – Valle d'Aosta	Soil temperature, organic matter mineralization rates
	Mont Mars	Valle d'Aosta	Università di Torino	Soil temperature, soil C and N cycling
IT 23 Parco Nazionale Gran Paradiso	Parco Nazionale Gran Paradiso	Piemonte/Valle d'Aosta	Parco Gran Paradiso, CNR	Soil forming processes, soil gas fluxes
IT 25 Val di Mazia	Monteschino	Provincia Autonoma Bolzano	EURAC	Soil gas fluxes
	Bacino Idrografico Rio Saldura	Provincia Autonoma Bolzano	EURAC	Soil forming processes
	Rio Saldura	Provincia Autonoma Bolzano	EURAC	
	Area Proglaciale Mazia	Provincia Autonoma Bolzano	EURAC	Soil forming processes

4. IT - LULUCF (Regulation on the inclusion of greenhouse gas emissions and removals from land use, land use change and forestry)

The LULUCF monitoring system, part of part of National Greenhouse Gas Inventory System in Italy, is aimed to consistently represent national land area, broken down the IPCC categories (i.e. forest land, cropland, grassland, wetlands, settlements, other land) in order to produce accurate estimates of LULUCF emissions by source and removals by sinks. The consistent land representation is achieved on the basis of the National Land-Use Inventory (IUTI) data. Annual data for afforestation/reforestation areas are estimated from the forest area increase as detected by the National Forest Inventories. In addition, for cropland and grassland categories, detailed information on management practices, as included in Rural Development Plans under Common Agriculture Policy (CAP) are used. The same datasets are used for estimate emission projections for LULUCF categories, officially reported under Article 3(2) of the Monitoring Mechanism Decision (Commission Decision 280/2004/EC).

4.1 Institution(s) responsible for the implementation and/or evaluation of the policy instrument

According the Legislative Decree 51/2008, the Institute for Environmental Protection and Research (ISPRA) is the single entity in charge of the development and compilation of the national greenhouse gas emission inventory; in this framework ISPRA is also responsible for LULUCF monitoring system (i.e. collection and processing of activity data; selection of appropriate emission factors and estimating methodologies; reporting and quality management activities; archiving of the inventory results). ISPRA is also responsible of the National system for policies, measures and emissions projections, and, in cooperation with the Ministry of Environment Land and Sea (MATTM), collects all the information and data from the competent Ministries. The Italian Atmospheric Emission Inventory and the Italian Greenhouse Gas Inventory are compiled and maintained by ISPRA and reported under the United Nations Convention on Climate Change (UNFCCC) and the Convention on Long Range Transboundary Air Pollution (UNECE/CRLTAP).

4.2 Monitoring sites

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5. Further international monitoring system relevant for soil monitoring in the perimeter of the Alpine Convention

IT - ICOS NETWORK (https://www.icos-cp.eu/)

The network of ICOS Ecosystem stations is an instrumentation setup, usually on a tower, that measures the fluxes of greenhouse gases, as well as living and non-living components and drivers responsible for the exchange of greenhouse gases, water and energy between ecosystems and the atmosphere. Ecosystems typically consist of different types of forests, wetlands, croplands, grasslands, agricultural areas, heatlands, lakes or cities. The location of a station represents the local surface where soil, vegetation and environmental conditions differ. It is important to observe greenhouse gases in a variety of ecosystems in order to know how they react in a changing climate.

1.1 Institution(s) responsible for the implementation and/or evaluation of the policy instrument

Climate Change Unit, Environmental Protection Agency of Aosta Valley

www.arpa.vda.it

1.2 Monitoring sites

IT-Tor

https://www.icos-italy.it/network/torgnon.pdf

http://www.icos-etc.eu/home/site-details?id=IT-Tor

PI: Edoardo Cremonese

IT-Tor site is located in an unmanaged subalpine grassland in the north-western European Alps (Torgnon, Aosta Valley, Italy) at an elevation of 2160 m asl (45.84444, 7.578055). The site is characterized by an alpine climate with strong seasonality. The mean annual temperature is 3.1 ◦ C and mean annual precipitation is about 880 mm, however, growing season cumulative precipitation can show huge variations (from 160 to 630 mm). On average, the site is covered by a thick snow mantle (90-120 cm) from the end of October to late April or early May, which limits the growing season length to four-five months. Vegetation is mainly composed of matgrass (Nardus stricta) with other graminoids and forbs as co-dominant species. The peak value of leaf area index (LAI) is on average 2.2 m 2 m 2 and the maximum canopy height is 0.2 m. A weather station provides 30-min records of the main meteorological variables 1(e.g. air and soil temperature, soil water content, soil heat flux, net radiation, photosynthetically active radiation, snow height, precipitation, ...). Turbulent fluxes, sensible, and latent heat are measured using the eddy covariance technique. Precipitation is measured with OTT-Pluvio2 sensor and since 2014 SWE data are collected by Campbell Scientific CS725 sensor. On average monthly (Dec-Apr) snow density data are collected in snow pits.

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Questionnaire on permanent monitoring sites for international monitoring mechanisms

FL

1. ICP Forest Programme (International Cooperative Programme on Assessment and Monitoring of Air Pollution Effects on Forests)

Currently, no monitoring sites are determined and no monitoring is carried out.

1.1 Institution(s) responsible for the implementation and/or evaluation of the policy instrument

Office of Environment, Gerberweg 5, Postfach 684, LI-9490 Vaduz, info.au@llv.li

1.2 Level I monitoring sites

Currently, no monitoring sites are determined and no monitoring is carried out.

1.3 Level I monitoring sites

Currently, no monitoring sites are determined and no monitoring is carried out.

2. NEC Directive (National Emission Ceilings Directive)

Air quality and compliance with threshold values for human health and environmental protection is monitored in cooperation with the monitoring network of the east Swiss cantonal network of east Switzerland 'OSTLUFT'. Threshold immission values for human health and environmental protection and emission limits for energy production, industry, agriculture, traffic, combustion and power fuel, and domestic heating are defined in the national clean air act and further developed in the national air quality action plan.

2.1 Institution(s) responsible for the implementation and/or evaluation of the policy instrument

Office of Environment, Gerberweg 5, Postfach 684, LI-9490 Vaduz, info.au@llv.li https://www.llv.li/inhalt/12556/amtsstellen/luftqualitatsuberwachung

2.2 Monitoring sites

Within the OSTLUFT monitoring network there is one permanent online monitoring station for air quality (including NO_x, O_3, PM10 and PM2.5) in Vaduz, Liechtenstein. Additional online measurements of PM10 and NO_x are performed with a mobile station to focus on specific questions and/or hot spots. Passive sampler spread across the country to monitor NO_2, NH_3 and BTEX (Benzol, Toluol, Ethylbenzol and Xylole). Locations and measurement data are available online: www.ostluft.li.

3. LTER Sites (Long-Term Ecosystem Research in Europe)

The survey of the population and development of plant and animal species in Liechtenstein is currently being conducted within the framework of natural history research in the country. Animal and plant species are surveyed at irregular intervals throughout the country and the results are compared with those from previous surveys. From this, trends can be derived and red lists drawn up. For example, breeding birds were surveyed in 1985 (Volume 5), 2006 (Volume 22) and 2019 (Volume 31). Analogous, repeated surveys exist for fish and crustaceans, amphibians, reptiles, mammals and vascular plants.
In addition to these general and nationwide surveys, specific investigations are also carried out for certain areas such as the “Ruggeller Riet” nature reserve.

3.1 Institution(s) responsible for the implementation and/or evaluation of the policy instrument

Office of Environment, Gerberweg 5, Postfach 684, LI-9490 Vaduz, info.au@llv.li

https://www.llv.li/inhalt/112166/amtsstellen/naturkundliche-forschung

3.2 Monitoring sites

As already mentioned, species monitoring is basically spread across the whole country. However, certain areas, such as nature reserves, are looked at more closely within this monitoring, or there are even specific monitoring programmes for certain species or issues in these areas.
The location of these nature reserves can be found in the public geodata portal:
https://geodaten.llv.li/geoportal/naturlandschaft.html

4. LULUCF (Regulation on the inclusion of greenhouse gas emissions and removals from land use, land use change and forestry)

LULUCF is one sector of the national greenhouse gas inventory and is reported under the UNFCCC and the Kyoto Protocol. There is no LULUCF policy instrument established in Liechtenstein. Spatial planning is still under review.
There is a list of related policies available at:
https://www.gesetze.li/konso/suche?search_text=wald&search_loc=titel&lrnr=&lgblid_von=&observe_date=24.04.2018

https://www.gesetze.li/konso/2009044000?search_text=baugesetz&search_loc=titel&lrnr=&lgblid_von=&observe_date=24.04.2018

https://www.gesetze.li/konso/suche?search_text=bauland&search_loc=titel&lrnr=&lgblid_von=&observe_date=24.04.2018

4.1 Institution(s) responsible for the implementation and/or evaluation of the policy instrument

Office of Construction and Infrastructure
https://www.llv.li/inhalt/113213/amtsstellen/landesrichtplan

Office of Environment

www.au.llv.li

4.2 Monitoring sites

Not applicable.

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Soil Protection Working Group

Questionnaire on permanent monitoring sites for international monitoring mechanisms

SL

1. ICP Forest Programme (International Cooperative Programme on Assessment and Monitoring of Air Pollution Effects on Forests)

Answered in 1st questionnaire

2. NEC Directive (National Emission Ceilings Directive)

Answered in 1st questionnaire

3. LTER Sites (Long-Term Ecosystem Research in Europe)

eLTER RI is a pan-European Research Infrastructure which has been built on the basis of existing national investments over several decades in the context of dedicated networks and ecosystem, critical zone and socio-ecological research projects. LTER Slovenia is a network of eight institutions engaged in a long-term, site-based ecological and socioeconomic research since 2003. LTER Slovenia geographically covers wide spectrum of monitoring sites, from which are two cave systems, 11 forest platforms, two lakes and one marine site. Depending on the physical characteristics of the LTER site, several ecological and biodiversity data are measured. Parameters are monitored in the air, water, soil, and vegetation. All of them for a separate site can be found on the official data base web address:
https://deims.org/search/sites?field_country_value%5B%5D=SI

3.1 Institution(s) responsible for the implementation and/or evaluation of the policy instrument

Members of LTER Slovenian Consortium are:

• **Research Centre of the Slovenian Academy of Sciences and Arts** (national coordinator and headquarter): https://www.zrc-sazu.si

• **National Institute of Biology – Marine Biology Station Piran**: https://www.nib.si

• **Slovenian Forestry Institute**: http://en.gozdis.si

• **University of Ljubljana – Biotechnical Faculty**: https://www.uni-lj.si

• **University of Nova Gorica**: http://www.ung.si

• **Škocjan Caves Park Public Service Agency, Slovenia**: https://www.park-skocjanske-jame.si

• **Slovenian Museum of Natural History**: https://www.pms-lj.si

• **Society for Cave Biology - Tular Cave Laboratory**: https://www.tular.si

3.2 Monitoring sites

Monitoring sites (https://deims.org/search/sites?field_country_value%5B%5D=SI) are:

Borovec
Brdo
Cerknica Lake
Fondek (in the perimeter of the Alpine Convention)
Gameljne
Gropajski bori
Gulf of Trieste
Krakovski gozd
Lake Bohinj (in the perimeter of the Alpine Convention)
Lontovž
Murska šuma
Podgorski Kras
Pokljuka (in the perimeter of the Alpine Convention)
Postojna-Planina Cave System
Škocjan Caves
Tratice (in the perimeter of the Alpine Convention)

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Soil Protection Working Group

Questionnaire on permanent monitoring sites for international monitoring mechanisms

CH

1. ICP Forest Programme (International Cooperative Programme on Assessment and Monitoring of Air Pollution Effects on Forests)

Long-term Forest Ecosystem Research (LWF)

The Long-term Forest Ecosystem Research (LWF) follows multiple objectives by gathering data through 19 monitoring sites that are scattered across Switzerland. Its objectives are:

- Early detection and a representative assessment of changes in forest condition
- Determination of external influences, both from anthropogenic and natural sources and their effect on the forest ecosystem (element inputs, climate)
- Determination of changes in important components within the forest ecosystem
- Development of indicators to assess the condition of the forest
- Integrated risk assessment based on different stress scenarios
- Extended platform for internal and external research projects

The monitoring sites are all part of the ICP Forests Network.

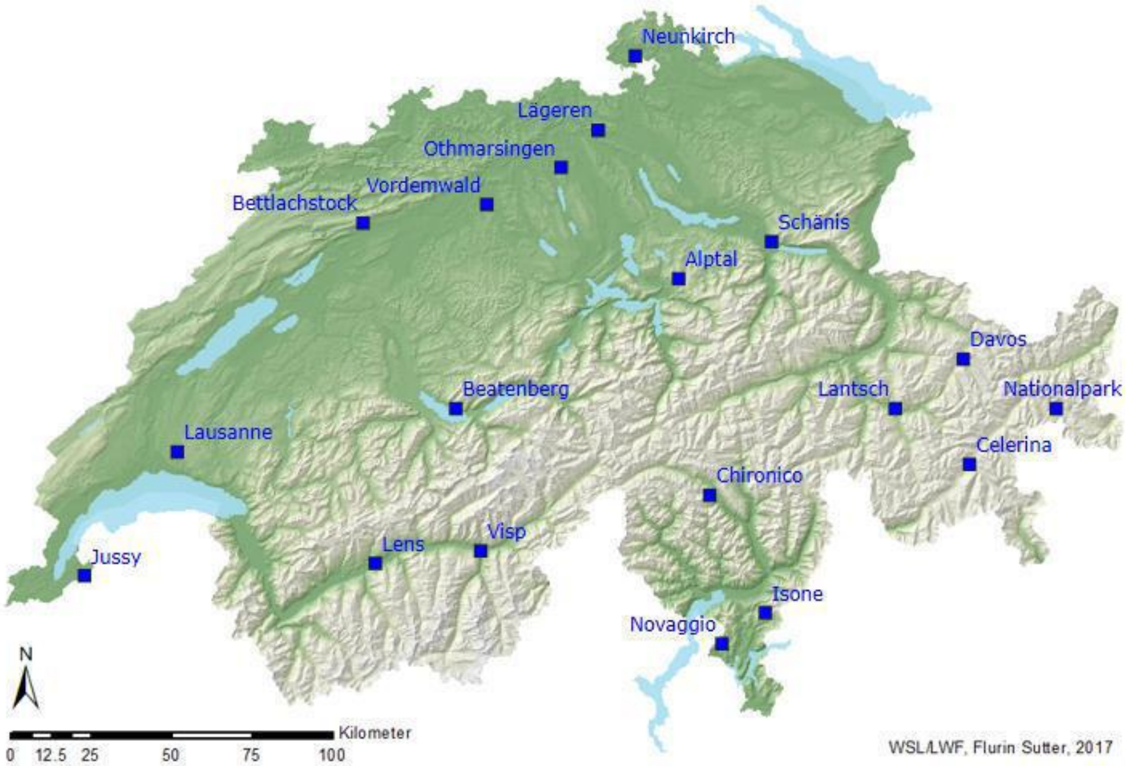
1.1 Institution(s) responsible for the implementation and/or evaluation of the policy instrument

The LWF-Programe is run and financed by the Swiss Federal Institute for Forest, Snow and Landscape Research (WSL) (https://www.wsl.ch/en/index.html).

1.2 Level I monitoring sites

-

1.3 Level II monitoring sites



There are 19 Long-term Forest Ecosystem Research (LWF) sites, which are part of the ICP Forests Network. The LWF Sites within the AC-perimeter are:

- Beatenberg
- Alptal
- Schänis
- Lens
- Visp
- Chironico
- Lantsch
- Davos
- Novaggio
- Isone
- Nationalpark
- Celerina

2. NEC Directive (National Emission Ceilings Directive)

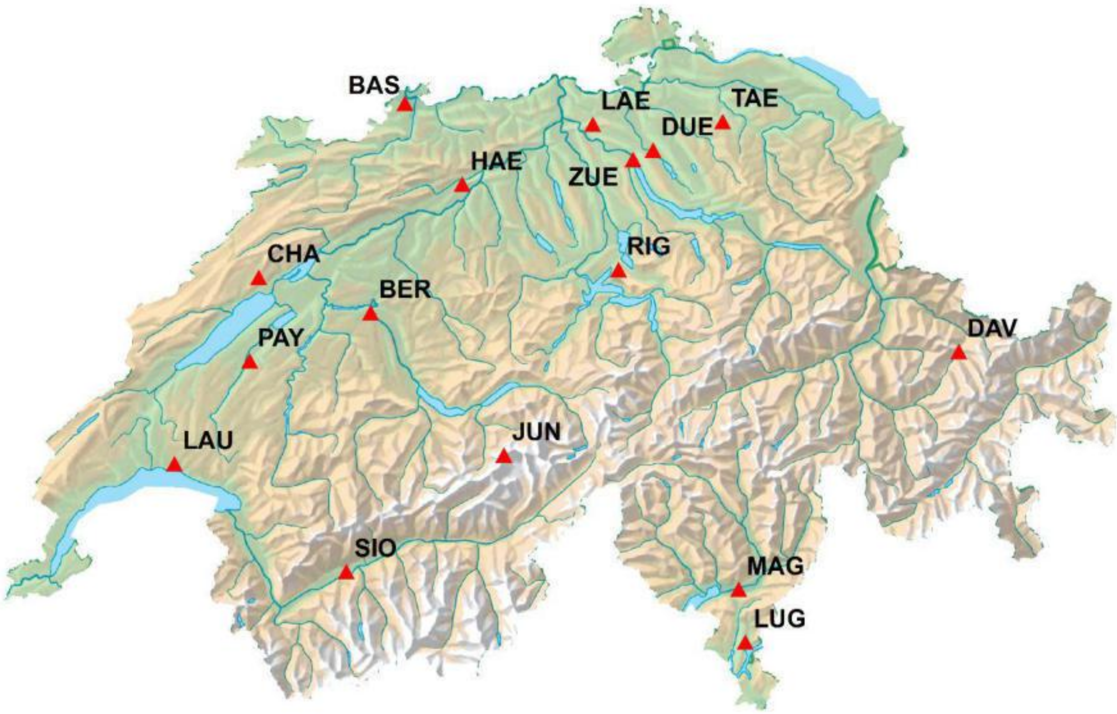
Switzerland has set a target similar to the target of the NEC Directive. It aims to reduce the VOC-emissions by 30% until 2030, taking the year 2005 as the starting point.

2.1 Institution(s) responsible for the implementation and/or evaluation of the policy instrument

Federal Office for the Environment FOEN, Section Air Pollution Control and Chemicals Division (https://www.bafu.admin.ch/bafu/en/home/office/divisions-sections/air-pollution-control-and-chemicals-division.html)

2.2 Monitoring sites

There are 16 monitoring sites in Switzerland which measure air pollution. These are part of the National Air Pollution Monitoring Network (NABEL). The Monitoring Sites within the AC-perimeter are: Sion-Aéroport (SIO); Magadino-Cadenazzo (MAG); Davos-Seehornwald (DAV); Rigi-Seebodenalp (RIG); Jungfraujoch (JUN).



3. LTER Sites (Long-Term Ecosystem Research in Europe)

The same 19 LWF sites mentioned above in the ICP Forests program are part of the LTER-Europe network.

Continuous measurements of environmental factors and observation of forest condition on long-term research plots, allow the evaluation and meaningful conclusions on possible causes of changes and future scenarios. Measurements are based on international standard methods and quality control as set down in the manuals of ICP Forests and ICOS.

3.1 Institution(s) responsible for the implementation and/or evaluation of the policy instrument

The LWF-Programe is run and financed by the Swiss Federal Institute for Forest, Snow and Landscape Research (WSL) (https://www.wsl.ch/en/index.html).

3.2 Monitoring sites

The 19 monitoring sites, which are part of the ICP Forests Network, are as well part of the LTER-Europe Network.

4. LULUCF (Regulation on the inclusion of greenhouse gas emissions and removals from land use, land use change and forestry)

As a third country, Switzerland is not directly involved in the implementation of the Regulation. Switzerland did however agree to a further commitment period under the Kyoto Protocol. Under the Paris Agreement on Climate Change, Switzerland has undertaken to halve its greenhouse gas emissions by 2030 compared with 1990 levels.
In accordance with the requirement of the Paris Agreement to submit a long-term climate strategy until the end of 2020, the Federal Office for the Environment (FOEN) is currently developing a strategy, which aims to reduce the net carbon emissions to net zero by 2050.

4.1 Institution(s) responsible for the implementation and/or evaluation of the policy instrument

Federal Office for the Environment (FOEN)
(https://www.bafu.admin.ch/bafu/en/home.html)

4.2 Monitoring sites

-

alpenkonvention • convention alpine
convenzione delle alpi • alpska konvencija

Soil Protection Working Group

Questionnaire on permanent monitoring sites for international monitoring mechanisms

Please send your feedback ***by FR, 27 March 2020*** *to* *vera.bornemann@alpconv.org* *to allow us to prepare an overview of the results for the 3rd meeting of the working group.*
Please delete this instruction text and the other instructions in the document. Just keep the answers.

Country Prefix

Please replace the heading 'country prefix – name of the monitoring scheme' with the standard country prefix (e.g. DE, AT)

1. ICP Forest Programme (International Cooperative Programme on Assessment and Monitoring of Air Pollution Effects on Forests)

Briefly summarize the main content of the monitoring scheme (its aim and scope, links to policy objectives and other policy instruments, which parameters it focuses on, other key information you think is relevant to understand the monitoring scheme)

Please KEEP to around 150 words.

1.1 Institution(s) responsible for the implementation and/or evaluation of the policy instrument

Which institutions are responsible for the implementation and/or evaluation of the monitoring scheme? Please include the names and link to their home pages, and delete the instructions text.

1.2 Level I monitoring sites

Please list here the monitoring sites, which are in the perimeter of the Alpine Convention. List the locations, site characteristics and other relevant information as exact as possible in writing. Please include cartographic overview(s), if available.

1.3 Level I monitoring sites

Please list here the monitoring sites, which are in the perimeter of the Alpine Convention. List the locations, site characteristics and other relevant information as exact as possible in writing. Please include cartographic overview(s), if available.

2. NEC Directive (National Emission Ceilings Directive)

Briefly summarize the main content of the monitoring scheme (its aim and scope, links to policy objectives and other policy instruments, which parameters it focuses on, other key information you think is relevant to understand the monitoring scheme)

Please KEEP to around 150 words.

2.1 Institution(s) responsible for the implementation and/or evaluation of the policy instrument

Which institutions are responsible for the implementation and/or evaluation of the monitoring scheme? Please include the names and link to their home pages, and delete the instructions text.

2.2 Monitoring sites

Please list here the monitoring sites, which are in the perimeter of the Alpine Convention. List the locations, site characteristics and other relevant information as exact as possible in writing. Please include cartographic overview(s), if available.

3. LTER Sites (Long-Term Ecosystem Research in Europe)

Briefly summarize the main content of the monitoring scheme (its aim and scope, links to policy objectives and other policy instruments, which parameters it focuses on, other key information you think is relevant to understand the monitoring scheme)

Please KEEP to around 150 words.

3.1 Institution(s) responsible for the implementation and/or evaluation of the policy instrument

Which institutions are responsible for the implementation and/or evaluation of the monitoring scheme? Please include the names and link to their home pages, and delete the instructions text.

3.2 Monitoring sites

Please list here the monitoring sites, which are in the perimeter of the Alpine Convention. List the locations, site characteristics and other relevant information as exact as possible in writing. Please include cartographic overview(s), if available.

4. LULUCF (Regulation on the inclusion of greenhouse gas emissions and removals from land use, land use change and forestry)

Briefly summarize the main content of the monitoring scheme (its aim and scope, links to policy objectives and other policy instruments, which parameters it focuses on, other key information you think is relevant to understand the monitoring scheme)

Please KEEP to around 150 words.

4.1 Institution(s) responsible for the implementation and/or evaluation of the policy instrument

Which institutions are responsible for the implementation and/or evaluation of the monitoring scheme? Please include the names and link to their home pages, and delete the instructions text.

4.2 Monitoring sites

Please list here the monitoring sites, which are in the perimeter of the Alpine Convention. List the locations, site characteristics and other relevant information as exact as possible in writing. Please include cartographic overview(s), if available.

5. Further international monitoring system relevant for soil monitoring in the perimeter of the Alpine Convention

Please copy this section (5. – 5.2) as many times as need to fill in additional international monitoring system relevant for soil monitoring in the perimeter of the Alpine Convention!

Briefly summarize the main content of the monitoring scheme (its aim and scope, links to policy objectives and other policy instruments, which parameters it focuses on, other key information you think is relevant to understand the monitoring scheme)

Please KEEP to around 150 words.

5.1 Institution(s) responsible for the implementation and/or evaluation of the policy instrument

Which institutions are responsible for the implementation and/or evaluation of the monitoring scheme? Please include the names and link to their home pages, and delete the instructions text.

5.2 Monitoring sites

Please list here the monitoring sites, which are in the perimeter of the Alpine Convention. List the locations, site characteristics and other relevant information as exact as possible in writing. Please include cartographic overview(s), if available.

ALPENKONVENTION
CONVENTION ALPINE
ALPSKA KONVENCIJA
CONVENZIONE DELLE ALPI

Soil Protection Working Group

Mandate 2019-2020

Cooperation with the JRC

regarding the Soil Conservation Protocol Articles 20 and 21: Harmonized Databases and Soil Monitoring

Introduction

The Working Group on Soil Protection is mandated to facilitate the implementation of the Articles 20 (establishment of harmonized databases) and 21 (establishment of permanent monitoring areas and coordination of environmental monitoring) of the Soil Conservation Protocol of the Alpine Convention, which is also part of the EU law. These Articles read as follows:

> **Article 20: Establishment of Harmonised Databases**
>
> (1) The Contracting Parties agree to create comparable databases (soil parameters, sampling, analysis, evaluation) within the framework of the Alpine monitoring and information system, and to establish possibilities for data exchange.
>
> (2) The Contracting Parties shall reach agreement about soil-endangering substances which require priority treatment, and they shall strive for comparable evaluation parameters.
>
> (3) The Contracting Parties shall strive to establish representative records of the condition of Alpine soils taking into account the geological and hydrogeological situation, on the basis of identical evaluation systems and harmonised methods.
>
> **Article 21: Establishment of Permanent Monitoring Areas and Coordination of Environmental Monitoring**
>
> (1) The Contracting Parties undertake to establish permanent monitoring areas in the Alpine region and to integrate them in an Alpine-wide soil monitoring network.
>
> (2) The Contracting Parties agree to coordinate their national soil monitoring programmes with the environmental monitoring programmes for air, water, flora and fauna.
>
> (3) Within the framework of their monitoring programmes, the Contracting Parties shall establish soil sample databases according to comparable parameters.

Background

A broad discussion regarding the facilitation of the implementation of Article 20 of the Soil Conservation Protocol took place during the 2nd meeting of the Soil Protection Working Group on 16 – 17 October 2019 in Innsbruck. There was a consensus that this is a difficult issue, which has been discussed for many years. For example in 1994 the subgroup on “Permanent soil monitoring sites” of the joint working group on soil protection of the Regional Working Communities Arge Alp, Arge Alpen-Adria and Arge Donauländer had prepared a report in German language on permanent soil monitoring sites including a concrete recommendation to set up sites and monitor them in a coordinated way. These recommendations were applied in several cases, but they were not implemented in all regions participating in the process and the implementation was not comprehensively coordinated. Beyond that co-operations regarding joint monitoring leading to a harmonized dataset between some Countries during a certain timeframe on specific issues had already been successfully undertaken, such as the Interreg Alpine Space project “MonarPOP - MOnitoring Network in the Alpine Region for Persistent and other Organic Pollutants” (2005 – 2007 and continued until 2010) by Austria, Germany, Italy, Slovenia and Switzerland. During the meeting of the Working Group the question was raised as well for whom and for which purposes which kind of Alpine-wide harmonized data would be needed.

However, to establish one standardized national soil monitoring system is challenging and could not be achieved in every State. Thus, not every State has a national or regional monitoring system in place. This applies also to the Alpine area and to the whole European Union, which is why the European soil survey LUCAS Soil has been established in 2006. LUCAS Soil is a database comprising comparable data covering the major parts of the Alpine area. During the Soil Protection Working Group’s 3rd meeting it was decided that LUCAS Soil should be considered or even play a significant role. The LUCAS Soil surveys have already collected harmonized soil data on a European scale and will continue this process in the future. Consequently, a contact with the responsible institution, the Joint Research Centre (JRC) of the European Commission has been established and representatives of the JRC actively participated in the 4th meeting of the Soil Protection Working Group.

LUCAS Soil was developed for the purpose of generating harmonized and thus comparable soil data for the EU, because the availability of soil data in the Member States and in their regions was very heterogeneous and the available soil data were not comparable and thus could not be harmonized. Such harmonised soil data is necessary for meeting policy needs of the EU and the Member States concerning nature protection, climate change and agricultural matters for example. Soil data are currently becoming even more important in light of the European Green Deal (EU Biodiversity Strategy, Zero Pollution Strategy, Farm2Fork Strategy, Circular Economy, EU Climate Law) and for reporting on the SDG indicators.

While Eurostat coordinates the LUCAS Soil surveys, the implementation and development is done by the JRC. The soil surveys were continuously further developed, enlarging the extent and number of sample sites as well as the parameters covered from the first survey in 2006, to the replications in 2009, 2012, 2015 and 2018. As the sampling interval has been extended to taking place every 4 years, the next survey will be done in 2022. For the Alpine area, the surveys from 2015 onwards are most relevant, since also sites on a higher elevation than 1.000 m above sea level were covered and additionally, Switzerland was included in the survey. Liechtenstein and Monaco are not participating in the LUCAS soil program.

Roadmap for cooperation

1. Establishing an exchange, 21 and 22 July 2020

The aim of the exchange about LUCAS Soil during the 4th meeting of the Soil Protection Working Group was to investigate how the program could be integrated with initiatives of the Contracting Parties of the Alpine Convention. The JRC representatives expressed to be open for further increasing collaboration with the Alpine Convention and with the single Member States. Good bilateral cooperation already exists between the JRC and Alpine States, e.g. with Switzerland since the survey in 2015, where the LUCAS results were comparable with the Swiss national soil monitoring. In addition, the good cooperation with Austria was highlighted, where currently the project LUCASSA is running, in which duplicate samples are taken and analyzed in Austria to compare the results with the LUCAS Soil data. Also, Germany is planning a cooperation project.

2. Data and information from JRC on soil monitoring in the AC perimeter and further topics, August 2020

As next step, it is important to identify which soil sampling sites in the perimeter of the Alpine Convention were included in the LUCAS soil surveys 2015 and 2018 and which parameters were analyzed. Furthermore, the planned sampling sites and the planned parameters currently foreseen for the next survey in 2022 should be made known in order to be able to comment on them. Some information regarding this question has already been delivered by the JRC.

In addition, the JRC could give feedback to the report “Economical use of soil in the Alps” developed by the Soil Protection Working Group. Furthermore, finalized maps and finalized

LUCAS soil data from the European Soil Data Centre (ESDAC) can be used freely for Alpine Convention purposes, e.g. it can be fed into the System for the Observation and Information on the Alps (SOIA).

3. Further exchange, September and October 2020

An important question is whether LUCAS Soil covers the condition of Alpine soils taking into account the geological and hydrogeological situation in a representative way (Art. 20 para 3 Soil Conservation Protocol). The sampling locations delivered by the JRC should be evaluated regarding the representativeness for the Alpine area.

Currently the next LUCAS Soil survey is being prepared for the sampling phase from March to September 2022. While the first part of the surveys is always based on photointerpretation, the soil sampling will be increased from 25.000 to 41.000 points. The samples will also be taken from deeper horizons (down to 30 cm) and it is foreseen to expand the research on soil biodiversity, sulphur and more cations as well as to research heavy metals again more extensively. While carbon content and organic soils were already a topic in the 2018 survey, a soil carbon indicator is currently further developed for reporting e.g. for the new CAP and the SDG target 15.3.

Since the next survey is currently being prepared, a unique possibility ("window of opportunity") exists to propose differing and additional sampling locations in the Alpine area to reach a representative coverage of the soils in the Alps. By January 2021, the locations of the sampling sites need to be decided. The focus of new sampling sites will be on cultivated areas. Pastureland is currently under-represented and could thus be put into focus for proposing additional sites, while for forest areas the attempt is to collaborate with the ICP forest program to reach an improved coverage of this land class. The definition of parameters planned to be measured can also be finalized a little later. A possible question could be, whether soil-endangering substances, which require priority treatment and shall be monitored by using comparable evaluation parameters are included (Art. 20 para 2 Soil Conservation Protocol). It could also be explored, if parameters, which are especially important for the Alpine area, are missing.

The Soil Protection Working Group will furthermore discuss the LUCASSA project.

4. Possible cooperation from 2021 on

The Alpine Convention, the Contracting Parties and the JRC could further develop which ways of complementing each other might be envisaged in order to reach the objective of establishing a harmonized soil database based on regular monitoring, which is representative for the Alpine area. On the basis of a joint cooperation agreement the options might comprise:

- LUCAS Soil data could be used for the purposes of the Alpine Convention.
- Are data missing in LUCAS Soil and could these data be made available from the national or regional level to close gaps, which the Alpine Convention has identified for the Alpine area?
- The JRC could offer the service, that LUCAS Soil surveyors could also collect additional soil samples for Contracting Parties, to be analyzed in the laboratories of the respective State.
- Contracting Parties participating in the Soil Protection Working Group, might be able to help regarding accessibility of sampling sites, since they could have better ways for contacting e.g. landowners regarding the process of taking soil samples.
- For improving the validity of European soil data, regarding soil health, erosion, contamination etc., the JRC is working on approaches for collaborating with agencies of Member States and on approaches for being enabled to take other systems into consideration, which are relevant for land monitoring (e.g. agricultural practices). The Soil Protection Working Group might be able to facilitate establishing contacts for this purpose or to give input regarding existing land monitoring/management systems of relevance for the status of soils in the Alps.

Conclusions

- The existing Soil Protection Working Group has established contacts with the JRC, has held a first exchange of views and reflected on a longer-term cooperation.
- The Soil Protection Working Group proposes that during its mandate 2021-2022 the framework conditions for closer and long-term cooperation between the relevant national experts of the Alpine countries and the JRC are defined.
- On the basis of these framework conditions a joint cooperation agreement could be concluded between the Contracting Parties of the Alpine Convention and the JRC to facilitate the further implementation of Articles 20 and 21 of the Soil Conservation Protocol.

Stock taking of the Alpine Convention Soil Protection Working Group:
Institutions, projects and networks relevant for soil protection in the Alps

Update 09.09.2020

Name	Type	Alpine Countries	Timeframe	How to cooperate	Information	Website
PLANALP	Thematic working body of AC	AC CPs	since 2004	Exchange between the groups, e.g. PLANALP presentation during 2nd meeting of AG Soil Protection	The Natural Hazards Working Group of the Alpine Convention (PLANALP) was set up to develop common strategies designed to prevent natural hazards in the Alps as well as to exchange on adaptation strategies. The extent of the damage caused by such hazards is constantly increasing and the reasons are well known. Measures agreed across the whole Alpine region are therefore necessary and in some fields they are urgently needed.	https://www.alpconv.org/en/home/organization/thematic-working-bodies/detail/natural-hazards-working-group-planalp/
Alpine Climate Board	Thematic working body of AC	AC CPs	since 2016	Exchange between the groups, e.g. WS development of soil implementation pathways at 2nd meeting of AG Soil Protection and feedback loop with the Group.	In 2016, the XIV Alpine Conference established the Advisory Committee on the Alpine Climate (in short Alpine Climate Board), "in order to bundle together relevant climate change activities carried out in the framework of the Alpine Convention and to elaborate proposals for a concrete system of objectives of the Alpine Convention in regard to the perspective of a "climate neutral Alpine space" in accordance with European and international objectives." The resulting Alpine Climate Target System was adopted by the XV Alpine Conference in the frame of the Declaration of Innsbruck "Climate-neutral and climate-resilient Alps 2050".	https://www.alpconv.org/en/home/organization/thematic-working-bodies/detail/alpine-climate-board/ https://www.alpineclimate2050.org
AC Mountain Agriculture and Mountain Farming WG	Thematic working body of AC	AC CPs	since 2019	Mutually informing each other	The Mountain Agriculture and Mountain Forestry Working Group was established by the XV Alpine Conference in 2019. This working group is expected to contribute to the concrete operationalization of the Alpine Climate Target System 2050 of the Alpine Convention. This practical translation concerns the step towards climate-friendly mountain agriculture on the one hand and a sustainable management of mountain forests on the other hand.	https://www.alpconv.org/en/home/organization/thematic-working-bodies/detail/mountain-agriculture-and-mountain-forestry-working-group/
EUSALP AG 6	EUSALP Action Group	AT, DE, FL, FR, IT, SL, CH	since 2016	Mutual exchange	Preserve and valorise natural resources, including water and cultural resources. Subgroup 1 on soil protection and spatial development	https://www.alpine-region.eu/action-group-6 https://www.alpconv.org/en/home/projects/eusalp-action-group-6/
EUSALP AG 7	EUSALP Action Group	AT, DE, FL, FR, IT, SL, CH	since 2016	Exchange	Green infrastructure: to develop ecological connectivity in the whole EUSALP territory	https://www.alpine-region.eu/action-group-7
Arge Alp	Working community of Alpine Regions	AT, DE, IT, CH	since 1972	is Observer to the AG Soil Protection	Has been working on soil issues in the past, e.g. on permanent monitoring sites in 1994.	www.argealp.org

Name	Type	Alpine Countries	Timeframe	How to cooperate	Information	Website
European Soil Bureau Network (ESBN) / Joint Research Centre (JRC)	DG Environment of the EC	EU member states	ESBN since 1996 JRC since 1958	Knowledge & data exchange E.g. during 4th meeting of the AG Soil Protection	ESBN: The European Soil Bureau Network (ESBN), located at the Joint Research Centre (JRC) of the European Commission, Ispra (I), was created in 1996 as a network of national soil science institutions. The ESBN at the JRC is operated by staff members of the Land Management Unit (LMU). Its main tasks are to collect, harmonise, organise and distribute soil information for Europe. JRC: Bringing together scientific knowledge for Europe For soil: Institut for Environment and Sustainability, Land and Resource Management, Soil action ESDAC: European Soil Data Centre	https://ec.europa.eu/jrc/en/network-bureau/european-soil-bureau-network https://ec.europa.eu/jrc/en https://esdac.jrc.ec.europa.eu/
EC Soil Expert Group	Lead DG Environment of the EC	EU member states	since 2015	Exchange	Following the withdrawal of the legislative proposal for a Soil Framework Directive (COM(2006) 232) in 2014, the group is working on the implementation of the soil protection provisions of the 7th Environment Action Programme, to reflect with Member States on how soil quality issues could be addressed using a targeted and proportionate risk-based approach within a binding legal framework. They are working on an EU soil strategy in the follow up of the withdrawal of the EU Soil Framework Directive and are working on the 8th EAP, which might also be (combined with) the European Green Deal.	https://ec.europa.eu/transparency/regexpert/index.cfm?do=groupDetail.groupDetail&groupID=3336
EC Mission Board "Soil health and food"	Lead DG Research and Innovation, associated DG Agriculture and Rural Development	15 individual experts from EU Member States appointed in his/her personal capacity	since 2020	Exchange	The mission in the area of soil health and food will provide a powerful tool to raise awareness on the importance of soils, engage with citizens, create knowledge and develop solutions for restoring soil health and soil functions. This will allow full use of the potential of soils to mitigate the effects of climate change. Results will have a direct impact on the success of the new European Commission's Green Deal and its ambition to progress on climate, biodiversity and sustainable food.	https://ec.europa.eu/transparency/regexpert/index.cfm?do=groupDetail.groupDetail&groupID=3668 https://ec.europa.eu/info/horizon-europe-next-research-and-innovation-framework-programme/mission-area-soil-health-and
EU 2030 Biodiversity Strategy and Europe's green recovery	DG Environment of the EC	EU member states	2020	Take into consideration	The new EU Biodiversity Strategy for 2030 was adopted in May 2020 and takes into regard a green recovery in the post-COVID context. The strategy and the EU Green Deal "put the citizen at the centre, by committing to increase the protection of land and sea, restoring degraded ecosystems and establishing the EU as a leader on the international stage both on the protection of biodiversity and on building a sustainable food chain."	https://ec.europa.eu/environment/nature/biodiversity/strategy/index_en.htm
SONDAR (Soil Strategy Network in the Danube Region)	Task Force of EU Strategy for the Danube Region (EUSDR)	AT (and CZ, HU, SK)	2010	Take into consideration	Task Force of EU Strategy for the Danube Region (EUSDR) of Priority Area 6 "Biodiversity, landscapes, air and soil" including the topic of soil protection The task force SONDAR is managed by Lower Austria.	http://www.sondar.eu
ICP Forests	International cooperative programme	AT, DE, FL, FR, IT, SL, CH + 35 further EU states	since 1984	Knowledge & data exchange, e.g. in scope of the stock taking of permanent soil monitoring sites in the AC perimeter the sites from ICP Forest network were included.	International cooperative programme on assessment and monitoring of air pollution effects on forests; specifically the "expert panel on soil and soil solutions"	http://icp-forests.net/
Alpine Soil Partnership (AlpSP)	Partnership	AT, DE, FR, IT, SL	Since 2018	Exchange on every meeting, 2nd meeting of AG Soil Protection back-to-back to Alpine Soil Forum, AG Soil Protection supports AlpSP to enable the establishment of a Coordination Unit.	Multi-level and multi-sectoral approach for sustainable soil management, soil conservation and the exchange of soil knowledge (authorities, practitioners, NGO's, etc.) to introduce soil protection in land management practices, to promote Alpine-wide cooperation on soil protection & soil ecosystem services management. AlpSP links experts on horizontal and vertical levels: Public authorities and soil experts have the opportunity to understand gaps & needs of soil conservation and to integrate solutions and created tools better in their day-to-day work.	https://alpinesoils.eu/

Name	Type	Alpine Countries	Timeframe	How to cooperate	Information	Website
European Land and Soil Alliance (ELSA)	Partnership	Municipalities and districts from 9 EU countries, from the Alps: DE, IT, AT	since 2000	Contribute to next annual conference in Bolzano/Bozen 14 – 15 May 2020	Municipalities and districts in 9 European countries, as well as a variety of regional NGOs and other organisations, are members of ELSA. ELSA is the largest European city network dedicated to the protection of soil. It offers an important platform for European cities and municipalities, and for all soil activists to get together to promote and exchange expertise about the important topic of soil protection. ELSA considers itself to be an important and dynamic platform and lobbyist for soil protection	www.bodenbuendniss.org
European Soil Partnership (ESP)	Partnership	Countries from the European continent, from the Alps: AT, DE, FR, IT, SL, CH	since 2013	Take into consideration	The European Soil Partnership (ESP) was established in October 2013 during the second Global Soil Week to bring all networks and soil related activities under a common framework. Its Secretariat is hosted at the European Commission DG JRC in Ispra, Italy. The Partnership is open to institutions and stakeholders willing to actively contribute to sustainable soil management in Europe.	http://www.fao.org/global-soil-partnership/regional-partnerships/europe/en/
European Confederation of Soil Science Societies	Network	AT, DE, FR, IT, SL, CH	since 2018?	Group did spread information on Eurosoil in Genf (CH) 2020 which was postponed to 2021 Option to contribute to new date in scope of the AG and CH presidency of the AC?	The objectives of the ECSSS shall be to foster collaboration and co-operation amongst the National Societies of Soil Science in Europe and amongst European soil scientists in all branches of the soil sciences and their applications, and to give support to the above in the pursuit of their activities. Next Eurosoil August 2021 in Geneva, CH	https://soilscience.eu/
European Network on Soil Awareness (ENSA)	Network	?	since 2009	Possibly cooperation regarding AR events?	Supported by ELSA and the ESBN in the JRC of the European Commission	http://www.bodenbuendnis.org/en/cooperation/partnership/ensa/
People4Soil	Network of organizations		since 2016, still active?	?	This network of European NGOs, research institutes, farmers' associations and environmental protection groups was founded in Italy by the Italian environmental organisation Legambiente. Through a widely-distributed petition People4Soil seeks to persuade the EU to introduce laws for the protection of soils.	https://agrikaido.com/en?utm_source=people4soil.eu
Links4Soils	Project	AT, DE, IT, SL, FR, CH	November 2016 - April 2020	Mutual exchange was done as long as the project was ongoing.	The project aimed at linking Alpine soil knowledge, end-users and experts, elaborate sectoral soil information, create best-case practices and promote soil management, to enhance the applicability of the Alpine Convention Soil Conservation Protocol and contributes to the protection, conservation and connectivity of Alpine ecosystems. The project linked expertise and governance on various levels and sectors to jointly develop and implement sustainable Alpine land management policies / strategies.	https://www.alpine-space.eu/projects/links4soils/en/home https://alpinesoils.eu/

Name	Type	Alpine Countries	Timeframe	How to cooperate	Information	Website
trAILs	Project	AT, FR, IT, SL	April 2018 - April 2021	Invite to present project to Group	The project aims to generate significant knowledge about Alpine industrial landscapes and to develop and test sustainable transformation strategies applicable and replicable in the whole Alpine space. In a multidisciplinary, transnational approach the project combines expertise in the fields of spatial and landscape planning, socio-economic sciences and ecologic restoration while directly cooperating with local communities in four pilot sites in Austria (Eisenerz), Italy (Borgo San Dalmazzo), France (L'Argentière-la-Bessée) and Slovenia (Tržič).	https://www.alpine-space.eu/projects/trails/en/home
Impuls4Action	Project	AT, IT, SL, CH	August 2019 - January 2021	Active exchange on the peatland part of the project at 4. meeting of AG Soil Protection	ARPAF project co-initiated by EUSALP AG 6 Topics: Watermanagement in soils, protection of peatlands, interior development	https://www.impuls4action.eu/