# BioDiv-Support Newsletter February 2023

**The BioDiv-Support research program started in 2019, involving eight partners from five European countries. The research project is in its final phase and this newsletter provides a summary of the results achieved in the project.**

## Understanding future changes in biodiversity, climate and air pollution in high-altitude areas

Biodiversity is an ecological concept that refers to the variety of organisms, species and interactions (and even to the genetic variation within specific species) that occurs in a certain habitat or region. High biodiversity usually means a more resilient ecosystem and a substantial contribution of basic ecosystem services vital for human survival and well-being.

*Alpine region, rich vegetation of low woody plants including a wide range of willow (Salix) species. The Sarek national park. Scandes Mountains, Sweden. Photo: E. Sjökvist.*

Loss of biodiversity is one of the major problems currently facing humanity. Among the greatest threats are climate change, change of habitats and air pollution. High altitude mountain regions represent some of our most pristine environments with high biodiversity, often with small historical impacts from air pollution, but at risk of disproportionate impacts from climate change. Arctic high-altitude regions are especially at risk from both climate change and increasing air pollution loads due to changed human activities as a result of disappearing sea ice (e.g. shipping, flaring).

We have used a chain of state-of-the-art models to describe potential future impacts from climate change and air pollution to ecosystem development at high altitudes, focusing on three mountain regions, namely the Scandinavian Mountains (the Scandes), the Spanish Central Mountain System and the Pyrenees Mountains.


*Locations of the mountain areas studied in the project; Scandinavian Mountains, the Pyrenees Mountains and the Spanish Central Mountain system.*

Our main scientific discoveries are described in the box on the next page of this newsletter. In subsequent articles of this newsletter, you will learn about a developed web tool, and more detailed information on results from the three case studies. Lastly, short news articles are also included for selected scientific papers and conference contributions by this project.

MAIN SCIENTIFIC FINDINGS OF BIODIV-SUPPORT

**Vegetation belts are projected to shift to higher elevation in the mountains, but also to move northward in the Scandes.** In particular, species of shrubs and trees are driving these shifts; leading to a loss of tundra in the Scandes and biodiversity-rich mountain vegetation in the southern study sites. The shift is at risk of proceeding more rapidly than the species can adapt to or follow spatially, leading to high risk of local extinction of species, or decreased vigour e.g. with implications for forests susceptibility to disturbances such as drought- and heat-related tree mortality and forest pests. This shift has implications for local management practices, e.g. for forestry from local to national level, and herding practices e.g. for reindeer management. It has implications for local climate feedbacks. In addition, it is also highly relevant for tourism, e.g. because of reduced snow cover and an altered flora in the landscape, and for nature conservation. Vegetation cover and composition can change profoundly, altering the characteristics of the landscape and representing a threat for a substantial number of red listed species.

**Climate change leads to warming and changes in precipitation also at high altitude, and increased risk for e.g. fire events.** Scenarios show there is an increased prevalence of some types of extreme weather, e.g. heatwaves. The unprecedented, very high spatial and temporal resolution in climate models that has been used in BioDiv-Support permits an improved assessment of the frequency and intensity for extreme precipitation events and a wider range of climate change indicators including also in areas of complex terrain.

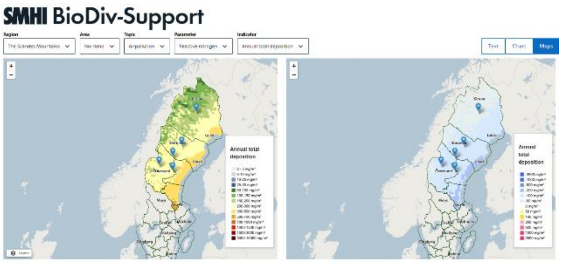
**The total nitrogen deposition is projected to decrease in the Scandes, Pyrenees and Spanish Central System until the mid-21$^{st}$ century. However, additional policy action is needed, especially for the agricultural sector to reduce adverse impacts from nitrogen deposition.** Policy interventions have led to decreasing nitrogen deposition in Europe, but despite this the load will remain at levels far above the pre-industrial in most parts of Europe, even for remote high-altitude areas such as the Scandinavian Mountains. Reductions in nitrogen deposition to the Central Mountain System in Spain are expected to decrease impacts to sensitive habitats by 2050, with substantial decrease in the exceedances of critical loads in a majority of these (mainly shrub and pasture habitats). Critical loads for nitrogen will still be exceeded in mid-21$^{st}$ century in many parts of Europe.

**We project that impacts on the mountain vegetation from near-surface ozone will be reduced by 2050 as a result of planned reductions in precursor emissions.** However, this is dependent on countries continuing their efforts to decrease emissions**.** As a result, the Spanish Central System is expected to meet the target value for impacts to vegetation set out in the current EU Air Quality Directive, but not the corresponding long-term objective. In Scandinavia, extreme weather events (heat-waves, wildfires) can promote elevated near-surface ozone also in the future. Additionally, an earlier and higher spring peak in near-surface ozone is partly a result of a prolonged growing season caused by climate change (as seen in our ecosystem simulations).

## A web tool that can be used to plan for adaptation

We have created a planning tool for assessing changes in climate, air quality and vegetation in mountainous regions from present day to mid-century (2000-2050), considering socio-economic and policy development, and management practices. We constructed a list of climate, air pollution and ecosystem indices in collaboration with stakeholders, and this was used in the design of the web tool.

The web tool is publicly available online. We provide maps of selected indicators, based on high-resolution climate, air quality and dynamic vegetation model simulations, showing projected changes in the mountain environments. Accompanying texts clarify how the results can be interpreted, the meaning of indices and how the predictions are obtained.




*An example of web interface for the web tool, showing current deposition of nitrogen to northern Sweden (left), and change to future (right)*[1]*. The tool shows current and future climate, air pollution load and ecosystem evolution and can be used for follow up of the case areas including a number of regions in Sweden.*

**Learn more:**

https://biodivsupport-tst.smhi.se/

Visit the project web page:

https://smhi.se/research/biodivsupport

# Case specific findings

## The Scandinavian Mountains – a part of the shrinking Arctic

The Scandinavian Mountain range is one of the longest in Europe, 1700 km long and up to 300 km wide, located on the western side of the Scandinavian peninsula, with substantial variations in climate depending on latitude, elevation, lee and wind side. The range includes a variety of different ecosystems, from rich and moist deciduous forests to tundra in alpine areas. Biodiversity hotspots are located in both the south and the north.

*From distant to near: Alpine region, mountain birch belt. Characteristic vegetation zone in the Scandinavian mountains. Photo: H. Pleijel, Härjedalen*

The northern part of the Scandinavian Mountains is located inside the polar circle, and the Arctic. A wide range of climate scenarios show that the Arctic and also the higher altitudes of the Scandes will likely experience stronger climate change compared with more southern latitudes. Climate models with high horizontal grid resolution become increasingly important as a basis for decision making. A new generation of such models, so called "convection-permitting" climate models have shown superior performance in

[1] *Based on current legislation emission scenarios (ECLIPSE V6b) and impact of climate change (HCLIM using greenhouse gas scenario RCP8.5) modeled with the chemistry transport model MATCH. ECLIPSE (Evaluating the Climate and Air Quality Impacts of Short-lived Pollutants) is commonly used global anthropogenic emissions datasets, compiled by IIASA (International Institute for Applied Systems Analysis). RCP is Representative concentration pathways.*

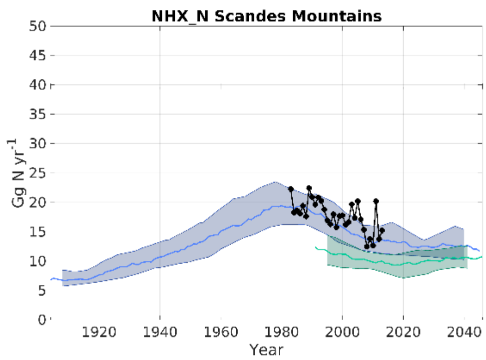
simulating important aspects of the climate including extremes.

We have performed the first long-term[2], 3km resolution, simulation over Fenno-Scandinavia with the HCLIM regional convection-permitting climate model. This is an unprecedented effort. The use of HCLIM leads to more realistic representation of precipitation compared to coarser-scale climate models. Specific improvements include an increased and more realistic occurrence of higher intensity events, an improved timing and amplitude of the diurnal cycle, and an improved relative occurrence of snowfall versus rain in the Scandinavian mountains.

*Lake Torneträsk, northern Scandinavian Mountains, Sweden. Photo: H. Pleijel.*

We project continued temperature increase throughout the 21st century, including fewer cold and more warm extremes, and rainfall events in the winter that can change the ecological conditions. We project more precipitation, but with more pronounced wet and dry extremes, and reduced snowfall everywhere except for high-altitude sites in winter. The reduction in snow cover is expected to amplify climate warming. We project more rain on snow events and zero-crossings in parts of the year, with implications for e.g. reindeer management.

We have studied the impact of climate and emission change on the Scandes ecosystem exposure to nitrogen deposition and near-surface ozone from the 1990s until mid-21st century using the MATCH model.[3] Our work shows a decrease by 19% in total atmospheric nitrogen deposition in the Scandes from the 1980s until today and continued decrease to mid-century, but still at levels far above the pre-industrial. Reduced nitrogen (NHX_N) deposition is projected to continue at present levels. An increased frequency of extreme events such as the wildfires seen in 2018, leads to high input of nitrogen, an increase by 600% in the vicinity of fires and 300% in a vast area of the Scandes.[4] High-growth shipping in the northern seas in 2050 may also contribute to increased total nitrogen deposition in coastal areas of the Scandes, by up to 50%.




*Atmospheric reduced nitrogen deposition (NHX_N) to the Scandinavian Mountains, modelled with MATCH in three set-ups, in this project (green), with coarser resolution based on an older emission scenario (blue) and by a measurement-model fusion (black). Andersson et al., 2023.*

Nitrogen deposition impacts biodiversity adversely by promoting specific species over others, while the impact of ozone on wild plants in the Scandes is poorly understood. We project a decrease in ozone exposure in the Scandes until 2050, and very weak climate

[2] *Periods: 1998-2018; 2040-2060; 2080-2100. HCLIM was forced by the strongly increasing carbon dioxide emission scenario RCP8.5, and EC-EARTH GCM, with a nest using ALADIN 12km resolution covering most of Europe.*

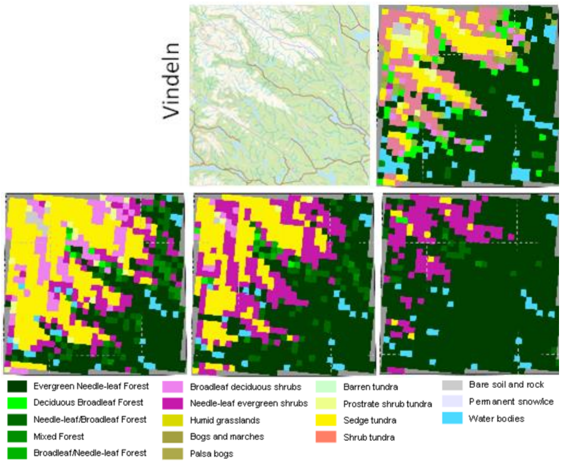
[3] *MATCH was forced by the HCLIM scenario described above and ECLIPSE V6b anthropogenic emissions scenario (current legislation). We also compared our future scenario with a multi-century scenario (1900-2050) at coarser resolution.*

[4] *Studied using the year 2018 as an indicator of a possible future year.*

penalty/benefit in the Scandinavian mountains. However, our observationally-based analyses show that extreme events such as the summer of 2018 where large parts of Europe were affected by a long-lasting heat wave promote high ozone concentrations in south-west Sweden. Additional work is needed to understand the processes of extreme ozone during heat-waves in Scandinavia and flux-based ozone vegetation impacts assessments.

During recent decades, Scandinavian Mountain regions have experienced an advancement of the tree-line. Above this, medium to tall shrub species are observed in moist to wet areas. In dry communities, there has been an increase in semi-prostrate evergreen shrubs like heather and crowberry. Changes in winter conditions are also common with more frequent episodes of winter warm spells, ground icing and rain-on-snow events damaging vegetation and altering ecosystem services such as carbon storage and grazing grounds for reindeer husbandry.

We further developed the leading ecosystem model “LPJ-GUESS” to investigate how vegetation in the Scandes is likely to respond to the climate and air quality scenarios described above. The scenarios’ extremely high spatial resolution of 3 km allowed us to model in unprecedentedly fine detail the vegetation dynamics across the Scandes, and to zoom in on six specially-selected “hotspot” areas for which we compiled records of rare and threatened animal and insect species. Our results suggest that increasing temperatures and carbon dioxide concentrations during the 21st century will likely lead to increased vegetation productivity overall, characterized by generally taller and denser vegetation. Our hotspot analyses suggest that the southern alpine region in Sweden will be dominated by (increasingly mixed) forests at the end of the 21st century, putting many rare and threatened species at risk. In the northern alpine regions, most vegetation types will persist but we project a shift of trees and shrubs to higher altitudes with some species being restricted to small regions, endangering vulnerable species that depend on these habitats. Tree-line advance will proceed more slowly than climate change, due to the competition from prevailing vegetation and a threshold for establishment of new species. Furthermore, the projected vegetation changes are likely to impact the character of existing reindeer grazing grounds, making adaptation necessary. In spring, summer and autumn, potential reindeer consumption is projected to increase, most dramatically during the summer at higher latitudes. Temperature was found to be a strong driver of vegetation change, with nitrogen availability identified as an important modulator of treeline advance.




*The official vector-based map from Lantmäteriet (top left) in the mountain area Vindeln[5]. Satellite-based (GLCE, top right) and simulated (bottom) vegetation composition for 1995-2004 (bottom left), mid 21st century (bottom, middle) and end of century (bottom, right) according to RCP8.5. The hotspot area is 90 × 90 km (30 × 30 gridcells).*

**Learn more:** selected, published and submitted papers[6].

[5] *Vindeln is one of six analysed hotspots, 4 mountain hotspots and 2 forest hotspots in total.*

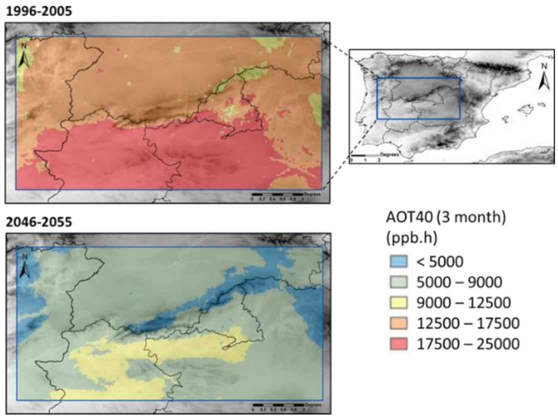
[6] *Geels et al., 2021.* [https://acp.copernicus.org/articles/21/12495/2021/acp-21-12495-2021.html](https://acp.copernicus.org/articles/21/12495/2021/acp-21-12495-2021.html) *Johansson et al., 2020.*

## The Spanish Central Mountain system – rich biodiversity threatened by climate change and air pollution

The Spanish Central System mountain range extends more than 450 km across the centre of the Iberian Peninsula from northeast to southwest, passing approximately 50 km north of Madrid City. The bioclimatic, geo-morphological and lithological complexity has given rise to a very high biodiversity. As well as having a large number of Mediterranean plant species, the mountains also act as a refuge for species more typical of the colder climates in central Europe. Climate change represents a threat to this biodiversity. While low altitude species are able to move slowly up the mountain slopes, thus avoiding increasing temperatures and drought, those at high altitudes have no similar refuge. Air pollution is another threat to these mountain ecosystems, which are exposed to high concentrations of tropospheric ozone and high rates of atmospheric nitrogen deposition, problems that are exacerbated due to the proximity to Madrid.

*Sierra de Gredos in the Central System, Spain. Photo: M. Toro.*

Modelling results of the chemistry transport model CHIMERE[7] were used in a risk assessment for impacts of ozone exposure and atmospheric nitrogen deposition to the vegetation of the Central System at a spatial resolution of approximately 3 km. Separate assessments were carried out for the historic period (1996-2005) and for a future period (2044-2055; CMIP5 RCP8.5 scenario). Historic and future impacts of ozone were estimated using AOT40 (accumulated ozone concentrations above a threshold of 40 ppb) objectives and critical levels defined in the current European Air Quality Directive and the UNECE Air Convention respectively, as well as an annual AOT40 critical level developed for Mediterranean evergreen forests calculated over an entire year.




*Estimated AOT40 (3 month exposure) for the historic (top) and future (bottom) periods for the Central System domain shown in the inset.*

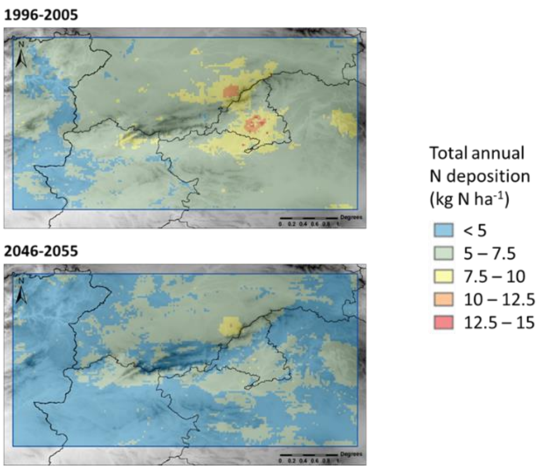
The results show that for the historic period, all objectives and critical levels from the EU Directive and Air Convention were exceeded. However, the specific 12-month critical level for Mediterranean evergreen forests was only partially exceeded in the historic period. Impacts are expected to be reduced in the future, due to reductions in emissions of nitrogen oxides and volatile organic compounds that can lead to the formation of

---

*http://www.borenv.net/BER/archive/pdfs/ber25/ber25-039-050.pdf Lind et al. 2020. https://doi.org/10.1007/s00382-020-05359-3 Gustafson et al 2021. https://doi.org/10.5194/bg-18-6329-2021 Lagergren et al., 2023. Submitted manuscript. Tang et al. Manuscript under review at Nature Communications. Doi: https://doi.org/10.21203/rs.3.rs-1143422/v1*

[7] *The CHIMERE model was run within two zoomed domains (Iberian Peninsula and the Central System, with spatial resolutions of approximately 10 km and 3 km), using boundary conditions from simulations at a European scale (EURO-CORDEX). Anthropogenic emissions were taken from the ECLIPSE V6b database (current legislation scenario) and meteorological data came from dynamically-downscaled (WRF) climate simulations (IPSL-CM5).* https://www.euro-cordex.net/ https://cmc.ipsl.fr/ipsl-climate-models/

ozone. However, the improvements are not expected to be sufficient to meet the long-term objective of the Air Quality Directive or the critical levels of the Air Convention throughout the Central System; although a substantial improvement is expected for the more tolerant Mediterranean evergreen forest with a higher critical level based on the 12 month-AOT40 index. Work is ongoing to calculate the impacts using the ozone-absorbed dose ($POD_Y$) which considers the ozone entering plant tissues, which describes actual ozone plant damage. Ozone-dose based indices can better take into account the response of the vegetation under drought restrictions and changing climate.




*Estimated total annual nitrogen deposition) for the historic (top) and future (bottom) periods for the Central System domain.*

Impacts due to nitrogen deposition were estimated by calculating the exceedance of the recently revised nitrogen empirical critical loads for the different vegetation types, taking the minimum of the range of values as a precautionary approach. Out of the 39 protected habitat types analysed within the modelled area, 18 exceeded the critical loads in the historic period. Of these, exceeded areas are expected to be reduced by more than 25% in the future for 16 habitat types. These improvements are mainly expected to affect shrub and pasture habitats. Further analysis will study the spatial patterns in the changes of critical load exceedances.

*Exceedance of objectives and critical levels defined in the current European Air Quality Directive and the Air Convention for the historic and future periods.*[8]

| *AOT40 - $O_3$ exposure-based indicators* | | | | |
|---|---|---|---|---|
| **Vegetation** | **Accumulation period (months)** | **Critical Level (ppb.h)** | **Exceedance HISTORIC** | **Exceedance FUTURE** |
| **All types (EU Directive)** | 3 | 3000 (Long Term – from 2020) | **Yes** | **Yes** |
| **All types (EU Directive)** | 3 | 9000 (Objective) | **Yes** | **Partially** |
| **Agricultural crops (Air Convention†)** | 3 | 3000 | **Yes** | **Yes** |
| **Annual grasslands (Air Convention)** | 3 | 3000 | **Yes** | **Yes** |
| **Permanent grasslands (Air Convention)** | 6 | 5000 | **Yes** | **Yes** |
| **Deciduous Forest (Air Convention)** | 6 | 5000 | **Yes** | **Yes** |
| **Mediterranean evergreen forests** | 12 | 35000 | **Partially** | **No** |

[8] *Air convention refers to Manual on Methodologies and Criteria for Modelling and Mapping Critical Loads and Levels and Air Pollution Effects, Risks and Trends (2017).*

## Pyrenees Mountains – unique biodiversity with risk of reduced habitat availability

With ~130 peaks exceeding 3000 m in altitude the Pyrenees Mountains represent a natural border between France and Spain. The range is more than 450 km long and ~100 km wide, spanning in a west-east direction from the Atlantic Ocean to the Mediterranean Sea. The Pyrenees' biodiversity is rich and unique, with more than 4500 vascular plant species and 180 endemic species. The Pyrenees is one of the European plant biodiversity centers, threatened by climate change.

*Pyrenees mountains.*

According to our new climate simulations, the warming effect in France is more marked in mountain areas (the Alps and the Pyrenees). Here, the average temperature change will exceed 2°C by the middle of the century under a scenario with strong future growth in greenhouse gas emissions (RCP8.5). Climate change has strong geographic variations with 20% less precipitation on the Mediterranean side and 20% more on the Atlantic side, when comparing two extended periods for the past (1961-1991) and the future (2041-2051). It is important to note that this is based on one climate scenario only.

The performance of CHIMERE for near-surface ozone concentrations was evaluated by comparison with measured concentrations in the European Environmental Agency (EEA) network. The seasonal cycle in measured concentrations over Europe is rather well reproduced with a low average bias over the Pyrenean region (around 1 µg/m$^3$).

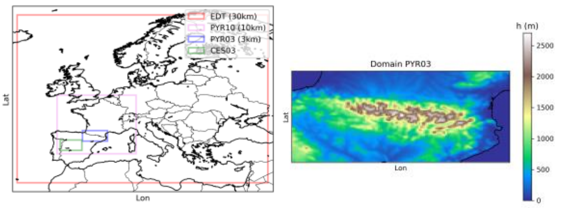
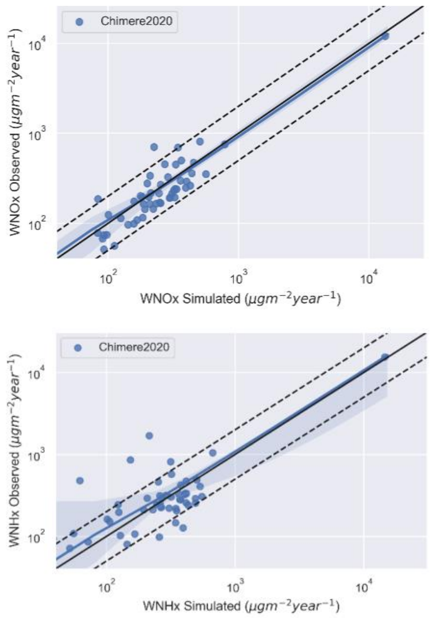



*Illustration of domains used in BioDiv-Support for the Pyrenees Mountains.*

The wet deposition of reduced and oxidized nitrogen was evaluated by comparison with measurements over Europe from the EMEP[9] network retrieved from the EBAS database[10]. The model manages to reproduce the order of magnitude of wet deposition (within a factor 2 except for a small number of stations).



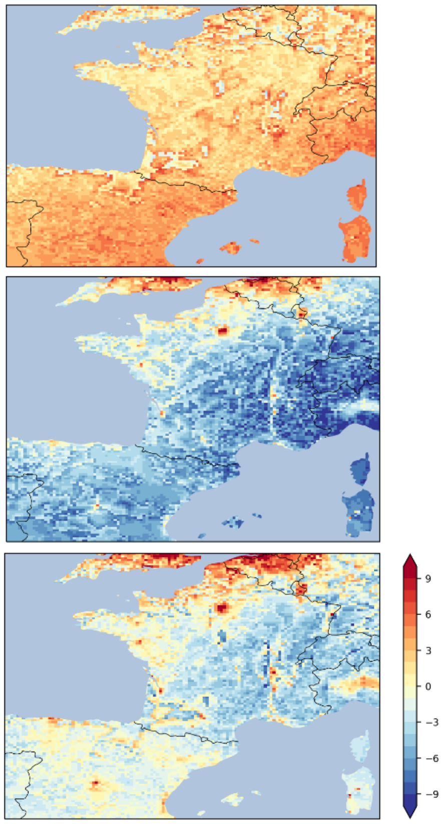

*Annual (2016) measured wet deposition vs simulated wet deposition for oxidized nitrogen (top) reduced nitrogen (bottom).*

[9] *European Monitoring and Evaluation Programme*

[10] *Database with atmospheric measurement data* https://ebas.nilu.no/

Our results indicate a climate penalty in near surface ozone annual concentration, whereas we found no clear climate penalty of climate change on nitrogen deposition and AOT40. The effect of climate change on annual mean ozone can be compensated by emission mitigation as the concentrations are estimated to slowly decrease when also accounting for emission change. For nitrogen deposition, over all of the domain, the evolution of nitrogen deposition is dominated by the effect of emission mitigation with a decrease around 300 µg-N/m² over the Pyrenees until mid-century. Thus, the decreased ozone and nitrogen loads by mid-century are relying on continued efforts to decrease anthropogenic emissions.

This was simulated by the CHIMERE model, using meteorology from a climate model based on RCP8.5 for current (1996-2005) and future (2041-2050), with current (ECLIPSE V6b, 2005) and future emissions (ECLIPSE V6b, 2050 current legislation). For isolation of potential climate penalty, 2005 emissions were used in the model simulation based on future climate.




*Impact in µg/m³ of climate change (top), emission mitigation (middle) and of both (bottom) on ozone concentrations. The impact is computed as the difference between averaged concentrations in the future (between 2041 and 2050) and the historical period (between 1996 and 2005).*

Climate change will probably impact plant communities across the entire Pyrenees Mountains, caused by vegetation zones climbing higher up in altitude. This may result in reduced habitat available for species adapted to the higher altitude. Air quality has the potential to be improved more rapidly compared with climate change, at least partly due to the shorter lifetime of air pollutant species. Thus, mitigation of air pollutant emissions should be continued, as these have the potential to decreasing the overall load on mountain ecosystems such as the Pyrenees.

## Short articles on selected new papers and manuscripts

### Atmospheric nitrogen deposition restricts future sub-arctic treeline advance in an individual-based dynamic vegetation model

Arctic high-latitude ecosystem composition is undergoing change, mainly advancement of trees into tundra and increased abundance and size of shrubs. We have studied how key climatic and environmental drivers (climate, nitrogen deposition and carbon dioxide) could affect distributions of major ecosystem types in the Torneträsk area using using a dynamic vegetation model (LPJ-GUESS). Our finding is that atmospheric nitrogen deposition can modulate a treeline advance driven largely by temperature increases.

*Lake Torneträsk, northern Scandinavian Mountains, Sweden.*

**Learn more**:
Gustafson et al., 2021. https://doi.org/10.5194/bg-18-6329-2021

### High-resolution ecosystem modelling reveals loss of Fennoscandian tundra

We have studied the impact of climate change on vegetation composition in Fennoscandia by using a unique high-resolution (3km) climate scenario to drive a dynamic vegetation model (LPJ-GUES) including a newly developed reindeer grazing module. The simulations show a dramatic shift in vegetation composition, accelerating at the end of the 21st century, resulting in the southern Swedish alpine region being completely covered by forests. This could make it difficult to preserve many rare and threatened species in the southern regions. In the northern alpine regions, most vegetation types could persist but shift to higher elevations with a reduced areal extent. This also has implications for reindeer grazing practices, where differences in food availability between the northern and southern regions will diminish or even shift to become higher in the north, especially for the summer grazing grounds.

*Meadow on the border between the national parks Sarek and Padjelanta, with blue bell in the foreground. Scandes Mountains, Sweden. Photo: E. Sjökvist.*

**Learn more**:
Lagergren et al., 2023. Submitted.

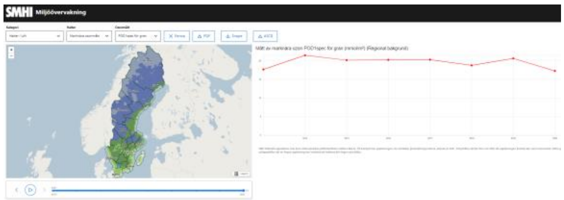
## Nitrogen in high-Alpine ice cores – a high model resolution improves estimates

Atmospheric chemical transport modeling of nitrogen and sulfate in precipitation at different high-Alpine sites shows that a higher resolution improves the spatial variation in deposition. A recently submitted paper shows that model estimates exhibit a strong decrease in both nitrogen and sulfur deposition since the 1980:s. This compares well to sulfur observations extracted from ice cores but corresponding nitrogen observations do not decrease. The cause for the discrepancy remains to be investigated further.

*Glacier in the Alps. Photo: H. Pleijel.*

**Learn more**: Eichler et al., 2023. Submitted.

## Innovative method to improve atmospheric deposition estimates for ecosystem impacts studies - future roadmap



*The MATCH Sweden system is the only operational measurement model fusion system for total atmospheric deposition. It has been operating since the 1990s, funded by the Swedish EPA.*

High-quality estimates of atmospheric deposition are of vital importance for environmental impact studies, from mountain ecosystems to the whole world. A paper was published describing the priorities, needs and possibilities for a global production of timely, high-quality deposition estimates. The road-map describes a production that includes innovative, state-of-the-art measurement model fusion approaches combining ensemble modeling with observations, both from satellite and ground based measurements. An operational production of atmospheric deposition estimates on a national scale is currently only deployed by Sweden, while such methods also have been developed in North America (Canada and USA). The work was endorsed by the world meteorological organization.

**Learn more**:
https://luftwebb-miljoovervakning.smhi.se/SMHI-luftwebb-miljoovervakning-app/

Fu et al., 2022.Environ. Sci. Technol.
https://doi.org/10.1021/acs.est.1c05929;

## Exposure to smoke-plume from 2018 Swedish wild fires

Sweden experienced wide-spread wildfires in 2018, and the region Jämtland-Härjedalen was particularly impacted. This is a low-densely populated area. We modeled the emission, chemistry and transport of wildfire emissions in a nest from European to sub-national scale, to describe population exposure to particles (PM2.5) from the 2018 wildfire. We showed that the exposure led to a significant increase in daily asthma visits, with a relative risk of 1.68. This research was done in collaboration with the research project ACROBEAR.

*Wild fires emit smoke that can cause adverse health impacts, but also other pollutants that lead to increased nitrogen deposition and tropospheric background ozone.*

**Learn more**:
Tornevi et al., 2022; Andersson et al., 2023.
https://doi.org/10.3390/ijerph1813987

## Exposure to near-surface ozone causes 7% of preterm births in Europe - problem remains in 30 years

Preterm birth is the largest contributor to neonatal mortality globally, and associated with several adverse health outcomes. A recent paper shows that 7% of European (EU30) preterm births in 2010 were due to maternal exposure to near-surface ozone.

Projected air quality improvements in 2050 due to emission decreases in current legislation causes the number of attributable cases to decrease by 30%, however with a penalty of climate change in southern and central Europe. The maternal exposure to near-surface ozone is expected to have a substantial impact on public health also in mid-21$^{st}$ century.

**Learn more**: Ekland et al., 2021. *Environ. Res. Lett. 16.*
https://doi.org/10.1088/1748-9326/abe6c4

## Model ensemble confirms decreasing exposure to fine particulate matter in Europe

A multi-model ensemble investigated the robustness of trends in fine particulate matter (PM2.5 and PM10) in Europe in comparison with observations for the period 2000-2010. This work was conducted in collaboration between teams in the framework of the Eurodelta-trends (EDTRENDS) initiative, under the Task Force of Measurement and Modellng (TFMM).

Both PM2.5 and PM10 concentrations decreased over the period, by 10% and 30% respectively across most of Europe. The models showed reasonable similarity in trends, with an inter-model variability of less than 30-40% in most parts of Europe except in the north and east. This shows that the modeled decrease in PM2.5 and PM10 is robust.

**Learn more**: Tsyro et al., 2022.
https://doi.org/doi.org/10.5194/acp-22-7207-2022

# Short news articles on selected conference contributions

## Swedish climate symposium, 2022

Results from the project were presented at the Swedish climate symposium in Norrköping, Sweden, in May 2022. In an oral presentation, a summary of results for the Scandes case were presented, spanning from high resolution climate change in the Scandes, through future change in air pollutant load to future change in vegetation types and sensitive nature.

**Learn more:** Andersson et al., 2022. BioDiv-Support.
https://swedishclimatesymposium.com/

## United Nations Food Systems Summit, 2021

We presented impacts of ground-level ozone deposition to food production, and its coupling to climate change and changes in growing season in Sweden, at the United Nations Food Systems Summit (UNFSS) Science days in 2021. The contribution also included a panel discussion on impacts, mitigation of and potential adaptation to ozone pollution to crops.

**Learn more**:
Andersson et al., 2021. Ground-level ozone deposition to Sweden: food production.

## European Geophysical Union, 2021

We presented and discussed results from interactions with end users, focusing on indices most relevant for the web tool and end user needs.

**Learn more**: Andersson et al., 2021. BioDiv-Support: scenario-based decision support tool for policy planning and adaptation to future challenges in biodiversity and ecosystem services.

## BioDiv-Support final general assembly November 2022

The final project meeting was held in Paris November 14-15, 2022. The hybrid meeting was hosted by INERIS, with 9 physical and 5 online participants. Results from the project were summarized and dissemination activities were planned.

*Photo: C. Andersson.*


# Acknowledgement

The project is funded through the 2017-2018 Belmont Forum and BiodivERsA joint call for research proposals, under the BiodivScen ERA-Net COFUND programme, and with the funding organisations AKA (contract no 326328), ANR (ANR-18-EBI4-0007), BMBF (KFZ: 01LC1810A), FORMAS (contract no:s 2018-02434, 2018-02436, 2018-02437, 2018-02438) and MICINN (through APCIN: PCI2018-093149).



**Contact:** biodiv-support@smhi.se

**PIs:**

Camilla Andersson, SMHI, Sweden
Augustin Colette, INERIS, France
Robert Björk, UGOT, Sweden
Thomas Hickler, BiK-F, Germany
Jukka-Pekka Jalkanen, FMI, Finland
Paul Miller, LU, Sweden
Gunhild Rosqvist, SU, Sweden
Marta Vivanco, CIEMAT, Spain