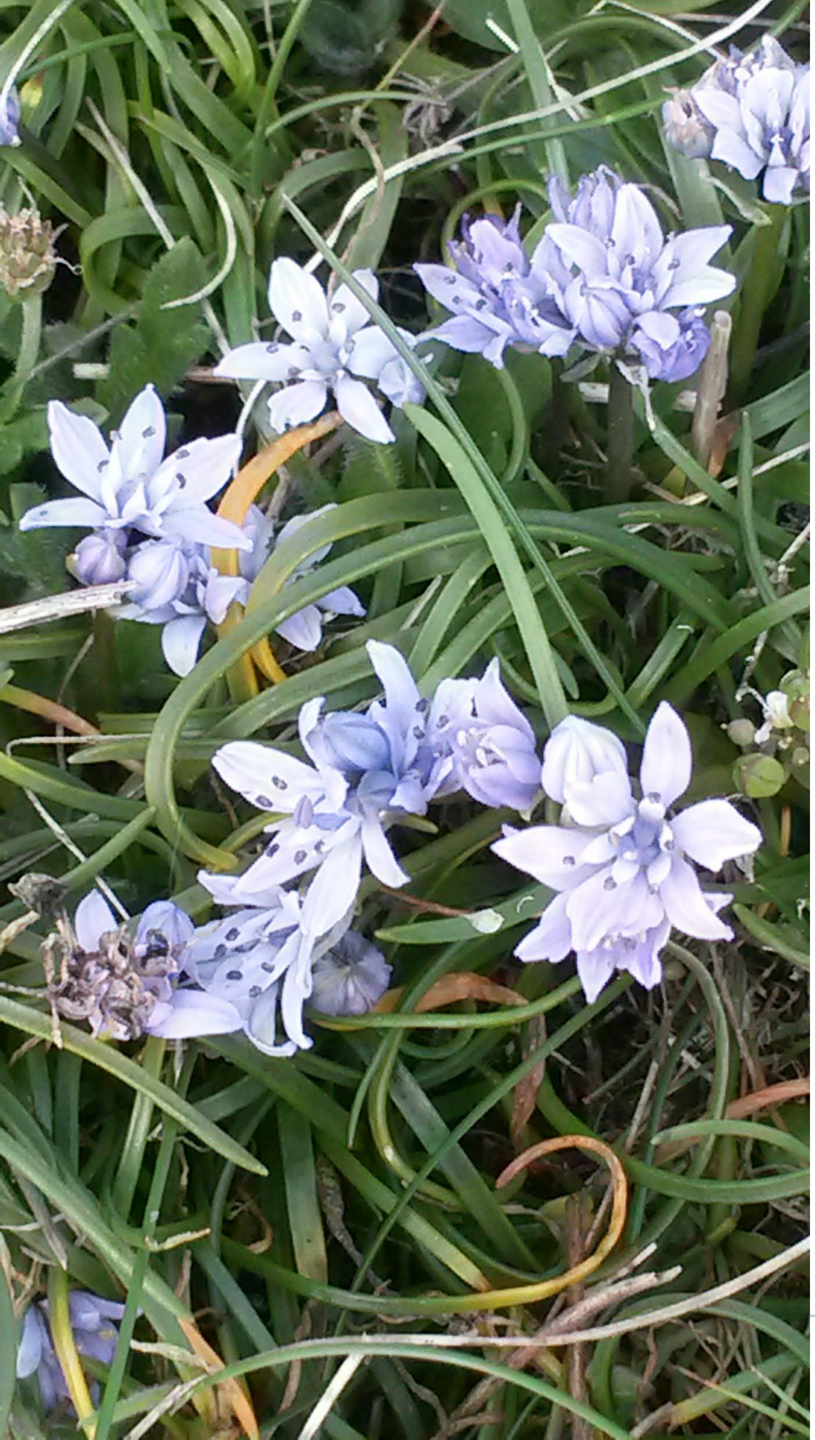


ICP Vegetation update

Felicity Hayes, Katrina Sharps and Mike Perring
ICP Vegetation Coordination Centre, UKCEH*

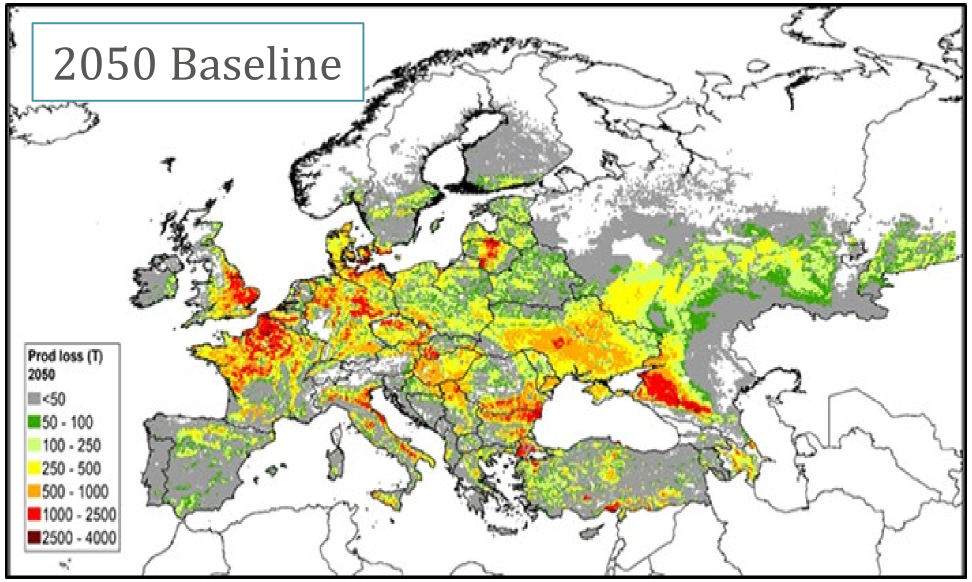
** Financial support provided by Defra (UK) and UNECE*

Task Force Meeting 2024

In person: 19-22 February 2024. Hosted by Lithuanian Research Centre for Agriculture and Forestry.
62 registered participants

Next meeting will be In Person (hopefully!), 10-13 February 2025 in Albania

Review of the effectiveness of the Gothenburg Protocol



ICP Vegetation will produce maps and tables of impacts 'as required'

Wheat production loss (Tonnes) due to ozone, using the POD_3IAM metric.

Deciduous forest biomass increment (related to biodiversity risk)

More limited coverage for **grassland biodiversity**

Methane vs Other Emissions as Ozone Precursors

Ex-post analysis using outputs from EMEP MSC-West in comparison to the current legislation (CLE) scenario for 2050, (which includes 2050 methane levels).

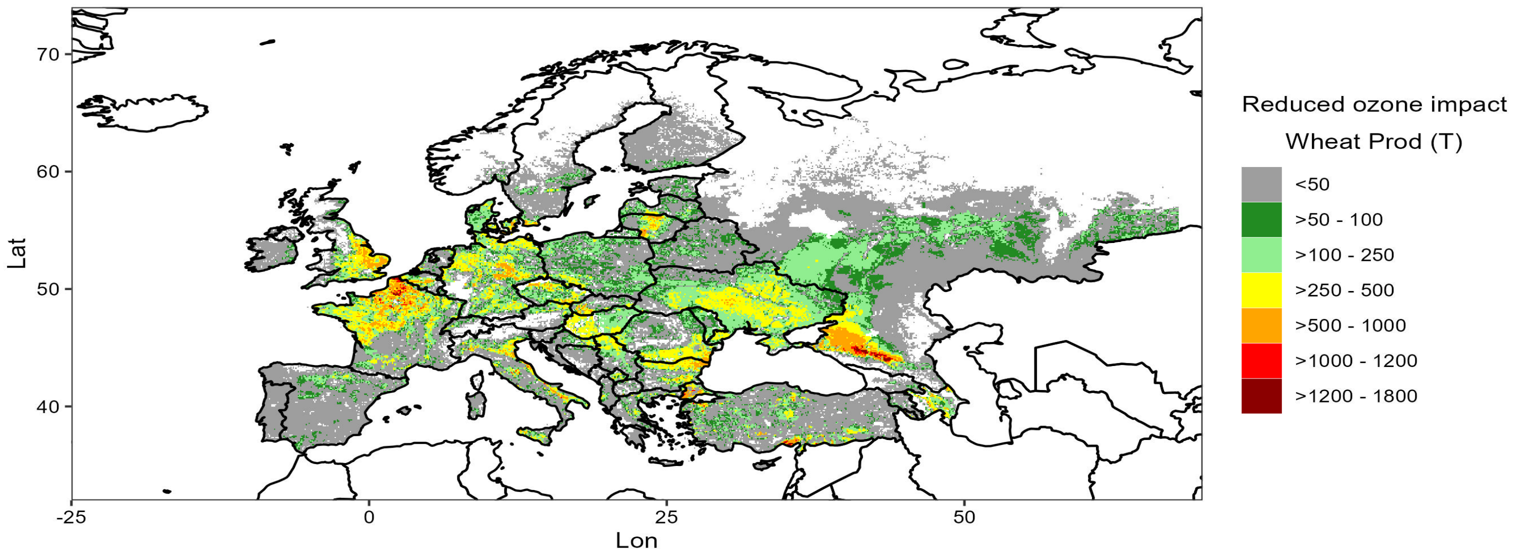
a) reducing non-methane emissions globally (LRTAP + Rest Of World) **and** background methane concentrations (i.e. using the full LOW scenario).
b) reducing non-methane emissions globally (LRTAP + Rest Of World) using the LOW scenario, but **without** reducing methane.

In both cases, results are 'potential avoided wheat production losses'

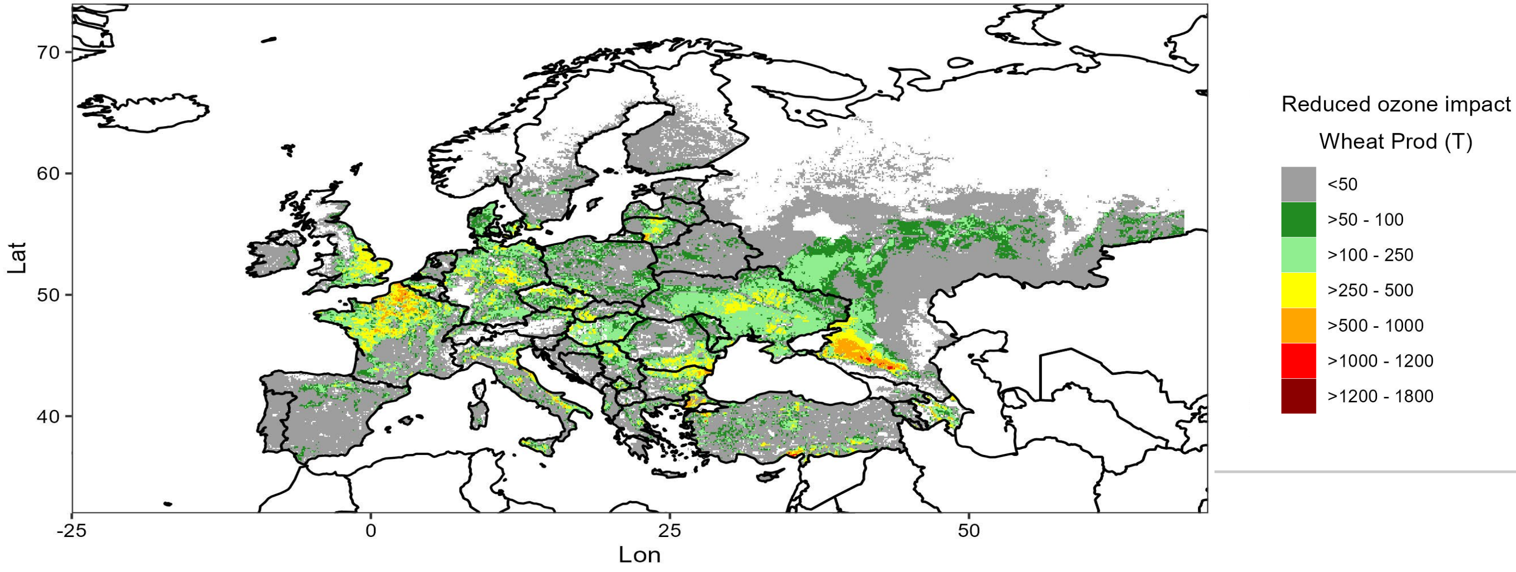
Note: The LOW scenario is a very ambitious scenario that goes beyond the maximum technical feasible (MFR) scenario in that it includes climate policies compatible with Paris goals and developments in the agricultural sector

Avoided wheat production losses, LOW vs CLE, 2050 (GLOBAL)

All emissions globally (non CH4 **and** CH4)



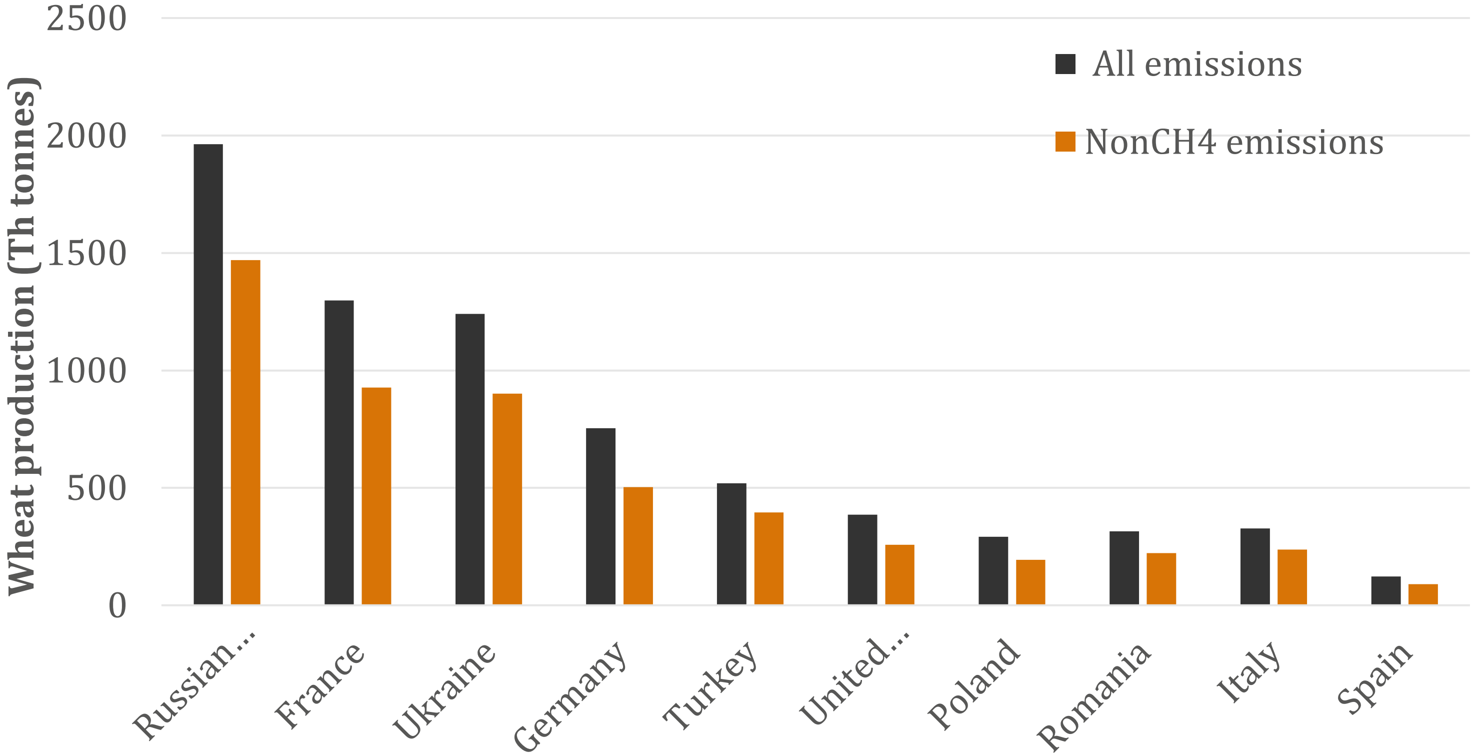
Non CH4 emissions globally



The LOW emissions reduction scenario in 2050 (compared to CLE) would avoid wheat production losses of 7.2 million tonnes, for the top 10 wheat producing countries in the EMEP domain.

When only non-CH4 emissions are considered (i.e. background methane kept constant at 2050 levels), the saving in wheat production is reduced, but values are still 5.8 million tonnes for the top 10 wheat producing countries in the EMEP domain.

Avoided wheat production losses, LOW vs CLE, 2050 (GLOBAL)



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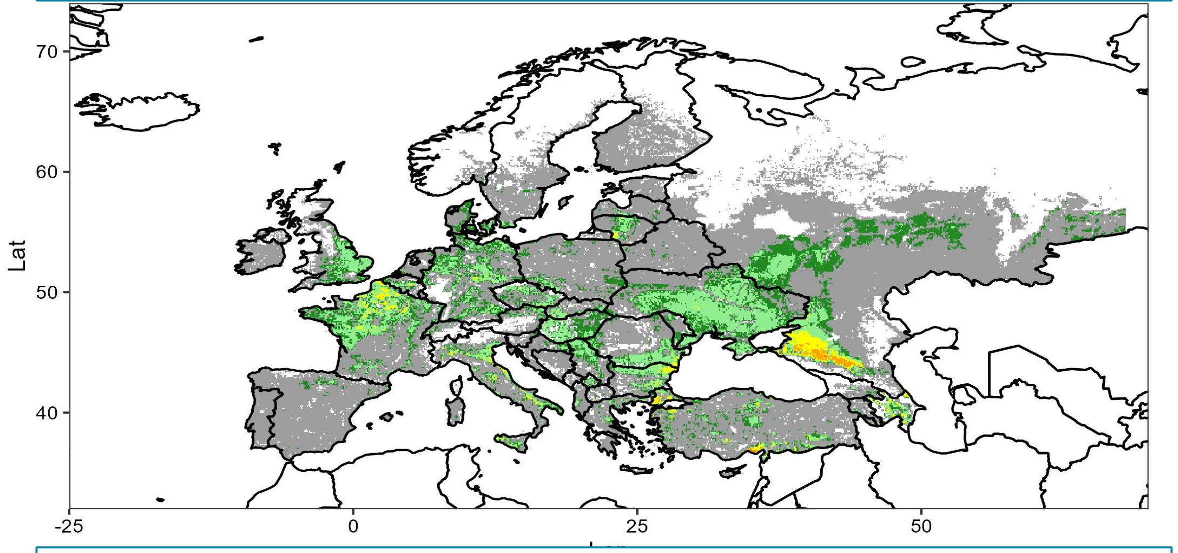
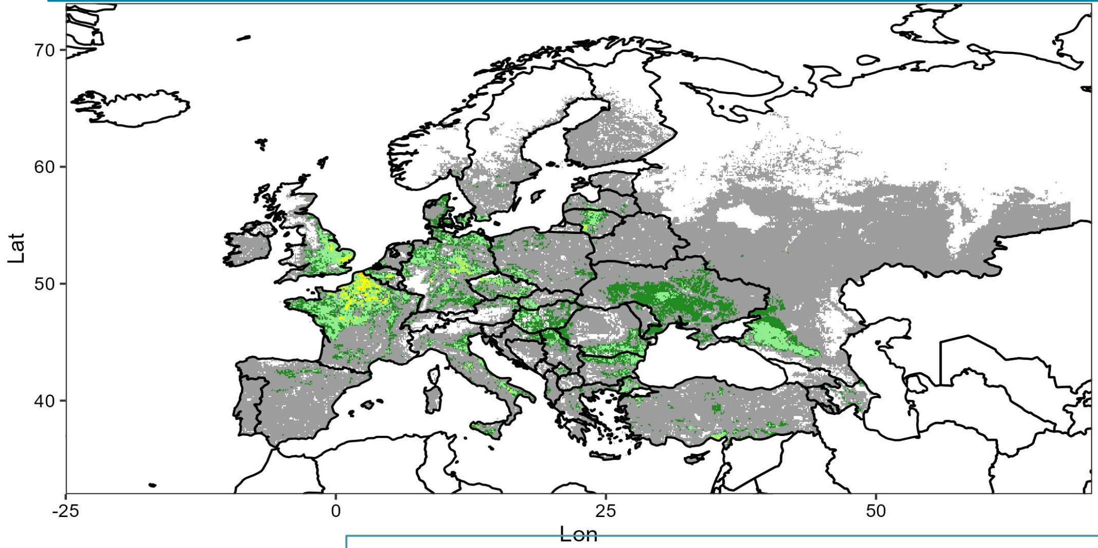
Avoided wheat production losses, LOW vs CLE, 2050 (Regional/ROW/CH4)

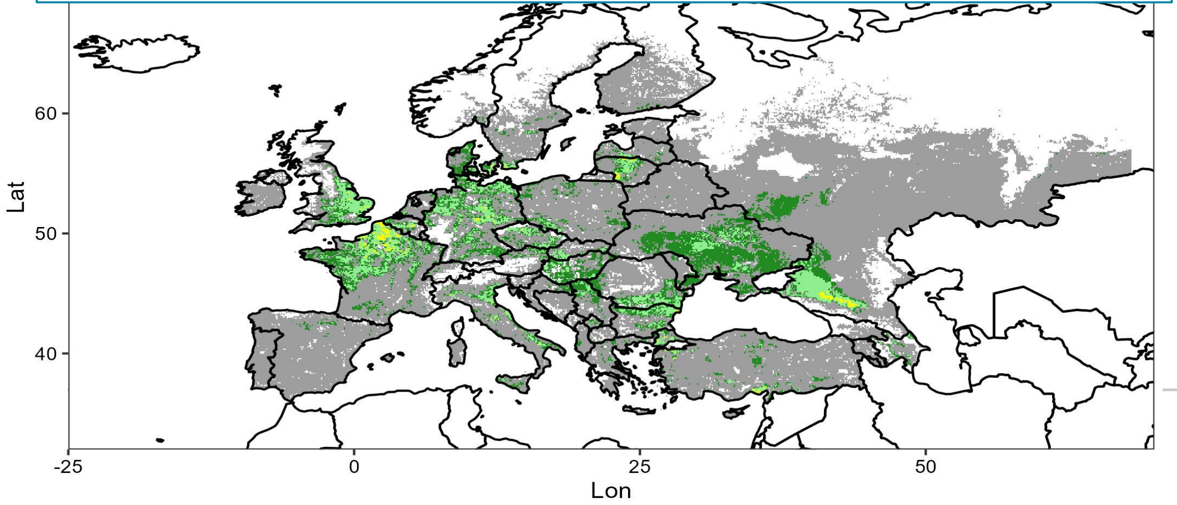
LOW emissions within LRTAP only (non CH4 only)

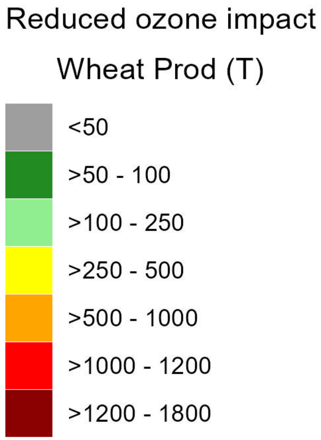


LOW emissions for Rest of World only (non CH4 only)



Reduction in global methane (when emissions are already LOW in CLRTAP and Rest of World)



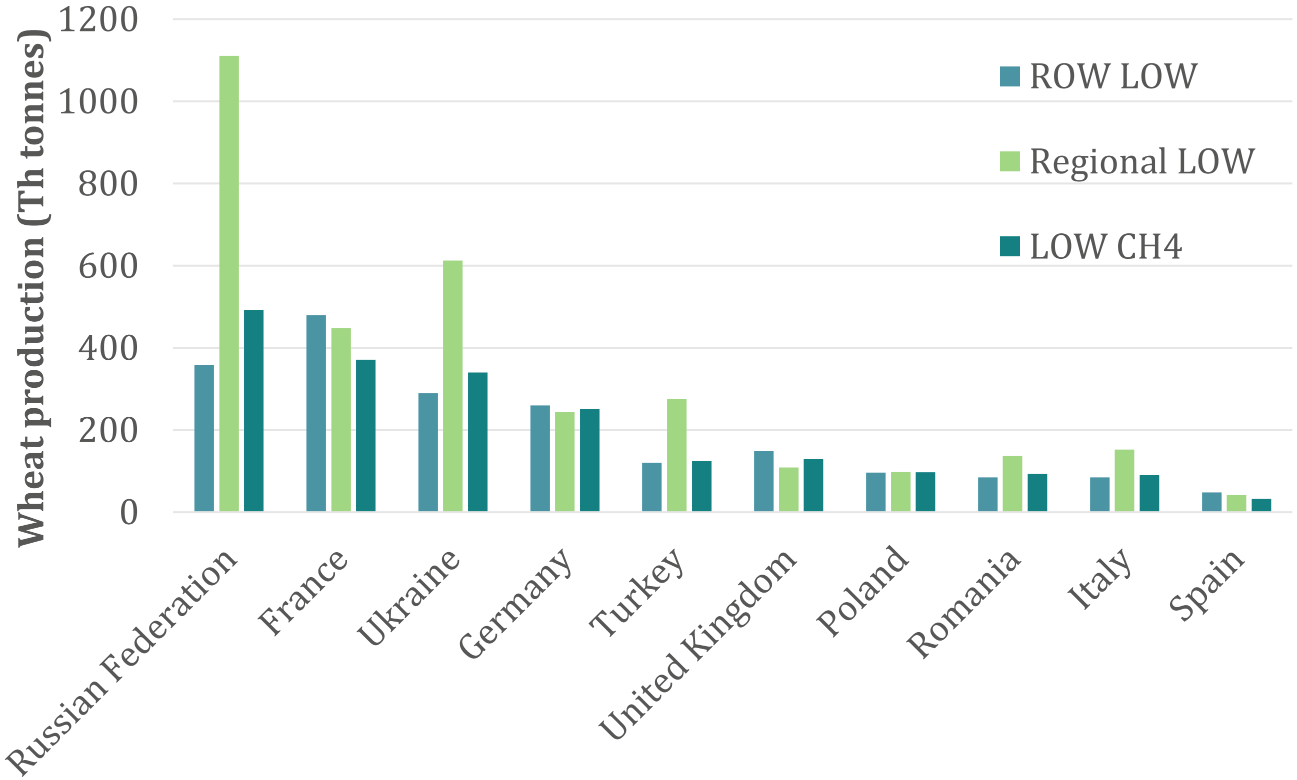


Scenarios have been compared to allow regional, ROW and reducing only methane to be looked at individually.

The impact of CH4 is comparable to the impact of ROW LOW and regional LOW emission reductions.

Reducing future methane concentrations will have an important role in reducing ozone impact on crop production.

Avoided wheat production losses, LOW vs CLE, 2050 (Regional/ROW/CH4)



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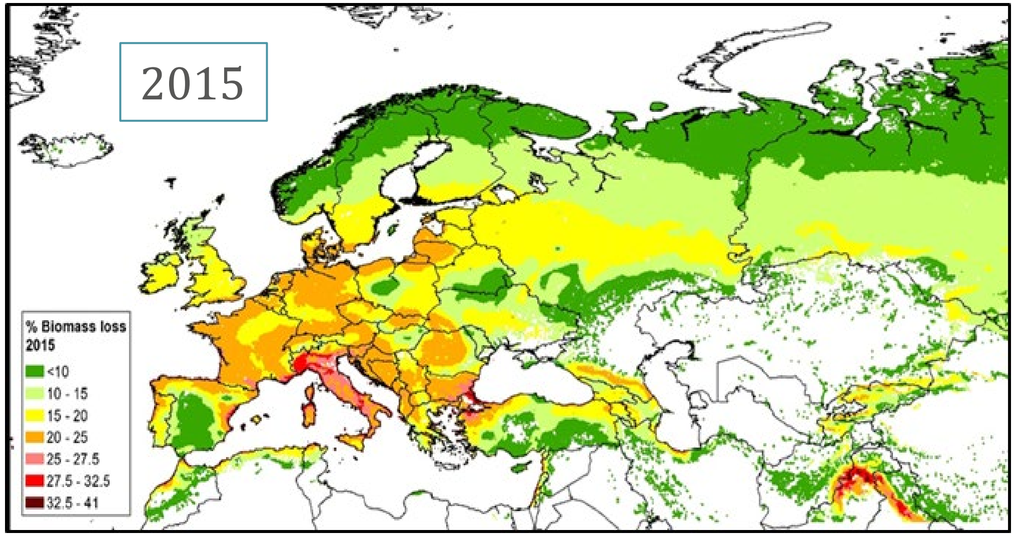
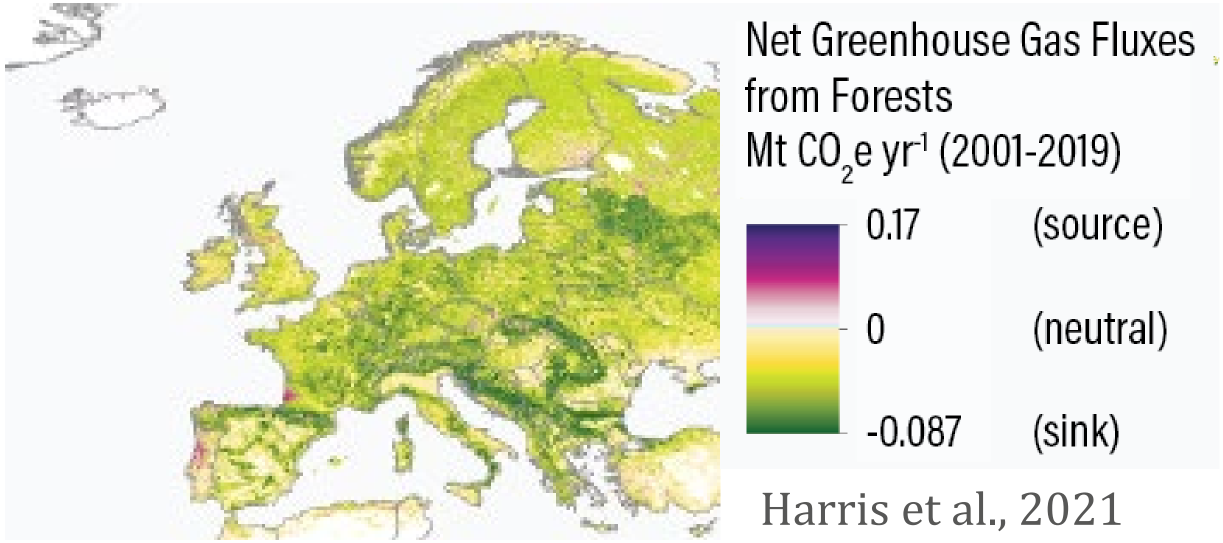
Ozone impacts on carbon sequestration by trees

Workplan item 1.1.1.14



Risk of reduction in annual growth of living biomass

Risk from ozone is high in some regions with high existing tree biomass. Potential for large increases in sequestration in some regions if ozone is reduced.



Harris et al., 2021

Impact of ozone on tropical forests

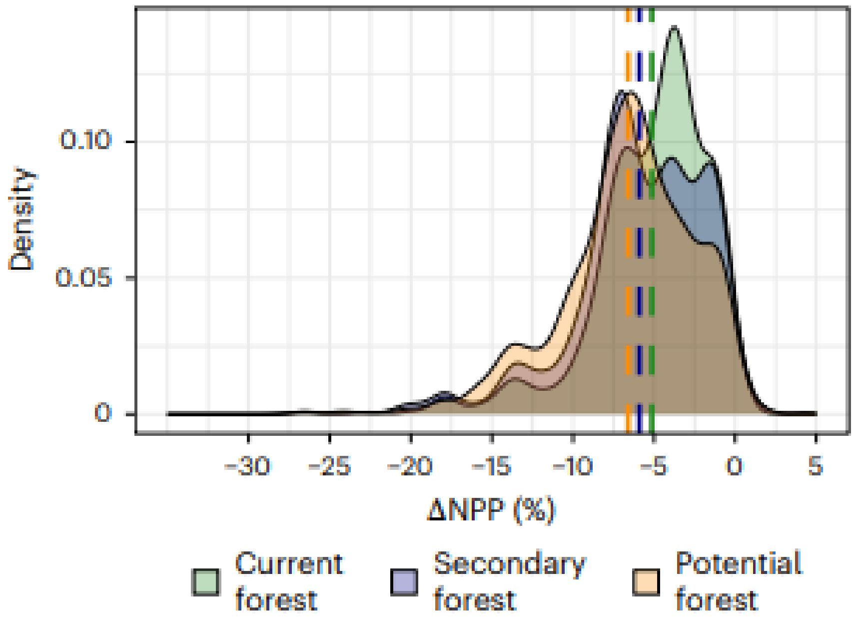


Fig. 3 | Impact of O_3 on productivity across different tropical forests. Normalized distribution of predicted change in NPP across tropical forest types as a result of anthropogenically derived [O_3], assuming a moderate O_3 susceptibility. The figure represents the ten-year average (2005–2014) weighted by grid-cell area and fraction of existing tropical forests (average −5.1%), current secondary forests (average −5.9%) and areas of potential forest restoration (average −6.6%).

Workplan item 1.1.1.14

NPP of tropical forest is reduced by ozone (5.1% to 6.6% depending on forest type)

Secondary forest and areas of potential forest restoration in tropical regions are at greater risk of ozone impacts than existing intact forests (due to their location generally being nearer regions of land-use change and/or urbanisation)

Cheesman et al., 2024

Review of NOx Critical Levels – in progress

Workplan item 1.1.1.15

Current critical levels are:
Annual mean 30 μg m^3
24h mean 75 μg m^3

Evidence of impacts on sensitive ecosystem components (e.g. lichens) below these levels

Currently reviewing data to make recommendations – difficulties due to changing pollution landscape since the early studies (with high SO_2) compared to more recent studies

Lichen biodiversity

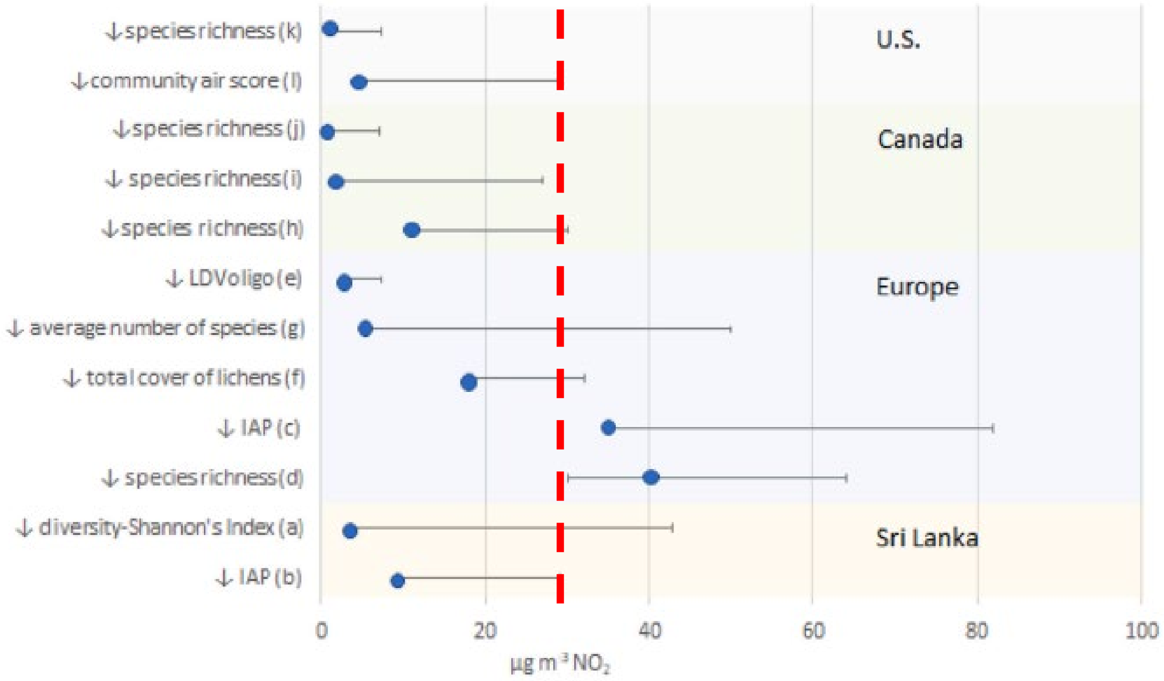


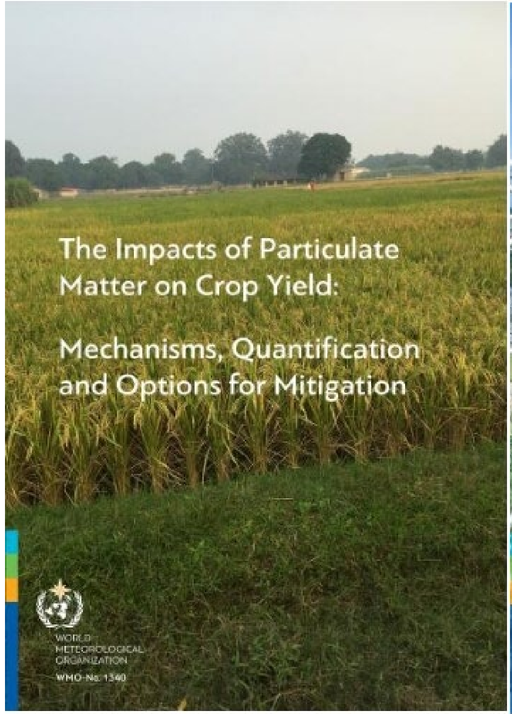
Fig. 3. Studies evaluating the effects of NO_2 on lichen biodiversity. a= (Attanayaka and Wijeyaratne, 2013), b=(Yatawara and Dayananda, 2019), c=(Cepeda Fuentes and Barcia Rowe, 1998), d=(Davies et al., 2007), e=(Pinho et al., 2008), f=(Manninen, 2018), g=(Watmough et al., 2017), h=(Watmough et al., 2014), i=(Gadsdon et al., 2010), j=(Gibson et al., 2013), k=(Perlmutter et al., 2018), l=(Jovan et al., 2012). LOEC levels are indicated by circles, and bars represent the range of NO_2 exposures observed in the study.

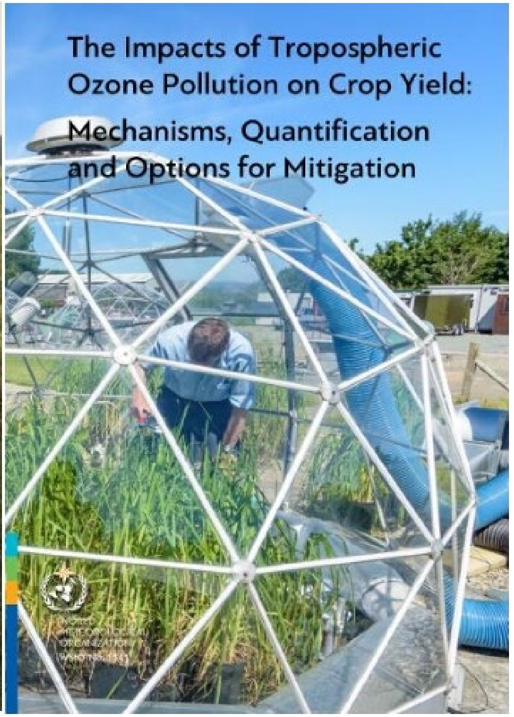
Modified after Greaver et al. 2022

Reports published with World Meteorological Organisation

- The Impacts of Particulate Matter on Crop Yield: Mechanisms, Quantification and Options for Mitigation (WMO-No. 1340) - https://library.wmo.int/idurl/4/68653

- The Impacts of Tropospheric Ozone Pollution on Crop Yield: Mechanisms, Quantification and Options for Mitigation (WMO-No. 1341) - https://library.wmo.int/idurl/4/68654

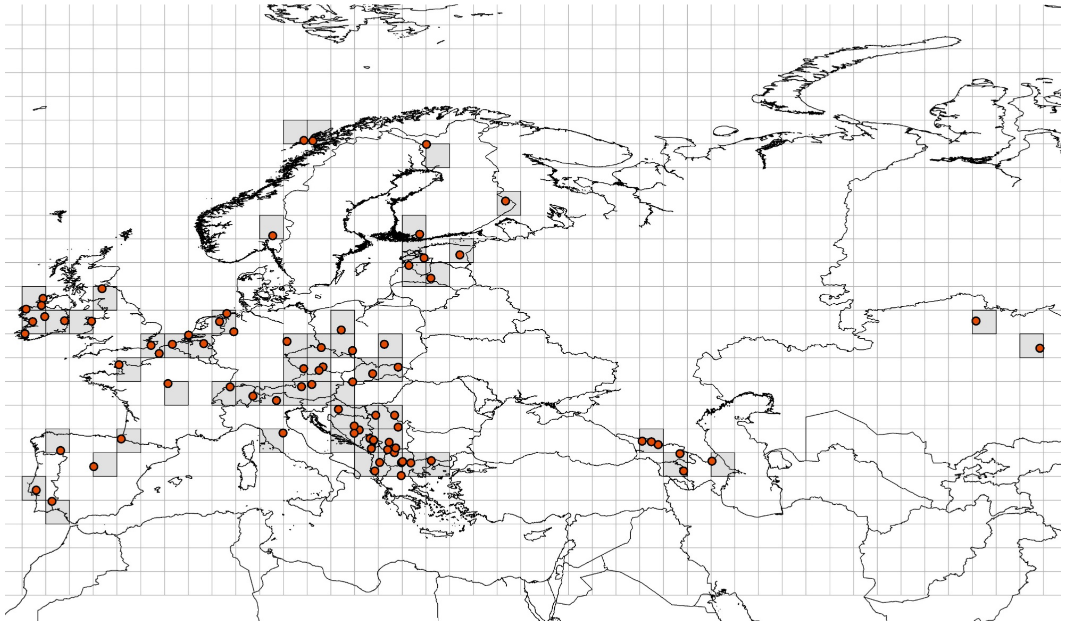




PM is affecting crop production in many of the world's key agricultural areas, including those in Central Africa, Pakistan, India, China and South-East Asia. People living in these areas are also at risk of health impacts from PM, with concentrations in exceedance of WHO AQG levels for health, often by a factor of 5–10 times, or more.

Microplastic Atmospheric Deposition Assessment using Moss in Europe (MADAME)

Workplan item 1.1.1.13



Airborne microplastics are found throughout the UNECE region, even in rural areas such as Scandinavia and western Ireland.

Mosses can be used as a biomonitor for microplastics, but does cause some analytical challenges. Moss is difficult to chemically digest in large quantities.

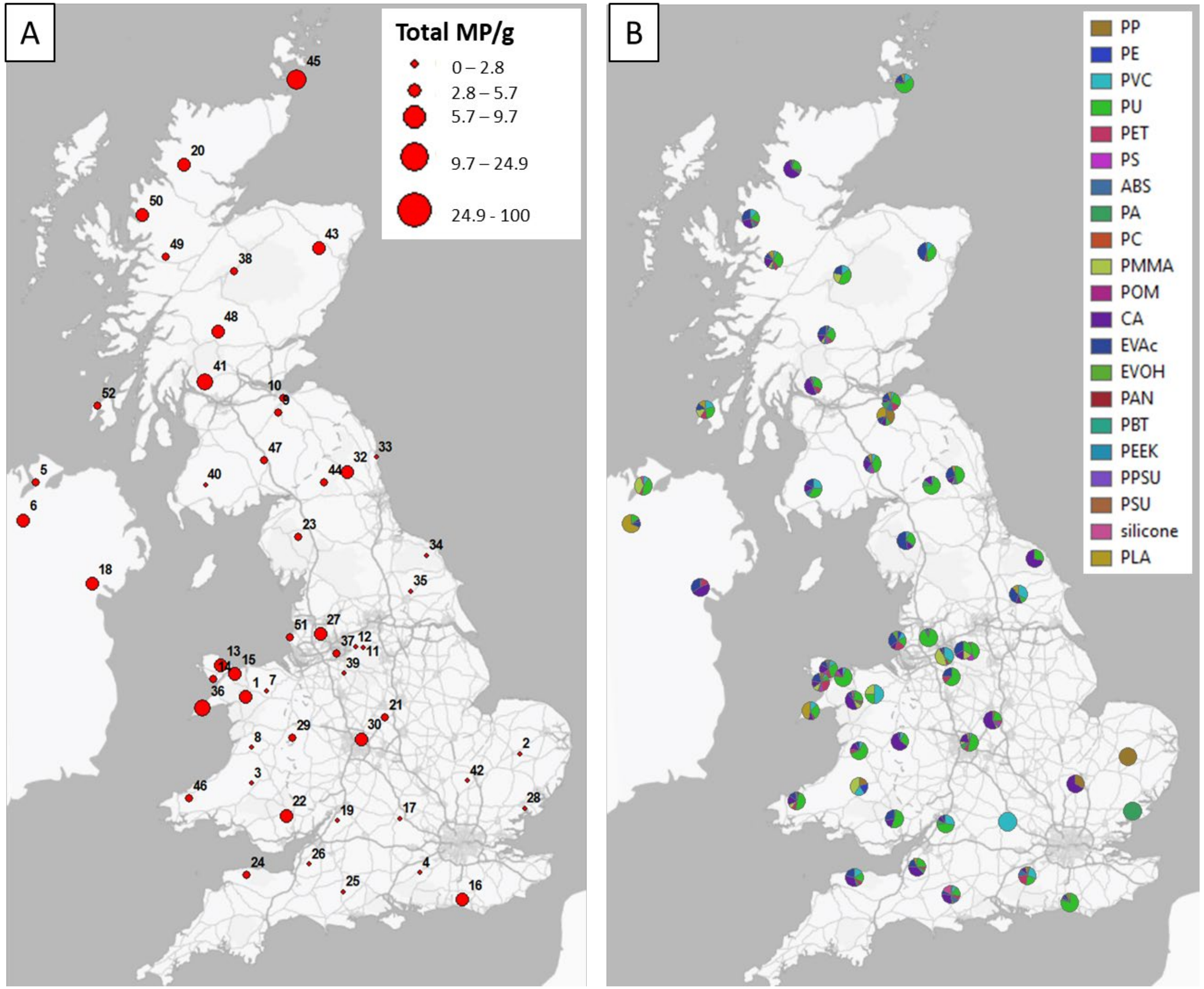
MADAME has found a wide range of microplastics in moss samples:

- textiles
- plastic litter
- foams

- polyurethane
- cellulose acetate
- polyethylene

Questions remaining about sources, retention time in moss, whether internal or external, impacts

Microplastic content of moss from UK samples



Microplastics found in 50 sites (out of 52).

Polyurethane was the most commonly found (diverse sources including flexible foam, insulation, clothing).

Microplastics associated with 'litter' (e.g. polyethylene and polypropylene) were less common.

Different types of microplastic compared to those found in rivers.

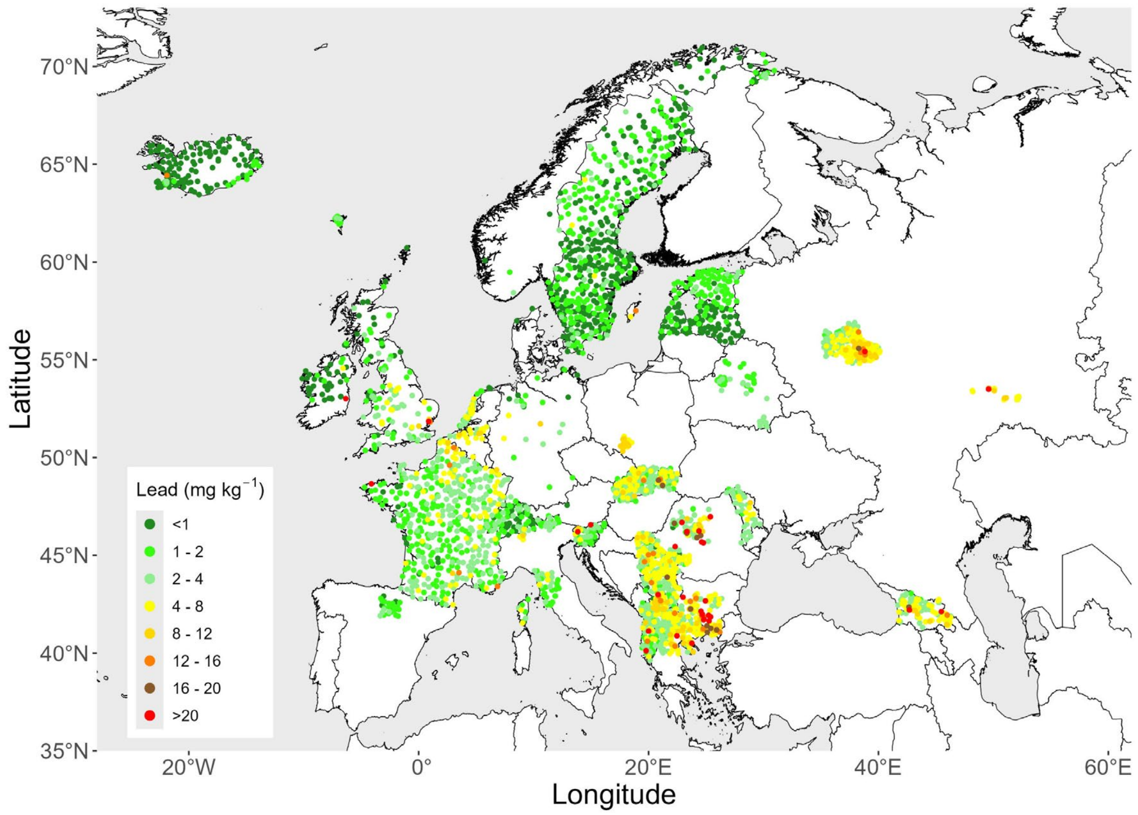
Microplastics were found in 'very rural' areas.

Moss results from 2020 survey (draft)

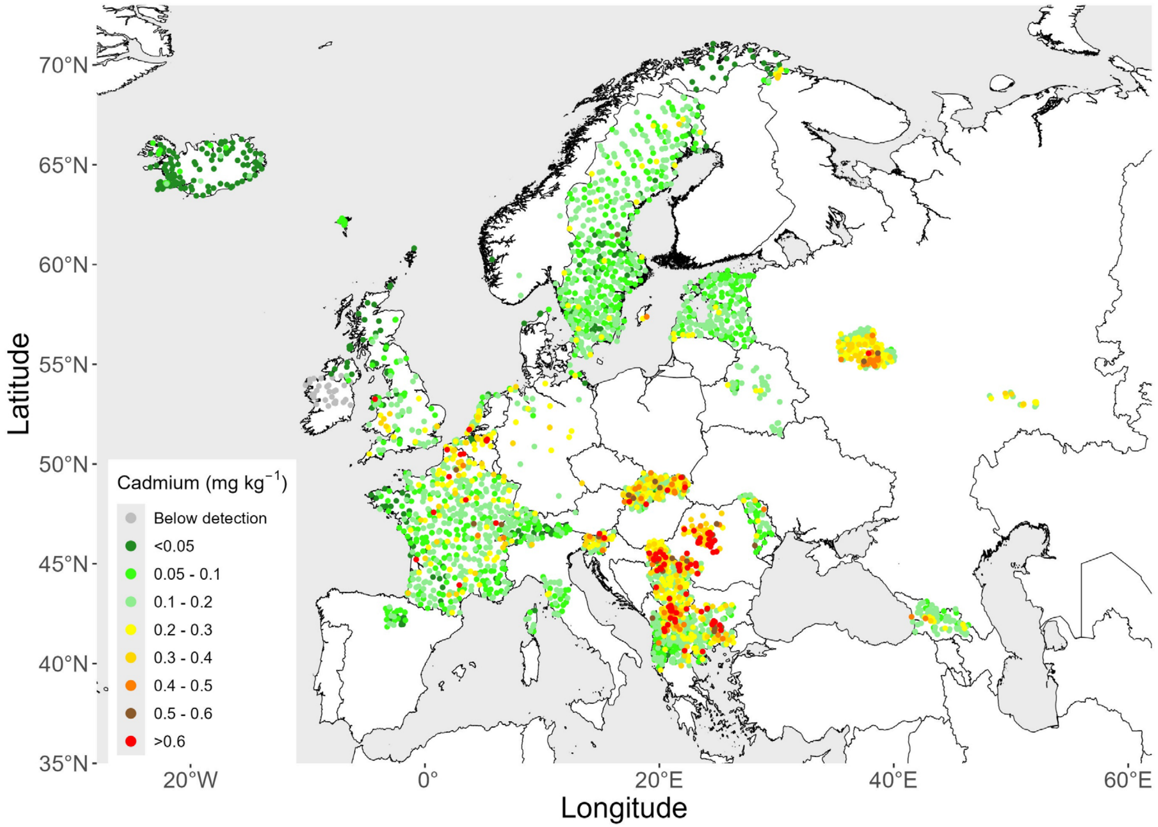
Final few datasets are being checked

Workplan item 1.1.1.13

Lead



Cadmium



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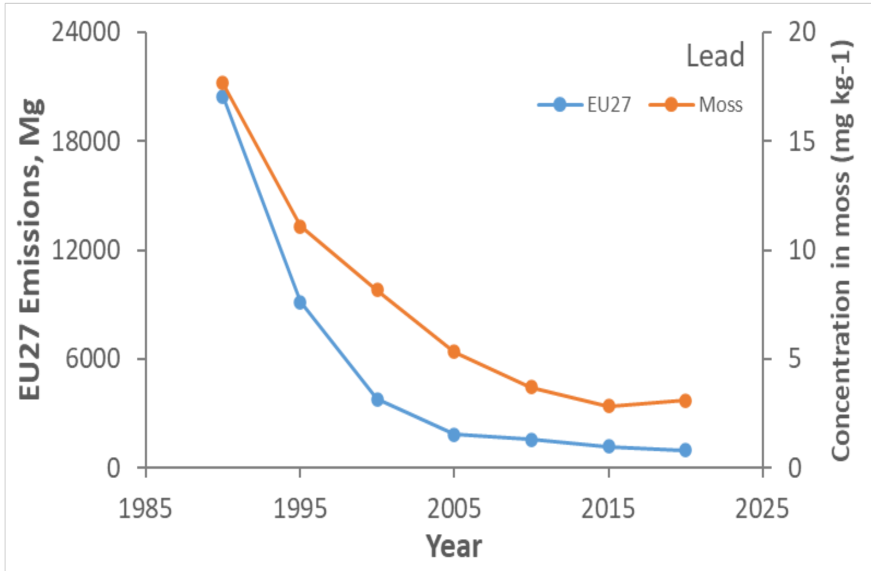
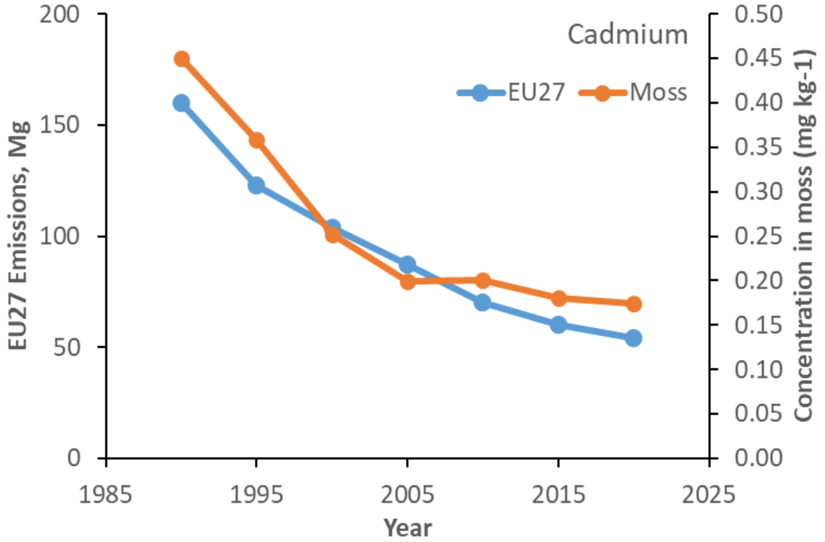
Workplan item 1.1.1.13





Lead

EU Emissions: 95.2 %

EU Moss: 82.5 %

Cadmium

EU Emissions: 66.3 %

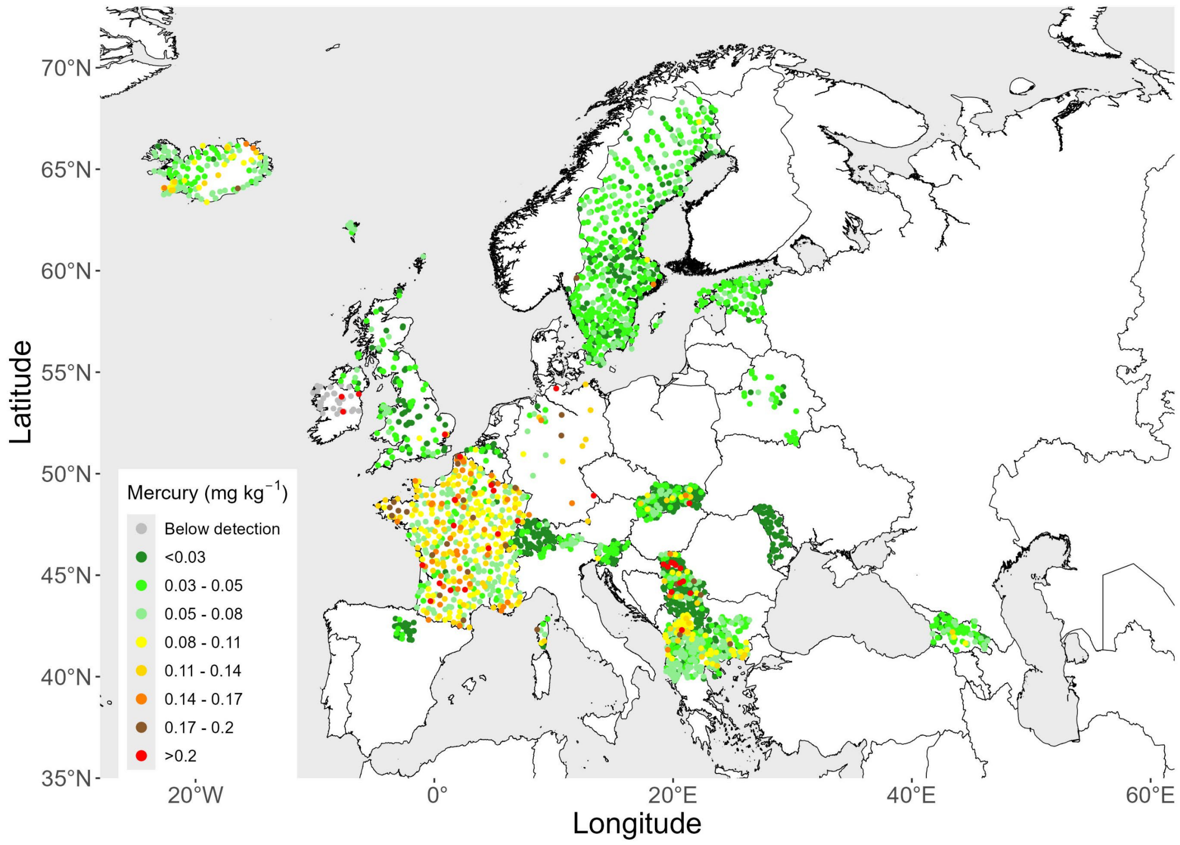
EU Moss: 61.5 %

Moss results from 2020 survey (draft)

Final few datasets are being checked

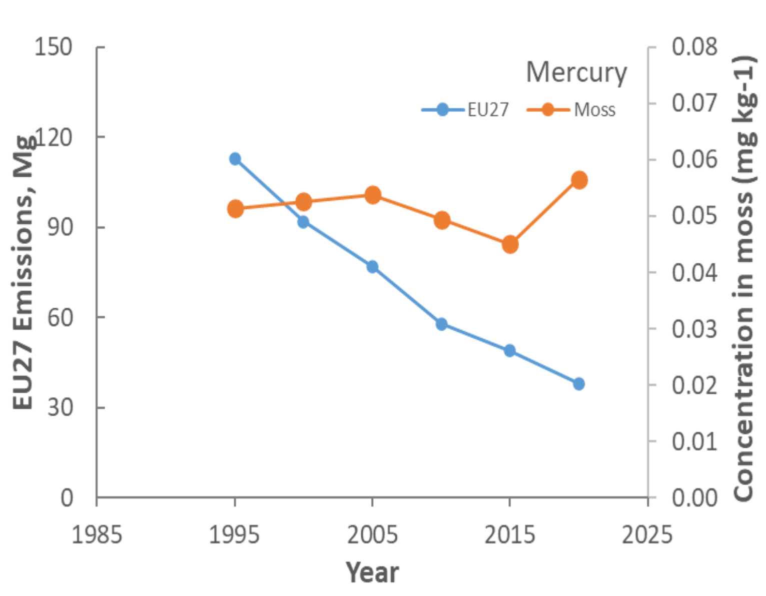
Workplan item 1.1.1.13

Mercury



EU Emissions: 66.4 %

EU Moss: -10.0 %



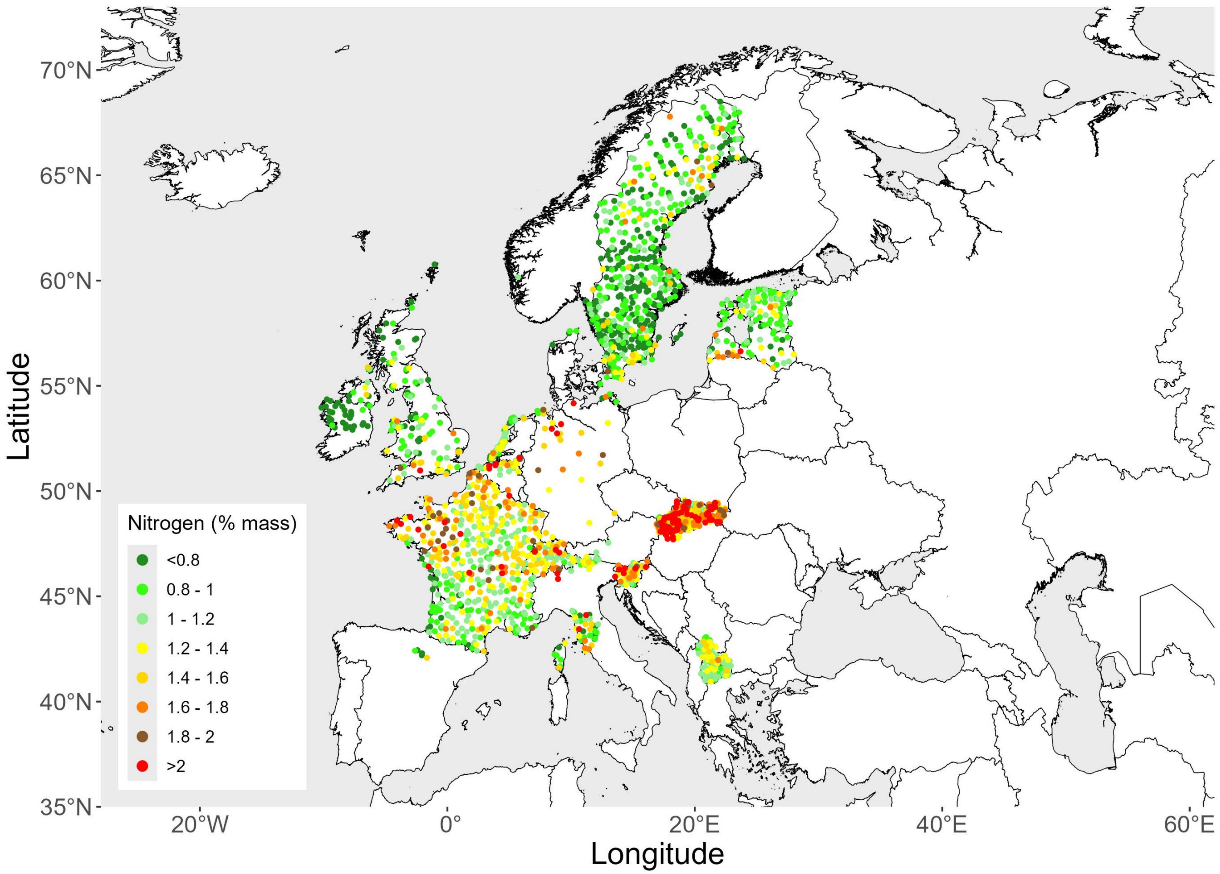
UK Centre for Ecology & Hydrology

Moss results from 2020 survey (draft)

Final few datasets are being checked

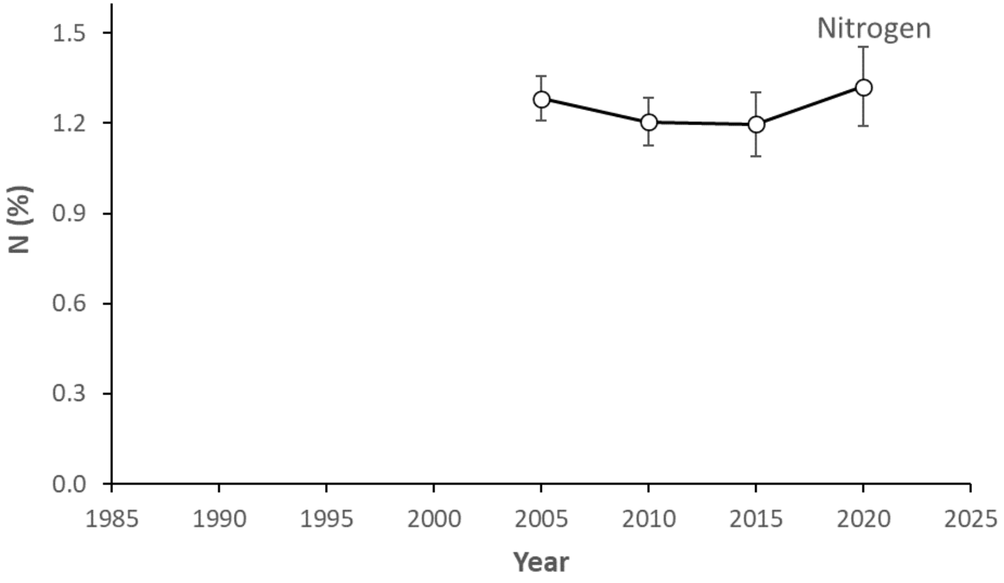
Workplan item 1.1.1.13

Nitrogen



Nitrogen

Moss: -3.13 %



Outreach

Assisting Indian scientists to parameterise and run the DO_3SE ozone flux model for wheat in India using a local parameterisation

Incorporating a nitrogen module into the DO_3SE model to quantify the impact of ozone on grain protein of wheat (using data from India and Europe)

Sugarcane productivity loss due to ozone of 5.6% to 18.3% (collaboration including researchers from Brazil)

Testing ozone sensitivity of tropical vegetation (crops and trees) to develop an awareness guide

Ozone impacts on urban trees (collaboration with researchers from China)

Facilitating analysis of moss samples for metals for countries without analytical capability

Ozone diffusion tubes measuring within a cocoa plantation in Ghana. Lakpo Agboyi (CABI)

ICP Vegetation Workplan (2024/2025)

Number	Item	Notes
1.1.1.13	Call for data for moss survey 2025-2026	
1.1.1.13	Report on results from 2020– 2021/22 moss survey on HM, N and POPs	In progress
1.1.1.13	Report of survey of microplastic content of mosses (2022/2023) and potential for use of mosses as bioindicators of airborne microplastics	In progress
1.1.1.14	Develop state of knowledge report: Impacts of O3 on C sequestration in Europe	With ICP Forests
1.1.1.15	Review critical levels for NOx	In progress
	Additional work relating to the Review of the Gothenburg Protocol, and impact to vegetation from the methane contribution to ozone formation	In progress

Thank you