Heavy metal pollution assessment within EMEP: Progress and plans

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Joint EMEP SB/WGE meeting, September 2022

Heavy metal research and assessment in 2022

- Operational assessment of HM (Cd, Pb, Hg) pollution in 2020
  - Collection and analysis of monitoring data (CCC)
  - Compiling, gap-filling and gridding of emissions data (CEIP)
  - Model assessment of transboundary pollution (MSC-E)
- Country-scale study of Hg pollution in Norway (national experts, TFMM)
- Scientific co-operation on Hg assessment (national experts, AMAP, TF HTAP)
  - Assessment of Hg pollution in the Arctic
  - Co-operative activities within TF HTAP
- A pilot study of HM pollution from wildfires (TF HTAP)
- Co-operation with WGE: Trend analysis (ICP-Vegetation)
- Outreach: Marine pollution assessment (OSPAR, HELCOM)
- GLEMOS model open source distribution

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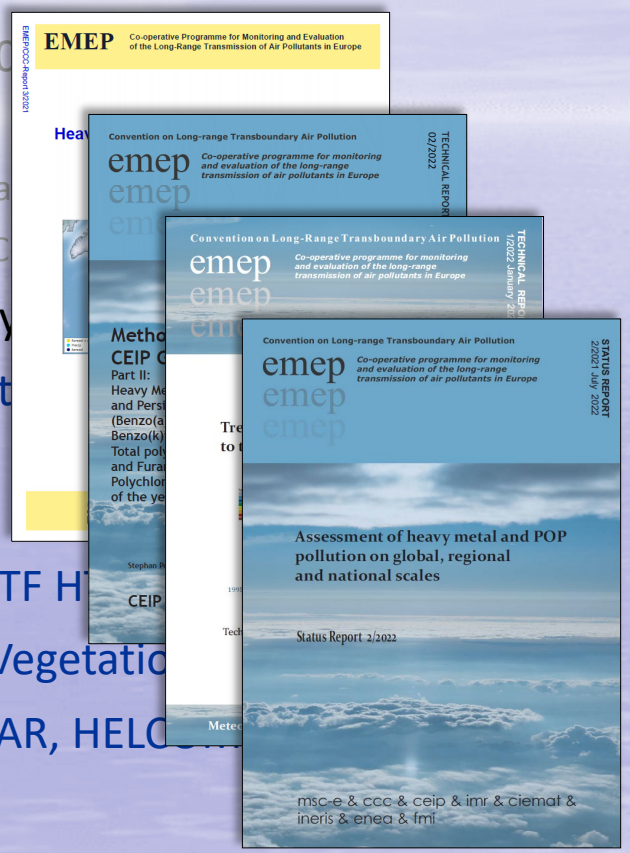


Country-scale studies for the EMEP countries (2010-2022)

In co-operation with Task Force on Measurements and Modelling (TFMM)

Objective:

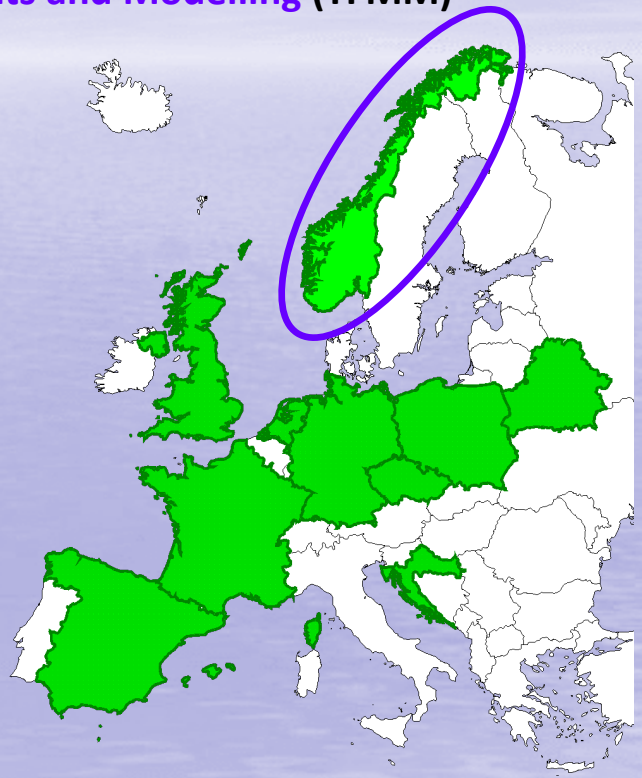
Assessment of HM and POP pollution on a country scale involving national experts and variety of national data

Countries involved:

Czech Republic, Croatia, Netherlands, Belarus, UK, Poland, Spain, France, Germany, Norway

Main outcomes:

- Refined information on pollution levels
- Analysis of national emissions
- Improvement of modelling approaches

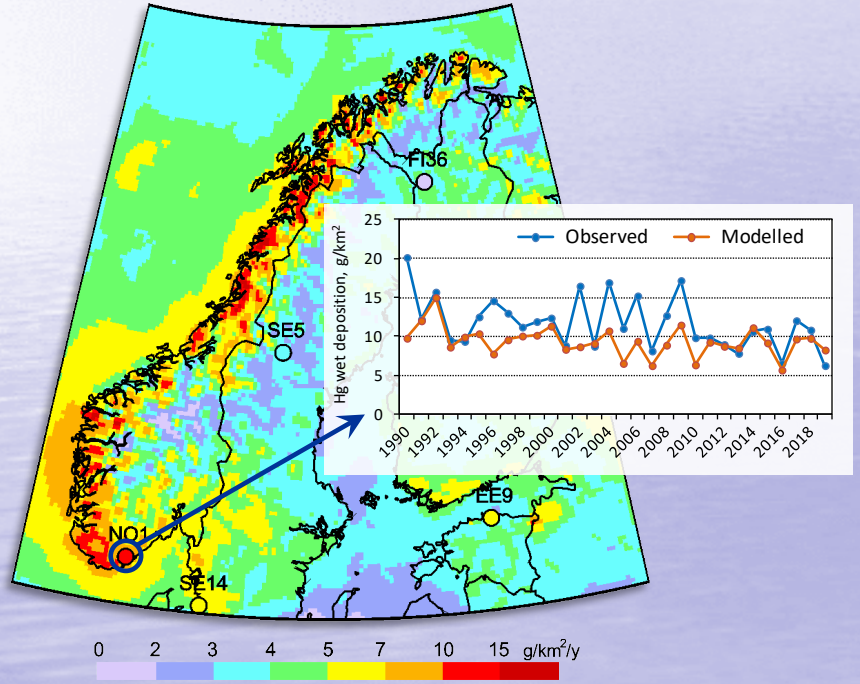


Participating countries

Case study: Hg pollution in Norway

EMEP/MSC-E contribution to the *Norwegian Mercury Assessment 2022*

Hg wet deposition (2015)



Contributors:

- Norway: NILU, NIVA, NP, IMR, NEA, NIPH
  EMEP: MSC-E

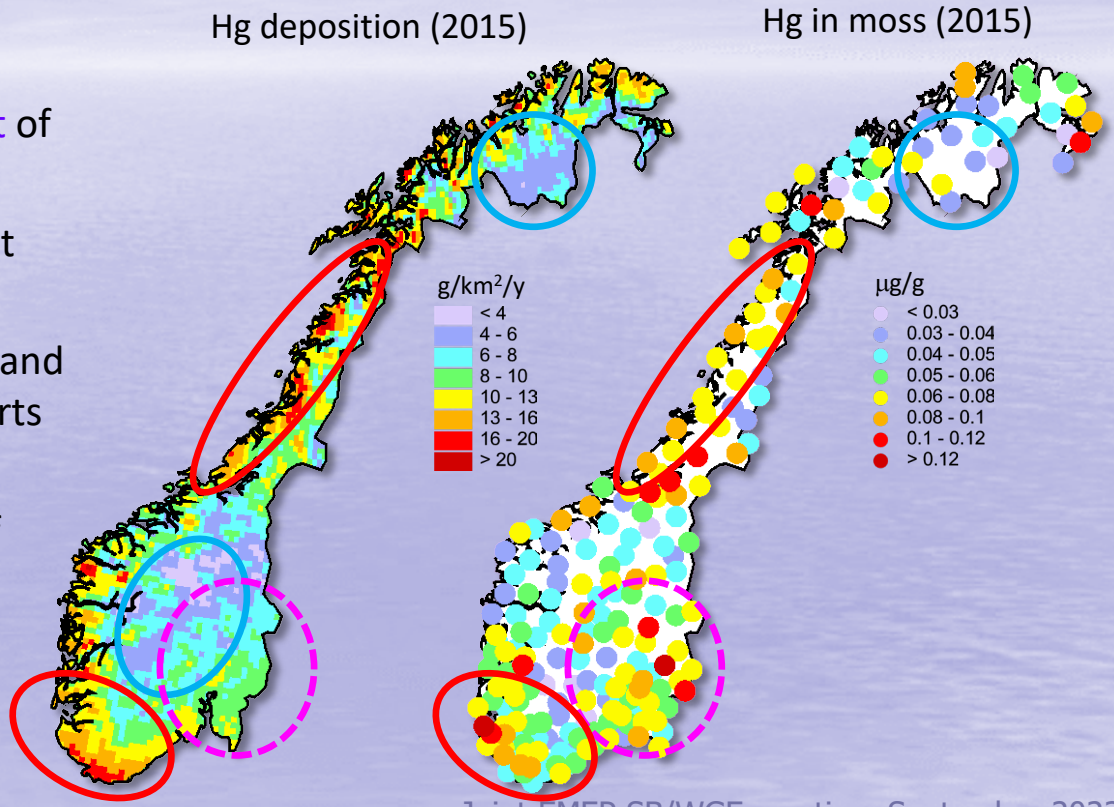
Provided data and analysis:

- Modelled spatial patterns of Hg loads to Norway and adjacent seas
- Long-term trends (1990-2020) of Hg emissions, air concentration and deposition
- Contribution to analysis of Hg levels and trends in biota (fish, bears, foxes)

Case study for Norway: Spatial patterns of Hg deposition

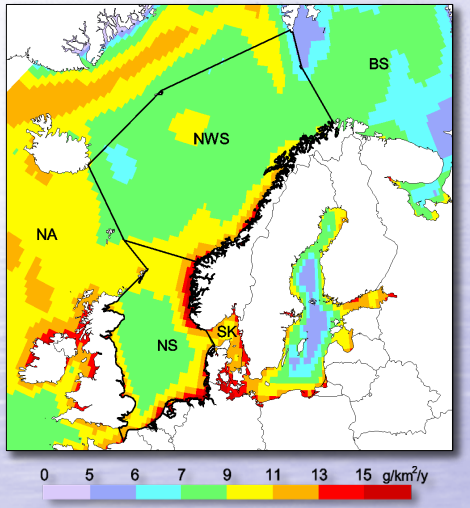
Main outcome:

- No significant north-south gradient of Hg deposition over the country
- Elevated Hg levels in the southmost part and along the Atlantic coast
- The lowest Hg deposition in the inland areas of southern and northern parts of the country
- Discrepancies in spatial patterns of Hg deposition and Hg in moss require additional analysis



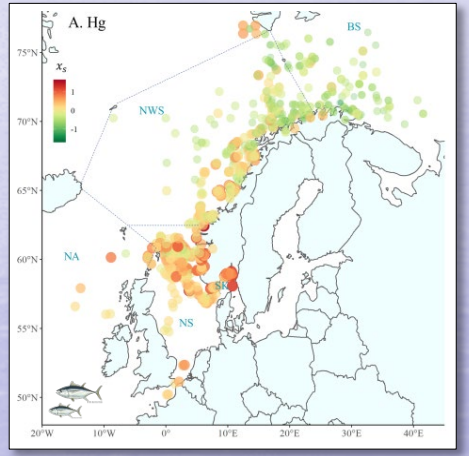
Case study for Norway : Hg deposition to aquatic regions

Hg deposition to the North East Atlantic (2015)



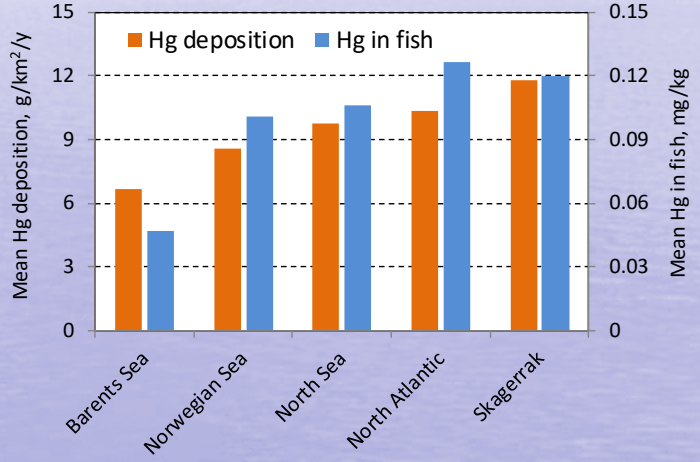
Multi-model simulations
(GLEMOS, GEM-MACH-Hg, GEOS-Chem, DEHM)

Hg concentration in marine fish (2006-2019)



Fish measurements
(Ho et al., 2021)

Mean Hg deposition vs. Hg concentration in fish

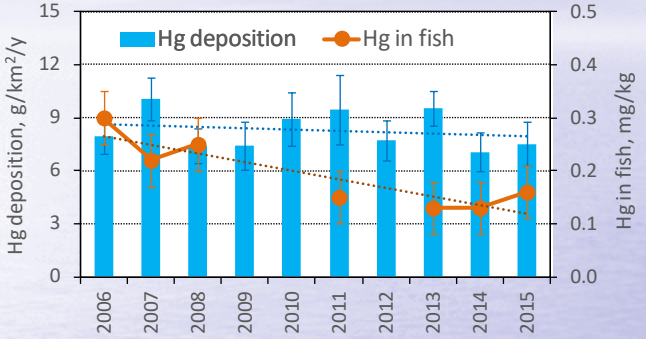


Note:

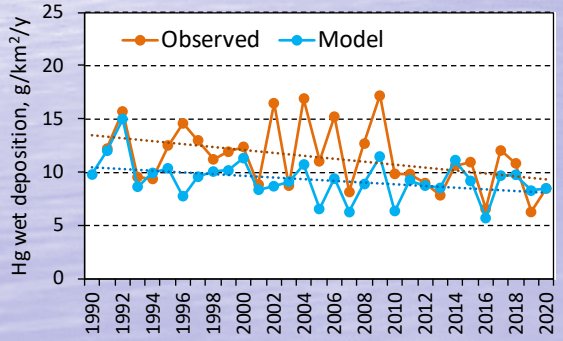
- Hg levels in fish geographically correlate with Hg atmospheric loads

Case study for Norway : Long-term trends of Hg pollution

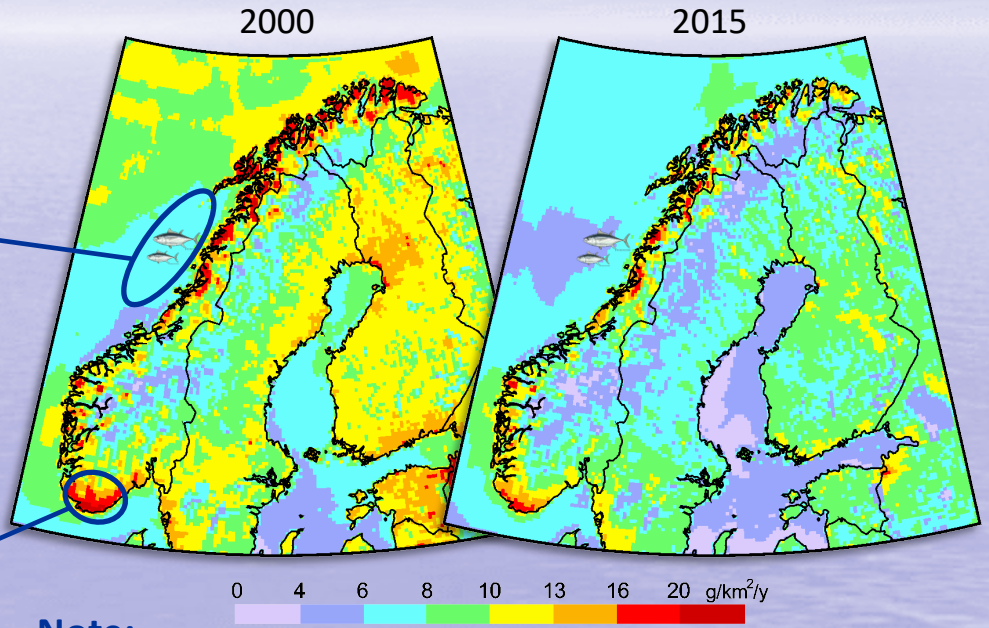
Hg deposition vs. Hg in fish (*Greenland halibut*)



Hg wet deposition (Birkenes/Lista)



Hg atmospheric deposition (GLEMOS)



Note:

- Reduction of Hg levels in fish is stronger than decrease of Hg deposition

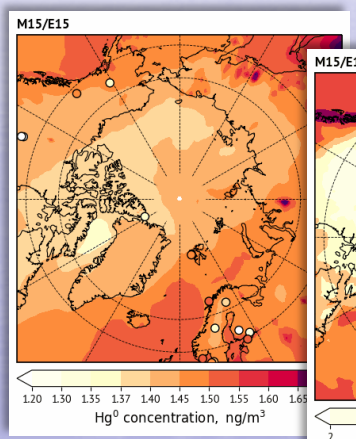
Mercury pollution in the Arctic

EMEP/MSC-E contribution to the co-operative follow-up studies based on AMAP Hg Assessment

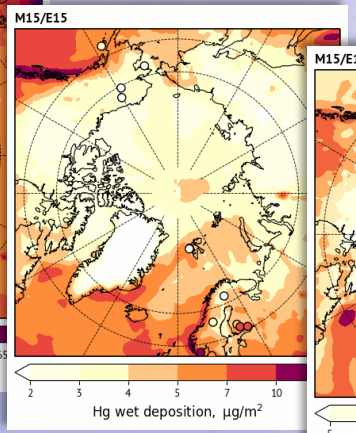
Topics:

- Literature review of Hg sources, transport and fate in the Arctic
- Update and evaluation of global Hg emissions inventory
- Estimates of the present-day Hg mass budget in the Arctic
- Analysis of factors affecting changes of Hg pollution in the Arctic (*permafrost thaw, glacier and sea ice melt, wildfires, etc.*)

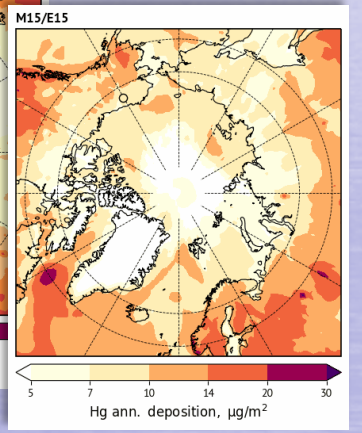
Hg concentration



Hg wet deposition



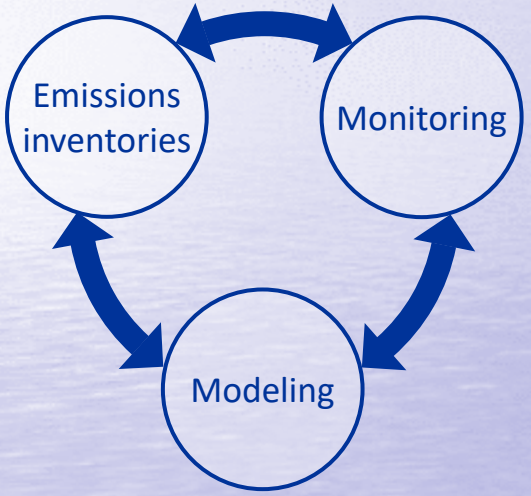
Hg total deposition



Publications:

1. *Dastoor et al. (2022) Nature Reviews Earth & Environment*
2. *Dastoor et al. (2022) Science of the Total Environment*

Scientific co-operation on Hg pollution assessment (TF HTAP)



Recent and future activities (MSC-E):

- TF HTAP virtual meeting on Hg (18 May 2022) focused on Hg global and regional emissions and modelling
  - *Identifying fields of co-operation between CLRTAP and Minamata Convention*
  - *Formulation of near-term activates on Hg under TF HTAP*
- Elaboration of an action plan for multi-model assessment of Hg trends and source attribution (*white paper*)
- Contribution to the *multipollutant* model experiments on the effect of wildfire emissions on pollution levels

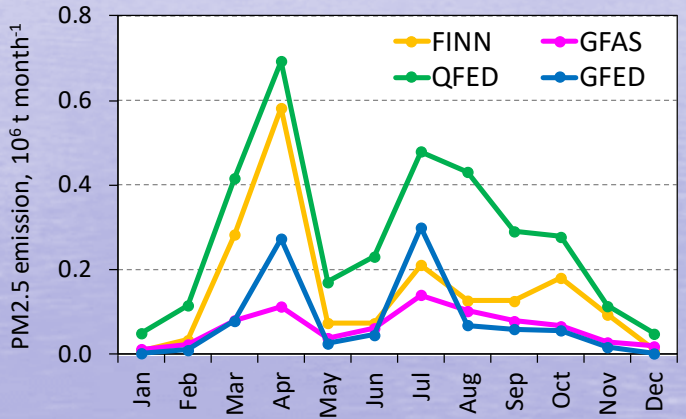
A pilot study of heavy metal pollution from wildfires

Model evaluation of wildfires contribution to HM pollution within EMEP region

Objectives:

- Review of available wildfire databases (FINN2.5, GFAS1.2, GFED4s, QFED2.4)

$PM_{2.5}$ emission from wildfires within EMEP region (2017)



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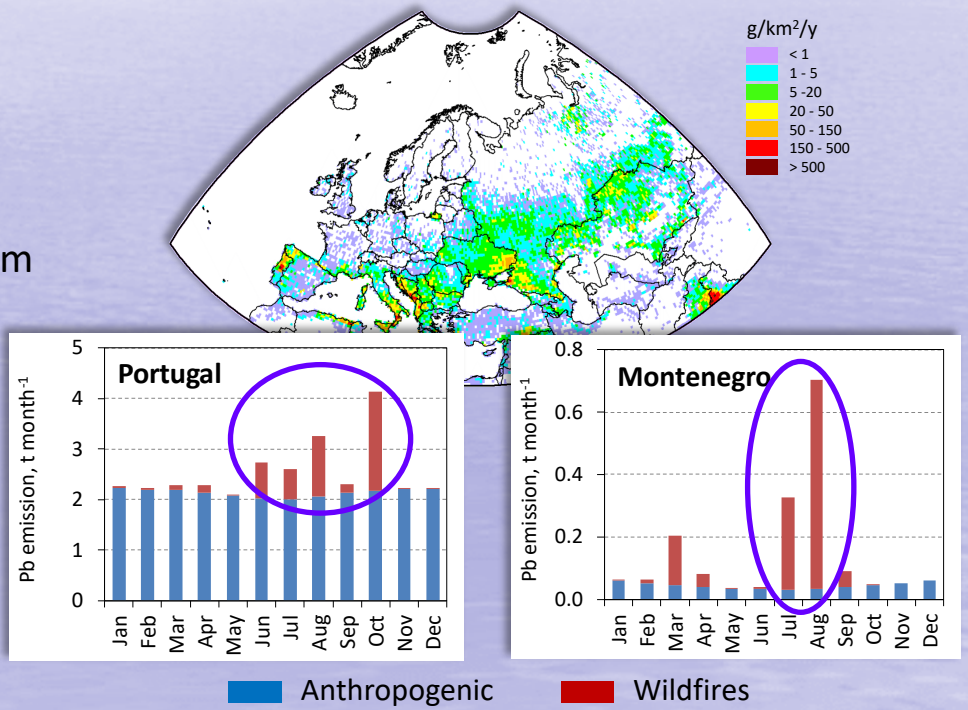
- Estimates of heavy metal emissions from wildfires in the EMEP region

Pb emission from wildfires in 2017



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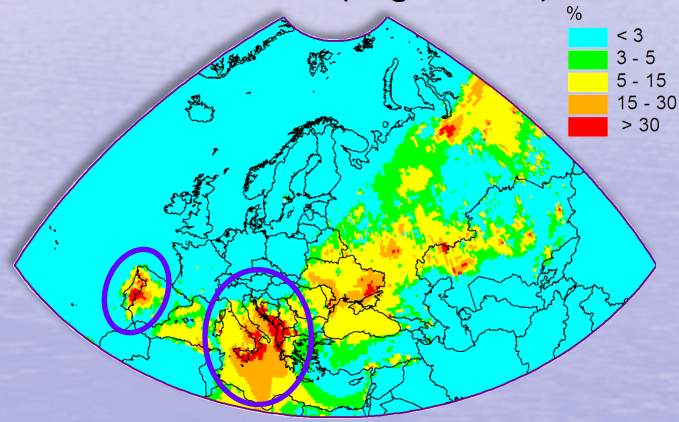
- Review of available wildfire databases (FINN2.5, GFAS1.2, GFED4s, QFED2.4)
- Estimates of heavy metal emissions from wildfires in the EMEP region
- Simulations of the wildfires effect on pollution levels in the EMEP countries

Relative contribution of wildfires to Pb concentration (August 2017)

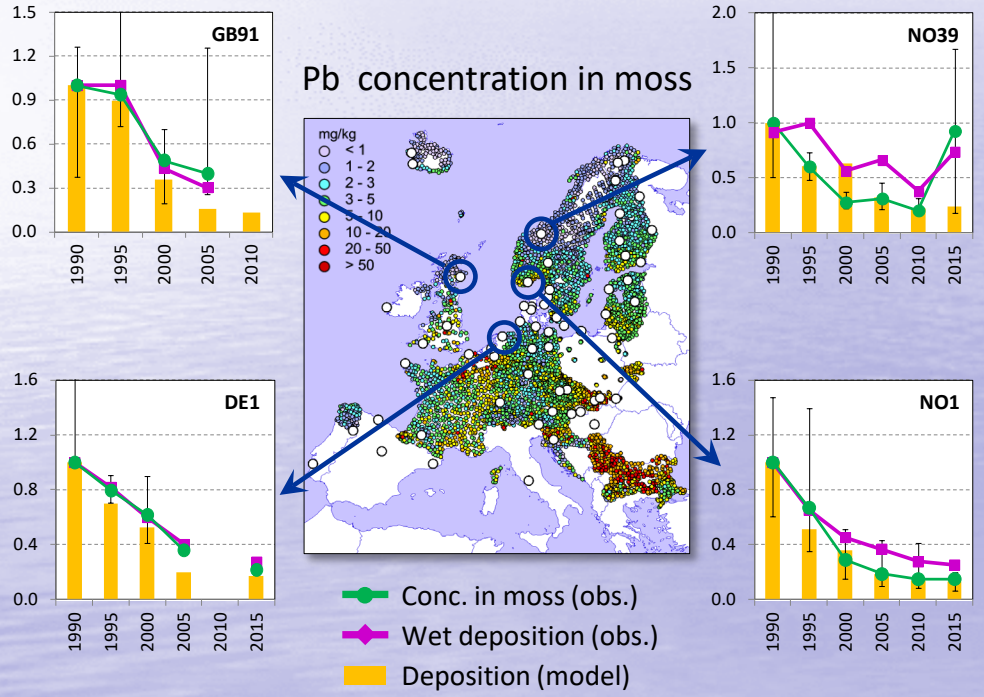


Note:

- Contribution of wildfires exceeds 30% in particular countries and months

Co-operation with effect community

Use of EMEP observations, modelling, and moss measurements (ICP-Vegetation) for trend analysis



Key features:

- Combination of different data types provides more reliable estimates of pollution changes on local and regional scales
- Analysis of discrepancies allows revealing assessment uncertainties (e.g. emission estimates, model parameterizations etc.)

Presented at the ICP-Vegetation Task Force meeting (21-23 Feb 2022)

Contribution to marine pollution assessment

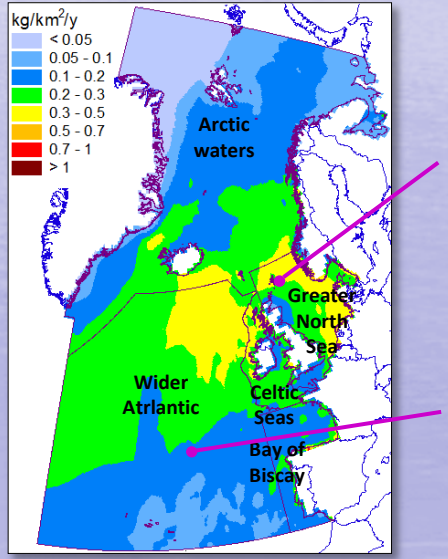
Model assessment of heavy metal loads to the Northern Atlantic (co-operation with OSPAR)

Assessm

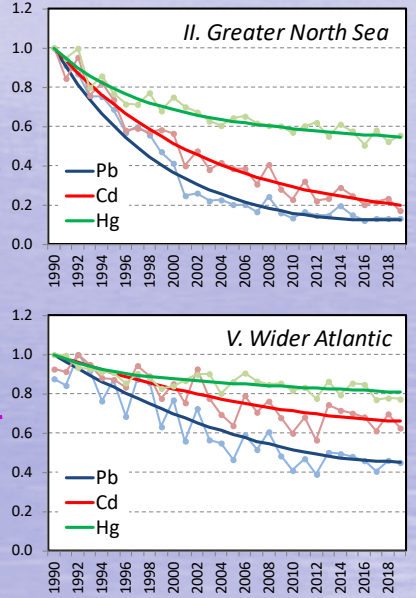
- Consi , Hg
- Long- ition to the OSPA
- Sourc leposition
- Evalu vs. obser

The pr

Pb deposition (2015)

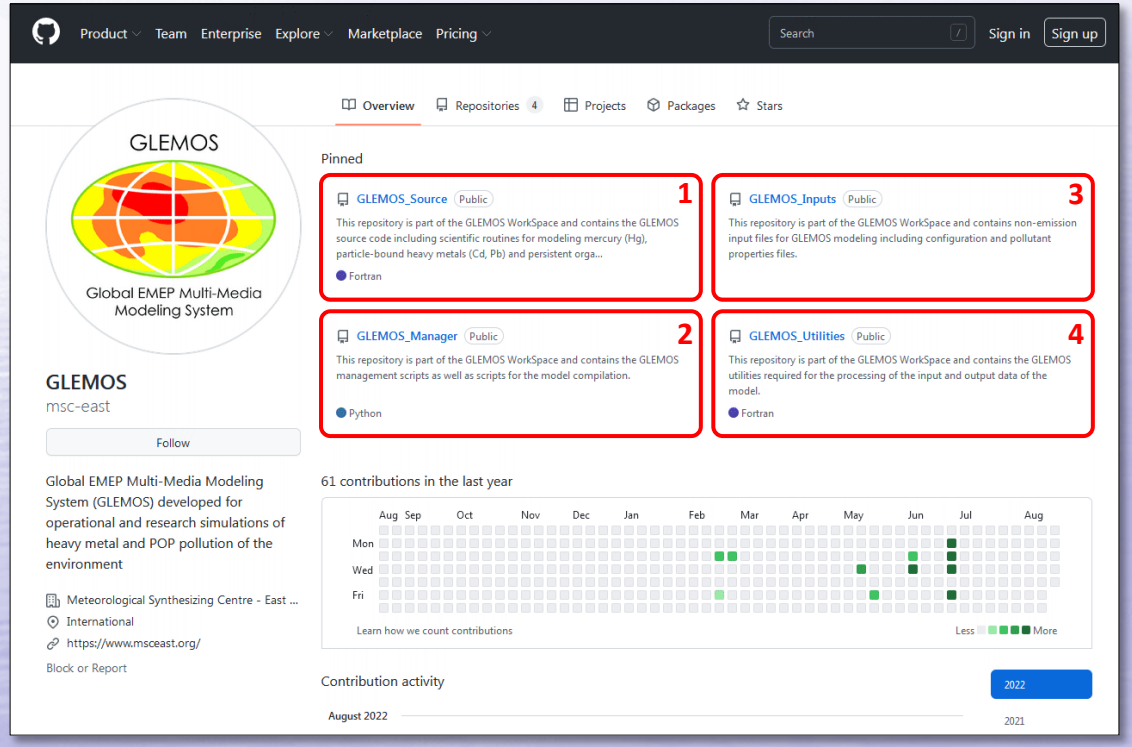


HM deposition trends



GLEMOS open source (pilot version)

GLEMOS model source code is available at GitHub platform



GLEMOS distribution:

1. Source code *(GLEMOS_Source)*
2. Control scripts *(GLEMOS_Manager)*
3. Input parameters *(GLEMOS_Inputs)*
4. Data processing utilities *(GLEMOS_Utilities)*

https://github.com/msc-east

Future research activities

(Work plan 2022-2023, EMEP Strategy)

- Scientific collaboration on multi-model assessment of Hg trends and source attribution (TF HTAP, Minamata Convention)
- Contribution to the multi-pollutant model experiments on the effect of wildfire emissions on pollution levels (TF HTAP)
- Co-operation with the effect community on assessment of heavy metal and POP pollution and trends (WGE, ICP Vegetation)
- Research of heavy metal pollution of the marine environment (co-operation with OSPAR and HELCOM)
- Further development and support of GLEMOS open source distribution