

EMEP MSC-East activities: Progress and plans

Oleg Travnikov, Isabel Garcia Arevalo, Jan Gačnik,
Reza Gholizadeh, Mikhail Kleimenov, Viktória Koncz,
Milena Horvat



Jožef Stefan Institute
Ljubljana, Slovenia



Meteorological
Synthesizing
Centre /East

On-going research and development

- **Mercury pollution**: Complex multi-model study (MCHgMAP)
- **PAH pollution** assessment:
 - ❖ Source attribution of PAHs in the Arctic
 - ❖ Downscaling of pollution assessment (Slovenia)
- **Moss biomonitoring** for model evaluation
- **Natural sources**: Dioxin pollution from wildfires
- **Trend assessment** of HM and POP marine pollution
- Future plans (2026-2027)



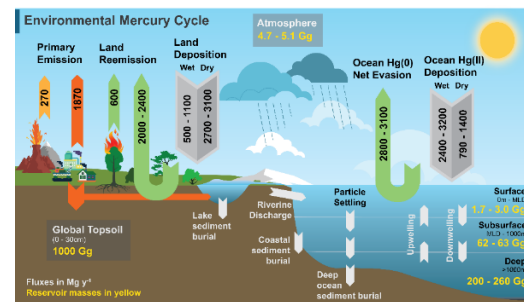
Mercury pollution: Complex multi-model study

Multi-Compartment Hg Modeling and Analysis Project (MCHgMAP)

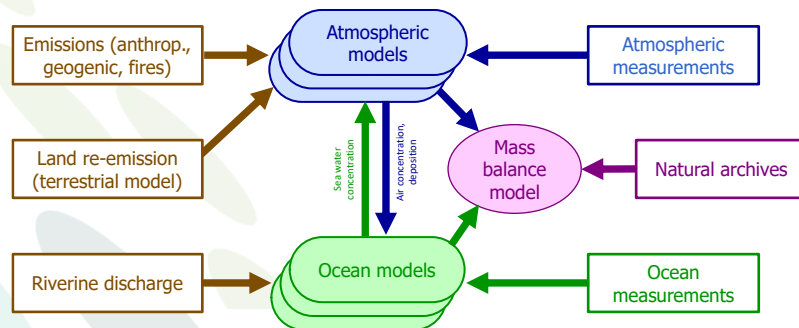
MCHgMAP project (TF HTAP, Minamata Convention):

- **Objective** – Multi-model assessment and attribution of spatial and temporal trends in Hg pollution
- **Multi-compartment simulations** – Coupling atmospheric, oceanic, terrestrial, and mass balance models
- **Collaboration** – Integrating Hg emissions, monitoring, and modelling communities to enhance data collection and simulation processes

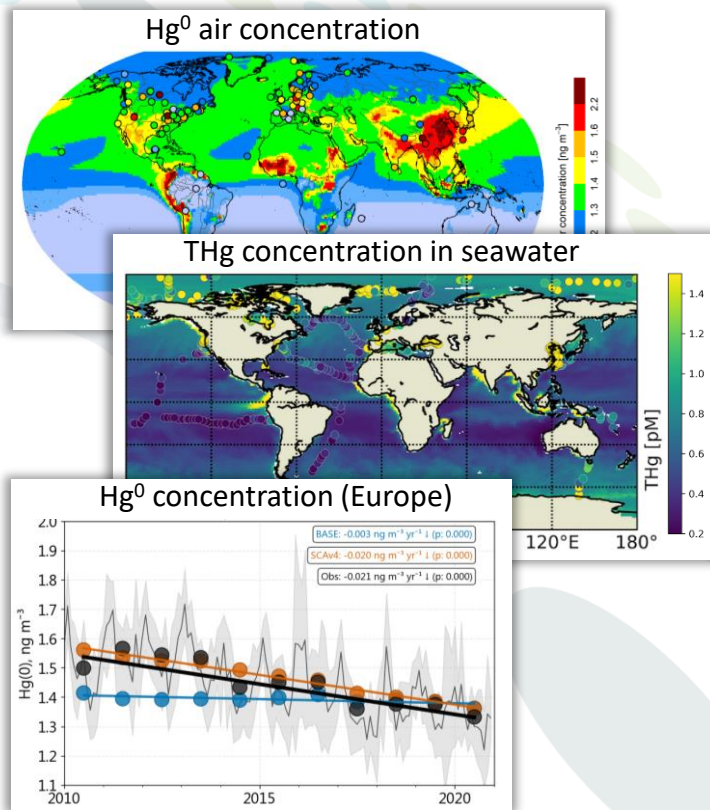
Hg cycling in the environment



Multi-model simulations scheme

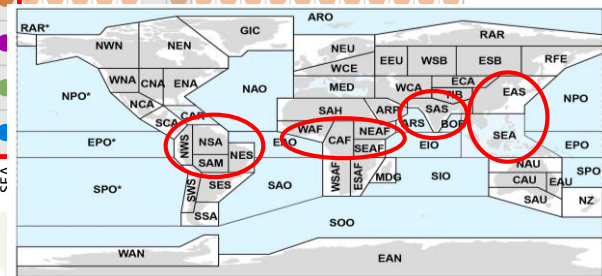
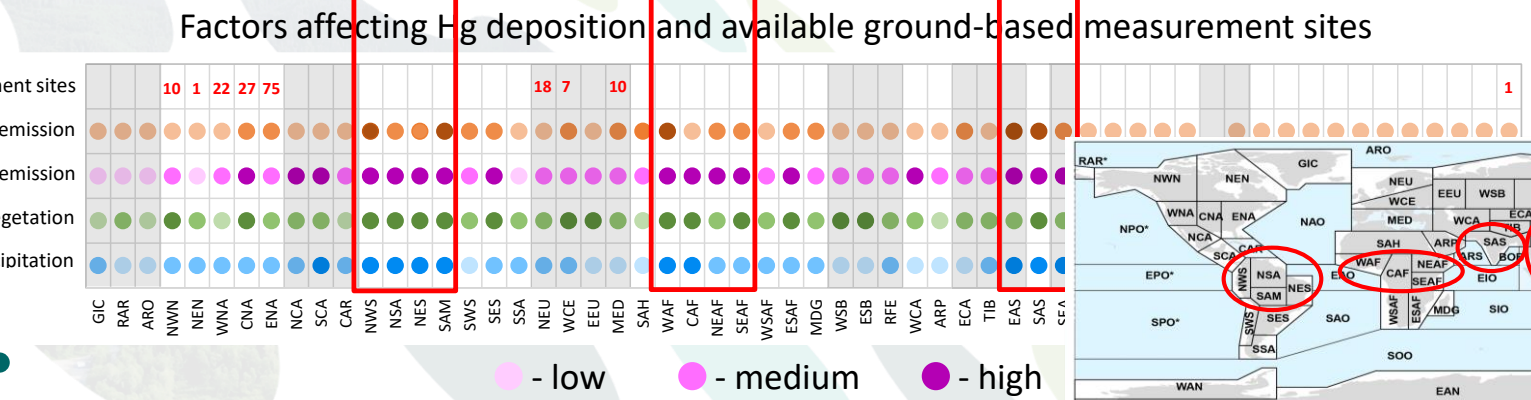


Multi-model study of Hg pollution



Results of the Phase I of the project:

- Collection of global anthropogenic, geogenic, and secondary **emission inventories** and **future projections** (CIAM/IIASA)
- **Coupled simulations** of Hg trends in the atmosphere and ocean over 2010-2020
- Development and testing **historical emissions scenarios** to reproduce observed trends
- **Analysis of driving factors** affecting Hg spatio-temporal variability



Atmospheric reactive Hg: A case study

Reactive mercury (Hg(II)):

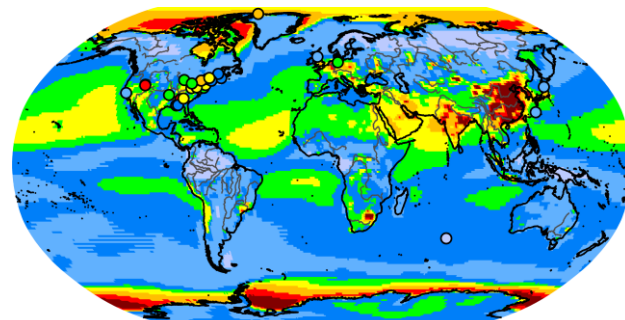
- Small fraction of global atmospheric Hg (<10%)
- Key component of atmospheric chemistry and deposition processes
- Available measurement datasets have high uncertainties and are biased low

On-going work:

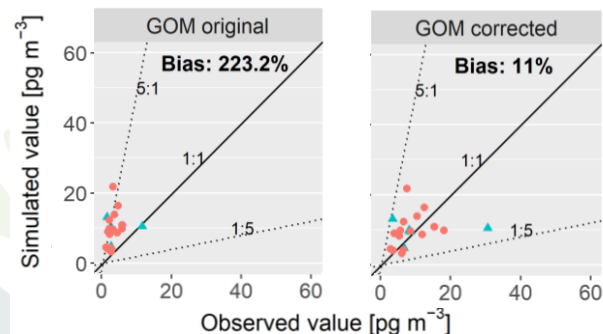
- Analysis of measurement uncertainties and limitations
- Development of a statistical methodology for correcting existing measurement data
- Application of the corrected dataset for model evaluation

Cooperation with JSI Department of Environmental Sciences

Hg(II)_{gas} air concentration



RM concentration [pg m^{-3}]



MCHgMAP publications plan (Phase I)

1. Spatial distribution and seasonal variation of atmospheric mercury
2. Multi-model analysis of the drivers of recent atmospheric mercury trends
3. ICON-MERCY a global unstructured grid mercury cycling model
4. Integrating coastal and open ocean observations to explore mercury spatio-temporal variability in the global surface ocean
5. Atmospheric reactive mercury: Bias-corrected observations and modelling
6. Model analysis of the atmosphere-ocean exchange of mercury

Inter-Journal Special Issue (ACP/GMD/BG) “Mercury science to inform international policy: the MCHgMAP and other research”



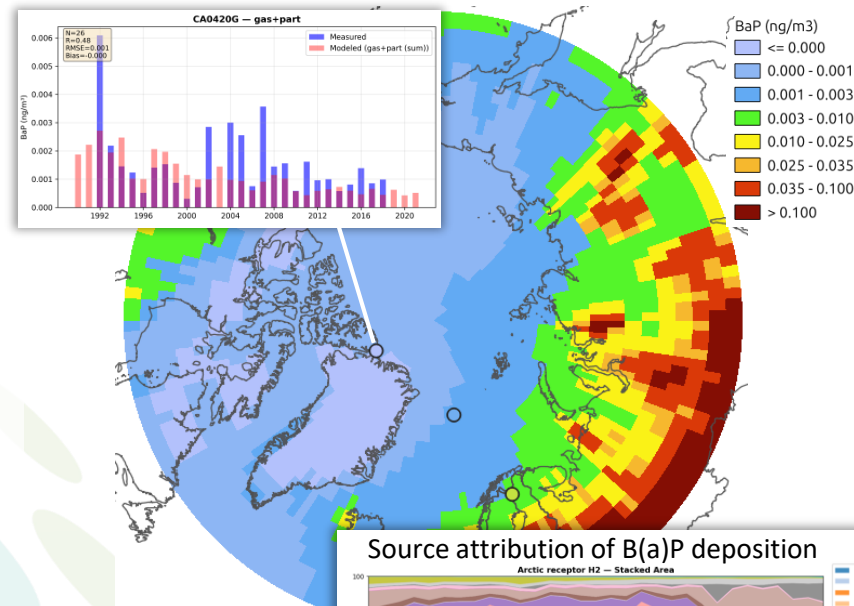
Source attribution of PAHs in the Arctic

On-going work:

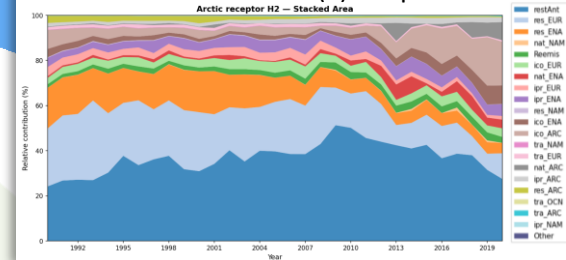
- Simulations of PAH pollution in the Arctic
- 16 PAHs (*BaP*, *BbF*, *BkF*, *IcdP*, *NAP*, *ANY*, *ANA*, *FLO*, *PHE*, *ANT*, *FLT*, *PYR*, *BaA*, *CHR*, *DahA*, and *BghiP*)
- Simulated period – 1990-2021
- Source attribution of PAH levels (contribution of geographical regions and emission sectors)
- Contribution to the AMAP Assessment on POPs

More information in a separate presentation

B(a)P air concentration in the Arctic



Source attribution of B(a)P deposition

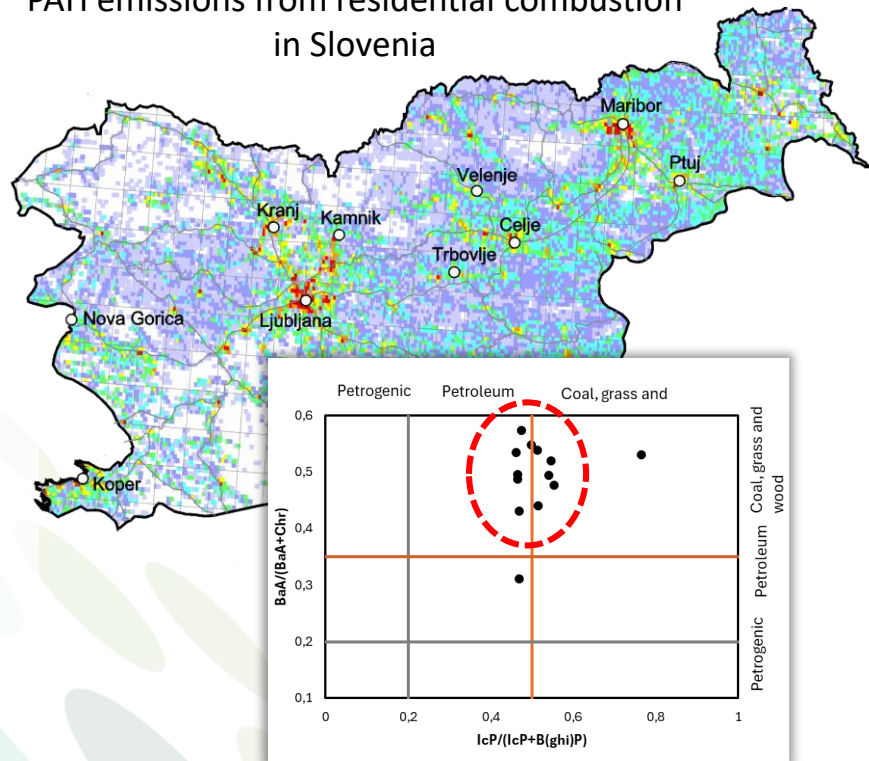


Downscaling of pollution assessment (Slovenia)

On-going work:

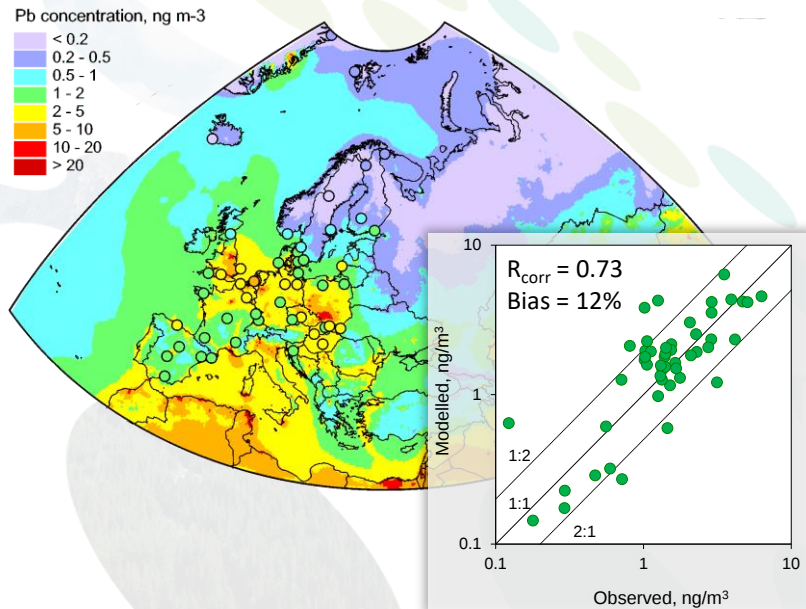
- Compiling country-scale **PAH emissions** data with fine spatial resolution (1x1 km)
 - Detailed national activity data on heating of individual buildings (residential combustion)
 - Geospatial distribution of industrial sources
- Collection of **national monitoring data** (air, moss)
- Preliminary **source attribution analysis** using available moss data
- Preparatory work for **model assessment**

PAH emissions from residential combustion
in Slovenia



Moss biomonitoring for model evaluation

Pb concentration in air (2022)

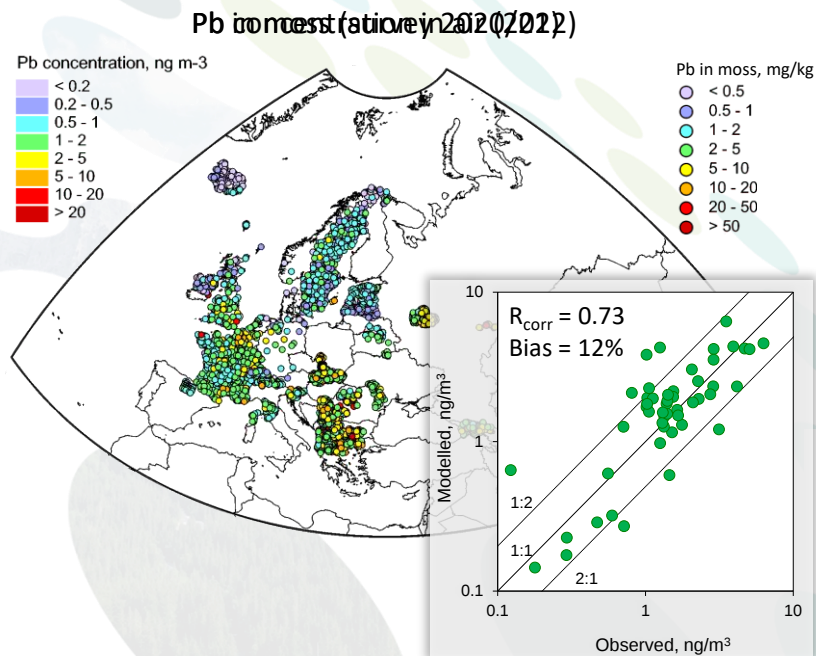


Limitations of air monitoring data:

- Limited coverage and number of EMEP monitoring sites (low spatial resolution)
- Evaluation of modelled air concentration and wet deposition (no dry deposition data)



Moss biomonitoring for model evaluation



Limitations of air monitoring data:

- Limited coverage and number of EMEP monitoring sites (low spatial resolution)
- Evaluation of modelled air concentration and wet deposition (no dry deposition data)

Benefits of moss measurements:

- Large number of sites (fine spatial resolution)
- Available in areas uncovered by air monitoring (e.g. EECCA countries)
- Allow characterizing total (wet + dry) deposition

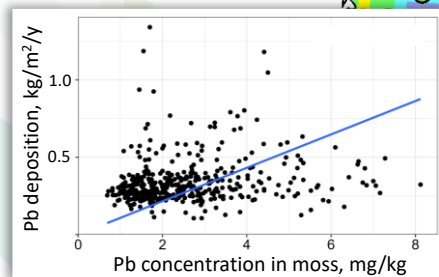
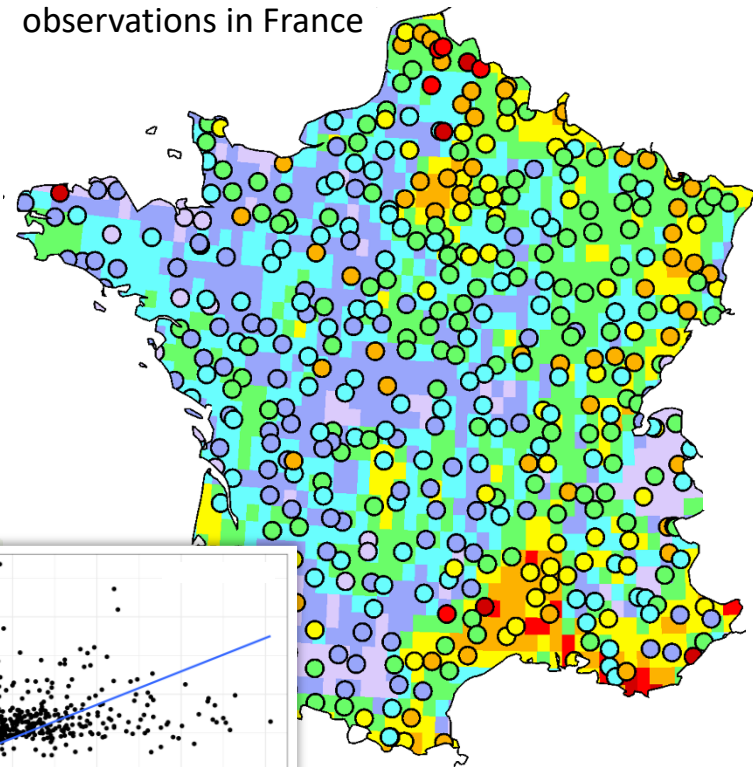
Moss biomonitoring for model evaluation

Simulated Pb deposition vs. moss observations in France

On-going activities:

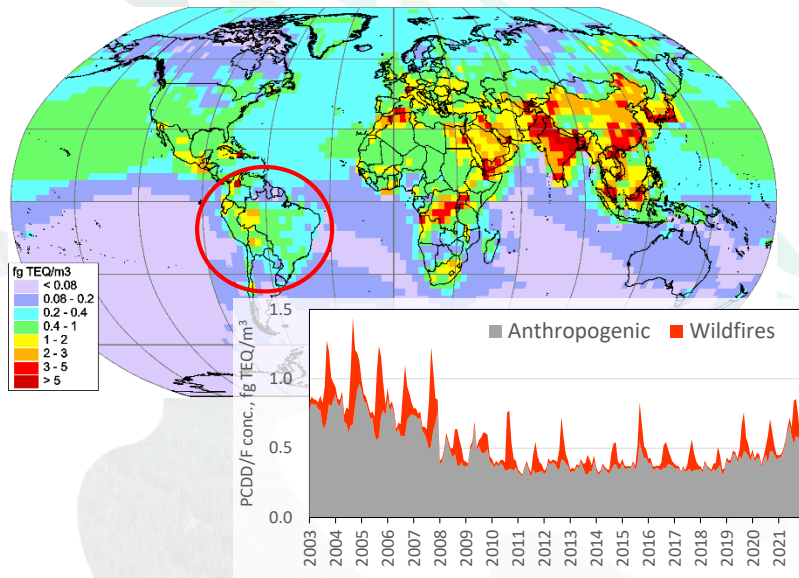
- Analysis of **country-scale variability** of heavy metal levels in individual countries
- Testing model-to-measurements **comparison methods and applied statistics** (spatial averaging)
- **Evaluation of simulated parameters** - air concentration, total (wet/dry) or ecosystem-specific deposition
- **Source attribution** of heavy metal deposition involving moss data and source-receptor simulations

Cooperation with ICP-Vegetation



Natural sources: Dioxin pollution from wildfires

PCDD/F air concentration (2020)



On-going work:

- **Aim:** Assessment of wildfires and biomass burning contribution to PCDD/F pollution levels
- **Emissions:** wildfires (HTAP-Fires), anthropogenic (GEMS/PKU)
- **Simulations:** 2003-2023, contribution of wildfires from different geographical regions

Collaboration with TF HTAP activities on pollution impact of wildfires (HTAP-Fires)



Marine pollution trends

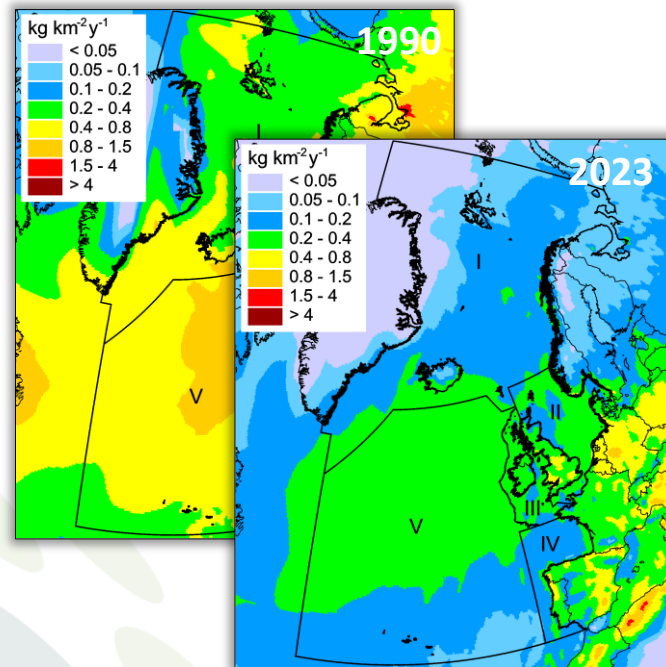
Trends of heavy metal and POP deposition to the Baltic and North-East Atlantic

Modelling activities:

- Co-operation with marine conventions (HELCOM and OSPAR)
- Compilation of emissions data for the trend analysis (1990-2023)
- Simulations of Pb, Cu, HCB, and PCDD/Fs atmospheric deposition (1990-2023)
- Source attribution – contributions of countries and emission sectors

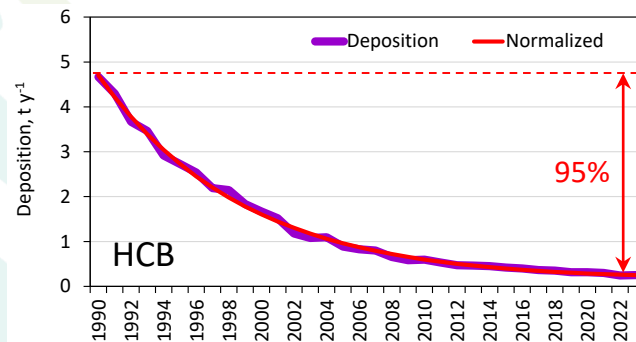
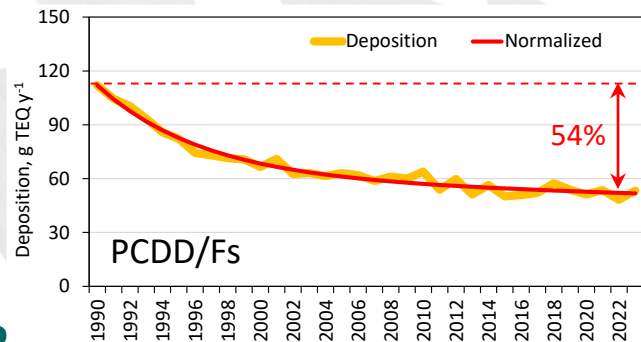
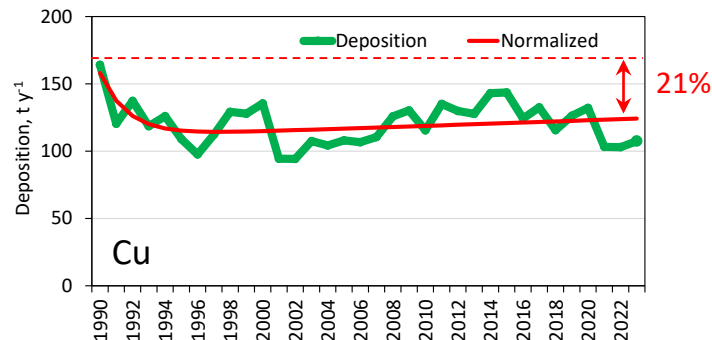
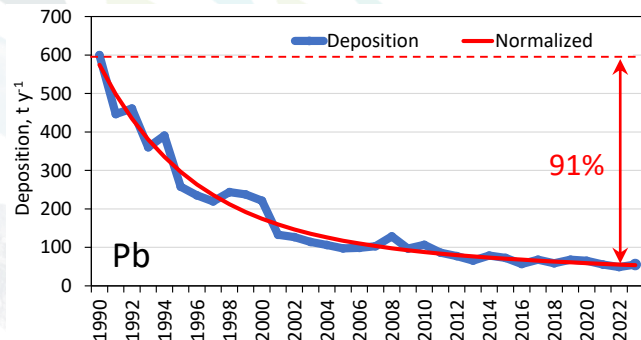
Funded by HELCOM and OSPAR

Pb deposition to the North-East Atlantic



Metals and POP deposition to the Baltic

Time series of Pb, Cu, HCB, and PCDD/Fs total deposition to the **Baltic Sea**



Future plans (2026-2027)

Research and model development

- Study of [Hg heterogeneous processes](#) and influence of dust pollution events on Hg chemistry (1.1.11)
- Revision and re-evaluation of [gas-particle partitioning](#) and [chemical degradation](#) of POPs in the atmosphere (1.1.12)

Co-operation with TF HTAP

- Multi-model assessment and attribution of Hg trends ([MCHgMAP](#)) (1.1.60)
- Multi-model, multi-pollutant study of fire impacts ([HTAP Fires](#)) (1.1.61)
- Preparatory activities for a global multi-compartment modelling exercise on [PFAS](#) (1.1.63)



Future plans (2026-2027)

Co-operation with TFMM

- Pilot study of **PAH pollution in Slovenia** and Western Balkan countries (1.1.10)

Co-operation with WGE

- Integrated analysis of heavy metal and PAH pollution using **modelling and moss measurements data** on (ICP-Vegetation) (1.1.21)

Co-operation with Marine Conventions (HELCOM and OSPAR) and AMAP

- Assessment of heavy metal and POP pollution in the **Baltic Sea and Northern Atlantic**

