Heavy metal pollution assessment: emissions, monitoring and modelling

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Heavy metal emissions (CEIP)

Main activities:

- Collection, check, and analysis of emissions reporting by countries (CEIP)
- Gaps filling and preparation of gridded emissions for modelling (CEIP)
- Preparation of additional emissions parameters (*vertical distribution, seasonal variation, speciation*) (MSC-E)
- Collection of global emissions data (MSC-E)

*Note:* Long-term time series of heavy metal gridded emissions are not prepared
Monitoring of heavy metals (CCC)

Main activities:

- Support, co-ordination, and collection of heavy metal measurements (CCC)
- Checking and storing data in the EBAS database (CCC)
- Collection of auxiliary measurements (MSC-E)
- Regular EMEP laboratory intercomparisons for QA of wet deposition measurements (CCC, countries)

Note: Hg data are not included to the QA process. A new field intercomparison is proposed (CCC).
Main activities:

• Modelling heavy metal (Cd, Pb, Hg) pollution on regional and global scales

• Preparation of country-specific information on heavy metal pollution (website)

• Evaluation of ecosystem-specific deposition for exposure assessment

• Update and improvement of the modelling tools in co-operation with scientific community
Heavy metal pollution assessment (MSC-E)

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CEIP:  www.ceip.at
CCC:  projects.nilu.no/ccc/
MSC-E:  www.msceast.org
Model study of Hg atmospheric chemistry

Objectives:
- Improvement of understanding of Hg dispersion in the atmosphere
- Evaluation of new Hg oxidation/reduction mechanisms

Expert group: CSIC (Spain), MSC-E, CNRS (France), Harvard (USA), Leeds (UK), HZG (Germany)

Research activities:
- New photo-reduction schemes were developed and tested (results published in PNAS, Saiz-Lopez et al., 2020)
- The study is continued with research of Hg\(^0\) heterogenic oxidation mechanisms
**Motivation:**

- Explain long-term pollution changes in the EMEP and other regions
- Isolate the effect of regional emissions reduction from other factors

**Factors analyzed:**

- Emissions changes in the EMEP countries
- Long-range transport from other regions
- Variation of meteorological and surface conditions
- Changes in atmospheric chemistry

**Changes of Hg concentration in Europe**

Co-operation with TF HTAP
Scientific co-operation on Hg pollution assessment

TF HTAP/MSC-E Workshop on Hg (April 13, 2021)

Objectives:

- **Review progress** made and identify **needs** of CLRTAP and other international forums for Hg pollution assessment
- **Formulate short term** (2 years) and **longer term plans** for cooperative activities on Hg under TF HTAP

**Participation:** 85 experts (incl. UNEP, Minamata Conv., AMAP, GOS4M, GMOS-Train, countries)

**Discussions:** Needs and opportunities for Hg emissions inventories, monitoring and modeling

Co-operation with TF HTAP
Scientific co-operation on Hg pollution assessment

TF HTAP/MSC-E Workshop on Hg (April 13, 2021)

Long-term goal:

• Co-operative analysis and attribution of long-term trends and projection of future levels of Hg pollution in the EMEP and other regions

Short-term activities (2022-2023):

• Development/update of global Hg emissions inventory and future scenarios (TF HTAP, CEIP, CIAM, AMAP, JRC)

• Multi-model study of Hg cycling on a global scale with focus on air-surface exchange and secondary emissions (MSC-E, national experts)
Assessment of the Arctic pollution with Hg

EMEP/MSC-E contribution to the AMAP Hg Assessment 2021

Model assessment:

- Multi-model study by international research group (MSC-E, Canada, USA, Denmark)
- Model estimates of Hg concentration, deposition and source apportionment over the Arctic and large rivers watersheds
- Balance estimates of Hg transport and accumulation in the Arctic

Results are under review in Nature Reviews Earth & Environment

Hg\(^0\) air concentration in the Arctic

- Winter
- Summer
- Spring
- Autumn

Scientific co-operation on Hg pollution assessment
Hg pollution in Norway: A case study

Country-scale assessment in co-operation with national experts (TFMM)

EMEP/MSC-E contribution to Norwegian Hg assessment (2021-2022)

Expected model outcome:

- Long-term time series of Hg concentration and deposition in the country
- Country-scale simulations of Hg levels with fine spatial resolution
- Comparison with national observations
- Ecosystem-specific Hg deposition for exposure analysis
Marine pollution assessment

Model study of heavy metal atmospheric loads to the regional seas

Motivation:

- **Regional seas** (Baltic, Northern, Mediterranean, etc.) are significant part of the EMEP domain
- Focus of regional **marine conventions** (HELCOM, OSPAR, ...), EU Marine Strategy Framework Directive
- **Ad-hoc group** on marine pollution (Bureau meeting, March, 2021)

Cd deposition to aquatic regions (2019)
Co-operation with HELCOM and OSPAR:

- Model assessment of long-term trends of HM deposition to the Baltic and North Seas, and the Northern Atlantic
- Source apportionment of HM deposition
- Considered pollutants – Cd, Pb, Hg, other metals (Cu)

The projects are funded by the marine conventions (HELCOM, OSPAR)
Main future research activities
(Proposals for work plan 2022-2023)

- Multi-model study of Hg cycling on a global scale with focus on air-surface exchange and secondary emissions (co-operation with TF HTAP)
- Country-scale pollution assessment: A case study of Hg pollution in Norway (co-operation with TFMM, national experts)
- Co-operation with the effect community on assessment of heavy metal pollution and trends (WGE, ICP Vegetation, ICP Integrated Monitoring)
- Research of heavy metal pollution of the marine environment (co-operation with HELCOM and OSPAR)
- Co-operation with other international bodies (UNEP, Minamata Convention, AMAP, etc.) on Hg pollution assessment