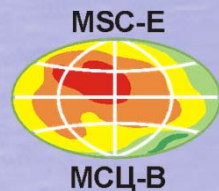


Heavy metal pollution assessment within EMEP

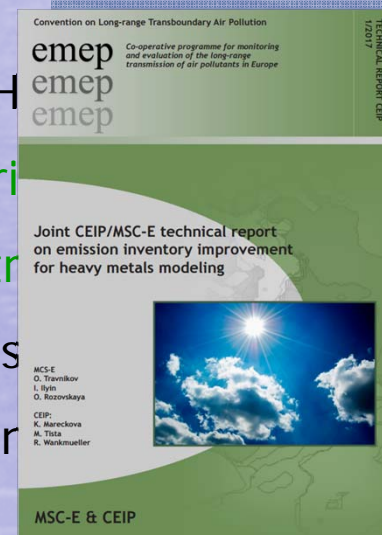
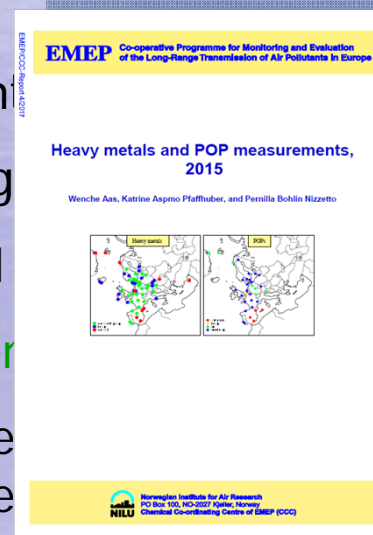
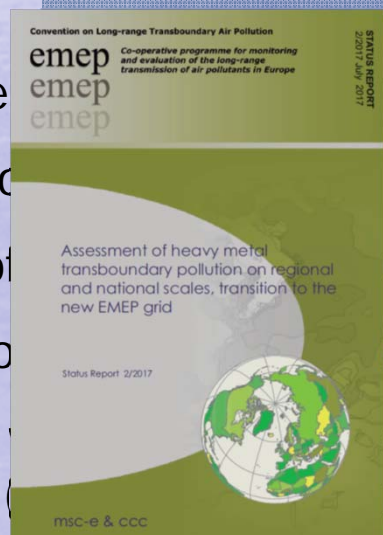
Oleg Travnikov on behalf
of MSC-E and CCC



EMEP activities on heavy metals in 2017

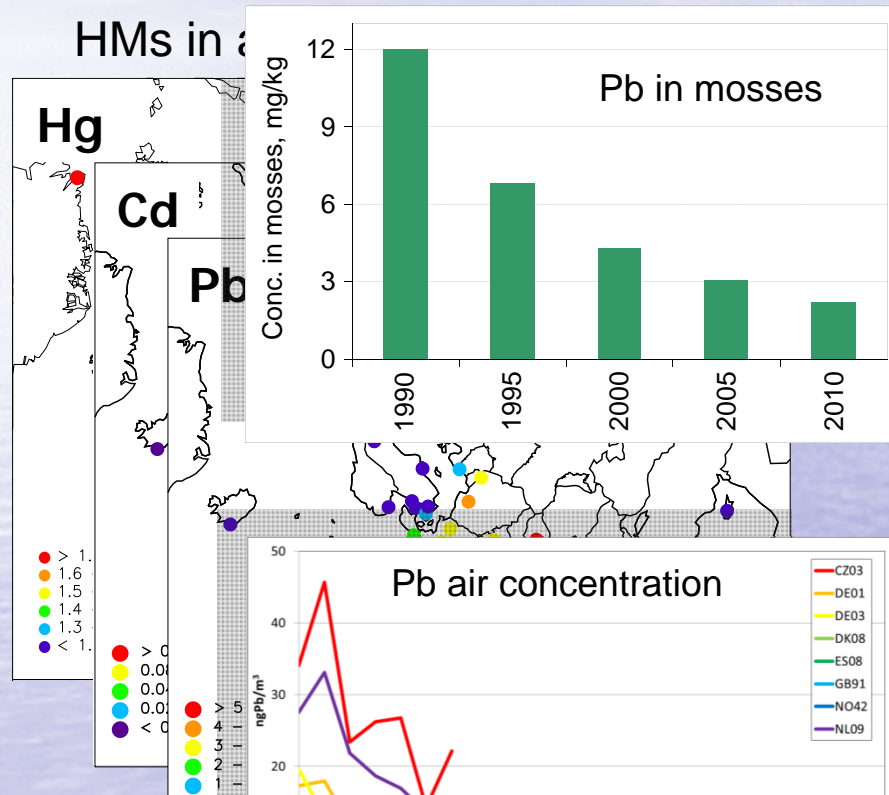
2016/2017 workplan (ECE/EB.AIR/133/Add.1)

- ✓ **Monitoring** of heavy metals within EMEP
- ✓ Review and improvement of **HM emissions data** for modelling
- ✓ Model assessment of **HM transboundary pollution** in EMEP region
- ✓ Global-scale modelling to assess contribution of **Hg intercontinental transport**
- ✓ Assessment of **ecosystem-specific pollution** by HMs for the effect community
- ✓ Country-scale
- ✓ Transition of
- ✓ Preparation of
- ✓ Scientific co-o
- ✓ **Co-operation** programmes



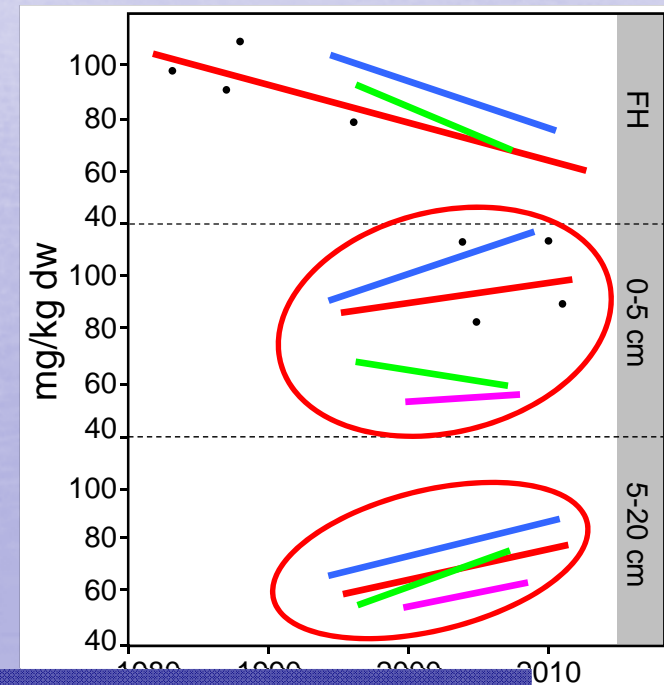
Monitoring of heavy metals

Measurements of heavy metals within **EMEP** and **WGE**



WGE Assessment Report (2016)

Pb in soil (Sweden)



More close co-operation between EMEP and WGE is needed to evaluate dynamics of heavy metal pollution in Europe

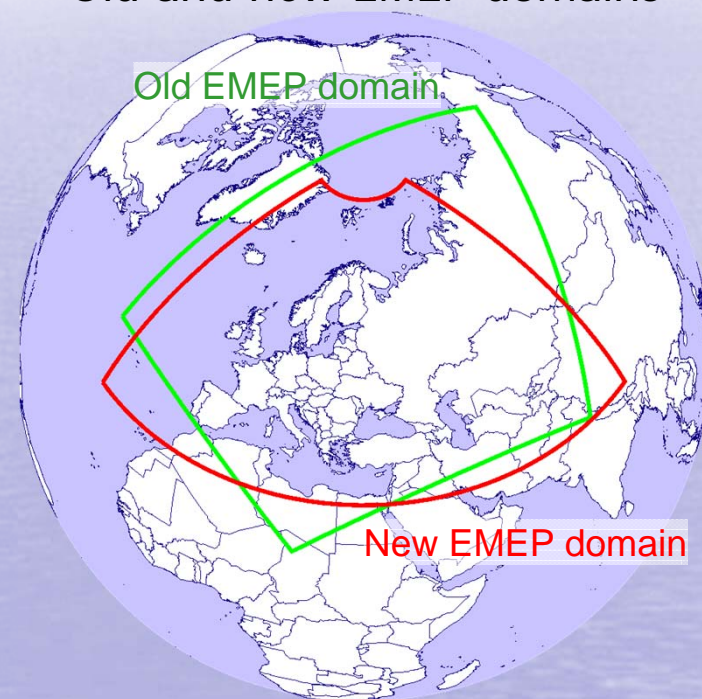
Further model development

Transition to the new EMEP grid

Activities on implementation of the new grid:

- Preparation of input data on the new grid (meteorology, emissions, etc.)
- Model testing for Hg and evaluation against measurements
- Adaptation of the HM re-suspension scheme for the new grid
- Pilot simulations of Cd and Pb with anthropogenic and secondary sources
- Evaluation vs. measurements and analysis of deviations

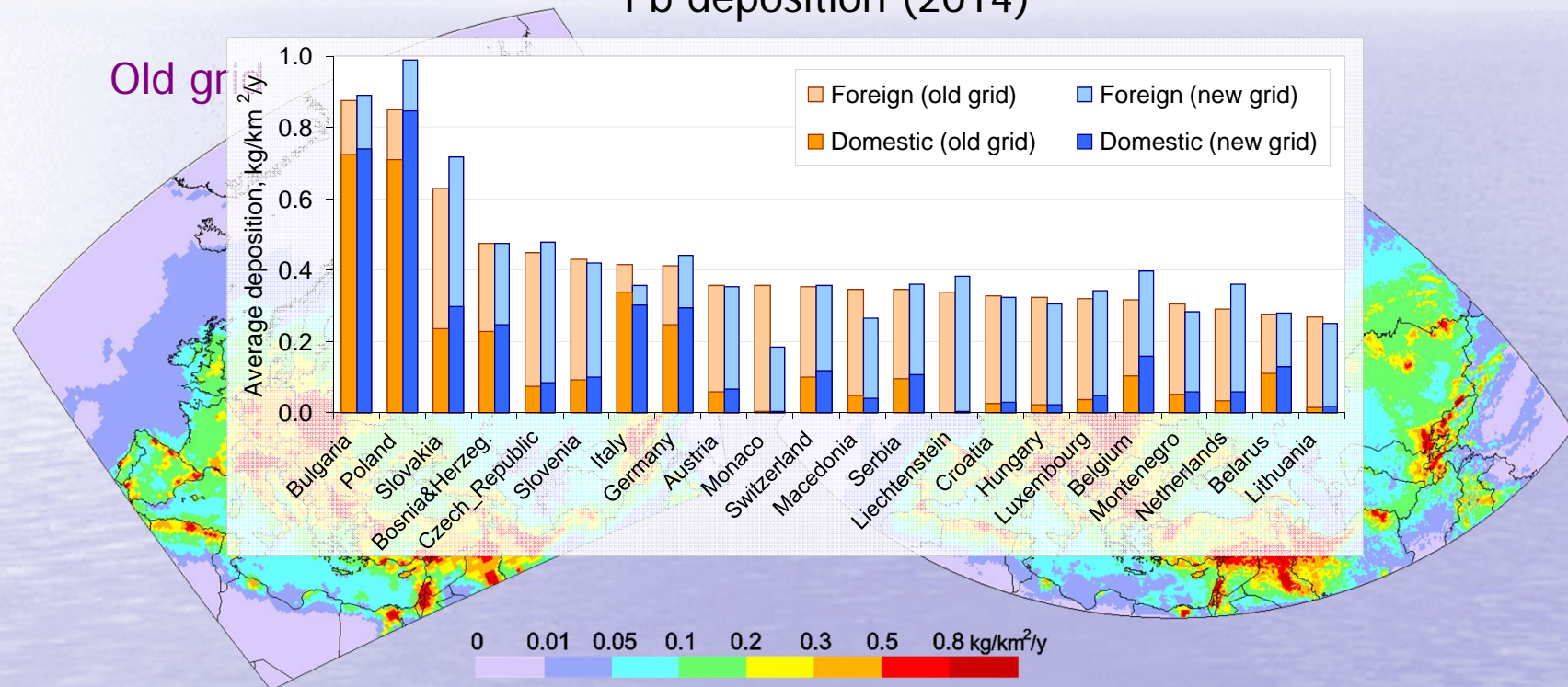
Old and new EMEP domains



Pilot simulations of Pb and Cd

Simulations of HM transport from **anthropogenic sources**

Pb deposition (2014)

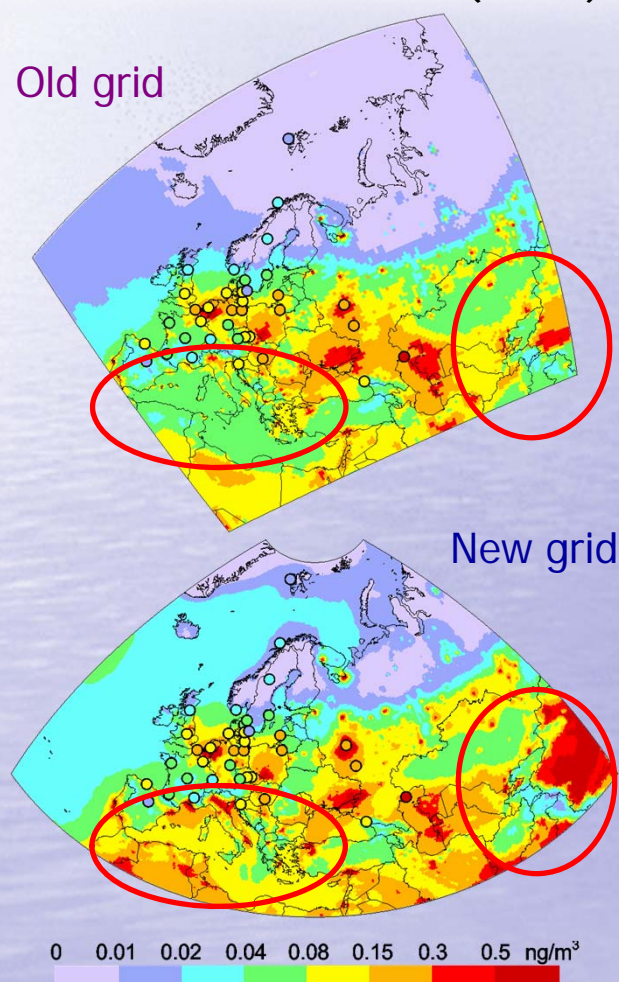


Pilot simulations demonstrate good succession between the old and new grids for assessment of transboundary transport

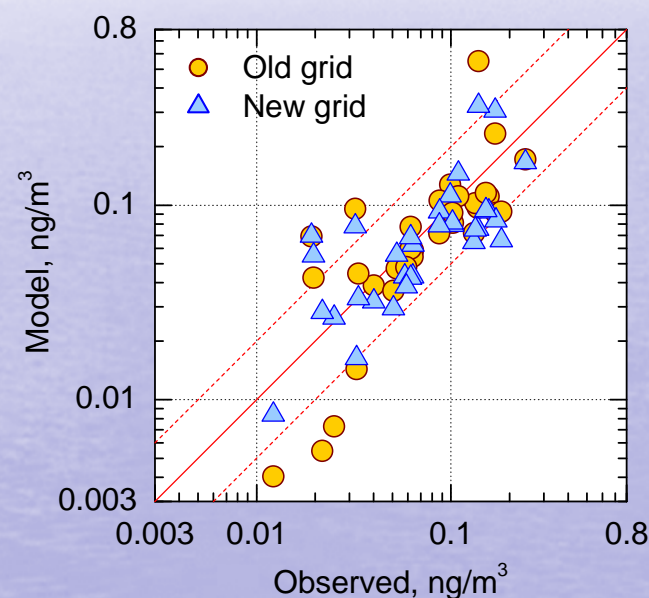
Pilot simulations of Pb and Cd

Evaluation model simulations with **all sources** (anthrop. and secondary)

Cd air concentration (2014)



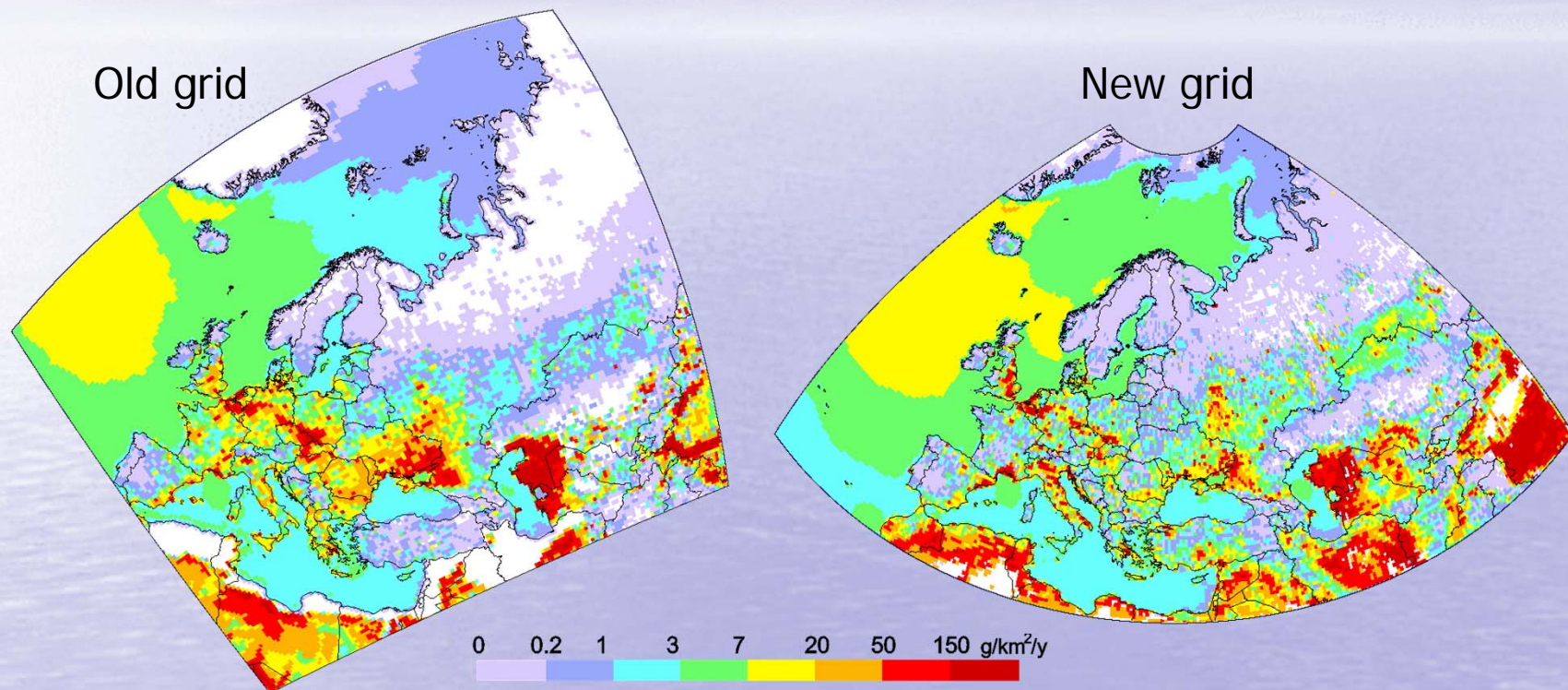
Evaluation vs. measurements



	Old grid	New grid
Correlation	0.52	0.59
Bias, %	2	-8

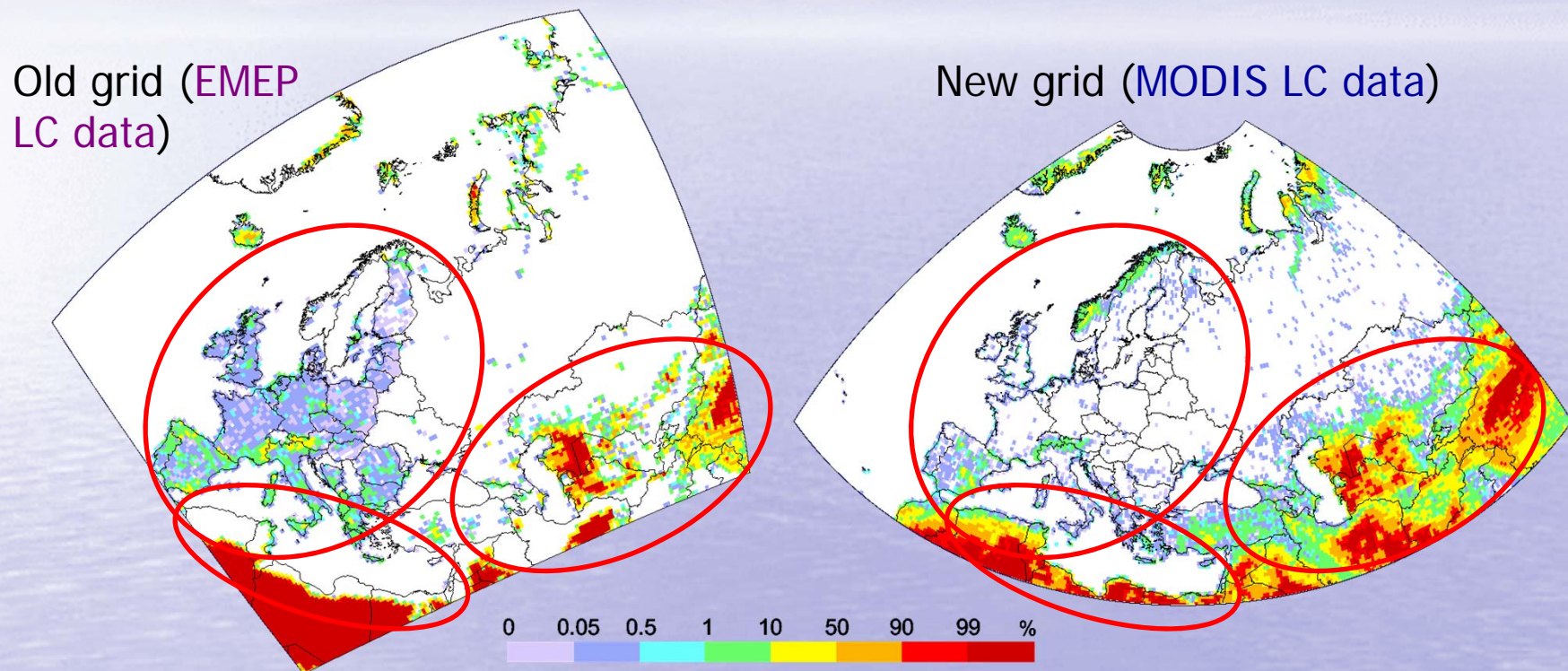
Wind re-suspension of heavy metals

Annual mean **re-suspension flux** of Cd (2014)



Wind re-suspension of heavy metals

Land cover data: **Barren lands**



Harmonization of the **land cover data** is required within the Convention to avoid inconsistencies in data products

Country-scale assessment: Poland

Case studies of HM pollution in selected EMEP countries

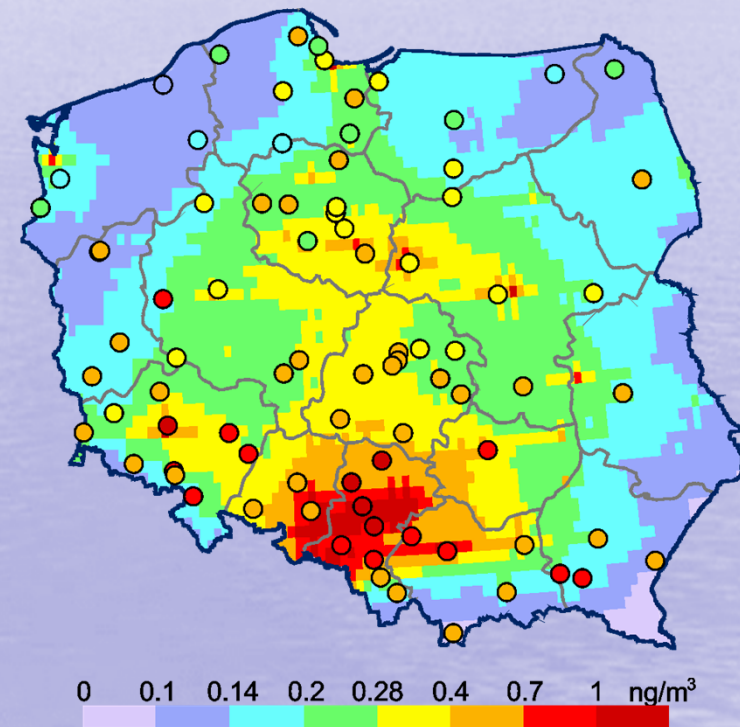
Objective:

Evaluation of pollution levels in a country with **fine** spatial resolution involving variety of **national data**

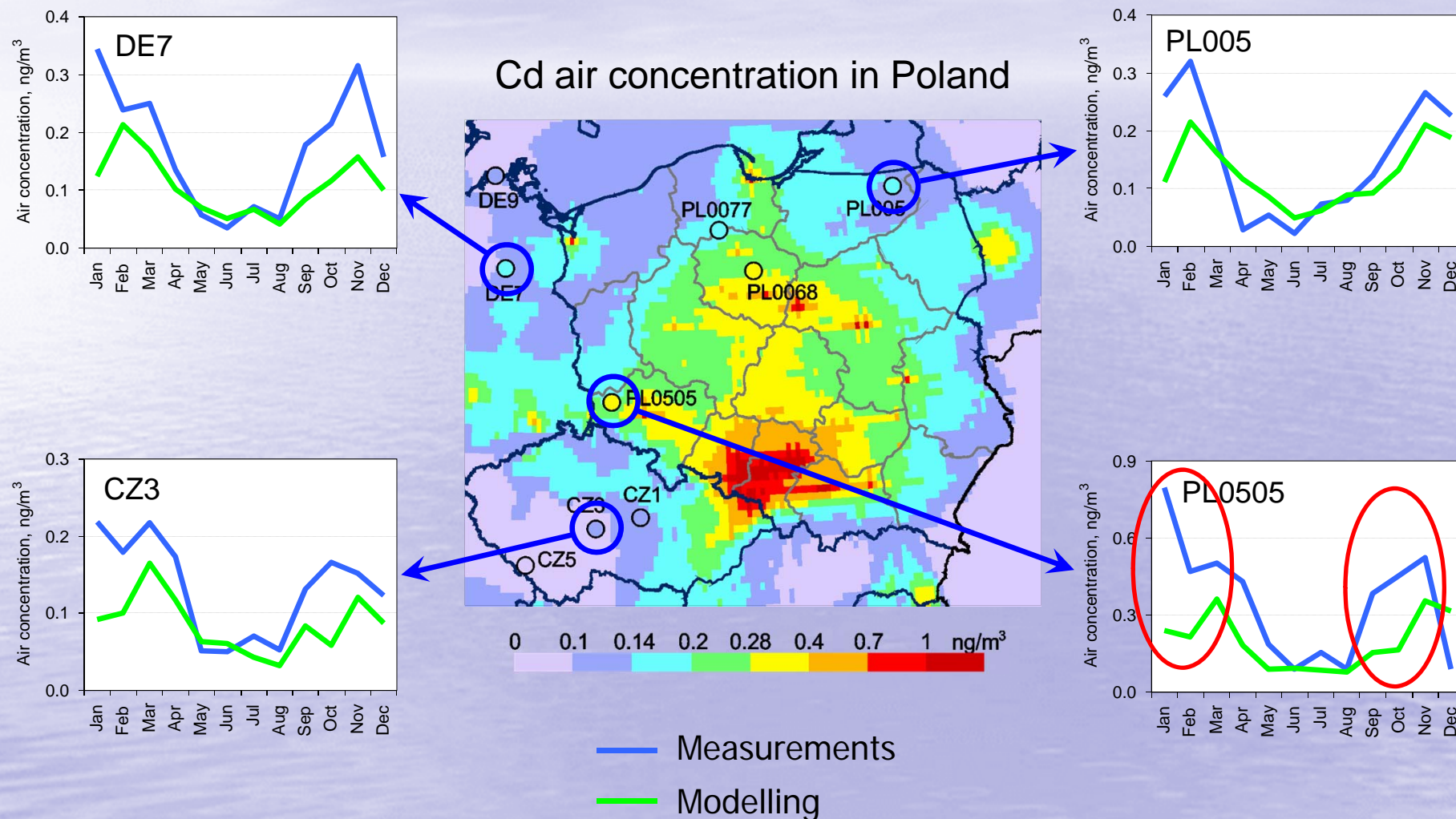
Current activities (Poland):

- Model assessment of Cd pollution levels ($0.1^\circ \times 0.1^\circ$)
- Analysis of transition from rough to fine resolution
- Detailed **evaluation against observations** and analysis of deviations
- Initial study of urban pollution based on measurements and modelling

Cd air concentration in Poland



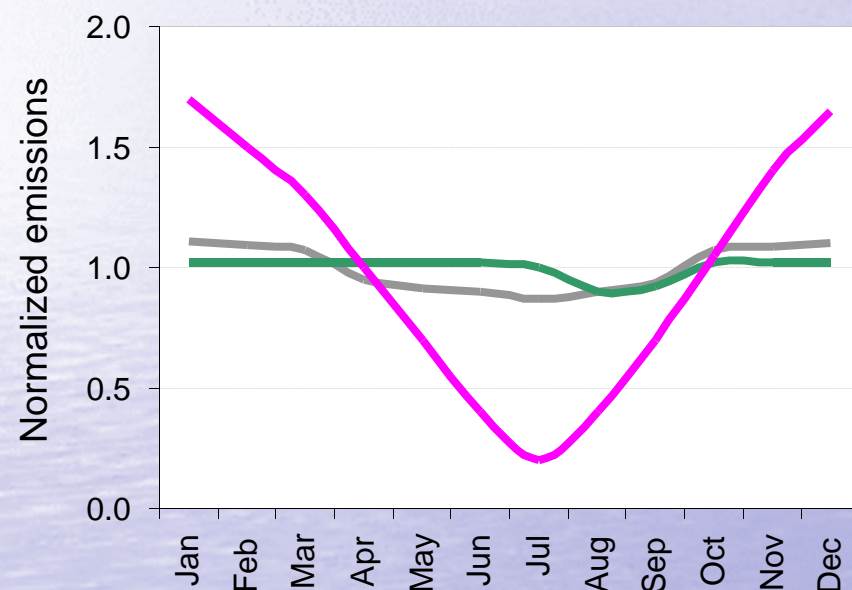
Evaluation vs. observations



Analysis of model-measurement deviations

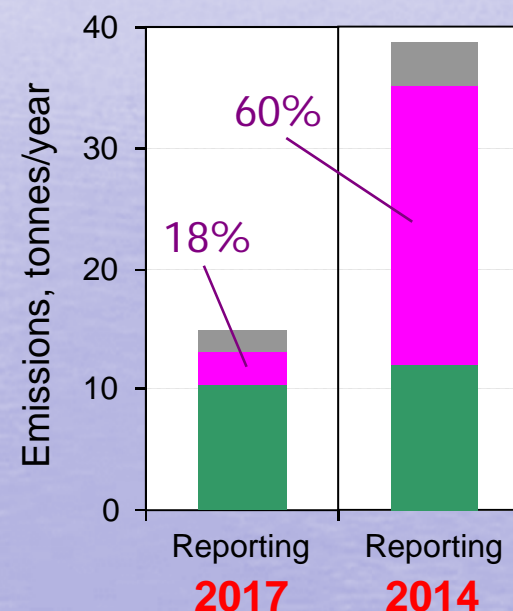
Seasonal variation of anthropogenic emissions

Seasonal variation of emissions
(TNO expert estimates)



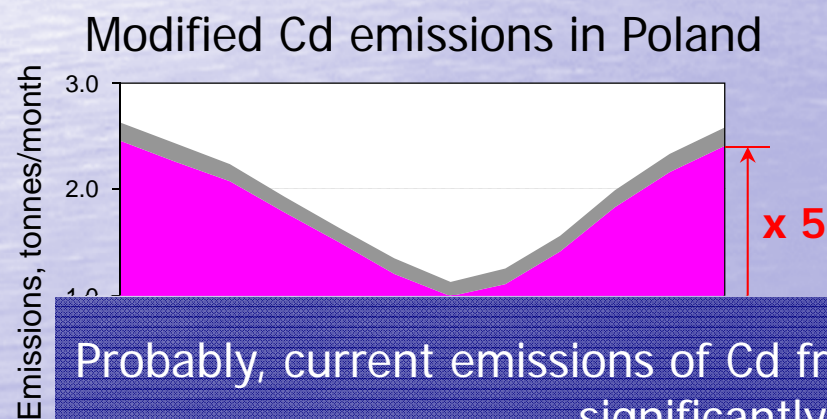
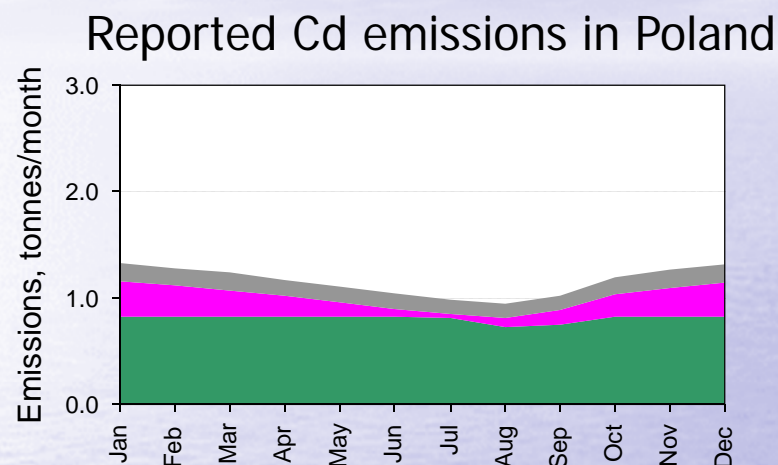
- Industrial emissions (B)
- Residential combustion (C)
- Others

Contribution of major sectors to
Cd emissions in Poland



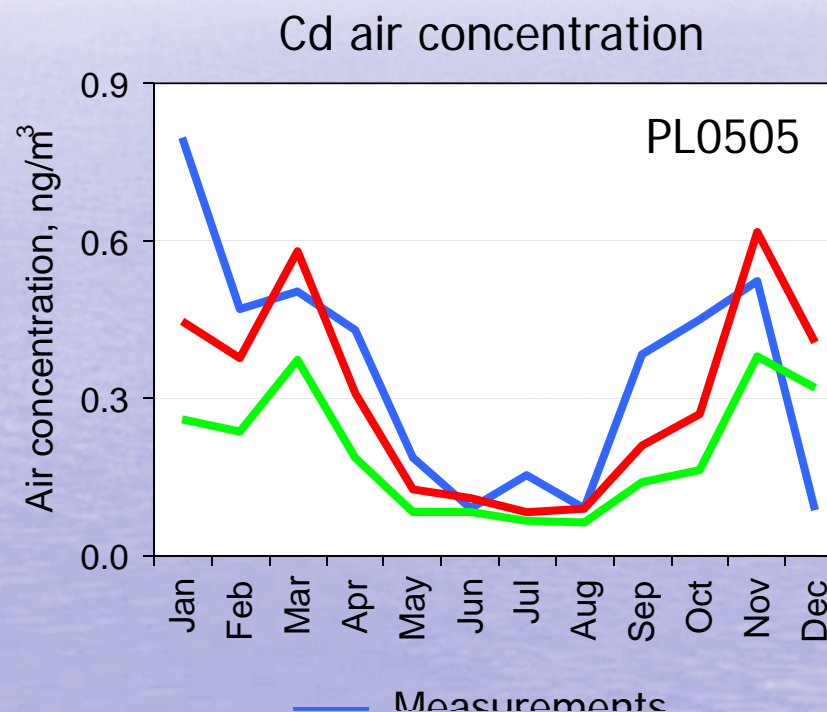
Analysis of model-measurement deviations

Model experiments with emission scenarios



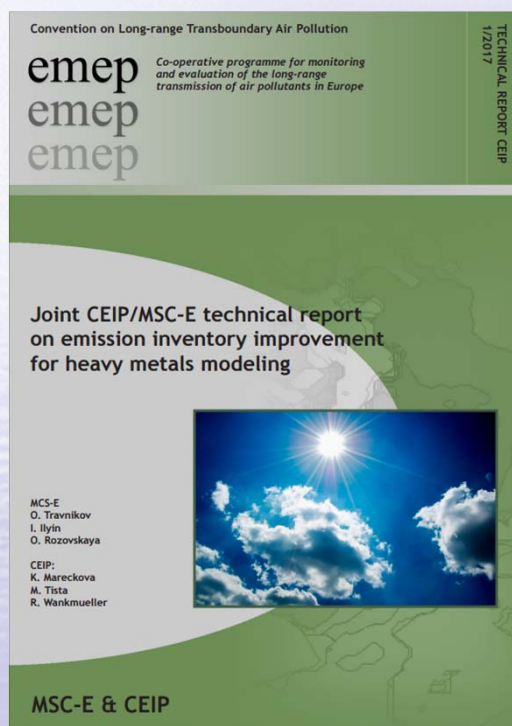
Probably, current emissions of Cd from residential combustion in Poland are significantly underestimated

Industrial Residential Others



Review of HM emission data for modeling

Joint CEIP/MS-C-E Technical Report



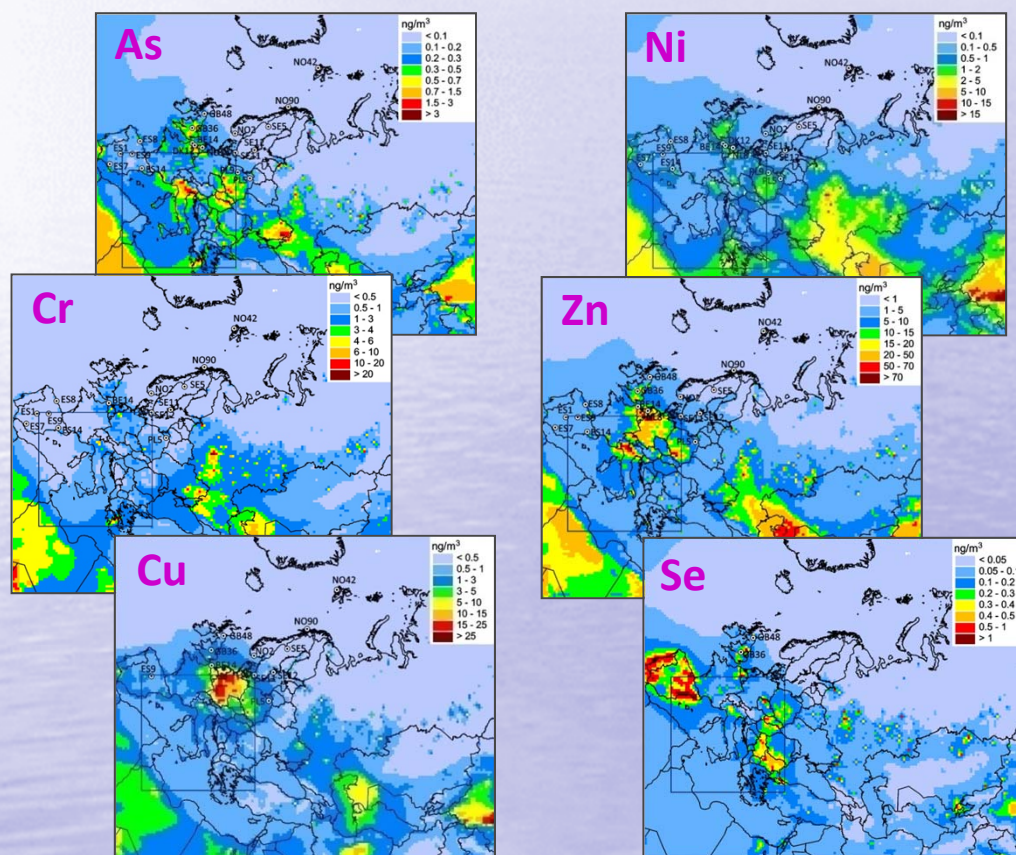
Recommendations:

- **Quality of gridded emission** data (including completeness of reported data and quality of expert estimates used for gap filling) is among the first priority parameters.
- Other parameters with the highest priority include **chemical composition** of emissions (for Hg).
- Lower priority parameter, which is still important for Hg, is **global emissions** inventory.
- Predominantly airborne substances (Pb, Cd) can be more affected by **temporal variation of emissions** and **vertical distribution** of emission sources.

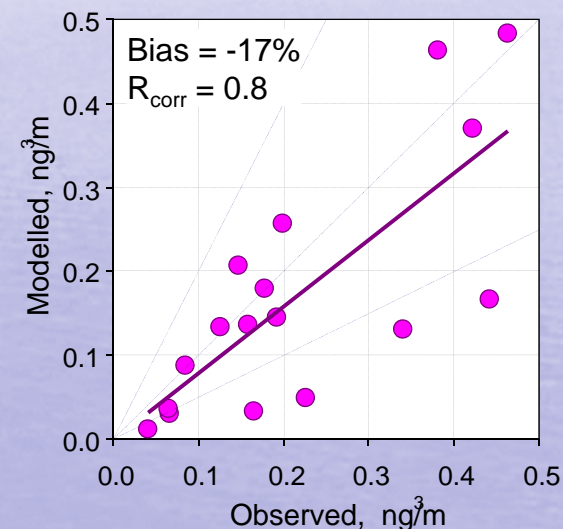
Support of national modelling in Italy

Simulations of **second priority metals** (As, Ni, Cr, Cu, Zn, Se)

Air concentration of HMs (2015)



Evaluation vs. measurements



Evaluation statistics

Relative Bias	$\pm 20\%$
Correlation	0.6 – 0.8

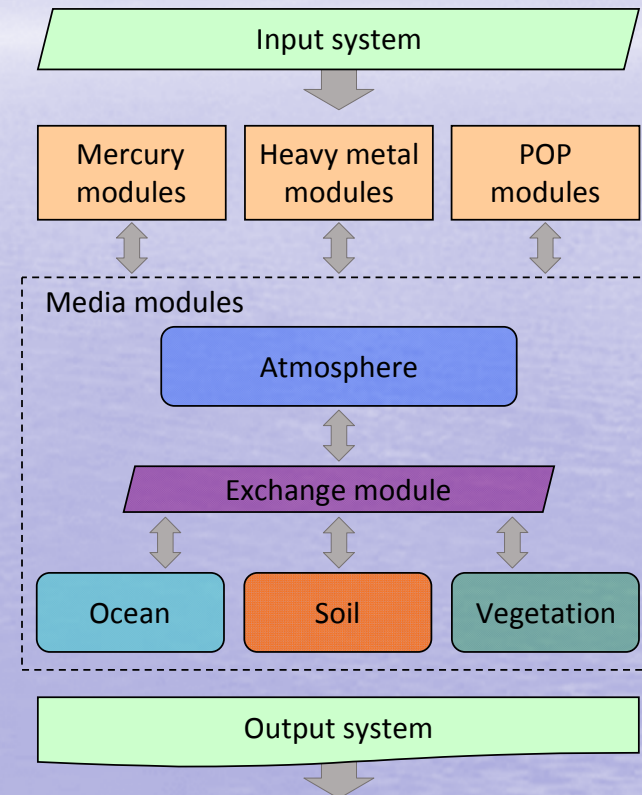
* The study was funded by ENEA (Italy)

GLEMOS distribution as open-source

Distribution set:

- GLEMOS **source code** (FORTRAN 95)
- A set of **control scripts** for compilation and running the model (c-shell)
- A set of **utilities for pre-processing** input data and post-processing output results
- A **set of input data** for test simulations
- Technical documentation

Scheme of GLEMOS modules



A pilot version of the GLEMOS open-source set was delivered to national experts from **Aarhus University, Denmark** (Moscow, August 2017)

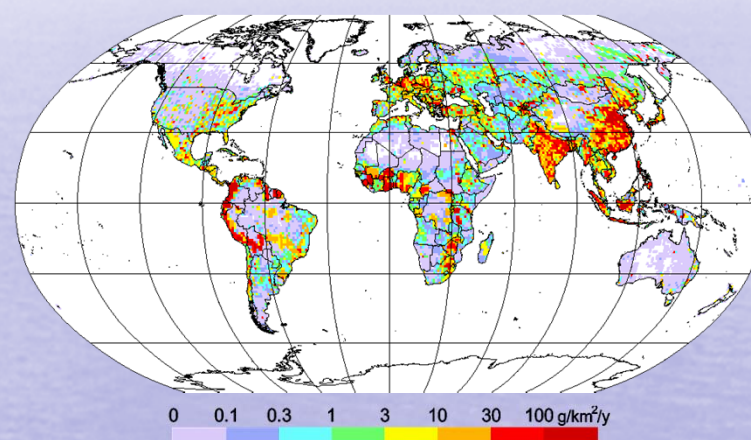
Global Mercury Assessment 2018

Co-operation with **UN Environment** and **Minamata Convention**

Main components:

- Updated **global Hg emissions** inventory for 2015

Global Hg emissions in 2015



Characteristics:

- Global coverage
- Fine spatial resolution ($0.1^{\circ} \times 0.1^{\circ}$)
- Sectoral composition (4 groups of sectors)
- Reviewed by countries

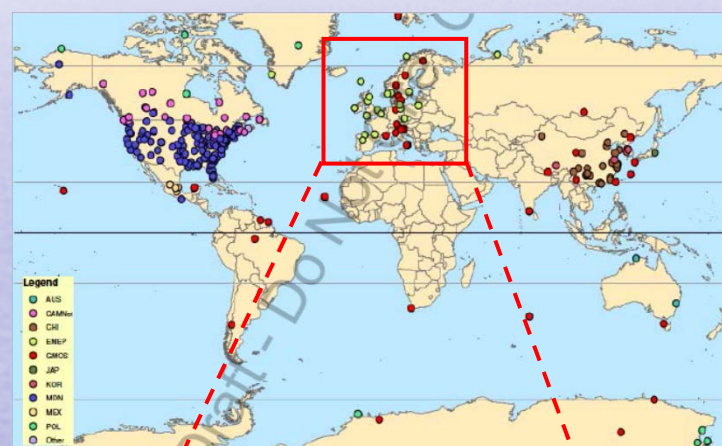
Global Mercury Assessment 2018

Co-operation with **UN Environment** and **Minamata Convention**

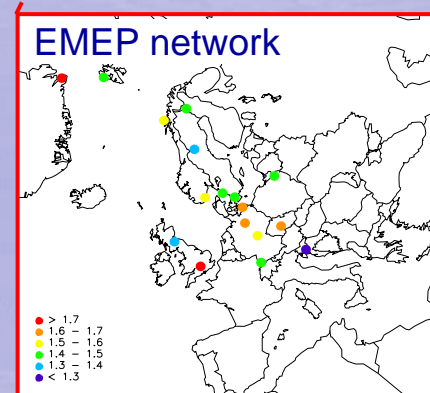
Main components:

- Updated **global Hg emissions** inventory for 2015
- Overview of **Hg measurements** in the global atmosphere

Hg measurements worldwide



EMEP network



Global Mercury Assessment 2018

Co-operation with **UN Environment** and **Minamata Convention**

Main components:

- Updated **global Hg emissions** inventory for 2015
- Overview of **Hg measurements** in the global atmosphere
- **Model assessment** of Hg transport and fate (**coordinated by EMEP/MSC-E**)
- **Hg release to the modelling results in the literature**
- **Hg levels and trends in human populations and biota**
- Multi-model simulations with the updated Hg emissions (2015)

Modelling groups:

<i>Model</i>	<i>Institution</i>
GLEMOS	EMEP/MSC-E
GEM-MACH-Hg	Environment Canada (Canada)
GEOS-Chem	MIT (USA)
ECHMERIT	CNR-IIA (Italy)
HYSPLIT	NOAA (USA)
CMAQ-Hg	HZG (Germany)
CMAQ-Hg	Lamar Univ. (USA)



Environment
Canada

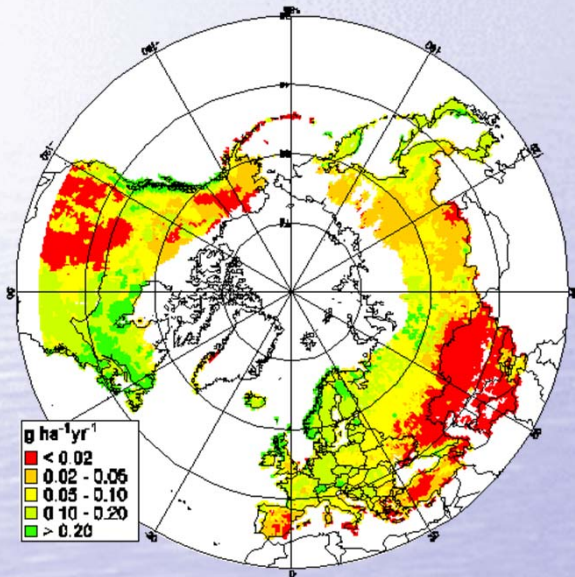


* MSC-E contribution to GMA 2018 is funded by UN Environment/AMAP

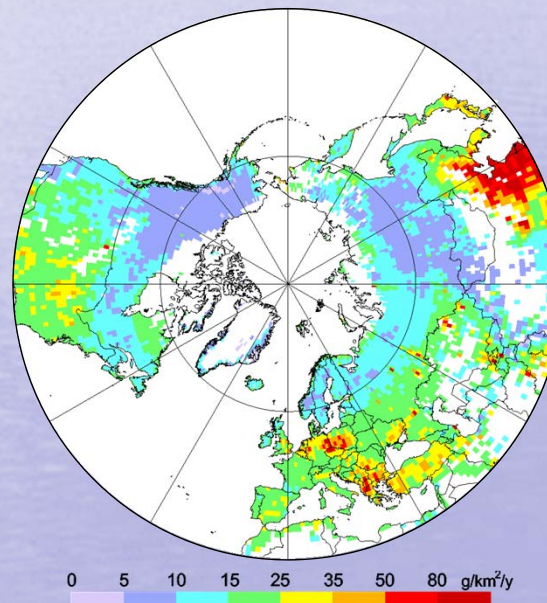
Assessment of Hg adverse effects

Co-operation with **WGE/CCE** and **Alterra** on critical load exceedancies in Northern Hemisphere (preliminary results)

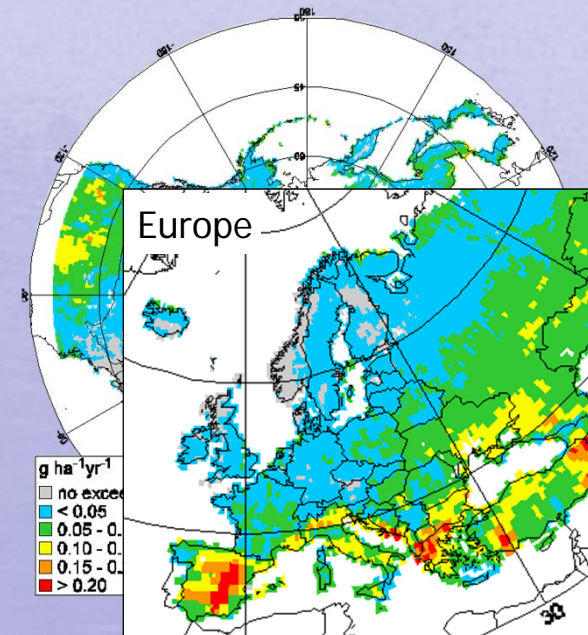
Hg **critical loads** for terrestrial ecosystems



Hg **deposition** to forests (2010)



Accumulated **exceedance** of Hg critical loads



Results of the study can be discussed within the Task Force on Hemispheric Transport of Air Pollution (TF HTAP)

Proposals for workplan 2018-2019

(science part, in accordance with recommendations of PRG)

1. Country-scale assessment of HM pollution (Case Studies)

- Assessment of HM pollution using detailed national emission and monitoring data for **Poland** (Cd), **Germany** (Hg), **United Kingdom** (Pb, Cd)
- Analysis of factors affecting quality of HM pollution **modeling with fine spatial resolution**
- Evaluation of pollution levels in **high-emission** and **high-impact** (e.g. urban) areas using data fusion approaches

2. Evaluation of multi-compartment intercontinental transport of Hg

- Contribution to **UNEP Global Mercury Assessment 2018**
- Analysis of the key factors affecting **Hg accumulation** in and **exchange** between the environmental media
- Evaluation of **secondary emissions** of Hg and their contribution to pollution of the EMEP countries