Modeling of transboundary air pollution within CLRTAP and the role of EMEP

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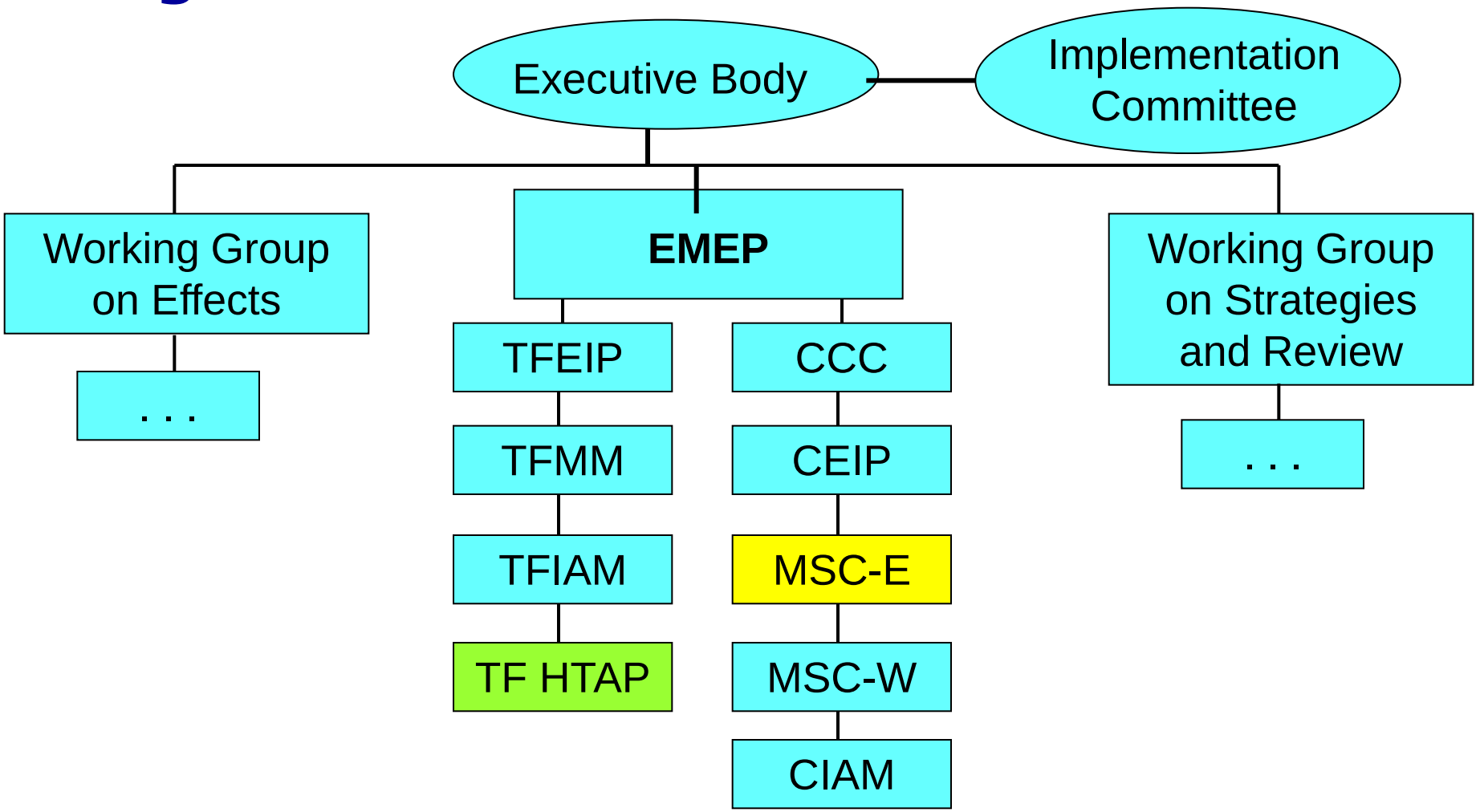
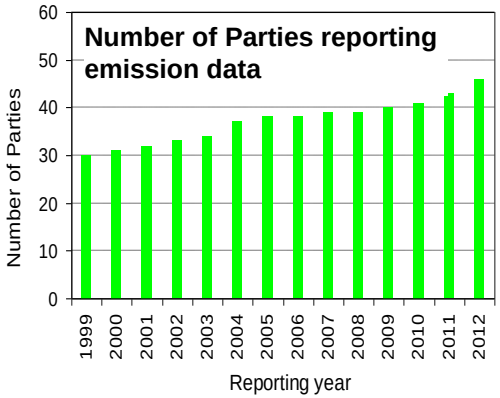
Organization of the work under CLRTAP



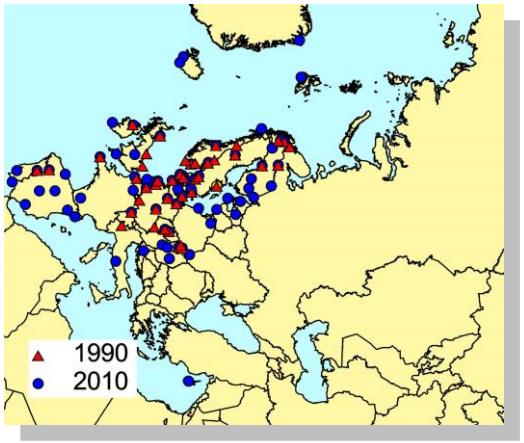
EMEP activities are carried out in close cooperation with various international Bodies and programs: AMAP, EEA, EU, ECHA, HELCOM, OSPAR, Stockholm Convention, UNEP, WHO, WMO . . .

Main fields of the EMEP activity

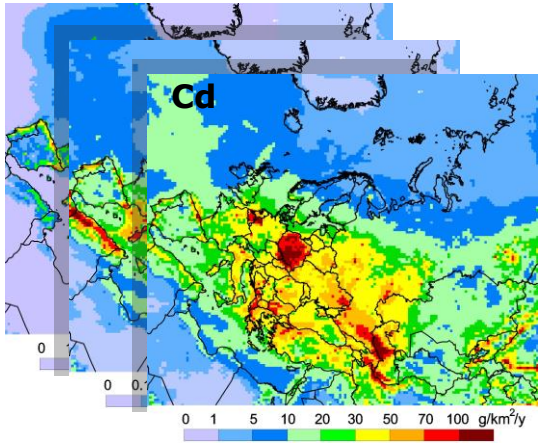
Emissions



Monitoring



Pollution levels



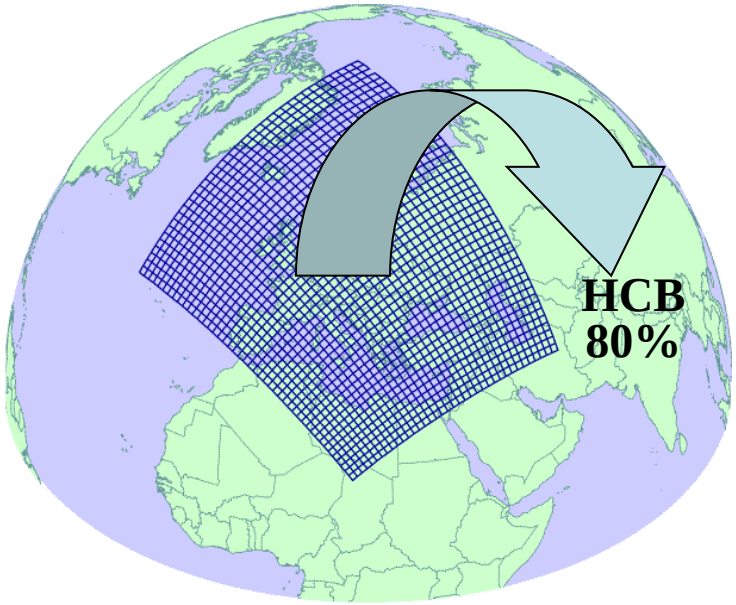
List of pollutants targeted by the Protocols under Convention:

- ozone and its precursors
- acidifying substances
- heavy metals (Pb, Cd, **Hg**)
- Persistent Organic Pollutants

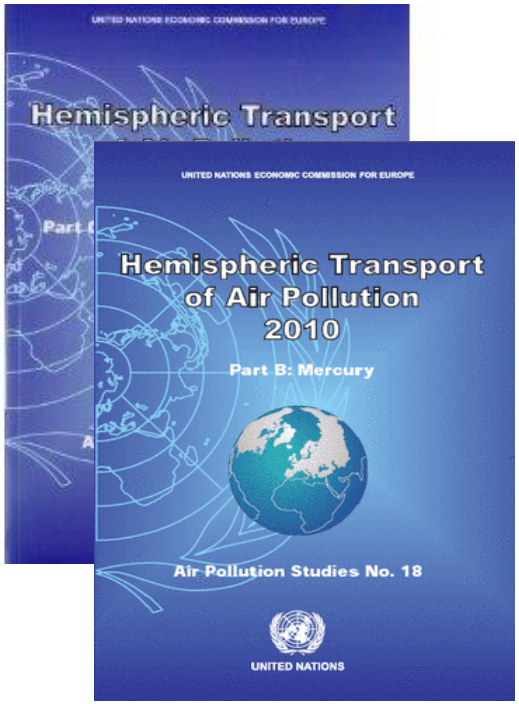
can be transported on regional and **global scale**

LRTAP
Long-range Transboundary Air Pollution

Task Force on Hemispheric Transport of Air Pollution



	Outflow, % of annual emission
B[a]P	30
PCBs	50
PCDD/Fs	60
g-HCH	75
HCB	80



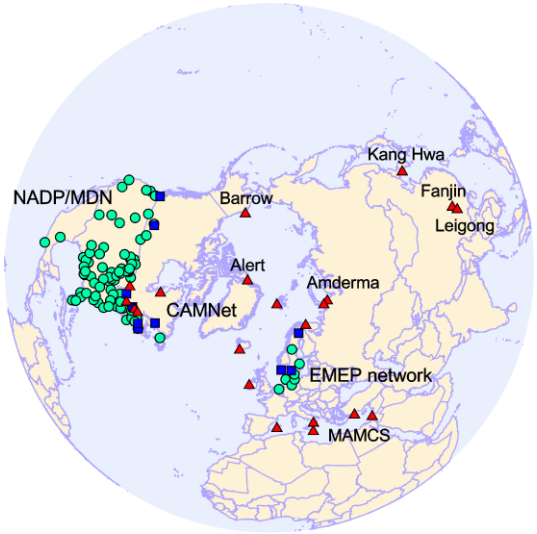
TF serves as a forum for international scientific communication and collaboration in the field of fuller understanding of intercontinental transport

Available Hg/POP measurements in air

Regular measurements at EMEP monitoring sites

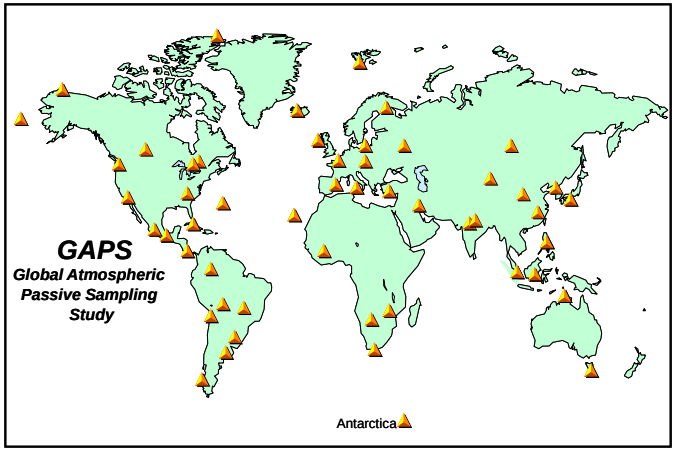
National measurement campaigns

Data from passive sampling campaigns (RECETOX, GAPS, EMEP)



Active sampling data on mercury

MONET-CEEC passive sampling data (2006 – 2008)

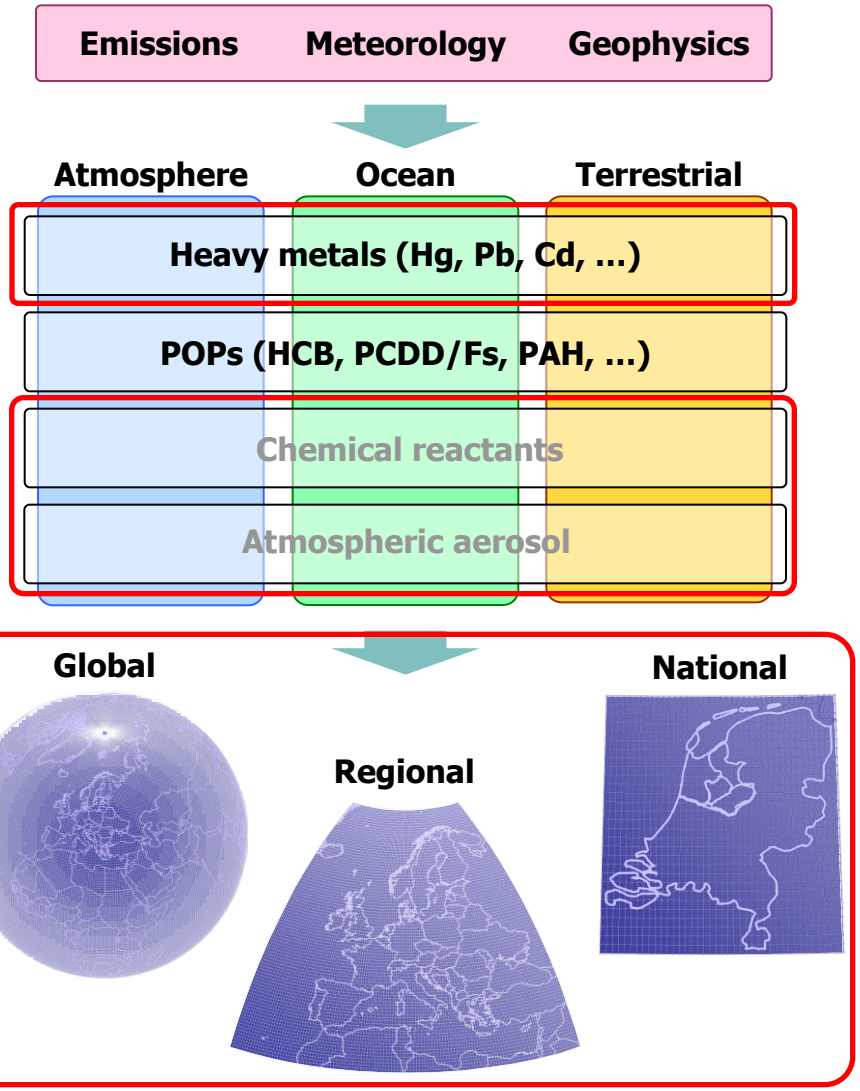


Data from Global Atmospheric Passive Sampling study (GAPS)

Global EMEP Multi-media Modelling System (GLEMOS)

Main features:

- Multi-pollutant formulation (heavy metals, POPs, aerosol, …)
- Multi-media simulation approach
- Modular architecture
- Consistent approach for multi-scale simulations (multiple nesting)

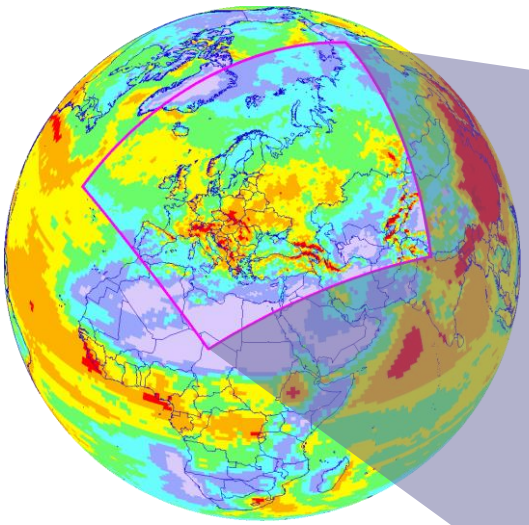


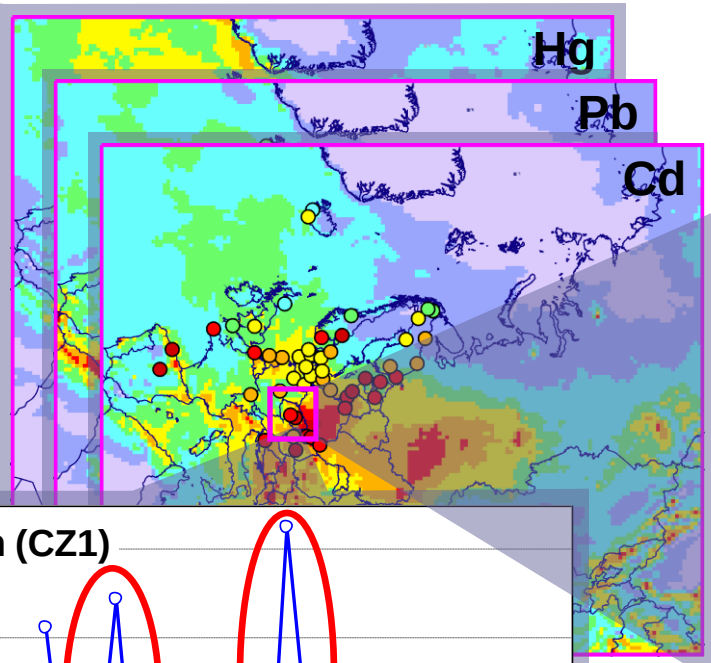
From global to regional and local scale

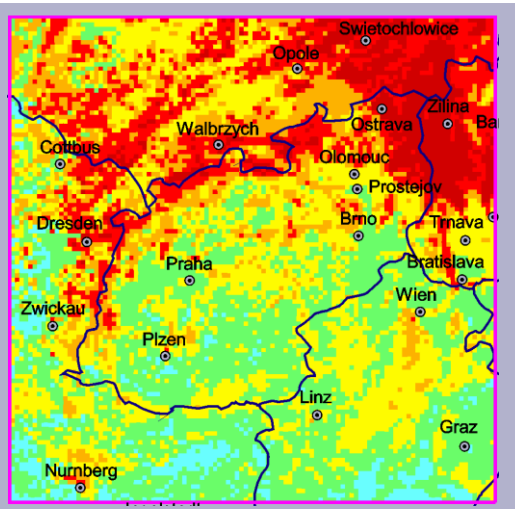
Global scale simulations

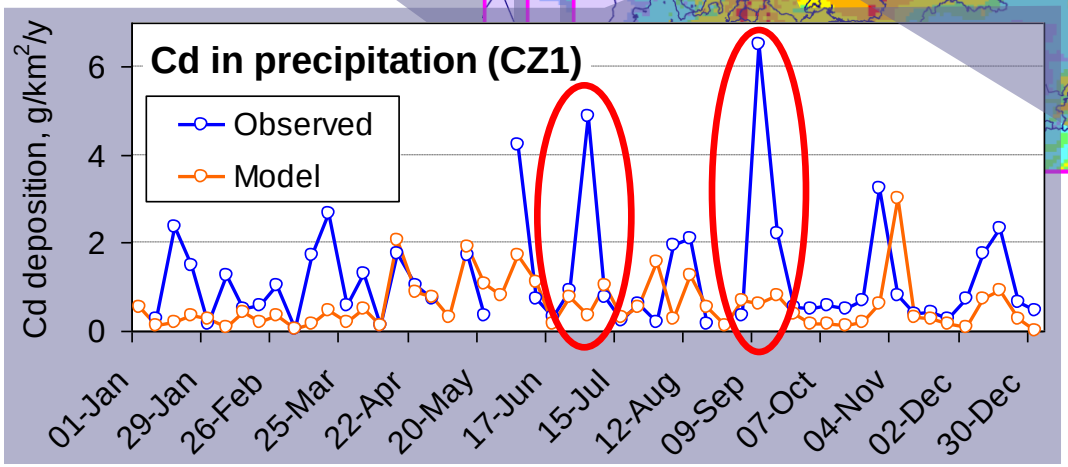
Operational modelling on a regional scale (2008)

National/local scale assessment



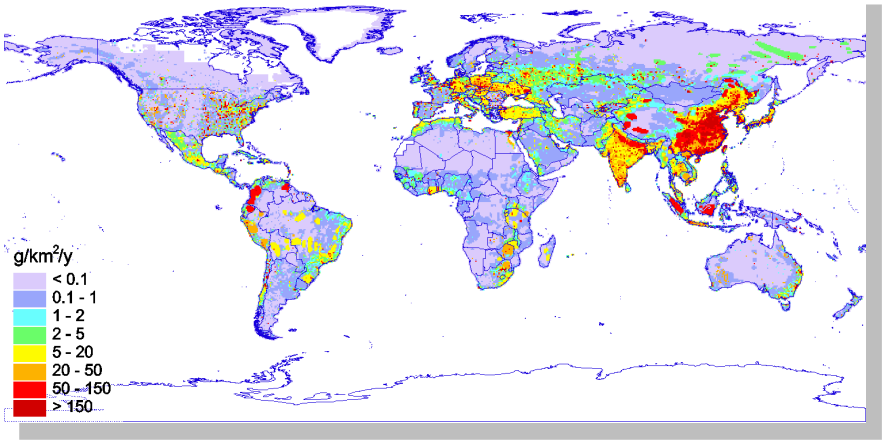


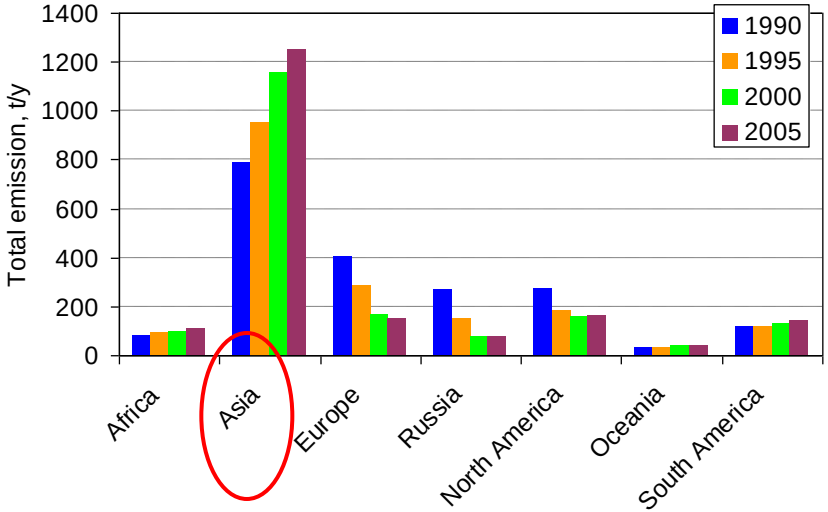


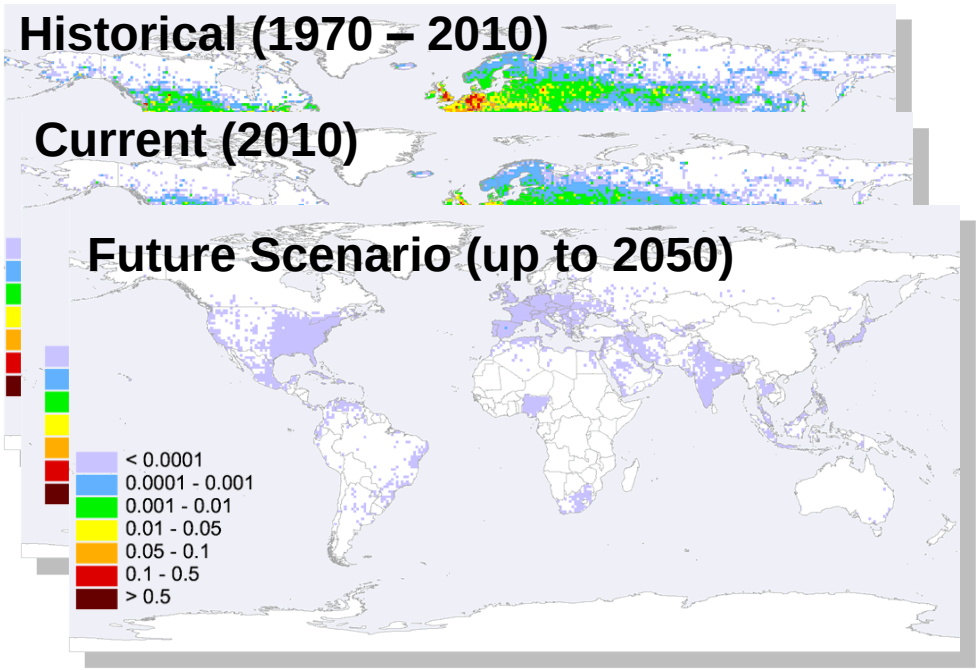


Emission data for modelling

Hg emissions, 2005





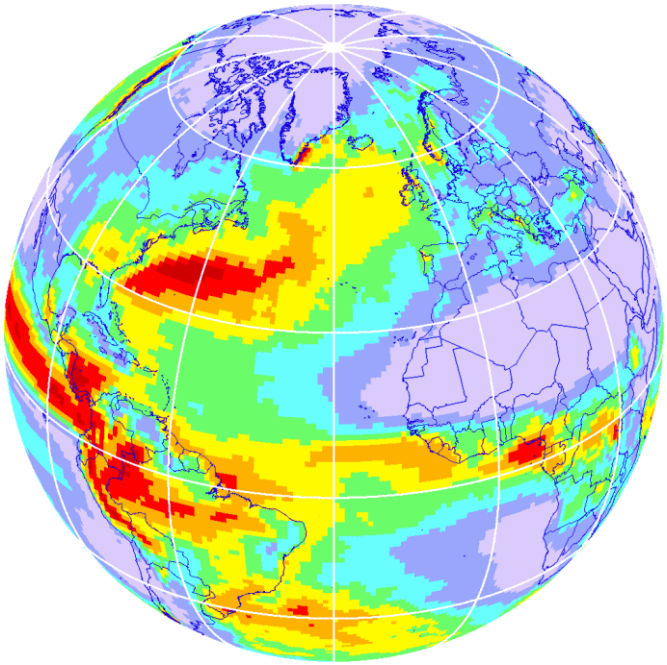


Available global emissions of PCBs

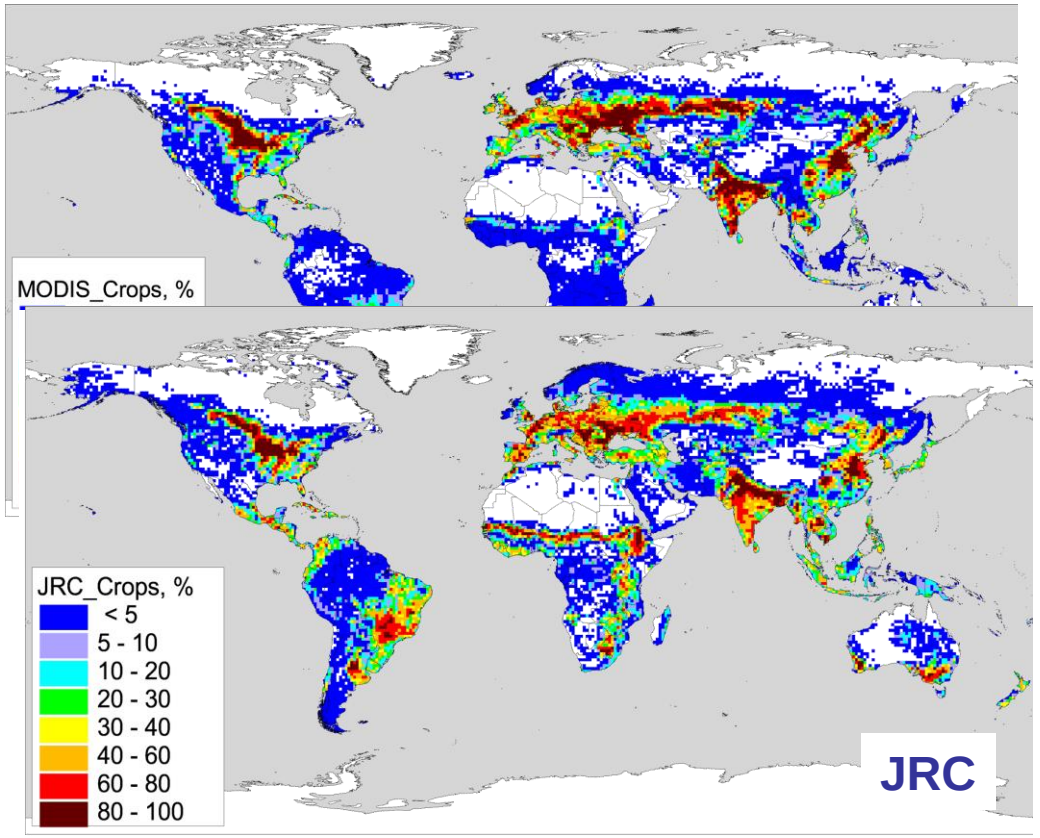
Other input data for global modelling

Meteorology (WRF model)

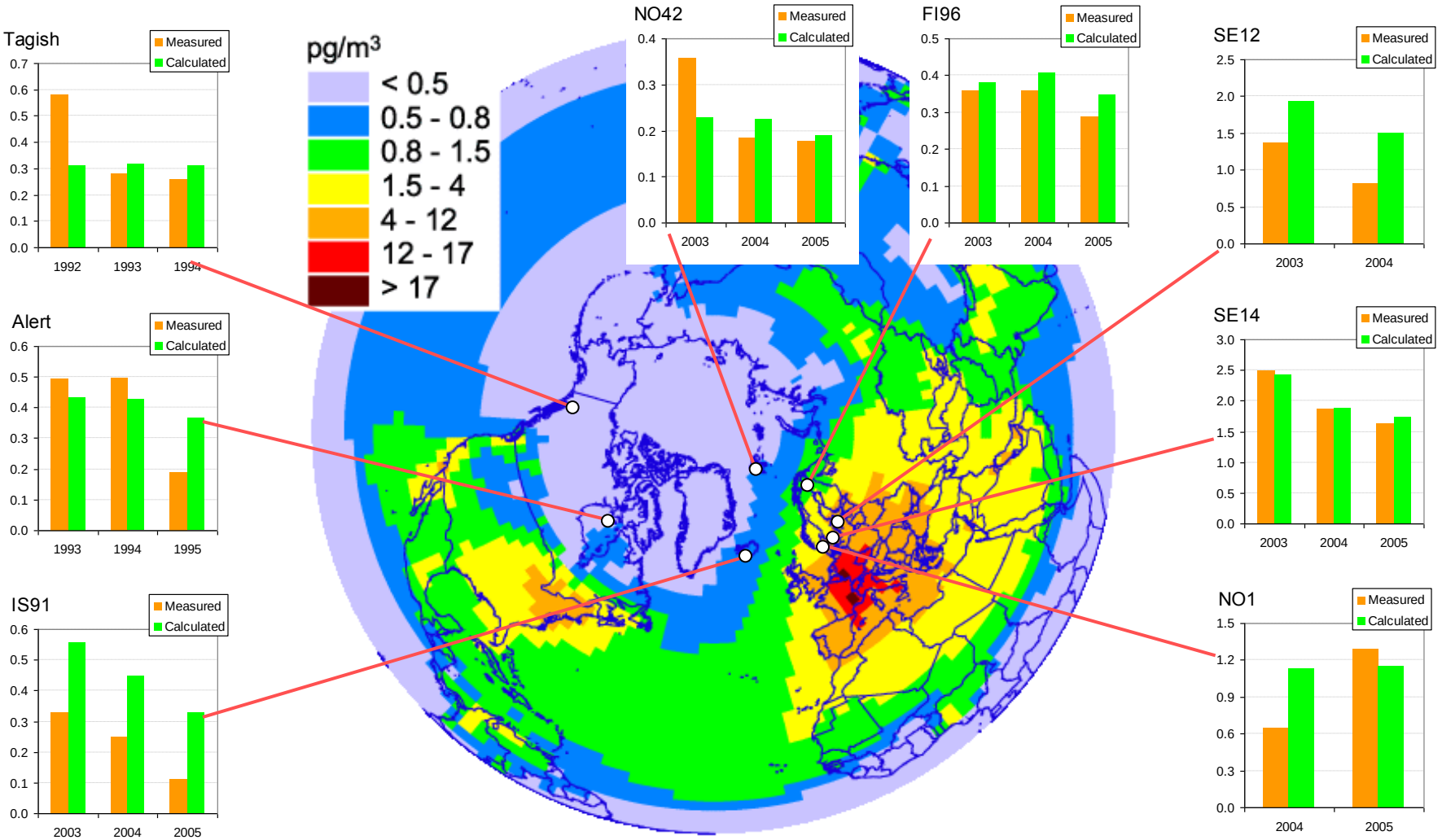
WRF-generated global precipitation field (2009)



Land Cover



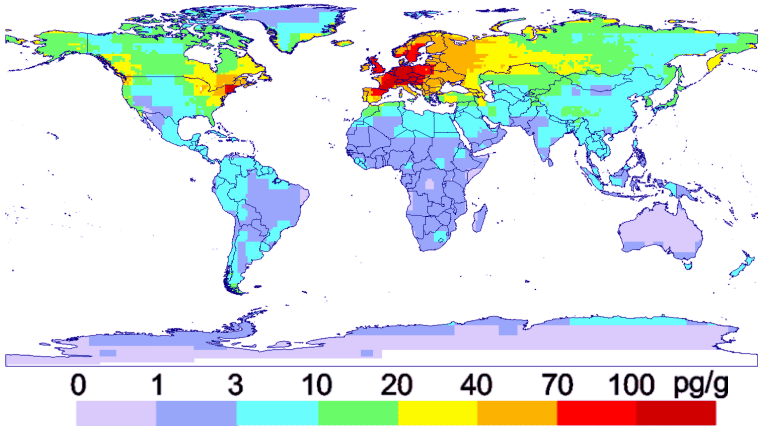
POP monitoring-modelling assessment



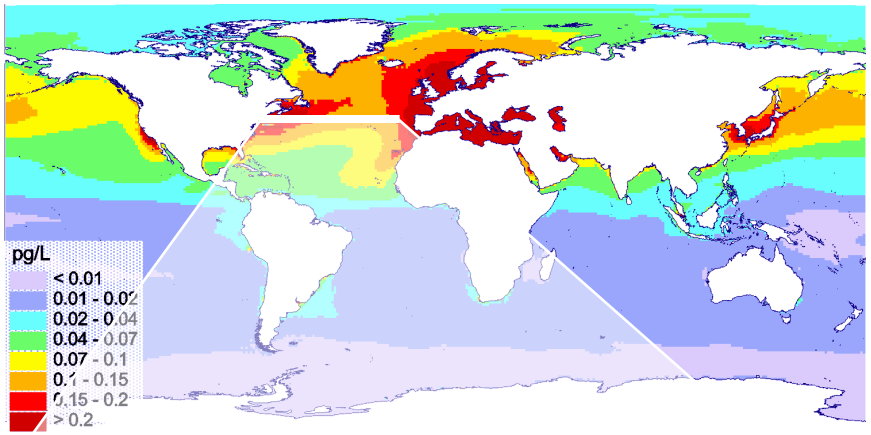
Measured and calculated PCB-153 air concentrations in 2005, pg/m³ (calculated from 1970 to 2005)

PCB-153 simulations on a global scale

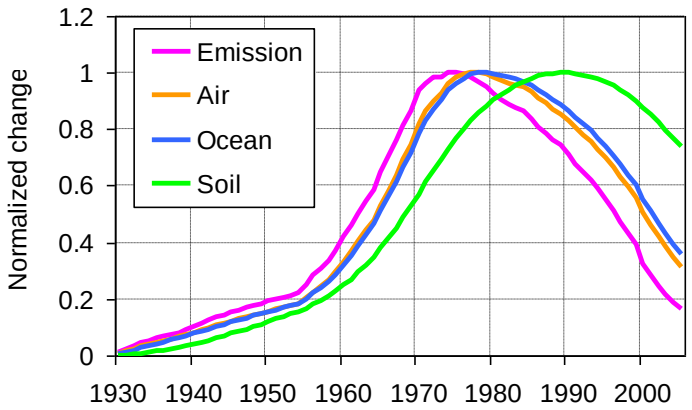
Concentration of PCB-153 in soil (2008)



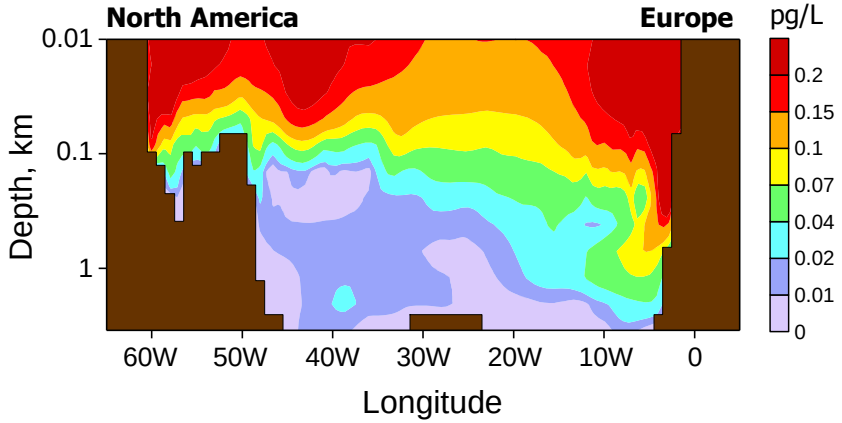
Concentration of PCB-153 in seawater (2009)



Historical changes of PCB-153 in media

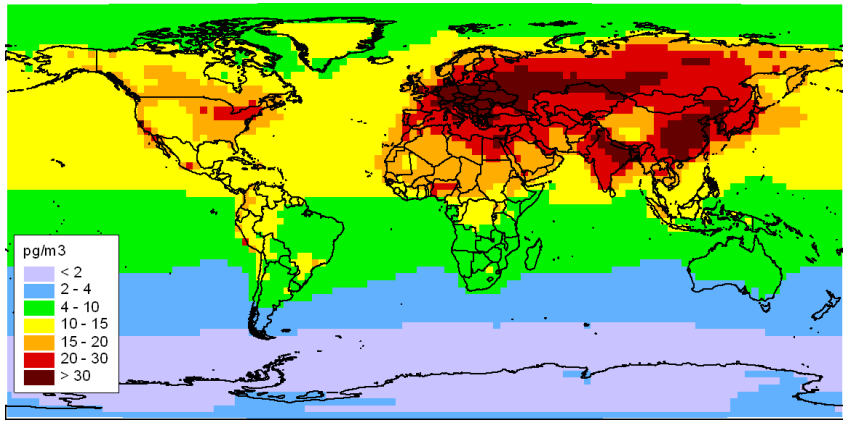


Atlantic ocean transect at 45°N (July 2009)

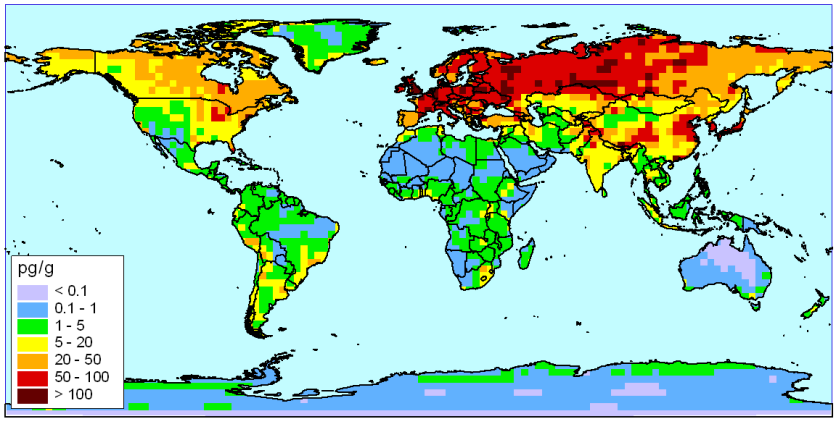


HCB simulations on a global scale

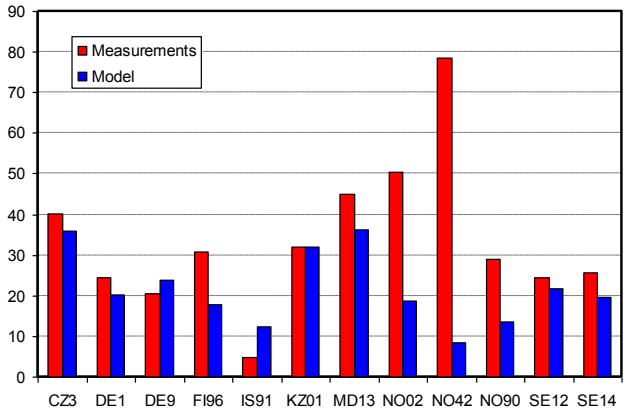
Concentration of HCB **in air** (2010)



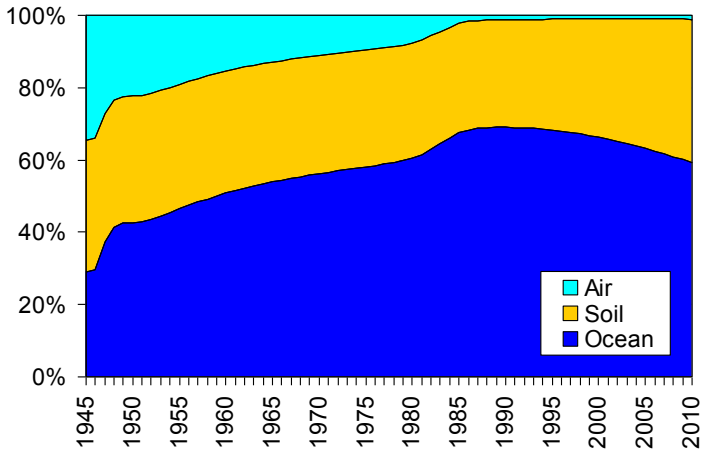
Concentration of HCB **in soil** (2010)



Concentration of HCB in air
at the EMEP monitoring sites (2010)



HCB content in environmental media

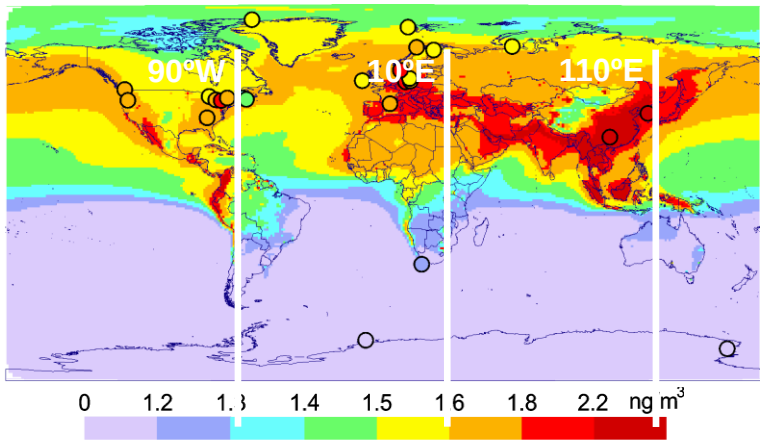


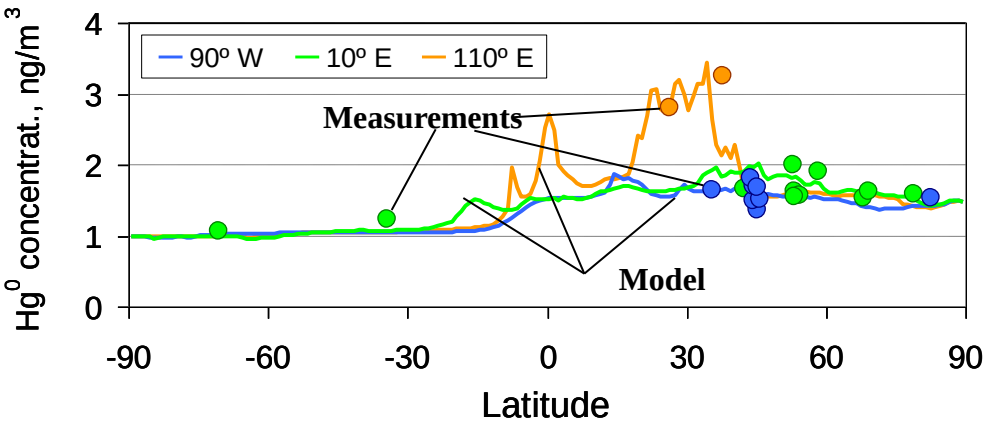
Mercury simulations on a global scale

Modelling results:

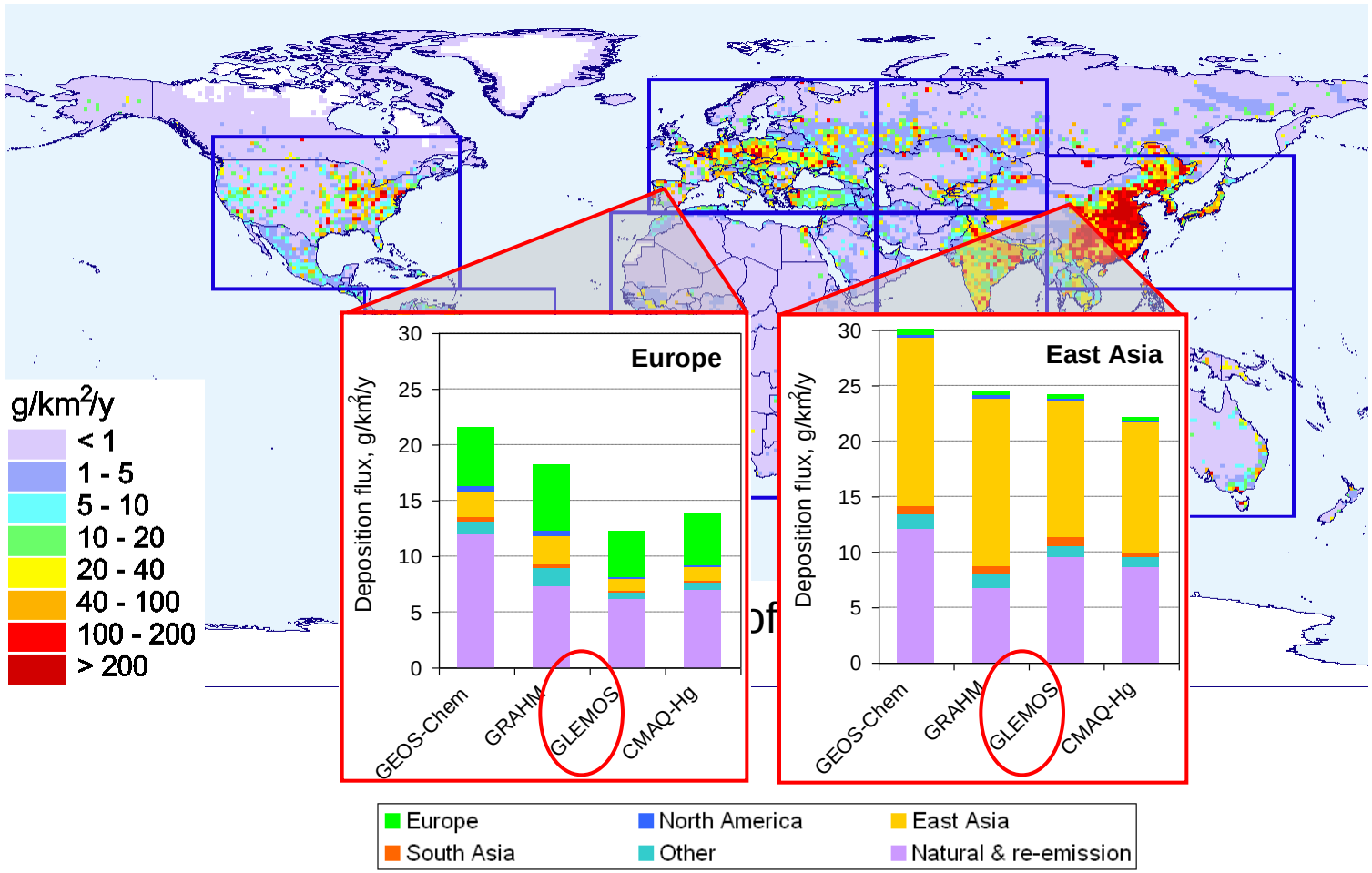
- Assessment of mercury concentration and deposition levels on a global scale
- Estimates of intercontinental transport and source attribution
- Detailed evaluation against observations

Hg^0 concentration in ambient air (2005)



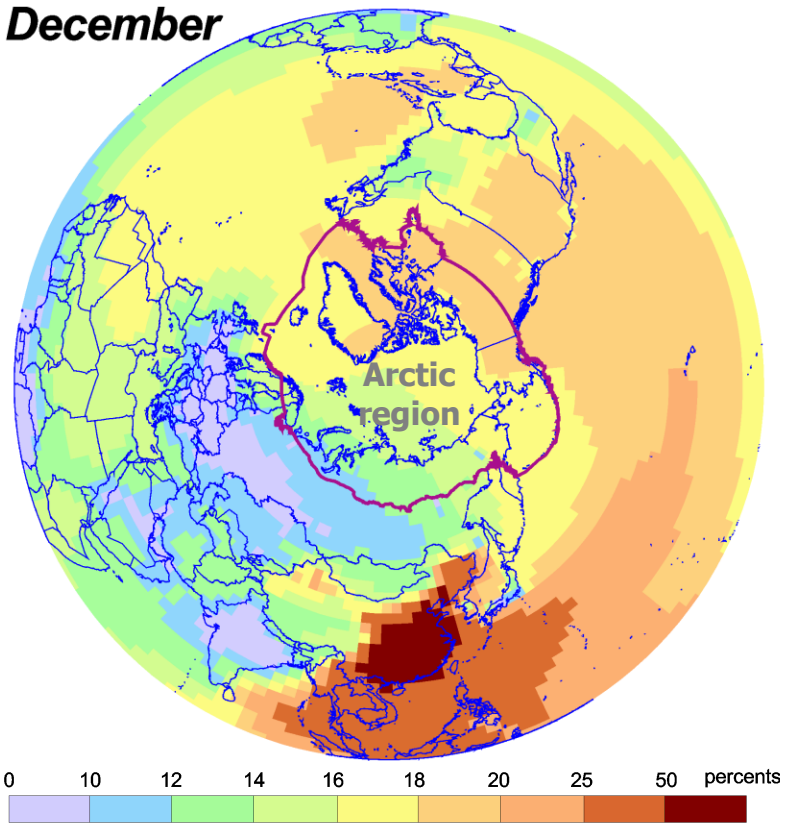


Source-receptor relationships for Hg, 2005



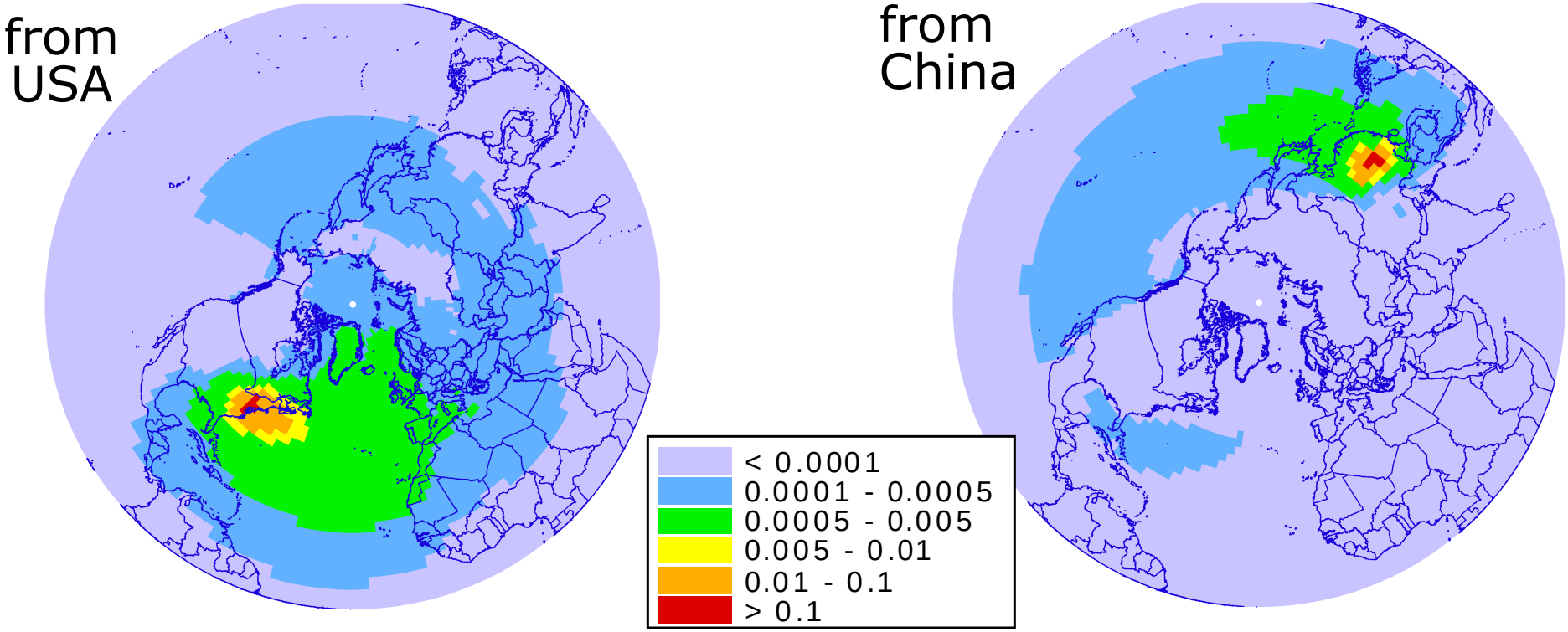
Pathways of Hg transport

Relative contribution of South-eastern Asia to Hg concentration in air in 2000



Intercontinental transport from different countries

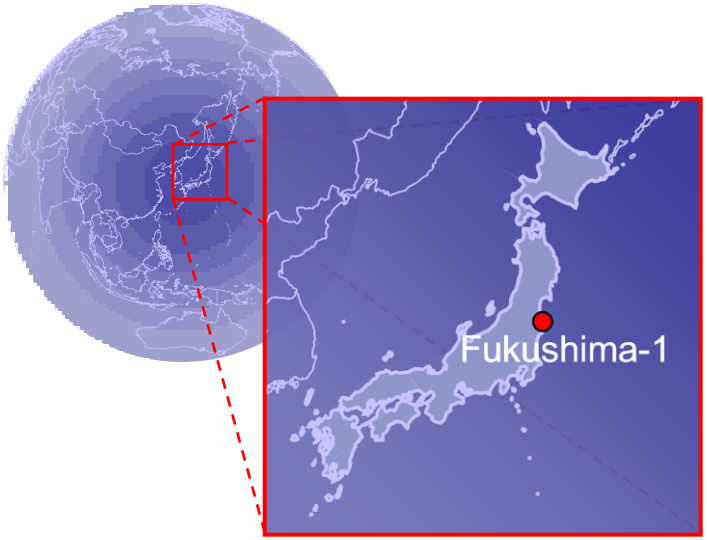
PCB-153 transport



Air concentrations, annual means, relative units

Atmospheric transport from point source

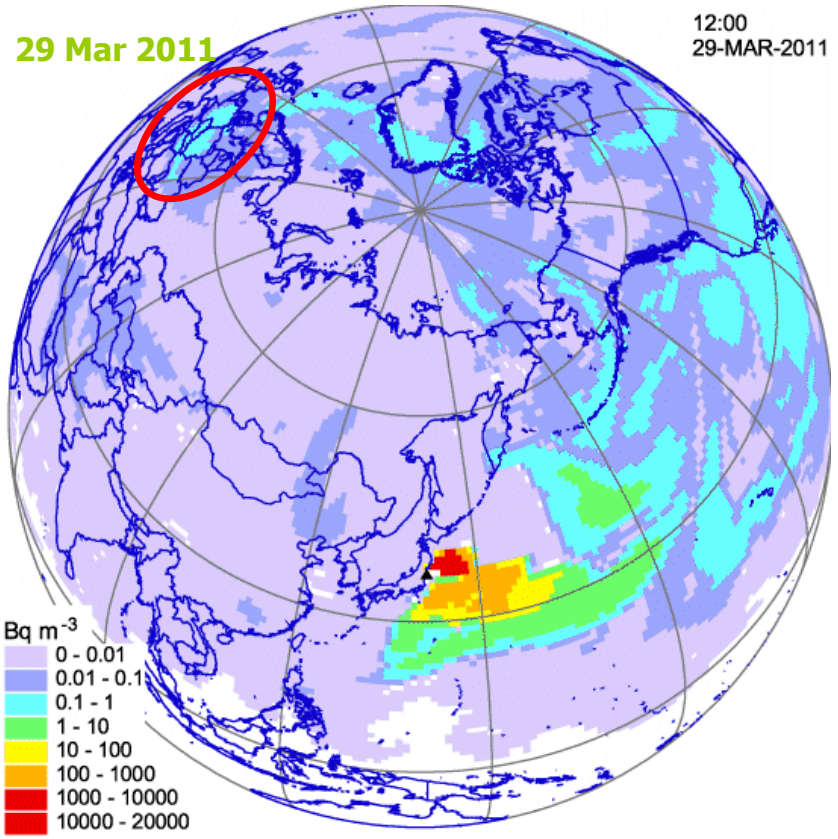
Simulation of a tracer transport from Fukushima-1 accident



Conventional source:

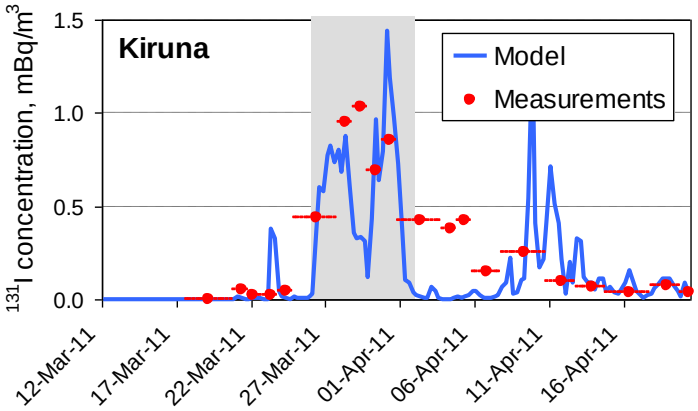
Tracer:	^{131}I
Half-life:	8.02 days
Release:	$2.5 \cdot 10^{16}$ Bq/day
Location:	Fukushima-1

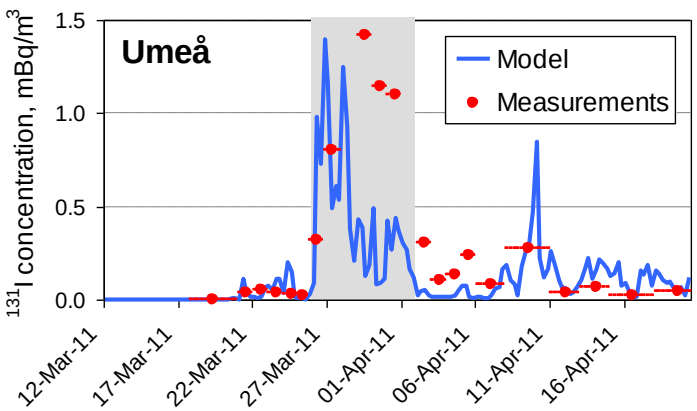
Atmospheric dispersion of ^{131}I from Fukushima-1 (Mar-Apr 2011)

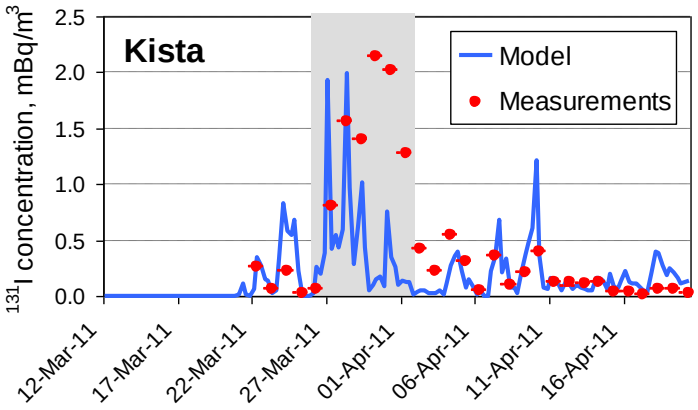


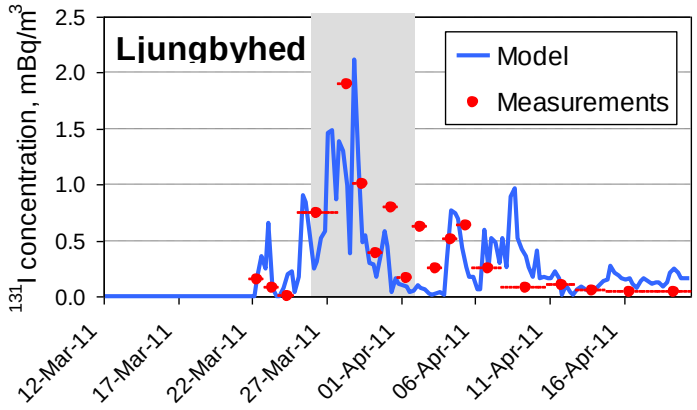
Atmospheric transport from point source

Sites location (Sweden)









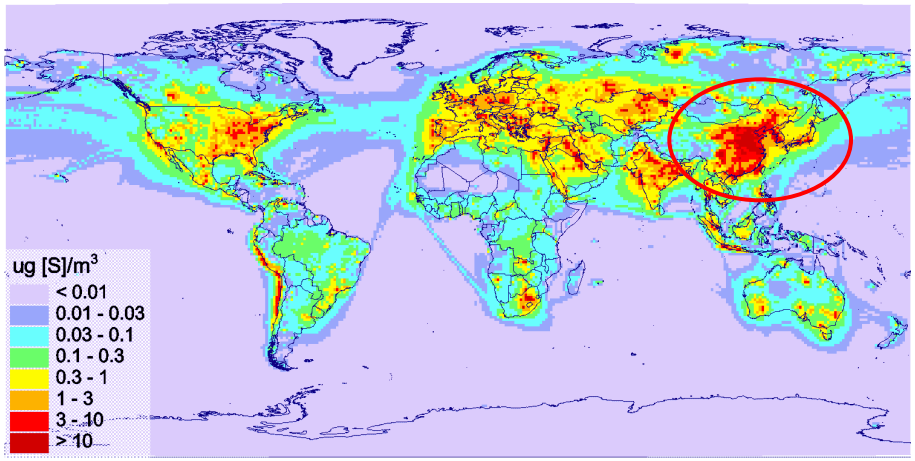
Acknowledgements: Measurement data were provided by Swedish Radiation Safety Authority (SSM)

Simulations of chemical reactants

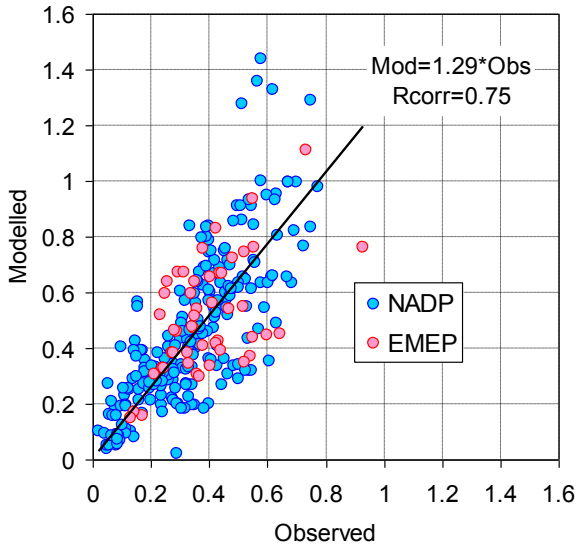
Purpose:

Support and improvement of HM and POP simulations with consistent data on reactants (SO_x, O_3, OH, BrO, …)

Annual mean SO_2 air concentration, mg[S]/m^3



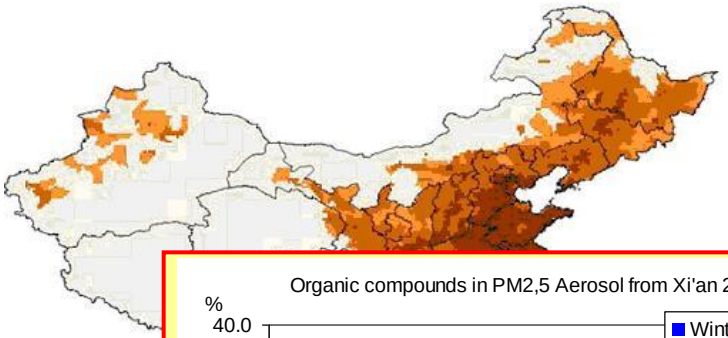
Concentration in precipitation, mg[S]/L

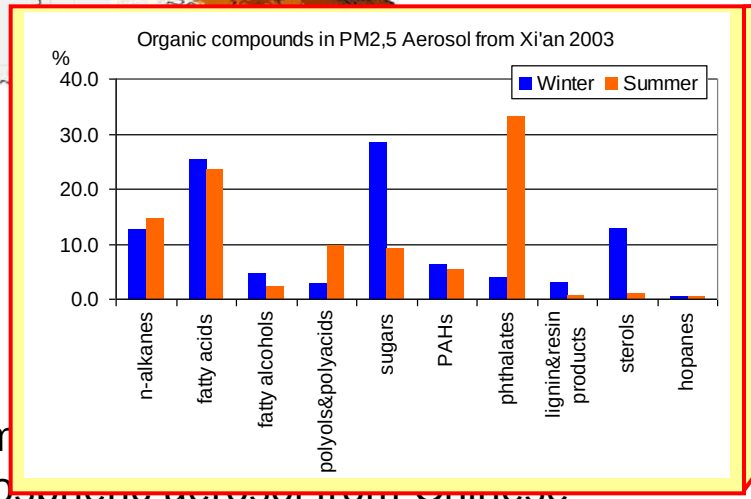


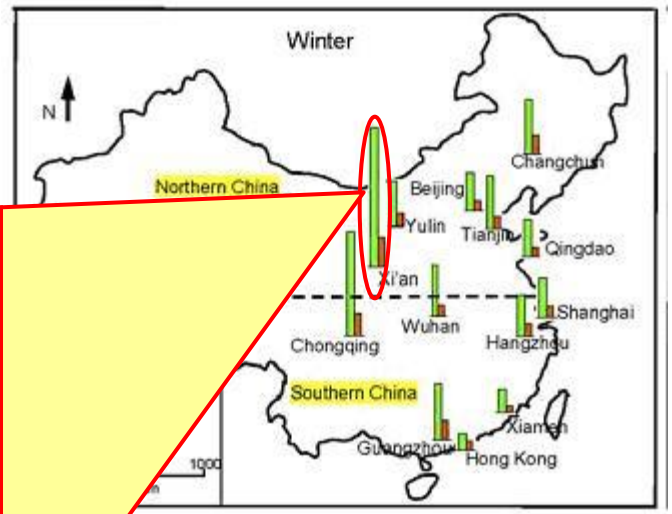
Data on organic carbon content in atmospheric aerosol

Purpose:

Support and improvement of HM and POP simulations with consistent data on atmospheric aerosol







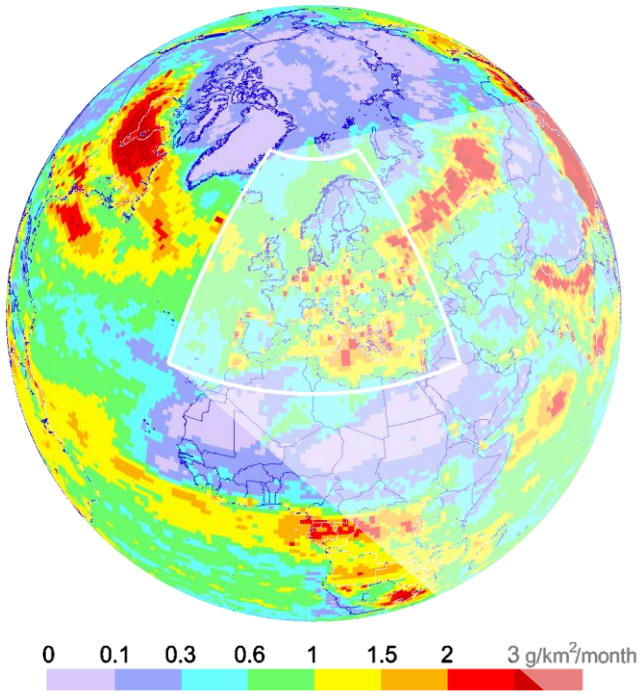
Em
atmo
sources in 2000

Measurements of carbonaceous aerosol in Chinese cities in 2003

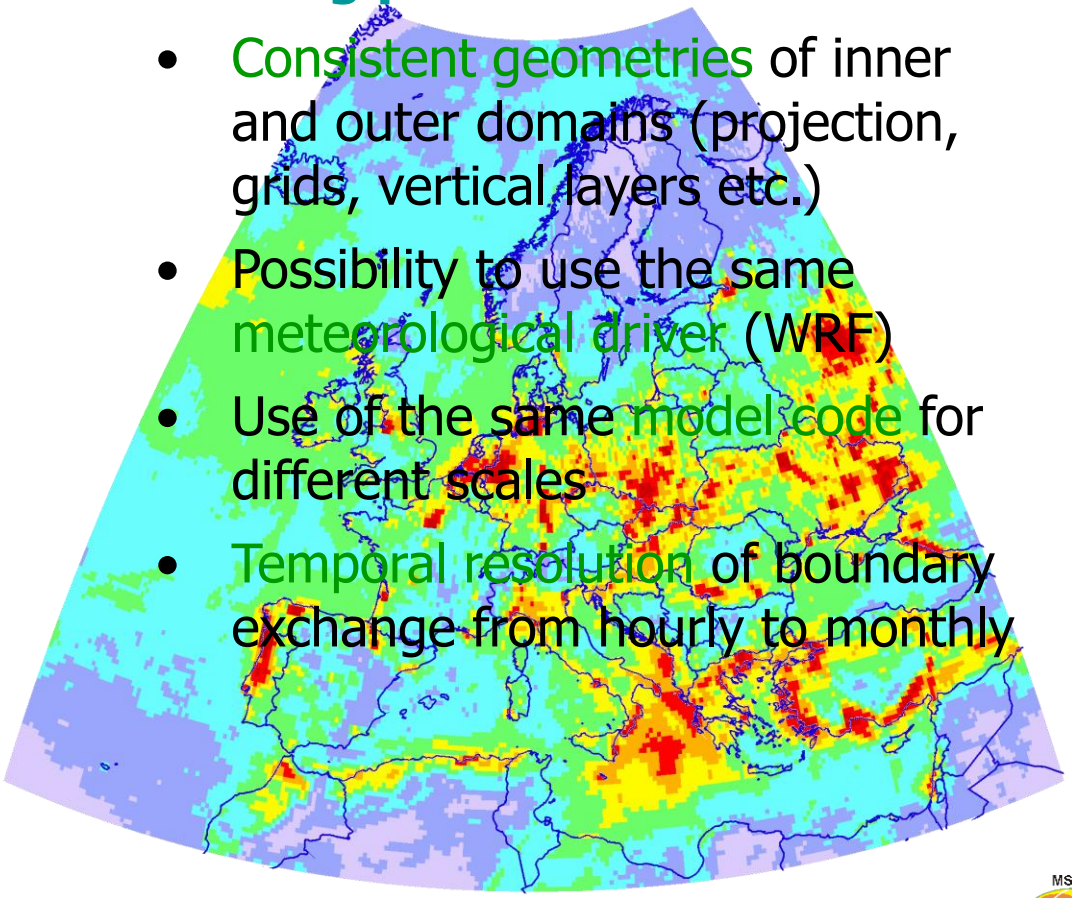
Multi-scale simulations

Nesting in GLEMOS: regional simulations in lat-lon projection

Global Hg deposition (Jan 2009)
(**1°×1°**)



Hg deposition in Europe
(**0.25°×0.25°**)



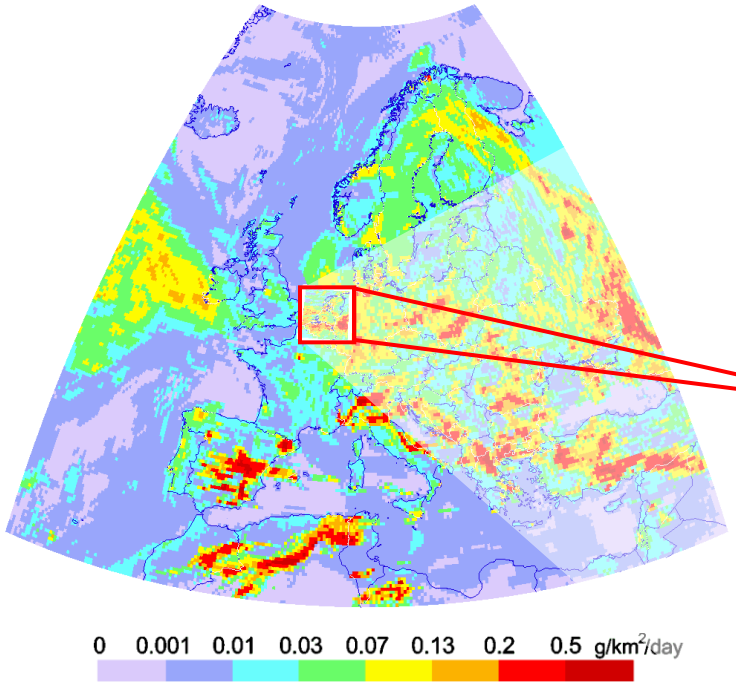
Nesting procedure:

- Consistent geometries of inner and outer domains (projection, grids, vertical layers etc.)
- Possibility to use the same meteorological driver (WRF)
- Use of the same model code for different scales
- Temporal resolution of boundary exchange from hourly to monthly

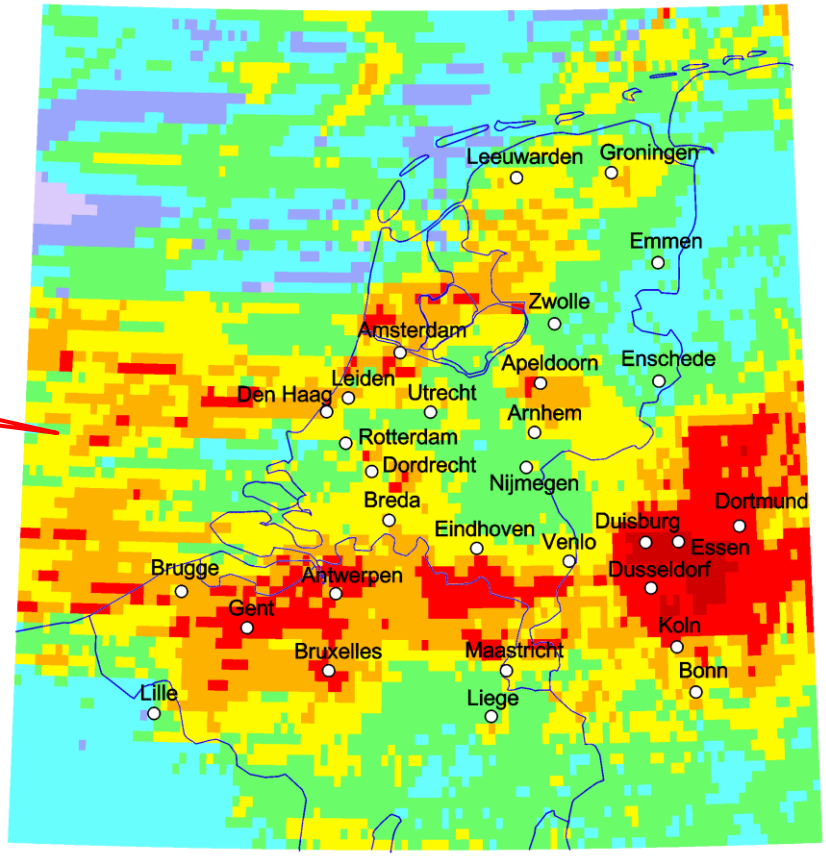
Multi-scale simulations

GLEMOS application for local scale simulations in Europe

Hg deposition in Europe
(**0.25°×0.25°**)



Hg deposition over the Netherlands
(**0.05°×0.05°**)



Recent MSC-E publications and reports

Travnikov O. 'Atmospheric transport of mercury', In: Environmental Chemistry and Toxicology of Mercury (Eds. Liu, Cai and O'driscoll), Wiley & Son, in press.

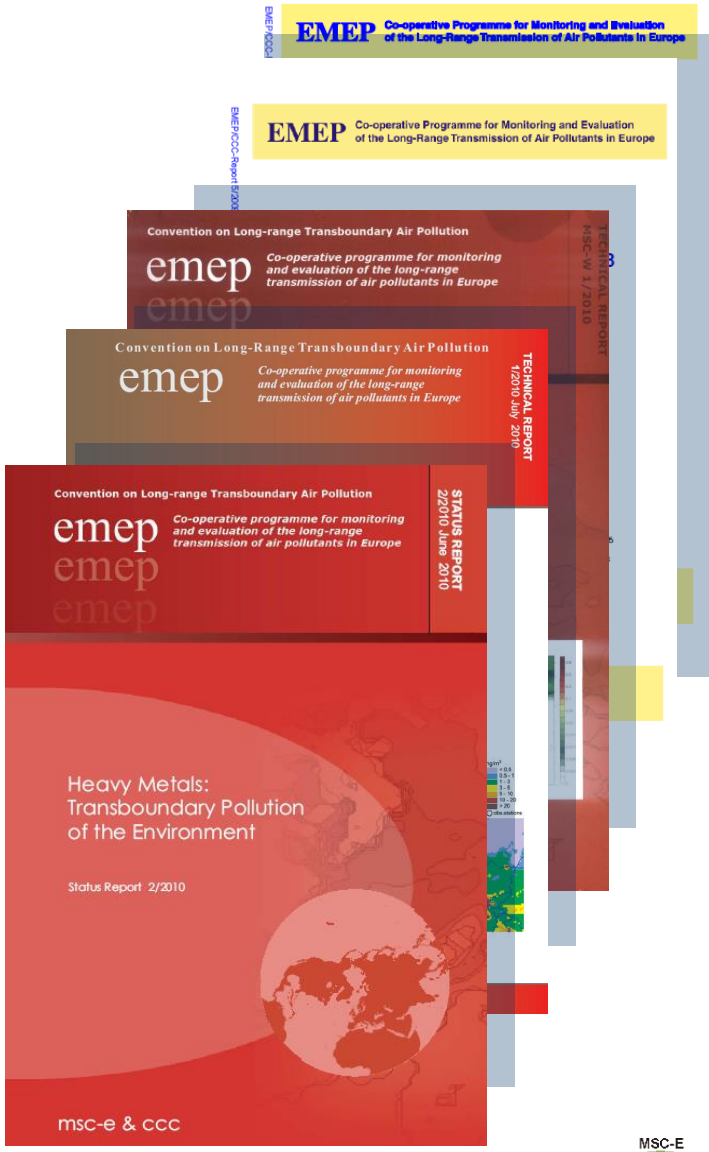
Thöni L., Yurukova L., Bergamini A., Ilyin I., Matthaei D. (**2011**) Temporal trends and spatial patterns of heavy metal concentrations in mosses in Bulgaria and Switzerland: 1990–2005. Atmos. Environ. 45(11) 1899-1912.

Kaltz A, Harmens H., Holy M., Pesch R., Schröder W. and Ilyin I. (**2010**) Metalle und Stickstoff angereichert in Moosen Sachsens. Umweltwissenschaften und Schadstoff-Forschung. DOI: 10.1007/s12302-010-0126-5.

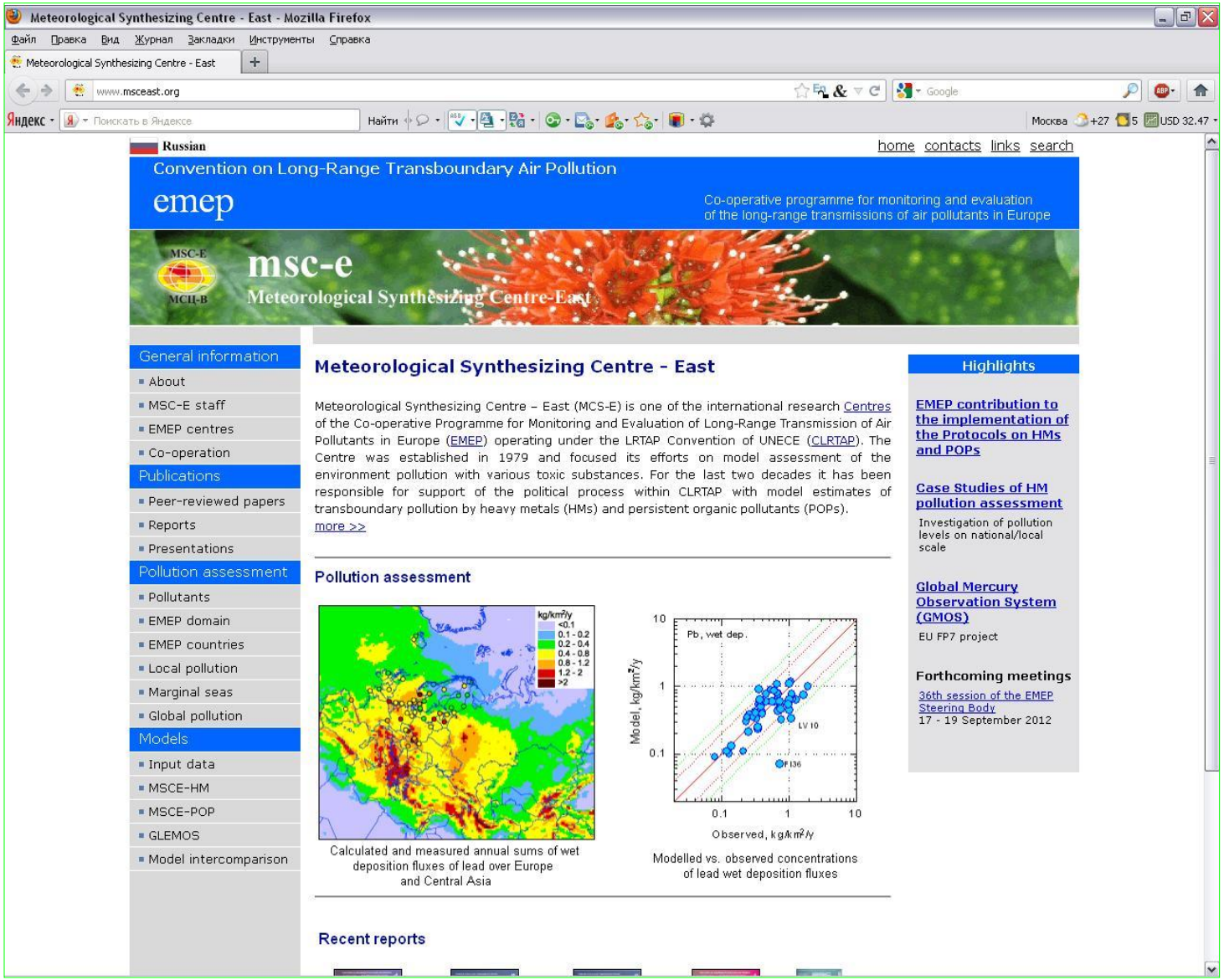
Genßler L., Holy M., Pesch R., Schröder W., Harmens H. and Ilyin I. (**2010**) Anreicherung atmosphärischer Depositionen von Metallen und Stickstoff in Moosen Mecklenburg-Vorpommerns von 1990 bis 2005. Umweltwissenschaften und Schadstoff-Forschung, DOI: 10.1007/s12302-010-0128-3.

Schröder W., Pesch R., Kratz W., Holy M., Zechmeister H., Harmens H., Fagerli H. and Ilyin I. (**2010**) Atmosphärische Deposition und Anreicherung von Schwermetallen und Stickstoff in Natura-2000-Gebieten Deutschlands. Umweltwissenschaften und Schadstoff-Forschung, DOI: 10.1007/s12302-010-0128-3.

Schröder W., Holy M., Pesch R., Ilyin I., Harmens H. and Gebhardt H. (**2010**) Erfassung der Anreicherung von Metallen und Stickstoff in baden-württembergischen Moosen. Umweltwissenschaften und Schadstoff-Forschung. DOI: 10.1007/s12302-010-0146.



MSC-E web-site: www.msceast.org



EMEP/ESCAP cooperation

First stage:

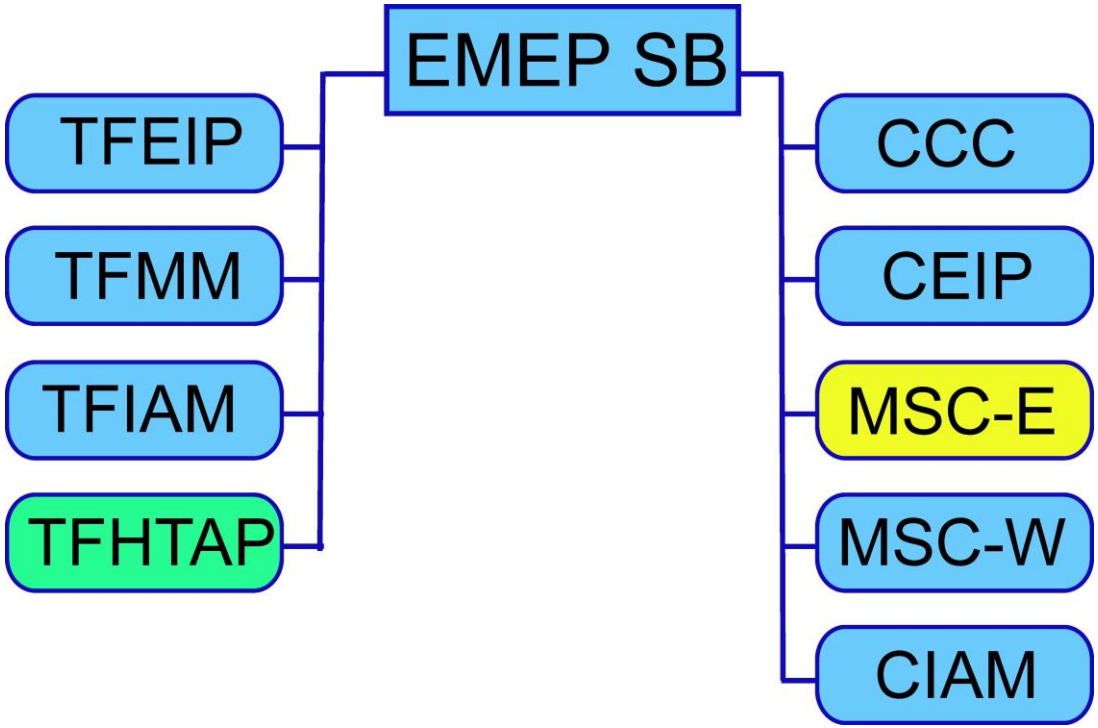
Exchange of information in the field of:

- global emission data
- monitoring
- modelling

is highly appreciated

…

Organization of the work under CLRTAP



EMEP activities are carried out in close cooperation with various international Bodies and programs: AMAP, EEA, EU, ECHA, HELCOM, OSPAR, Stockholm Convention, UNEP, WHO, WMO . . .