TF HTAP

GMOS
Global Mercury Observation System

HTAP Model Experiments: Relevant activities on Hg and POPs

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CNR-IIA

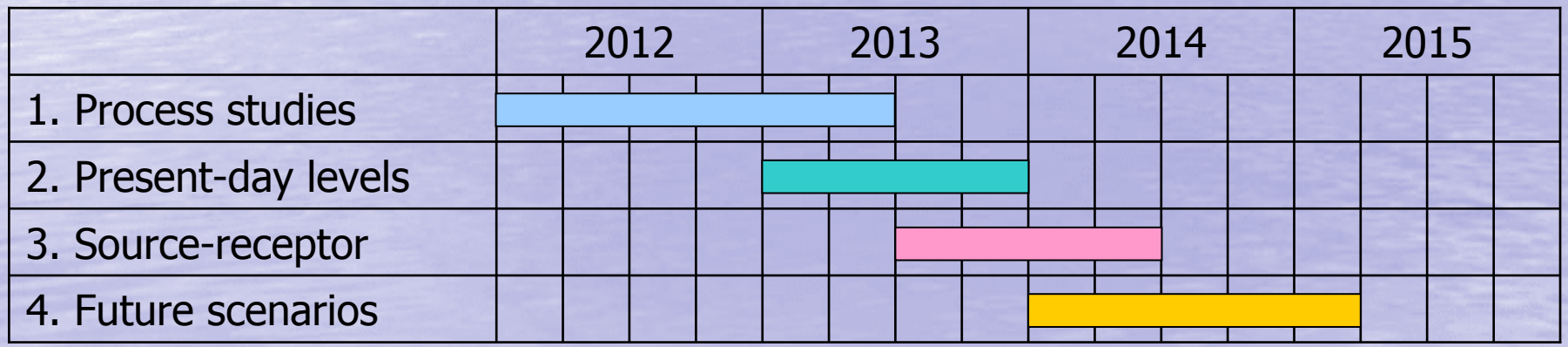
Environment Canada

TF HTAP meeting, San Francisco, 2013

GMOS/HTAP simulations program for Hg

Modeling activities:

1. Model studies of Hg atmospheric processes and evaluation vs. field campaign measurements (HTAP WP3.10)
2. Assessment of present-day and historical deposition levels (HTAP WP3.10)
3. Source-receptor analysis and evaluation of global sources contribution to Hg deposition in Europe (HTAP WP2.4)
4. Forecasting future Hg pollution levels for 2030



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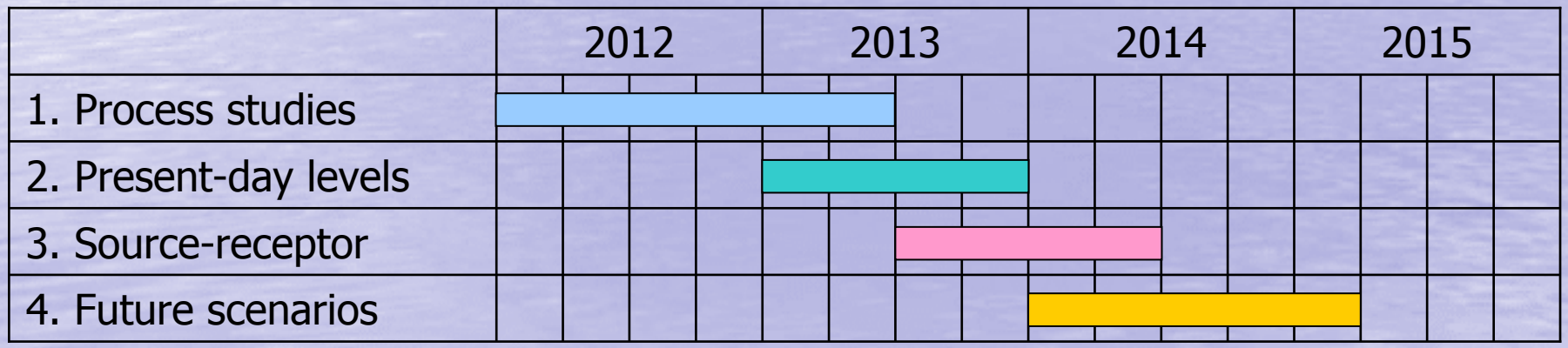

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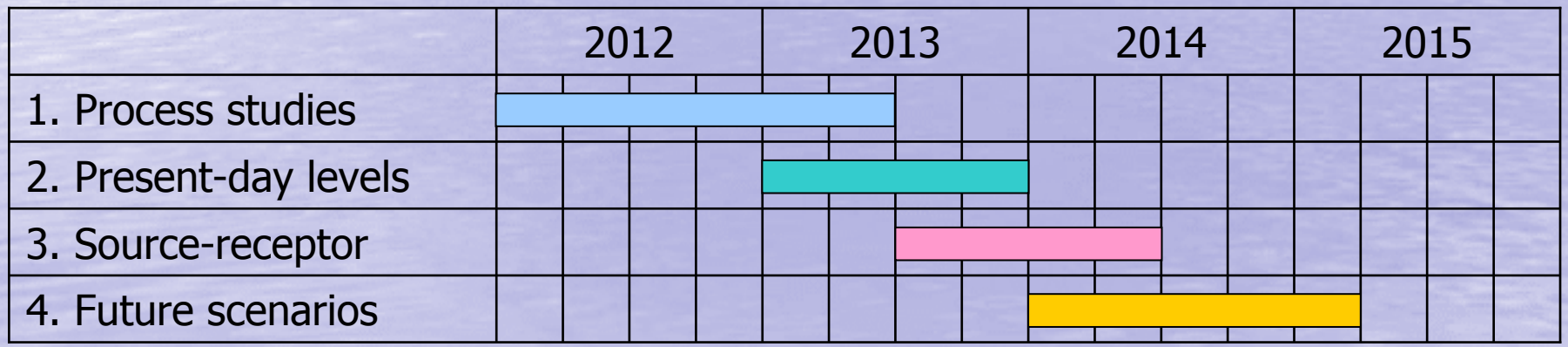
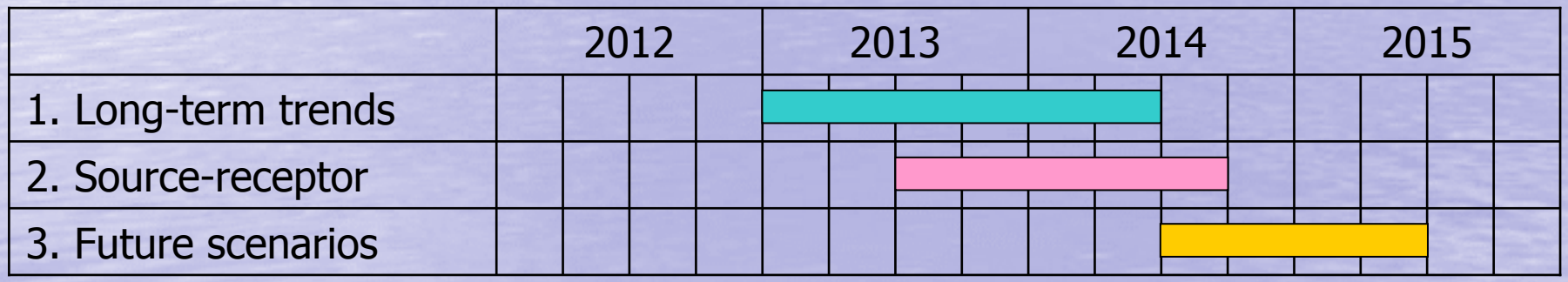


EMEP simulations program for POPs

Modeling activities:

1. Assessment of long-term changes in POP pollution levels, evaluation vs. EMEP and GMP SC measurements (HTAP WP3.11)
2. Source-receptor model simulations using HTAP regions, evaluation of contribution of secondary emissions (HTAP WP2.4)
3. Evaluation of future changes of POP pollution levels



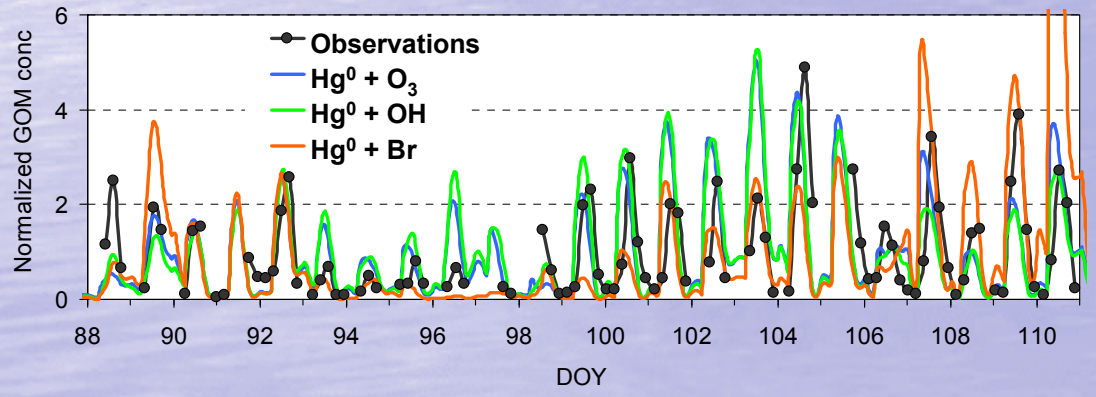
Hg process studies in CBL

Model experiments: Sensitivity runs with selected oxidation processes

Measurements: Speciated Hg (Hg^0, $Hg(II)_{gas}$, $Hg(II)_{part}$), Hg wet deposition, O_3, PM, …

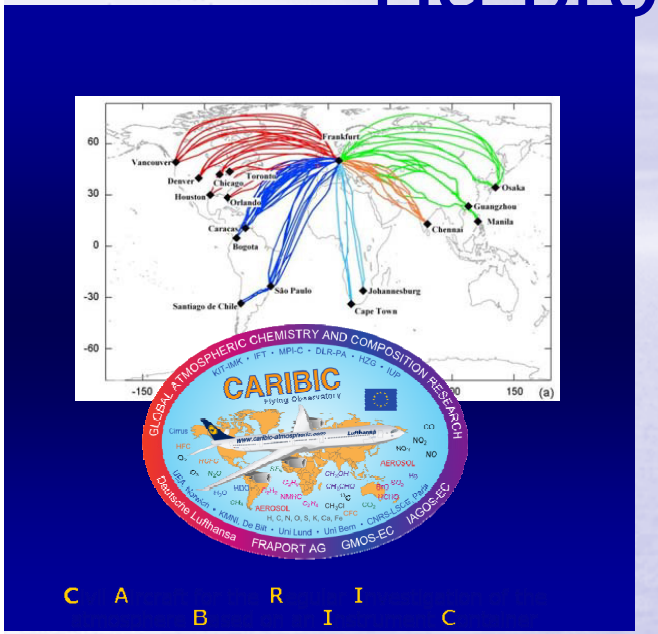
Site: Waldhof, Northern Germany, flatland

Simulations of different Hg oxidation processes at Waldhof (2009)



Mechanism	*Regression*	R_{corr}
$Hg^0 + O_3$	0.93	0.64
$Hg^0 + OH$	3.2	0.6
$Hg^0 + Br$	2.6	0.57

Hg process studies in UT/LS

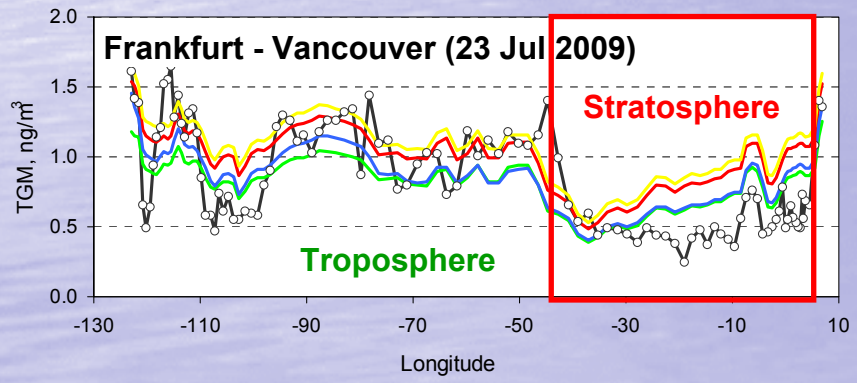


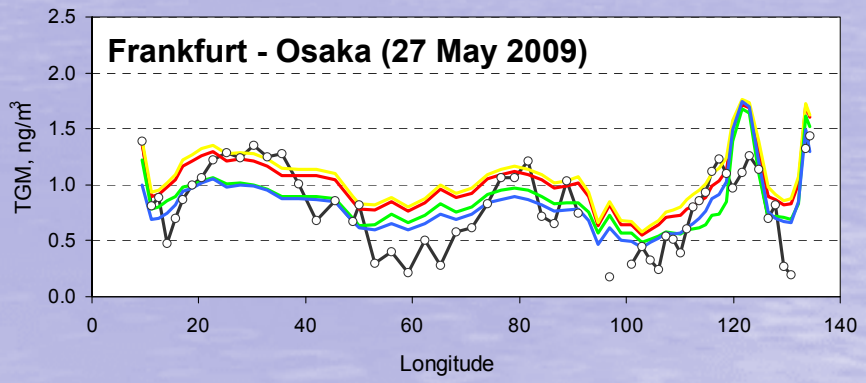
Model experiments: Sensitivity runs with selected oxidation processes

Measurements: Total gaseous Hg (Hg^0+$Hg(II)_{gas}$), O_3, aerosol, CO, CO_2, NO, NO_y, oxygenated organic compounds, …

Location: Lufthansa intercontinental flights

Simulations of selected CARIBIC flights (2009)





Future process studies

GMOS Mercury Modelling Task Force (GMOS MMTF)

Objectives:

- Multi-model studies of Hg atmospheric and other processes making use of the extensive GMOS measurement data
- Multi-model assessment of Hg pollution levels in selected regions and over the globe
- Enhancement of co-operation between GMOS and other international programmes and organizations (TF HTAP, UNEP, AMAP etc.)

Timeline:

- Kick-off meeting (February or April, to be fixed)

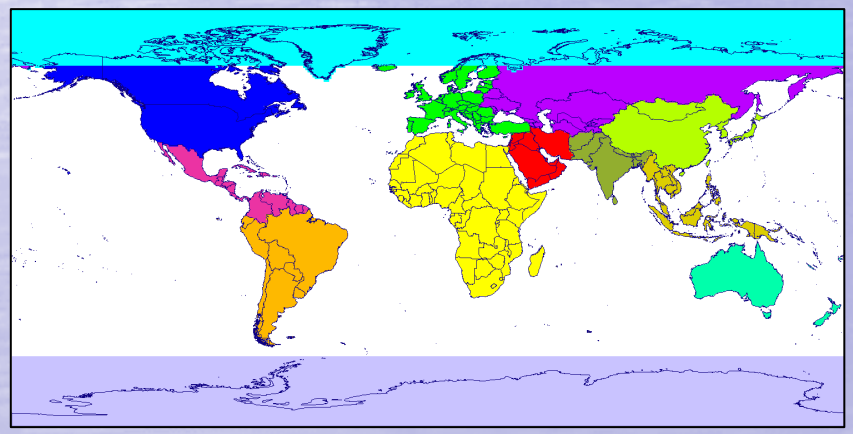
The program of model simulations will be coordinated with the on-going activities within TF HTAP

HTAP2 relevant simulations

Current Hg and POP modeling activities:

- Simulations of present-day Hg deposition levels and historical trends (GMOS)
- Model evaluation of source-receptor relationships for Hg deposition (GMOS/EMEP)
- Model evaluation of source-receptor relationships for PCB-153 air concentration (EMEP)

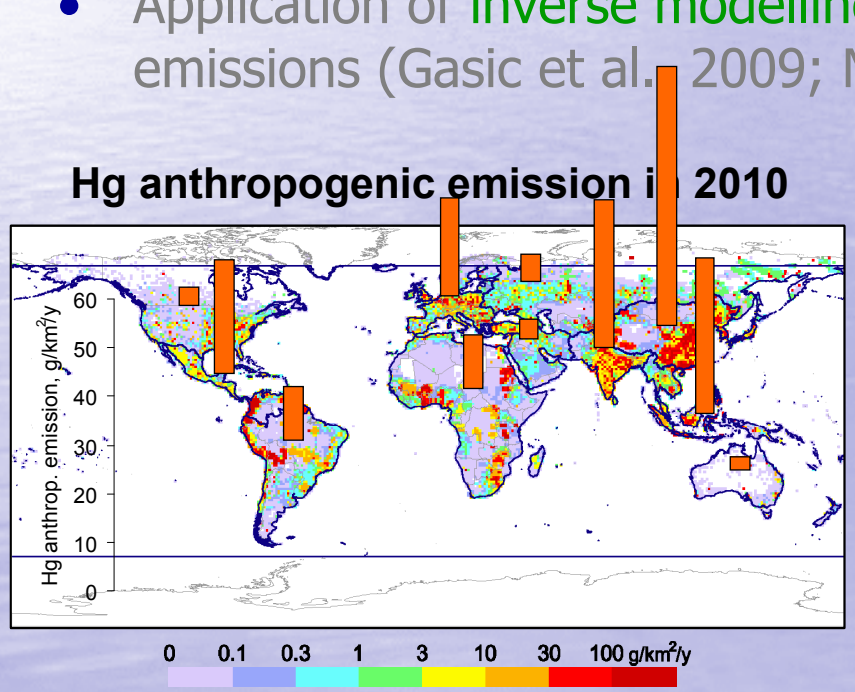
Definition of source/receptor regions

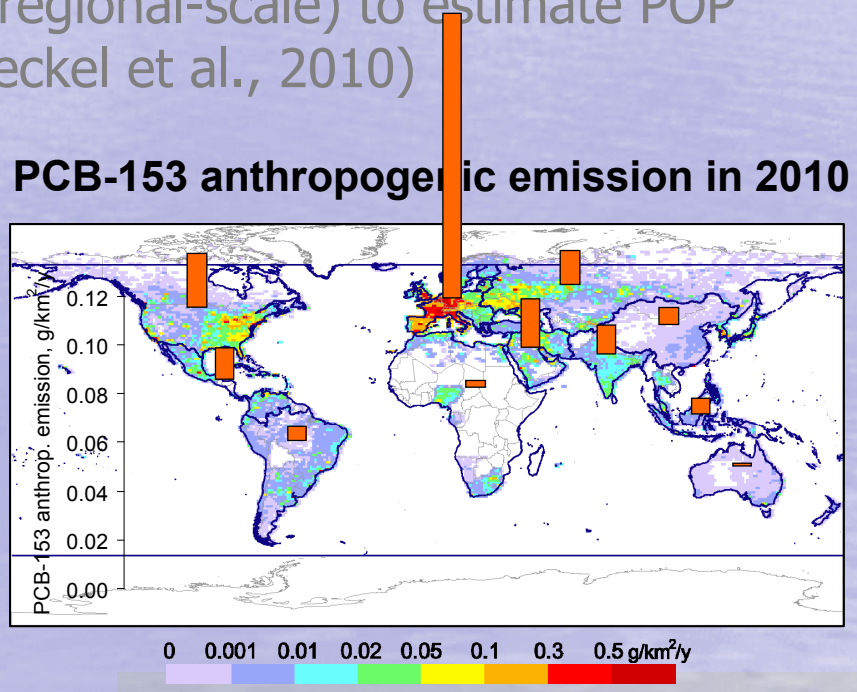


Hg and POP emissions data

Emission inventories:

- Global Hg emissions inventory for 2010 (AMAP/UNEP, 2013)
- Global PCB emissions inventory for 1930-2100 (Breivick, 2007)
- Global PCDD/F emissions inventory based on UNEP Toolkit, 1999-2009 (Fiedler et al., 2007, 2012)
- Application of inverse modelling (regional-scale) to estimate POP emissions (Gasic et al., 2009; Moeckel et al., 2010)



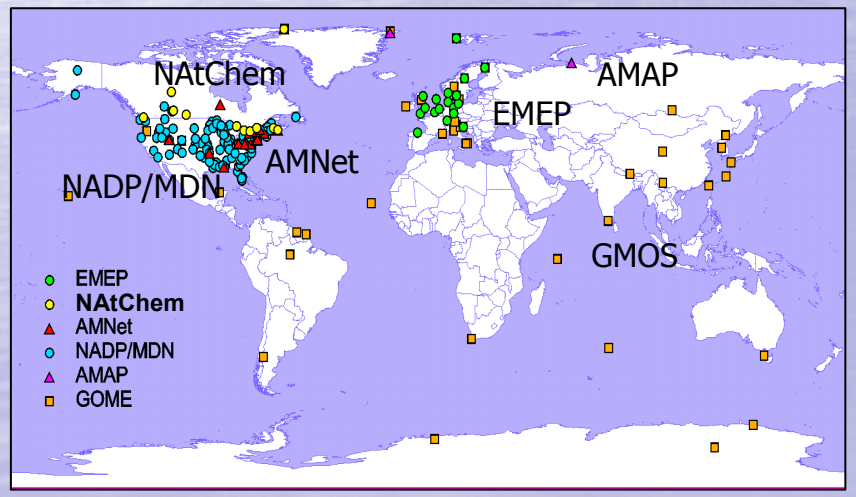


Hg and POP measurement data

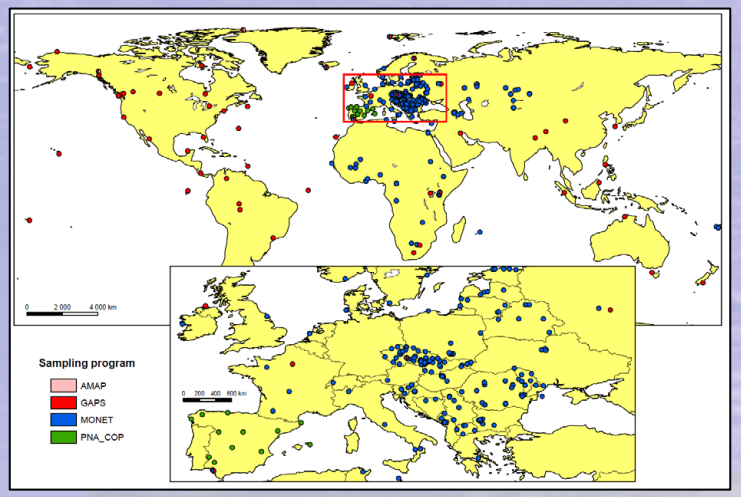
Monitoring networks and programs:

- Regional Hg networks (EMEP, AMAP, MDN, AMNet, NAtChem, …)
- GMOS global network for Hg (2012 - …)
- Regional POP networks (EMEP, AMAP, IADN, …)
- Global and regional POP passive sampling programs (GAPS, MONET, PNA COP, …) available through GMP of Stockholm Convention

Hg measurement networks



POP passive sampling programs



GMOS multi-model simulations

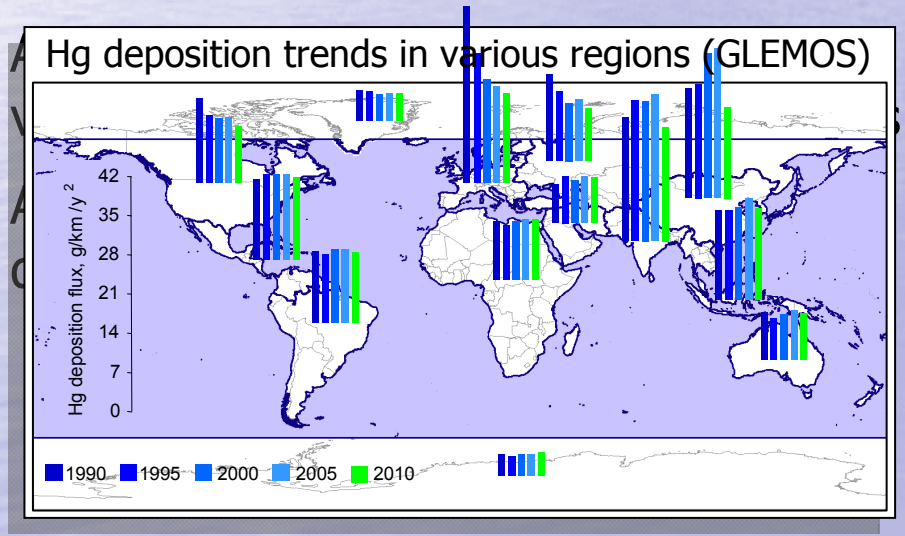
Participating models:

Model	*Scale*	*Institution*
GLEMOS	global/regional	EMEP/MSC-E
ICHMERIT	global	CNR-IIA (Italy)
GRAHM	global	Environment Canada
WRF-Chem	regional	CNR-IIA (Italy)
CMAQ-Hg	regional	HZG (Germany)

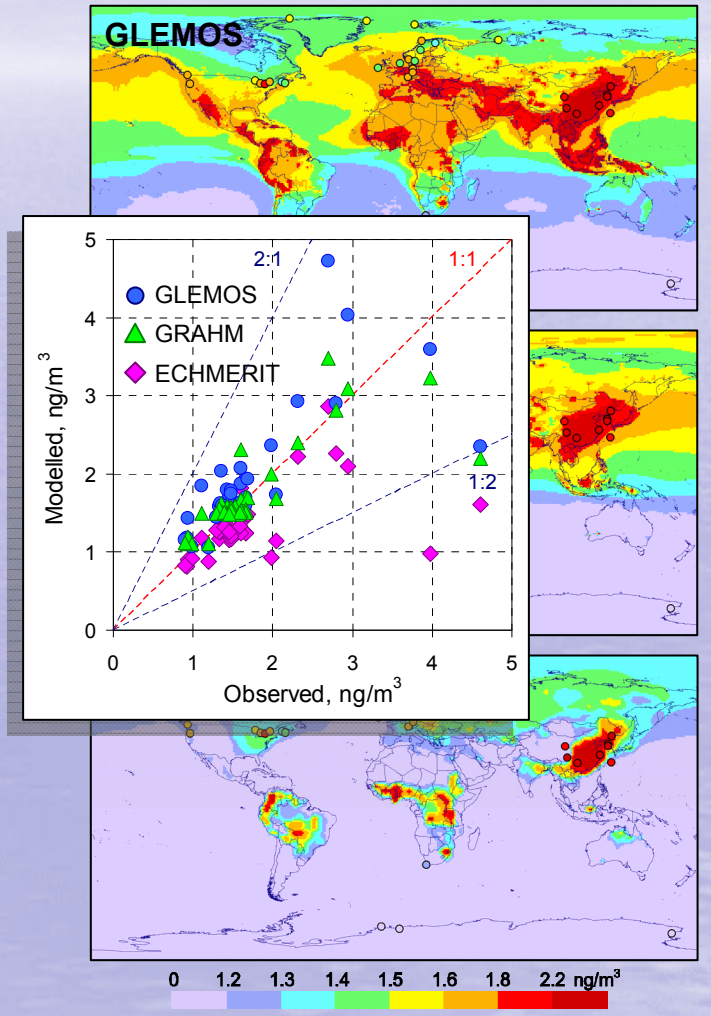
GMOS multi-model simulations

Current modelling activities:

- Simulations of present-day Hg concentration and deposition levels (2010)
- Evaluation of modelling results against observations (EMEP, MDN, GMOS …)
- A
- A

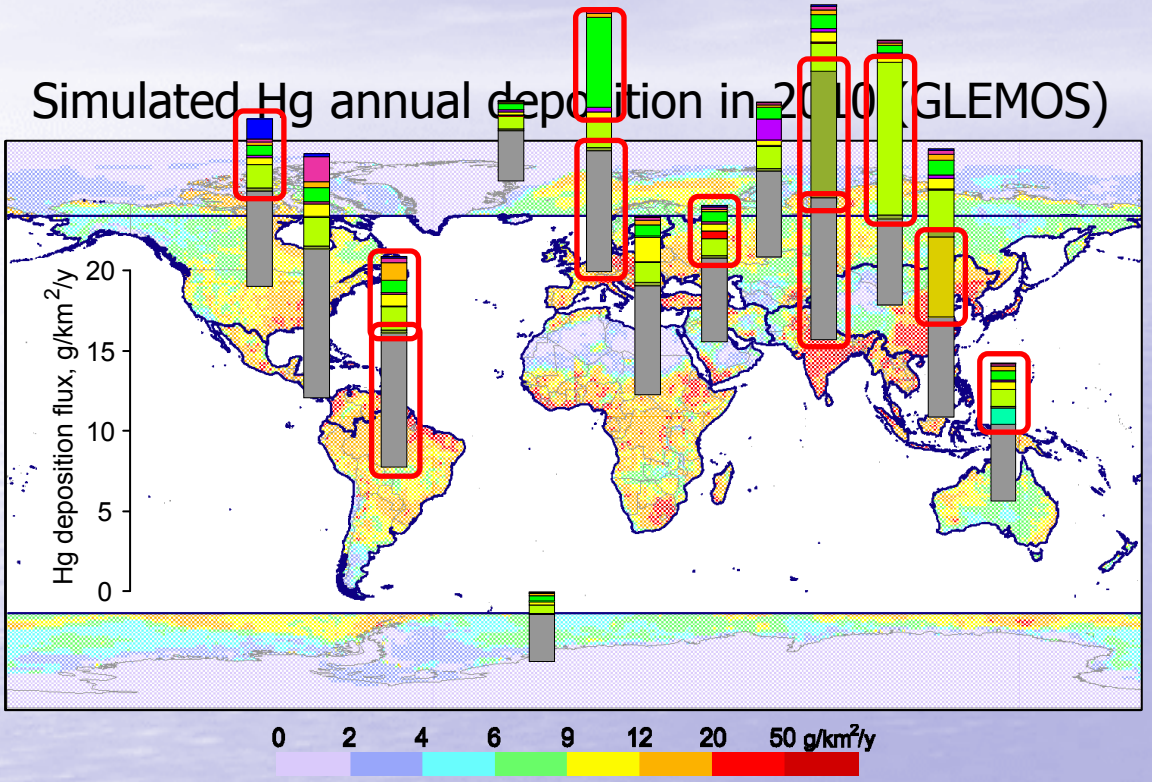


Hg^0 concentration (2010)

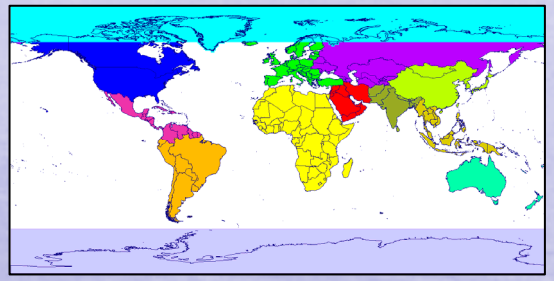


Intercontinental transport of Hg

Source apportionment of Hg deposition (2010)



Source regions



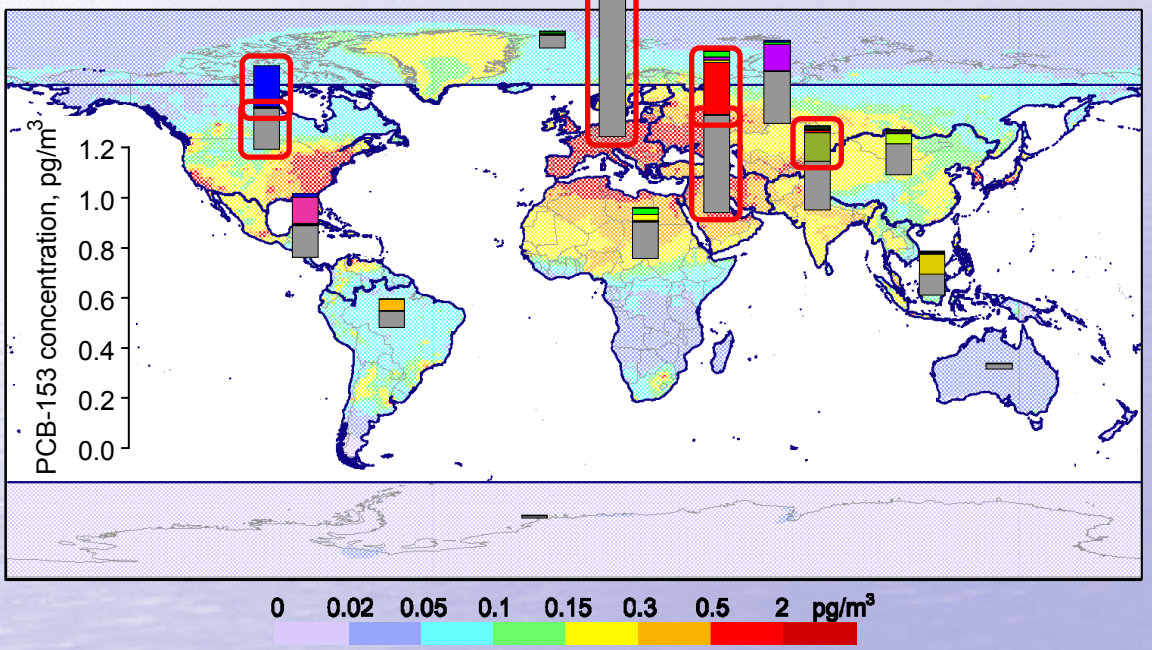
Source/receptor regions:

- North America
- Mexico & Central America
- South America
- Europe
- CIS countries
- Africa
- Middle East
- East Asia
- South Asia
- South East Asia
- Australia and New Zealand
- Arctic
- Antarctica
- Natural and legacy sources

Intercontinental transport of PCB-153

Source apportionment of PCB-153 air concentration (2010)

Simulated PCB-153 air concentration in 2010 (GLEMOS)



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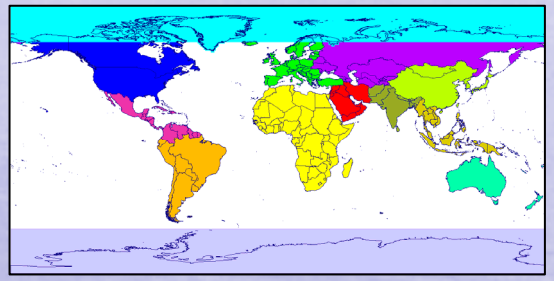

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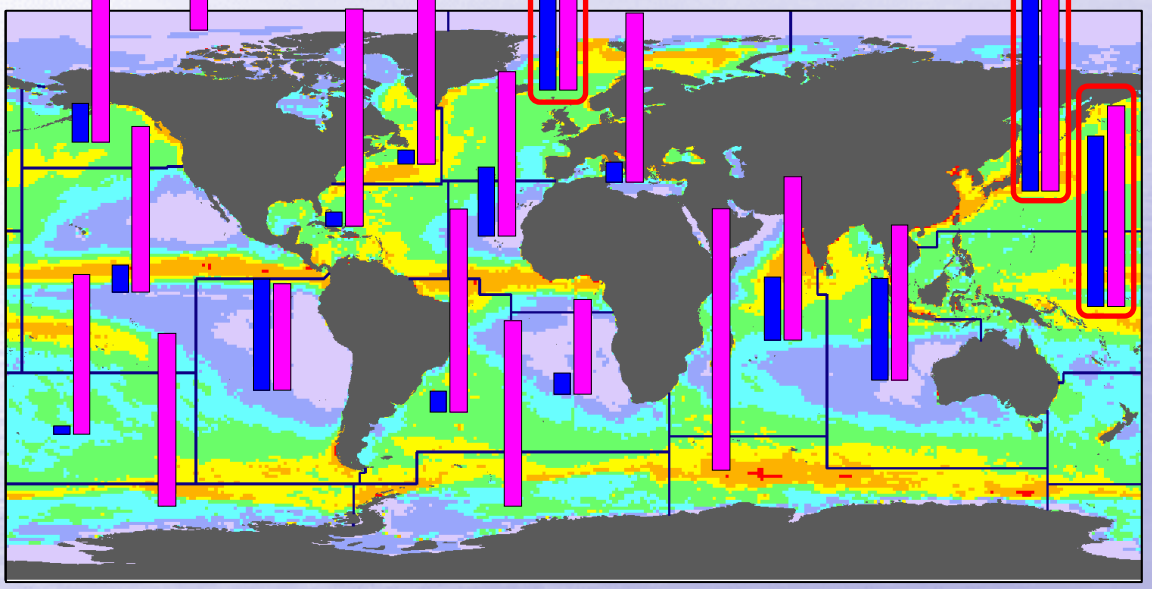
- Legacy sources

Multi-media dispersion character requires source apportionment of secondary emissions over longer period

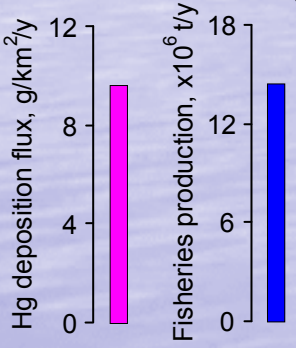
Hg deposition to the ocean

Source attribution of Hg deposition to fishing areas (2010)

Simulated Hg annual deposition in 2010 (GLEMOS)

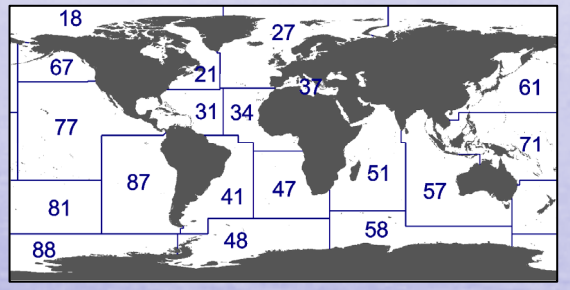


0 2 4 6 9 12 20 50 g/km^2/y



- Hg deposition flux
- Total marine capture fisheries production (FAO, 2013)

FAO fishing areas



18 - Arctic Sea
21 - Northwest Atlantic
27 - Northeast Atlantic
31 - Western Central Atlantic
34 - Eastern Central Atlantic
37 - Mediterranean and Black Sea
41 - Southwest Atlantic
47 - Southeast Atlantic
48 - Antarctic Atlantic
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57 - Eastern Indian Ocean
58 - Antarctic Indian Ocean
61 - Northwest Pacific
67 - Northeast Pacific
71 - Western Central Pacific
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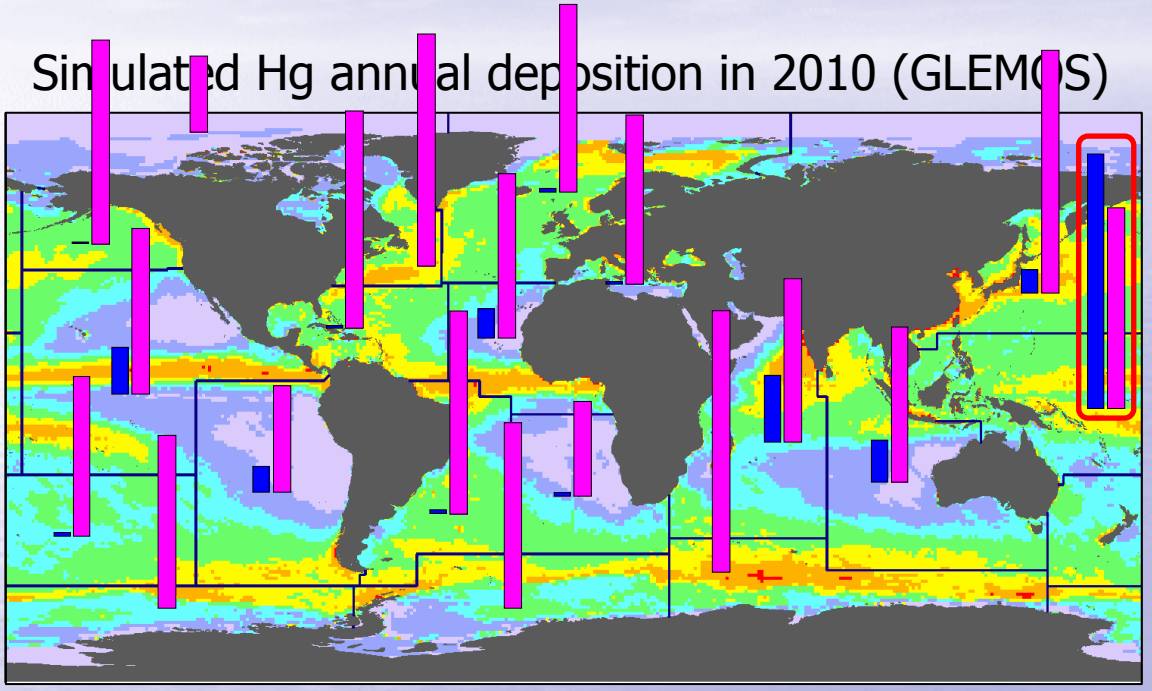

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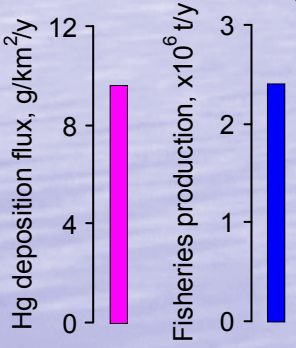
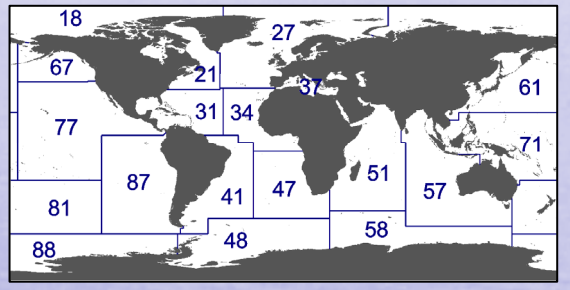


- Hg deposition flux
- Tuna capture fisheries production (FAO, 2013)

FAO fishing areas



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Co-operation with UNEP

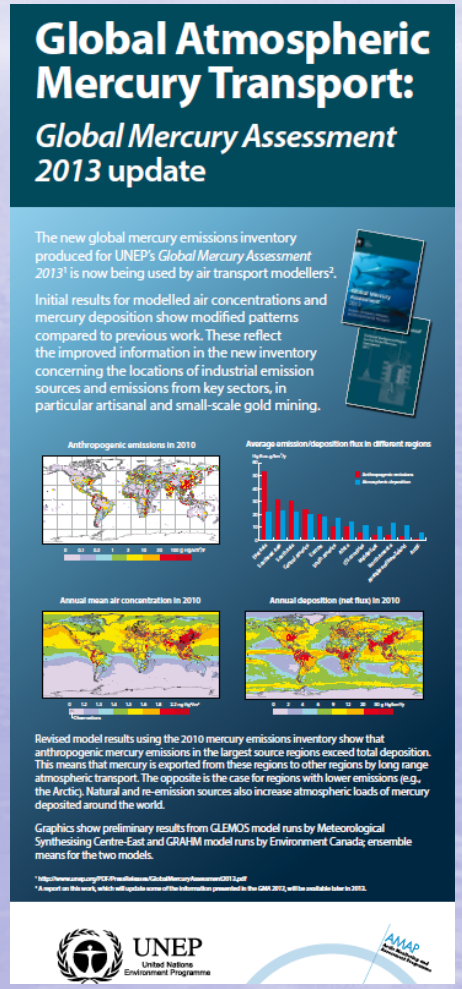
Minamata Convention on Mercury

- Adoption of the global legally binding instrument on Hg (Minamata Convention) (Geneva, January 2013)

  EMEP took part in preparation of the Global Mercury Assessment 2013 for the 5th session of the Intergovernmental Negotiation Committee (INC5)

- Diplomatic Conference on the Minamata Convention (Japan, October 2013)

  EMEP was invited to update results of the Global Mercury Assessment with new model estimates of Hg global pollution



TF HTAP meeting, San Francisco, 2013

Co-operation with UNEP

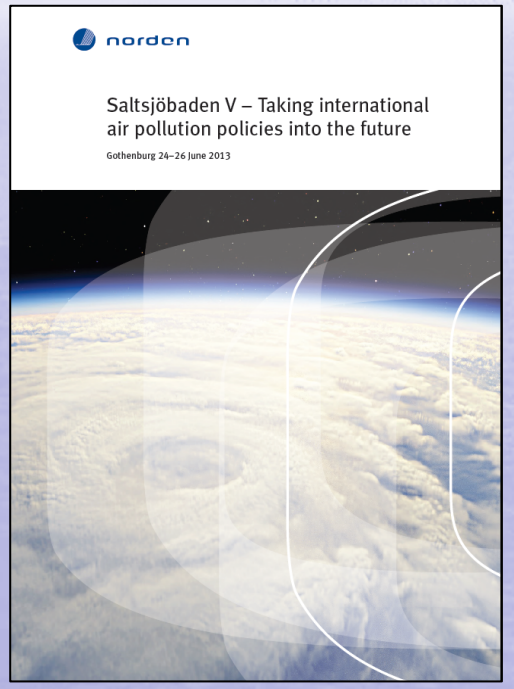
Stockholm Convention on POPs

- Recommendations of Saltsjöbaden V workshop in Gothenburg (Sweden, June 2013):

  Enhance synergies and cooperation between the CLRTAP and SC and other conventions with regard to work on POPs.

- Information Note by the SC Secretariat for the 37th EMEP Steering Body meeting (Sep, 2013) proposed:

  Enhanced cooperation of SC with EMEP on air monitoring, emission inventories and long-range transport modelling of POPs



TF HTAP could be very useful for assessment of POP long-range transport, changes over time and effectiveness of abatement measures

Directions of further Hg and POP activities

- Source apportionment of Hg and POP pollution over longer periods (tagging of accumulation and media exchange)
- Evaluation of future scenarios of Hg and POP pollution
- Continue Hg process studies within the framework of GMOS MMTF
- Application of inverse modelling for reconstruction of regional and global POP emissions
- Focus of the assessment output on evaluation of Hg and POP impacts on human health and ecosystems
- Enhancement of co-operation with UNEP (Minamata and Stockholm Conventions)