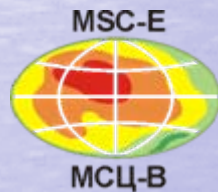


EMEP activities on Hg and POPs on a global scale

Oleg Travnikov, Alexey Gusev



*Meteorological Synthesizing Centre East
of EMEP (EMEP/MSC-E)*

HTAP new objectives

1. Evaluate implications of future scenarios and benefits of mitigation options for intercontinental transport
2. Improve scientific understanding of intercontinental transport
3. Engage experts inside and outside the CLRTAP

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HTAP new objectives

1. Evaluate implications of future scenarios and benefits of mitigation options for intercontinental transport
2. Improve scientific understanding of intercontinental transport
 - Refinement of **emissions inventories** and projections
 - Integration of surface, ship, aircraft, sonde and space-based **observations**
 - Improvement of **understanding of key** transport and transformation **processes**
 - Further development of **atmospheric** and **multi-media modeling**
 - Assessment of **health, ecosystem, and climate forcing impact**
3. Engage experts inside and outside the CLRTAP

Available data and on-going activities

Emission inventories

<i>Information source</i>	<i>Scope</i>	<i>Period</i>
Mercury		
EMEP	UNECE region (Europe – 37 countries, USA, Canada)	1990-2009
AMAP/UNEP	Global	1990-2020
<i>Streets et al., 2009</i>	Global	2050
GMOS project	Global, Europe	2005, 2030
POPs		
EMEP	UNECE region (PAHs, PCDD/Fs, HCB,...)	1990-2009
<i>Breivik et al., 2007</i>	Global (PCBs)	1930-2100
<i>Tao et al., 2009</i>	Global (PAHs)	2004
<i>Li et al., 2000; 2003</i>	Global (HCHs)	1948-2000
ArcRisc project	Global (DDT)	2000, 2010

Available data and on-going activities

Monitoring networks

<i>Information source</i>	<i>Scope</i>	<i>Period</i>
Mercury		
EMEP network	Europe (~20 sites)	1990-present
NADP/MDN, AMNet	USA (~170 sites)	1996-present
CAMNet	Canada (11 sites)	1994-present
AMAP	Arctic	1990-present
GMOS project	Global (~35 sites)	2012-...
POPs		
EMEP network	Europe (~35 sites)	1991-present
IADN network	Canada (~17 sites)	1992-present
AMAP	Arctic	1990-present
MONET	Europe, Africa, Fiji	2005-present
GAPS (Stocholm Convention)	Global (~50 sites)	2004-present

Available data and on-going activities

Global/hemispheric models

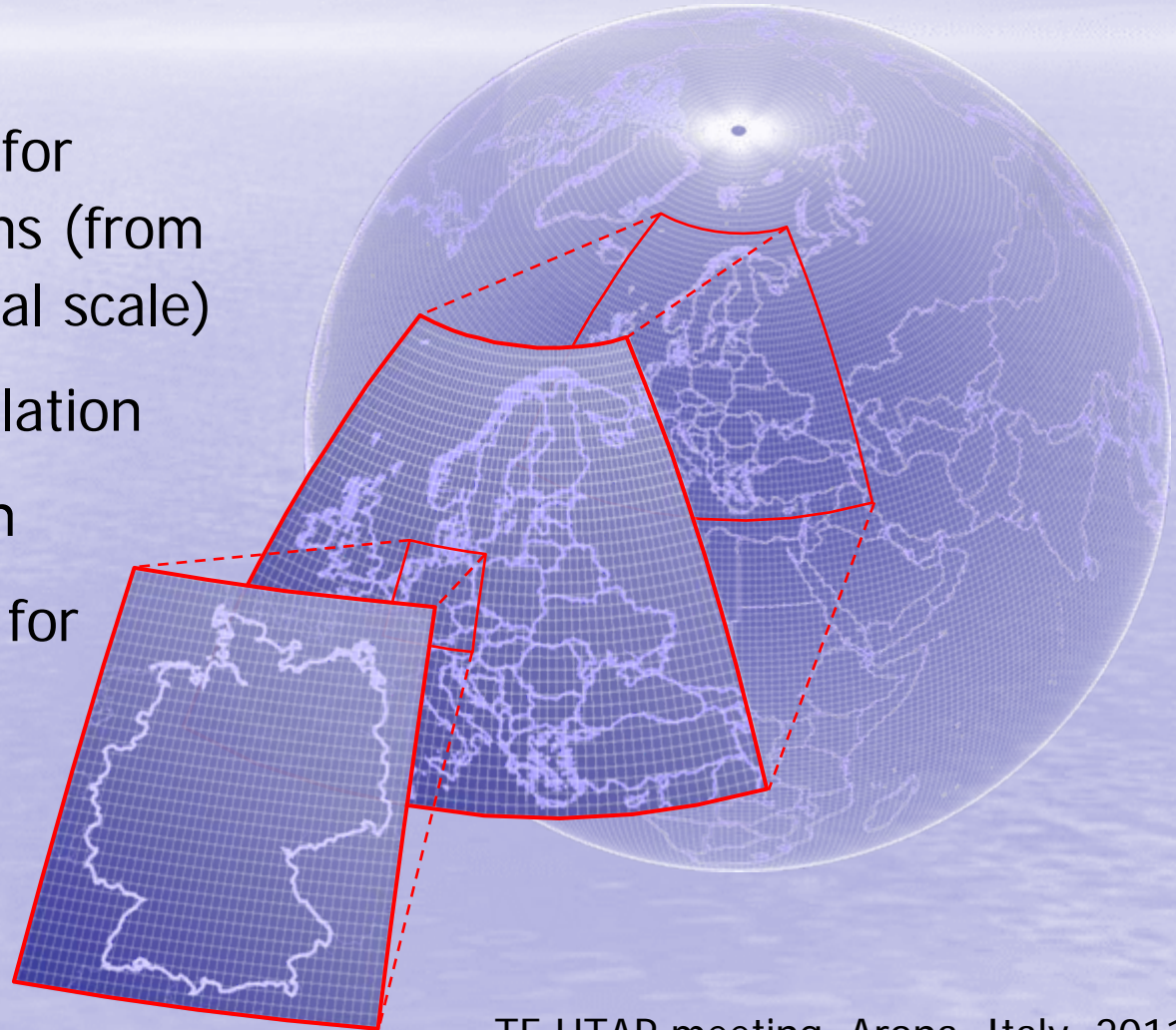
<i>Model</i>	<i>Institution</i>	<i>Scope</i>
Mercury		
GLEMOS	EMEP/MSC-E	Global
GEOS-Chem	Harvard University (USA)	Global
GRAHM	Environment Canada (Canada)	Global
CMAQ-Hg	Lamar University (USA)	N. Hemisphere
ECHMERIT	CNR-IIA (Italy)	Global
DEHM-Hg	Aarhus University (Denmark)	N. Hemisphere
POPs		
GLEMOS	EMEP/MSC-E	Global
BETR-Global	ETH Zurich (Switzerland)	Global
MPI-MCTM	MPI-M (Germany)	Global
GEM/POPs	Environment Canada (Canada)	Global
CanMETOP	Environment Canada (Canada)	Global
DEHM-POP	Aarhus University (Denmark)	N. Hemisphere
HYSPLIT-SV	NOAA (USA)	Global

Multi-media modeling within EMEP

Global EMEP Multi-media Modelling System (**GLEMOS**)

Main features:

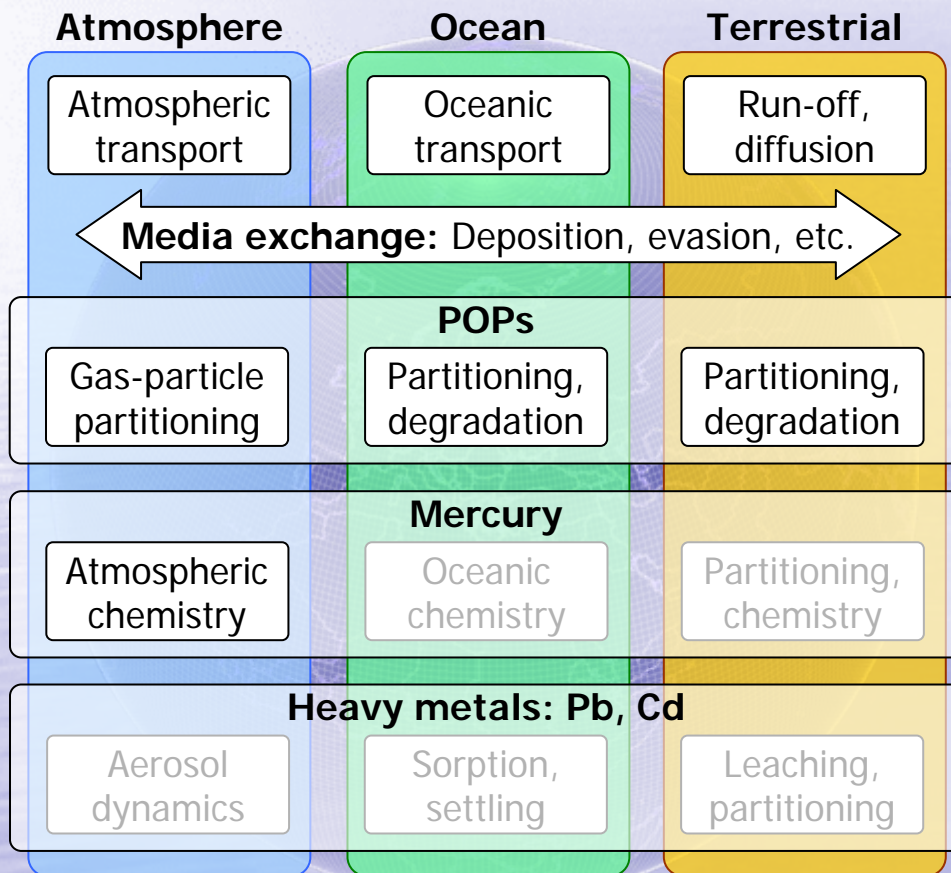
- Consistent approach for multi-scale simulations (from global to regional/local scale)
- Multi-pollutant formulation
- Multi-media approach
- Modular architecture for flexible configuration



Multi-media modeling within EMEP

Global EMEP Multi-media Modelling System (**GLEMOS**)

GLEMOS modular architecture



Environmental media:

- Atmosphere
- Ocean
- Terrestrial media (soil, vegetation, freshwater)

Groups of substances:

- POPs (PCBs, B[a]P, ...)
- Mercury
- Reactants (O₃, OH, Br, ...)
- Aerosol (PM, BC, ...)

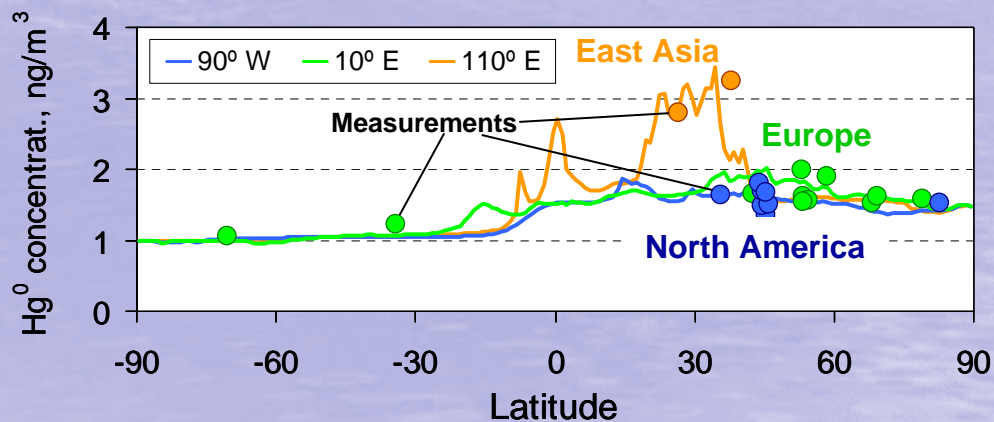
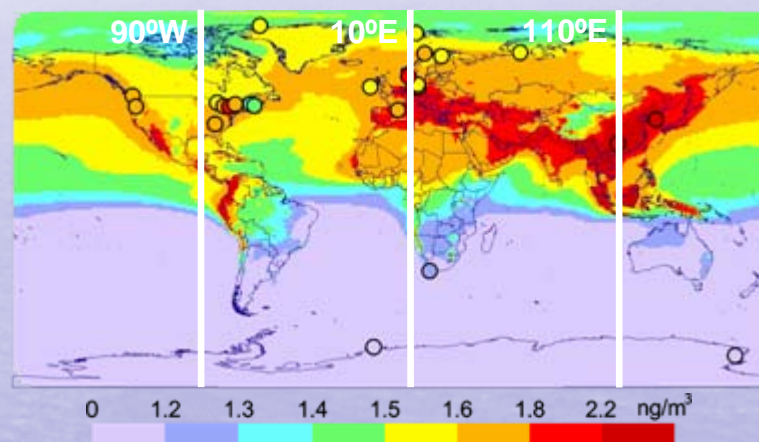
Application of GLEMOS modelling system

Mercury simulations on a global scale

Modelling results:

- Assessment of **concentration** and **deposition** levels on a global scale
- Estimates of **intercontinental transport** and source attribution
- Detailed **evaluation** against observations
- Participation in **multi-model assessment** (TF HTAP)

Hg⁰ concentration in ambient air (2005)



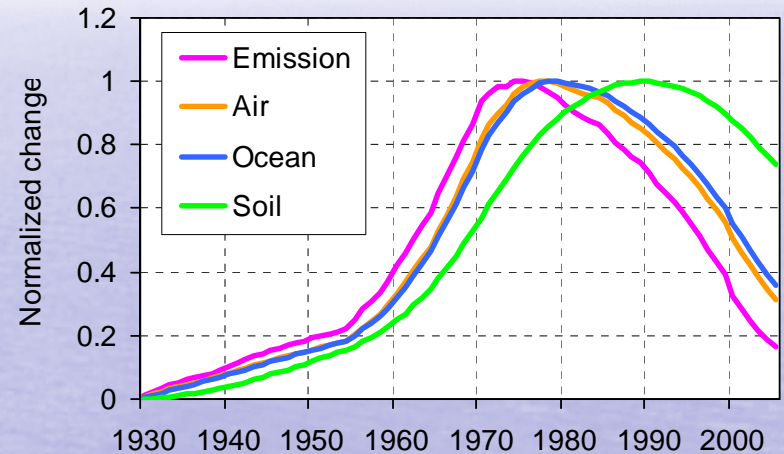
Application of GLEMOS modelling system

POP simulations on a global scale

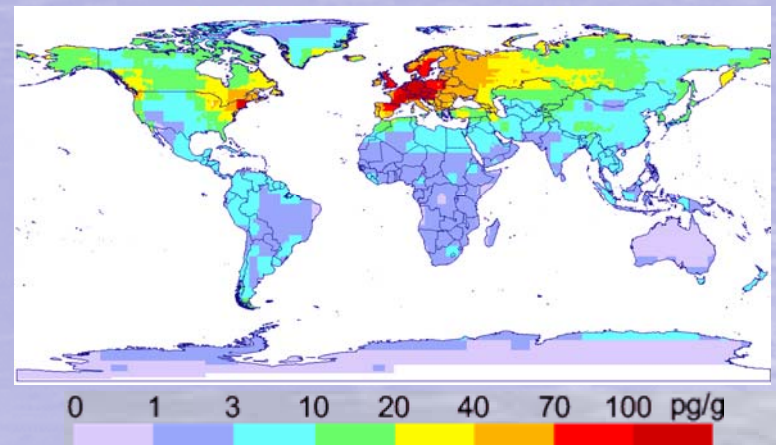
Modelling results:

- Evaluation of POP levels in **different media** on a global scale
- Long-term simulations of POPs **historical changes** in the environment (1930-2005)
- Estimates of **accumulation** and life-time in media
- **Evaluation** against available measurements in air, soil and sea water

Historical changes of PCB-153 in media

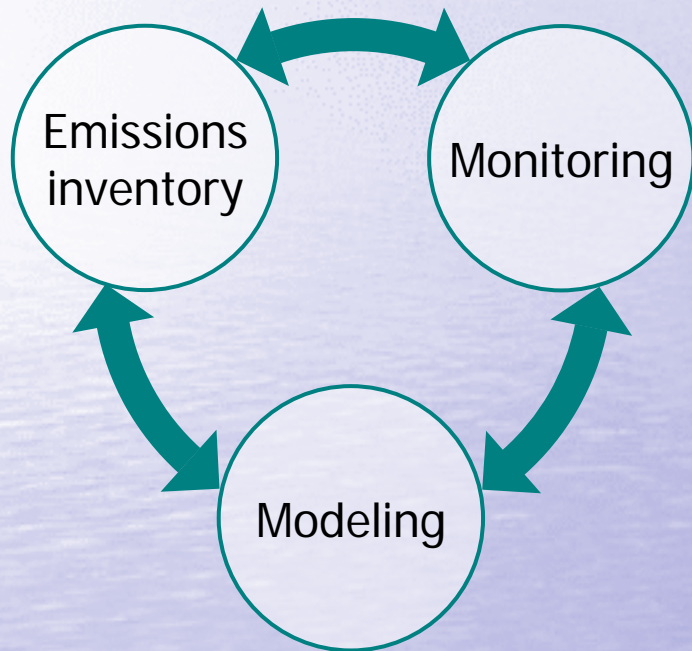


PCB-153 concentration in soil (2008)



Integrated approach (IA)

Combined use of emissions, monitoring and modeling



Possible applications:

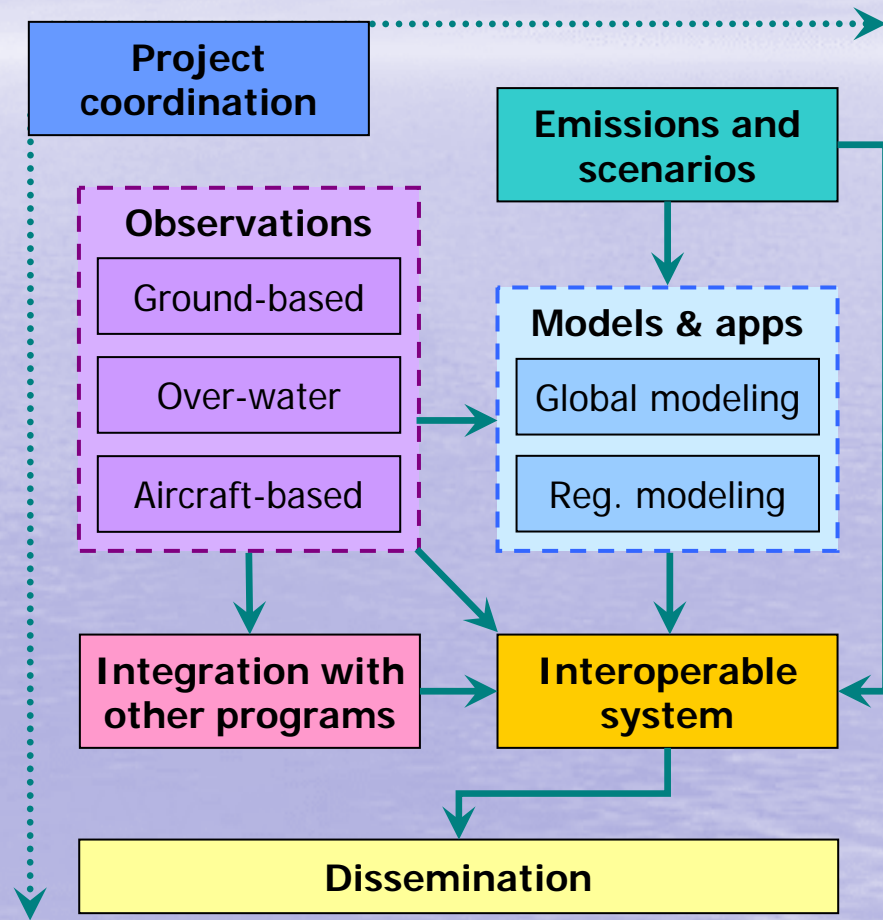
- Direct use of emissions and measurement data for **feeding and evaluation** of model simulations
- **Constraining** model formulation and process parameterizations on observations
- Application of inverse modeling for **evaluation of emissions** inventories
- **Reconstruction** of historical emissions based on long-term measurements
- Use of modeling results for **planning field measurement campaigns** and monitoring networks

GMOS: application of IA for mercury

Global Mercury Observation System (GMOS)

Major project components:

- **Global monitoring system** for Hg (land-based, over-water and aircraft observations)
- Updates of Hg **emissions inventory** and future scenarios
- Development and application of **global and regional scale models**
- **Interoperable system** for collection and dissemination of the project data



GMOS: application of IA for mercury

Role of EMEP/MCS-E: Leading global scale modelling activity

Consortium models:

<i>Model</i>	<i>Institution</i>
GLEMOS	EMEP/MSC-E
ECHMERIT	CNR-IIA (Italy)

External partners:

<i>Model</i>	<i>Institution</i>
DEHM	Aarhus University (Denmark)
GRAHM	Environment Canada (Canada)
CMAQ-Hg (hem.)	Lamar University (USA)
GEOS-Chem	Harvard University (USA)

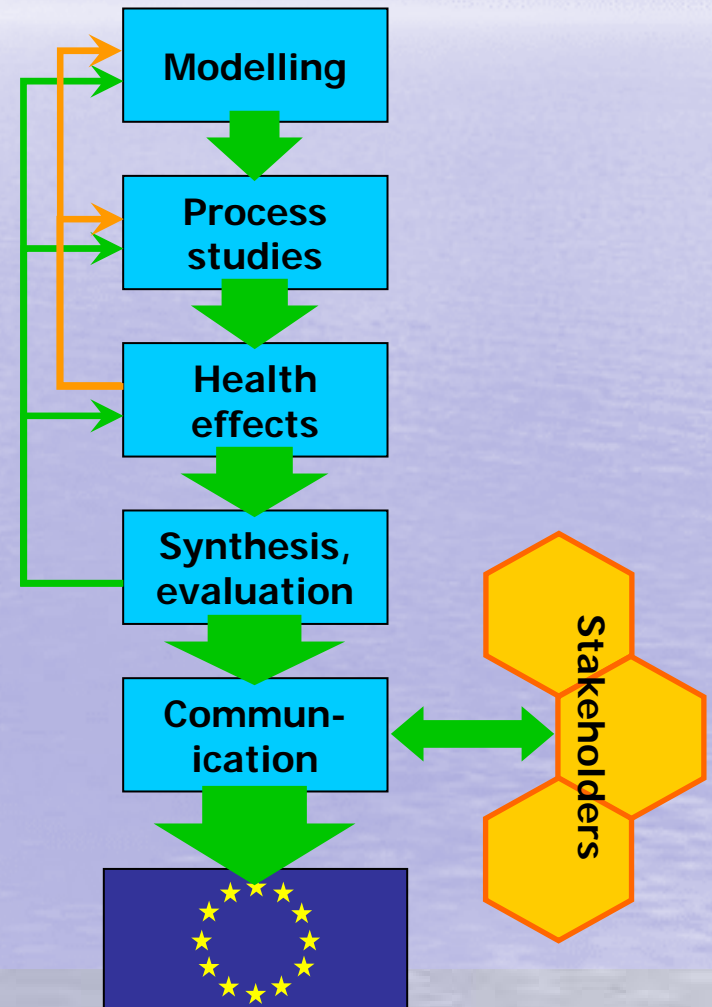
ArcRisk: Arctic Health Risk

Impacts on health in the Arctic and Europe owing to climate induced changes in cycling of **POPs** and **HMs**

Major project activities:

- **Modelling** impacts of climate change on pollutant transport and fate
- **Processes studies** of contaminant transfer in the Arctic
- Human **health effects** of contaminants and the influence of climate change
- **Synthesis** and policy implications

Main focus: Climate induced changes in the Arctic pollution



Climate change and pollution interaction

Potential impacts of climate change on multi-media pollution (Hg, POPs), including altering of:

- Dispersion pathways of pollutants in the atmosphere
- Atmospheric chemistry and phase partitioning
- Removal processes (precipitation, land cover)
- Physical and chemical processes in media (ocean, soil, vegetation)
- Air-surface exchange fluxes (surface wetness, temperature, salinity, etc.)
- Cycling and accumulation in the environment

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Climate change and pollution interaction

Actuality of the problem in international community

HTAP Assessment 2010

Climate change has the potential to affect POP and Hg pathways in the atmosphere, hydrosphere, cryosphere, biosphere, and soil

New CLRTAP Long-term strategy

“CLRTAP will give high priority now and in the longer term to establishing work on the **links between climate change and air quality**, including Hg and POPs.”

UN Climate Change Conference (December 2010)

Special UN CC Conference “Climate change increases Planet’s vulnerability to POPs”

UNEP/AMAP expert group report (2011)

“Climate change and POPs: Predicting the impacts”

Proposals for future HTAP activities

Cooperate with relevant projects and programmes (GMOS, ArcRisc, UNEP, AMAP, Stockholm Convention) on implementation of the HTAP research program:

- Contribute to update of Hg and POP **emission inventories** and development of future scenarios
- Facilitate extension of Hg and POP **monitoring networks** to the global scale and performing process-oriented field studies
- Promote further development of **multi-media models** and their evaluation in coordinated multi-model studies
- Participate in the **integrated analysis** of key Hg and POP processes involving both measurements and model simulations
- Update knowledge on Hg and POP **intercontinental transport** and interaction with other pollutants (**ozone**, **aerosol** etc.)
- Initiate integrated study on **climate change** interaction with Hg and POP environment pollution on a global scale

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HTAP could play the role of an international platform for collection, discussion and dissemination of the research results on Hg and POPs