

GMOS

Global Mercury Observation System



*Funded by:
European Commission - DG Research
(2010 - 2015)*

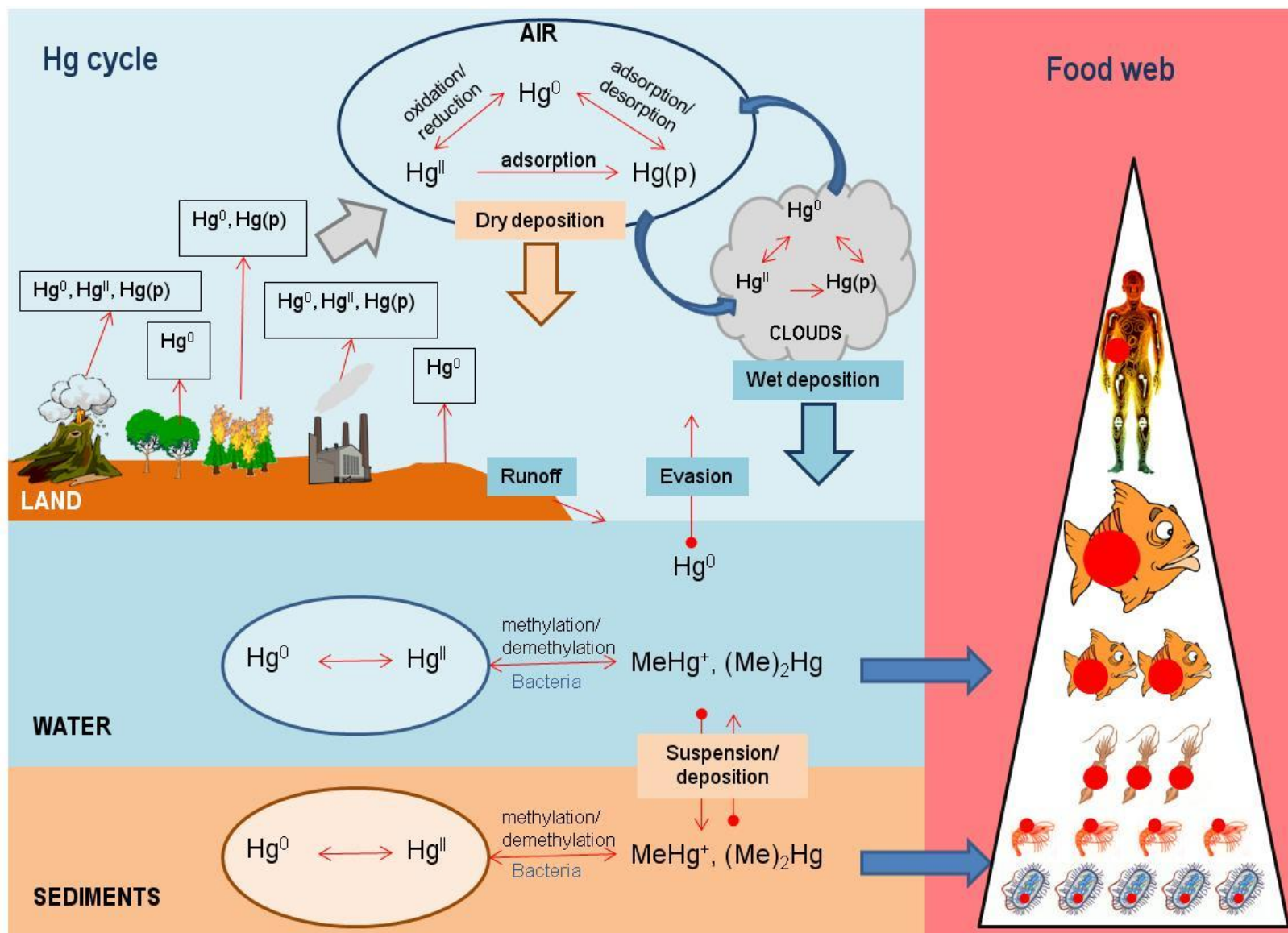


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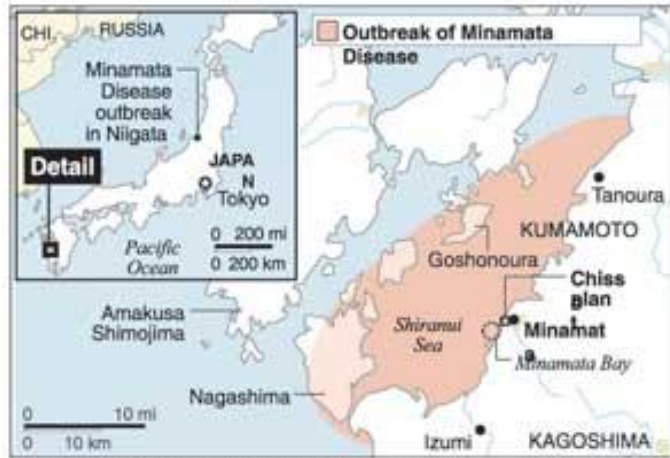
The mercury cycle...



...and the impact on human health

Mercury poisoning in Minamata

Minamata Disease was identified 50 years ago in Japan, but thousands of victims are still fighting for compensation from the company that dumped lethal mercury into their fishing grounds.

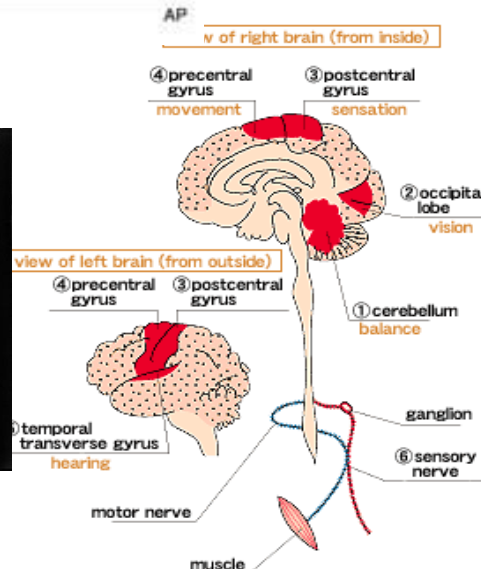


SOURCES: ESRI; Japanese Ministry of Environment



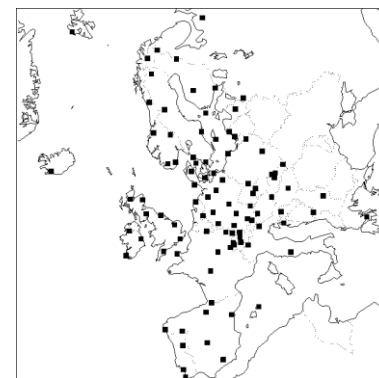
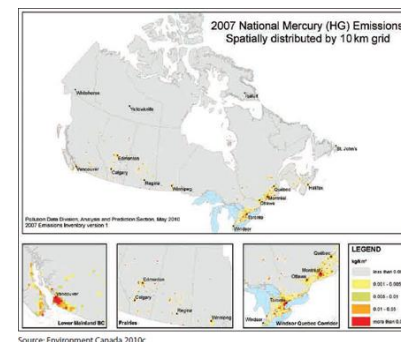
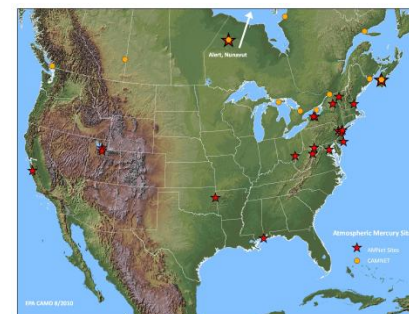
Symptoms of the

- **Mild**
 - Ataxia
 - Muscle weakness
 - Narrowed field of vision
 - Hearing and speech damage
- **Severe cases cause**
 - Insanity
 - Paralysis
 - Coma
 - Death



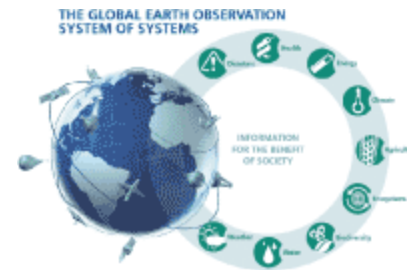
The International Framework related to monitoring networks:

- Atmospheric Mercury Network (AMNet)
- Canadian Atmospheric Mercury Measurement Network (CAMNet)
- The European Monitoring and Evaluation Programme (EMEP)
- Other scattered (Mexico, Japan, Australia)



The International Framework related to mercury pollution:

- GEO Task He-09-02d "Global Observation System for Mercury"
- UNEP Mercury Program - Global Partnership on Atmospheric Mercury Transport and Fate Research (F&T)
- Task Force on Hemispheric Transport of Air Pollutants (TF HTAP) under the UNECE-Convention on Long-Range Transboundary Air Pollution (LRTAP) conventions



Area	Health
Overarching Task	HE-09-02: Monitoring and Prediction Systems for Health
Sub Task	HE-09-02d: Global Monitoring Plan for Atmospheric Mercury
Related Communities of Practice	Air Quality & Health, Atmospheric Chemistry (former IGACO), Biodiversity & Forest

Task leaders

Italy, CNR-IIA	Nicola Pirrone (PoC)
Japan, NIES	Noriyuki Suzuki
South Africa, DEADP	Joy Leaner
United States , EPA	David Schmeltz & Stan Durkee

Task aims (1/2)

- **Develop a global observation system for mercury** by harmonizing standard operating procedures for monitoring mercury and its compounds in air, atmospheric deposition, water, soil, sediments, vegetation and biota.
- The **sharing of data** from this network, allowing access to comparable and long-term data from a wide array of locations, will help understand temporal and spatial patterns of mercury transport and deposition to, and evasion from, terrestrial and aquatic ecosystems.
- The data produced will support the **validation of regional and global atmospheric mercury models** for use in evaluations of different policy options for reducing mercury pollution impacts on human health and ecosystems.

Task aims (2/2)

- **Build upon the contributions of**, among others, UNEP Mercury Programme, the Hemispheric Transport of Air Pollutants Task Force (TF HTAP), and the European Monitoring and Evaluation Program (EMEP).
- Moreover build upon the **GMOS Project, the US MercNet initiative and international monitoring and modelling efforts led by Italy, Japan and South Africa.**

Development:

An important contribution to the future development of the Task HE-09-02d will be provided by GMOS in addition to the contributions from other countries that act as Co-Leads and as Contributors.

Status of Play:

- The European Commission approved for funding the proposal "Global Mercury Observation System - GMOS".
- GMOS involves 23 partners from all over the world.
- GMOS started in November 2010 and will end in 2015.

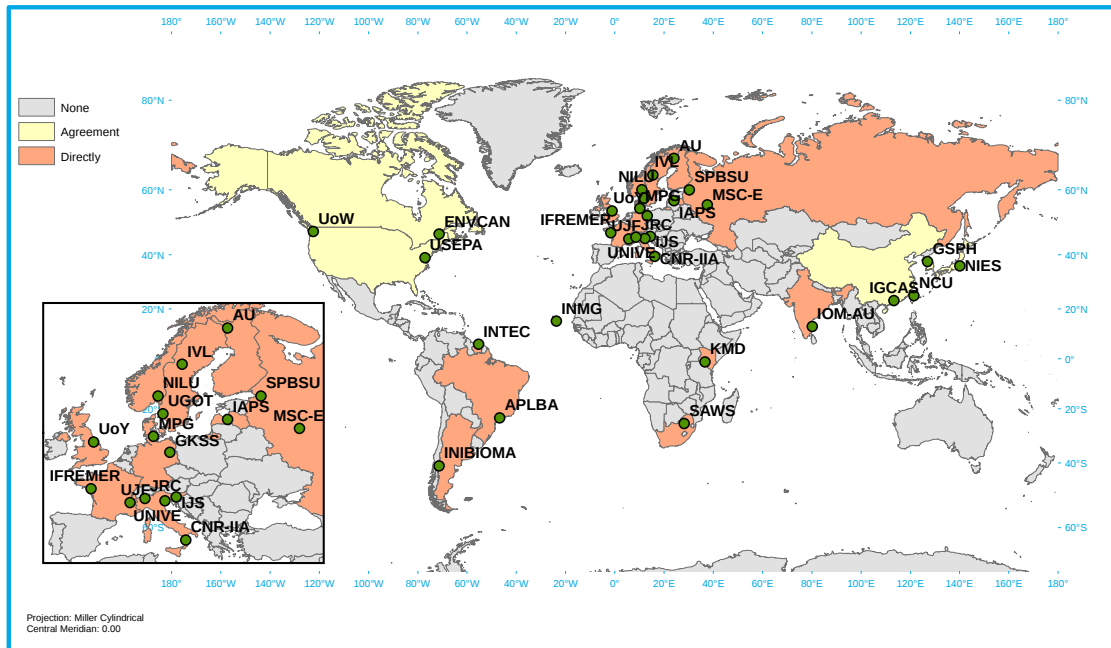
To establish a **Global Observation System for Mercury** able to provide ambient concentrations and deposition fluxes of mercury species around the world, by combining observations from permanent ground-based stations, and from oceanographic and tropospheric measurement campaigns.

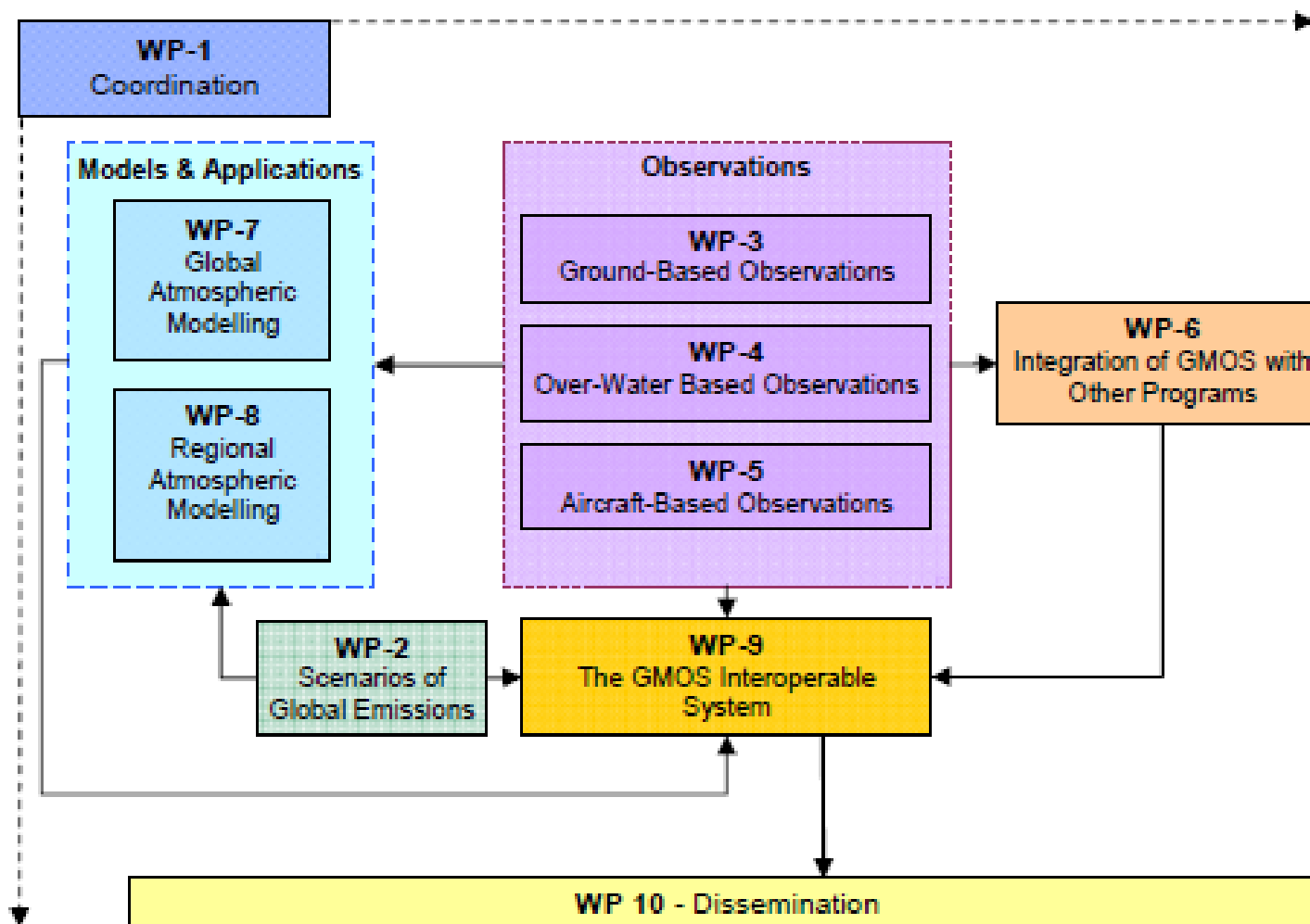


- To validate regional and global scale **atmospheric mercury modelling systems** able to predict the temporal variations and spatial distributions of ambient concentrations of atmospheric mercury, and Hg fluxes to and from terrestrial and aquatic receptors.
- To evaluate and identify **source-receptor relationships** at country scale and their temporal trends for current and projected scenarios of mercury emissions from anthropogenic and natural sources.
- To develop **interoperable tools** to allow the sharing of observational and models output data produced by GMOS, for the purposes of research and policy development and implementation as well as at enabling societal benefits of Earth observations, including advances in scientific understanding in the nine Societal Benefit Areas (SBA) established in GEOSS.

- The outcomes of **GMOS** will support the achievement of goals and objectives of key international programs including the GEO Task HE-09-02d "Global Observation System for Mercury", the UNEP F&T, and TF HTAP of the UNECE-LRTAP convention.
- For the first time, a coordinated **Global Mercury Observation System** will be established which will include observations from continuous ground-based stations, ad-hoc over-water observation programs, and aircraft-based tropospheric programs.
- For the first time **vertical profiles of tropospheric mercury concentrations** at different latitudes and time of the year will be provided by coordinating the efforts of GMOS with those of other on-going international programs in Europe and North America (i.e., CARIBIC, NAAMEX).

- For the first time a **full validation of global and regional scale atmospheric models** will be performed on the basis of observations that are representative of different regions, locations of natural and anthropogenic sources, terrestrial and aquatic receptors, and atmospheric transport patterns.
- For the first time **fully validated** regional and global scale atmospheric models, will be used to evaluate spatial and temporal patterns of ambient concentrations, and re-emission rates from and deposition fluxes to aquatic and terrestrial receptors for **different scenarios of mercury emissions** at regional and global scales.





GMOS Ground-Based Observation System

- Ground-Based Observation System



**33 stations in
the Northern and
Southern
Hemisphere -**

GMOS Ground-Based Observation System

Table I - Master and Secondary Ground-Based Sites in GMOS

Running sites are those where Hg measurements are already on-going. New Sites are those where Hg measurements would be started as part of GMOS. (*) **M: master sites** (GEM, RGM, Hgp, Hg in pricip); **S: Secondary sites** (TGM, Hg in pricip)

Monitoring Site	Elevation (m asl)	Latitude	Type	Station Type (**)	Running Sites by Outside Partners (*)	Running Sites by GMOS Partners	New Sites by GMOS Partners	Responsible GMOS Partners
GMOS Sites								
Alert, Canada	210	82.5° N	GAW	M	X			NADP/AMNet
Station Nord, Greenland	310	81.6	AMAP	S		X		AU
Ny Alesund, Norway	550	78.9	GAW	M		X		NILU
Pallas, Finland	560	68.0	EMEP	S		X		IVL
Rao, Sweden	5	57.4	GAW	S		X		IVL
Mace Head, Irland	5	53.3	GAW	S		X		GKSS
Waldhof, Germany	74	52.8	EMEP	M		X		GKSS
Listvyanka, Russia	560	51.9	GAW	M				SPBSU
Monte Rosa, Italy	4554	45.9		S			X	UNIVE
Iskrba, Slovenia	520	45.6	EMEP	M			X	JSI
Mt. Bachelor, WA, USA	2743	44.1	NOAA	M	X			UoW
La Seyne, France	20	43.4		S			X	IFREMER
Mt. Changbai, Located in the boundary area of China and North Korea in Jilin province, China	736	42.4	GAW	S		X		IGCAS
Longobucco, Italy	1379	39.8	EMEP	M		X		CNR-IIA
Storm Peak, CO, USA	4086	39.3	DRI	M	X			DRI
Kanghwa Island, Korea	88	37.7		S	X			KNU
Waliguan, China	3616	36.3	GAW	M		X		IGCAS
Ev-K2, Nepal	5050	28.0	GAW	S			X	CNR-IIA
Zhuzhang Observatory, Northwest of Yunnan province, China	3580	27.8	GAW	S		X		IGCAS
Cape Hedo, Okinawa, Japan	498	26.8		M	X			MoE
Minamata, Kyushu islands, Japan		32°12"		M	X			MoE
Lulin, Taiwan, China	2862	23.5	GAW	M	X			UoT
Mauna Loa, Hawaii, USA	3397	19.5	GAW	M	X			NADP/AMNet
Villahermosa, Tabasco, Mexico	20		GAW	S			X	JRC
Cape Verde Obs., Capo Verde	10	16.9	GAW	S			X	UoY / INMG
Kodaikanal, India	2343	10	GAW	M			X	IOM-AUC
Paramaribo, Suriname	23	5.8	GAW	S			X	INTEC
Mt. Kenya, Kenya	3678	0°	GAW	M			X	KMD
Manaus, Brazil	45	2.6	GAW	M			X	APLBA
Cape Point, South Africa	230	34.4	GAW	S		X		SAWS
Amsterdam Island	70	37.8	GAW	M			X	UJF
Bariloche, Argentina	840	40.4	GAW	M			X	INIBIOMA
Cape Grim, Australia	94	40.7	GAW	S			X	IVL
DOME-C, Antarctica	40	66.7° S		S			X	CNR-IIA / UJF

19 running
14 new sites

Neumayer	
Hg ^o (ng.m ⁻³)	Ebinghaus et al., 2002 Terime et al., 2003
Avg.	0.99
Std. Dev.	0.27
Min.-Max.	0.16-1.89

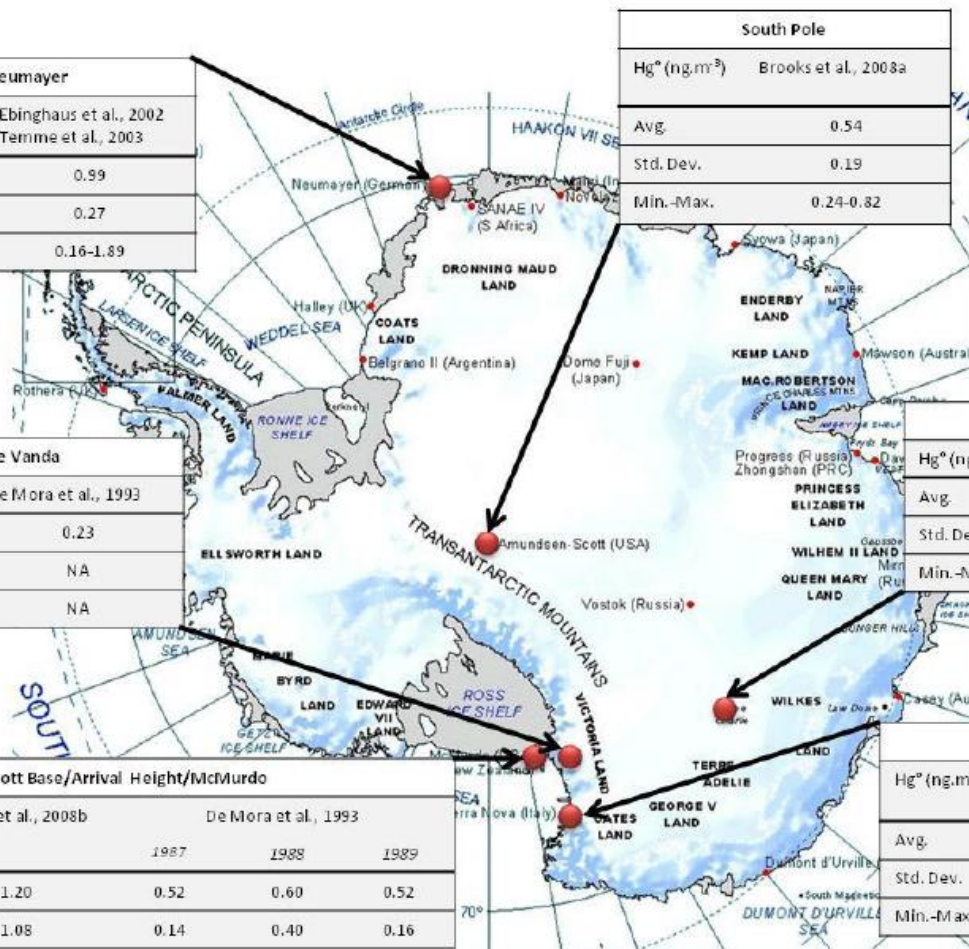
Lake Vanda	
Hg ^o (ng.m ⁻³)	De Mora et al., 1993
Avg.	0.23
Std. Dev.	NA
Min.-Max.	NA

Scott Base/Arrival Height/McMurdo				
Hg ^o (ng.m ⁻³)	Brooks et al., 2008b	De Mora et al., 1993		
		1987	1988	1989
Avg.	1.20	0.52	0.60	0.52
Std. Dev.	1.08	0.14	0.40	0.16
Min.-Max.	BDL-11.2	0.16-0.83	0.02-1.85	0.11-0.78

South Pole	
Hg ^o (ng.m ⁻³)	Brooks et al., 2008a
Avg.	0.54
Std. Dev.	0.19
Min.-Max.	0.24-0.82

Concordia	
Hg ^o (ng.m ⁻³)	Courteau et al., in prep
Avg.	0.85
Std. Dev.	0.46
Min.-Max.	BDL-2,2

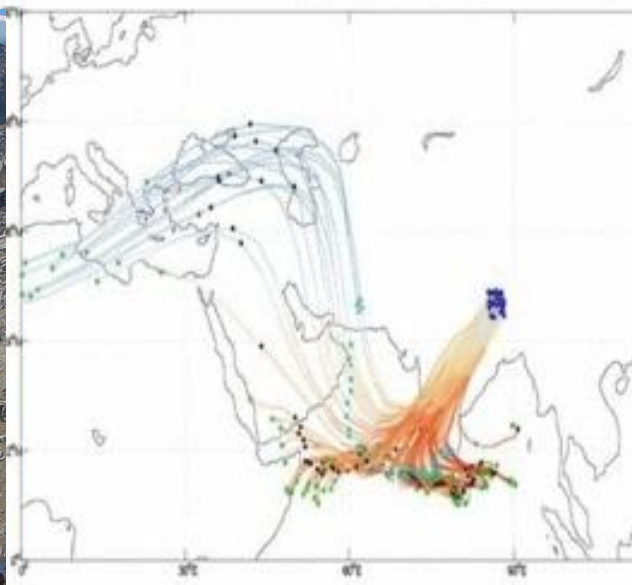
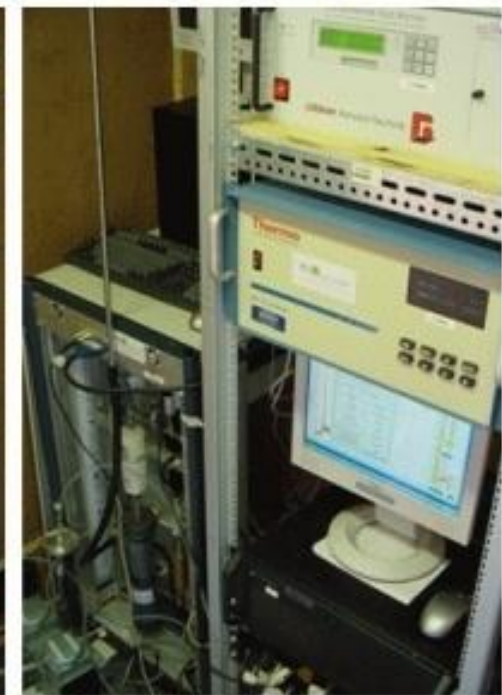
Terra Nova Bay	
Hg ^o (ng.m ⁻³)	Sprovieri and Pirrone, 2000 Sprovieri et al., 2002
Avg.	0.9
Std. Dev.	0.3
Min.-Max.	0.29-2.3



The Nepal Climate Observatory at Pyramid

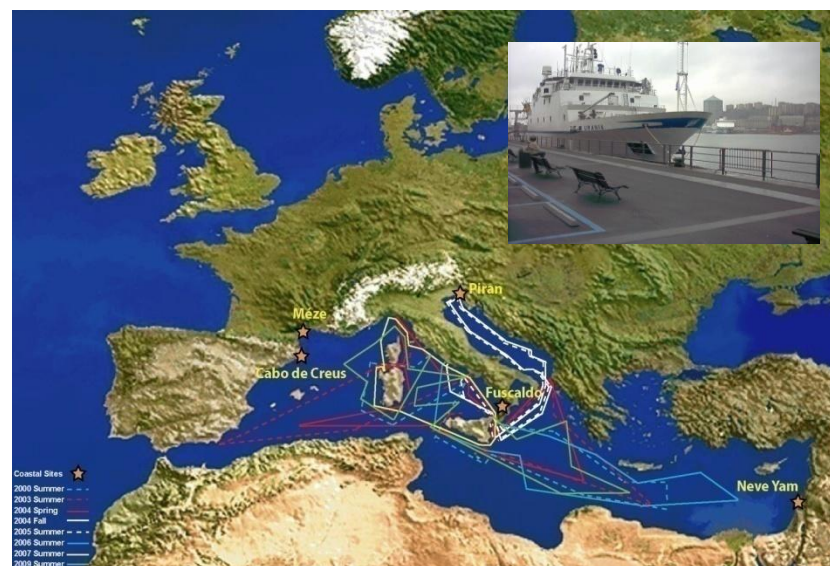
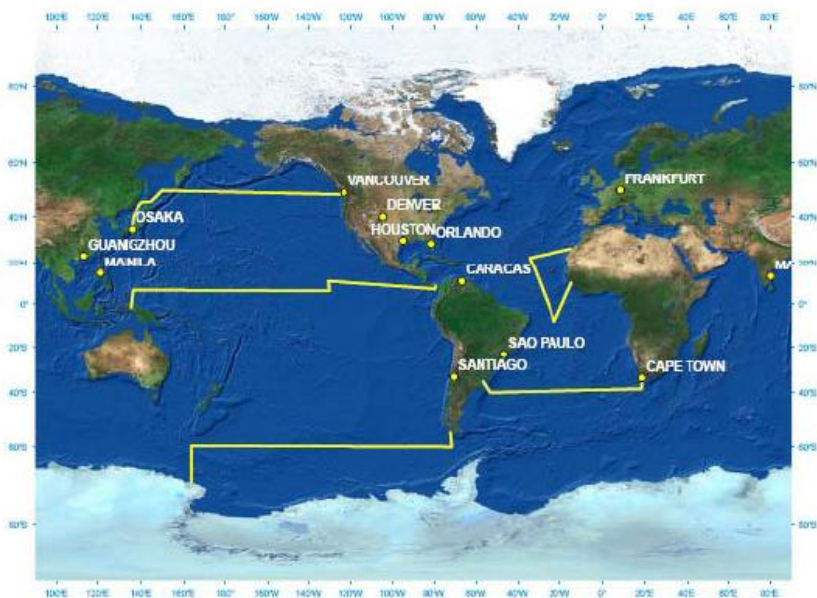
Alt: 5079 m a.s.l

GAW
GLOBAL
STATION



GMOS Oceanographic Program

- Oceanographic Observation program which will include:
 - Cruises over the Pacific Ocean
 - Cruises over the Atlantic Ocean
 - Cruises over the Mediterranean and North/Baltic Seas



GMOS Aircraft-Based Program

- Aircraft program which will include:
 - Intercontinental Flights in the Upper Troposphere / Lower Stratosphere
 - Regional scale flights in Europe (and likely also in USA) up to the mid Troposphere

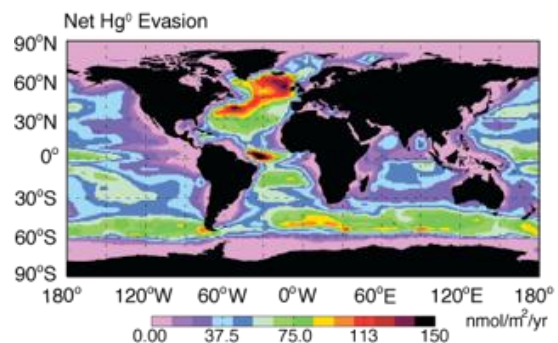
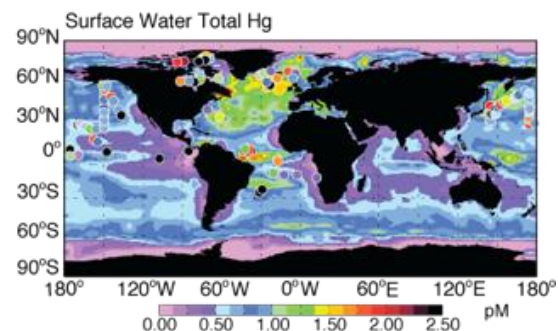
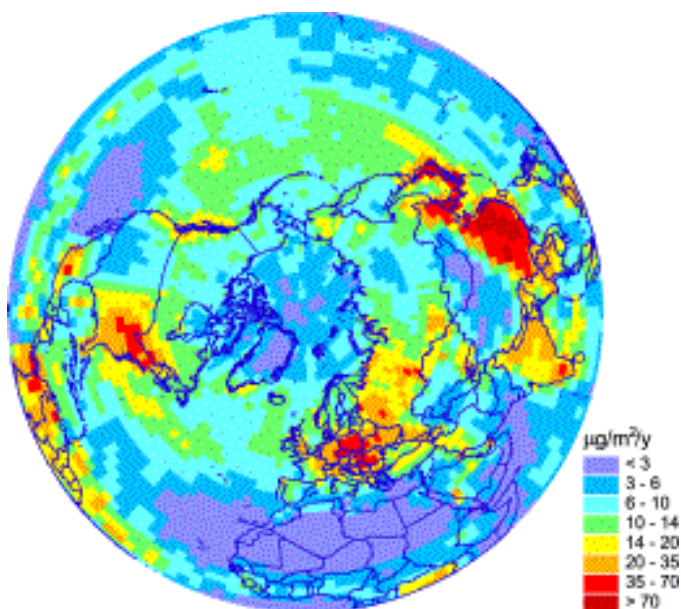


D-AIHE

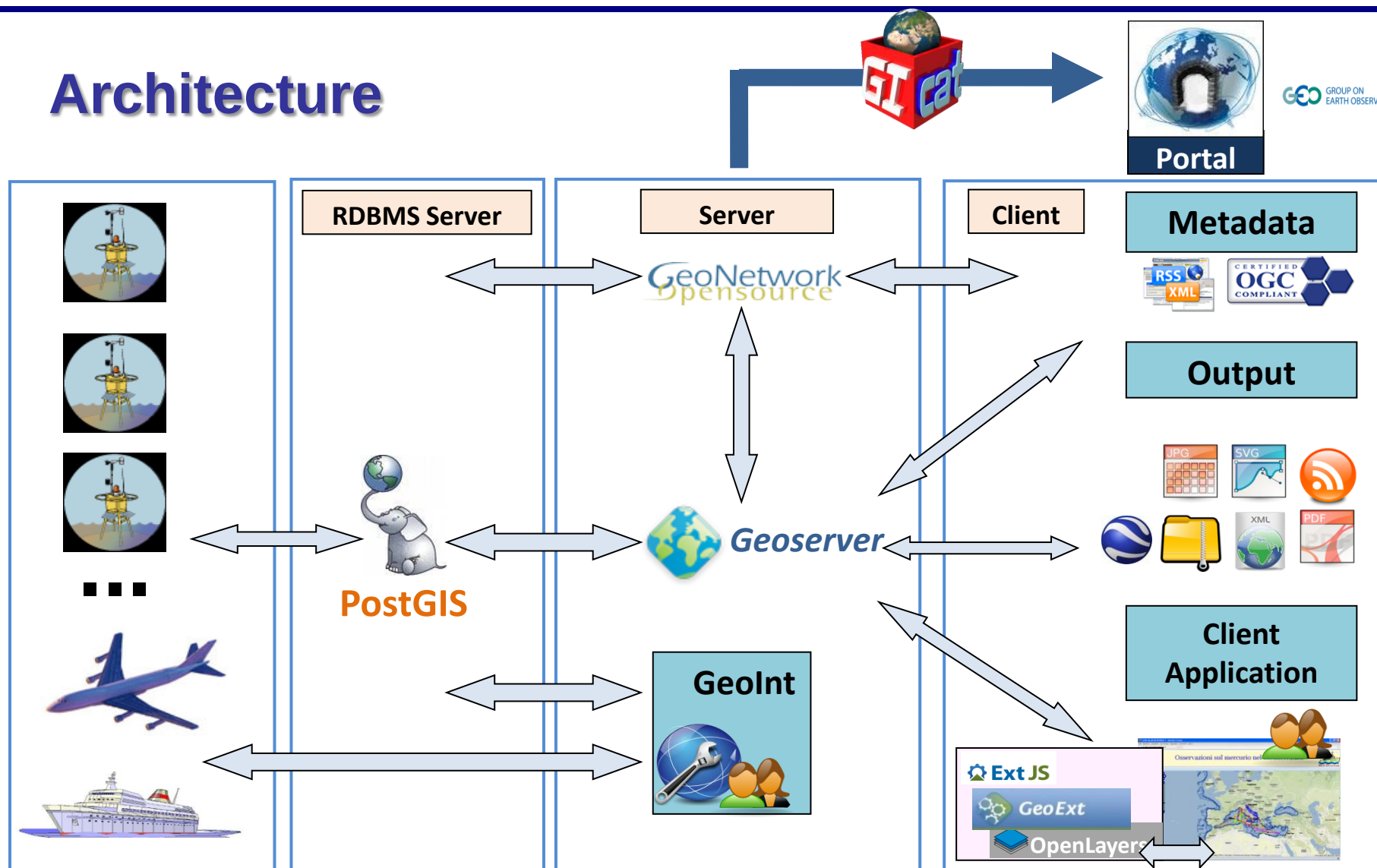


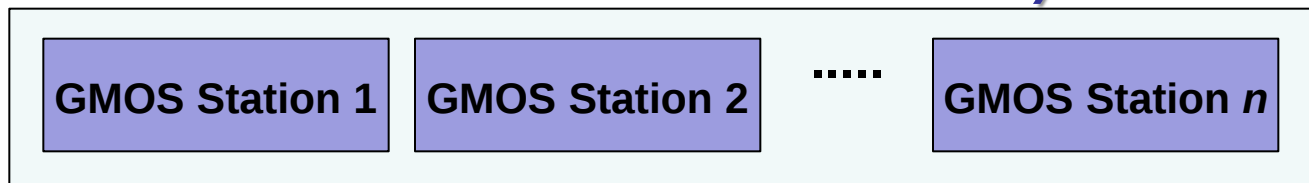
GMOS Models

- Atmospheric mercury cycle modelling:
 - Global scale modelling
 - Regional scale modelling



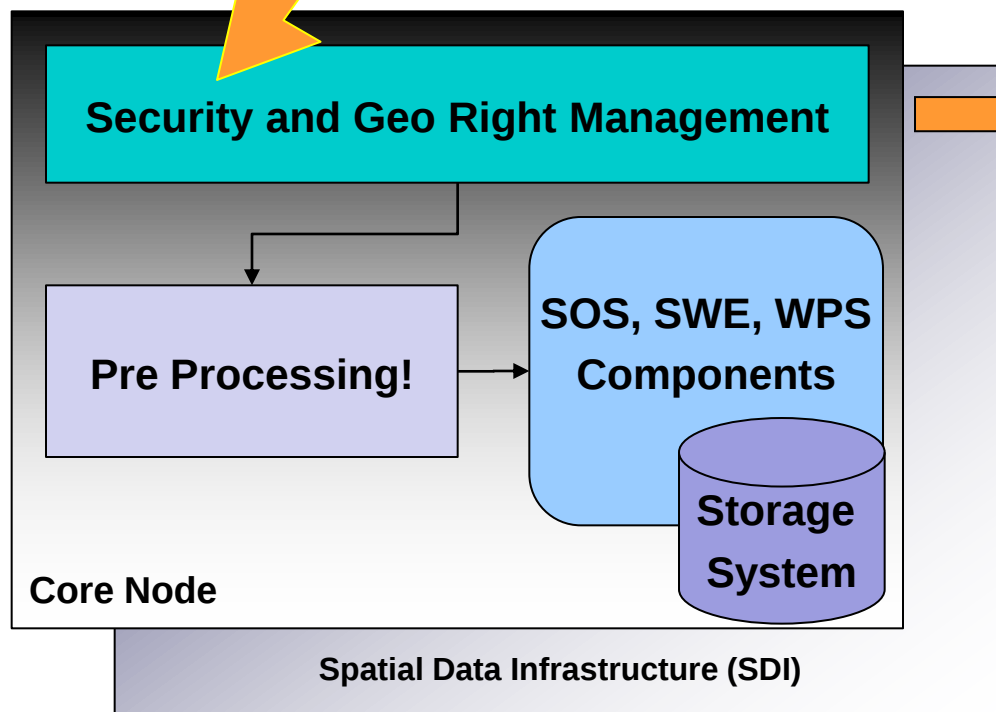
Architecture





AQUIRE OBSERVATIONS FROM

**HTTP
Mobile (GMS/UMTS)**
.....

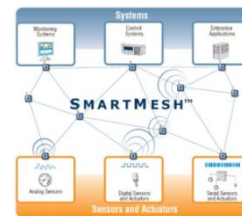
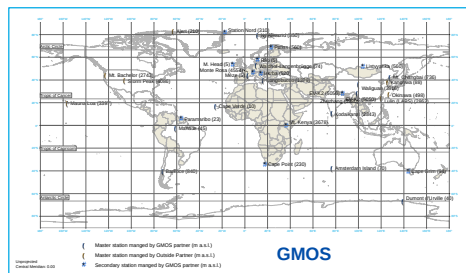


Output:

- Desktop GIS (uDig, ArcMap)
- SWE Thin Client
- Web Gis (OpenLayers,...)
- Metadata ISO 19115, CS-W 2.0.2
- OGC Web Services (WMS, WFS, WPS, SOS..)
- SMS,



GMOS Impact



Spatial Data Infrastructure (SDI)

OGC®
Web
Processing
Service

emep

Co-operative programme for monitoring and evaluation of the long-range transmissions of air pollutants in Europe

macc

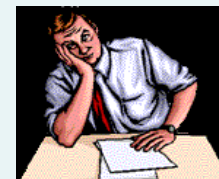
Monitoring atmospheric composition & climate

Users



- Nearcast
- Forecast
-

Decisors



- Scenarios
- Directives
-

Proposal for a New Task as part of Information Services of the GEO WP (2012-2015)

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Director

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GEO Health and Environment Community of Practice
3rd Workshop

Press Room, World Meteorological Organization (WMO) Building
7 bis, avenue de la Paix, 1202 Geneva, Switzerland
4-6 May 2011

New Task Title

Global Mercury Observation Information Services (DS-xx)

**It builds on the previous sub-Task
HE-09-02d:
“Global Monitoring Network for Mercury”**

- **Develop a global observation system for mercury by:**
 - combining ground-based, over-water and tropospheric observations
 - Harmonizing standard operating procedures for monitoring mercury and its compounds in air, atmospheric deposition, water, soil, sediments, vegetation and biota.
- The **sharing of data** from this network, allowing access to comparable and long-term data from a wide array of locations, will help understand temporal and spatial patterns of mercury transport and deposition to, and evasion from, terrestrial and aquatic ecosystems.
- The data produced will support the **validation of regional and global atmospheric mercury models** for use in evaluations of different policy options for reducing mercury pollution impacts on continental and global scales.
- **Build upon the GMOS Project, the US MercNet initiative and international monitoring and modelling efforts led by Italy, Japan and South Africa.**
- Moreover build **upon the contribution of**, among others, UNEP Mercury Programme, the Hemispheric Transport of Air Pollutants Task Force (TF HTAP), and the European Monitoring and Evaluation Program (EMEP).

Deliverables / Priority Actions / Leads

- A. Standard operating procedures (SOPs)** for monitoring mercury and its compounds in air, atmospheric deposition, water, soil, sediments, vegetation and biota relevant to public health.

Responsible: Francesca Sprovieri, CNR-IIA, Italy

- B. Ground-based observations** aimed to provide spatially distributed information on mercury concentrations in ambient air and precipitations.

Responsible: Nicola Pirrone, CNR-IIA, Italy

- C. Marine Observations** aimed to provide spatially distributed data on mercury concentration in biotic and abiotic systems of major oceans (i.e., Atlantic, Pacific, Indian) and seas (i.e., North Sea, Baltic Sea, Mediterranean Sea).

Responsible: Milena Horvat, Jozef Stefan Institute, Slovenia

- D. UTLS Observations**, aimed to provide mercury speciation data along with major atmospheric oxidants data in the troposphere and lower stratosphere including vertical profiles; data will be gathered on board of regional and intercontinental flights.

Responsible: Ralf Ebinghaus, HZG, Germany

Deliverables / Priority Actions / Leads

E. Validated regional and global scale atmospheric mercury models on the basis of the data produced at ground-based sites (as in A), over oceans and seas (as in B) and in the UTLS (as in C).

Responsibles:

- Oleg Trvnikov, MSC-East, Moscow (*for Global Models*)
- Volker Matthias, HZG, Hamburg, Germany (*Regional Models*)

F. The interoperable system to allow the sharing of data and tools produced (in A-E above) that will represent the core of the forecasting and alerting system.

Responsibles: Sergio Cinnirella and Ian M. Hedgecock, CNR-IIA, Italy

PoC / Contributors / Co-Leads

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Resources Available for Implementation

- **From EC-FP7, through GMOS (2010-2015)**
- **Italian Polar Program (PNRA)**
- **French Polar Program**
- **U.S.EPA (to support the operation of several sites in USA)**
- **NSF (support NAAMEX aircraft tropospheric studies at Univ. of Washington)**
- **Government of Japan for the Okinawa sites**
- **Government of Canada for Alert site**
- **MOST, PR China, for sites in China**
- **Others....**

- Establish a close cooperation/ coordination with INFRASTRUCTURE tasks.
- Increase advocacy for in-situ QA/QC procedure.
- Ensure a close cooperation with **DS-04** “Ocean Monitoring, Forecasting and Resources Management”, **DS-08** “Human Impact Monitoring and Forecasting”, **DS-06**: Disease Early Warning”.
- Ensure a better link between task level (deliverables) and policy level within GEO; issues related to data property rights, data sharing, etc. need to be better framed.
- Plan for the infrastructure (observing + data) management after 2015

from GEO to Environmental Policy

The proposed Task will contribute to the overall GEOSS goal to *further the implementation of international environmental treaty obligations.*

- European Mercury Strategy
- UNEP Mercury Program – Global Partnership on Atmospheric Mercury Transport and Fate Research (F&T)
- Task Force on Hemispheric Transport of Air Pollutants (TF HTAP) under the UNECE-LRTAP conventions.
- On-going programs in US, Canada, Asia, etc.

www.gmos.eu

the official GMOS web portal provides all the information concerning project development, interoperable system, field campaigns, atmospheric modelling, major findings and press releases

Thanks