GMOS

Global Mercury Observation System

Funded by:
European Commission – DG Research
(2010 – 2015)

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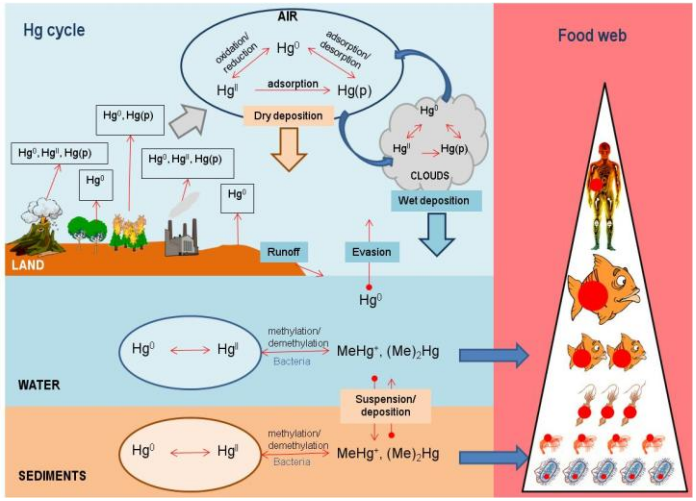
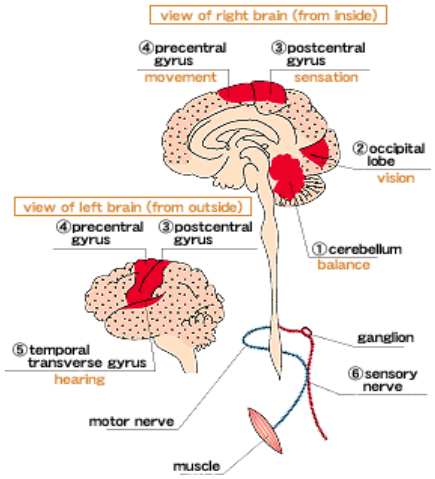
The context in which ripened





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 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

GEO Task HE-09-02d

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

GEO Task HE-09-02d

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.

GEO Task HE-09-02d

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**.

GEO Task HE-09-02d

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 24 partners from all over the world.
- GMOS started in November 2010 and will end in 2015.

GMOS Goal

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.

GMOS Overarching Objectives

- 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.

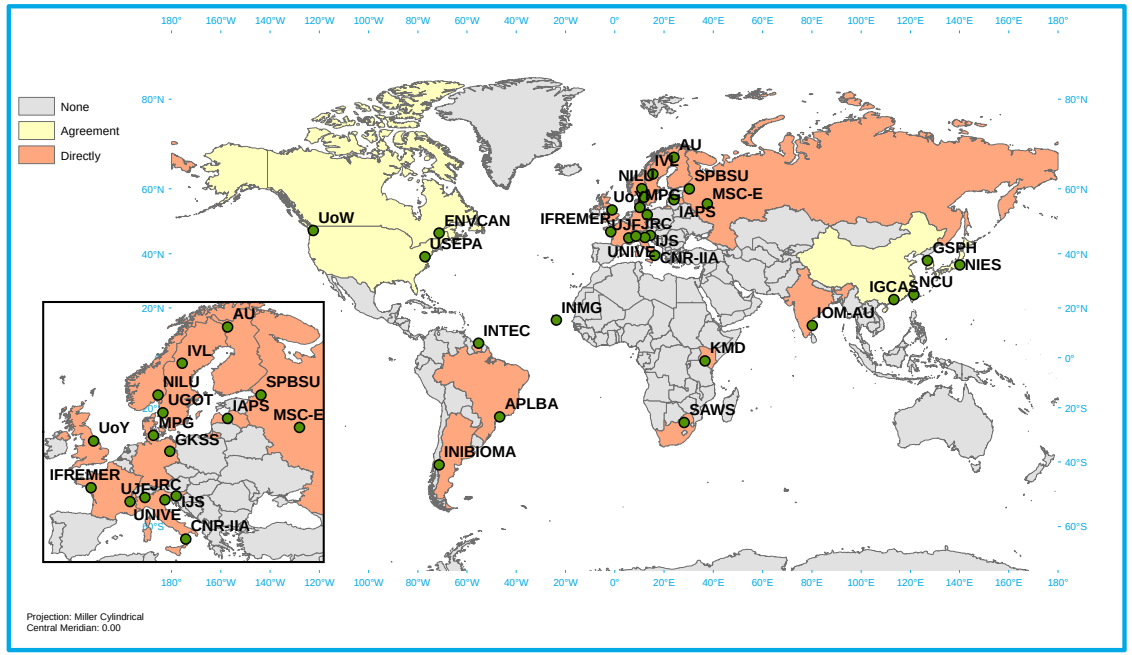
Innovative Aspects of GMOS (1/2)

- 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).

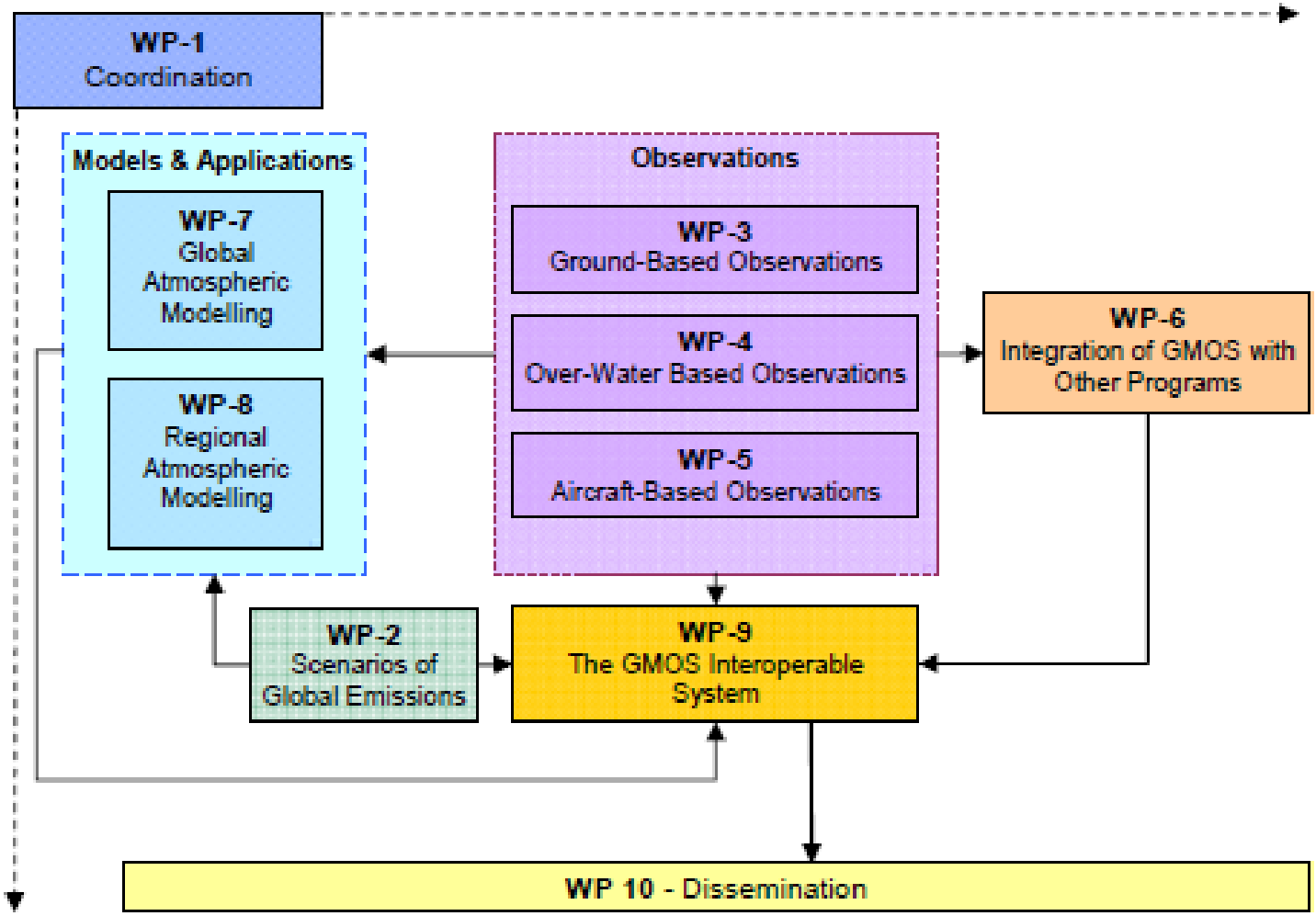
Innovative Aspects of GMOS (2/2)

- 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 structure



GMOS structure



GMOS Ground-Based Observation System

- Ground-Based Observation System

33 stations in the Northern and Southern Hemisphere -

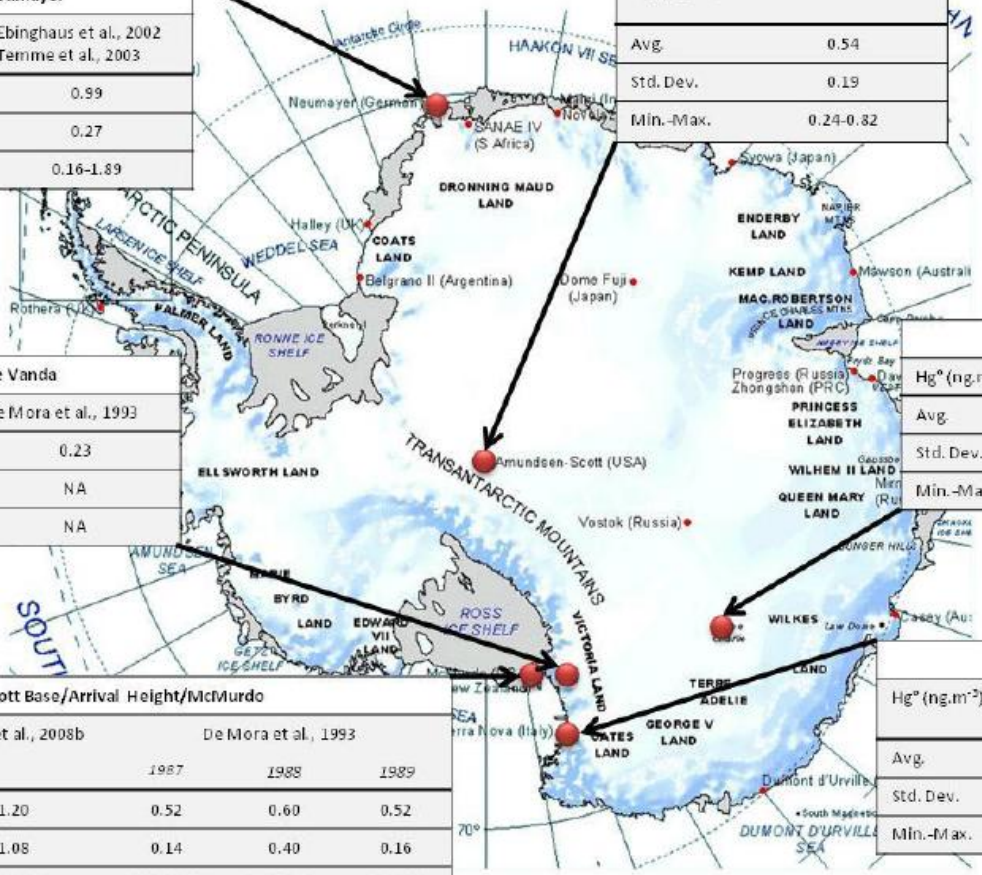
GMOS Ground-Based Observation System

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

Running sites are those where Hg meaurements 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	3816	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
Kodaicanal, 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° (ng.m^{-3})	Ebinghaus et al., 2002 Temme et al., 2003
Avg.	0.99
Std. Dev.	0.27
Min.-Max.	0.16-1.89

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

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

Concordia	
Hg° (ng.m^{-3})	Courteaud et al., in prep
Avg.	0.85
Std. Dev.	0.46
Min.-Max.	BDL-2,2

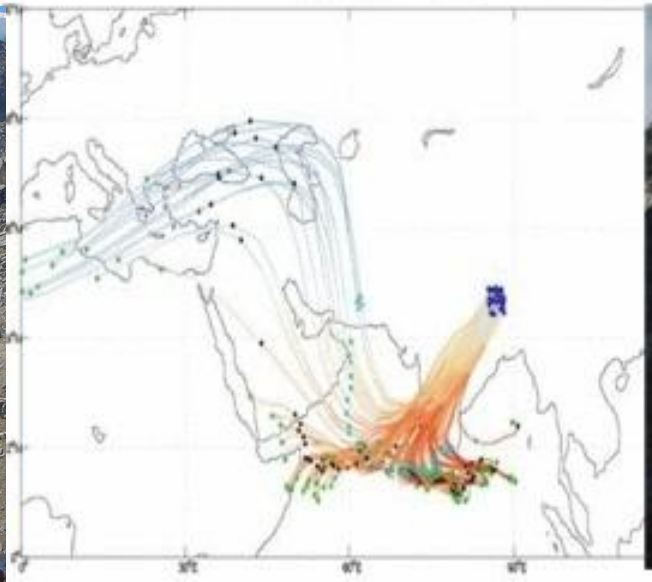
Scott Base/Arrival Height/McMurdo				
Hg° (ng.m^{-3})	Brooks et al., 2008b	De Mora et al., 1993		
		1987	*1988*	*1989*
Avg.	1.20	0.52	0.60	0.52
Std. Dev.	1.08	0.14	0.40	0.16
Min.-Max.	BDL-11.2	0.16-0.83	0.02-1.85	0.11-0.78

Terra Nova Bay	
Hg° (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

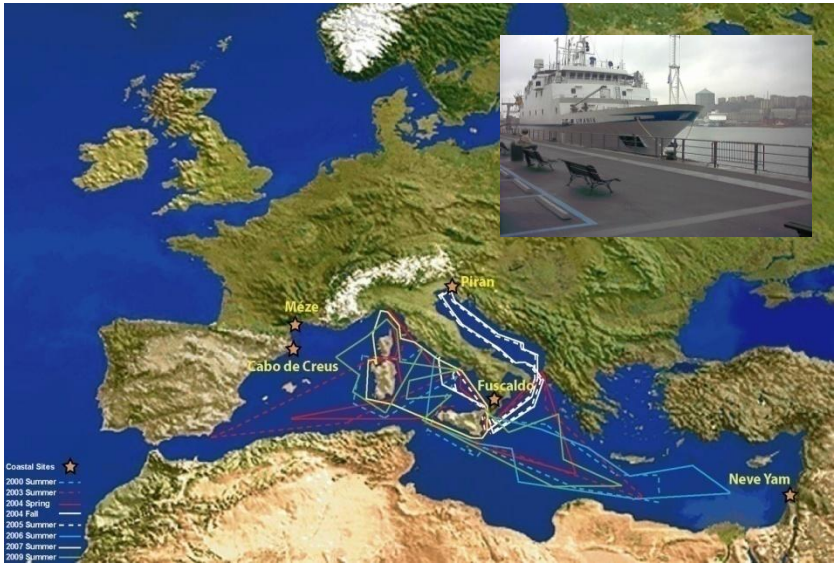
Alt: 5079 m a.s.l

GAW GLOBAL STATION



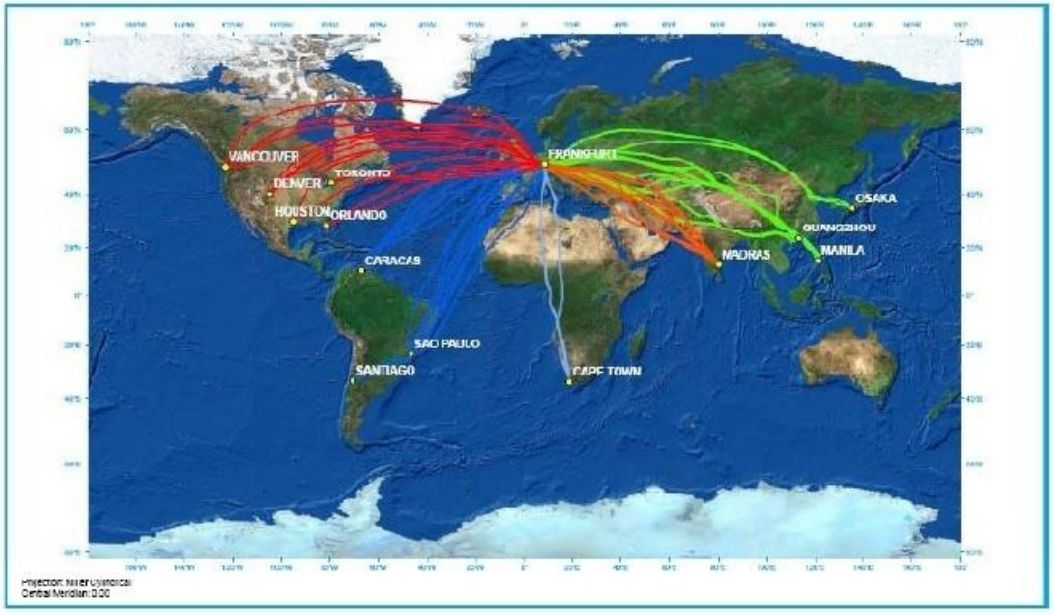
GMOS Oceanographic Program

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



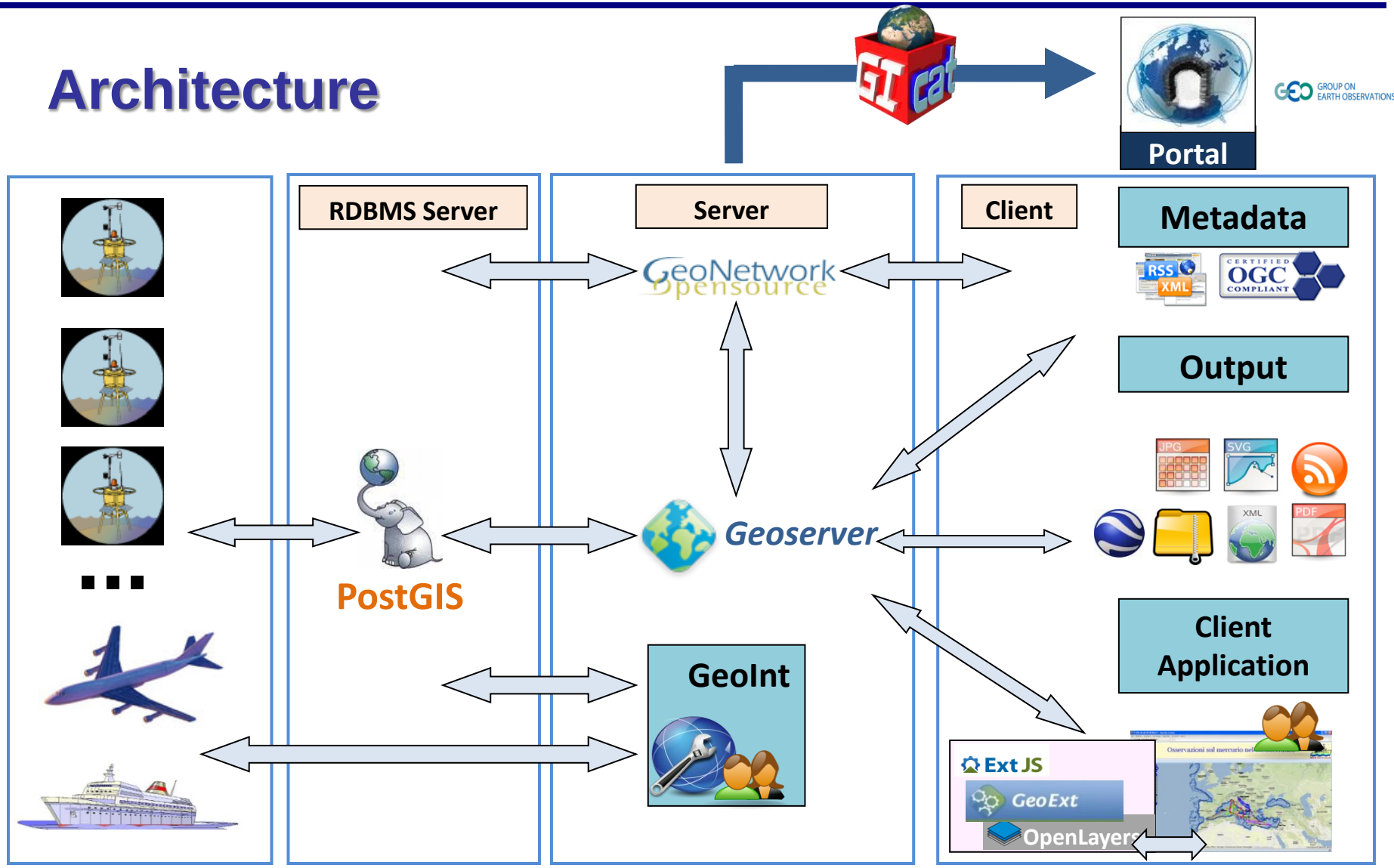
GMOS Aircraft-Based Program

- 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**



The GMOS SDI

Architecture



GMOS Interoperable Architecture (based on SWE)

GMOS Station 1 | GMOS Station 2 | ..... | GMOS Station *n*

AQUIRE OBSERVATIONS FROM

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

Security and Geo Right Management

Pre Processing!

SOS, SWE, WPS Components

Storage System

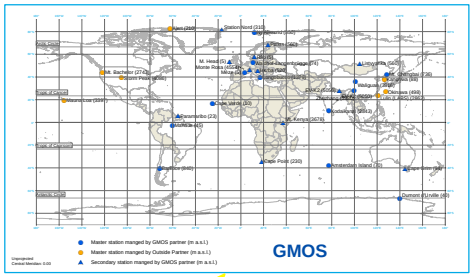
Core Node

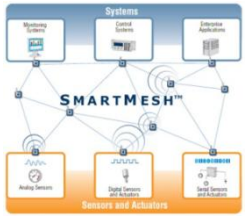
Spatial Data Infrastructure (SDI)

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

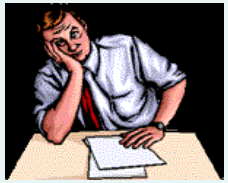




Users

- Nearcast
- Forecast
- .....

Decisors



- Scenarios
- Directives
- .....

Spatial Data Infrastructure (SDI)

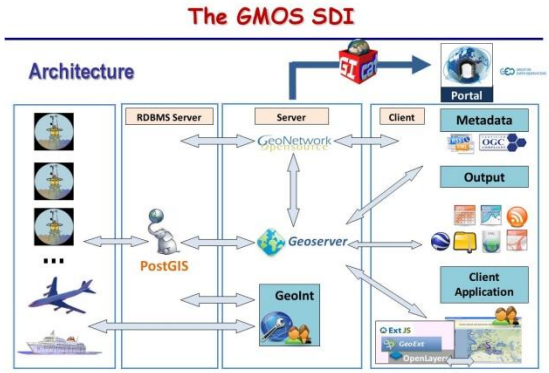
OGC® Web Processing Service

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

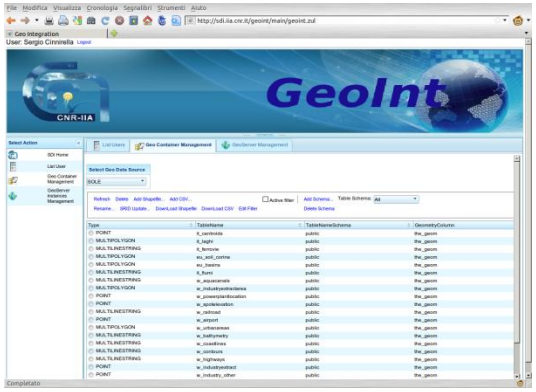
macc — Monitoring atmospheric composition & climate

What has been done (6 months activity)

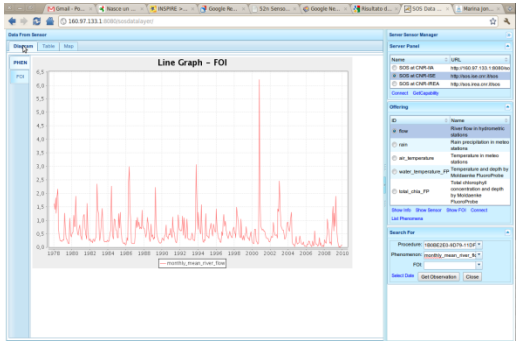
- Definition of the structure of the SDI for GMOS in the framework of GEO/GEOSS approach (WP-9)



- Still developing the end-user interface for data management



- Still developing the thin client for SWE



More about GMOS will be available at...

www.gmos.eu

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

Thanks