

# The WMO Global Atmosphere Watch (GAW) Programme

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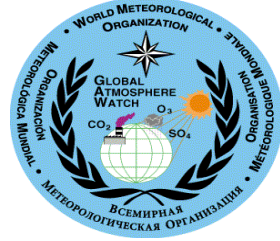
and

Dušan Hrček

WMO Representative for Europe

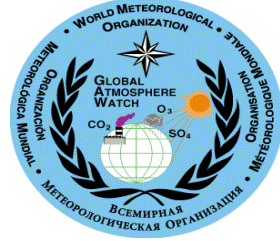
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For website Google "GAW"



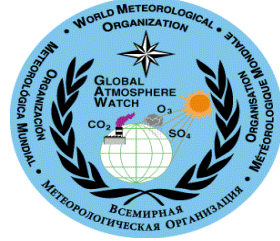
# Contents

- WMO GAW Programme
- GAW in the framework of GEOSS and IGACO
- Recommended GAW monitoring themes
- BEO Moussala, a potential GAW station



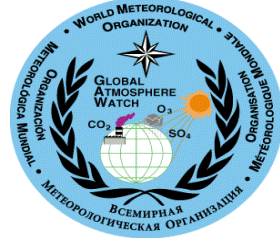
# GAW: What is it?

- The Global Atmosphere Watch programme of WMO
- *Established* in 1989 by merging the Global Ozone Observing System (GO<sub>3</sub>OS) and Background Monitoring of Air Pollution (BAPMoN) programmes
- *Coordinated* by the Environment Division of WMO's Atmospheric Research and Environment Programme (AREP) department under the Commission for Atmospheric Science (CAS) and its Working Group on Environmental Pollution and Atmospheric Chemistry.



# The GAW Mission

- ***Systematic Global Monitoring Of Chemical Composition of the Atmosphere.***
- ***Analysis and Assessment in Support of International Conventions.***
- ***Development Of Air Pollution and Climate Predictive Capability***

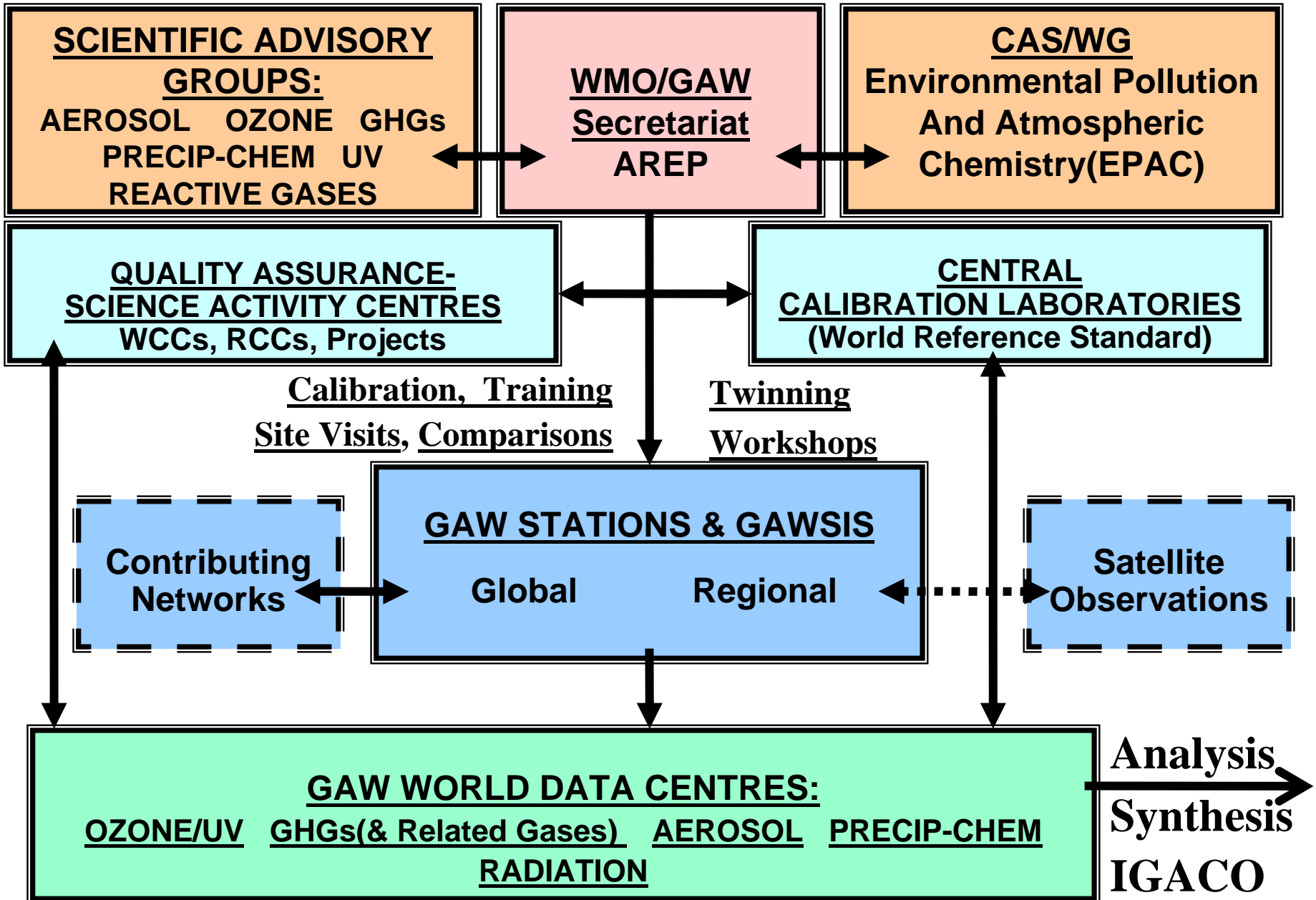


# Motivation

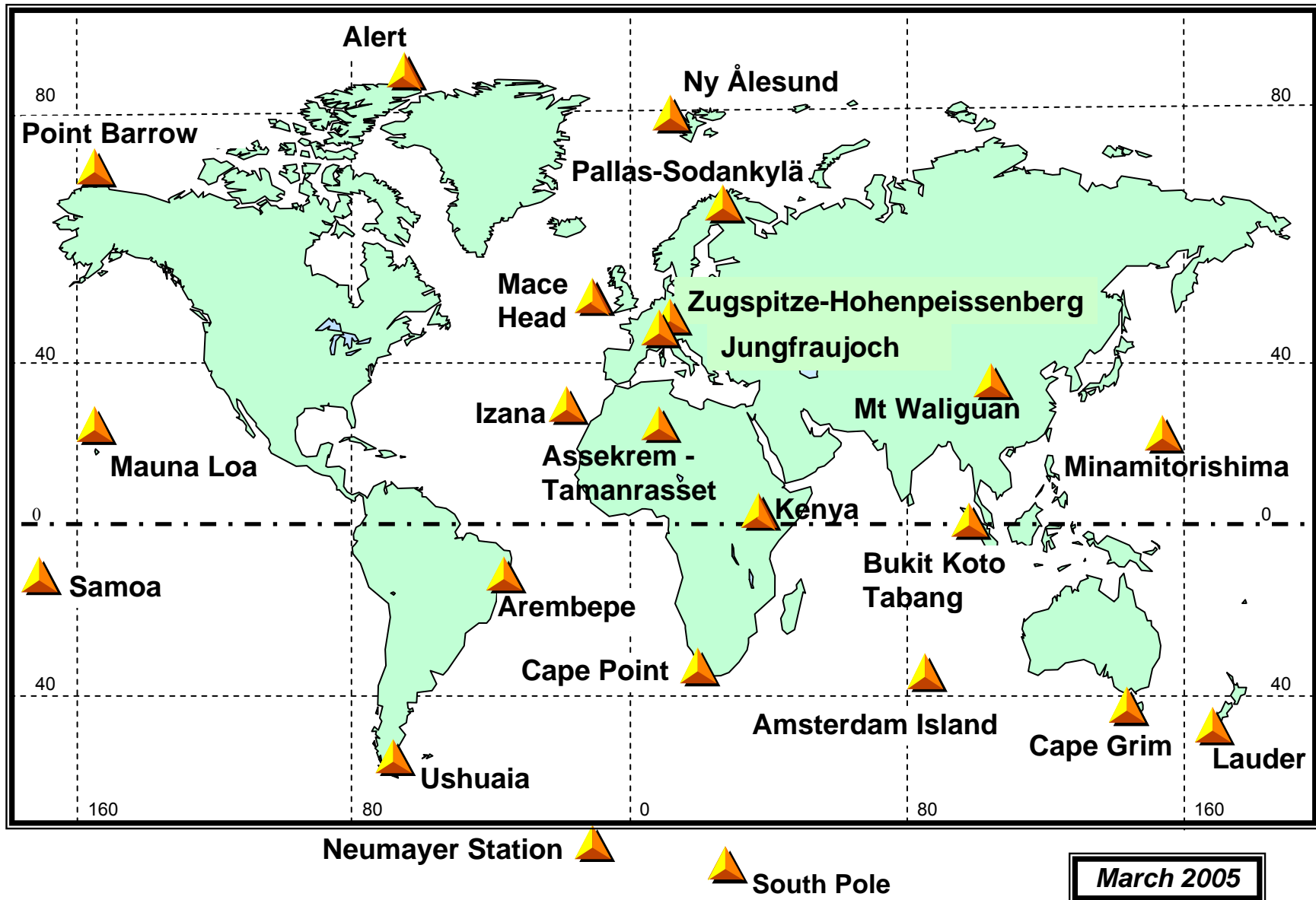
## Better Understanding of:

- Climate, Climate Change and Climate Prediction
- Improved Weather Forecasting: By Including Aerosols, Ozone and Reactive Gas Observations
- Air Pollution Forecasting, Effects, Long Range Transport and Deposition
- Stratospheric Ozone Depletion and Surface UV Enhancement: Are Halocarbon controls working?
- Oxidizing Power: The Atmosphere As A Waste Processor

# GAW Monitoring Components



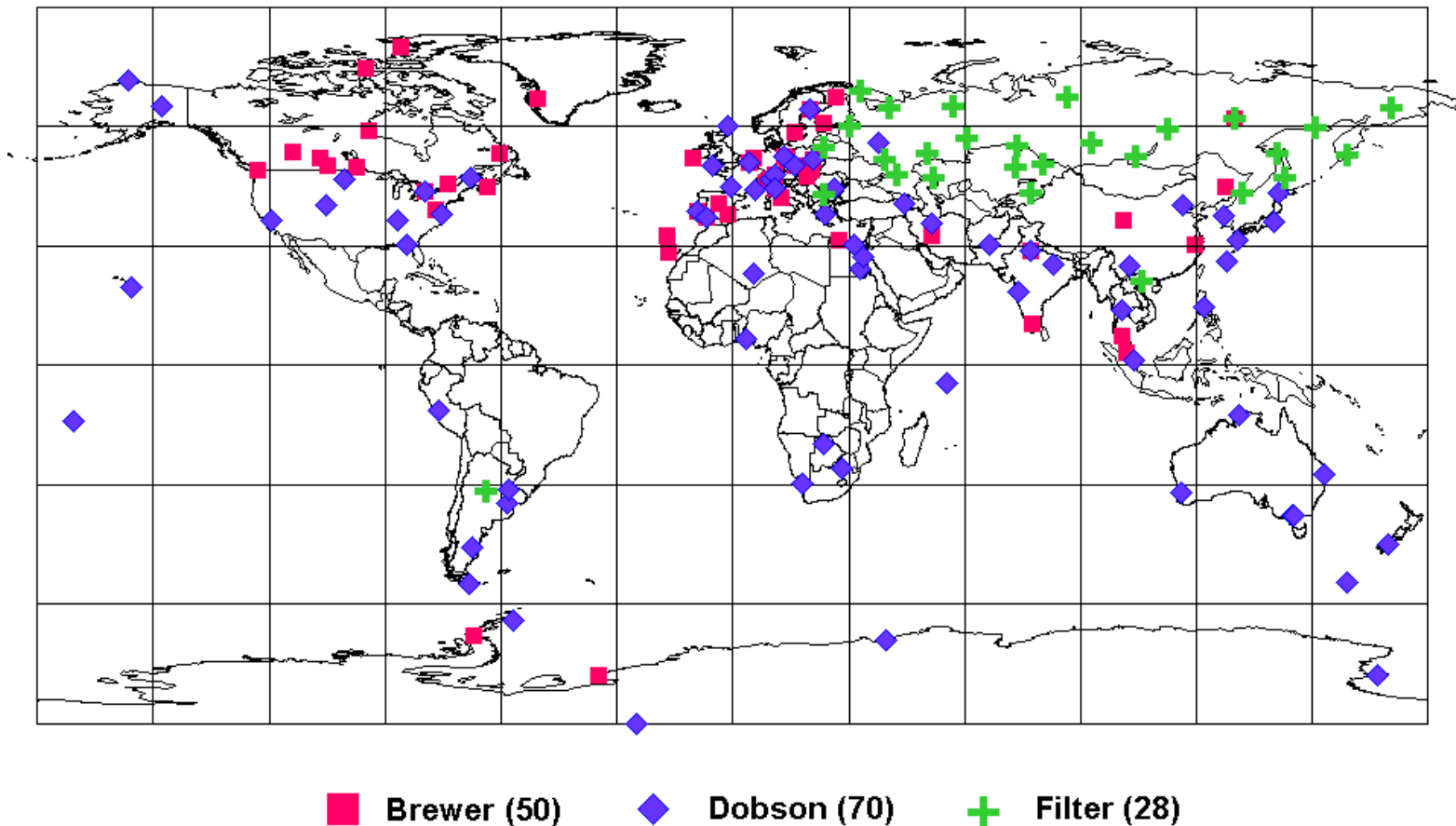
# GLOBAL STATIONS IN GAW





# GAW GLOBAL TOTAL COLUMN OZONE NETWORK: 2001- 2004

## Stations Submitting Data

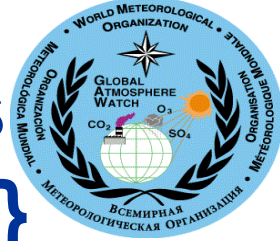


The symbols represent different instrument types.  
Compliments of WOUDC, MSC, Toronto {Ed Hare Manager}.



# Central Calibration Laboratories

{Hosts of WMO World Reference Standards}



- **CO<sub>2</sub>, CH<sub>4</sub>, N<sub>2</sub>O, CO** NOAA CMDL USA
- **Total Ozone** NOAA CMDL USA Dobson  
MSC, Canada Brewer  
MGO, Russia M124
- **Ozone Sondes** FZ-Juelich, Germany
- **In Situ Ozone** NIST USA
- **Aerosol Optical Depth** WORCC, Davos, CH

# World or Regional Calibration Centres

{Linking Observations to World Reference Standards and Ensuring Network Comparability}

- |  |  |
|--|--|
| ▪ Total Ozone  | 6 Regional Dobson Centres<br>1 Regional EU Brewer Centre<br>1 Brewer travelling standard |
| ▪ Ozone Sondes   | FZ-Julich, Germany   |
| ▪ <i>In Situ</i> O <sub>3</sub> , CO, CH <sub>4</sub>  | EMPA, Switzerland  |
| ▪ CO <sub>2</sub> , CH <sub>4</sub> , N <sub>2</sub> O | NOAA CMDL USA  |
| ▪ N <sub>2</sub> O, VOC                                | IMK-IFU Garmisch Germany   |
| ▪ Aerosol Optical Depth                                | WORCC, Davos, CH   |
| ▪ Aerosol physical                                     | IFT, Leipzig, Germany  |
| ▪ Precip. Chemistry                                    | SUNY Albany USA  |

# Integrated Global Atmospheric Chemistry Observation (IGACO) System



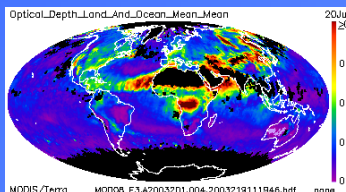
**An IGOS theme implemented by WMO**

## Objectives:

1. To ensure accurate, comprehensive global observations of key atmospheric gases and aerosols;
2. To establish a system for integrating ground-based, in situ and satellite observations using atmospheric models;
3. To make the integrated observations accessible to users.

## Observations

### Satellite



### Aircraft



### Ground-based

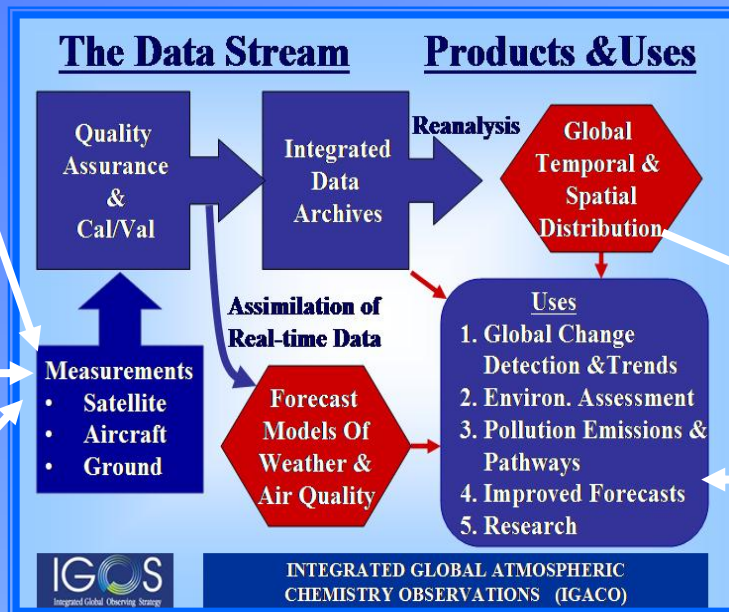
**WMO GLOBAL ATMOSPHERE WATCH (GAW)**  
Atmospheric composition monitoring for climate, ozone depletion and air quality.

GAW surface CO<sub>2</sub> networks: NOAA and WMO

- Greenhouse gases: (CO<sub>2</sub>, CH<sub>4</sub>, N<sub>2</sub>O, CFCs)
- Aerosols: (optical, physical, chemical properties)
- Ultraviolet radiation:
- Ozone: (vertical profiles, total column, surface fluxes)
- Reactive gases: (CO, NO, VOC, SO<sub>x</sub>)
- Precipitation chemistry

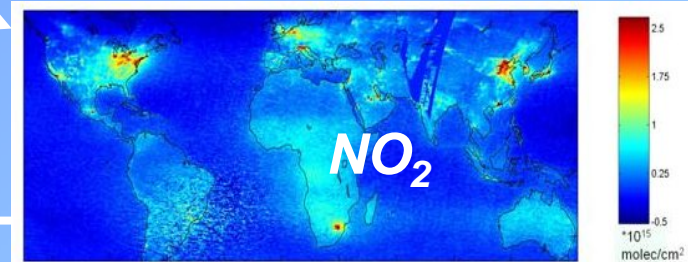
GAW ozone balloon sondes networks: WMO & NASA & NDSC

## IGACO System



An international process:  
Panel of 19 experts from 12 countries and independent reviewers from 7 countries.

## Products



**Air Quality**

**Climate**

**Ozone Depletion**

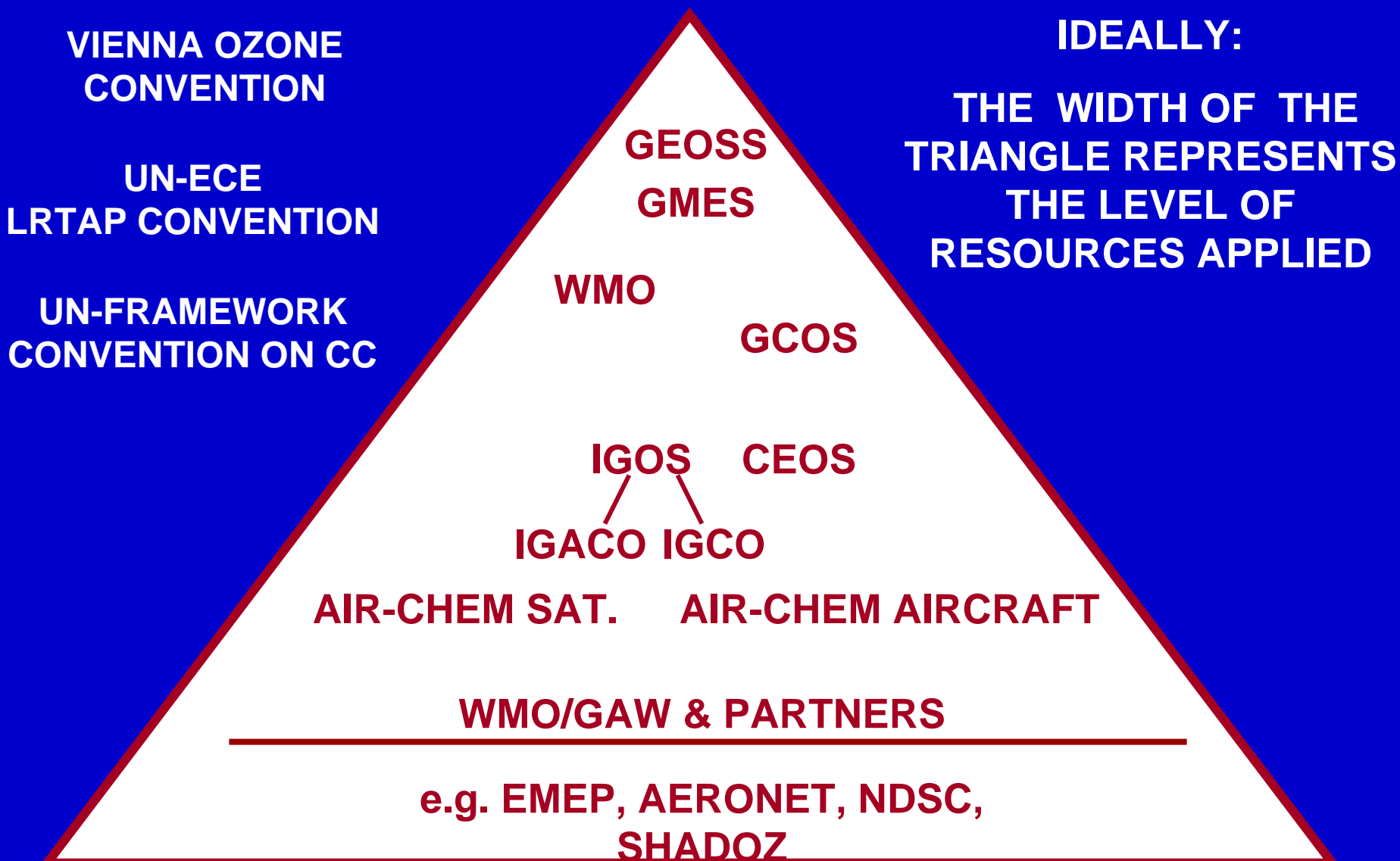
### Links to:

Space agencies, WCRP, GCOS, IGBP, IGOS themes

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# A Hierarchy Of Conventions, Strategies, Systems, Programmes, Networks, Related To Systematic Atmospheric Chemistry Observations





# GROUP ON EARTH OBSERVATIONS

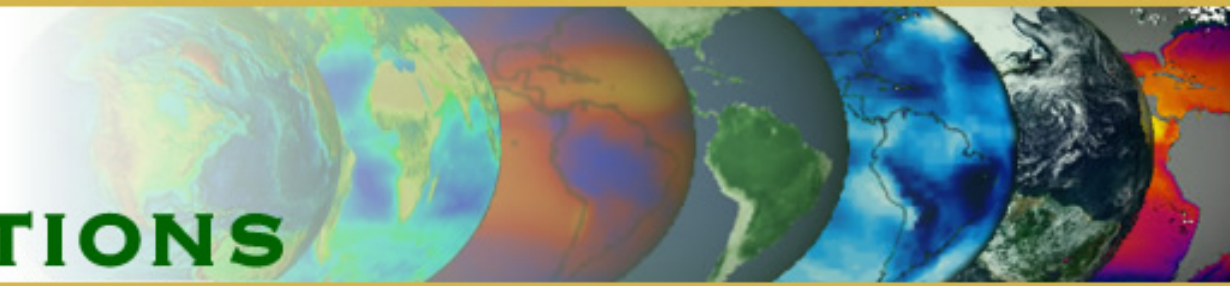


## GROUP ON EARTH OBSERVATIONS (GEO)

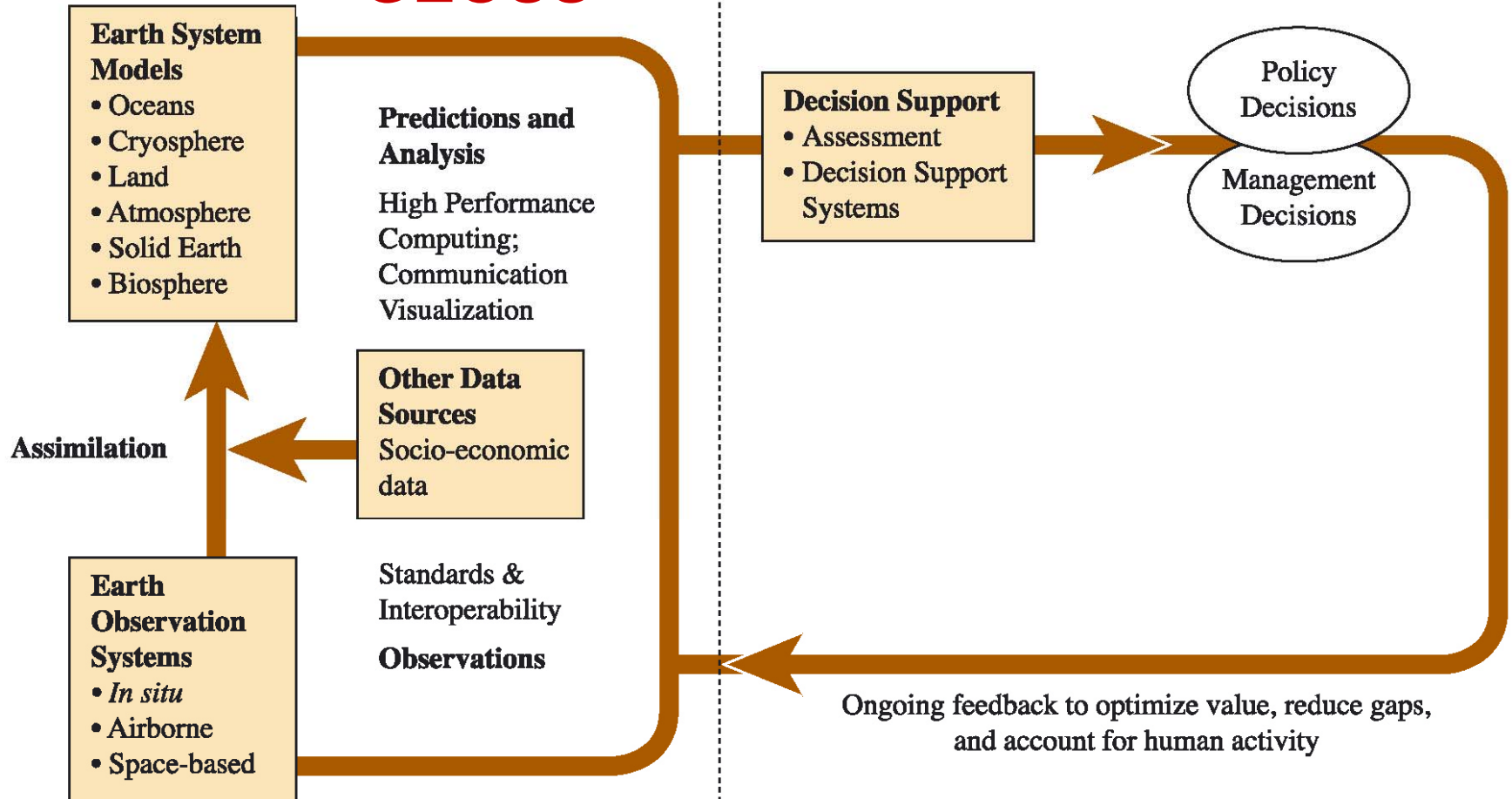
- 58 Countries and EC
- 43 International Organizations
- Plenary
- Executive Committee
- Secretariat
- 4 Standing Committees



# GROUP ON EARTH OBSERVATIONS



## GEOS

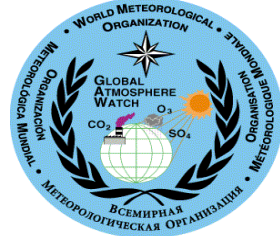




- **Global Earth Observation System of Systems (GEOSS):**
  - 9 societal benefit areas
- **Climate Change:**
  - Post-Kyoto Strategy (>2012): scenarios, mitigation and adaptation strategies, scientific knowledge
- **Sustainable Development/Johannesburg process:**
  - Sustainability impact assessment, integration of SD into management of land use and natural resources, modelling, externalities and thresholds
- **Environmental technologies:** Technology platforms
- **Ecosystems and biodiversity:**
  - Millennium Ecosystem Assessment
- **Environmental EU Policies:** Water, Soil, Marine Pollution, Urban Environment, Civil Protection, Habitats



# Contributions of Europe to GEOSS implementation (1)

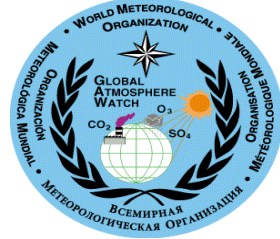


➡ The goals of the GEO initiative are highly relevant to EU policies in the areas of environment, sustainable development, research, external relations, which call for a strong European knowledge-based economy.

Therefore Europe strongly supports the implementation of GEOSS through:

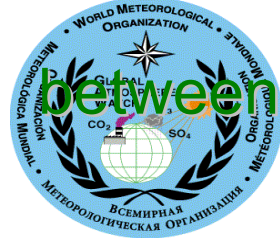
- EU research activities (Environment, ICT, Space Programmes) supporting in FP6 and even more in FP7 the implementation of GEOSS in the different societal benefit areas;
  - > **Several running FP6 projects already address GEO;**
  - > **4th FP6 call on Environment RTD explicitly asking for contributions to GEOSS in several topics closes on 3 Nov. 2005;**
  - > **Financial contribution for the operation of the GEO Secretariat;**
  - > **FP7 will address contributions to GEOSS Implementation;**

# Contributions of Europe to GEOSS implementation (2)

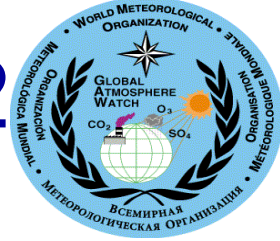


- The 'Global Monitoring for Environment and Security' (GMES) initiative, developing user-driven, operational, environmental monitoring services based on integrated EO data;
  - > ***The observation component of GMES will constitute a major European contribution to GEOSS***
- The 'INfrastructure for SPatial InfoRmation in Europe' (INSPIRE) initiative, aiming to make relevant, harmonised and quality geographic information available;
  - > ***INSPIRE will be a major European contribution to the GEOSS data management system***
- Data and information products from many regional and national European Earth observation networks  
**(e.g. *in situ* and remote sensing observation networks by NMHSS)**

# Memorandum of Understanding EC and WMO



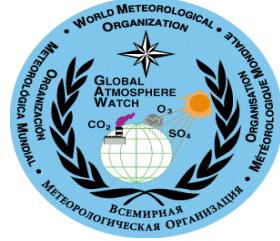
- **Signed** by former EC Research Comm. Busquin and by former WMO SecGen Obasi **on 18 December 2003**;
- Specifies **areas of common interest and cooperation** as well as **priorities for action**;
- **Areas of cooperation** include R+D, Policy development, Earth Observation, Global Change, Stratospheric ozone depletion, Supporting international conventions, Natural Hazards, Transport, Water resources, Urban environment, Air and water quality, Environment and health, Sustainable ecosystem management, Drought and desertification, Capacity building, Technology transfer, Education and training, Transfer of staff;
- **Meeting** of WMO SecGen Jarraud with EC Research Comm. Potocnik and Development Comm. Michel **on 19 July 2005 in Brussels** to discuss enhancing and strengthening of cooperation;



# 10 CHALLENGES TO GAW: 1 of 2

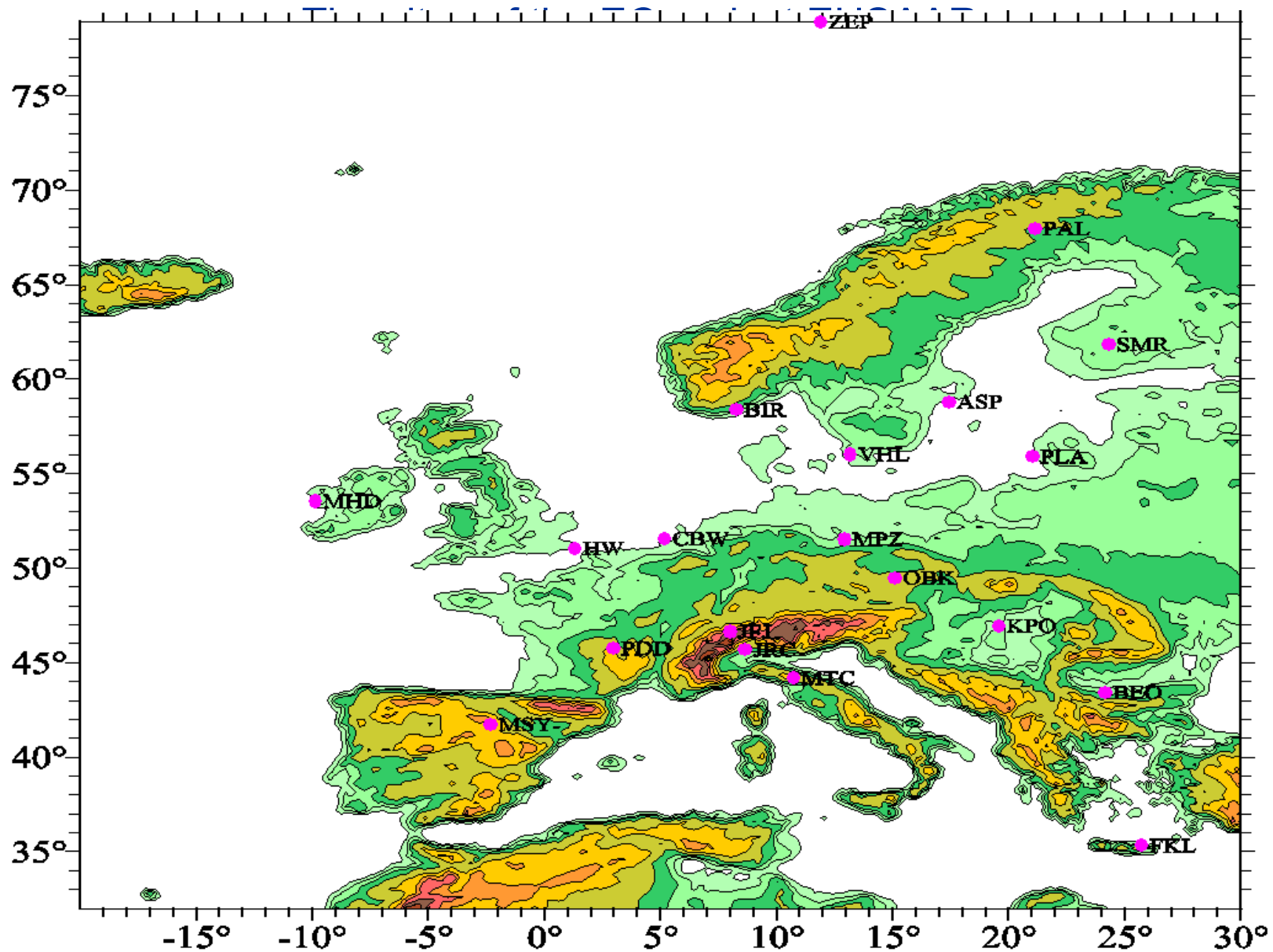
1. Maintaining long term measurements of quality in the current network
2. Establishing long term measurements of quality to improve global coverage, particularly in countries that are developing or in transition.
3. Developing collaboration between NHMSs and the chemical measurement community in some countries
4. Calibration, quality assurance and standard operating procedures: costly and not high profile but essential
5. Working with contributing partners that have networks as substantive as GAW to build a global network.

# 10 CHALLENGES TO GAW: 2 of 2



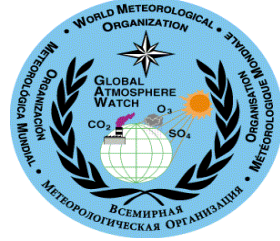
6. Developing World Data Centres that are comprehensive global repositories for high quality global observations of *targeted* GAW species.
7. Development of GAWSIS so that the GAW global network is accurately known.
8. Building a global aerosol monitoring network and integrated data analysis system in partnership with other organizations including satellite agencies.
9. Implementing with partners a Integrated Global Atmospheric Chemistry Observations (IGACO)
10. Continue to build air quality management capacity in countries with mega-city air pollution problems.





Name of Infrastructure	Aerosol chemical composition (inorganic)	Aerosol chemical composition (organic)	Aerosol mass	Aerosol optical depth	Light scattering coefficient	Absorption coefficient	Aerosol vertical distribution	Aerosol size distribution (10-500 nm)
Puy de Dôme	√	⊕	√	√	√	√		√
Junfraujoch <sup>1,2,5</sup>	√	√	√	√	√	√		√
Aspvreten <sup>1</sup>	√	√	√			√		√
JRC-Ispra <sup>1,2,3</sup>	√	√	√	√	√	√	√	√
Cabauw <sup>3,4</sup>	√	√	√	√	√	√	√	√
Melpitz <sup>1,3</sup>	√	√	√	√	√	√	√	√
Zeppelin <sup>1,2</sup>	√	√	√	√	√	√		√
Birkenes <sup>1</sup>	√	√	√					√
Mt. Cimone <sup>2</sup>	√	√	√		⊕	√		⊕
Hyytiälä	√	⊕	√			√		√
Mace Head <sup>2</sup>	√	√	√	√	√	√		√
Finokalia	√	⊕	√	√	√	√		
Pallas <sup>1,2</sup>	√		√	√	√	√		√
K-puszt <sup>1</sup>	√	√	√		√	√		⊕
Kosetice <sup>1</sup>	√	√	√					⊕
BEO Moussala	√		√		√			⊕
Harwell	√	√	√			√		√
Preila <sup>1</sup>	√		√			√		√
Vavihill <sup>1</sup>	√	√	√			√		√
Montseny	√		√					





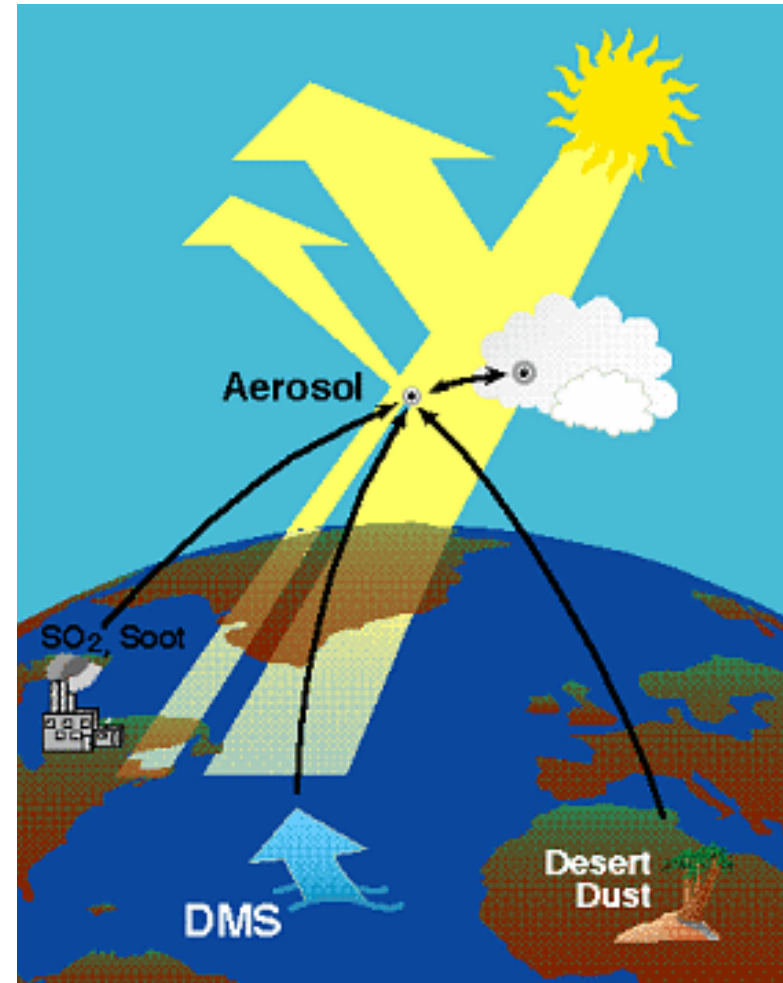
# Monitoring Themes

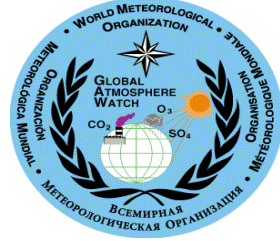
- **Stratospheric Ozone**
- **Tropospheric Ozone**
- **UV Radiation**
- **Greenhouse Gases (CO<sub>2</sub>, CH<sub>4</sub>, N<sub>2</sub>O)**
- **Synthetic Greenhouse Gases(CFCs, SF6 etc)**
- **Aerosols (optical, chemical, physical)**
- **Reactive Gases (CO, VOC, NO<sub>y</sub>, SO<sub>2</sub>)**
- **Precipitation Chemistry**
- **(Natural Radionuclides, Rn<sup>222</sup>, Be<sup>7</sup>, <sup>14</sup>CO)**



## Objective for the GAW Aerosol Programme

**To determine the spatio-temporal distribution of aerosol properties related to climate forcing and air quality up to multidecadal time scales**





## Aerosol recommended by the SAG Aerosol (in bold: core parameters)

### • Continuously:

- **Multiwavelength optical depth**
- **Mass in two size fractions**
- **Major chemical components in two size fractions**
- **Light absorption coefficient**
- **Light scattering coefficient** at various wavelengths
- Scattering and hemispheric backscattering coefficient
- Aerosol number concentration
- Cloud condensation nuclei at 0.5% supersaturation
- Diffuse, global and direct solar radiation

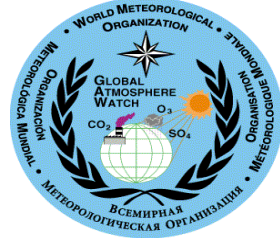
### • Intermittently:

- Aerosol size distribution
- Detailed size fractionated chemical composition
- Dependence on relative humidity
- CCN spectra (various supersaturations)
- Vertical distribution of aerosol properties

The guidelines for aerosol measurements  
(WMO/GAW Report No. 153 (2003))  
can be downloaded from the WMO website at

<http://netra1.wmo.ch/web/arep/gaw/publications.html>





# WMO



# THANK YOU

