An Integrated Global Atmospheric Observations System: Essential Components and Challenges

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Goal

Provide the Convention on Long Range Transboundary Transport of Air Pollution with:

“a better understanding of intercontinental transport of air pollution in the Northern Hemisphere.”
Objectives Of This Workshop Addressed In Session 3

Identify actions, efforts and mechanisms leading to:

- A common data base of observations suitable for evaluation of models and inventories for priority air pollutants, such as ozone and particulate matter and precursors.

D. Co-operative structures between regional observation networks and other sources of data.

E. Improved information technology infrastructure for sharing and integrating observational data with modeling for purposes of evaluation and improved data assimilation for air quality forecasting.

F. Greater participation of developing countries in a long range air pollution observation systems
Questions

1. What actions are needed to develop “the system”?

2. What is the status of the implementation of the IGACO strategy?

3. What next steps will help advance the common interests of TF HTAP, GAW, and GEO?

4. How can we build upon existing systems?

5. How can we leverage investments being made in the creation of GEOSS and in the development of regional air quality forecasting systems?
HTAP Assessment Chapt 6. Integration of Observations, Modeling, and Emissions Information

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- Lead authors: Oystein Hov, Rudy Husar, Brendan Kelly, Jill Engel-Cox, Sunling Gong, Tony Hollingsworth, Geir Braathen

Strong references to Chapter 5:
Dentener, Carmichael
Components: Integrated Atmospheric Observations System

- Cal/Val & Quality Assurance
- Forecast Models & Data Assimilation
- Long Term Data Archives
- Globally Gridded Data
- Observations
  - Satellite
  - Aircraft
  - Surface (in situ, remote)
- Observation Optimization
- Real Time Data Delivery
- Air/Surface Exchange & Emissions
- Inversion
- All Data Delivery
- Reanalysis

Applications
- Weather Prediction
- Air Quality Prediction
- Global Change Detection
- Environ. Assessment
- Ecosystem Impacts
- Seasonal Forecast
- Emergency Response
- Climate Research
- etc. etc.
Convergence of N.Hem and S.Hem Medium Range Forecast skill
1981 – 2004

Anomaly correlation of 500hPa height forecasts

Year

%
IGACO

- Presents the reason and need for Global Atmospheric Chemistry Observations
- Targets 14 variable groups including reactive gases.
- Assesses past, current and expected state of observing system for each target variable
- Reviews requirements for observations for each target variable group
- Makes 12 General Recommendations and 7 Specific Recommendations
- Provides a framework for the next generation GAW programme 2008-2015
WMO/IAEA CO2 & GHG Experts Measurements Meeting

1975 Scripps

2005 Boulder
Executive summary

The latest analysis of data from the WMO-GAW Global Greenhouse Gas Monitoring Network shows that the globally averaged atmospheric carbon dioxide (CO₂), methane (CH₄), and nitrous oxide (N₂O) have all reached new highs in 2004 with CO₂ at 377.1 ppm, CH₄ at 1751 ppm, and N₂O at 318.6 ppb. These values are higher than those in pre-industrial times by 35%, 155%, and 18% respectively. Atmospheric growth rates of these gases are consistent with previous years, though CH₄ growth has slowed during the past decade. The NOAA Annual Greenhouse Gas Index (AGGI) shows that from 1990 to 2004, the total atmospheric radiative forcing by all long-lived greenhouse gases has increased by 20%.

3 Globally averaged CO₂ (a) and its instantaneous growth rate (b) from 1983 to 2004.

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IGACO-Ozone
in operation by end of 2006

GAW Calibration & Quality Assurance

World Integrated Data Archive System: Includes WOUDC

Satellite: WMO Space Programme
Aircraft: GAW & MOZAIC
Surface-based: GAW

Assimilation of Real-Time Data By Forecast Models

WMO Real-Time Data Distribution: WMO Information System (WIS)

Global Products

Data Uses/Applications
1. Public UV Warnings
2. Public Ozone Bulletins
3. Research
4. Scientific Assessments
5. Forecasts of Ozone Depletion
6. Improved Weather Forecast

Secretariat at Finnish Met Institute
Leaders WMO/GAW & IO3C
IGACO-Ozone

- IGACO-O3 secretariat working since last year at FMI.
- Implementation Plan in preparation (joint effort with Ozone SAG and WMO-AREP).
- Implementation Workshop in May 2006 resulted in definition of 13 useful and practical activities that would improve over the existing system.
- IGACO-O3 latest news and documentation are available on [http://www.igaco-o3.fi/](http://www.igaco-o3.fi/)
Some activities defined at Anavyssos, Greece workshop in May 2006

- Better data access and archiving
  - Workshop to be held 12-14 March 2007 at EMPA, Dübendorf
- More total ozone and ozonesondes on GTS/WIS
  - Some stations are already submitting data to GTS in NRT
- Easier access to meteorological data
- Data assimilation of ground-based column ozone and ozone profile measurements
  - What is the added value of including ground-based data for producing regular gridded ozone fields?
Current situation

data providers
(e.g. ESA, NASA, NASDA, ECMWF, NCEP, station networks, individual stations, field campaign data centers, ...)

bureaucratic procedure, i.e., submission of proposal, annual reports, final report, etc.
simple registration or free access

Illustration courtesy of M. Rex, AWI Postdam

WMO TF-HTAP GEO Workshop Geneva 25-27 Jan 2007
A scientist’s dream

- Data providers
- Data protocol
- GTS/WIS
- Data centres
- Data users
The symbols represent different instrument types.

Compliments of WOUDC, MSC, Toronto {Ed Hare Manager}. 

**Brewer (50)**  
**Dobson (70)**  
**Filter (28)**
GAW GLOBAL OZONE SONDE NETWORK: 2001-2004
Stations Submitting Data To WOUDC

The red triangles represent sites of GAW Contributing partner NASA/SHADOZ

Compliments of WOUDC, MSC, Toronto {Ed Hare Manager}. 
WMO Antarctic Ozone Bulletins
Every Two Weeks Aug to Nov + Summary in Dec/Jan

Ozone hole area

Meteorology

NRT Station data

Sonde data

Minimum ozone

Station climatology

Satellite data

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An example of a need for integrated products in near-real time

http://www.wmo.int/web/arep/ozone.html
Operational Global Aerosol Observations Are Coming: So Far Only In Research Mode

A best estimate of the global distribution of annual average tropospheric aerosol optical depth (AOD) compiled by combining data from six satellites (operating for limited periods between 1979 and 2004). Observations for a region were selected using ground-based AOD observations as guidance (courtesy of S. Kinne MPI, Hamburg, Germany).
Core Aerosol Variables
GAW Aerosol SAG

- optical depth
- light scattering coefficient
- light absorption coefficient
- mass (preferably in two size fractions)
- major chemical components in two size fractions

& Lidar

Reference:
GAW Report #153. WMO/GAW Aerosol Measurement procedures guidelines and recommendations (September 2003) (WMO TD No. 1178)
A WMO/GAW Experts Workshop

“A Global Surface-Based Network for Long Term Observations of Column Aerosol Optical Properties”

March 2004, WORCC Davos, GAW Report # 162.
Expected outcome: Based on the draft proposals prepared by the working groups and working group interactions during the GALION workshop, an implementation plan for GALION will be defined and submitted to WMO for approval. The plan will cover all necessary steps to organise lidar observations of aerosol properties on a global scale and make the data available for user communities.

Program committee: Jens Bösenberg, Leonard Barrie, Raymond Hoff, Stefan Kinne, Jun Zhou.
The Ground-based Global AOD Network “is currently un-coordinated”

Latitudinal distribution
Polar regions: 4
Midlatitude North: 50
Tropics: 26
Midlatitude South: 10
Total 90

Major data gaps
Africa, Asia, India, Polar region and Oceans

International: AERONET, BSRN, GAWPFR, SKYNET
National: Australia, China, Finland, Germany, Japan, Netherlands, Russia, USA(4)

Courtesy of Chris Wehrli Davos AOD Calibration centre
The Challenges I

1. striking a balance between short term project and systematic long term efforts in an integrated observation system;
   a) avoid one community feeding off the other
   b) systematically archive and make accessible to users campaign research as well as operational research observations

2. combining regional network observations to address hemispheric transport issues through added-value cooperative projects and products.

3. wasteful boundaries between national agencies monitoring atmospheric composition
   a) Cooperation between space, meteorological and environmental agencies in many countries
The Challenges II

4. lack of near-real-time data,
   a) Bridging technical, territorial and legislative barriers in free data exchange
   b) Providing mechanism to exchange data (WMO Info System WIS; AIRNOW; etc)
   c) Linking the emissions and NRT modelling community
5. engaging models with data assimilation as integrators,
6. ensuring quality and hence mergeability of data
7. data archiving aimed at reanalysis
   a) Consider the meteorological communities success (e.g. ERA 40)
8. developing products and services that strengthen links to users
Thank you