IGOS Atmospheric Chemistry Theme

Integrated Global Atmospheric Chemistry Observations (IGACO)

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GAW 2005 Workshop, 14-16 March
2005 WMO Geneva
The Challenge

• To maintain, develop and integrate a global long term system of surface-based, aircraft and satellite atmospheric chemistry observations for improved weather forecasting, climate prediction, air quality management and solutions of environmental issues

• To do this in an evolving socio-economic situation that increasingly favors short term projects.
The Solution

Combine a *generally accepted* flexible framework of cooperation with specific national, regional and international research and measurement programmes

IGACO, a Theme of IGOS, is the Solution.
The Role Of The World Meteorological Organization (WMO)

• As the lead agency designated by IGOS to implement IGACO, WMO shall use its unique international experience, programmes and partnerships to build a generally accepted global plan and to promote implementation through bottom-up research efforts at the national and regional level.

• IGACO builds on GAW, other WMO programmes and partnerships. It bridges to the weather forecast community.
What Is The Integrated Global Observing Strategy (IGOS) Partnership?
[http://ioc.unesco.org/igospartners/index.htm]

- IGOS is a **strategic planning process**, uniting the major satellite and surface-based systems for global environmental observations of the atmosphere, oceans, and land in a framework for decisions and resource allocations by individual funding agencies.
- The IGOS Partnership **focuses** on all forms of data collection concerning the physical, chemical and biological environments of our planet.
What Is The Integrated Global Observing Strategy (IGOS) Partnership?

The IGOS Partners include the:

**Global observing systems**
- Global Climate Observing System (GCOS)
- Global Ocean Observing System (GOOS)
- Global Observing System (GOS) of WMO
- Global Atmospheric Watch (GAW) of the WMO
- Global Terrestrial Observing System (GTOS)

**Sponsors of the global observing systems**
- World Meteorological Organization (WMO)
- U.N. Educational, Scientific, and Cultural Organization (UNESCO)
- U.N. Environment Programme (UNEP)
- Intergovernmental Oceanographic Organization (IOC)
- International Council for Science (ICSU)
- Food and Agriculture Organization (FAO)

**Committee on Earth Observation Satellites (CEOS)**
includes all national and regional government agencies with an Earth observing satellite system

**Global change research programs**
- International Geosphere-Biosphere Programme (IGBP)
- World Climate Research Programme (WCRP)
- International Group of Funding Agencies for Global Change Research (IGFA)
Products of IGOS

Themes Reports
Strategies with recommendations for implementing integrated observations on:

- Ocean
  - Global Carbon Cycle (IGCO)
  - Global Water Cycle (IGWCO)
  - Geo-Hazards
    - Atmospheric Chemistry (IGACO)
    - Coastal (incl. Coral-Reef)
    - Land
    - ......

INTEGRATED GLOBAL ATMOSPHERIC CHEMISTRY OBSERVATIONS (IGACO)
Background of IGACO

• Early 2001, WMO/CEOS published GAW Report #140 on requirements for a globally integrated system for ozone observations
• June 2001: IGOS partners approved Atmospheric Chemistry as 4th theme, following Oceans, Carbon Cycle and Water Cycle
• May 2004: Rome IGOS approved the Theme Report entitled IGACO prepared by a panel of 17 convened by WMO and ESA and appointed WMO as lead in implementation
• June 2004: WMO Executive Council Approved IGACO and WMO Lead.
• September 2004 Report Distributed at GEO Summit Meeting
• By September 2005: Implementation Plan for IGACO led by WMO/GAW
IGACO
THE INTEGRATED GLOBAL
ATMOSPHERIC CHEMISTRY
OBSERVATIONS THEME

IGOS
Integrated Global Observing Strategy

For the Monitoring of our Environment from Space and from Earth

September 2004
An international partnership for cooperation in Earth observations
The IGACO Team

- L. Barrie (WMO) (co-chair)
- J. Langen (ESA) (co-chair)
- P. Borrell (P&PMB Consultants) (secretary)
- O. Boucher (Univ. Lille)
- G. Brasseur (MPI Meteorology)
- J. Burrows (Univ. Bremen)
- C. Camy-Peyret (CNRS/LPMA)
- J. Fishman (NASA-L)
- E. Hilsenrath (NASA-G)
- D. Hinsman (WMO)
- C. Granier (CNRS/SA)
- H. Kelder (KNMI)
- V. Mohnen (SUNYA)
- T. Ogawa (NASDA)
- T. Peter (Univ. Zürich)
- A. Volz-Thomas (FZ Jülich)
- P.-Y. Whung (NOAA)
- P. Simone (Inst.d’Aeronomie Spatiale de Belgique)
The IGACO Review

- H. Akimoto (FRSGC/JAMSTEC, Yokohama)
- G. Brasseur (IGBP & MPI Meteorology, Hamburg)
- M.-L. Chanin (SPARC & CNRS/SA, Paris)
- P. J. Crutzen (MPI Chemistry, Mainz)
- N. Harris (European Ozone Research Coordination Unit, Cambridge / UK)
- D. Jacob (Harvard University USA)
- M. J. Molina (UC Irvine USA)
- S. Oltmans (NOAA/CMDL, Boulder CO USA)
- M. Proffitt (WMO)
- A. M. Thompson (NASA/GSFC)
- U. Baltensperger (& GAW Aerosol SAG)
- J. Kaye (NASA)
The Challenges

- **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
The Issues and Benefits of IGACO (1)

- **Climate-chemistry interaction**
  - Scientific assessment of climate change (IPCC, UNFCCC)
  - Climate prediction and weather forecasting
  - Contribution to convention monitoring (e.g., CH₄ for Kyoto protocol)
  - Key element of GCOS Implementation Plan

- **Air pollution/air quality**
  - Localisation and quantification of pollution sources, identification of chemical processing, transport pathways and sinks
  - Air quality forecast
  - Monitoring of conventions (e.g. UN-ECE LRTAP) and national legislation
  - Support of impact assessment (e.g. air pollution and human health)
The Issues and Benefits of IGACO (2)

- **Stratospheric ozone depletion**
  - Monitoring of Vienna Convention/Montreal Protocol and amendments
  - UV-B irradiance forecast
  - Scientific assessment of stratospheric ozone evolution and recovery

- **Atmospheric self-cleaning capability**
  ("oxidising efficiency")
  - Scientific assessment of chemical and physical processes, in particular distinction between anthropogenic trends and natural variabilities, as relevant to the other issues
The Objectives of IGACO

- To promote accurate, comprehensive global observations of key atmospheric gases and aerosols

- To establish a system for integrating ground-based, aircraft and satellite observations using atmospheric models

- To make the integrated observations accessible to users.
Out of a Complex Mix of Atmospheric Chemical A Target List For Integration Identified
Consideration Of The Chemistry of:
Stratosphere, Free Troposphere, Air Quality, Climate

TECHNOLOGY INDEPENDENT
LIST OF OBSERVABLES

The Filter:
(I) Relevance to Key Issues, Added Value of Data Integration
(II) Global and Long-term Available with Synergistic Advantages in
Integrating Satellite and Non-Satellite Data with Models

TARGET LIST OF OBSERVABLES
By Issue

INTEGRATED GLOBAL ATMOSPHERIC
CHEMISTRY OBSERVATIONS (IGACO)
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The IGACO Report Reviewed, Analysed and Summarized in a “Timeline Chart” the Past, Present and Future State of the Global Observing System for each of the Target Groups in the Previous Slide

An Example for Tropospheric Ozone is shown next.
Example of a timeline diagram

Figure 4.2.1. An overview of satellite, ground-based and aircraft measurements for tropospheric $O_3$.
Building Upon WMO/CEOS GAW Report #140 Technical Requirements For Observations Were Reviewed And Augmented
### Target and Threshold Requirements for Gases

#### Atmospheric species in Group 2 to be measured by an integrated global observing system

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### Notes
- N/A: Not applicable
- *: Specific values indicated as needed.
## Target and Threshold Requirements for Aerosol

<table>
<thead>
<tr>
<th>Theme</th>
<th>Unit</th>
<th>Aerosol Optical Depth (VIS+IR)</th>
<th>Aerosol Extinction Coefficient (VIS)</th>
<th>Aerosol Absorption Optical Depth (VIS)</th>
<th>PM1, PM2.5, PM10</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>a, d</strong></td>
<td>Δx</td>
<td>km</td>
<td>1 / 10</td>
<td>10 / 100</td>
<td>N/A</td>
</tr>
<tr>
<td>Climate</td>
<td>Δz</td>
<td>km</td>
<td>N/A</td>
<td>0.5 / 1</td>
<td>N/A</td>
</tr>
<tr>
<td>studies</td>
<td>Δt</td>
<td>global daily</td>
<td>global weekly</td>
<td>global daily</td>
<td>N/A</td>
</tr>
<tr>
<td>and precision</td>
<td></td>
<td>0.005 / 0.01</td>
<td>0.005 / 0.01 km&lt;sup&gt;-1&lt;/sup&gt;</td>
<td>0.002 / 0.01</td>
<td>N/A</td>
</tr>
<tr>
<td>oxidizing</td>
<td>trueness</td>
<td>0.01 / 0.02</td>
<td>0.01 / 0.02 km&lt;sup&gt;-1&lt;/sup&gt;</td>
<td>0.004 / 0.02</td>
<td>N/A</td>
</tr>
<tr>
<td>capacity delay</td>
<td></td>
<td>weeks</td>
<td>weeks</td>
<td>weeks</td>
<td>N/A</td>
</tr>
<tr>
<td><strong>b</strong></td>
<td>Δx</td>
<td>km</td>
<td>0.25 / 1</td>
<td>0.5 / 2</td>
<td>0.25 / 1</td>
</tr>
<tr>
<td>Air quality</td>
<td>Δz</td>
<td>km</td>
<td>N/A</td>
<td>0.1 in PBL</td>
<td>N/A</td>
</tr>
<tr>
<td>(PBL and free trop)</td>
<td>Δt</td>
<td>regional hourly</td>
<td>regional daily</td>
<td>N/A</td>
<td>1 / 10 µg m&lt;sup&gt;-3&lt;/sup&gt;</td>
</tr>
<tr>
<td>precision</td>
<td></td>
<td>0.005 / 0.01</td>
<td>0.005 / 0.01 km&lt;sup&gt;-1&lt;/sup&gt;</td>
<td>N/A</td>
<td>1 / 10 µg m&lt;sup&gt;-3&lt;/sup&gt;</td>
</tr>
<tr>
<td>trueness</td>
<td></td>
<td>0.01 / 0.02</td>
<td>0.01 / 0.02 km&lt;sup&gt;-1&lt;/sup&gt;</td>
<td>N/A</td>
<td>1 / 10 µg m&lt;sup&gt;-3&lt;/sup&gt;</td>
</tr>
<tr>
<td>delay</td>
<td></td>
<td>near real-time</td>
<td>near real-time</td>
<td>N/A</td>
<td>near real-time</td>
</tr>
<tr>
<td><strong>c</strong></td>
<td>Δx</td>
<td>km</td>
<td>10 / 100</td>
<td>10 / 100</td>
<td>N/A</td>
</tr>
<tr>
<td>Ozone depletion</td>
<td>Δz</td>
<td>km</td>
<td>N/A</td>
<td>1 / 2</td>
<td>N/A</td>
</tr>
<tr>
<td>(UT/LS) precision</td>
<td>Δt</td>
<td>10 d</td>
<td>10 d</td>
<td>N/A</td>
<td>N/A</td>
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<tr>
<td>trueness</td>
<td></td>
<td>10&lt;sup&gt;-5&lt;/sup&gt; / 10&lt;sup&gt;-4&lt;/sup&gt;</td>
<td>10&lt;sup&gt;-6&lt;/sup&gt; / 10&lt;sup&gt;-5&lt;/sup&gt; km&lt;sup&gt;-1&lt;/sup&gt;</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>delay</td>
<td></td>
<td>days</td>
<td>days</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>
An example of the IGACO Challenge Follows for Tropospheric Ozone.

Three Types of Observations Are Available To Integrate Using Assimilation By Models
ESTIMATED GAW GLOBAL OZONESONDE NETWORK: 2003
Stations with data submitted since at least 1 Jan 1999

Compliments of WOUDC, Toronto Ed Hare Manager. Note that this map changes constantly as data is submitted to the data centre. Suggestions to correct any omissions are welcome by GAW. The red symbols represent sites of contributing partner NASA/SHADOZ.
Flight routes with regular observations

MOZAIC 21000 flights
JAL 1000 flights
NOXAR 622 flights
CARIBIC 83 flights

INTEGRATED GLOBAL ATMOSPHERIC CHEMISTRY OBSERVATIONS (IGACO)
Satellite Column Observations From Low Earth Polar Orbiting Satellites

Tropospheric ozone from combined TOMS and SBUV data, showing major source regions and large-scale transport in the Northern hemisphere. [Courtesy J. Fishman, NASA]
IGACO IMPLEMENTATION

• WMO/GAW confirmed by IGOS and WMO/EC as the lead for implementation
• Other essential players: ESA, CEOS, other components of WMO, IGCO, IGWCO, research community.
• IGACO implementation plan to be developed by September 2005
Proposed IGACO Implementation:
Top-Down Meets Bottom-Up

March 05

IGOS-Partners

IGACO Implementation Team
(Co-Chair WMO & ESA)

Scientific Advisory Group

Other WMO Components

IGACO Office WMO AREP/Space Programme

User Application Projects

Assimilation-Reanalysis Modelling Projects

Data Quality, Flow & Synthesis Projects

Observational System Development Projects

IGACO Relevant National, Regional, International Activities (examples below)

GMES-PROMOTE

GEMS

ACCENT

SCOUT

WMO/GAW

NDSC

IGOS Themes IGCO & IGWCO

GEMS

WMO/SDS

WMO-FWIS

GMES-GATO

IAGOS (MOZAIC)
SPECIFIC SHORT TERM GOAL

By Dec 2007

• an IGACO implementation plan prepared and accepted by IGOS, GCOS, WMO and GEOSS.

• a IGACO office established in WMO to administer implementation (partners can contribute through targeted WMO IGACO trust fund projects and/or secondment of staff)

• An IGACO Implementation Team identified.
THANK YOU