An Integrated Global Atmospheric Chemistry Observations Strategy & WMOs Leading Role: GAW & IGACO

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Search Engine “GAW” →

www.wmo.ch/web/arep/gaw/gaw_home.html

GAW: What is it?

- The Global Atmosphere Watch programme of WMO
- *Established* in 1989 by merging the Global Ozone Observing System (GO_3OS) 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.

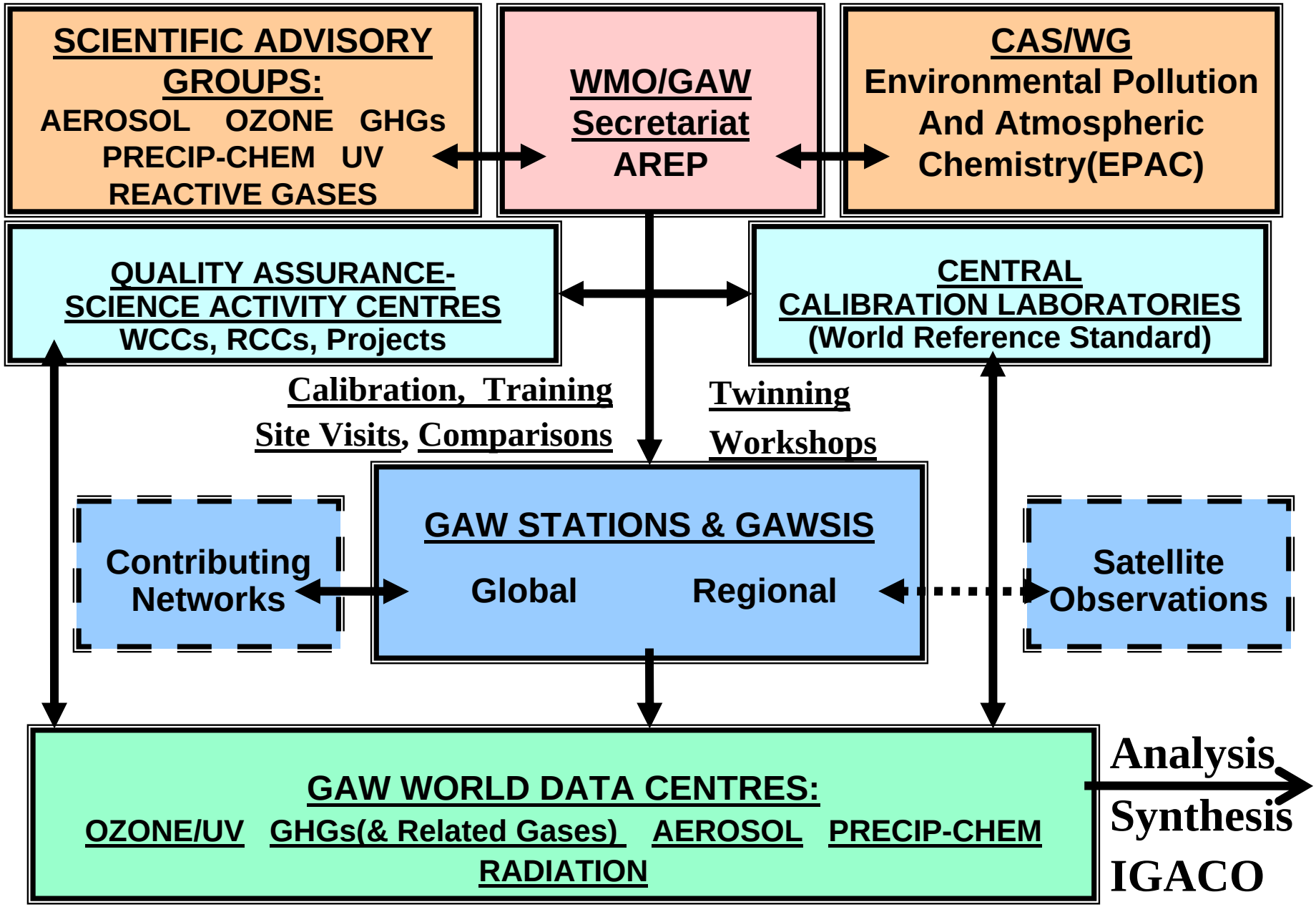
The GAW Mission

- ***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***

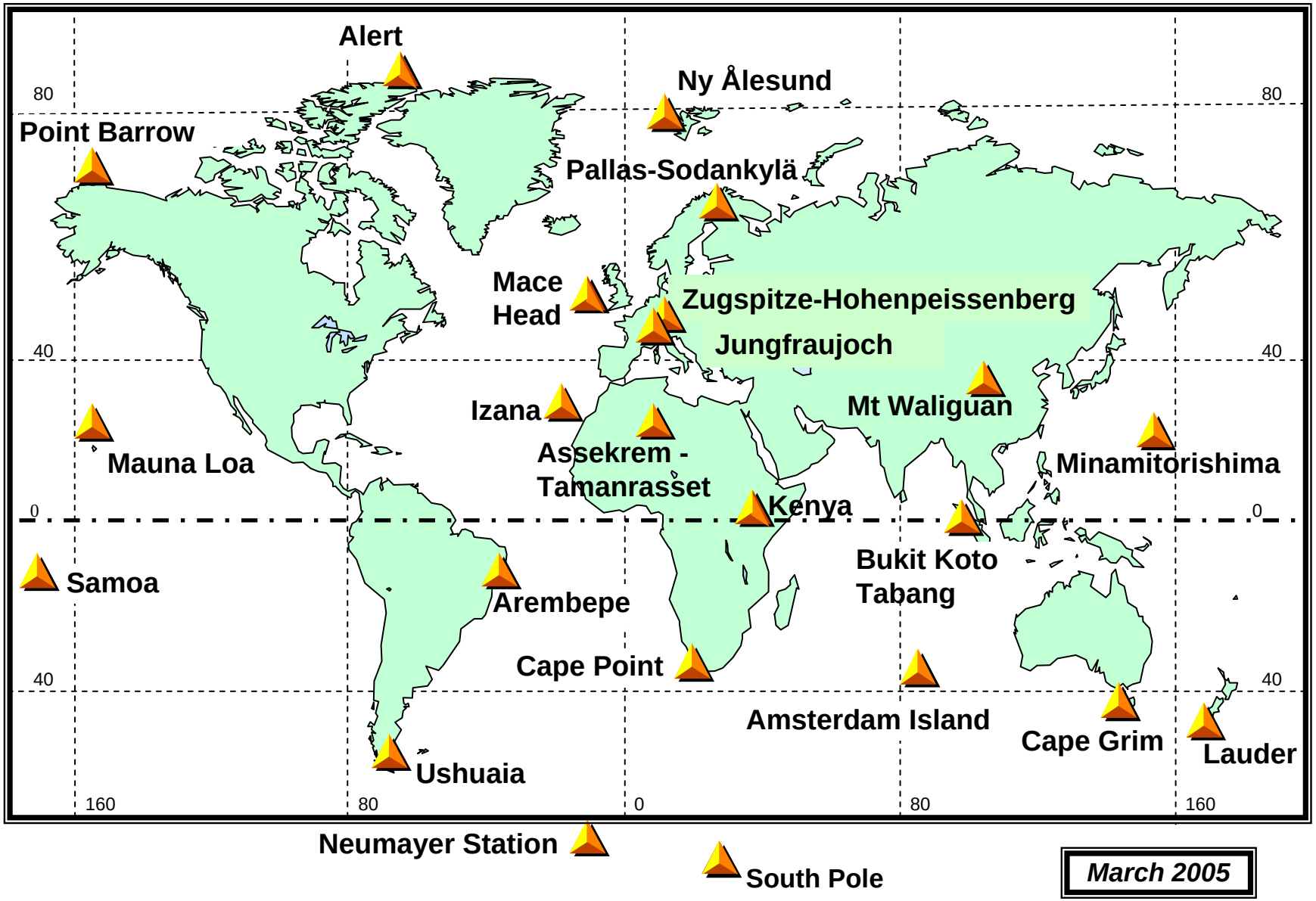
Motivation

- Improved Weather Forecasting: By Including Aerosols, Ozone and Reactive Gas Observations
- Air Pollution Forecasting, Health Effects, Long Range Transport and Deposition Effects
- Climate, Climate Change and Climate Prediction
- Oxidizing Power:The Atmosphere As A Waste Processor. Key to Global Hg and some POPs
- Stratospheric Ozone Depletion and Surface UV Enhancement: Are Halocarbon controls working? Effects of UV on biosphere?

GAW Monitoring Components



GLOBAL STATIONS IN GAW



Central Calibration Laboratories

{Hosts of WMO World Reference Standards}

▪ CO_2, CH_4, N_2O, 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}

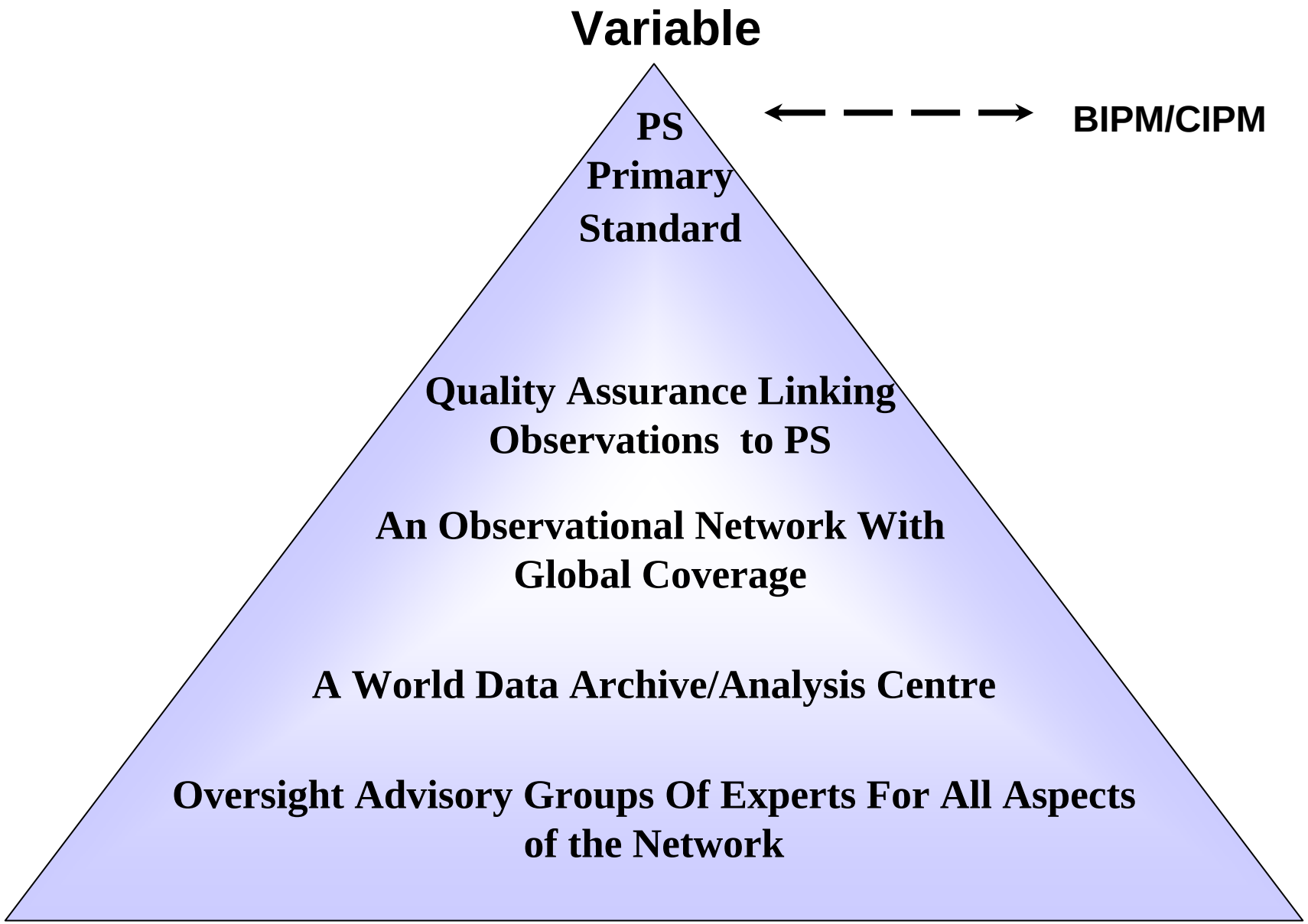
▪ Total Ozone	6 Regional Dobson Centres
	1 Regional EU Brewer Centre
	1 Brewer travelling standard
▪ Ozone Sondes	FZ-Julich, Germany
▪ *In Situ* O_3, CO, CH_4	EMPA, Switzerland
▪ CO_2, CH_4, N_2O	NOAA CMDL USA
▪ N_2O, VOC	IMK-IFU Garmisch Germany
▪ Aerosol Optical Depth	WORCC, Davos, CH
▪ Aerosol physical	IFT, Leipzig, Germany
▪ Precip. Chemistry	SUNY Albany USA

GAW Station Information System …

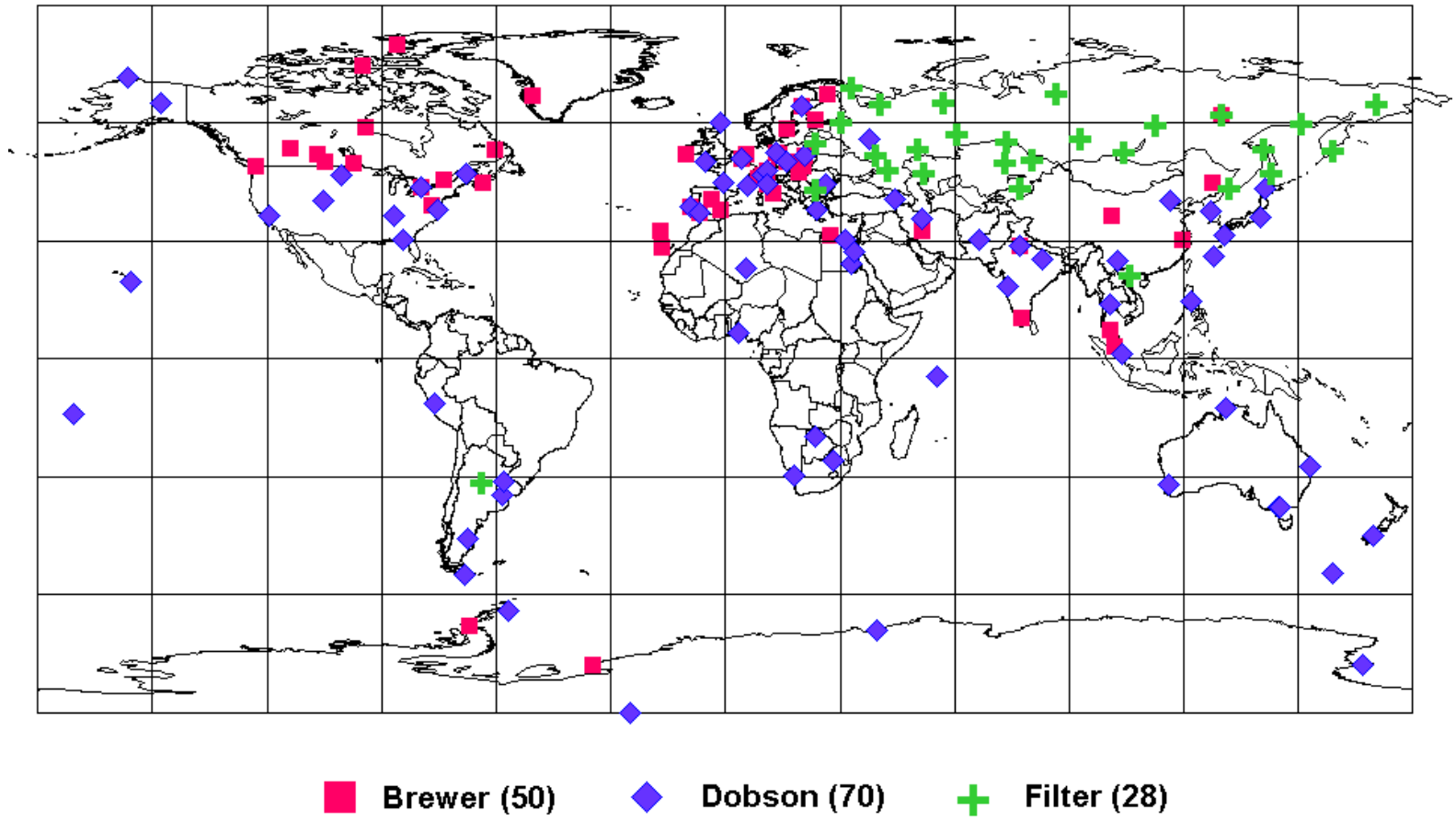
GAWSIS Online - comprehensive information on all GAW stations

- *Database*
- *Search / Update*
- *Inventory / Audit*

(Supported by Switzerland)

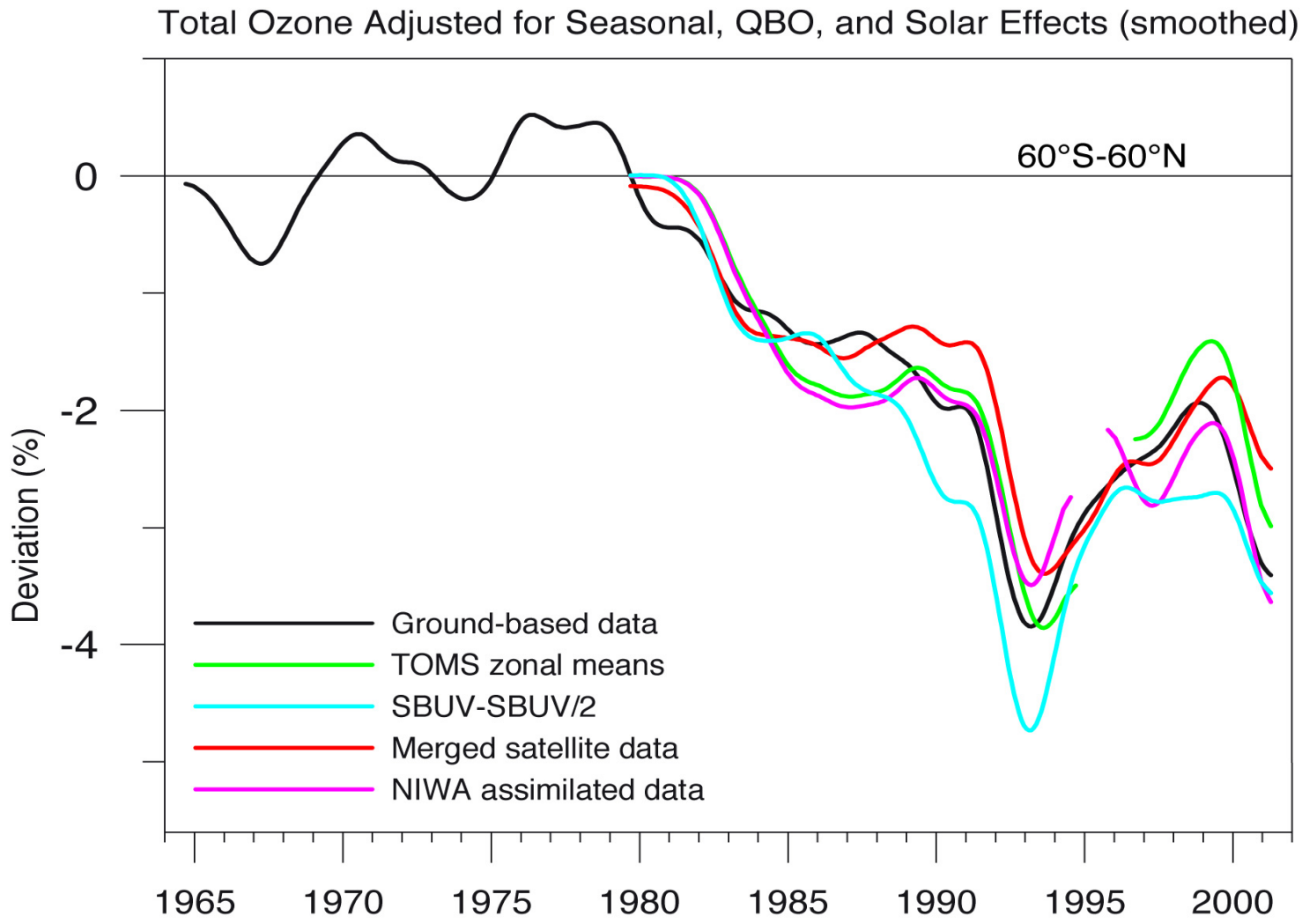

Variable
BIPM/CIPM
PS
Primary
Standard
Quality Assurance Linking
Observations to PS
An Observational Network With
Global Coverage
A World Data Archive/Analysis Centre
Oversight Advisory Groups Of Experts For All Aspects
of the Network

GAW GLOBAL TOTAL COLUMN OZONE NETWORK: 2001- 2004
Stations Submitting Data



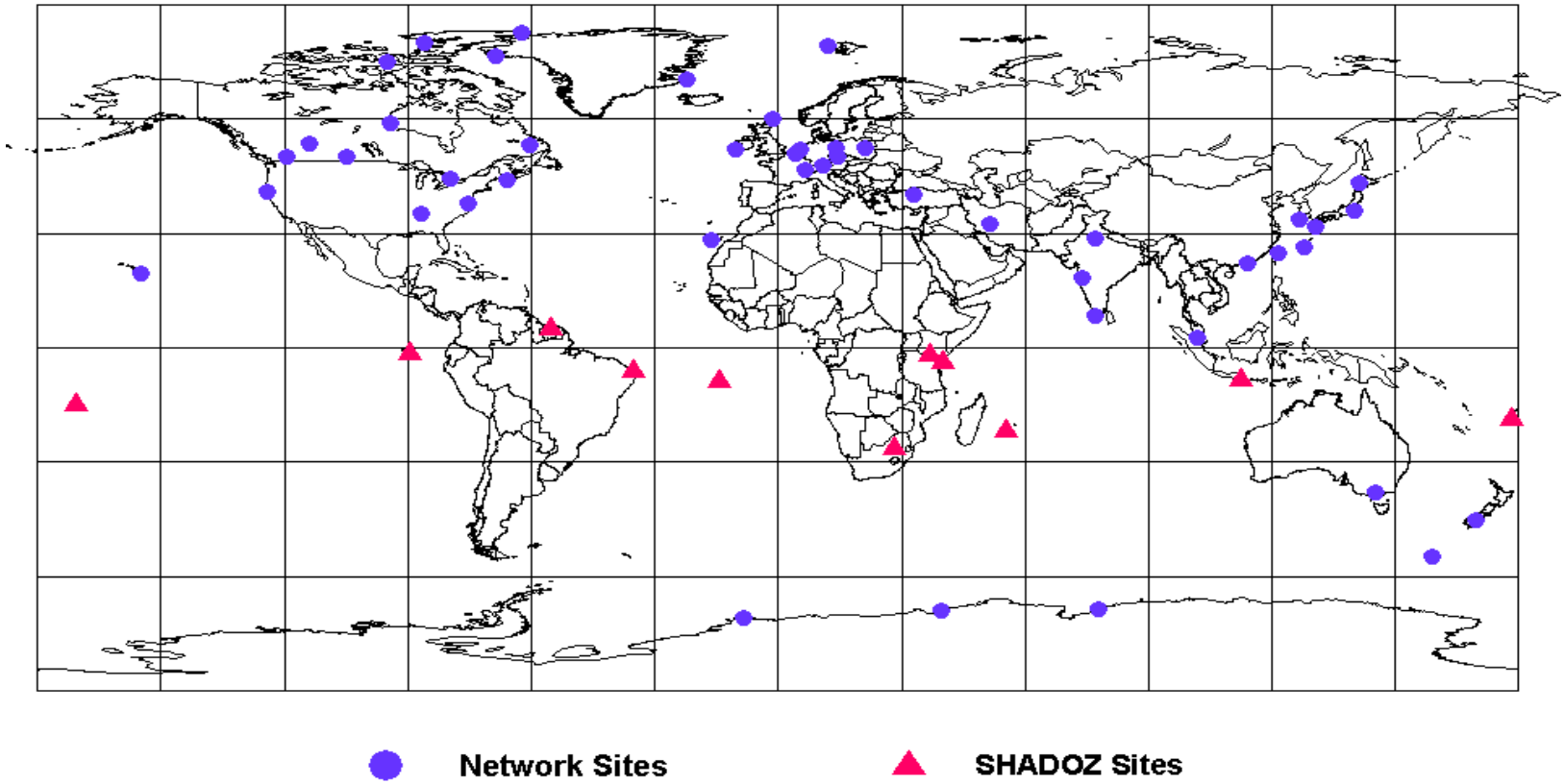
The symbols represent different instrument types.

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



Ozone Assessment 2002 Chapter 4 Figure 4-4
(adapted from Fioletov)
WMO/GAW Global Ozone Research and Monitoring Report # 47

GAW GLOBAL OZONE SONDE NETWORK: 2001- 2004
Stations Submitting Data To WOUDC

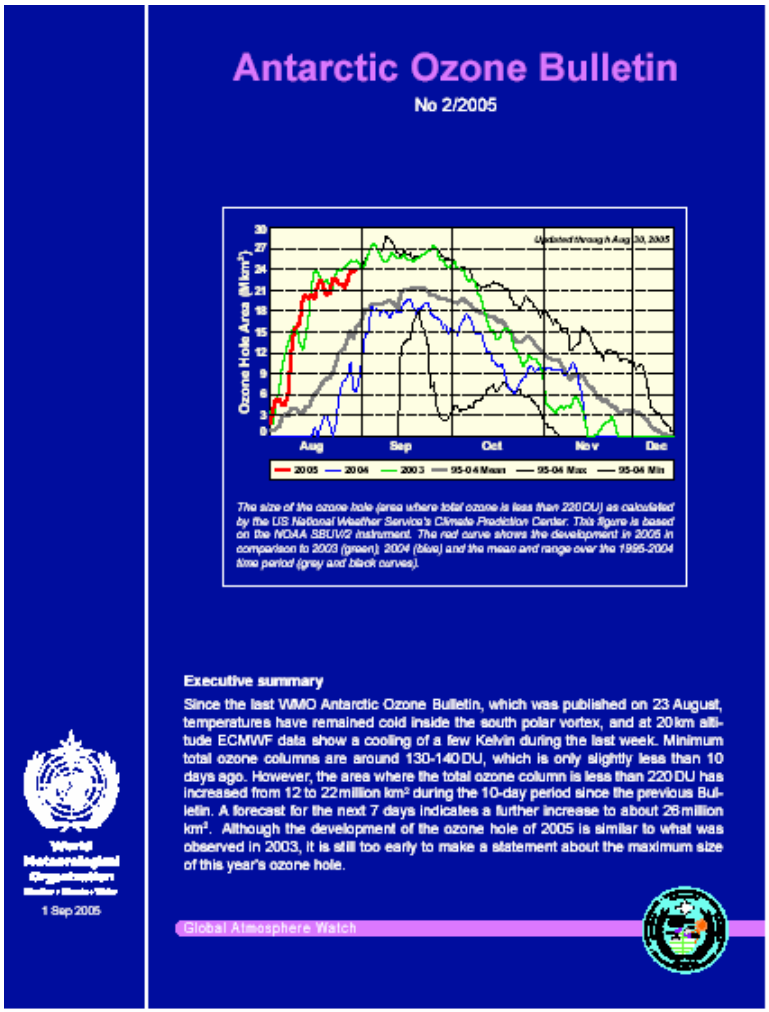


The red triangles represent sites of GAW Contributing partner NASA/SHADOZ.

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

WMO Ozone Bulletins

Every Two Weeks Aug to Nov



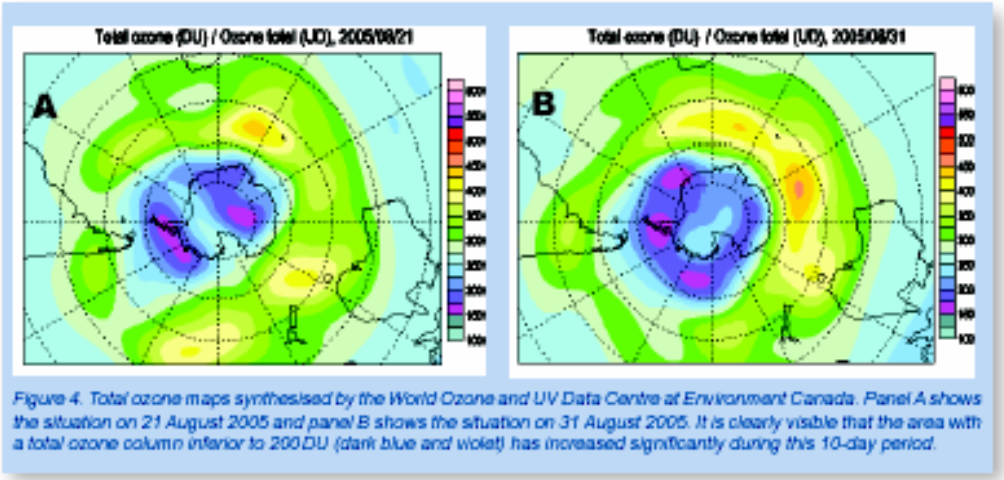


Figure 4. Total ozone maps synthesised by the World Ozone and UV Data Centre at Environment Canada. Panel A shows the situation on 21 August 2005 and panel B shows the situation on 31 August 2005. It is clearly visible that the area with a total ozone column inferior to 200 DU (dark blue and violet) has increased significantly during this 10-day period.

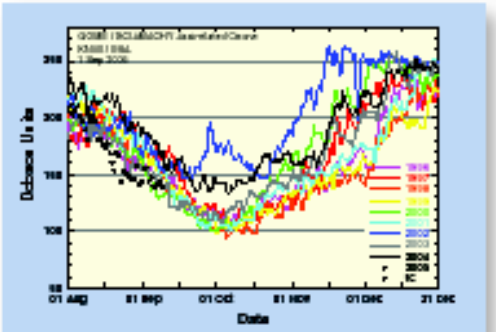


Figure 5. Daily minimum total ozone columns in the Southern Hemisphere as observed by GOME and SCIAMACHY from 1996 to now. The black dots show the observations for 2005. During most of August, minimum ozone columns have been lower that at the same time of the year for the 1996-2004 period. The forecast indicates that the first week of September will be similar to 2003.

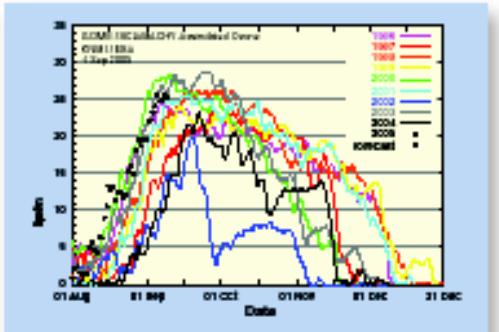


Figure 6. Area (millions of km²) where the total ozone column is less than 220 Dobson units. All the years from 1996 to 2005 (black dots) are shown. The open circles are forecasts for the next 8 days. This figure shows that the size of the ozone hole has increased from 12 to 22 Mkm² during the last 10 days. The forecasts indicate a further increase to about 26 Mkm² during the next week.

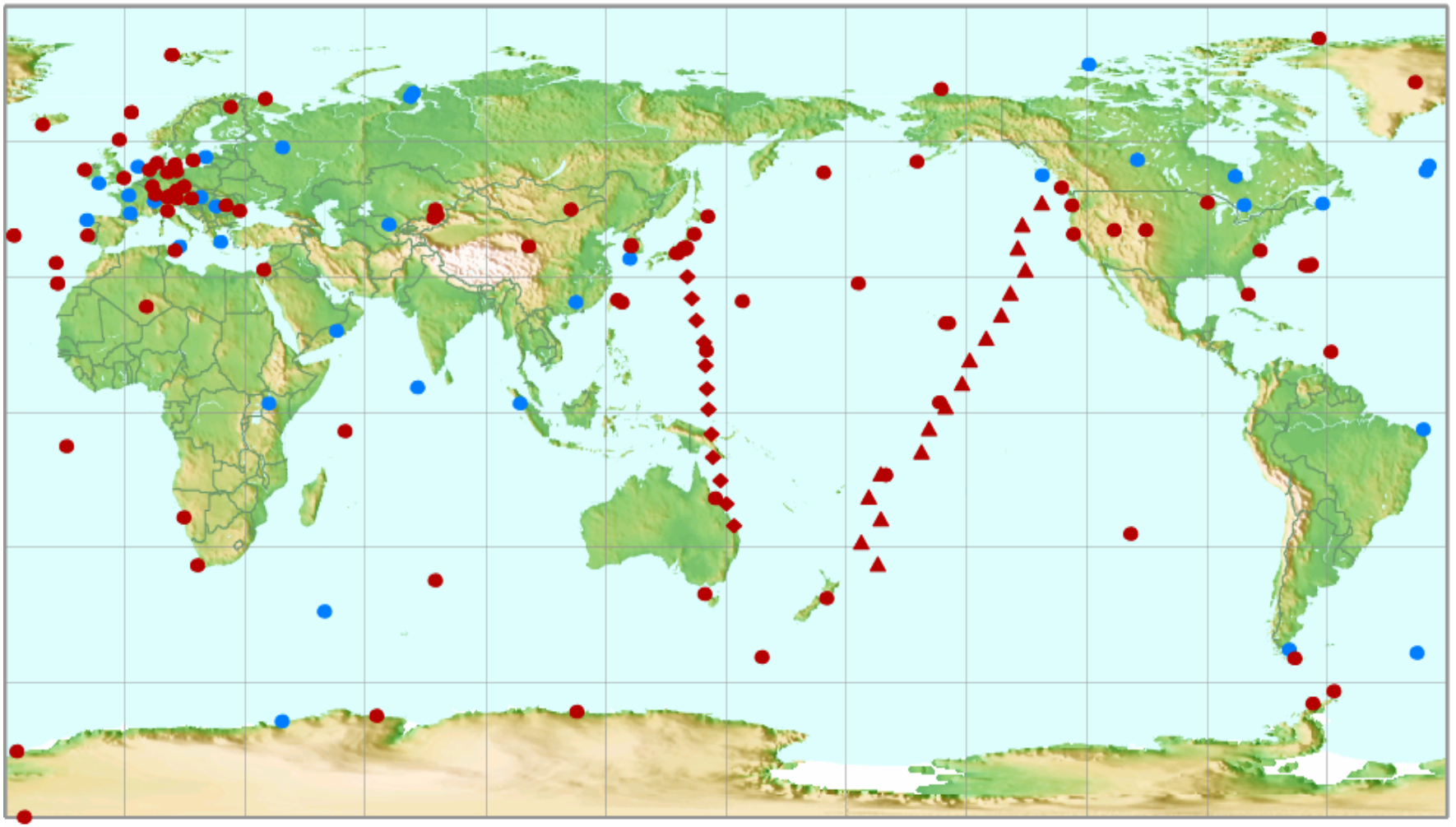
Contact: Geir Braathen Gbraathen @wmo.int

The WMO/GAW Global Atmospheric CO2 & CH4 Monitoring Network:

- Started as BAPMoN in the 1970s which became part of GAW in 1989
- Biennial WMO/IAEA CO_2 and Isotopes Measurements Experts Workshops (13th in Boulder 19-22 Sept 2005)
- Quadrennial International Carbon Dioxide Conference (7th in Boulder 26-30 Sept 2005)
- October 2005 GCOS Steering Committee endorses it as a Comprehensive network of GCOS.

GAW Global Carbon Dioxide Network

{Major Partner NOAA/CMDL}

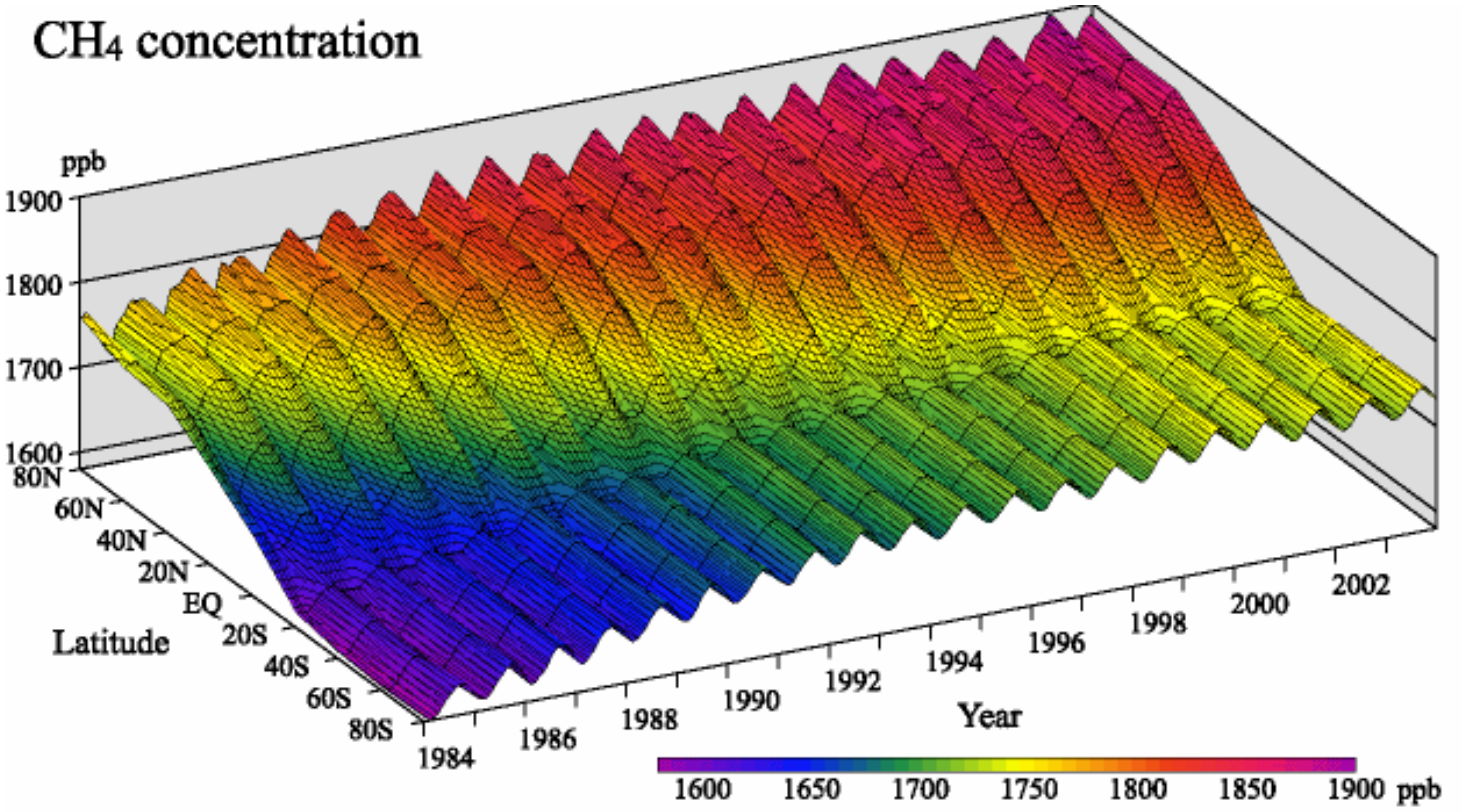


WMO World Data Centre for Greenhouse Gases

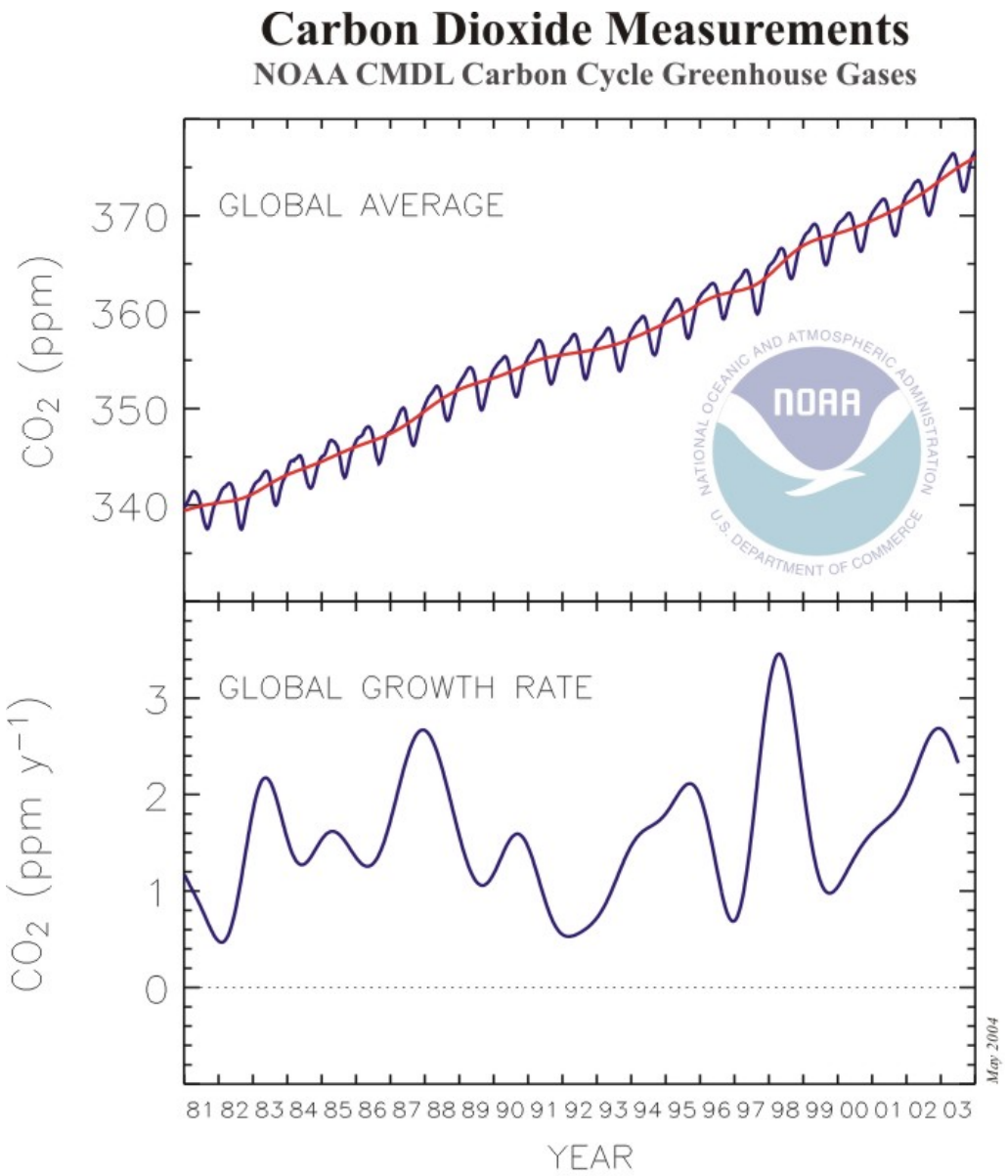
● Operational ▲ Operational (ship) ◆ Operational (aircraft) ● Report Expected

As of 30 September 2004

All Data Available From
GAW World Data Centre For Greenhouse Gases



http://gaw.kishou.go.jp/wdcgg.html



Top: Global average atmospheric carbon dioxide mixing ratios (blue line) determined using measurements from the NOAA CMDL cooperative air sampling network. The red line represents the long-term trend. Bottom: Global average growth rate for carbon dioxide. Principal investigator: Dr. Pieter Tans, NOAA CMDL Carbon Cycle Greenhouse Gases, Boulder, Colorado, (303) 497-6278 (pieter.tans@noaa.gov, http://www.cmdl.noaa.gov/ccgg).

Major Partner
NOAA/CMDL
Hosts “Global View”
and has many
products

&

works closely with
WDCGG

Core Aerosol Variables

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

GAW Report # 153. WMO/GAW Aerosol Measurement Procedures Guidelines and Recommendations (September 2003) produced by GAW Aerosol SAG

Building A Global AOD Network Monitoring

A WMO/GAW Experts Workshop

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

hosted by C. Wehrli, WORCC PMOD

March 2004 in Davos

A Blueprint For Moving Forward:

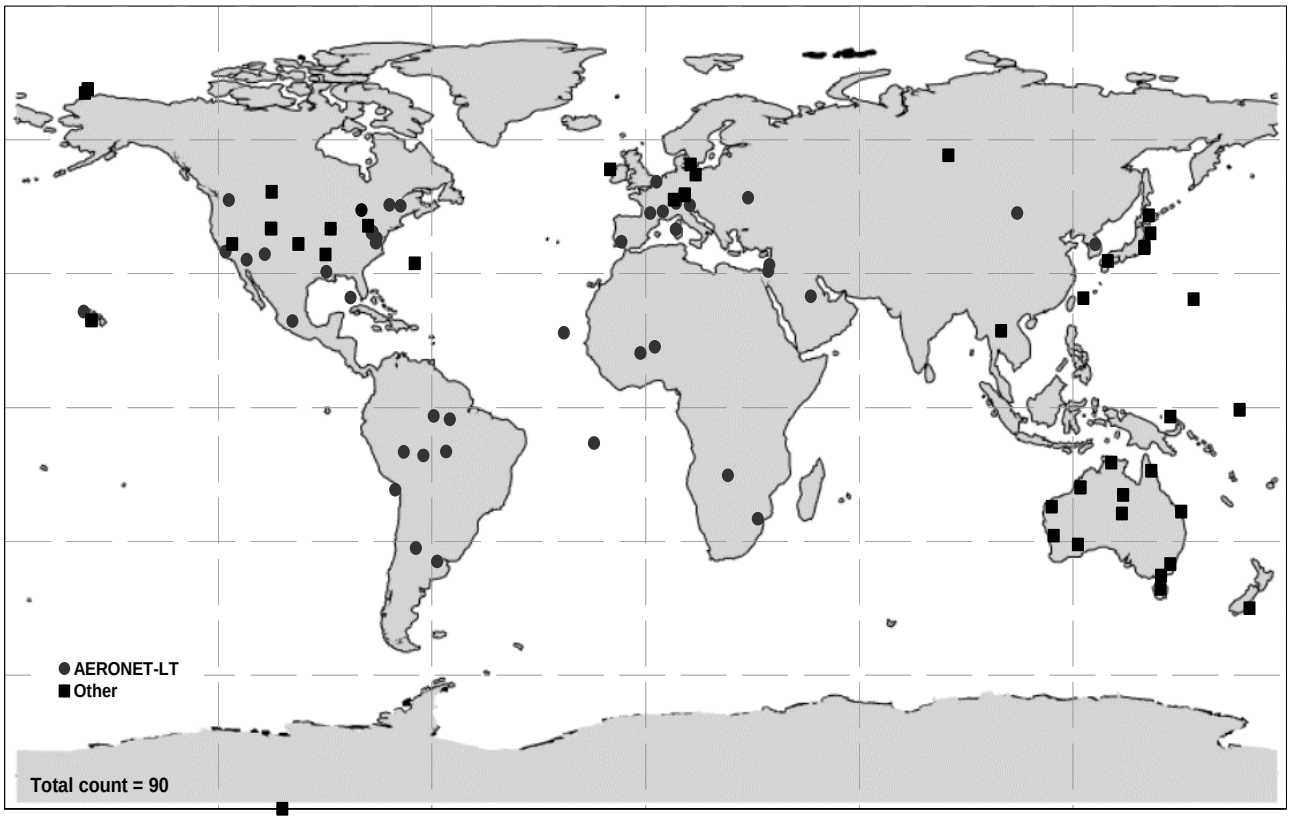
GAW Report # 162. WMO/GAW Expert Workshop on a Global Surface-based Network for Long Term Observations of Column Aerosol Optical Properties (Davos, Switzerland, 8-10 March 2004)

The Ground-based Global AOD Network

"is *currently un-coordinated*"

Global AOD Network Long-term Sites

4+ years in operation, >50% coverage, as of March 2004



Latitudinal distribution

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

Major data gaps

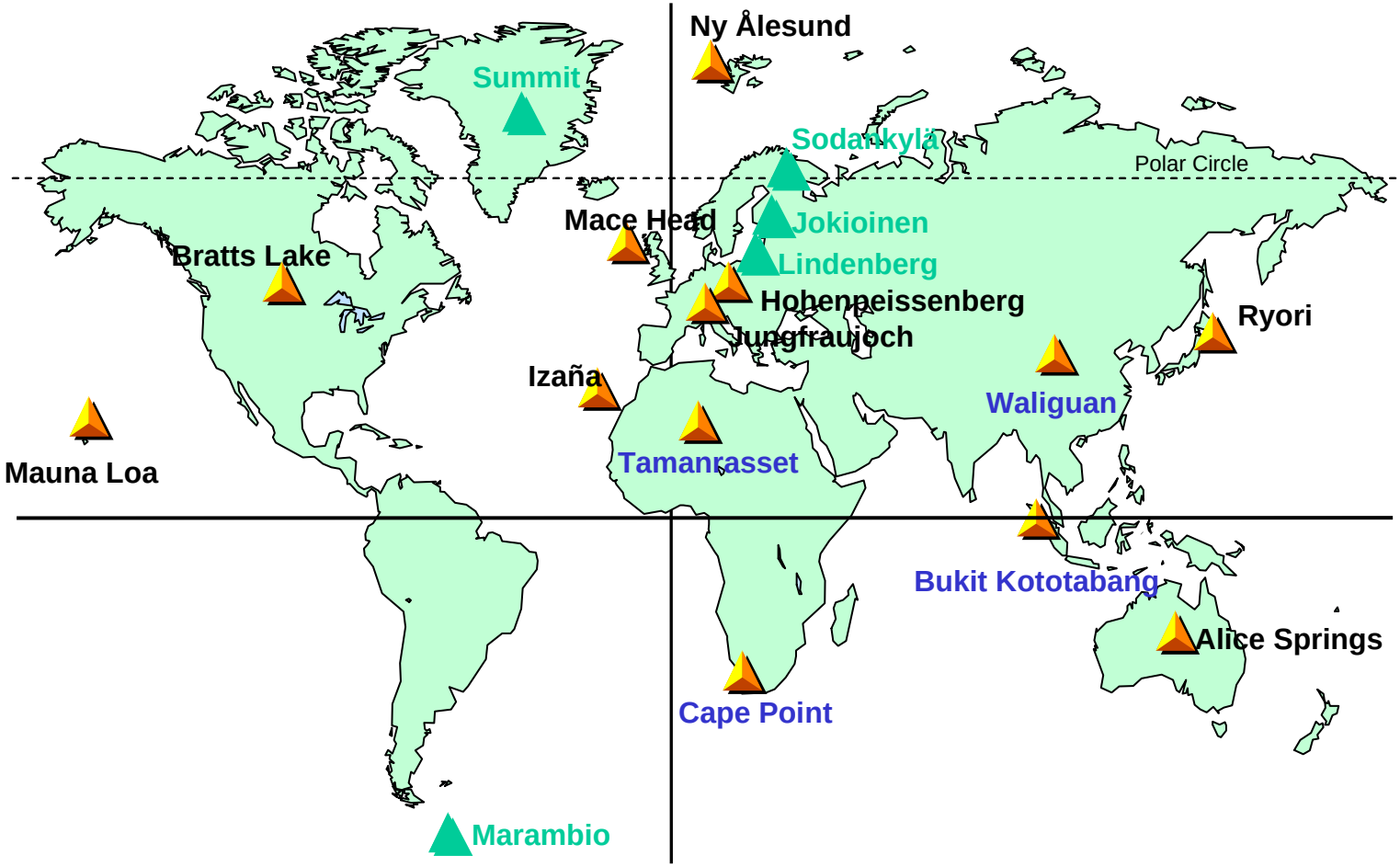
Africa, Asia, India, Polar region and Oceans

International: AERONET, BSRN, GAWPFR, SKYNET

National: Australia, China, Finland, Germany, Japan, Netherlands, Russia, USA(4)

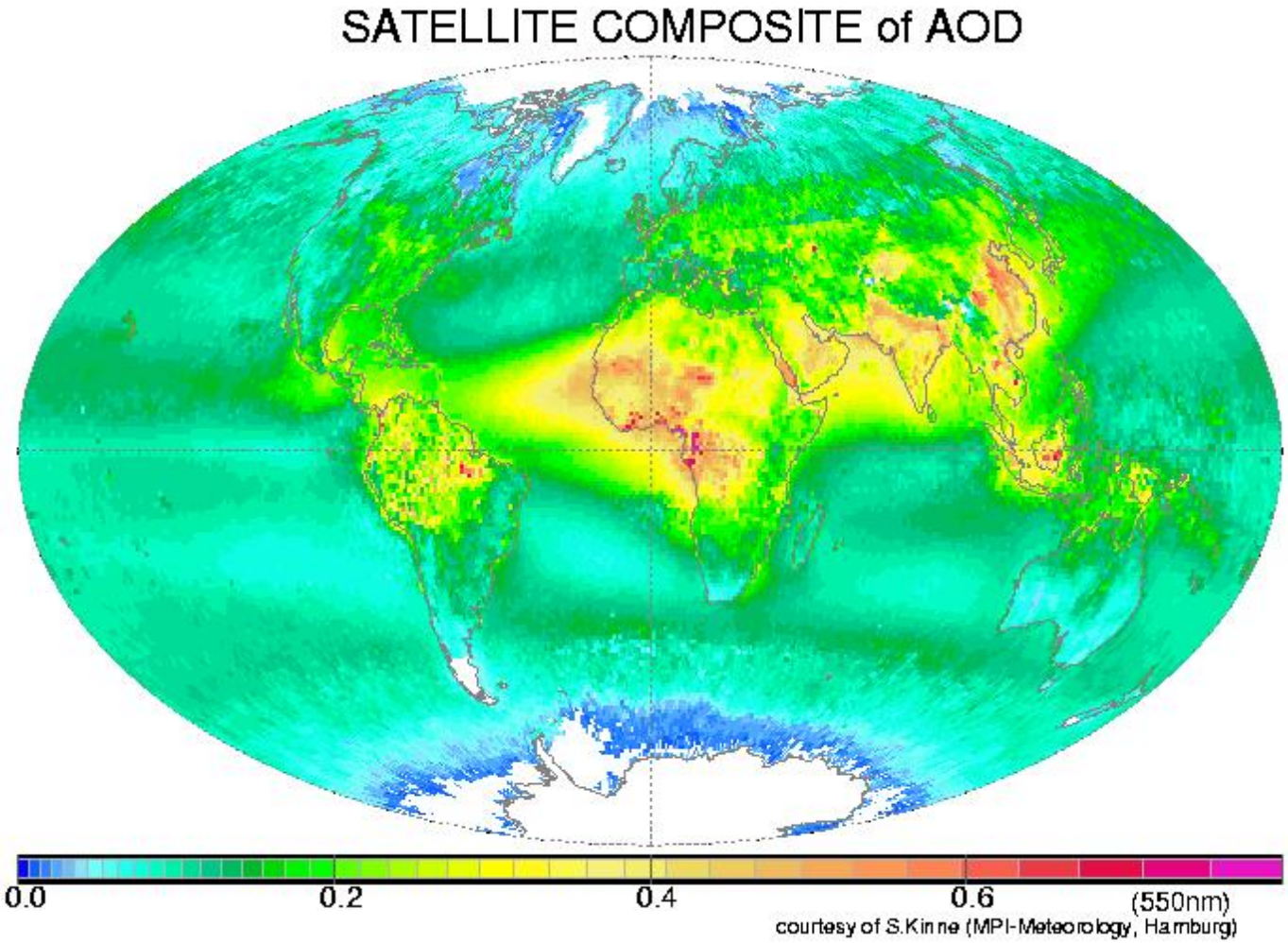
Courtesy of Chris Wehrli Davos AOD Calibration centre

GAWPFR and WORCC/Davos
The Core of Quality Assurance



2004: 9 GAW stations operational, 4 stations pending deployment &
5 additional PFRs operated by FMI, DWD, ETHZ

Operational Aerosol Satellites Are Coming: So Far Only Demonstration Missions



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).

A systematic approach to observations is needed

What Is The Integrated Global Observing Strategy (IGOS) Partnership?

A Consortium of 13 Partners Formed in 1999 with a secretariat that rotates lead every 2 years. They meet regularly with CEOS

- Food and Agriculture Organization (FAO)

The IGOS Partners include the:

Global observing systems

- Global Climate Observing System (GCOS)
- Global Ocean Observing System (GOOS)
- Global Observing System (GOS) of the 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)

Committee on Earth Observation Satellites(CEOS)

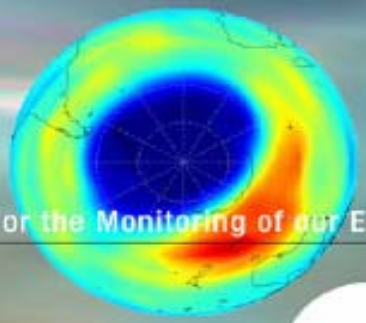
includes all national and regional government agencies with an Earth observing satellite system

Global change research programs

- International Geosphere-Biosphere Programme (IGBP)
- World Climate Research Programme (WCRP)
- International Group of Funding Agencies for Global Change Research (IGFA)

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

IGACO TARGET VARIABLE LIST

Chemical species	Air Quality	Oxidation Capacity	Climate	Stratospheric Ozone Depletion
O_3	✓	✓	✓	✓
H_2O (water vapour)	✓	✓	✓	✓
CO	✓	✓		
CO_2			✓	
CH_4		✓	✓	✓
HCHO	✓	✓		
VOCs	✓	✓		
N_2O			✓	✓
$NO_x = NO+NO_2$ HNO_3	✓ ✓	✓ ✓	✓	✓ ✓
SO_2	✓	✓	✓	✓
BrO, ClO, OClO HCl, $ClONO_2$ CH_3Br, CF_3Br, CFC-11, CFC-12, HCFC-22				✓ ✓ ✓ ✓
aerosol optical properties	✓		✓	✓
actinic flux	✓	✓		

Example of a timeline diagram

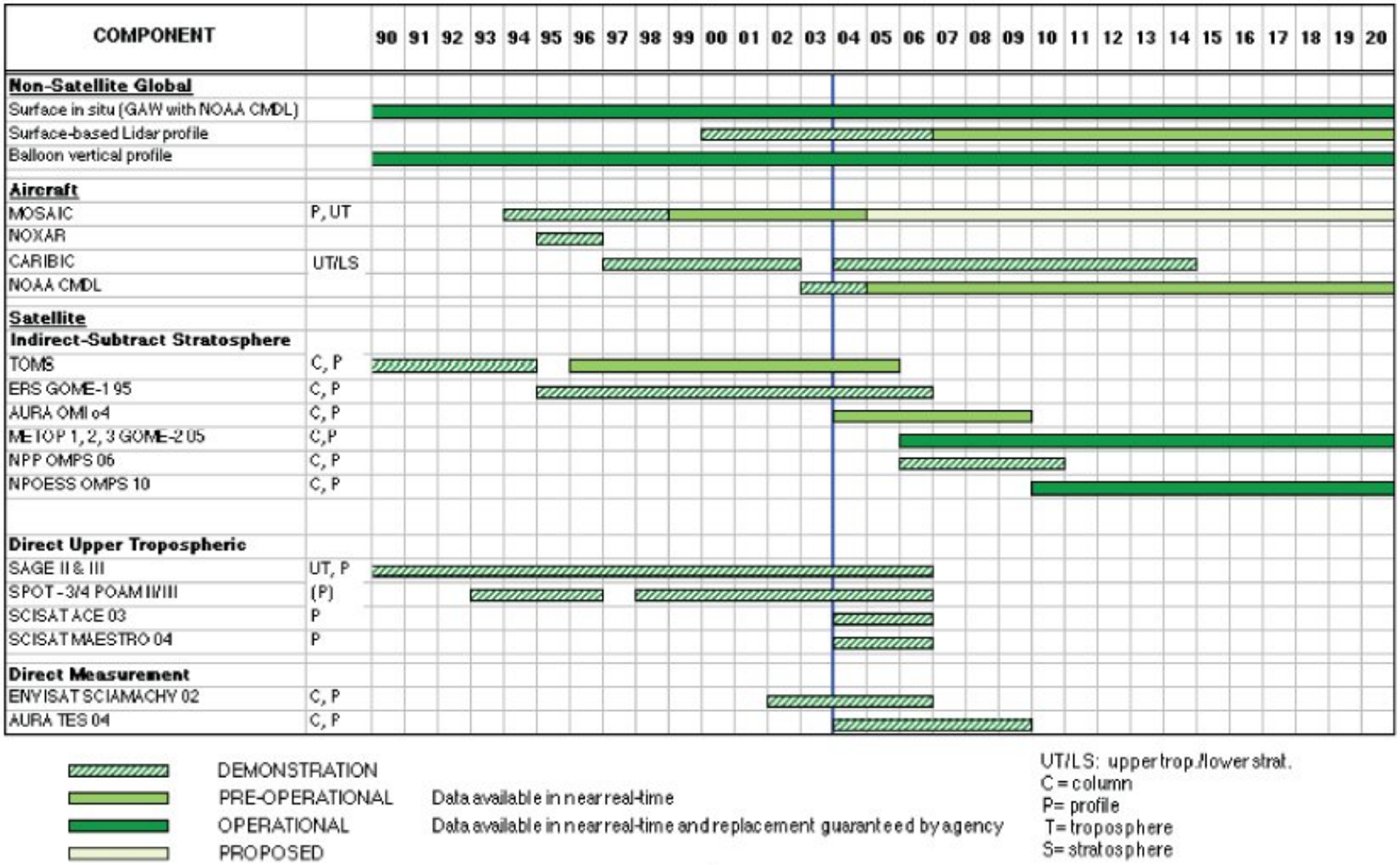
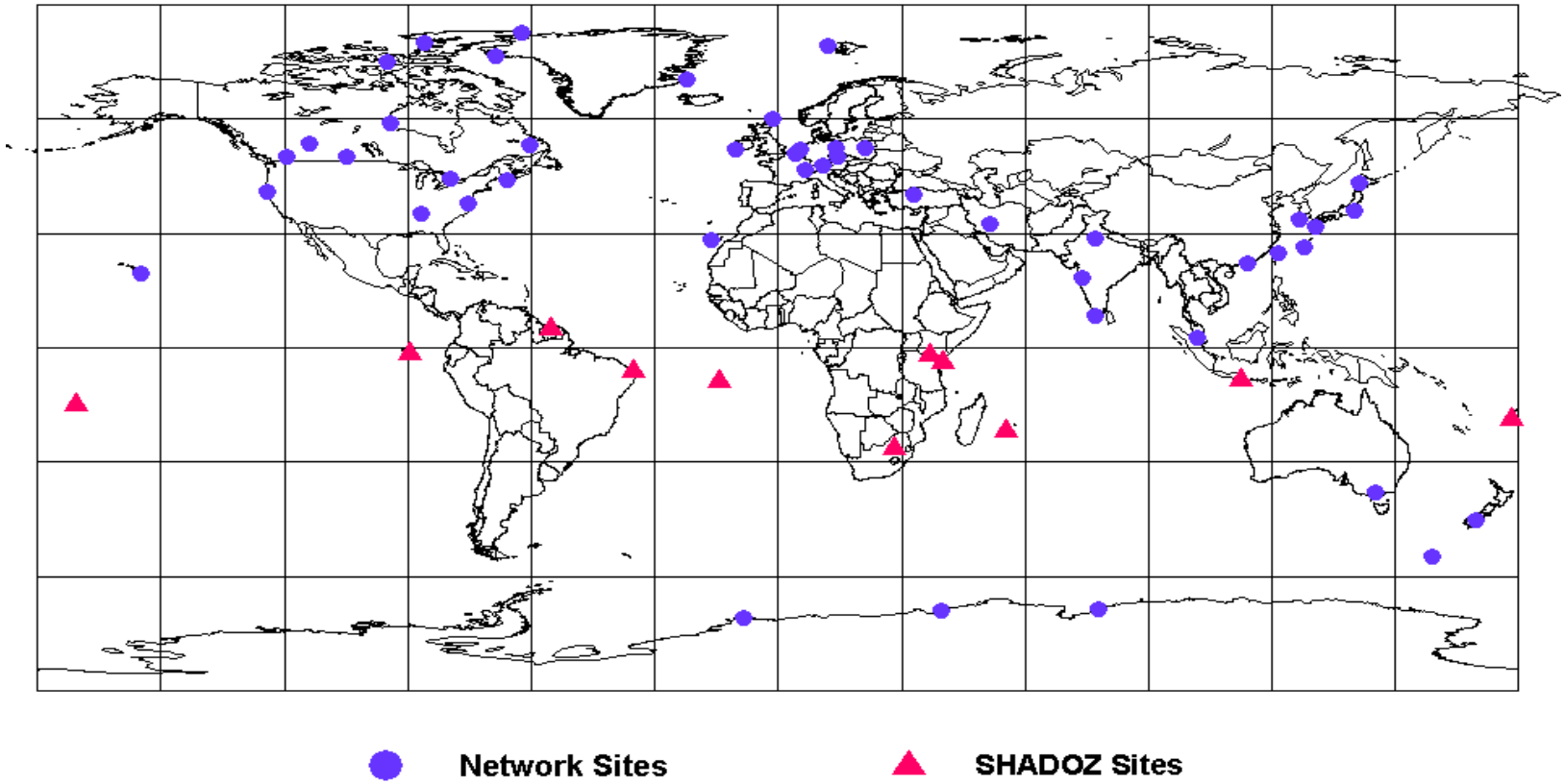


Figure 4.2.1. An overview of satellite, ground-based and aircraft meaasurements for tropospheric O_3

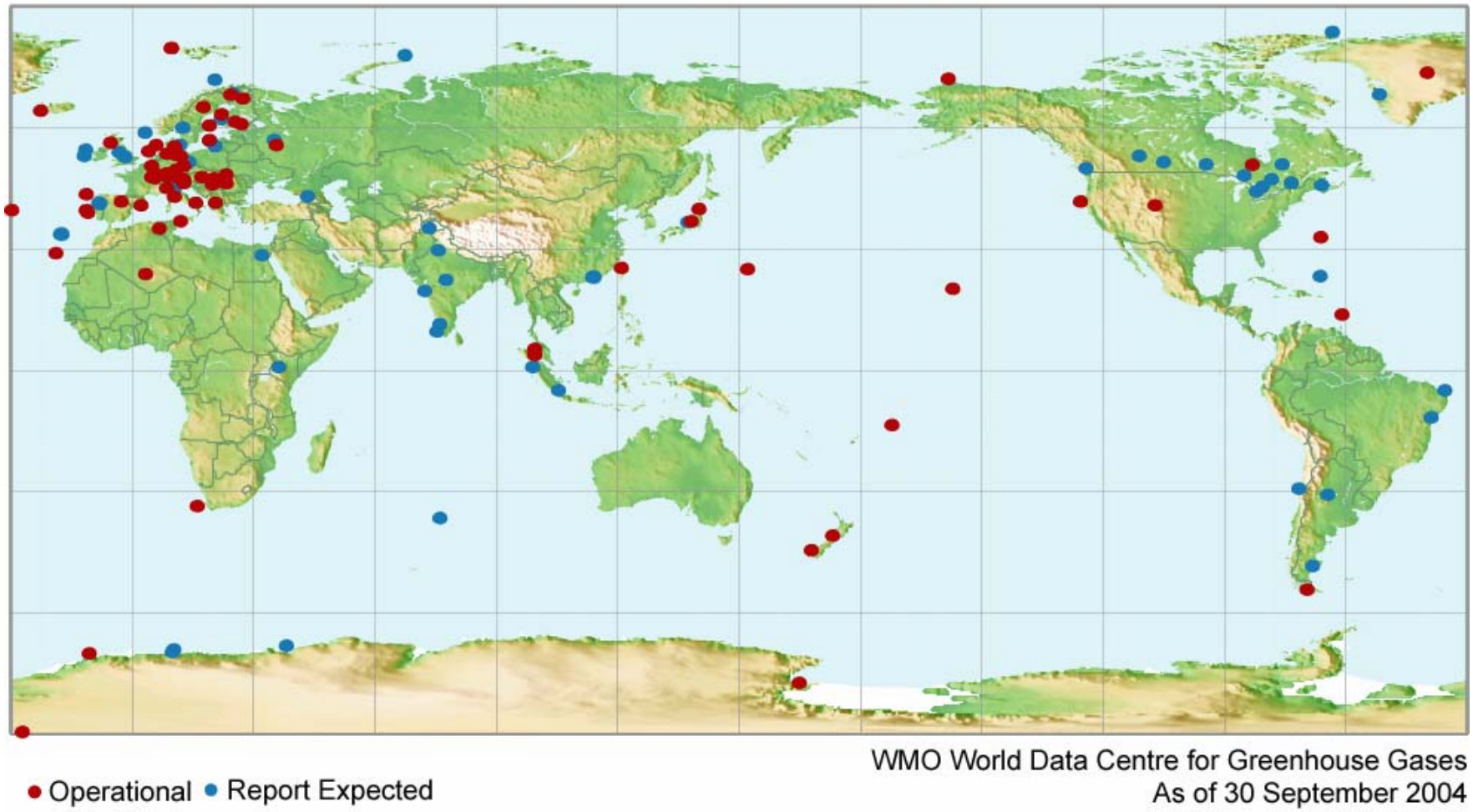
GAW GLOBAL OZONE SONDE NETWORK: 2001- 2004
Stations Submitting Data To WOUDC



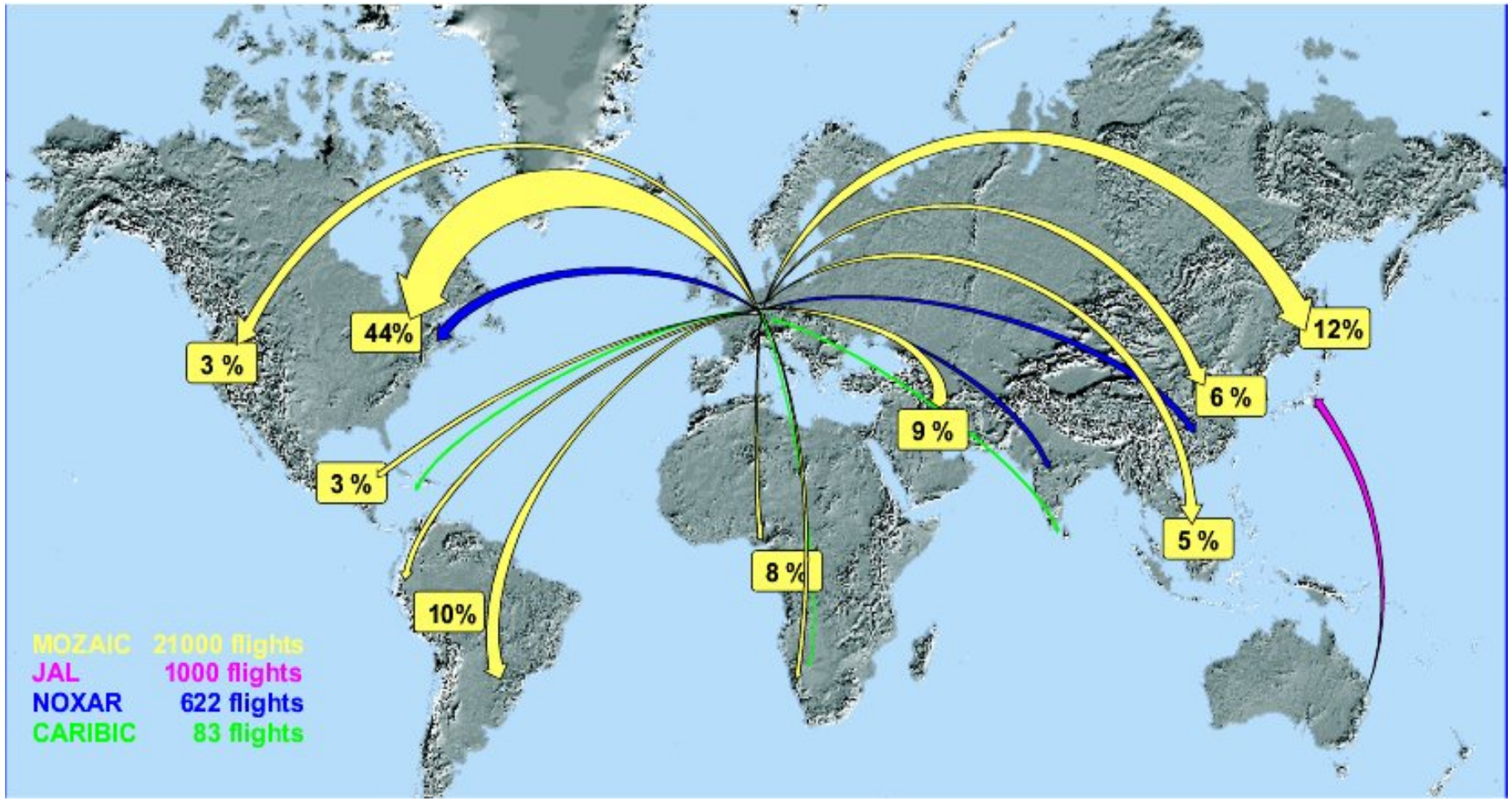
The red triangles represent sites of GAW Contributing partner NASA/SHADOZ.

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

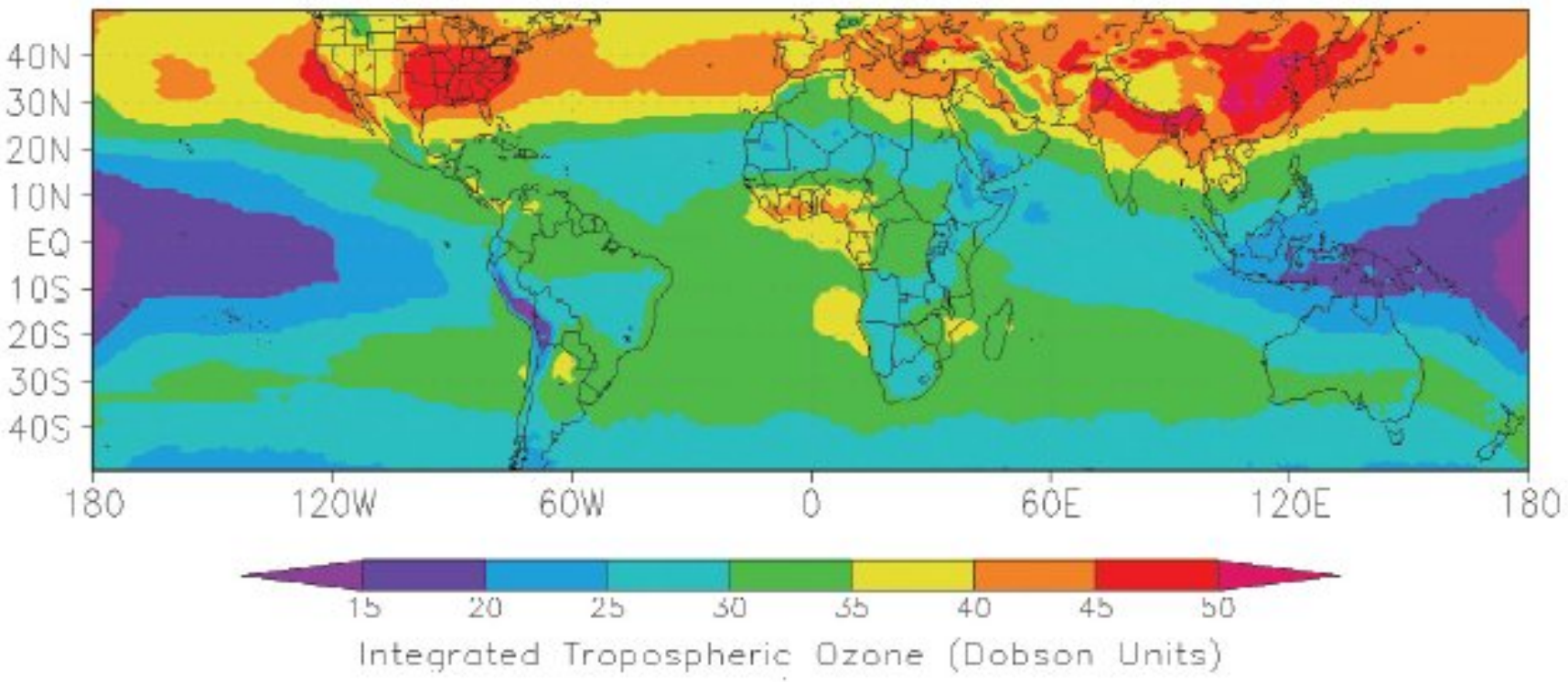
GAW Global In Situ Surface O_3 Network



Flight routes with regular observations

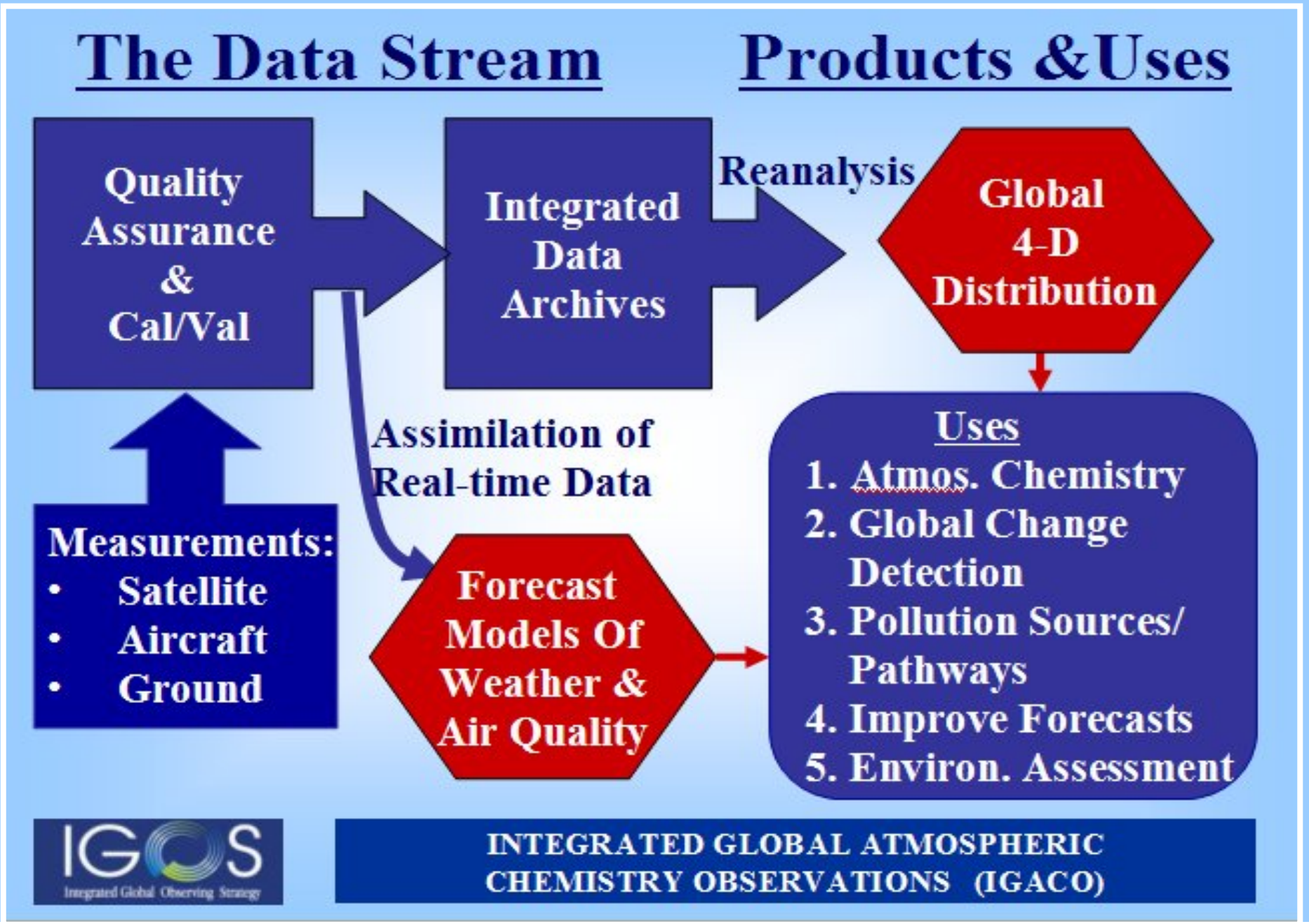


Satellite Column Observations From Low Earth Polar Orbiting Satellites

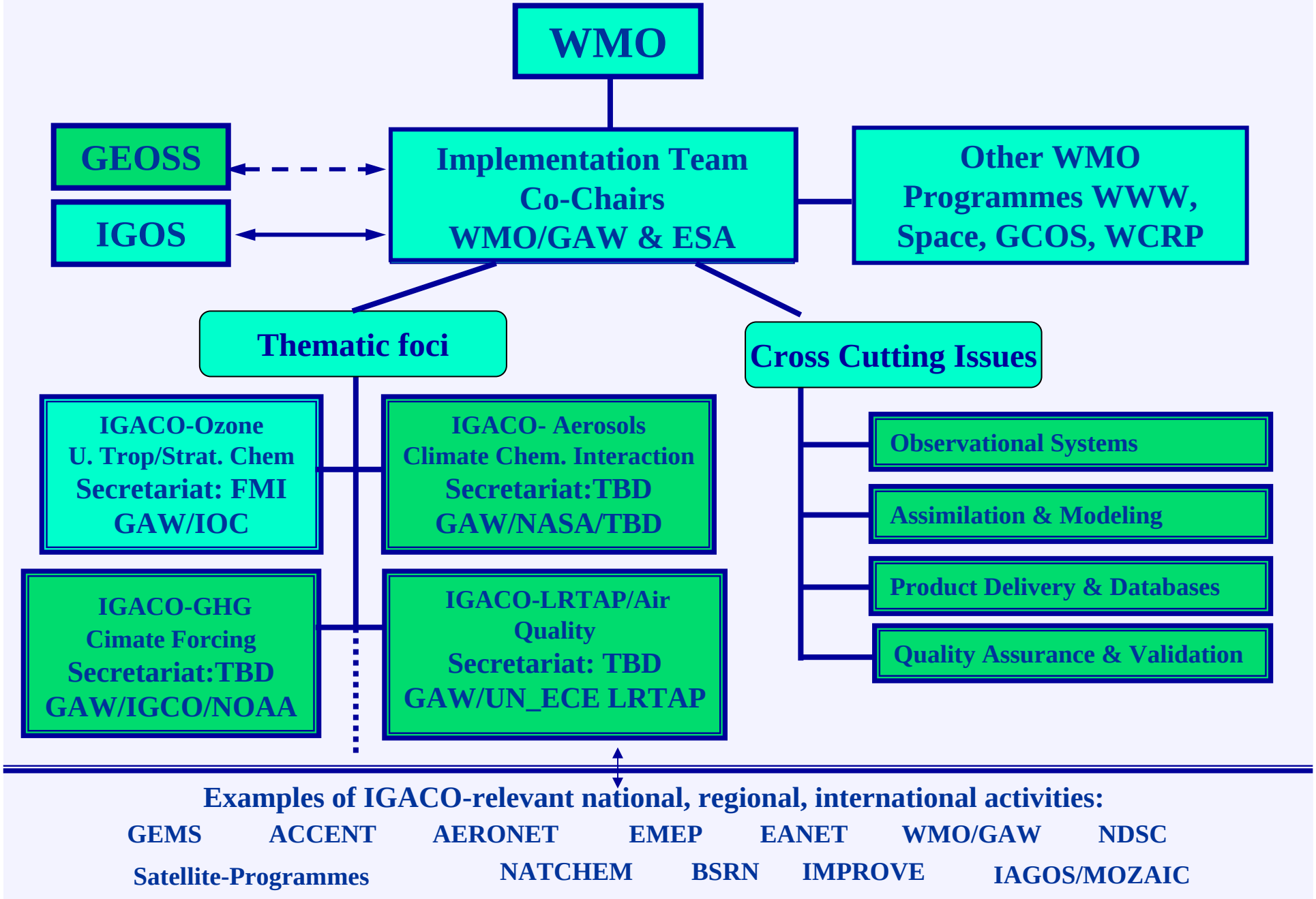


Tropospheric ozone from combined TOMS and SBUV data, showing major source regions and large-scale transport in the Northern hemisphere. *[Courtesy J. Fishman, NASA]*

The IGACO System Components



IGACO Implementation:Top-Down Meets Bottom-up



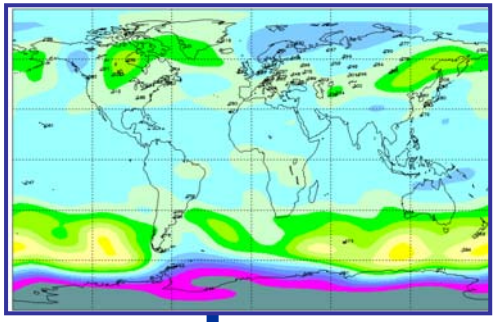
IGACO-Ozone

GAW Calibration & Quality Assurance

World Integrated Data Archive System: Includes WOUDC

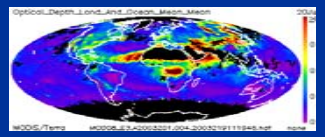
Reanalysis

Global Products



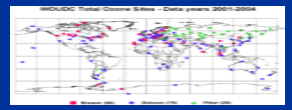
WMO Real-Time Data Distribution: Weather Information System (WIS)

Satellite: WMO Space Programme



Aircraft: GAW & MOZAIC

Surface-based: GAW



Assimilation of Real-Time Data By Forecast Models

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

Secretariat at Finnish Met Institute

Leaders WMO/GAW & IO_3C

Upcoming Cross- CuttingEvents

- 24-26 Oct., 2005 Joint WMO/GAW-ACCENT Workshop on the Global Tropospheric Carbon Monoxide Observations System, Quality Assurance and Applications, Zurich hosted by EMPA contact Jorg Klausen, L. Barrie, G. Braathen
- 24-26 April 2006 WMO Geneva “Chemical Data Assimilation in Atmospheric Forecast and Re-analysis Models An ACCENT/WMO Expert Workshop in support of IGACO”, contacts are P. Borrell and L. Barrie

WMO

THANK YOU