

Report to WGCV-25

Atmospheric Chemistry Subgroup (ACSG)

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May 2006
Budapest, Hungary

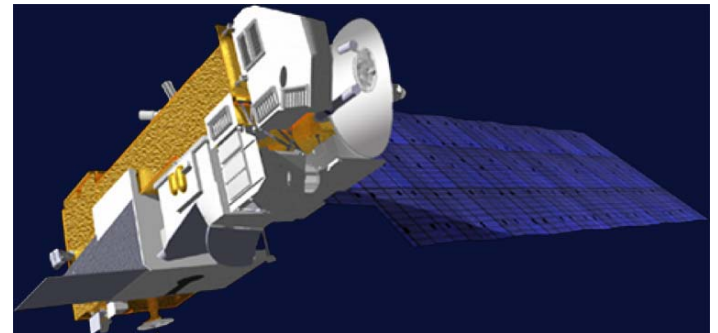


**Working Group on
Calibration & Validation**



ACSG Goals

- Insure accurate and traceable calibration of remotely sensed atmospheric chemistry radiance data and validation of higher level products, for application to atmospheric chemistry and climate research, from Earth Observing satellite missions.
- Support the calibration/validation recommendations of WMO/CEOS #140.
- 19 instruments on 10 missions for observing atmospheric chemistry will be flown by 2015.



Atmospheric Chemistry Satellite Timeline (19 instruments, 10 Missions → 2015)

In orbit

TOMS

SBUV/2

SAGE II, III

OSIRIS

ACE

MAESTRO

GOME-1

GOMOS

MIPAS

SCIAMACHY

MOPITT

HIRDLS/Aura

OMI/Aura

MLS/Aura

TES/Aura

2004

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To be launched

OMPS/NPP/NPOES 2007?-2015

GOME-2/Eumetsat 2006-2015

New chemistry TBD

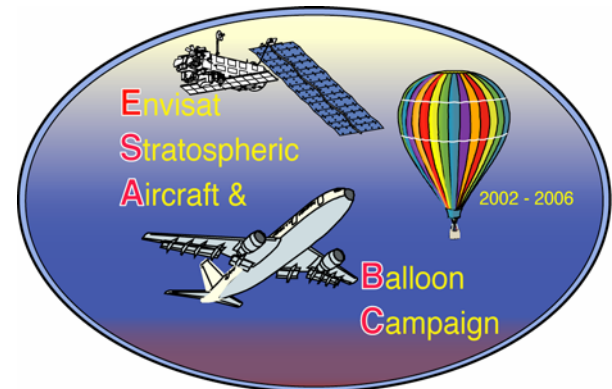


ACSG Objectives-1

- **Promote international collaboration and technical exchange to ensure sufficient use and maintenance of calibration/validation resources required for atmospheric chemistry missions.**
- **Verify accurate scientific products encouraging an end-to-end approach to the calibration and validation of Level 1 and Level 2 data products and subsequent re-calibration and reprocessing.**
- **Ensure that validation sensors are calibrated to traceable national standards with documented statements of accuracy and repeatability**
- **Encourage interaction between calibration scientists and data users to enable a better understanding of data uncertainties and user requirements.**

ACSG Objectives-2

- Develop comprehensive data validation methods that employ ground, aircraft, balloon, and satellite measurements and data assimilation with chemical transport models.
- Recommend a network of validation sites and to encourage continuous observation and quality control of data through the use of standard procedures and inter-comparisons.
- Specify a comprehensive, consistent and quality- controlled multi-mission validation data base in an accepted format employing user friendly tools.



ACSG - Status

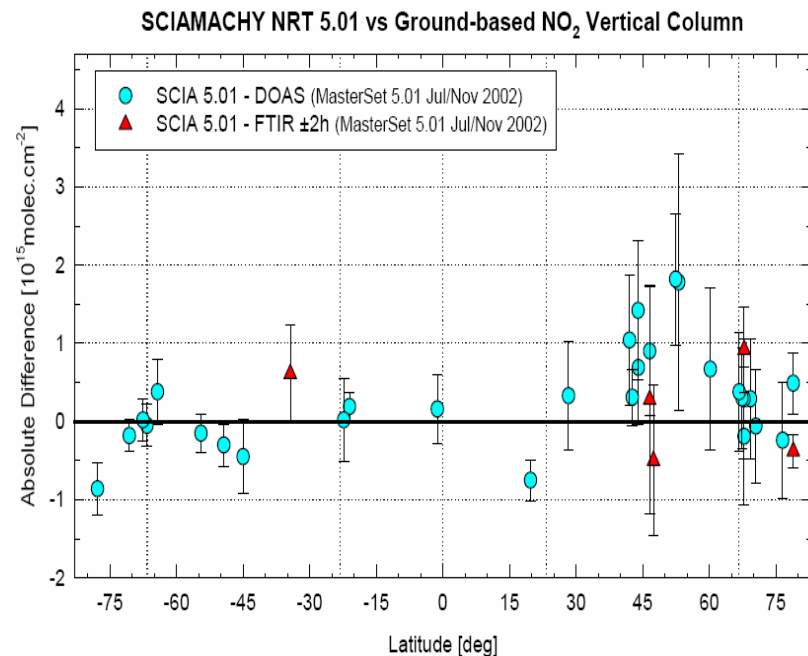
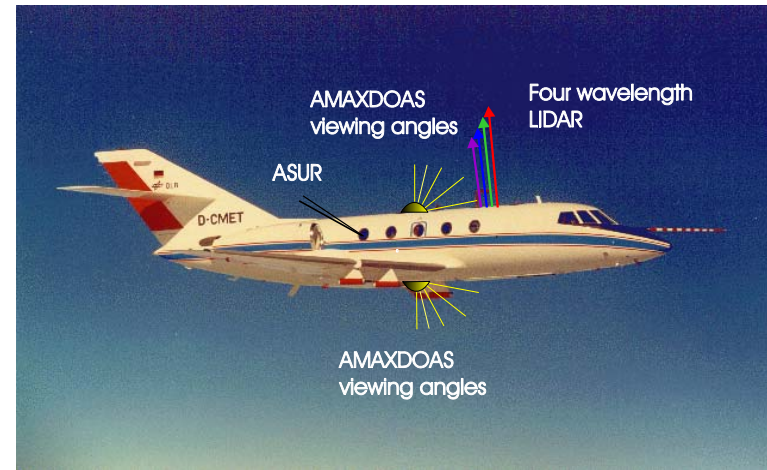
- **Participants (15 members):**
 - CNES, DLR, ESA, NASDA, NASA, KNMI, MSC, NOAA, IASB, EC, WMO, U. of Bremen, CSA (U of Tronto), Eumetsat, British National Space Center (BNSC)
- **Meetings: Four Subgroup meetings held:**
 - May '02 (Ottawa), December '02 (Frascati), July '03 (Toulouse), May '04 (Frascati)
- **ACSG Projects Approved/Underway and planned:**
 - Collaboration between Aura and Envisat Validation Data Centers (**Approved**)
 - Ground station cross calibration (**Approved**)
 - Eureka (Canada) station re-opened (**Approved**)
 - Cross platform data validation center (**Approved**)
 - High latitude ozone campaign (**Approved**)
 - Collaboration on future missions: Metop, NPP, NPOESS, and post Metop (**Planning**)

ACSG Activities

- **Envisat validation**
 - Envisat ACVT Workshop
- **Aura validation program**
 - NASA AO selected validation team
 - ESA/Aura/OMI AO validation team selected
 - Aura Validation Data Center
 - B-57 AVE missions underway
 - DC-8 Intex missions underway
- **Operational Metop and NPOESS Chemistry instruments**
 - Cal/Val program underway
 - NOAA process GOME-2 chemistry data products
 - Validation Data Center (based on Aura Validation Data Center)
- **Post Metop (>2019) planning for atmospheric chemistry**

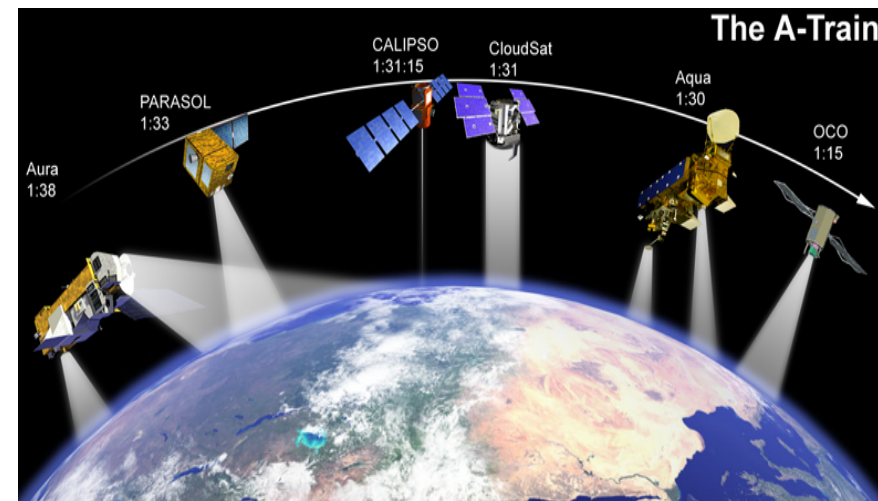
Envisat Validation

- **ESA Coordinated: Ground, aircraft, and balloon, main phase complete**
- **All three chemistry instruments continuation operating near nominal**
- **ESA sponsored Validation Workshops:**
Dec 2002, May 2004, Fall 2006
- **Aura/Envisat joint science team Meeting, Netherlands, Nov 2005**
- **Follow on Validation Workshop: Fall 2006**

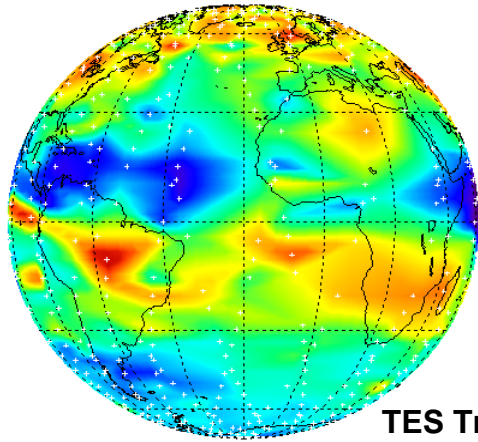


EOS Aura – Atmospheric Chemistry

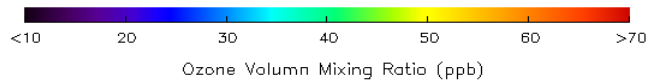
- Third large EOS Observatory following Terra and Aqua
- Four instruments (UV to microwave)
- Polar orbit at 1:38 PM crossing
- Launch – July 15, 2004
- Science Objectives
 - Tracking ozone layer
 - Global measurements of air quality
 - Connecting atmospheric chemistry with climate
 - Synergy with A-Train



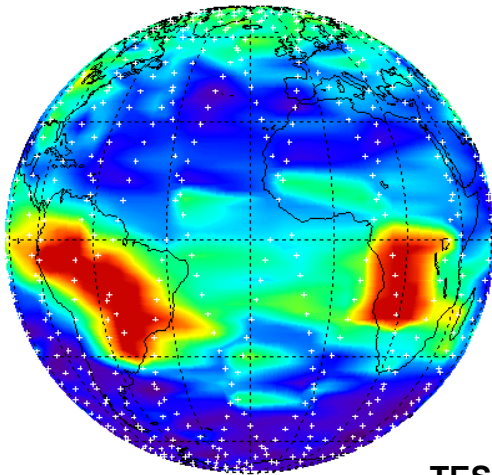
Aura Results – Pollution and Trends



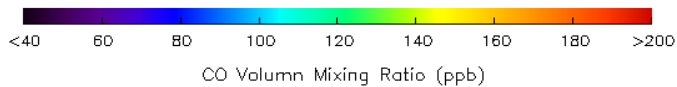
TES Trop O₃



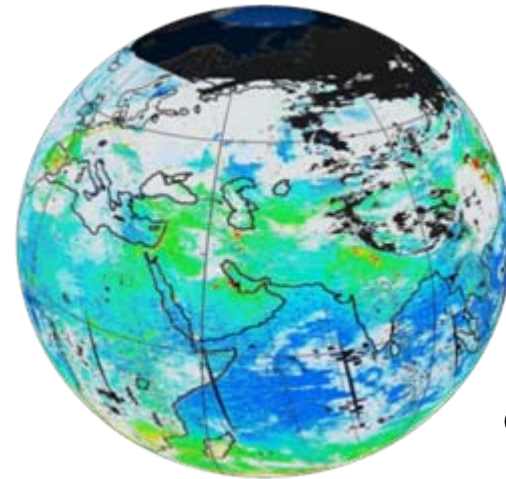
Ozone Volume Mixing Ratio (ppb)



TES CO

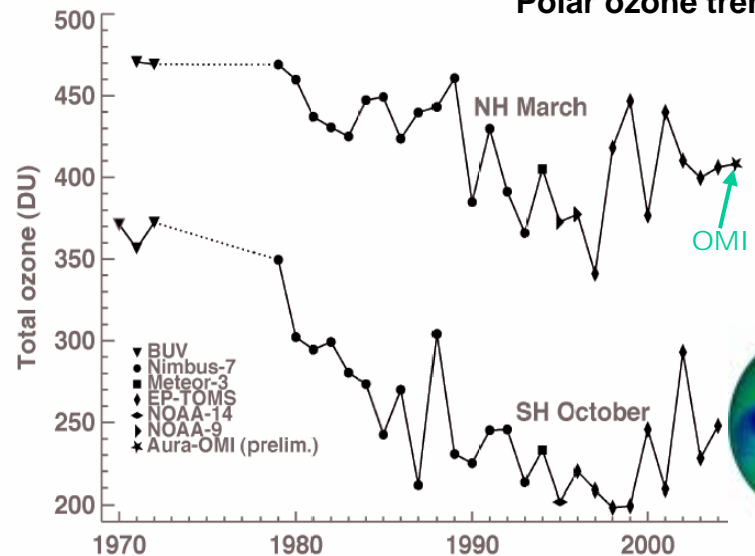


CO Volume Mixing Ratio (ppb)



OMI NO₂

Polar ozone trends



Total ozone (DU)

500
450
400
350
300
250
200

▼ BUV
● Nimbus-7
■ Meteor-3
◆ EP-TOMS
◆ NOAA-14
▲ NOAA-9
★ Aura-OMI (prelim.)

NH March

OMI

SH October

1970

1980

1990

2000

Aura Validation Program

- **Nine Aircraft field Campaigns - 2007**
 - Three major tropical UT/LS campaigns
 - Two tropospheric campaigns (transcontinental)
 - Polar mini-campaign
 - Regular mini-aircraft missions (AVE)
 - Targets different environments and seasons to exercise the algorithms
- **Ground based measurements for in situ and profile measurements focused on the troposphere**
- **Special high altitude instrumented balloon flights**
Additional H₂O and O₃ sondes
- **Aura Validation Data Center (AVDC) for inter-satellite data hosting and mission planning**
- **Multinational collaboration: NASA, ESA, KNMI, FMI, NDSC**



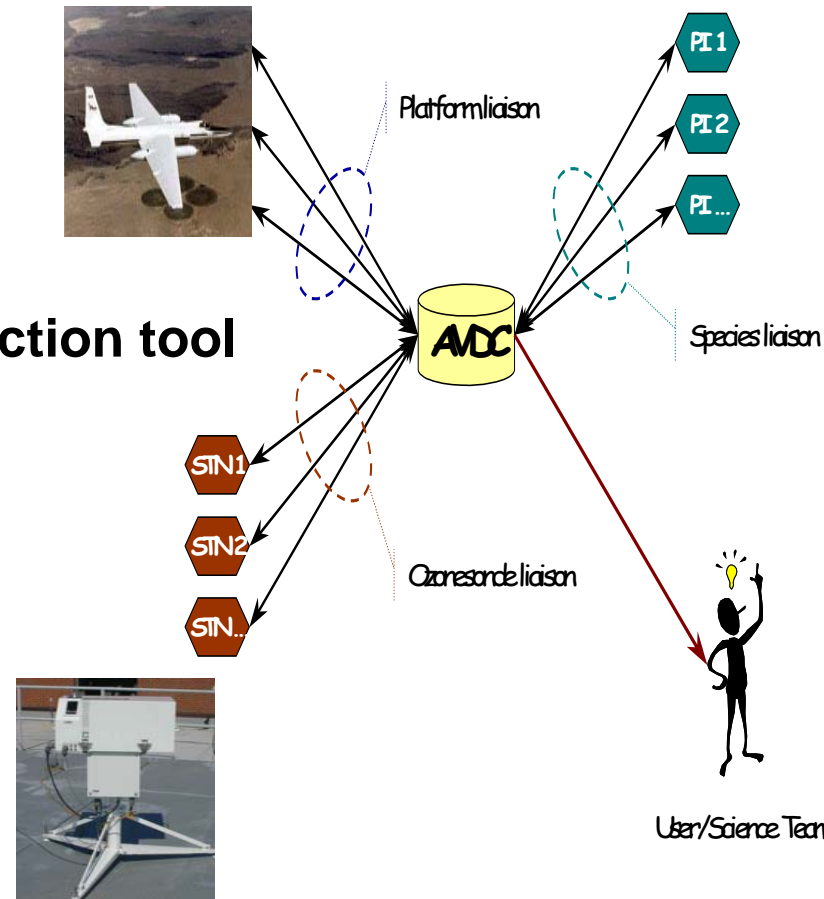
Aura Validation Data Center

- Archive and distribution center for ground, balloon, aircraft, and some satellite data for Aura validation
- Collaborative effort with ESA-ESRIN Envisat Cal/Val and the Canadian ACE mission (data exchange)
- AVDC operational (February 10, 2005)
- Web access only: <http://avdc.gsfc.nasa.gov>
- Access restrictions: AVDC data protocol
- As of April 2006:
 - 220 national and international registered users
 - 200 + Gb of validation data, 2.5 Tb of subsetted satellite data
 - In addition to Aura, supports ACE, OSIRIS, NOAA-SBUV/2 subsets



AVDC Functionality

- **Continuity in file format: AVDC/Envisat HDF**
 - Numerous tools for end users
 - ASCII to HDF,
 - IDL on-line,
 - Linux, OSX, Windows
- **Collocation tools**
 - Satellite instrument geolocations
 - Searchable (species, location, and time)
- **Aura Instrument Field of View prediction tool**
 - Aircraft mission planning/scheduling
 - Ground based/Aura FOV coincidences
- **Aura instrument data subsetting**
 - Aircraft flight path
 - Ground stations



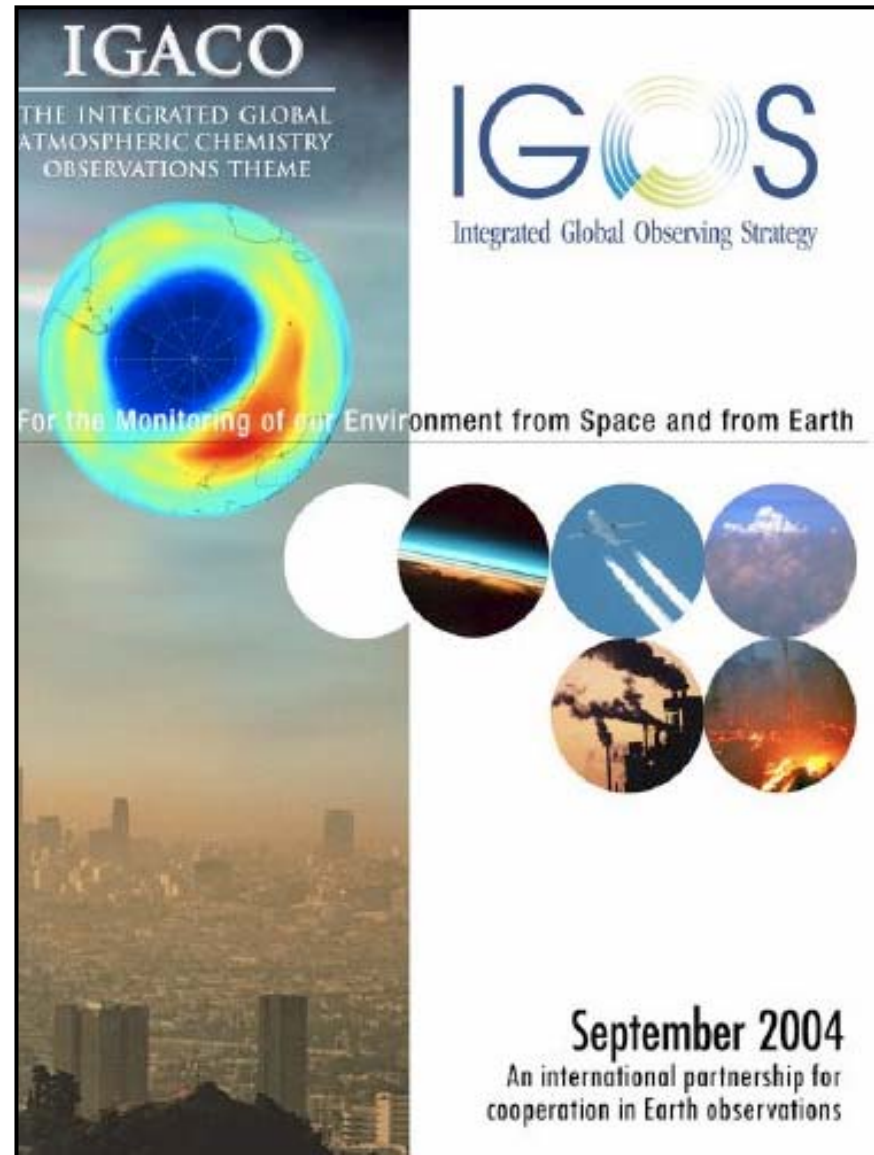
IGOS/IGACO Theme

IGOS seeks to provide a framework to harmonize space-based and in-situ systems for global observation.

Produce comprehensive global and regional data to satisfy the environmental information needs of policy-makers and support scientific and operational environmental programs.

Cal/Val is a major component of IGOS and IGACO

Strong connection between ACSG and IGACO



Network for the Detection of Stratospheric Change (NDSC) Satellite Working Group

[Home](#)

News

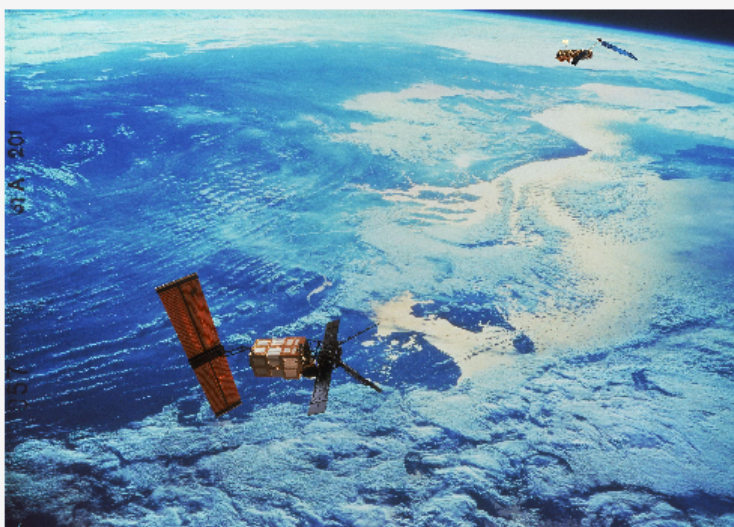
Activities

Satellite Missions

Members

Publications & References

Links



ERS-2/Envisat tandem flight (from pictures kindly provided by ESA)

Welcome to the NDSC Satellite Working Group
Homepage!

The objective of the Satellite Working Group is to foster collaboration among atmospheric scientists involved in the NDSC and in satellite missions. This website is a guide to ground-based researchers, space agencies and other interested parties to practical information on atmospheric chemistry satellite missions.

Enjoy your visit!



Site hosted by



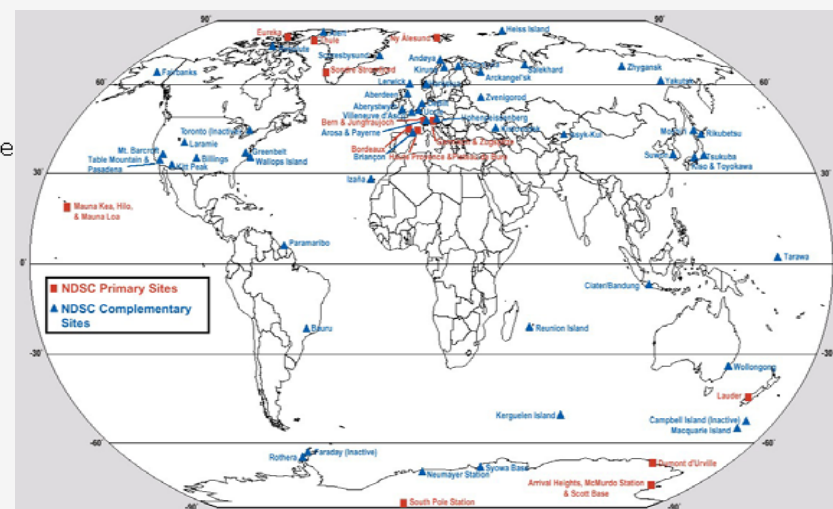
BIRA-IASB

Contact: [Webmaster](#)
Last update: Oct. 2005

For further questions or suggestions, please contact the Steering Committee:

Ir. Jean-Christopher LAMBERT

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Metop and NPOESS AC Instruments Cal/Val Plans

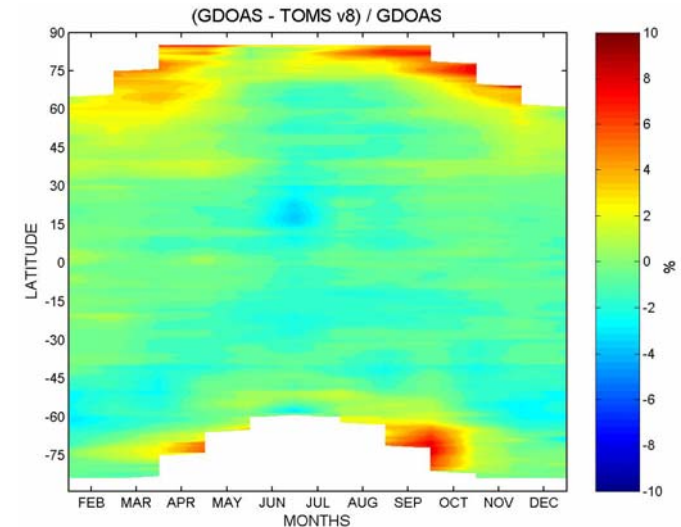
- **GOME-2**
 - Performance verification and long term tracking
 - Validate Level-1 and Level-2 with feedback
 - Algorithm revision data base for QC
 - Validation data center planned
 - Commitment to reprocessing is not clear
- **IASI**
 - Technical Expert Center at CNES for Level 1 validation
 - Level 2 validation TBD: AIRS heritage, Distributed responsibility
- **OMPS**
 - Instrument contractor provides post launch cal to system contractor
 - Government oversight
 - Instrument tracking and NRT calibration update by contractor
 - Level 2 validation responsibility of user (NOAA, NASA, DoD)
 - Cal/Val formulation and implementation is immature

Chinese BUV Ozone Instrument

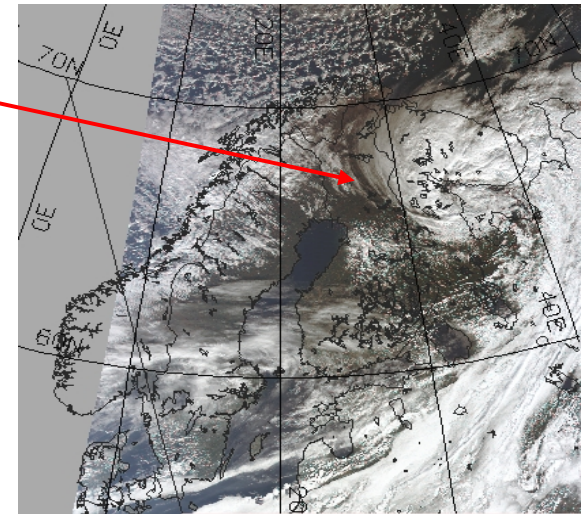
- **Chinese National Meteorological Satellite Center (NMSC) plans to fly BUV ozone instrument on FY-3 polar orbiter in 2007**
 - Instrument development (copy of NASA SBUV/TOMS)
 - NMSC requests NOAA for data processing algorithms
 - ACSG contacted NMSC about cal/val
- **Meeting planned with NMSC July 21, 2006**
 - Discuss algorithms (with NOAA/NASA)
 - Review US and European cal/val activities
 - Plan cal/val coordination between US and NMSC

Sodankylä, Finland Intercomparison

- 5-10% differences persist between satellites and ground stations at high latitudes and high SZA
- Ozone trends are largest in polar regions: track for ozone recovery
- Intercomparison campaign hosted by the Finnish Meteorological Institute to resolve differences
- Participants: Canada, Spain, USA, Germany, Belgium, Netherlands, France
- Ground based: Lidar, Brewer, Dobson, SAOZ, balloon, DOAS near daily observations for most of April 2006
- Satellite: Aura, NOAA, Envisat, ERS-2
- Supported by: NASA, FMI, ESA, KNMI, NDACC (NDSC)



Sodankylä,
Finland
67N, 27E



ACSG Action Items

- **Continue to lobby for stable funding from space agencies for ground based network to insure data quality and timely archiving**
- **Coordinate Envisat (chemistry) and Aura validation – NASA/ ESA discussions continue for near term and long term coordination**
- **Coordination of validation activities for next generation operational systems: Metop and NPOESS. Representatives are members of ACSG**
- **Include aerosol and met sounding validation in ACSG or form new subgroup – No consensus yet by Subgroup. GEOSS implication**
- **Include CO₂ (NASA and JAXA initiatives) in ACSG – under consideration by ACSG**
- **Consider universal policy for publication, referencing and citation of validation data – on going by ACSG**
- **Continue discussions with WGCV for GEOSS involvement**

ACSG Recommendations to WGCV

- 1. Establish uniform data protocols (nomenclature and formats) for collecting, archiving, and accessing validation data across Earth science disciplines**
 - **Aura and Envisat (chemistry) have agreed to maintain validation data protocol uniformity for their respective archives.**
 - **WGISS-WGCV project**
 - **Validation data are a global resource and cost effective archiving and access must be a high priority**
- 2. Consider role of CEOS Cal/Val in upcoming operational systems (NPP/NPOESS and Eumetsat)**
 - **Operational EO systems will be the major user for validation data**
 - **US and European operational systems are behind in establishing validation requirements and insuring resources**
- 3. Consider roles of CEOS Cal/Val in context of IGOS, GEOSS, and GMES**
 - **Next generation EO systems require validation and sharing global resources**
 - **CEOS WGCV has experience and reach and should play a role**