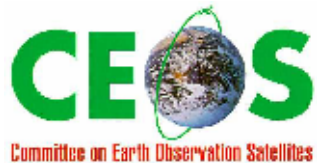


Report to WGCV-26

Atmospheric Chemistry Subgroup (ACSG)

Ernest Hilsenrath
University of Maryland (JCET)
NASA Headquarters



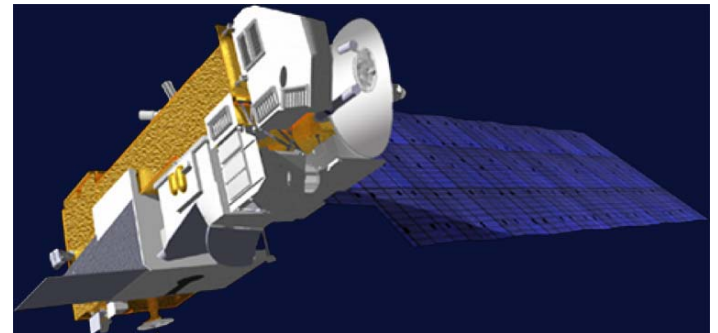
Working Group on
Calibration & Validation

November 2006
Chang Mai, Thailand



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 and IGACO (IGOS Atmospheric Composition Theme)
- 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

SBUV/2	HIRDLS/Aura	2004
OSIRIS	OMI/Aura	“
ACE	MLS/Aura	“
MAESTRO	TES/Aura	“
GOME-1	GOME-2/Metop	2006
GOMOS	IASI/Metop	“
MIPAS		
SCIAMACHY		
MOPITT		

To be launched

OMPS/NPP/NPOES	2009-2015
SBUS/TOU/FY-3	2007-?
NASA and ESA New chemistry-TBD	

ACSG Objectives

- **Promote international collaboration and technical exchange**
- **Encourage end-to-end approach to the calibration and validation**
- **Ensure that validation sensors are calibrated to traceable national standards**
- **Encourage interaction between calibration scientists and data users**
- **Develop comprehensive data validation methods employing ground, aircraft, balloon, and satellite measurements with data assimilation and chemical transport models**
- **Recommend a network of validation sites and to encourage continuous observations with data quality control**
- **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, JAXA, NASA, KNMI, MSC, NOAA, IASB, EC, WMO, U. of Bremen, CSA (U of Tronto), Eumetsat, British National Space Center (BNSC)
- **Meetings: Five Subgroup meetings held:**
May '02 (Ottawa), December '02 (Frascati),
July '03 (Toulouse), May '04 (Frascati), July '06 (Beijing)
Dec '06 (Frascati) - select new Subgroup chair
- **ACSG Projects Approved/Underway and planned:**
 - Collaboration between Aura and Envisat Validation Data Centers (**Ongoing**)
 - Ground station cross calibration (**Completed**)
 - Eureka (Canada) station re-opened (**Approved**)
 - High latitude ozone campaign (**Completed**)
 - Collaboration on future missions: Metop, NPP, NPOESS, and post Metop (**Planning**)

ACSG Activities

- **Envisat (launch 2002) validation**
 - Three instruments measure atmospheric chemistry
 - Core validation (balloon, ground and aircraft) period is complete
 - Envisat ACVE series of Workshops. Third at ESA/ESRIN Dec '06
- **Aura (launch 2004) validation**
 - Four instruments measure atmospheric chemistry
 - International validation teams
 - Eight aircraft campaigns: Polar, Tropical, and Mid-latitude inter-continental
 - Aura Validation Data Center in operation
 - Validation science team meeting in July '06 (Boulder, CO)
- **Operational Metop and NPOESS Chemistry instruments**
 - Cal/Val program plan underway
 - NOAA will process Eumetsat GOME-2 chemistry data products
 - Validation Data Center (based on Aura Validation Data Center)
- **Post Metop (>2019) planning for atmospheric chemistry observations**

Envisat Validation

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

ACE validation: Comparison of two Satellite instruments with balloon and lidar

ESA's Official Conference Organiser CONGREG

latest update: 16-Oct-2006

esa

PURPOSE | PROGRAMME | SCHEDULE | CALL FOR ABSTRACTS | ABSTRACT SUBMISSION | CALL FOR PAPERS | PAPER SUBMISSION
REGISTRATION & HOTEL | GENERAL INFORMATION | COMMITTEES | CONTACT | VENUE

Third Workshop on the Atmospheric Chemistry Validation of Envisat (ACVE-3)

4 - 7 December 2006

ESA - ESRIN
Frascati, Italy

Announcement & Call for Papers

The abstract submission will be open for late entry contributions till 24 November 2006.

Organised by the European Space Agency (ESA), Directorate of Earth Observation Programmes

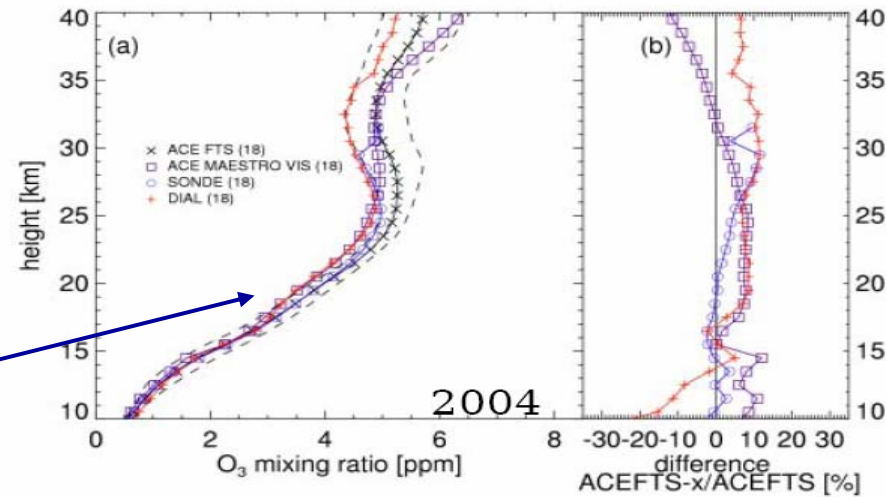
The Directorate of Earth Observation Programmes of the European Space Agency is organising a third workshop on the Atmospheric Chemistry Validation of Envisat. The workshop will be held from Monday, December 4th to Thursday, December 7th, 2006, at ESA's European Space Research Institute (ESRIN) in Frascati, Italy.

PURPOSE

Following the recommendations given at the Envisat Validation Workshop and at the second workshop on Atmospheric Chemistry Validation of Envisat (ACVE-2) held in May 2004 a (third) workshop on Atmospheric Chemistry Validation of Envisat (ACVE-3) will be organised. This is responding to the need for the subgroups of the ACVT to have a meeting to discuss the results of the correlative data acquisitions and analysis and to derive the current status of the operational atmospheric chemistry products including refining the error bars.

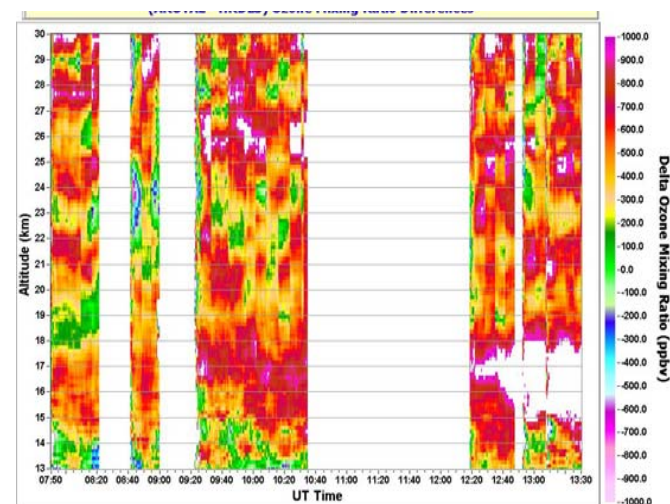
This meeting is primarily intended for the participants of the ENVISAT Atmospheric Chemistry Validation Programme.

<http://www.congreg.nl/06m25/>



Aura Validation

- **Eight Aircraft field Campaigns: 2005- 2007**
 - High and tropical latitudes
 - Intercontinental transport of pollution
 - Algorithms are tested under different environments
- **Ground based measurements for in situ and profile measurements focused on the troposphere**
- **High altitude instrumented balloon flights**
- **Small met balloon sondes for O₃ and H₂O**
- **Aura Validation Data Center (AVDC) for inter-satellite data hosting and mission planning**
- **Multinational collaboration: NASA, ESA, KNMI, FMI, NDACC**



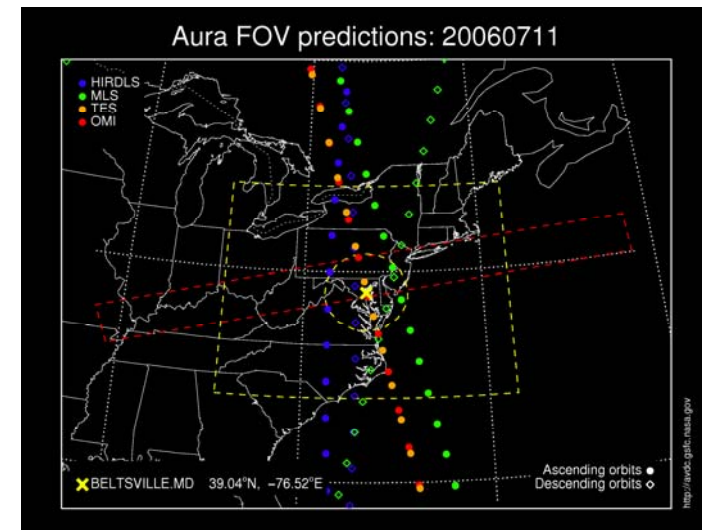
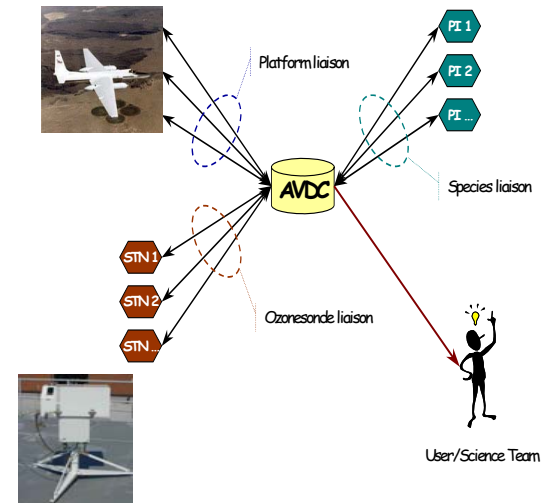
Aura Validation Data Center (AVDC)

- 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>
- Participation and accessibility: AVDC data protocol
- As of August 2006:
 - 220 worldwide 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

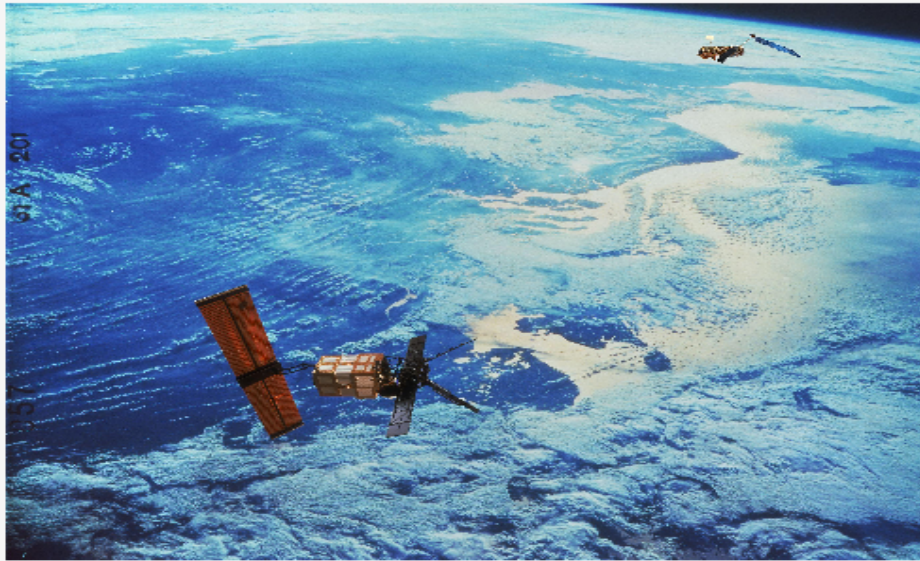
- **Consistent file format: AVDC/Envisat HDF**
 - Numerous tools for end users
 - ASCII to HDF,
 - IDL on-line,
 - Linux, OSX, Windows
- **Collocation tools**
 - Satellite instrument geolocations
 - Searchable (species, location, and time)
- **Aura Instrument Field of View prediction tool**
 - Aircraft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



Envisat Validation Website



Network for the Detection of Atmospheric Composition Change (NDACC)
Satellite Working Group



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

Welcome to the NDACC Satellite Working Group Homepage!

The objective of the Satellite Working Group is to foster collaboration among atmospheric scientists involved in the NDACC 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.



For further questions or suggestions, please contact the Satellite Working Group of the NDACC Steering Committee.

[Dr. Jean-Christopher LAMBERT](#)

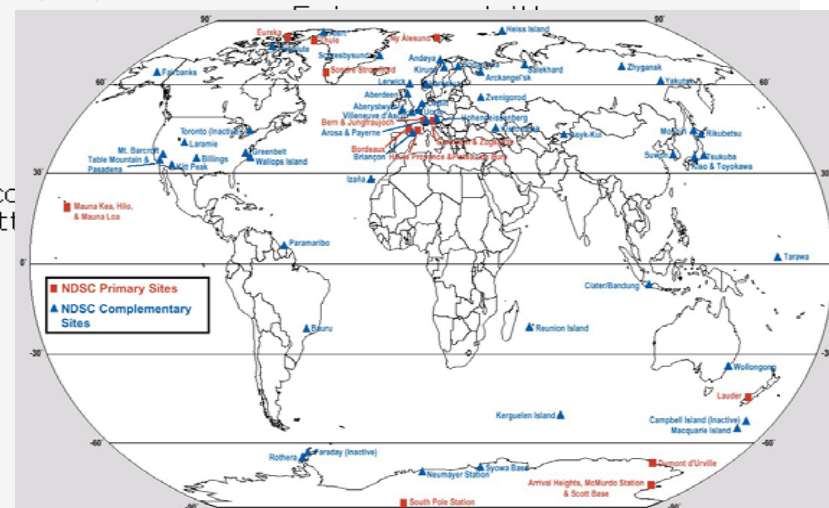
Pole Espace/Belgian Institute for Space Aeronomy (BIRA-IASB)
Avenue Circulaire 3, 1180 Brussels, Belgium

Site hosted by



BIRA-IASB

Contact: [Webmaster](#)



Metop (launched Oct 19) and NPOESS AC Instruments Cal/Val Plans

- **GOME-2/Metop**
 - Performance verification and long term tracking
 - Validate Level-1 and Level-2 with feedback
 - Validation data center planned
 - Commitment to reprocessing is not clear
- **IASI/Metop**
 - Technical Expert Center at CNES for Level 1 validation
 - Level 2 validation TBD: AIRS heritage, Distributed responsibility
- **OMPS/NPP/NPOESS**
 - Pre and post launch calibration responsibility of mission contractor
 - Government (NOAA and NASA) oversight and participation
 - Level 2 validation responsibility of user (NOAA, NASA, DoD)
 - Cal/Val formulation and implementation is immature

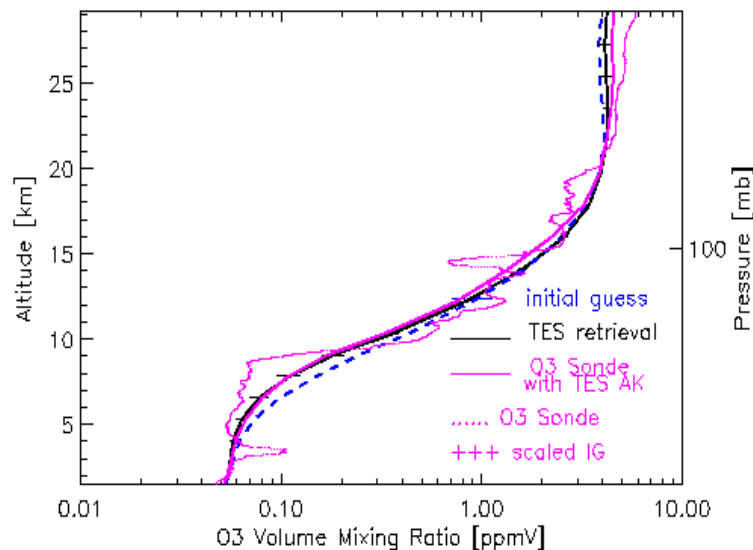
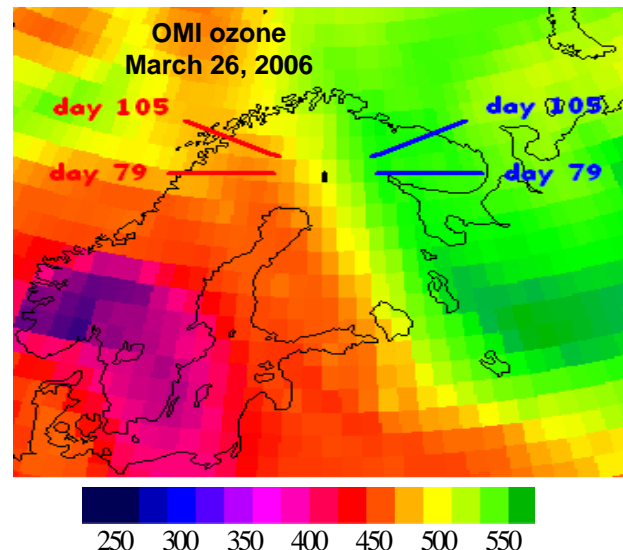
Sodankylä, Finland Intercomparison

MOTIVATION

- 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

CAMPAIGN

- Intercomparison campaign hosted by the Finnish Meteorological Institute to resolve differences
- Participants: Canada, Spain, USA, Germany, Belgium, Netherlands, France
- Ground based UV/VIS spectrometers (Brewer, Dobson, SAOZ), balloon ozone sondes and LIDARS with near daily observations for most of April 2006
- Satellites: Aura, NOAA, Envisat, ERS-2
- Supported by: NASA, FMI, ESA, KNMI, NDACC (NDSC)



Chinese BUV Ozone Instrument

- **Chinese National Meteorological Satellite Center (NMSC) plans to fly BUV ozone instrument on their FY-3 polar meteorological satellite in 2007**
 - **TOU instrument is being built by the Center for Space Science and Applied Research, Chinese Academy of Sciences in Beijing**
 - **SBUS instrument is being built by the Changchun Institute of Optics, Fine Mechanics, and Physics, Chinese Academy of Sciences in Shanghai.**
 - **The instruments are very similar to NASA's SBUV/TOMS**
 - **NMSC requests NOAA for help with data processing algorithms**
- **ACSG-5 meeting in Beijing at NMSC July 21, 2006**
 - **Review US and European cal/val activities**
 - **Review of Chinese cal/val activities – modeled after US SBUV/TOMS (in flight calibration and ground/sat intercomparisons)**
 - **Potential cal/val coordination between US and NMSC discussed but no agreements**



“Constellation”- New CEOS initiative Responds to GEO Action Item

- The Atmospheric Composition (AC) Constellation is one of four pilot projects to bring about technical/scientific cooperation and collaboration among space agencies that broadly meets GEO objectives and SBA delivery
- The AC Constellation Concept will identify missions or data delivery that serves the broader science and application community that can be advocated by the CEOS agencies (GEO AR-07-P3, Virtual Constellation)
- The AC Constellation study will prioritize user requirements and define missions or a “virtual” system consisting of space and ground segments including archives that meet user requirements
- Cal/Val will play a key role in the Constellation in order to insure consistency of data produced by the various observing and delivery systems

ACSG Action Items

Ongoing

- 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
- Coordinate validation activities for up-coming operational systems: Metop and NPOESS. Representatives are members of ACSG
- Continue discussions with WGCV for GEOSS involvement

To Do

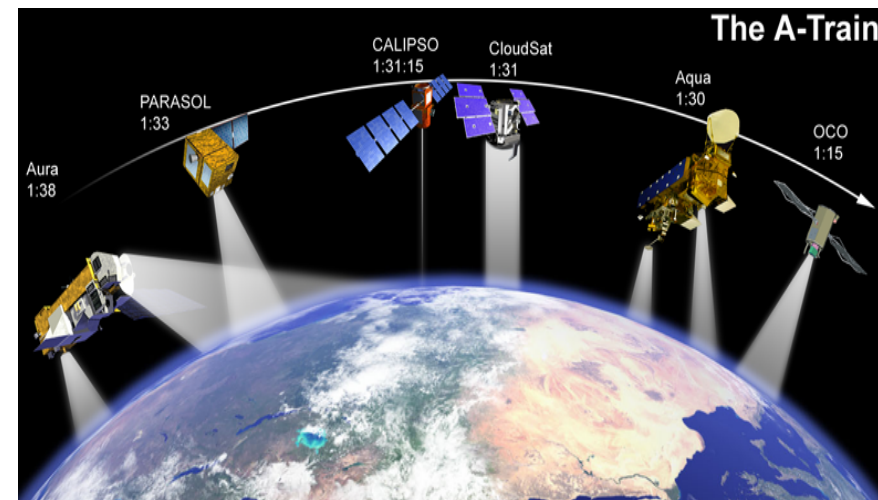
- Include aerosol and met sounding validation in ACSG or form new subgroup – No consensus yet by Subgroup. GEOSS implication
- Include CO₂ (NASA and JAXA initiatives) in ACSG – under consideration by ACSG
- Elect new ACSG chairman at next meeting (December 2006)

ACSG Recommendations to WGCV

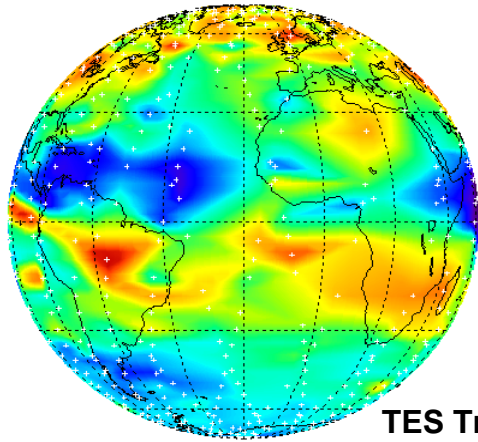
- 1. Establish uniform data protocols (nomenclature and formats) for collecting, archiving, and accessing validation data across Earth science disciplines**
 - Validation data are a global resource. Cost effective archiving and access must be a high priority**
 - Aura and Envisat (chemistry) have agreed to maintain validation data protocol uniformity for their respective archives.**
 - This is an excellent WGISS-WGCV project**
- 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**
 - This must be done at the CEOS SIT level**

EOS Aura – Atmospheric Chemistry

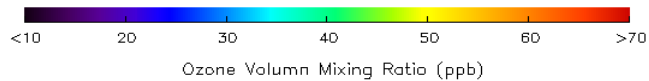
- Third large EOS Observatory following Terra and Aqua
- Four instruments (UV to microwave)
- Polar orbit at 1:38 PM crossing
- Launch – July 15, 2004
- Science Objectives
 - Tracking ozone layer
 - Global measurements of air quality
 - Connecting atmospheric chemistry with climate
 - Synergy with A-Train



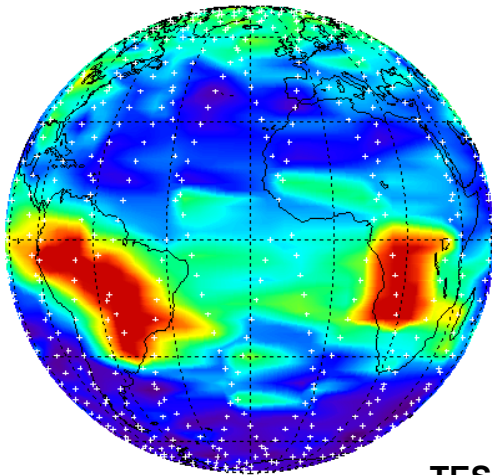
Aura Results – Pollution and Trends



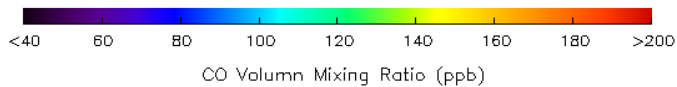
TES Trop O₃



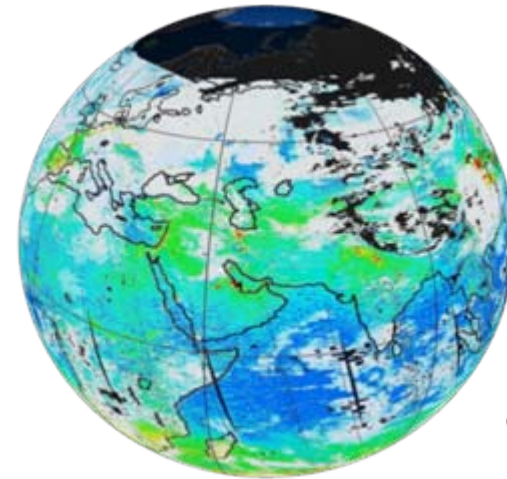
Ozone Volume Mixing Ratio (ppb)



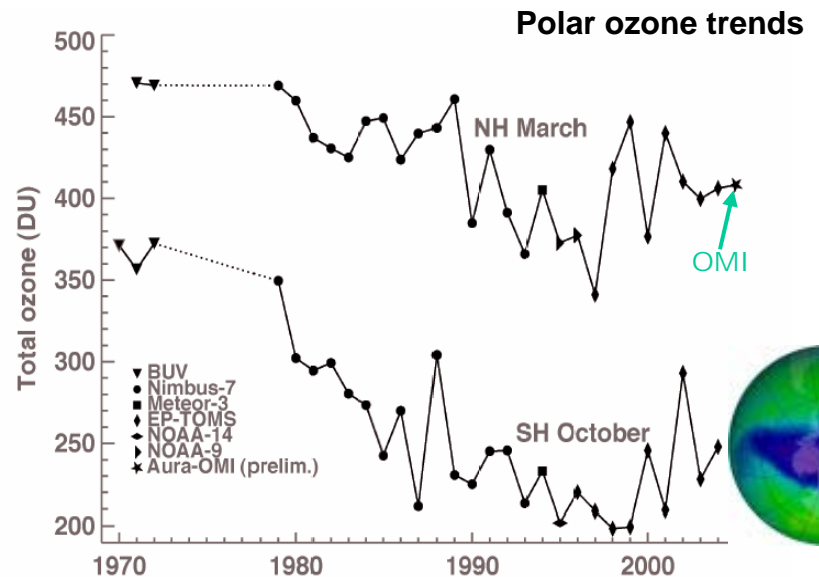
TES CO



CO Volume Mixing Ratio (ppb)



OMI NO₂



Polar ozone trends

Total ozone (DU)

NH March

SH October

BUV
Nimbus-7
Meteor-3
EP-TOMS
NOAA-14
NOAA-9
Aura-OMI (prelim.)

OMI

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

