Atmospheric Composition Constellation

Ernest Hilsenrath
NASA/HQ

J. Langen, C. Zehner
ESA

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ACC Objective

- **Establish a framework for long term coordination among the CEOS agencies** where the "Constellation" will identify specific opportunities for meeting science and application requirements

- **Collect and deliver data to improve predictive capabilities for coupled changes in the** *Ozone Layer, Air Quality, and Climate Forcing* **associated with changes in the environment.**

- **Objectives meet participating Agency priorities and are aligned to the GEO SBA's**

- **Objectives will be achieved through the following steps:**

  - **Develop a Requirements and Gap Analysis based on in-orbit and up-coming missions collecting AC data**

  - **Demonstrate how Constellation data can add value to data products serving the GEO SBA's through Projects**

  - **Develop rationale, strategy, and standards for collaboration to meet requirements not being met and remain open for possible new requirements.**

Status

- **ACC initiated four near term projects to demonstrate the Constellation concept. Projects involve five of its international partners using seven different instruments. Projects were selected for near term results and aligned with SBAs**

- **Projects are showing added value using constellation data over data used separately. Now in their implementation phases**
  - *Pollution prediction using Envisat and Aura*: <u>Health/Air Quality</u> (NOAA lead)
  - *Aircraft volcanic ash warning using Envisat and Aura*: <u>Hazards</u> (ESA lead)
  - *Smoke prediction from biomass burning using Aura, Aqua*, CALIPSO: <u>Hazard and Health</u> (NASA lead)
  - *Algorithm and cal/val collaboration* between GoSAT (JAXA) and OCO (NASA): <u>Climate</u> (WGCV Lead)

- *Requirements and Gap Analysis* **is underway and draft report is expected in June 2008,** <u>Cross-cutting</u> (SEO Lead)

- **Longer term projects will engage more satellites and international partners *focused toward GCOS Climate objectives*. Planning with CSA, JAXA, ESA, and EC (NASA lead for now)** <u>Climate</u>

- <u>**All Projects engage WGCV, WGISS and the SEO. Plan to engage WGEdu**</u>

- **Objective**
  - **Survey the requirements for AC measurements over the next two decades**
  - **Summarize capabilities of existing and planned missions**
  - **Identify mission gaps**

- **Status - Collated Requirements**
  - **US NRC Decadal Survey 2007**
  - **GMES, ESA and EUMETSAT (IGACO and CAPACITY reports, post-EPS, MTG and Sentinel 4 & 5 MRDs)**
  - **GCOS ECVs**

- **Final Report – *Draft June 2008***
  - **Mission summaries and AC instrument capabilities**
  - **Gap assessment in capabilities and time domain**
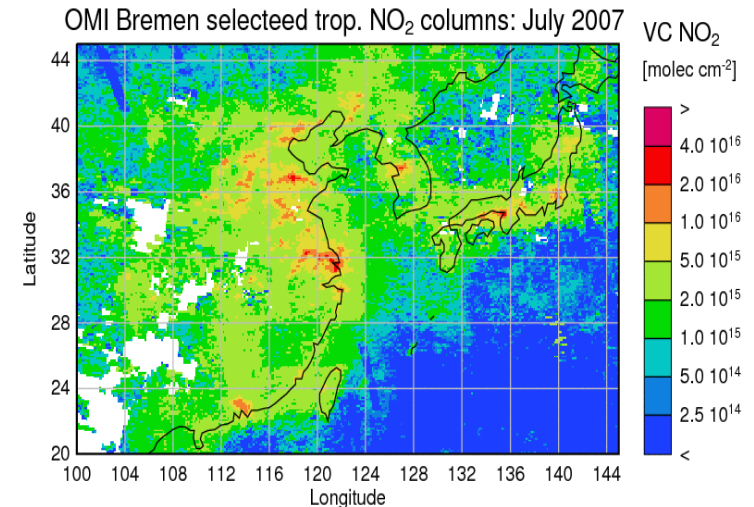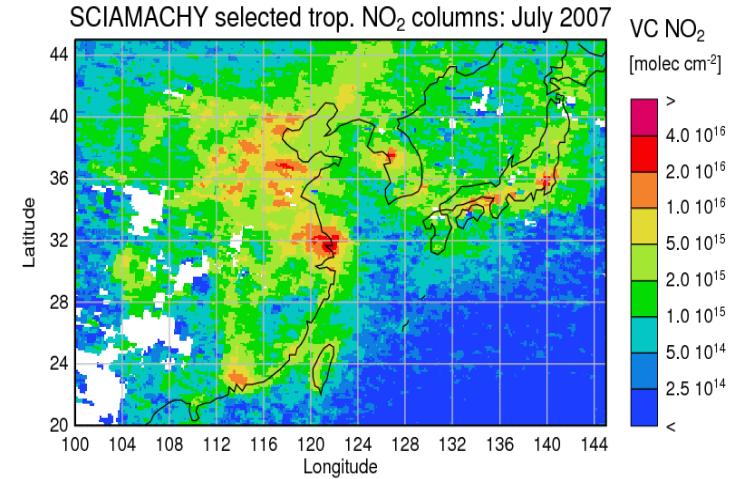 - **Recommendation to CEOS (Agencies): *September 2008***

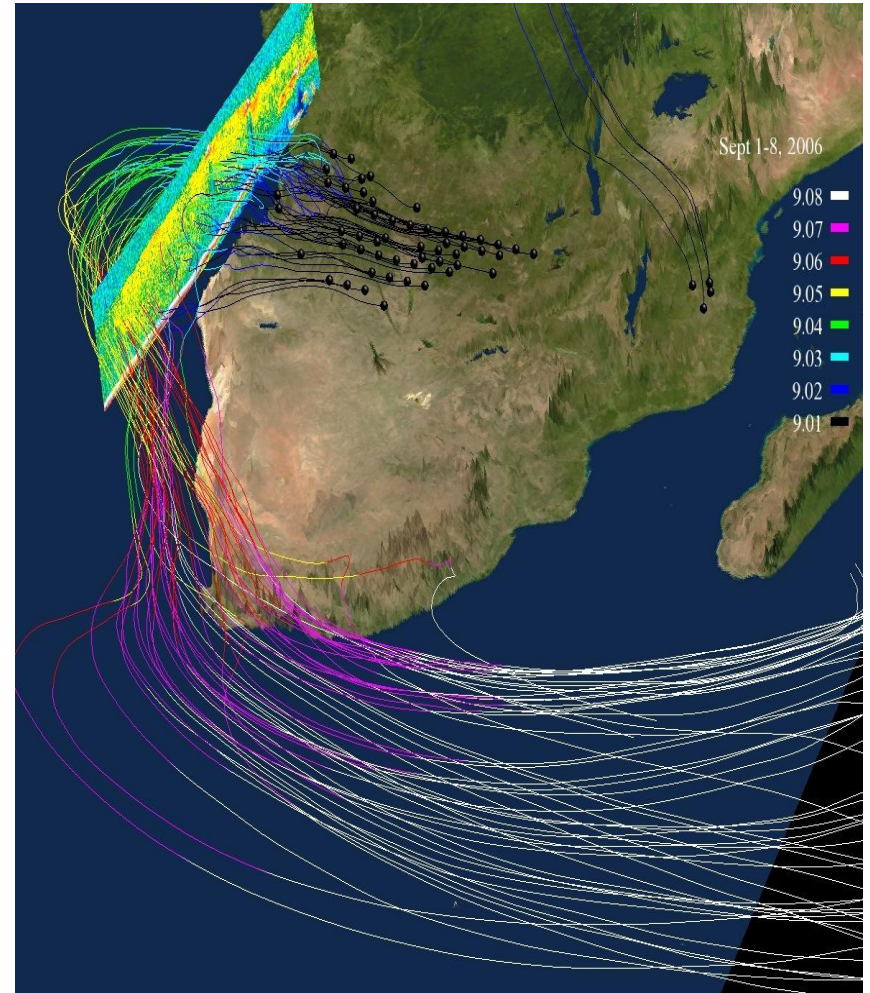| Programme	Source	Requirement Type	Height Domain	Horizontal Resolution (km)	Vertical Resolution (km)	Sampling Interval / Revisit Time	Accuracy	Coverage	Stability
GMES	Sentinel 4&5 MRD	Ozone layer - Protocol Monitoring	Total Column	50 / 100		24 / 24*3	3%	global	
		Ozone layer - NRT Data	UT	20 / 100	0.5 / 2	6 / 24*3	20%	global	
			LS	50 / 100	0.5 / 2	6 / 24*3	20%		
			MS	100 / 200	2 / 3	6 / 24*3	20%		
			US+M	100 / 200	3 / 5	12 / 24*7	20%		
			Trop Col	10 / 50		6 / 24*3	20%		
			Total Column	50 / 100		6 / 24*3	5%		
		Ozone layer - Assessment	UT	20 / 100	1 / 3	6 / 24*3	20%	global	
			LS	50 / 100	1 / 3	6 / 24*3	10%		
			MS	100 / 200	2 / 3	6 / 24*3	20%		
			US+M	100 / 200	3 / 5	6 / 24*7	20%		
			Trop Col	10 / 50		6 / 24*3	20%		
			Total Column	50 / 100		6 / 24*3	10%		
		Air Quality - Protocol Monitoring	PBL	5 / 20		0.5 / 2	10%	global & regional	
			FT	5 / 50	1 / 3	0.5 / 2	20%		
			Trop Col	5 / 20		0.5 / 2	25%		
			Total Column	50 / 100		24 / 24*3	3%		
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			Trop Col	5 / 20		0.5 / 2	25%		
			Total Column			0.5 / 2	3%		
		Climate - Protocol Monitoring	Troposphere	10 / 50	2 / 5	12 / 24*3	20%	global	
			Trop Col	10 / 50		12 / 24*3	25%		
			Total Column	50 / 100		24 / 24*3	3%		
		Climate - NRT Data	PBL	5 / 50	--	6 / 24	30%	global	
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			MS	50 / 100	2 / 3	6 / 24*3	20%		
			US+M	100 / 200	3 / 5	6 / 24*7	20%		
			Total Column	50 / 100		6 / 24*3	3%		
NASA	US Decadal Survey	Health - Ozone & Surface UV	Stratosphere	5	2 - 3			global	
			Troposphere	5	2				
		Health - Air Pollution	Trop inc PBL	10	1	hours - days		regional & global	
		Chemical Weather - Air Pollution	Trop Col	5		hourly		regional >5000km	
		Chemical Weather - Trop Ozone	Troposphere		2			global	
GCOS	GCOS Satellite Requirements	ECV Ozone	Troposphere	5 - 50	0.5	3 hr	10%		1%
			Stratosphere	50 - 100	0.5 - 3	3 hr	5%		0.6%

NO$_2$ is precursor to ozone and an EPA criteria pollutant

- **NOAA provides AQ forecast :**
  - **Improve emissions inventories**
  - **Characterize long range transport**
  - **Model and forecast improvements**
 - **Compliance and clean air rules**

- **Improvement using combined Metop and Aura NO$_2$ data sets**
  - **Common algorithm now running on both data sets (NRT)**
  - **Six month data set for evaluation**
  - **Compare with models**
  - *Make operational - 2009*

SCIAMACHY selected trop. NO$_2$ columns: July 2007

OMI Bremen selecteed trop. NO$_2$ columns: July 2007

A. Richter, University of Bremen

- **Smoke dust Forecast NASA, NOAA, and EPA collaboration**

  – **Automated fire detection algorithm for MODIS**

  – **AOD algorithm from MODIS and AVHRR**

  – **Employ trajectory model to predict distribution and location and smoke**

  – **Possibly include vertical aerosol distribution from CALIPSO**

  – **NRT ability still be implemented**

  – *Demonstrated aerosol forecast feasibility*

- **Extend to MSG/SEVIRI (Eumetsat)**

- **Deploy service on: *TBD***
  http://servir.nsstc.nasa.gov
  http://idea.ssec.wisc.edu/

- **Potential collaboration with PROMOTE/GMES Service**

Sept 1-8, 2006

9.08
9.07
9.06
9.05
9.04
9.03
9.02
9.01

ACC Project – Aviation Volcanic Advisory

- **Volcanic eruptions impact aviation safety; engine, window and skin damage**

- **The US (NASA, USGS, and NOAA) and ESA (PROMOTE) support national VAACs by providing alerts based on satellite data**

- **National services coordinated and extended to provide global service using enhanced capabilities through US and ESA combined efforts**
  - **Aura, Envisat, and MSG**
  - **Improved latency and accuracy of SO_2 and ash detection**
  - **Global alerts**

- **ESA sponsored workshop in October 2008 and is considering AO solicitation to focus activities via its PROMOTE program *in 2009***
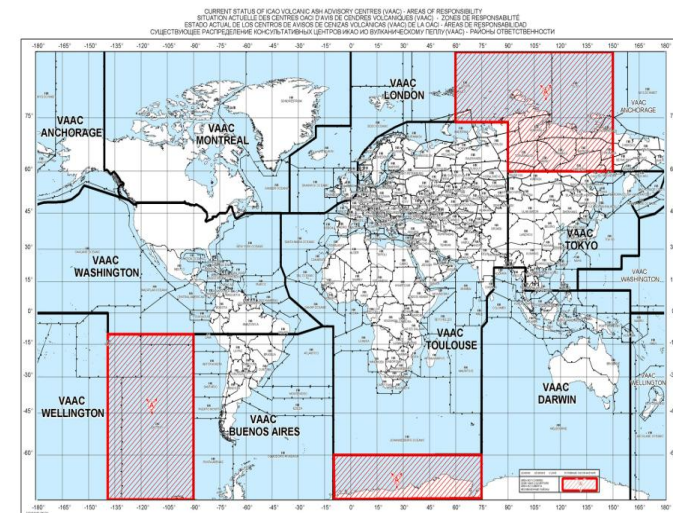
- **Both GEO (CL-06-02) and GCOS (ECVs) have requirements for long term data records to establish the connections between AC trends and climate needed for assessment and predictions**

- **NASA and other agencies are supporting development of data sets (ECVs)**
  - **Ozone trends (TOMS, SBUV, UARS, SAGE, Aura, Envisat, ACE, Metop, NPP/NPOESS)**
  - **Stratospheric Constituents (UARS, SAGE, Aura, Envisat, ACE, POAM)**
  - **Water Vapor trends (UARS, Aura, SAGE, balloon soundings)**
  - **Aerosol trends (TOMS, AVHRR, SeaWIFS, MODIS, NPP/NPOESS**
  - **Surface Reflectivity trends (TOMS, SBUV, SeaWiFS, Aura, Metop, NPP/NPOES**

- **Workshop planned at GISS:** *October 2008*
  - **Bring together international investigators producing ECVs**
  - **Resolution of drifts and biases is a major effort.   Maintaining cal/val data base is crucial and ca/val capabilities must be sustained (WGCV for implementation)**
  - **Accurate and interoperable data sets for assessments and policy needed. Coordinated through GEO UIC and ADC (WGISS for implementation)**

- **Launch of GoSat (JAXA) and OCO (NASA) for carbon emission and sinks is next major challenge for ACC coordination via CEOS**
  - **MoU between NASA and JAXA being negotiated**
 - **Algorithm and Cal/Val workshop at JPL:** *May, 2008*

ACC Back Ups

- **WGCV fully supports end-to-end validation of AC data products needed for SBAs**

- **ACC works closely with WGCV/ACSG to insure data "interoperability" because of the use of multiple satellites**

- **ACC accepts "best practices" and standards recognizing that standards are user dependent**

- **New requirements for validation**

  - **Tropospheric AC products for air quality forecasts and aviation hazard alerts (i.e. NO_2, SO_2)**

  - **Long term data sets (O_3, CO, CO_2, H_2O etc) for climate requires well maintained ground network**
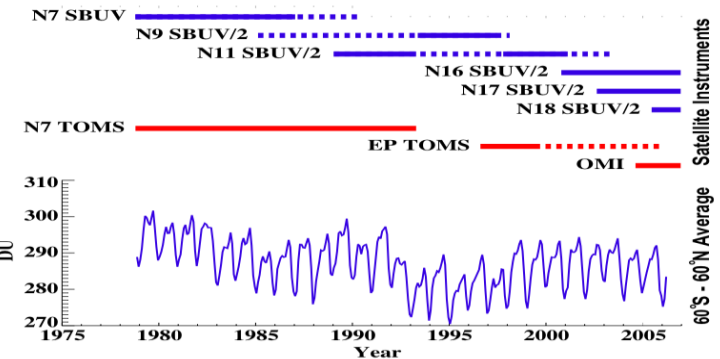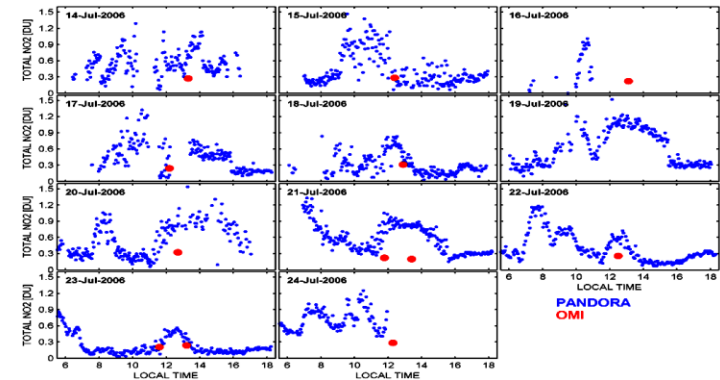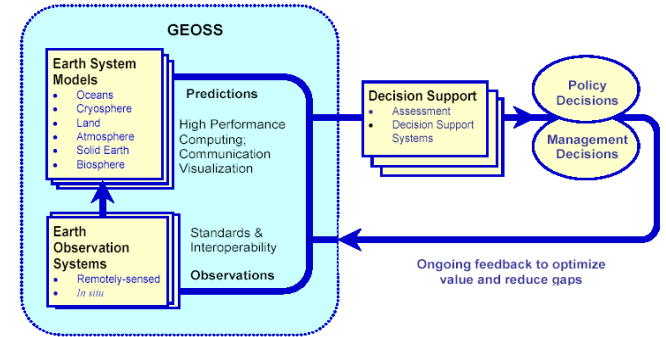
- **Access GEONETCast for low cost GEO compliant data distribution: ACC Projects #2 and #3**

- **SERVIR or IDEA websites for Project #2, possibly in Africa for on-line service by users**

- **Potential Sensor Web application for validation and improved latency: ACC Project #2 and #3**
  - **Validating data observations in real time**
  - **Possible sensor control feedback enabling real-time sensor tasking**
  - **Enable discovery and access to sensor web components and services**

- **Possible interaction with WGISS Test Facility (WTF) and other WGISS resources**

- **Explore applicability of OGC Network**

GCOS Priorities for AC
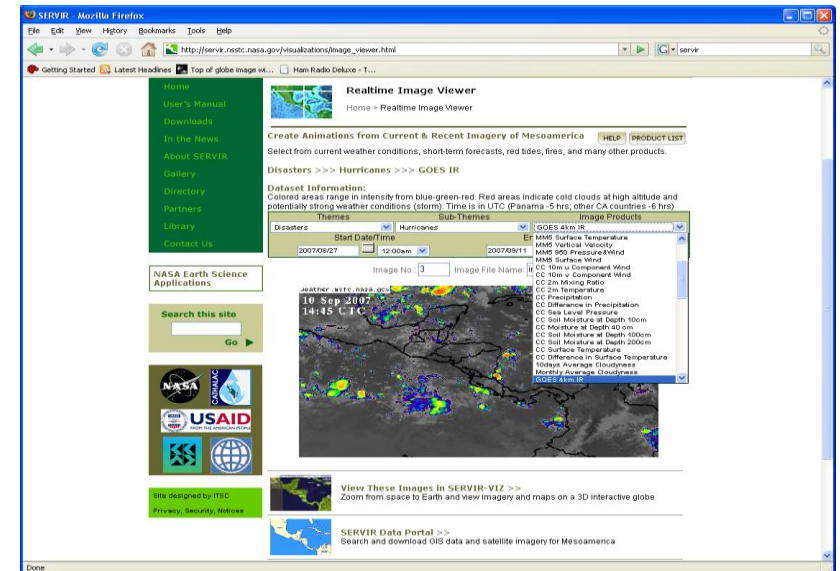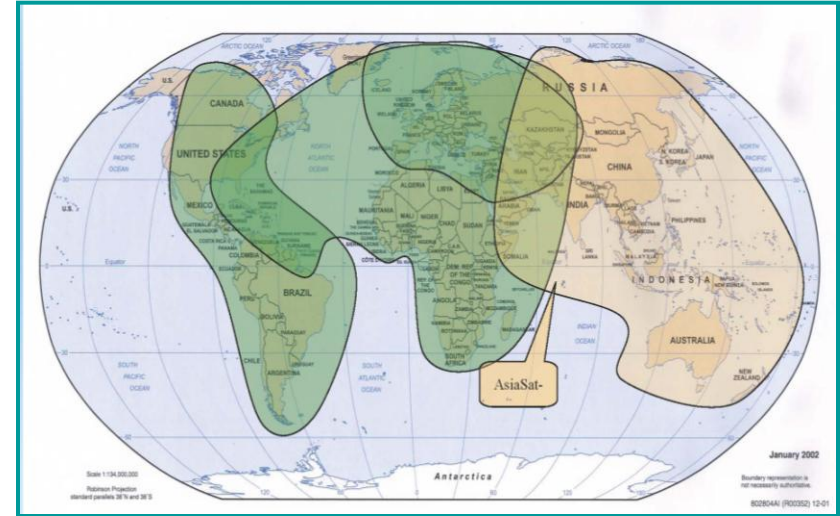
- **GCOS (http://www.wmo.ch/web/gcos/gcoshome.html) has established a set of requirement for Global Climate Observations endorsed by WMO, UNEP, ICSU and the space agencies. CEOS Response to COP-10**

- **GCOS data requirements can be mapped into the AC Constellation (encouraging international collaboration)**

Essential Climate Variable	Characteristic	Action required
Ozone mapping	Profiles, columns	– Reprocessing to remove biases and gaps, improved algorithms, integrated product
Aerosol characteristics	Profiles, columns	– Employ Data Assimilation for data homogeneity and integration
Water vapor content	Profiles, columns	– Research observations enhanced and standardized for upcoming operational missions
Cloud characteristics	Profiles	

- **GCOS specifically recommends deployment of "advanced observations" for Atmospheric Composition using multi-view and multi-spectral systems**