

# ADM-Aeolus and Climate Observation Requirements



ICSU  
International Council for Science

**Gilles Sommeria, GCOS Secretariat  
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- ADM-Aeolus, a demonstration project for the Global Climate Observing System
- ADM-Aeolus, a technological breakthrough for climate research and WCRP



# GCOS Mission

- ***To ensure that the data required to meet the needs of users for climate information are obtained and made available for:***
  - **Climate system monitoring, climate change detection and attribution;**
  - **Research, modelling and prediction of the climate system;**
  - **Assessing impacts, vulnerability & adaptation;**
  - **Application to sustainable economic development.**
- ***Global, long-term, high-quality, sustainable, reliable... data***



# GCOS Observational Strategy

- Achieving an optimal balance of **satellite** and *in-situ* data
- Ensuring data are **stable** enough to allow reliable detection of climate change –
- 20 GCOS climate monitoring principles (10 basic + 10 especially for space-based observations)



# Selected GCOS activities in the past 3 years



- GCOS Adequacy Report (2003): identified gaps and deficiencies
- GCOS Implementation Plan (2004): the roadmap for the global climate observing system in the next 5-10 years
- Both reports developed in response to and endorsed by the UNFCCC
- Broad participation and ownership by the climate community, including WCRP, WCP
- GCOS seen as the climate component of the GEOSS



# Essential Climate Variables (ECVs)

## ● Atmospheric (16)

- **Surface** – Air temperature, Precipitation, Air pressure, Surface radiation budget, Wind speed and direction, Water vapour
- **Upper Air** – Earth radiation budget (including solar irradiance), Upper-air temperature (including MSU radiances), **Wind speed and direction**, Water vapour, **Cloud properties**
- **Composition** – Carbon dioxide, Methane, Ozone, Other long-lived greenhouse gases, **Aerosol properties**.

## ● Oceanic (15)

- **Surface** – Sea-surface temperature, Sea-surface salinity, Sea level, Sea state, Sea ice, Current, Ocean colour (for biological activity), Carbon dioxide partial pressure
- **Sub-surface:** Temperature, Salinity, Current, Nutrients, Carbon, Ocean tracers, Phytoplankton

## ● Terrestrial (13)

- River discharge, Water use, Ground water, Lake levels, Snow cover, Glaciers and ice caps, Permafrost and seasonally-frozen ground, Albedo, Land cover (including vegetation type), Fraction of absorbed photosynthetically active radiation (FAPAR), Leaf area index (LAI), [Biomass], Fire disturbance, [soil moisture]



## **‘Satellite supplement’ to the GCOS IP (near-final v2.0)**

- Space agencies were requested by UNFCCC to respond to requirements in the GCOS IP by November 2006
- Space agencies asked GCOS, through CEOS, to provide more details for these requirements
- 9 Cross-cutting needs (related to GCOS climate monitoring principles, inter-calibration, unique datasets, independent scientific groups, data access)
- 35 ECV-based “Products”, based on “Fundamental Climate Data Records - FCDRs”
- Needs for reanalyses

# Priority needs in relation to research satellites



- The Satellite Report recognises, but does not detail, research needs and supplemental datasets and products that aid interpretation/ validation
- Key recommendations
  - “ **Sustain active research satellite programmes that address challenging measurement needs and that allow capabilities to advance and be more cost effective.**”
  - “ **Intensify efforts to further develop emerging operational capabilities for research-based variables**”

# Example of climate product: Upper-air Wind



- **Product:** Upper-air wind analyses, particularly from reanalyses
- **Benefits:** Monitoring fluxes of heat, momentum, moisture, including long-range transport of pollutants
- **Target requirements:** 2 m/s accuracy, 100km horiz., 0.5km vertical resolution, 3-hourly observing cycle, 2 m/s decadal stability
- **Instruments and Datasets:** Appropriate data records of VIS/IR imagery from
  - Geostationary satellites, to derive AMVs from successive images
  - Low Earth orbit satellites, to derive AMVs from successive, overlapping swaths
  - **Doppler wind lidar, e.g. through demonstration of ESA ADM/Aeolus**
- **Cal/val needs:** Collocated radiosonde and aircraft data, supplemented by data assimilation feedback statistics
- **Immediate actions:**
  - Reprocessing of GOES datasets, to supplement initial reprocessing of Meteosat and GMS data records
  - Reprocessing of wind products for the MODIS lifetime
  - Assessment of ADM/Aeolus impact



# Cloud Properties

- **Product:** **Cloud radiative properties** (initially key ISCCP products)
- **Benefits:** Reduce uncertainty in projections of future climate
- **Target requirements:** Generally under development or not defined; e.g. for Cloud cover: 10% accuracy, 100 km horizontal resolution, 3-hourly observing cycle
- **Instruments and Datasets:** Appropriate records of VIS/NIR imagery, and of IR and microwave soundings, e.g., through exploiting operational met satellites, ideally two LEO and five GEO satellites
- **Adequacy:** current products are barely adequate for monitoring large-scale spatial structure and regional variability, such as ENSO
- **Immediate actions:**
  - Reprocessing of existing historical record; build on ISCCP products; e.g., combined analysis of AVHRR and HIRS, new products from MODIS and SEVIRI
  - **Research using CLOUDSAT and CALIPSO necessary, plus new instruments**

# Aerosol Product



## Product:

**Aerosol optical depth, and other aerosol properties**

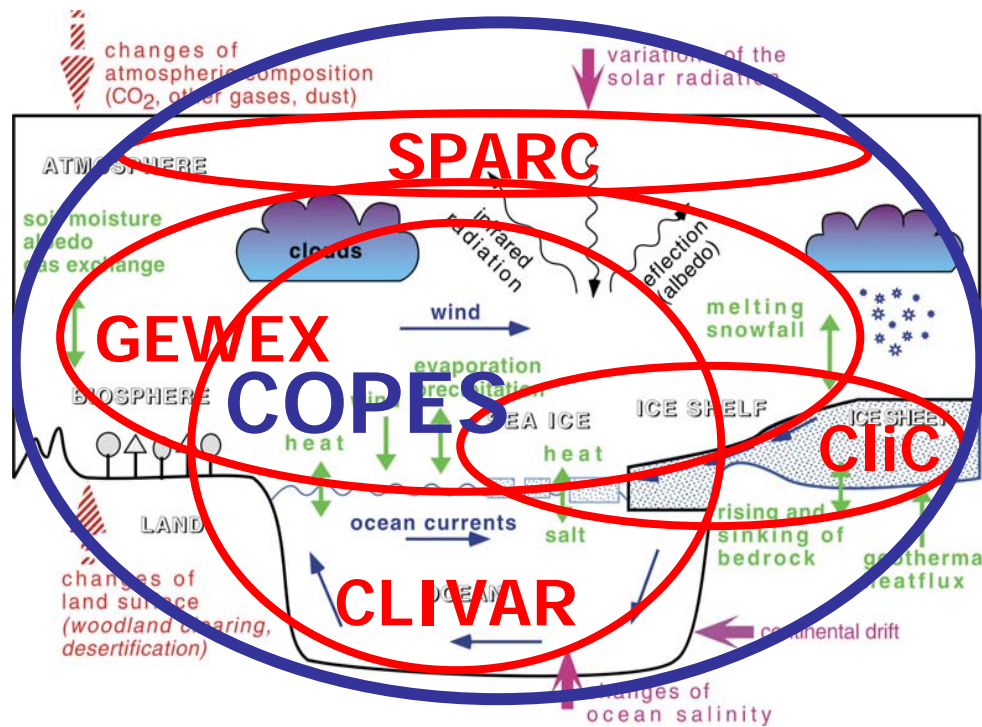
- **Benefits:** Reduce uncertainty in climate forcing
- **Spatial and temporal resolution** (total column AOD):  
1 km horizontal, 1-day cycle, RMS accuracy 0.01, decadal stability 0.005
- **Appropriate records at selected VIS/NIR/SWIR wavelengths**, through:
  - Optimal configuration of LEO/GEO satellites
  - Continuity by AVHRR-3, VIIRS, MTG
  - Reprocessing of AVHRR since 1981; of full GOES datasetSupplemented by:
  - Research with active instruments
- **Cal/val needs:** NDACC, WMO GAW, NASA AERONET
- **Immediate actions:** Reprocessing of historical datasets...**exploration of lidar capability (such as ADM/AEOLUS)**
- **Other applications of product:** Air quality, NWP, cloud chemistry

# WCRP STRATEGIC FRAMEWORK

Coordinated Observation and Prediction of the Earth System

## COPEs

(2005-2015)



Major contributions of projects and modeling groups:

- observing system components
- process understanding
- model components
- interactions within global system (impact and response)
- assimilation & reanalysis
- prediction & scenarios

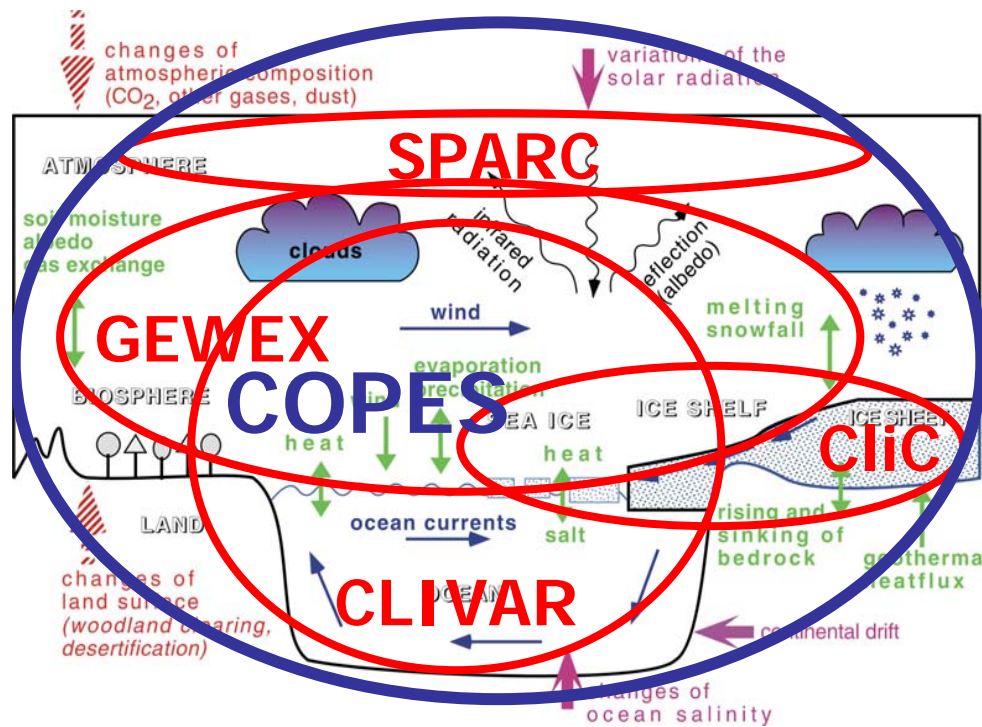
## ADM/Aeolus potential input to process studies and model developments

- Wind data for process studies especially in the tropics, the stratosphere and polar regions
- Use of cloud and aerosol data for radiative flux computations
- Major input to monsoon and El Niño studies
- Contribution to parameterization developments
- Complementarity with other satellite data

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- observing system components
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## ADM input to global change scenarios

- Accuracy of radiative forcing computations
- Improve simulation of tropical circulation patterns
- Improve simulation of tropical cyclone characteristics
- Improve simulation of mid-latitude storm characteristics
- Improve simulations of changes in global water cycle

# Potential impact on WCRP activities

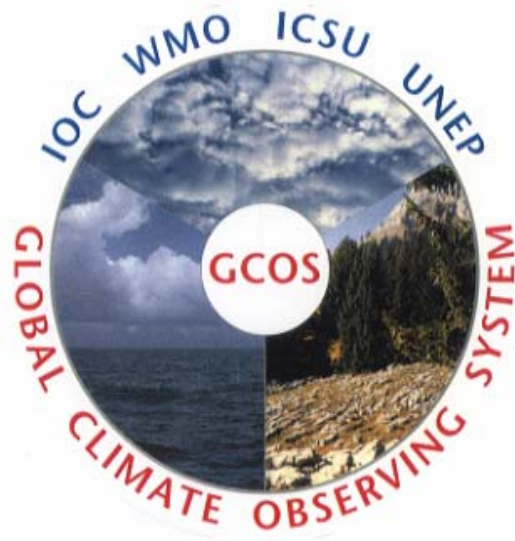
- Data assimilation and global analysis activities (WGNE, WOAP)
- Process and parameterization studies in GEWEX (GCSS), SPARC, CliC
- Improvement of global data sets (GEWEX), especially ISCCP and GACP
- Monsoon and tropical circulation studies in CLIVAR
- Contribution to global change scenarios (WGCM, WMP)

- ADM-Aeolus, a demonstration project for the Global Climate Observation System

CEOS calls for planning follow on mission

- ADM-Aeolus, a technological breakthrough for climate research and WCRP

Develop demonstration studies within WCRP projects



**Thank you for your attention.**



**ICSU**  
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**GCOS is comprised of climate components of various global observing systems including both satellite and *in situ* observations**





# Nomenclature

- Fundamental Climate Data Record (FCDR)

”a long-term data record, involving a series of instruments, with potentially changing measurement approaches, but with overlaps and calibrations sufficient to allow the generation of homogeneous products providing a measure of the intended variable that is accurate and stable enough for climate monitoring. FCDRs include the ancillary data used to calibrate them.”
- Products (aka TCDRs)

”denotes geophysical variables derived from FCDRs, often generated by blending satellite observations and in-situ data, and using physical model frameworks.”

# WCRP Overview

WCRP has worked towards system understanding through international coordination of

- ◆ global observations
- ◆ process studies
- ◆ modelling (RCM, AGCM, OGCM, CGCM)
- ◆ working units: projects, focussed on stratosphere, cryosphere, energy & water cycle, climate variability and predictability, and various modelling and obs. Working Groups