



# Coordination Instruments & Satellite Observation of the Climate System: the Contribution of CEOS

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# From CEOS to GxOS...

- **CEOS, the Committee on Earth Observation Satellites, was formed in 1984 with a view to coordinate space agencies activities in Earth remote sensing**
  - CEOS has now 26 members (mostly space agencies) and 20 Associates (national and international organisations)
  - ESA is a founder member and a very active contributor.
- **The international programs GCOS, GOOS and GTOS (for Global Climate, Ocean and Terrestrial Observing Systems) were initiated in the 1990s to develop scientific consensus on observational needs in these three domains**

# ... through to IGOS, GEO and GEOSS

- The IGOS (Integrated Global Observing Strategy) Partnership was created in 1998 to establish an observing strategy on an thematic basis i.e. ocean, water cycle, cryosphere...(up to 9 themes)
  - IGOS includes CEOS, the GxOS, United Nations agencies (WMO, IOC, UNEP, UNESCO, FAO), global change science programs (WCRP, IGBP, IHDP, DIVERSITAS), ICSU and IGFA\*
- The GEO (Group on Earth Observation) and GEOSS (Global Earth Observing System of Systems), launched in 2003, provide the policy framework necessary to the successful achievement of all these initiatives

*WMO: World Meteorological Organization*

*IOC: Inter-governmental Oceanographic Commission*

*UNEP: United Nations Environmental Program*

*UNESCO: UN educational, Scientific and Cultural Organisation*

*FAO: Food and Agriculture Organization*

*WCRP: World Climate research Program*

*IGBP: International Geosphere-Biosphere program*

*IHDP: International Human Dimension Program*

*ICSU: International Council of Science*

*IGFA: International Group of Funding Agencies for Global Change Research*

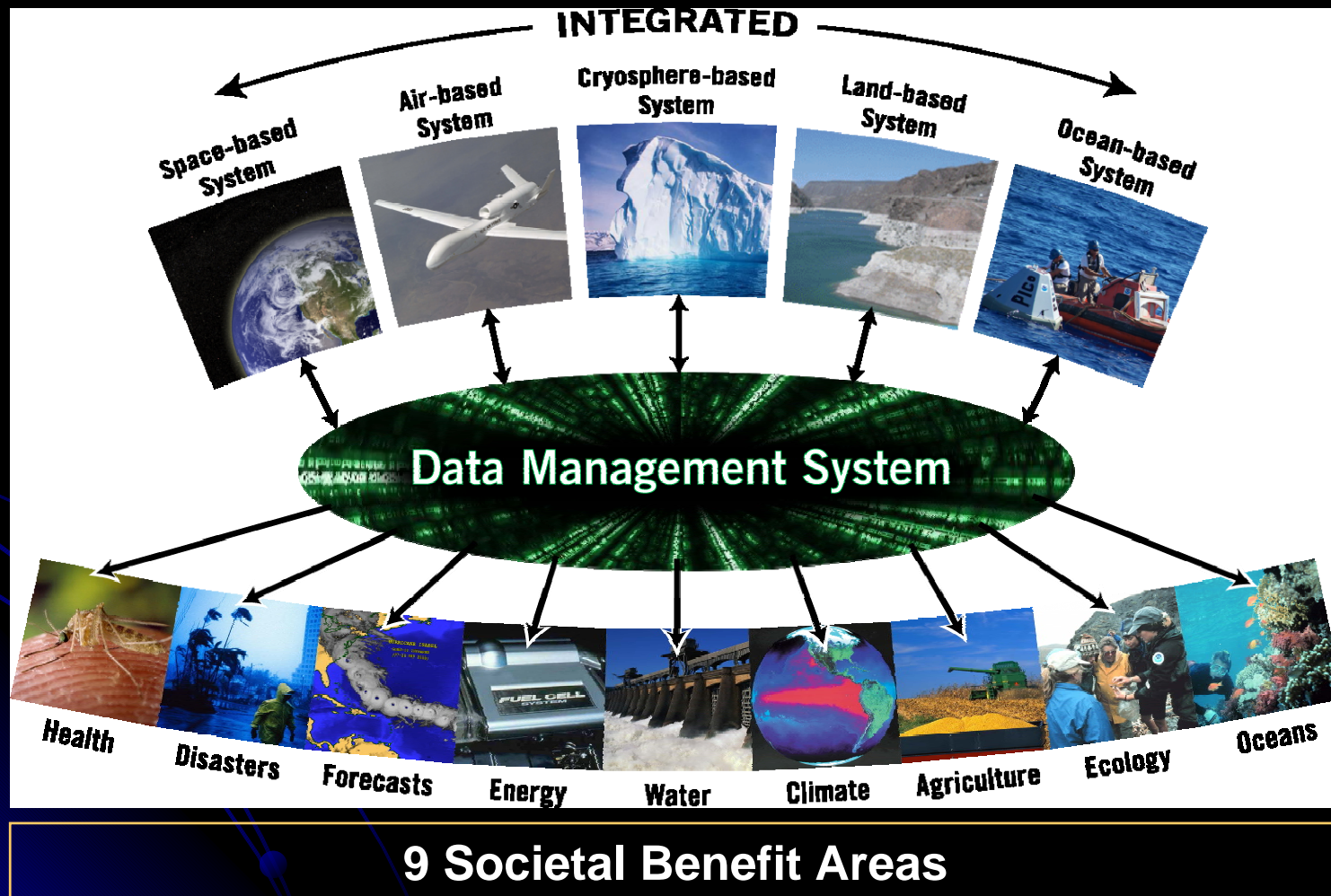
# GEO Summits

- **EOS I**
  - 31 July 2003, Washington, DC, USA
  - 34 countries and 20 international organizations
- **EOS II**
  - 25 April 2004, Tokyo, Japan
  - 47 countries and 26 international organizations
- **EOS III**
  - February 2005, Brussels, EU
  - About 60 countries (plus the European Commission) and over 40 international organizations
- **4<sup>th</sup> GEO Ministerial Summit**
  - Cape Town, 30 November, 2007
  - 72 countries (and the EC), over 50 international organizations





# GEOSS : A Global Earth Observation System of Systems



# GEOSS, a comprehensive, sustained, global observing system

- **Building a global observing system is surely not enough**
  - The observing system must be sustained—producing accurate data on a continuing basis.
- **Most current observing systems have been developed in a research context**
  - Once their value has been established, these capabilities need to transition into ongoing, 'operational' capabilities.

# The case for Climate

- **Climate is one of the nine GEOSS Societal Benefit Areas (SBAs), and certainly the most stringent in terms of observational requirements (sampling, precision, stability, calibration, validation, continuity, overlap, etc.)**
- **Over the years, GCOS has produced**
  - Two “Adequacy Reports” (October 1998, April 2003)
  - A 10-year “Implementation Plan” (October 2004)
- **GCOS requirements have been endorsed by the United Nations Framework Convention on Climate Change (UNFCCC).**

# Conference of the Parties (COP-10) Decision on Research and Systematic Observation

- “Invites Parties that support space agencies involved in global observations to request these agencies to provide a coordinated response to the needs expressed in the GCOS Implementation Plan” (December 2004)



# GCOS Implementation Plan

## Content

- **GCOS Climate Monitoring Principles**
  - Sampling, continuity, overlap, calibration, etc.
- **Cross-cutting actions**
  - Integrated products, reprocessing, reanalysis, archiving, etc.
- **28 Essential Climate Variables (ECVs)**
  - **Atmosphere:** Surface wind speed and direction, upper air temperature, water vapour, cloud properties, precipitation, ERB, ozone, aerosols, CO<sub>2</sub>, CH<sub>4</sub> and other GHGs
  - **Ocean:** Sea ice, sea level, SST, ocean colour, sea state, salinity
  - **Land:** lakes area, level and temperature, glaciers, ice caps and ice sheets, snow cover, albedo, land cover, fAPAR, LAI, biomass, fire disturbances, soil moisture
- **Types of requirements**
  - Reprocessing of past records, provision of archived data sets, requirements for future missions, calibration/validation issues

# COP-10 Decision on Research and Systematic Observation (ctd)

- **CEOS was asked to present its response to the Subsidiary Body on Scientific and Technical Advice (SBSTA) at COP-12 in November 2006.**

# GCOS Implementation Plan “Satellite Supplement”

## Systematic Observation Requirements for Satellite-based Products for Climate

Supplemental details to the satellite-based component of the “Implementation Plan for the Global Observing System for Climate in Support of the UNFCCC (GCOS-92)”

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GCOS Secretariat

GCOS-107  
WMO/TD No. 1338

September 2006

# The CEOS Response to GCOS Implementation Plan

*CEOS Response to the GCOS Implementation Plan – September 2006*

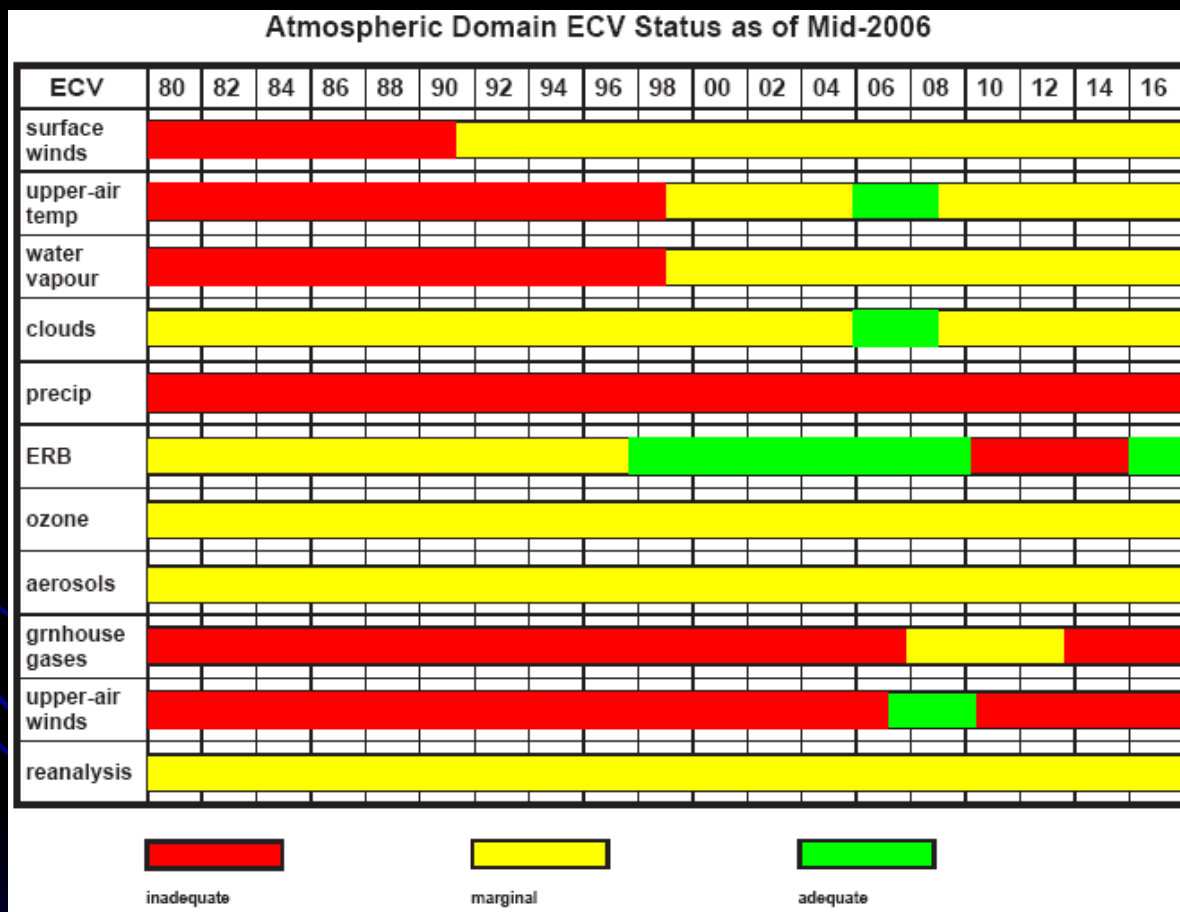
## Satellite Observation of the Climate System

The Committee on Earth Observation Satellites (CEOS) Response  
to the Global Climate Observing System (GCOS) Implementation  
Plan (IP)

**Developed by CEOS and submitted to the United Nations Framework  
Convention on Climate Change (UNFCCC) Subsidiary Body on Scientific  
and Technical Advice (SBSTA) on behalf of CEOS by the United States of  
America (USA) delegation**

**Visit <http://www.ceos.org> for the full report**

# CEOS Assessment of Atmosphere Essential Climate Variables (Atmosphere domain)





# Content of CEOS Response

- The CEOS Response includes **59 actions** covering the Atmosphere, Ocean and Terrestrial domains, plus a number of **Cross-cutting issues**. These cover:
  - What can be achieved by **better coordination of existing capabilities** or in **planning future capabilities**
    - Immediate responses (e.g., reprocessing of past data sets, improvement of data availability for reanalysis)
    - Plans for improved coordination of future missions, through the establishment of “Virtual Constellations”
  - Those improvements that require **additional means or mandates** beyond the present capacity of space agencies (e.g., the issue of transferring systems from research to operational status).
- “CEOS appreciates that meeting the UNFCCC climate needs described by GCOS would also contribute significantly to most, if not all, of the other GEOSS Societal Benefit Areas”

# The CEOS Implementation Plan

- In December 2005, CEOS offered to Lead GEO Task CL-06-02 (“Secure provision of key climate data from satellites”), which has the same objectives
  - CEOS (under leadership of USGS) and GCOS have worked together in 2006 to complete this task
- Further, the CEOS IP was prepared in answer to the GEOSS IP. Adopted at CEOS Plenary in Hawaii last year, it has as objective to become the “space arm” of GEO.

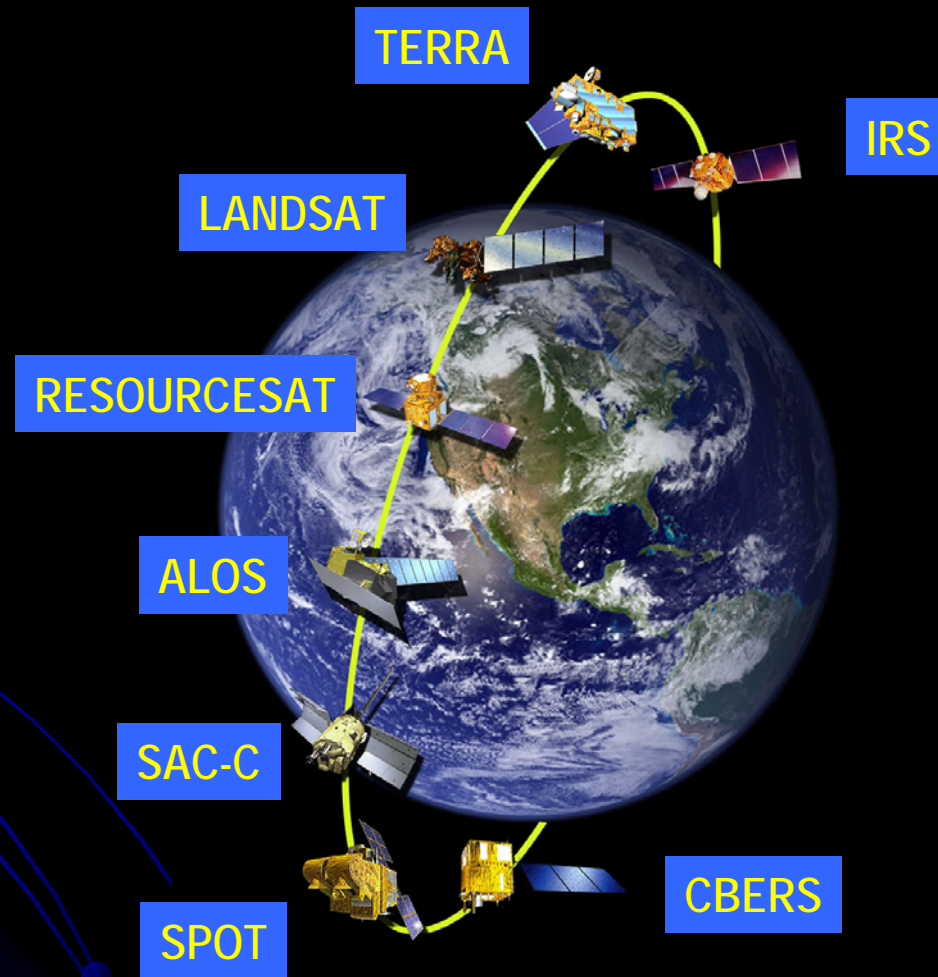
# Current status within CEOS

- Climate Focal Points have been designated by BNSC, CNES, CSA, DLR, EC/JRC, ESA, EUMETSAT, INPE, JAXA, NASA, NOAA, NSC, USGS, as well as by FAO and WCRP
- CEOS and GCOS have jointly defined lists of 1<sup>st</sup>, 2<sup>nd</sup> and 3<sup>rd</sup> priority actions, based on an evaluation of their ability to deliver significant results in the short (1-2yr), medium (4-6yr) and long term (~10yr).
  - All 1<sup>st</sup> Priority actions have been assigned to an “Action Team”, with a Team Leader. Action Plans are being defined, and a reporting process has been initiated.
- Some encouraging initial results can already be noted.

# CEOS Virtual Constellations

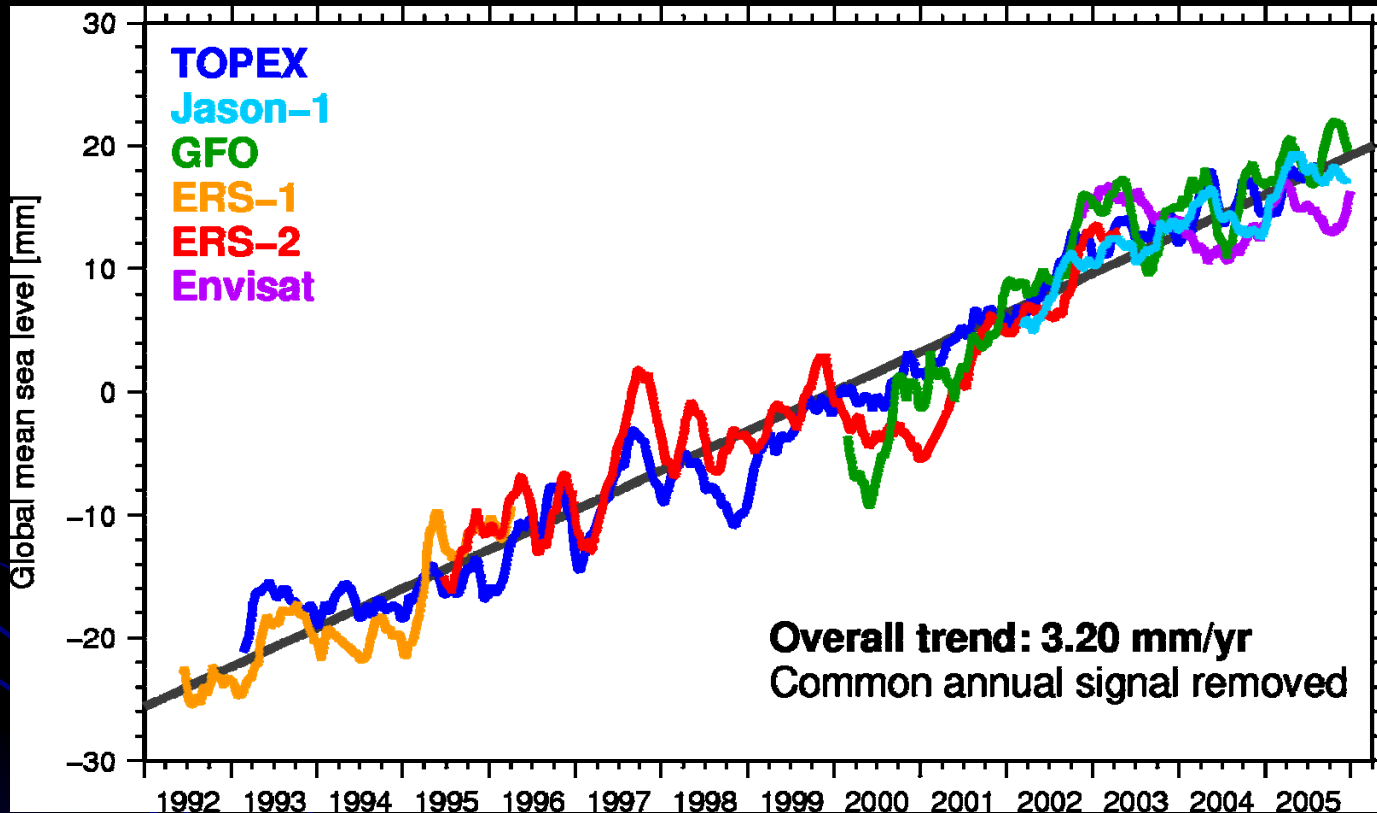
- **New implementation framework**
  - To inspire and facilitate commitments aimed at harmonizing observations within CEOS members
  - To move CEOS discussions and agendas away from the general to the specific, based on agreed standards and minimum requirements (technical and institutional)
- **Four Prototype Virtual Constellations – all of interest for Climate**
  - Land Surface Imaging
  - Ocean Surface Topography
  - Global Precipitation Mission
  - Atmospheric Composition
- **Study Teams established for each Constellation**
- **GEO Task DA-07-03 “Virtual constellations”**

# Land Surface Imaging Constellation





# The Ocean Surface Topography Constellation



Sea level is rising at a rate of 3.2 mm/yr  
as measured by 6 different altimeters

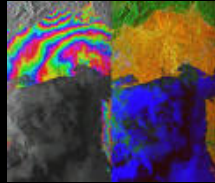
# The European GMES initiative

- In Europe, the GMES (Global Monitoring for Environment and Security) concept was launched in 1998. The initiative was jointly endorsed by the EU Council and ESA in 2001.
- GMES aims at providing Europe with “*an autonomous observational capability in support of European policies pertaining to environment and security*”
- GMES encompasses the European contribution to GEOSS

# The GMES space component

- In December 2005 the European Space Agency submitted to its members a program proposal aimed at responding to the long-term needs for space-based observation of GMES.
- The satellites developed for this purpose are called “Sentinels”. They will be partly funded by the EC.
- Ministers of ESA’s Member States subscribed 256 M€ for the initial definition studies, i.e., 128 % of the requested amount. The next step (segment 2) will be proposed to Ministers this November.

# The Sentinels



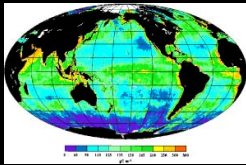
## Sentinel 1 – Synthetic Aperture Radar (SAR)

All weather imagery, interferometry, polar regions



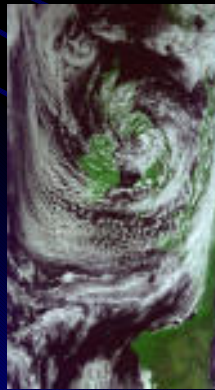
## Sentinel 2 – Super-spectral optical imagery

Continuity of Landsat, Spot & Vegetation data



## Sentinel 3 – Ocean monitoring

Ocean color, sea surface temperature and sea surface topography



## Sentinel 4 – Atmospheric Monitoring from GEO

Atmospheric composition, trans-boundary pollution

## Sentinel 5 – Atmospheric Monitoring from LEO

Atmospheric composition

# The European Space Agency's role

- Together with Eumetsat's meteorological operational satellites and with nationally-funded systems, the Sentinels will form the backbone of an operational system addressing European policies needs, including climate.
- ESA is also proposing a "climate monitoring initiative" to its Member states, with a view "to capitalize on previous investments in the space and ground segment in ESA, its Member states and its European partners", and "to ensure the delivery of appropriate climate information as a direct response to the well-defined requirements emanating from the sovereign states signatory to the UNFCCC."



# Conclusions

- There is a growing concern worldwide about the importance of monitoring the Earth's climate system.
- Satellites provide a unique way to provide sustainable information about it.
- There are a number of initiatives and mechanisms to co-ordinate the response to the needs of the climate user community.
- CEOS is fully involved in such co-ordination, by providing the "space-arm" of GEO, also in the climate SBA.