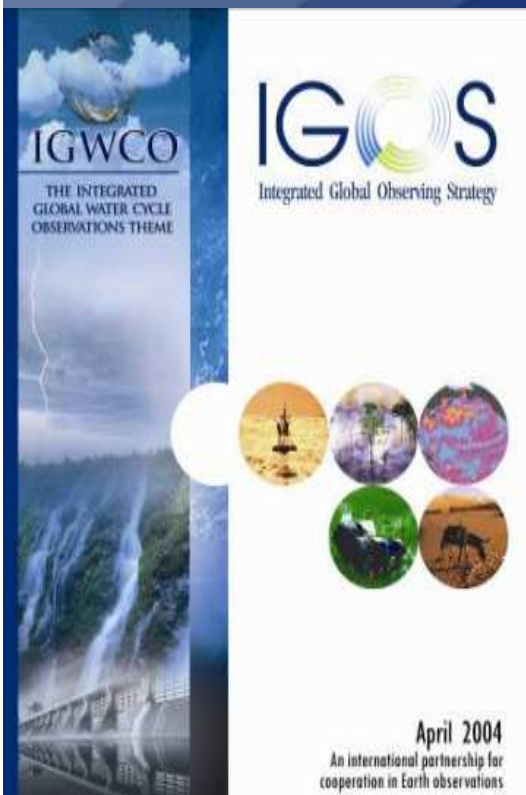


CEOS contribution to the Global Water Cycle Monitoring

Osamu Ochiai

CEOS Water SBA Coordinator



3rd GEOSS AfWCCI Workshop
El jadida, Morocco
4 – 5 Feb. 2013

Contents



**1.Space based observations of
Water Cycle variables**

2.CEOS roles and activities

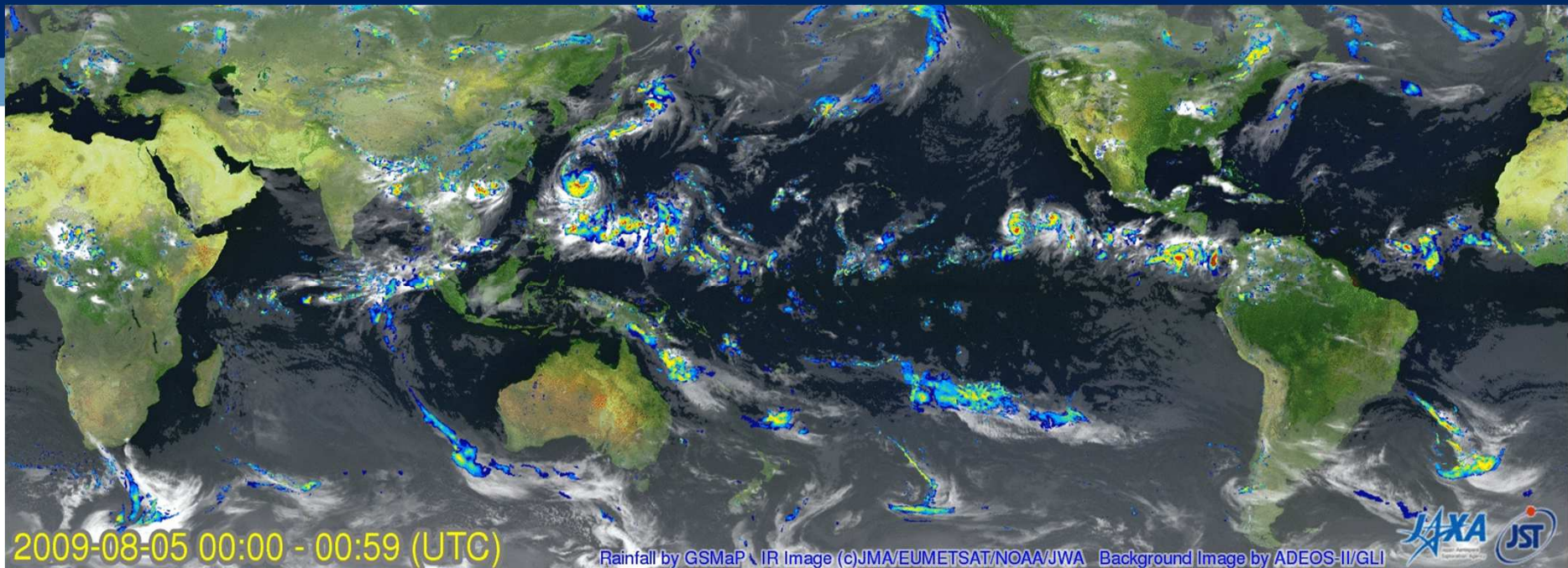


1. Space based observations of Water Cycle variables

Multitude of contributing systems



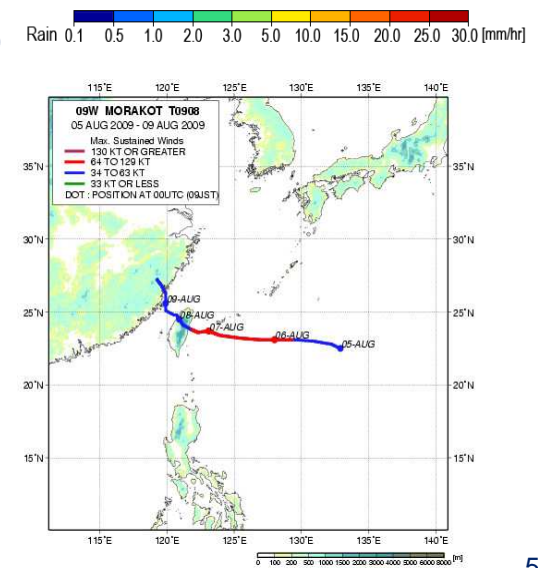
JAXA - Global Rainfall Map in Near Real Time



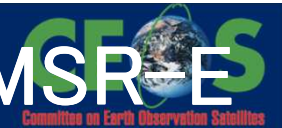
Typhoon MORAKOT (09W): Aug. 5 – 10, 2009 (Big impact in Chinese Taipei)

- Global rainfall map merging TRMM, AMSR-E and other satellite information
- Available 4-hour after observation, hourly update
- 0.1-degree latitude/longitude grid

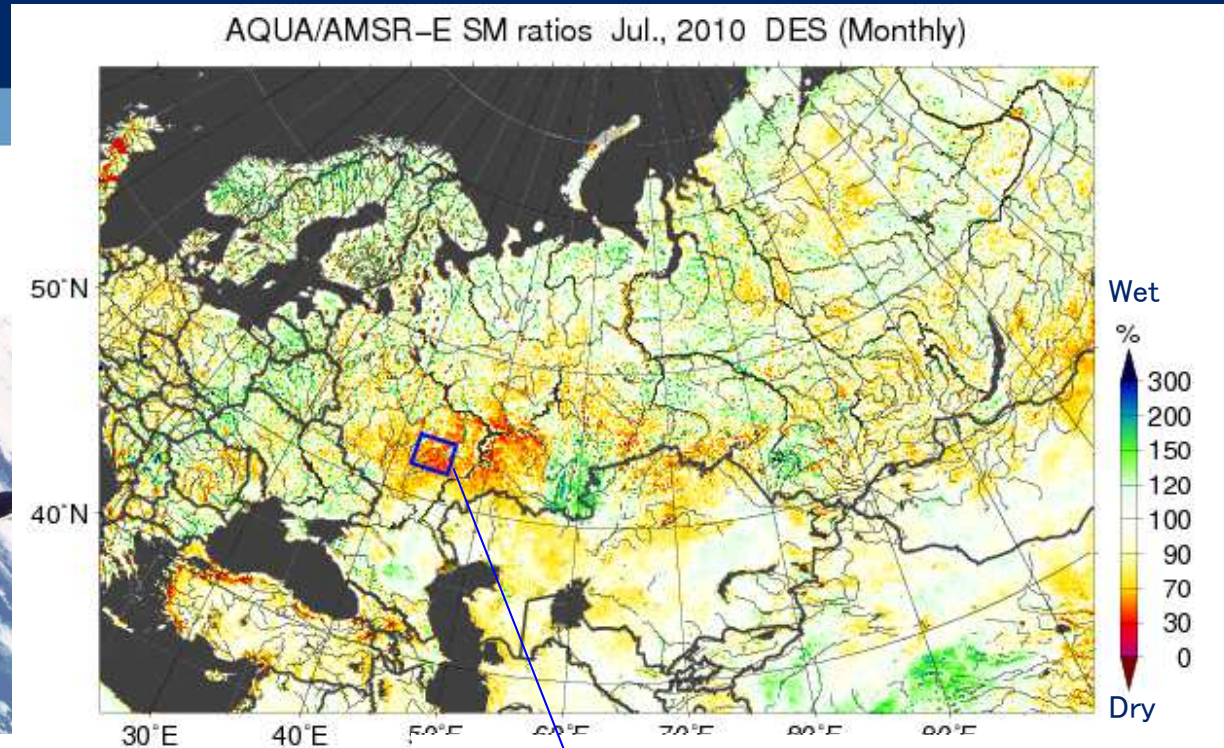
<http://sharaku.eorc.jaxa.jp/GSMaP/>



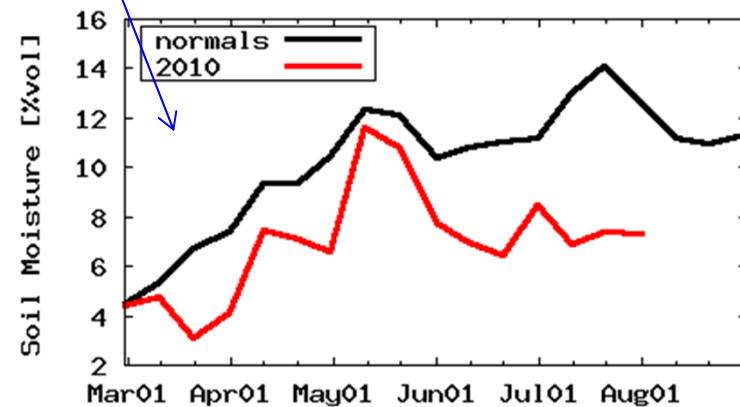
JAXA Drought Monitoring over Russia by AMSR-E



AMSR-E on US EOS Aqua satellite.



□ JAXA provided this data to the Russian government



Monthly changes of soil moisture (March-August)

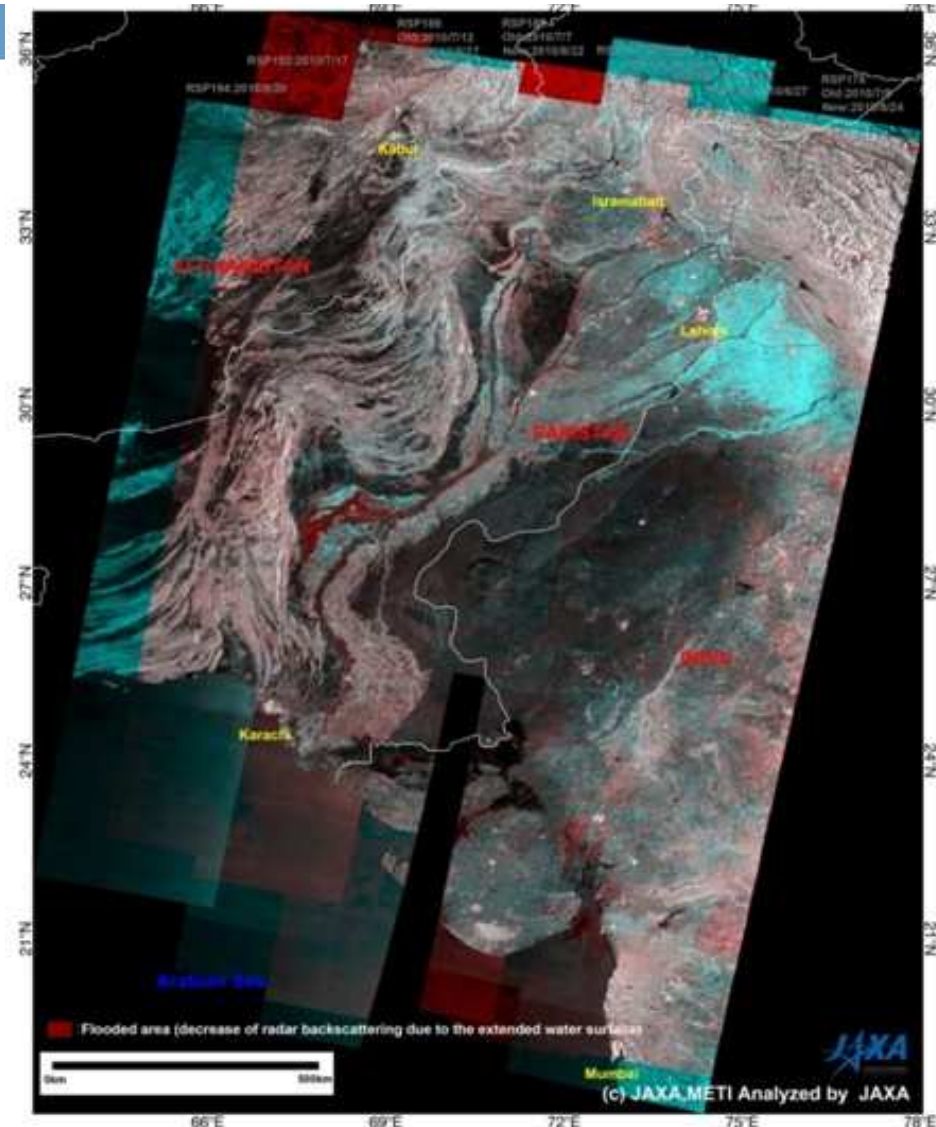
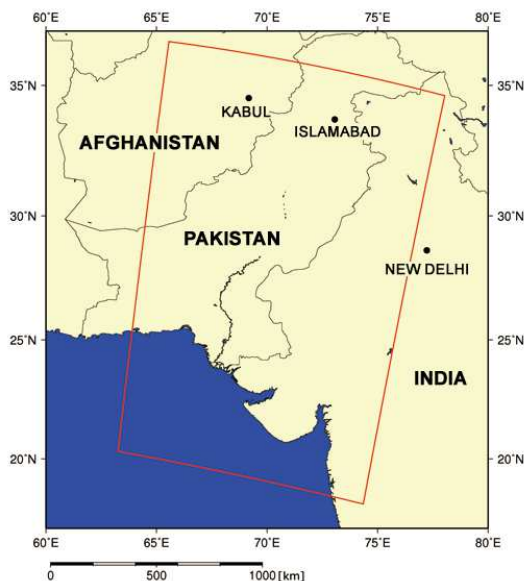
Black: Nominal trend (2002-2009 average)

Red : Trend in 2010

JAXA - Water Related Disaster response Flood in Pakistan August 2010



- JAXA analyzed ALOS Scan-SAR data of Pakistan observed from June to August 2010.
- Red represents the flooded areas of the Indus river region
- JAXA provided this data to the Pakistan government



<http://sentinel.tksc.jaxa.jp/>

NASA - Soil Moisture Active/Passive (SMAP) Mission



Soil Moisture Mapping

A *dedicated* soil moisture mission selected as a new Earth science mission

NASA fly an active / passive microwave soil moisture with mission in the 2014 timeframe

SMAP consists of an L-Band radar & radiometer in a low Earth, sun-synchronous orbit

Extends soil moisture to deeper depths with improved spatial resolution

Societal Benefits:



- Water, Energy & Carbon Cycles



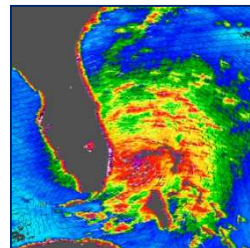
- Water and Food



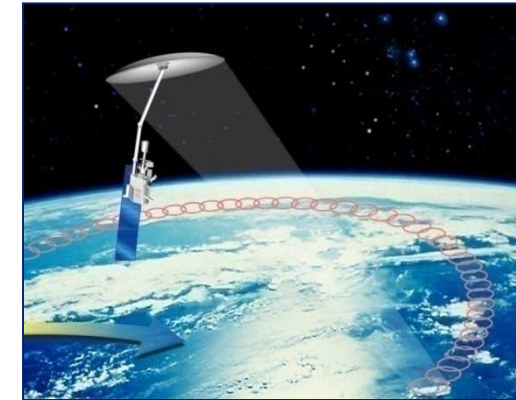
- Water Quality and Human Health



- Water and the Environment



- Weather & Climate Prediction
- Severe Storm Forecasts
- Agriculture Food Production
- Drought Monitoring and Assessment
- Flood Prediction, Assessment and Inundation Mapping



SMAP Applications web site
<http://smap.jpl.nasa.gov/benefit/>

NASA - Surface Water Ocean Topography (SWOT)

Stream Discharge and Surface Water Height

Committee on Earth Observation Satellites



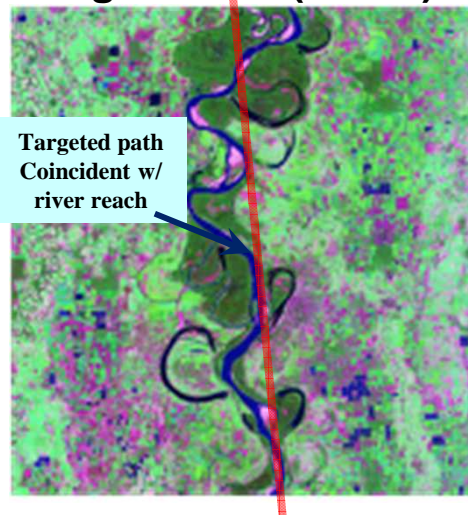
Planned Mission – 2 (Around 2019)

Motivation:

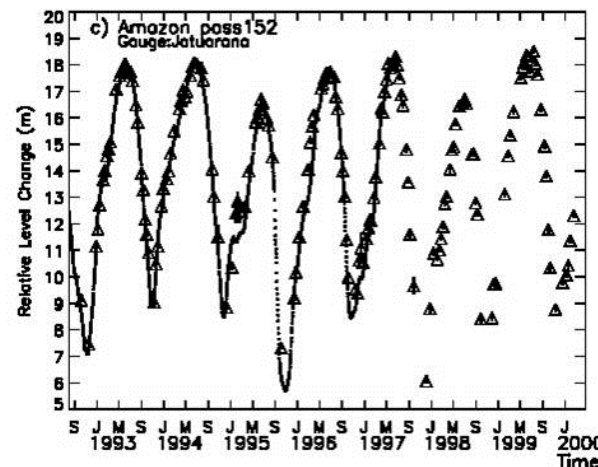
- critical water cycle component
- essential for water resource planning
- stream discharge and water height data are difficult to obtain globally

Mission Concepts:

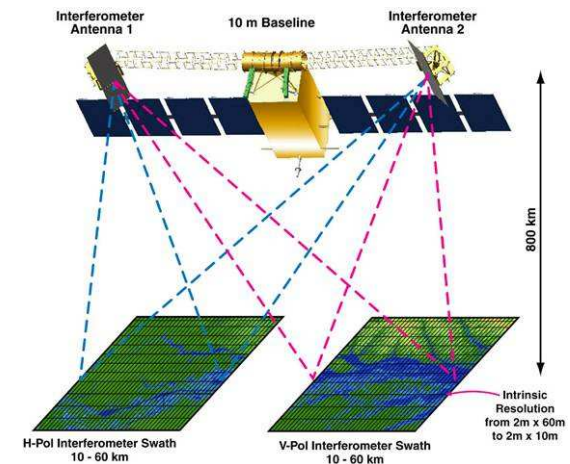
Laser Altimetry Concept e.g. ICESat (GSFC)



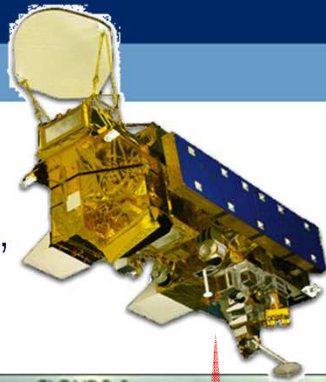
Radar Altimetry Concept e.g. Topex/Poseidon over Amazon R.



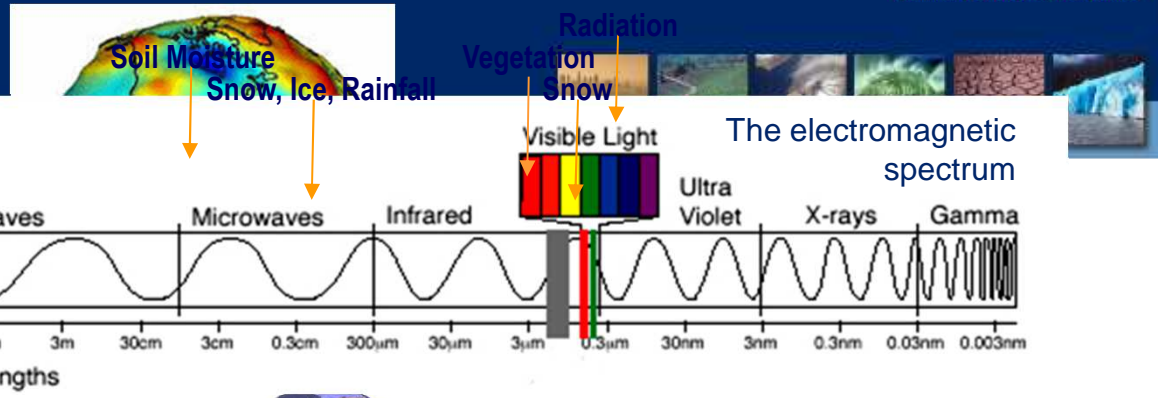
Interferometer Concept (JPL)



NASA - Remote Sensing of the Water Cycle



Aqua:
MODIS,
AMSR-E,
etc.

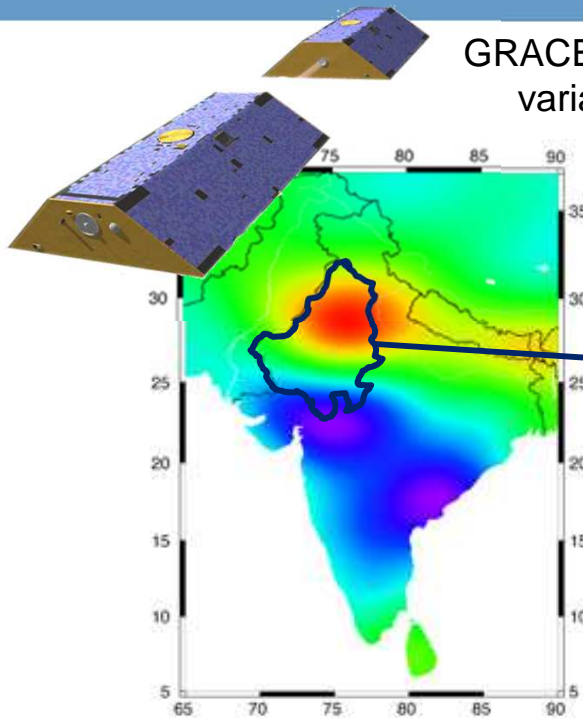


Traditional radiation-based remote sensing technologies measure variables such as temperature, soil moisture, or snow cover. GRACE satellites offer a different perspective, measuring gravity changes in groundwater levels.

NASA - GRACE Reveals Massive Depletion of Groundwater in NW India

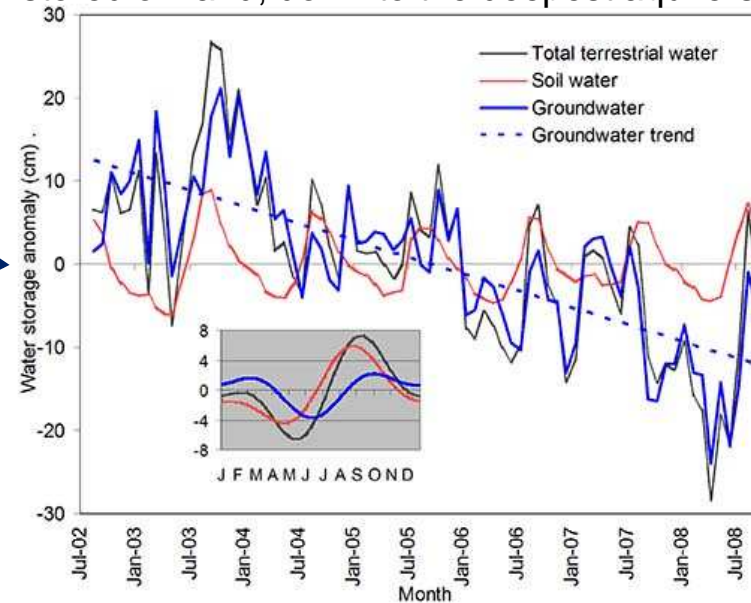


The water table is declining at an average rate of 33 cm/yr



GRACE is unique among Earth observing missions in its ability to monitor variations in all water stored on land, down to the deepest aquifers.

Rodell, Velicogna, and Famiglietti, *Nature*, 2009



Trends in groundwater storage during 2002-08, with increases in blue and decreases in red. The study region is outlined.

Time series of total water from GRACE, simulated soil water, and estimated groundwater, as equivalent layers of water (cm) averaged over the region. The mean rate of groundwater depletion is 4 cm/yr. Inset: Seasonal cycle.

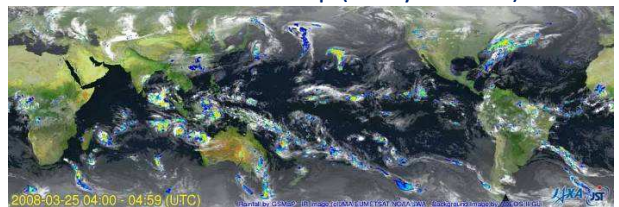
During the study period, 2002-08, 109 km³ of groundwater was lost from the states of Rajasthan, Punjab, and Haryana; triple the capacity of Lake Mead

Data Integration and Inform to users

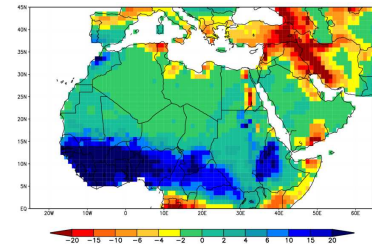


Global Precipitation Mission (GPM)
 Climate change assessment;
 Improvement in weather forecasts;
 Flood prediction;
 Water resource management;
 Other applications (Agriculture, etc).

Global Rainfall Map (every 4 hours)



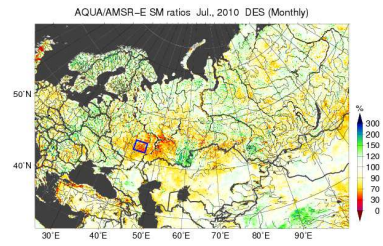
GRACE measures changes in total terrestrial water storage, including groundwater, soil moisture, snow, and surface water.



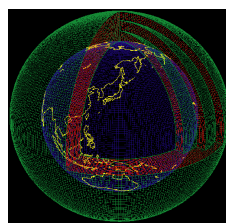
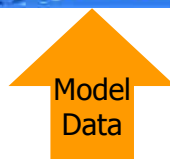
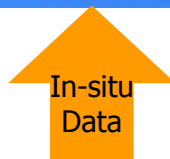
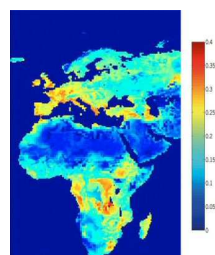
Wide users
 Incl. scientists and general users



Passive Microwave radiometer instrument can be detected the risk of drought.



SMOS measures soil moisture over the Europe and African region.





2. CEOS roles and activities

CEOS Background

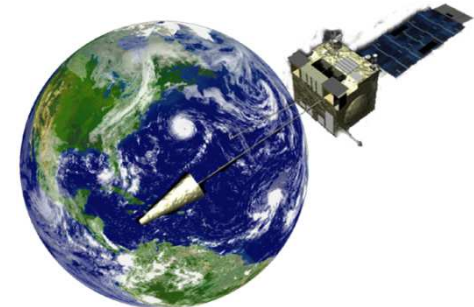


- Established in 1984 under auspices of G-7 Economic Summit of Industrialized Nations
 - Focal point for international coordination of space-related Earth Observation (EO) activities
 - Optimize benefits through cooperation of members in mission planning and in development of compatible data products, formats, services, applications, and policies
- Operates through best efforts of Members and Associates via voluntary contributions
- 30 Members (Space Agencies), 23 Associates (UN Agencies, Phase A programs or supporting ground facility programs)
- As the space component of the Global Earth Observation System of Systems (GEOSS), CEOS is implementing high priority actions in support of Group on Earth Observation (GEO) Tasks

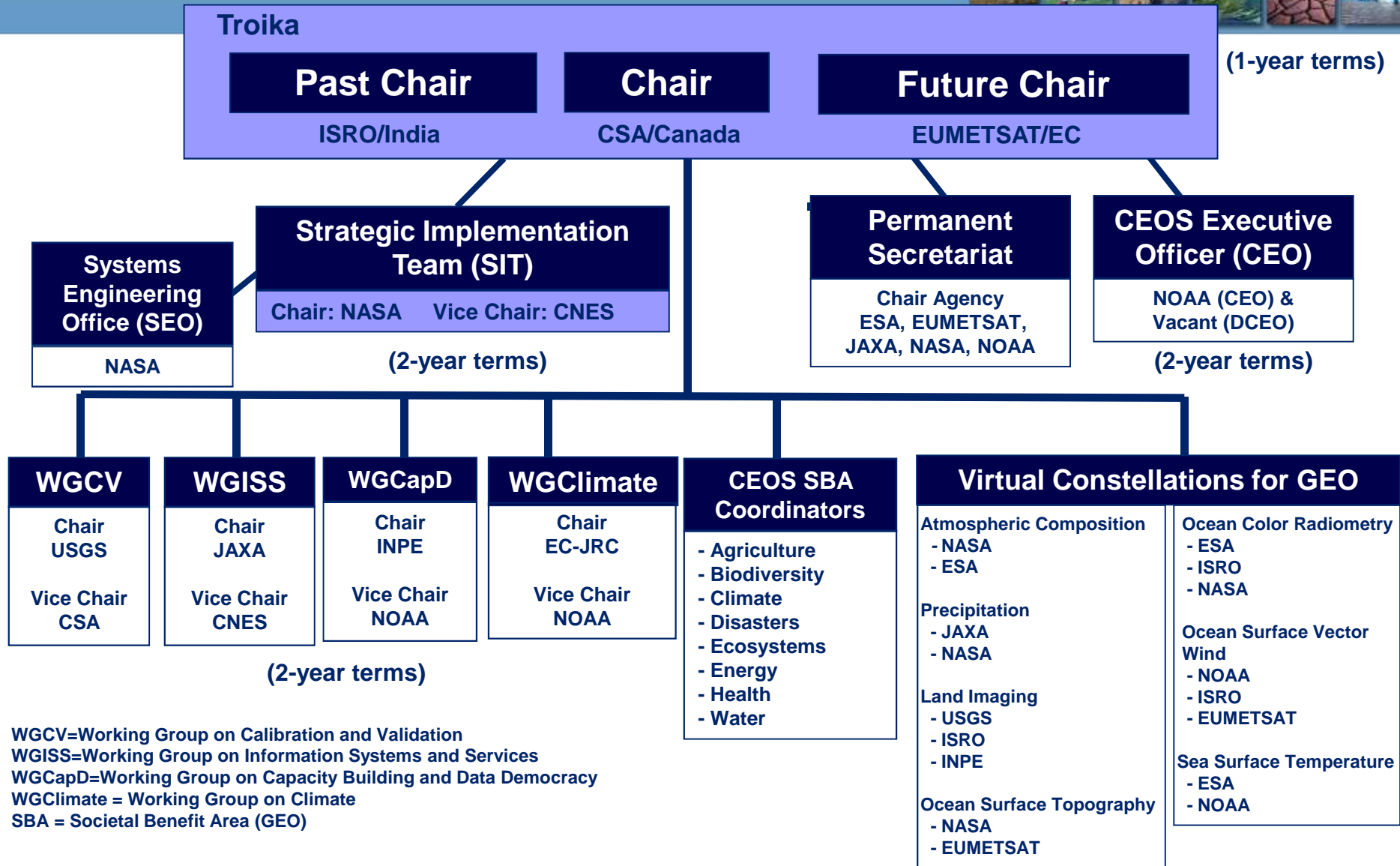
Primary Objectives of CEOS



1. To optimize benefits of space-borne Earth observations through:
 - Cooperation of its Members in mission planning
 - Development of compatible data products, formats, services, applications, and policies;
2. To serve as a focal point for international coordination of space-related Earth observation activities;
3. To exchange policy and technical information to encourage complementarity and compatibility of observation and data exchange systems.



CEOS Structure 2012-2013



Strategic Implementation Team (SIT)



- Created in 1996 to advance the involvement of CEOS in the development of the Integrated Global Observing System (IGOS)
- Plays a central role in coordination of existing and future missions of CEOS Agencies in support of GEO, GCOS, WMO, UNFCCC, etc.
- Comprised of the Principals of CEOS Member Agencies and some Associates with the authority to commit Agency support to initiatives
- SIT Chair Key Responsibilities
 - Lead CEOS interaction with GEO/GEOSS and strengthen linkages to GEO and GEOSS
 - Lead CEOS Virtual Constellation for GEO development and implementation activities
 - Assist CEOS interaction with GEO Committees

SIT Objective: To define, characterize, and develop the vision for CEOS participation in GEO and strengthen CEOS linkages to GEOSS

CEOS Virtual Constellations for GEO



- CEOS Virtual Constellations for GEO demonstrate the value of collaborative partnerships in addressing key observational gaps and bridging multiple GEO Societal Benefit Areas while maintaining the independence of individual contributions
- Focus dialogue from “all topics/all agencies” to smaller, more specialized groups
- Guidance for design and development of future systems to meet the broad spectrum of EO requirements
 - Avoid duplication and overlap in EO efforts
 - Close information gaps for GEO SBAs
 - Establish and sustain global EO coverage and data availability

Atmospheric Composition Co-Leads: NASA and ESA	Land Surface Imaging (LSI) Co-Leads: USGS, ISRO, and INPE	Ocean Surface Topography Co-Leads: NOAA and EUMETSAT	Precipitation Co-Leads: NASA and JAXA	Ocean Colour Radiometry Co-Leads: EC-JRC , JAXA, and NASA	Ocean Surface Vector Wind Co-Leads: NOAA, ISRO, and EUMETSAT
Sea Surface Temperature Co-Leads: ESA and NOAA					

CEOS Working Groups



Working groups enhance technical cooperation among CEOS Agencies in specific topical areas with broad international benefit.

- **Working Group on Calibration and Validation (WGCV)**
 - To ensure long-term confidence in the accuracy and quality of Earth observation data and products
- **Working Group on Information Systems and Services (WGISS)**
 - To coordinate the development of Earth observation satellite systems and services which manage and supply the data and information from CEOS Agencies' missions
- **Working Group on Capacity Building and Data Democracy (WGCapD)**
 - To increase the capacity of institutions in less developed countries for effective use of Earth Observation data for the benefit of society and to achieve sustainable development
- **Working Group on Climate (WGClimate)**
 - To facilitate the use of Essential Climate Variable (ECV) time-series through coordination Member Agencies' initiatives and activities

2013 CEOS expected outcomes



- **Climate Change (including Forest Carbon Assessments)**
 - Development of Climate Data Records (CDRs) and related data sets addressing Essential Climate Variables established by the Global Climate Observing System (GCOS);
 - Continued cooperation with GEO, GCOS, the World Meteorological Organization (WMO), and the Coordination Group for Meteorological Satellites (CGMS) in the development of a space-based system to support climate information and adaptation;
 - Further alignment of the Virtual Constellations objectives as building blocks of the space-based climate information strategy and as contributions to facilitating the observation of ECVs, as defined in the *CEOS Response to the Satellite Supplement of the 2010 GCOS IP*;
 - CEOS leadership within and support to GEO Global Forest Carbon Tracking (FCT) Task and GEO Global Forest Observation Initiative (GFOI); and,
 - Publication of the *CEOS Strategy for Carbon Observations from Space*.

2013 CEOS expected outcomes (cont'd)



- **Environmental Security (Support to Food Security and Disaster Risk Management)**

- Continued support to the Joint Experiments on Crop Assessment and Monitoring (JECAM) initiative;
- Enhanced support for Disaster Risk Management (DRM); and,
- Continued support to the Geohazards Supersites and Natural Laboratories initiative.

- **Capacity Building**

- Advancement of CEOS Data Democracy activities;
- Continued support to the development and operationalization of the GEOSS Common Infrastructure (GCI) and its CEOS-related elements; and,
- Continued CEOS leadership of, and support to, the Quality Assurance for Earth Observations (QA4EO) initiative.

2013 CEOS expected outcomes (cont'd)



- **Considering CEOS Support to Further Key Stakeholder Initiatives**

- Decision on whether and how CEOS Agencies may provide coordinated data acquisition support to the GEO Global Agricultural Monitoring (GEOGLAM) initiative;
- Continued dialogue on potential CEOS contributions to Integrated Water Cycle products and services;
- Continued dialogue on potential CEOS contributions to the GEO Biodiversity Observation Network (GEO BON);
- Dialogue on potential enhanced CEOS-level coordination to support improved research and monitoring of the Earth's polar regions; and
- Determine the level and scope of engagement of the four ocean-related Virtual Constellations in the GEO Blue Planet Task.

2013 CEOS expected outcomes (cont'd)



- **Continued and Enhanced CEOS Outreach to Key Stakeholders: GEO, UNFCCC, UN ISDR, UN CBD, G8/G20, and Others**
 - Engagement, attendance, and where appropriate, strategic involvement , reporting on CEOS achievements, and presentations at key meetings;
 - Maintenance to CEOS online services such as the CEOS website and Missions, Instruments and Measurements (MIM) database; and,
 - Publication of the CEOS Newsletter.

Summary



- CEOS recognizes the need for comprehensive data products support decision-making for efficient management of the world's water resources, based on coordinated, sustained observations of the water cycle on multiple scales. Current on-going activities are following;
 - The CEOS support to develop the GEO Water Cycle Strategy report.
 - The CEOS Precipitation Virtual Constellation is another key CEOS contribution to water-cycle management.
 - The CEOS Water Portal (<http://waterportal.ceos.org>) provides improved data access to scientists and general users supporting water-cycle management.
 - Capacity Building (Jacob's presentation)