CEOS Response to GCOS-IP Status of the 59 Actions

Agenda item: 24

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CEOS Climate Coordinator

CEOS 59 Actions

1. Ensuring continuity of climate-relevant satellite measurements (13 actions);
2. Taking a systematic approach to generating fundamental climate data records (FCDRs) (11actions);
3. Preserving climate data records (4 actions);
4. Ensuring access to climate data products (10 actions);
5. Coordinating international communities and interaction with users (10 actions); and
6. Addressing future measurement needs (11 actions).

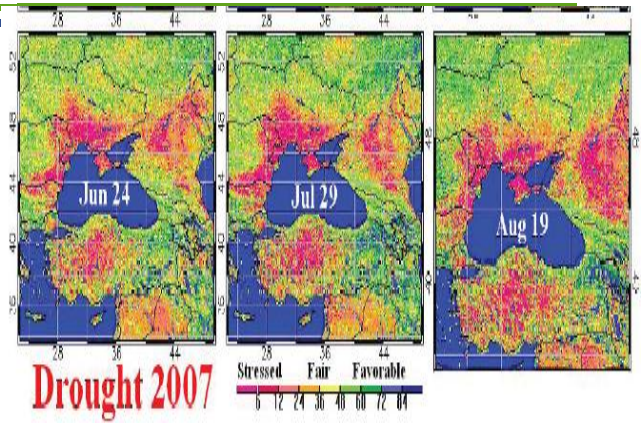
SIT-21

Challenges

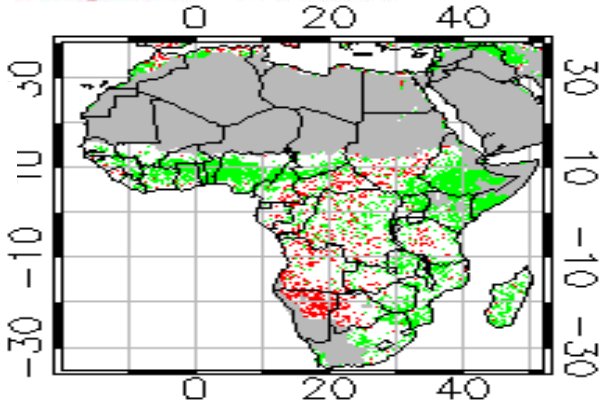
AVHRR - longest record
1981 - 2020+

- Sustaining research to develop and demonstrate utility of climate data records, including intercalibration
- Transitioning mature research products to operations.
- Cultivating and sustaining international collaboration on algorithm development and CDR generation
- Generation of Climate Information Records
- Engagement of the user community
- Engagement of the science community on understanding physical processes and impacts on society

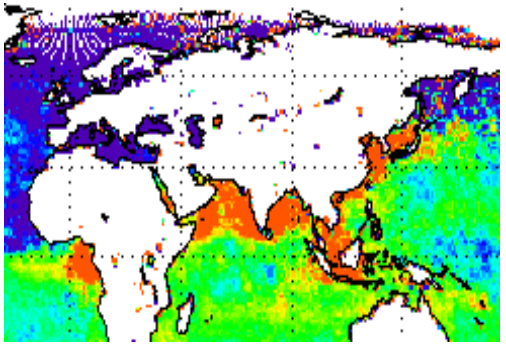
Vegetation Health



Malaria Index - Red is high risk April 20, 2008

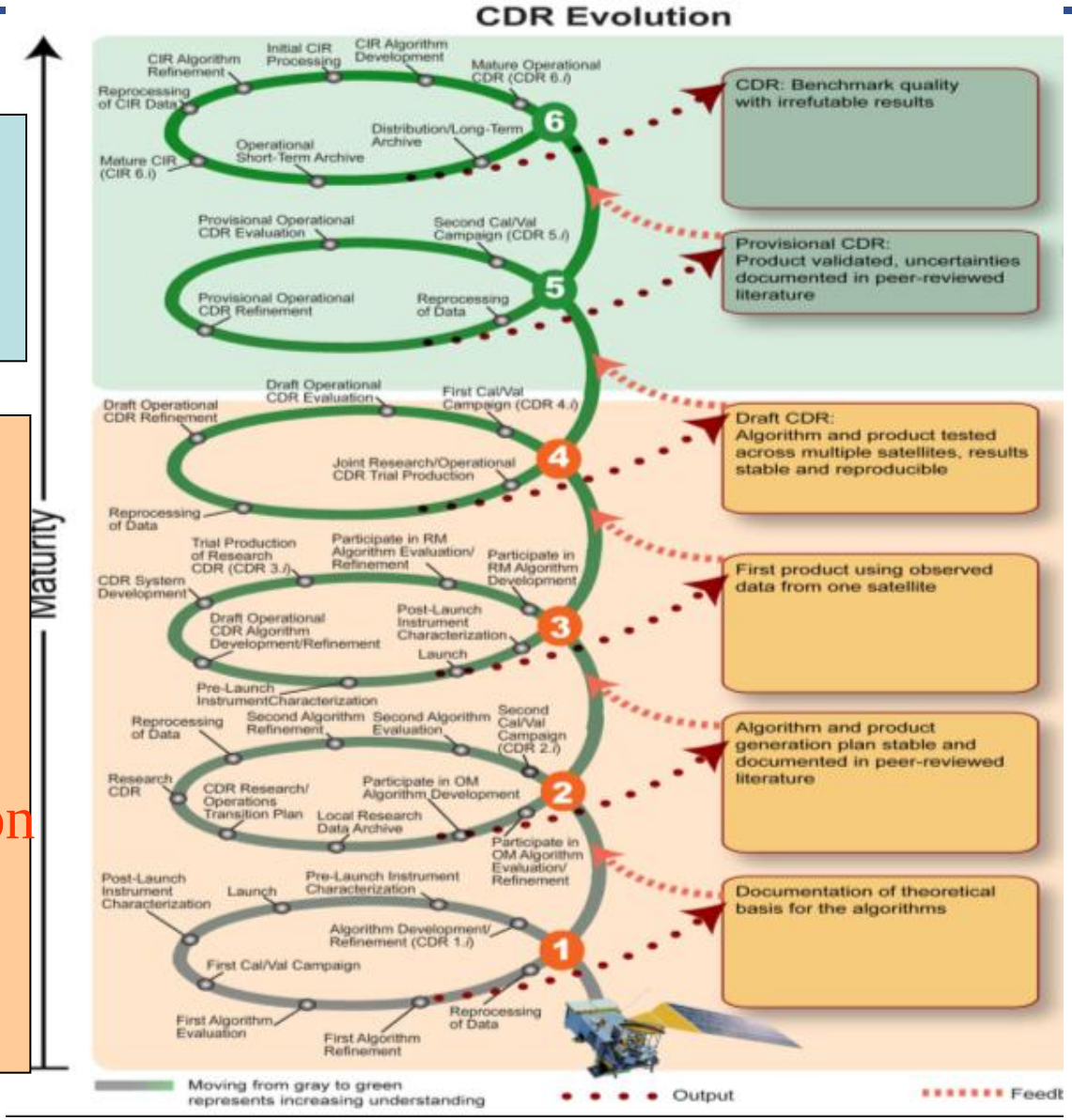


Aerosol trend; Red = significant large trends



Ready for Operations

Research and Demonstration



CEOS Climate Actions

- A first round of climate actions assessment, in coordination with GCOS, led to the identification of:
  - 22 “Priority 1 actions”
    - Deemed to be progressed immediately
    - Capable of delivering significant outcomes within a 1-2 year timescale.
  - 32 “Priority 2 actions”
    - Continuous, on-going, or require additional information from potential contributors in order to be suitably defined
    - will not necessarily deliver significant results in the 1-2 year timescale.
  - 5 “Priority 3 actions”
    - Considered premature at this stage.

CEOS CLIMATE ACTION STATUS REPORT

Action N°	Action Statement	Leader	Climate Action Team
A-3	CEOS will support in 2007 investigations of cloud properties and cloud trends from combined satellite imager plus sounder measurements of clouds (with horizontal as well as vertical information) using Cloudsat/Calipso for validation.	**Hal Maring (NASA)**	Andy Heidinger (NOAA) Didier Renaut (CNES) Karl-Göran Karlsson (SMHI/EUMETSAT CM-SAF) Bernhard Mayer (DLR/IPA), Gerhard Gesell (DLR/DFD-KA) Thomas Piekutowski (CSA) Others
Reference Documents	GCOS-IP (GCOS-92) Actions A22 & A23 GCOS-IP Satellite Supplement (GCOS-107), § 3.1.4		
Related ECVs	Cloud Properties	**Partner organizations**	
Related SBAs	Weather, Energy	GEWEX Radiation Panel, International TOVS Working Group (ITWG), others	

Action Plan	
NASA	NASA supports a number of investigations of cloud properties and climatologies by NASA scientists as well as scientists from other USA agencies, universities, and private companies. These studies are funded as part of the CALIPSO and CloudSat sciences teams, Earth Observing System satellite science teams, and the Research &Analysis Programs (e.g., Radiation Sciences Program, Upper Atmospheric Research Program, and Atmospheric Dynamics Program). These activities include modelling and analysis of satellite observations, airborne *in situ* and remote sensing measurements, as well as ground-based remote sensing observations.
NOAA	NOAA scientists and university partners have submitted a proposal to NASA to fund an effort to make cloud properties from combined satellite imager and sounder data. While waiting for this proposal to be funded, NOAA has archived one month of CALIPSO data and developed tools to validate NOAA's existing cloud products. Concerning combined imager/sounding applications: Ongoing development of an enhanced cloud top product based on a combination of AVHRR and IASI data. Interaction with scientists working with the EPS/MetOp processing in Darmstadt initiated. According to the CM-SAF plan this enhanced product will be under reviews in 2010 (Product Consolidation Review) and 2011 (Operational Readiness Review).
CNES	CNES is operating two R&D satellites able to monitor cloud properties: Calipso (with NASA) and Parasol. A thematic data center, ICARE, is supported by CNES and other French institutes to produce and distribute global satellite data sets on atmospheric clouds, aerosols and water vapor. CNES is supporting a lot of scientists using imager/sounder satellite data to monitor cloud properties: Parasol-Modis algorithms for global cloud properties, Calipso (Caliop and IIR) - Cloudsat algorithms and validation for cloud properties, HIRS and AIRS for cirrus global properties and trends, development of a Calipso simulator for climate models.
EUMETSAT	Cloudsat/Calipso data are used for validating the cloud physical products as it is believed to be the only data/observation source that can be used for validation on the MSG disk or global scale.
DLR	DLR has generated a 15 year European cloud climatology (ECC) based on AVHRR HRPT data (Meerkötter et al., GRL, 2004) including cloud cover, optical thickness, cloud top temperature and other parameters. It is intended to continue the work with NOAA/AVHRR, MetOp/AVHRR and MSG/SEVIRI data to produce a consistent long-term data set.

Atmospheric Domain

SIT-21

Red – constellation role, Blue – CGMS role
Green – Working Group role

Active Actions

Potential new active actions

Action A-1: In 2007 CEOS agencies will review the capability of passive microwave sensors to make scatterometer-quality measurements and will work to ensure A.M. and P.M. satellite coverage of surface wind speed and direction by 2015.

Action A-2: CEOS will strive to ensure continuity of GPS RO measurements with, at a minimum, the spatial and temporal coverage established by COSMIC by 2011. CEOS will continue efforts in 2007 to exploit the complementary aspects of radiometric and geometric upper-air determinations of temperature and moisture.

Action A-3: CEOS will support in 2007 investigations of cloud properties and cloud trends from combined satellite imager plus sounder measurements of clouds (with horizontal as well as vertical information) using Cloudsat/CALIPSO for validation.

Action A-4: CEOS agencies will ensure continued improvements to precipitation determinations demonstrated by TRMM and planned by GPM in 2010. The Japan Aerospace Exploration Agency (JAXA) and the National Aeronautics and Space Administration (NASA) will lead a CEOS study team to establish, by 2007, the basis for a future Global Precipitation Constellation.

Action A-5: CEOS will plan by 2011 to make absolute, spectrally resolved measurements of radiance emitted and reflected by the Earth to space for information on variations in both climate forcings and responses.

Action A-6: CEOS agencies will participate in re-planning, by 2007, the Earth Radiation Budget Sensor (ERBS) removed from the planned payload of NPOESS.

Action A-7: CEOS agencies will participate in re-planning, by 2007, the Total Solar Irradiance Sensor (TSIS) removed from the planned payload of NPOESS.

Action A-8: CEOS agencies will participate in re-planning, by 2007, the OMPS limb instrument removed from the planned payload of NPOESS.

Atmospheric Domain

Action A-9: CEOS agencies will participate in re-planning, by 2007, the APS instrument removed from the planned payload of NPOESS.

Action A-10: CEOS agencies will participate in planning, by 2011, the operational follow-on to the chemistry missions planned for the next 5 to 7 years.

Action A-11: CEOS agencies will commit in 2007 to reprocessing the geostationary satellite data for use in reanalyses projects before the end of the decade.

Action A-12: CEOS will determine options by 2010 for continuing improvements to wind determinations demonstrated by MODIS and to be demonstrated by ADM Aeolus.

Ocean Domain

Action O-1: CEOS agencies will examine their respective plans to maintain provision of microwave brightness temperatures and visible/infrared radiances for the sea ice ECV.

Action O-2: Relevant CEOS space agencies will consult with the science community on appropriate retrieval algorithms of passive microwave observation for reprocessing sea-ice products. Norway has expressed interest in committing to operational production of a global sea ice ECV (an initiative by the Norwegian Meteorological Institute, and coordinated by the Norwegian Space Center). The European Space Agency (ESA) is currently reprocessing the relevant ERS and Envisat archive to complement Canada's Radarsat in the context of WCRP's Climate and the Cryosphere (CLiC) core project.

Action O-3: New space-based measurements and products, including ice thickness and ice drift, will be considered by CEOS agencies as part of their future research missions.

Action O-4: The National Oceanic and Atmospheric Administration (NOAA) and EUMETSAT will lead a CEOS study team to establish, by 2007, the basis for a future Ocean Surface Topography Constellation that satisfies the threshold requirements for the sea level ECV (and those of the sea state ECV). This will include consideration of a future Jason-3 mission and requirements for new altimeter technologies to improve spatial resolution and extend observations in coastal regions (and over lakes and rivers for the lakes ECV).

Action O-5: The Centre National d'Etudes Spatiales (CNES) and the Indian Space Research Organization (ISRO) will cooperate on a new polar-orbiting altimeter aimed at filling a potential data gap beyond 2008. ESA and the European Union (EU) will lead planning for Sentinel-3 carrying an altimeter to complement spatial/temporal coverage of the sea level (and sea state) ECVs (and possibly sea ice extent and thickness, river, and lake level with the altimeter operating in Synthetic Aperture Radar (SAR) mode beyond 2012).

Action O-6: An ATSR-like instrument is planned on ESA's Sentinel 3, presently scheduled for launch in 2012. JAXA will lead planning for Global Change Observation Mission-Water (GCOM-W) and GCOM-C (Climate) to maintain continuity of the sea surface temperature ECV.

Ocean Domain

Action O-7: CEOS agencies will examine their respective plans to maintain provision of microwave brightness temperatures for the sea surface temperature ECV.

Action O-8: Relevant CEOS agencies will examine their respective plans to maintain continuity of a 10-km-resolution sea surface temperature data sets global product.

Action O-9: CEOS agencies will cooperate to support the combination of all existing sea surface temperature data sets into a global FCDR.

Action O-10: ISRO will lead planning of Oceansat-2, ESA and the EU of Sentinel-3, and JAXA of GCOM-C, which are all new missions planned to carry an ocean colour sensor.

Action O-11: Relevant CEOS agencies will examine their respective plans to maintain continuity of the 25-km-resolution ocean colour global product.

Action O-12: CEOS agencies will cooperate to support the combination of all existing ocean colour data sets into a global FCDR.

Action O-13: In consultation with GCOS and the relevant user communities, CEOS agencies will explore the means to secure, by 2011, continuity of the 1-km-resolution global ocean colour product needed to fulfil the target GCOS requirements.

Action O-14: CEOS agencies will cooperate with the user community to support efforts aimed at building on the decade-long satellite sea state records and making a comprehensive use of future altimeter- and SAR-bearing missions.

Action O-15: ESA will fly SMOS in 2007 to demonstrate measurement of the sea surface salinity (and soil moisture) ECV; NASA/CONAE will fly Aquarius/SAC-D in 2009 to demonstrate measurement of the sea surface salinity ECV.

Action O-16: CEOS agencies will cooperate in developing future plans for an Ocean Salinity Constellation.

Ocean Domain

Action O-17: CEOS agencies will undertake planning for reprocessing past data to improve FCDRs and legacy databases (e.g., AVHRR Pathfinder, ATSR, Sea Level Pathfinder, and the sea ice ECV) in close coordination and partnership with existing advisory groups and reanalysis centres. All Level 2 data products for use in reanalysis should be properly accompanied by estimates of their uncertainty.

Action O-18: CEOS, through its Working Group on Calibration and Validation (WGCV) and in the context of developing standards for on-going missions and for the Constellations, will recommend best practices for pre-launch and onboard calibration of ocean sensors and for validation of space-based ocean observations with in situ sensors, including the establishment and maintenance of calibration and validation sites and networks. This will facilitate the combination of data from different sources and enable the establishment of global data sets and long-term series.

Action O-19: CEOS agencies, in cooperation with other partners, will support planning for a follow-on to GODAE by 2007.

Terrestrial Domain

Action T-1: CEOS agencies will determine which alternative approach best fills the current Landsat-class data gap and will explore the potential of integrating high-resolution data from multiple platforms (e.g., China-Brazil Earth Resources Satellite (CBERS), Indian Remote Sensing (IRS) satellite, Landsat, Satellite Pour l'Observation de la Terre (SPOT), and others) based on the results of a CEOS study team led by the United States Geological Survey (USGS) that will establish, by 2007, the basis for a future Land-Surface Imaging Constellation.

Action T-2: CEOS agencies will assess the feasibility of generating global historic and continuing ECVs at fine resolutions for land cover and glacier change.

Action T-3: CEOS (led by USGS and NOAA), in cooperation with relevant stakeholders, will explore the feasibility, by 2007, of retrieving and reprocessing the 1-km AVHRR data record from various centralized archives (NOAA and High Resolution Picture Transmission (HRPT) stations).

Action T-4: CEOS will work to enhance the quality of the FCDRs and the ECVs generated from the AVHRR record to meet threshold requirements.

Action T-5: CEOS agencies will undertake research to support satellite technology development, such as lidar or P-band sensors, that are capable of retrieving biomass and LAI globally that meet GCOS requirements. CEOS agencies will also support research to improve algorithms that do not currently meet GCOS threshold requirements. New satellite technology and algorithms should be available by 2015.

Action T-6: CEOS will assess the feasibility of collecting operational multi-angle observations. Research will be carried out by CEOS agencies to improve radiation transfer schemes for albedo and fAPAR, especially under cloudy conditions.

Cross Cutting

Action C-1: CEOS will review the prevailing institutional arrangements in place for the planning and implementation of cooperative efforts by space agencies in the domain of climate (among others) by 2007. In particular CEOS agencies will review the ways to improve coordination of future remote sensing tasks that address the upcoming space-based measurement challenges, so as to avoid duplication of efforts while taking cooperation between the international partners to a higher level.

Action C-2: CEOS agencies will work with GEO to leverage progress and results from the implementation actions for climate to benefit all other relevant SBAs.

Action C-3: CEOS will work with GCOS to periodically evaluate climate needs and their realization.

Action C-4: CEOS agencies will adjust their internal procedures and mechanisms relative to satellite mission planning and operating processes in order to ensure adequate adherence to the GCMPs.

Action C-5: CEOS agencies will review their respective satellite data records with particular attention to adherence to the GCMPs and will consider undertaking necessary corrective actions within available resources.

Action C-6: CEOS will consider the GCMPs and relevant ECV requirements in defining criteria that will serve as the foundation for the CEOS Constellation studies being initiated in 2006 and beyond.

Action C-7: CEOS agencies will increase their cooperation in ensuring stability, accuracy, and inter-comparability of their respective satellite observations. These observations will be tied to irrefutable international standards in order to enhance the utility of space programmes for climate applications.

Action C-8: CEOS agencies will contribute to development of GSICS under development by CGMS and WMO to better integrate calibration efforts. Furthermore, CEOS agencies will continuously pursue establishment of reference measurements in space, complementing those on the ground and in the air, which will enable absolute inter-calibration of radiance measurements.

Action C-9: CEOS will charge its WGCV to promote existing in situ networks, identify new opportunities for product validation, and support both validation research and operational validation projects at an adequate level.

Cross Cutting

Action C-10: CEOS agencies will coordinate their efforts in designing future data archives and data dissemination systems, ensuring that past data holdings (including associated metadata) are preserved, assessing standards and protocols, and incorporating new information technology (IT) developments as much as possible. Practical actions in response to this cross-cutting need will be developed by CEOS' Working Group on Information Systems and Services (WGISS) in line with the technical solutions adopted by GEO.

Action C-11: CEOS agencies will systematically consult with appropriate scientific and user advisory groups in establishing detailed specifications for each FCDR and derived products, including associated uncertainties.

Action C-12: CEOS agencies will consult on appropriate rules to ensure sustained, open accessibility to FCDRs in order to allow the periodic reprocessing and generation of homogeneous products.

Action C-13: CEOS agencies will generate, within available resources, independently processed data sets and products.

Action C-14: Recognising that space agencies are responsible for only a portion of the value chain involved in the generation of FCDRs, CEOS will explore ways to strengthen linkages to the communities involved in climate product generation and use, e.g., through framework agreements with major reanalysis centres.

Action C-15: CEOS agencies will encourage funding of climate change research at an adequate level for multiple groups to analyze data records, reprocess climate variables, and perform reanalysis.

Action C-16: CEOS agencies will consider, in the context of the Constellations, ways and means to support the transfer of demonstrated observations from research satellites into operational capabilities. In particular, CEOS will encourage "convergence" of climate-observing requirements (usually for high-quality data) with operational requirements (usually for rapid and ensured data availability), and support institutional arrangements that would help transfer ECVs from research to operations

Cross Cutting

Action C-17: CEOS agencies will maintain R&D efforts aimed at confronting the knowledge challenge posed by climate and climate change, and strive to overcome the current scientific and technical limitations of climate-quality measurements.

Action C-18: CEOS agencies will ensure that data acquired through research satellites are fully used for the benefit of creating and/or improving the FCDRs of all ECVs.

Action C-19: CEOS agencies will continue to devote particular efforts to the reprocessing and improvement of these fundamental data sets.

Action C-20: CEOS agencies will endeavour to ensure global, easy, and timely access to climate-related products, including by developing countries.

Action C-21: CEOS will establish a programme in 2007 to document the data archive and access arrangements in place for each of the FCDRs contributed by space agencies. WGISS will lead this effort in order to evaluate practical solutions to current obstacles and issues.

Action C-22: CEOS agencies will continue their efforts, both individually and through the CEOS Working Group on Education and Training (WGEdu), to build capacity.

Progress since CEOS Plenary and near term activities

Current Status – De-manifested Sensors (A-5 to A-9)

- Total Solar Irradiance Sensor (TSIS)
  - President's FY2009 budget request includes support for instrument development and ongoing analyses to identify a suitable satellite platform for hosting the sensor (First NPOESS C1)
- Clouds and Earth Radiant Energy System (CERES)
  - A CERES instrument is approved for flight on the NPOESS Preparatory Project (NPP) in 2010
  - President's FY2009 budget request includes funds to build another CERES instrument to fly on the first NPOESS planned for 2013 launch
- Ocean Altimetry (ALT)
  - NOAA plans to provide operational continuity for satellite altimetry data with a Jason-3 mission
  - Jason-3 is a NOAA-EUMETSAT partnership mission, planned for launch in 2013
- Ozone Mapping and Profiler Suite (OMPS) Limb sensor
  - Approved for flight on NPP
  - Resources not identified for NPOESS OMPS-Limb
- Aerosol Polarimeter Sensor (APS)
  - NOAA is monitoring NASA's development of APS scheduled to launch in March 2009 on the GLORY mission and will evaluate it before making a decision

AVHRR CDR Workshop in December 2008

- A number of CEOS-GCOS Actions and CEOS-GEO Actions are related to the utilization of AVHRR for generating climate data records
- Each action/activity requires the generation of accurate AVHRR level 1b and products
- Workshop will also address **Action A-3**: CEOS will support in 2007 investigations of cloud properties and cloud trends from combined satellite imager plus sounder measurements of clouds (with horizontal as well as vertical information) using Cloudsat/CALIPSO for validation
  - Excellent progress, but did not include sounder data to better characterize cloud top heights and cloud phase.

CEOS Report to UNFCCC

- CEOS to provide update progress report on how space agencies are meeting needs of GCOS IP.

Need to improve the process for initiating and completing actions

Process

- The framework for working the actions is assigned to an “Action Team”, with a Team Leader.

- Climate Action Status Report is filled in by each action team to report on progress and the climate coordinator rolls up the reports into CL-06-02 task sheet.

Issue

- Often little interaction between the team leader and the action team

- Too many actions for one Climate coordinator

Possible solutions

- Atmosphere, Ocean and Terrestrial coordinators
- Bi-monthly meetings with CEOS agency climate focal points, constellation leads, working group leads

What GCOS really wants

- In addition to observing systems for monitoring climate, GCOS wants a commitment from CEOS for the generation of homogenized Climate Data Records.

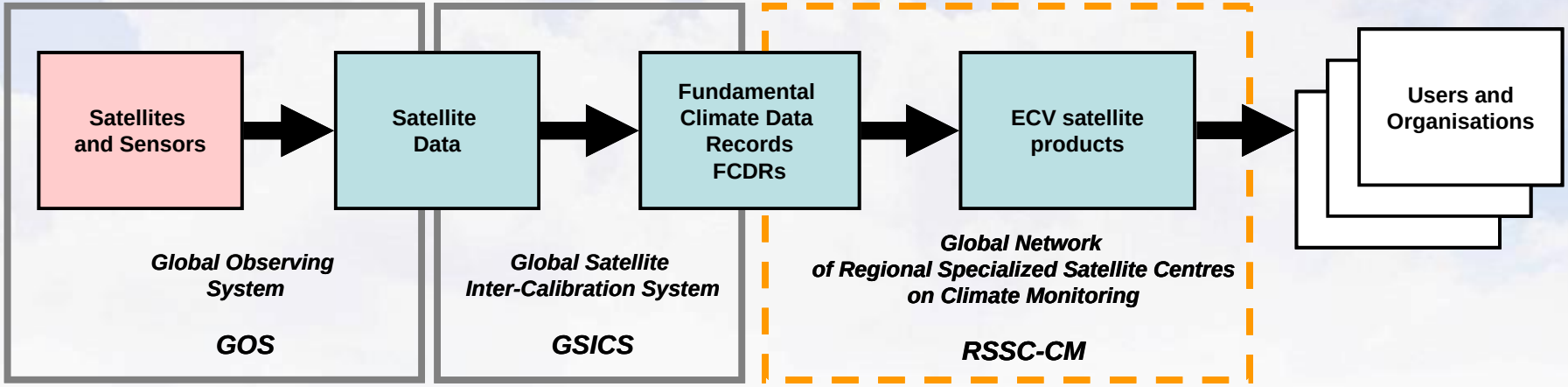
- Need a framework and resources to provide sustained CDRs

Implementation

Overall objective: Continuous and sustained provision of high-quality Essential Climate Variables satellite products on a global scale (includes reprocessing)

The R/SSC-CM Network will be:

- Based on activities of existing initiatives (GOS, GCOS and GSICS)
- Build upon existing operational infrastructures
- Serve users and other organisations (e.g. WMO Regional Climate Centres RCC, National Weather Services)



R/SSC-CM is establishing a sustained effort. Start small think big

Most of required FCDRs are being address by GSICS

ECV	FCDR
Water Vapour	MW and IR (SSMI, HIRS, Geostationary)
Cloud Properties and Aerosols	VIS/NIR (AVHRR)
Winds	IR Imagery (primarily Geostationary)
Precipitation	Passive MW
Albedo	VIS/IR Imagery

P2 Action A-11: CEOS agencies will commit in 2007 to reprocessing the geostationary satellite data for use in reanalyses projects before the end of the decade.

Conclusion

- CEOS actions aimed at addressing GCOS implementation requirements
- Actions related to CDR generation can benefit by CEOS representation in R/SSC. Mutual benefits, because clearly CEOS agencies have experts in CDR generation.
- We need active leaders to successfully initiate and complete the remaining climate actions.
  - Encourage CEOS agencies to review the 59 Actions, and nominate team leads.