Continuity and Architecture Requirements for Climate Monitoring

FIRST WORKSHOP ON SPACE-BASED ARCHITECTURE FOR CLIMATE

Geneva, 13-14 January 2011

Context and Scope

Building on the GCOS[1] Implementation Plan (IP), its Satellite Supplement, the GCOS Climate Monitoring Principles (GCMPs) and GEO Task CL-09-02 (Accelerating the implementation of the global climate observing system) , steps are needed to further engage the community in refining a cooperative technical framework for space-based climate monitoring that will meet the requirement for gap-free observing of the GCOS Essential Climate Variables (ECVs) across many decades. The framework must promote and enable greater mutual commitments and understanding of roles and responsibilities among international space agency partners and consortia, further exploiting research and operational satellite capabilities. It should lay the groundwork for system design considerations including the eventual transition of selected research climate observing capabilities into a sustained or operational mode. The scope of coordination must include end-to-end considerations from requirements definition, through coordination of mission design, planning, operation, and mutual backup of space-borne observing assets.

The GGOS/WMO organized workshop will be focused on:

- Advancing the understanding of GCOS continuity requirements building on the GCMPs, and of risks associated with planning and implementing a robust global satellite-based climate observing capability;

- Engaging the climate community to consider in some depth continuity priorities in relation to individual, and collections of, ECVs; and

- Using this analysis to specify architectural enhancements that will enable the WMO Global Observing System (GOS) to better meet the needs for sustained climate observation from space.

The workshop will consider contingency issues and risk mitigation approaches, recognizing the implied mutual commitments among space agencies, their coordination mechanisms and working groups and climate science and applications communities. The workshop will invite representatives of the climate community (including GCOS, WCRP, SCOPE-CM), space agencies of CEOS and CGMS, including the CEOS Virtual Constellation leads, chairs of the newly formed CEOS Climate Working Group, and co-chairs of the CGMS-sponsored science groups – IPWG, IWWG, IROWG and ITWG. Such coordination is necessary to both leverage existing efforts and optimize international space observation technology investments for global climate monitoring and change detection.

[1] The Global Climate Observing System (GCOS) is co-sponsored by UNEP, UNESCO and its IOC, WMO and ICSU.

Foundational Documentation and Driving Requirements

The GCOS Implementation Plan and Satellite Supplement embody observing requirements for climate monitoring, for climate trend analyses, and for sustained observations in support of climate research. These requirements identify what geophysical variables (the GCOS ECVs) need to be measured, and at what resolution and accuracy. Guidance on the generation of datasets and products in terms of their user-friendly documentation and access has been developed[2]. The current requirements are captured in the WMO Database of Observing Requirements and are used as reference to the Rolling Requirements Review process. The GCOS Climate Monitoring Principles provide additional high-level requirements for the operation of observing systems and address the critical importance of continuity. The Principles include requirements for overlap between consecutive missions, stability of instrument design, stability of orbital planes, and traceability of processing.

Space agencies, under the aegis of CEOS, have formulated Virtual Constellations which focus on particular satellite missions (e.g., atmospheric composition, global precipitation, land surface imaging, ocean surface topography, etc.). Under the aegis of SCOPE-CM, space agencies have established pilot projects (atmospheric motion vectors, cloud properties, surface albedo, etc.) for the sustained generation of selected satellite products for climate. And WMO[3] and CEOS[4] are collaborating on inventories of satellite instruments, from which associated gaps can be derived. Each of these efforts will ultimately strengthen the international collaboration needed to monitor climate over the long range.

The WMO Executive Council "invited the WMO Space Programme, in coordination with GCOS and with the support of relevant technical commissions, to work with space agencies, the CGMS, the Committee on Earth Observation Satellites (CEOS), and the Group on Earth Observations (GEO) in order to develop an architecture for sustained, space-based climate monitoring as a component of the future WIGOS and GFCS, for consideration by next Congress." While earlier discussions have led to a "Vision" of the missions needed, the issue is now to discuss *how* these missions should be coordinated, implemented and sustained.

Advances have been made toward mission continuity, harmonization of space observing instrumentation, and contingency planning agreements particularly in support of weather applications. These advances have resulted in convergence toward consistency in channel selections and resolutions, and mature scientific and technical capabilities to develop, and use, advanced instrumentation. There are also numerous examples of advances across a broader suite of applications related to instrument technologies, ground systems, data acquisition, processing and distribution, payload opportunities and launch support, contingency planning agreements and scientific research. More, however, needs to be done.

[2] http://www.wmo.int/pages/prog/gcos/Publications/gcos-143.pdf
[3] WMO space-based GOS Dossier: http://www.wmo.int/pages/prog/sat/Refdocuments.html#spacebasedgos
[4] CEOS Handbook MIM Database: http://database.eohandbook.com/

Issues and Rationale

A central issue of the workshop will be to consider how "climate" instrument assets, even while shared and hosted on the same spacecraft constellations with operational weather missions, may be optimized with respect to achieving the sustainability and quality required for climate applications. Specifically, the most important climate requirements are to assure acquisition of quality, accurate, inter-calibrated Sensor Data Records, followed by the generation of Fundamental Climate Data Records (FCDRs), and derived GCOS ECV products. This capability should be sustained and uninterrupted in the long term (for many decades) across successive generations of satellites.
It is understood, however, that ensuring such continuity, and mitigating the risk of any gap can be a design driver with high cost implications, for instance if it implies in-orbit redundancy or achieving an overlap between consecutive missions. Furthermore, real world circumstances often require compromises. Therefore, it is imperative that the climate community be engaged to refine and prioritize the continuity constraints associated with the ECVs and investigate whether any flexibility is allowed for specific derived products and applications. It is understood that such a prioritization is an important input to a comprehensive analysis of gaps between climate observing requirements, and actual and planned space-based capabilities. It is further recognized that mitigating observing gaps should logically be discussed with respect to a reference architecture, which is not fully defined in the Vision for the GOS in 2025.

Engaging the climate science and climate applications stakeholder communities in the definition of the architecture is the point of this first workshop, with particular emphasis on understanding the continuity requirements and their implications on the space-based architecture for climate.