WMO Considerations on the Architecture for Climate Monitoring from Space: *Sensing Level*

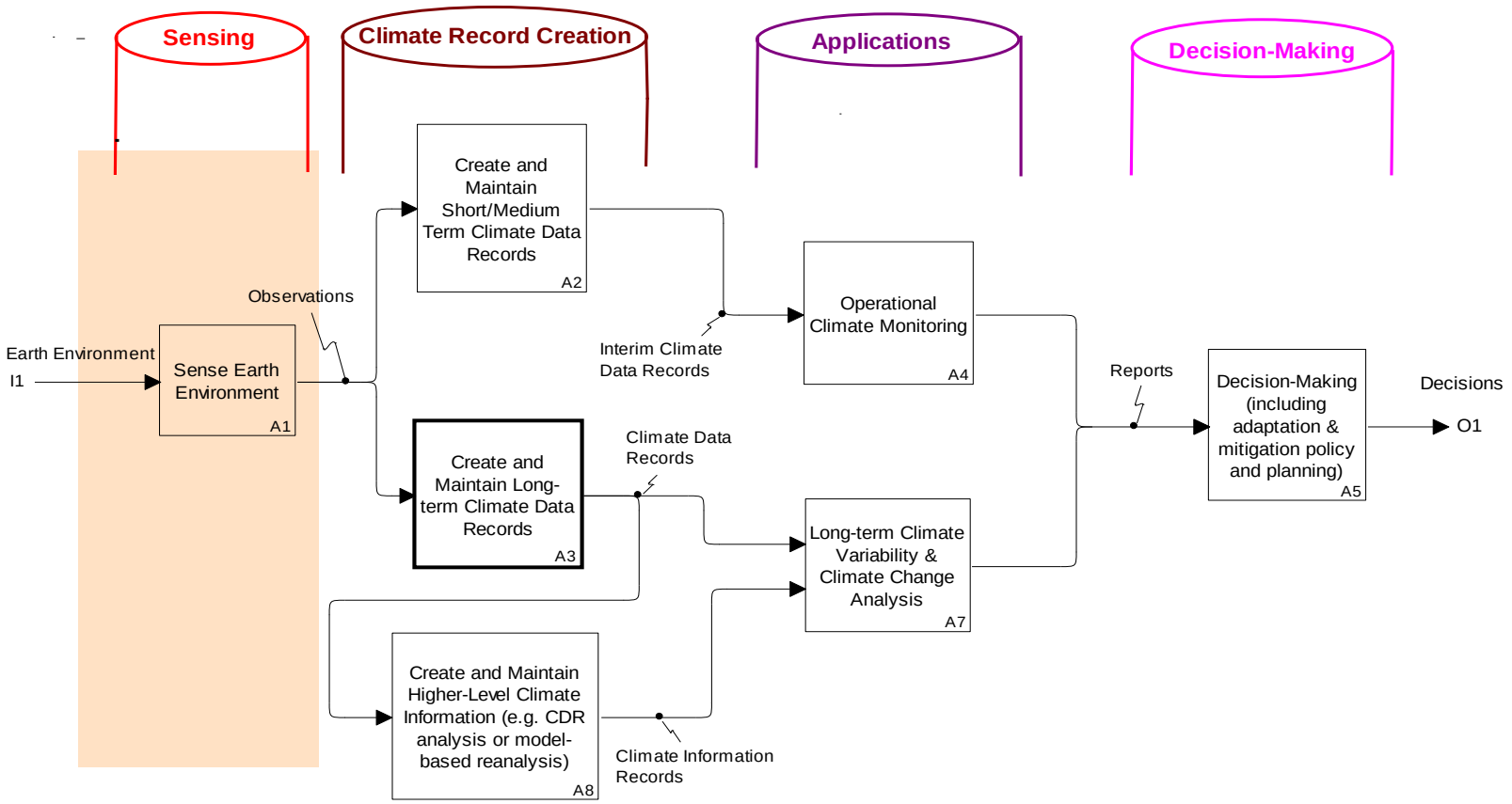
Wenjian Zhang, Jérôme Lafeuille
(WMO Space Programme)

WMO Congress initial framework for the architecture

- In 2011 WMO Members decided to develop an Architecture for Climate Monitoring from Space
- Res. 19 (Cg-16) provides guidance (http://www.wmo.int/pages/prog/sat/documents/SAT-GEN_ST-13-Climate-space-monitoring-architecture-Res19-Cg16.pdf)

- "*end-to-end system for weather (…) can be leveraged for climate monitoring*"
- «*Review of requirements, observation, calibration, product generation, user engagement, training*»
- climate architecture to be "*an important component of WIGOS*"
- should be reflected in «*WMO regulatory material*» (incl. Manual on WIGOS)

End to end Architecture for Climate Monitoring from Space



In order to meet the expectations from WMO Congress, the focus is here on the **sensing level** (sensor, orbit, calibration) as a complement to WG-Climate's effort which focusses so far on the processing and application levels

Climate within the overall space-based architecture

- Most of the climate variables are also required for other applications (weather, hydrology, air quality, ocean applications, land use, etc)
- While the «right pillars» are application-specific, the «left pillar» should be integrated as far as possible (WIGOS)

- The goal is not a «climate monitoring constellation» distinct from a «weather monitoring constellation» …
  … but a «Climate view» of the space observing system ensuring that climate requirements can be met
- Recognizing different requirements : climate requires decadal stability, rather than round-the-clock continuity and timeliness

- Eventually reflected in Regulatory Material as voluntary commitments of WMO Members (= States, through their space agencies and other institutions)
- Such international commitments are the foundation of the success of GOS

Elements for an architecture at sensing level (1)

- Climate monitoring requirements review/updating process

- Monitoring of agencies' plans
  - Assess their ***potential*** to support generation of Fundamental CDR
  - Need to record long-term plans at a proper granularity
  - CGMS baseline is an attempt to capture long-term commitments but is not detailed enough
  - Need of inventory of main sensor characteristics driving the ability to meet climate requirements
  - Study presented at WG-Climate in 2014 is an example of such inventory. Will be facilitated with new version of OSCAR

Elements for an architecture at sensing level (2)

- Gap Analysis
  - Looking backward: comparing past potential FCDR and actualECV inventory (*Supports objective 2 of the main objectives of WG Climate*)
  - Looking forward: comparing future FCDR potential and requirements (*Supports objective 3 of the main objectives of WG-Climate*)
  - Leads to recommendations with priorities
  - Highlights the most critical gaps (e.g. single points of failure)
- Master plan (Call it «Baseline», or «Vision» or …)
  - «Virtual constellations» defined by types of sensors with minimum performance characteristics, and relevant orbital configuration details
  - Agencies in-principle commitments with time frame
  - Level of commitment depending on time range (5 years, 20 years..,), of possible redundancy (among similar missions) and alternatives (different missions addressing similar ECVs)

Main objectives of the WG Climate (from itsToR)

The over-arching goal of the CEOS/CGMS Working Group on Climate (WG Climate) will be to improve the systematic availability of Climate Data Records through the coordinated implementation, and further development of the architecture for climate monitoring from space.

More specifically, the coordination shall be designed to achieve three main objectives:

- Provision of a structured, comprehensive and accessible view as to what Climate Data Records are currently available from satellite missions of CEOS and CGMS members or their combination;
- Creation of the conditions for delivering further Climate Data Records, including multi-mission Climate Date Records, through best use of available data to fulfil GCOS requirements (e.g. by identifying and targetting cross-calibration or re-processing gaps/shortfalls);
- Optimisation of the planning of future satellite missions and constellations to expand existing and planned Climate Data Records, both in terms of coverage and record length, and to address possible gaps with respect to GCOS requirements.

Elements for an architecture at sensing level (3)

- Calibration: infrastructure and processes
  - Ground-based and in-orbit references for traceability (WGCV & GSICS)
  - Databases and tools (WGCV and GSICS)
  - Processes for pre-launch calibration (WGCV and GSICS)
  - Processes for in-orbit intercomparison and calibration (GSICS)
  - Processes for vicarious calibration (WGCV)
- Continuity and stability
  - Redundancy and contingency planning
  - Comparability of successive generations of sensors to retrieve ECVs (combined with intercalibration to provide the actual comparisons)
  - Mission overlaps or traceability to continuously available references

Conclusion

- Important tasks need to be tackled with to meet the expectations of WMO Congress
- How far can the WG-Climate contribute to these tasks ?
- Other tasks to be pursued by WMO as complementary effort to – however in coordination with - the WG-Climate