CSQ-14 Summary

Question	Knowledge Advancement Objectives	Geophysical Observables	Measurement Requirements	Tools & Models	Policies / Benefits
What are the main issues with calibration/validation, absolute calibration, long-term monitoring?	To obtain calibrated data in absolute values	• all ECVs for which quality is crucial for inputting models and understanding ongoing processes	• Calibration before flight and validation on-flight of space instruments • Cross-calibration between instruments on board different satellites	• Ground-truth observation networks • CalVal facilities • Coordinated airborne observations	• Better absolute calibration of space sensors to provide high quality observations needed for the climate models • Determination of long-term trends and variability of ECVs
	To monitor the long-term evolution of ECVs	• ECVs that need to be followed on the long term to follow global and regional changes	• Validation of space observations during the full life of satellite missions	• Ground-truth observation networks • Gap filling in space observations using ground-based data • Homogenisation of past data for reanalysis	

CSQ-14 Narrative

High quality space data of geophysical variables are needed to perform process studies, build climatologies, evaluate long-term trends and constrain and validate models. Space instruments are calibrated before launch but the measurement configuration is often not representative of observations in orbit. Furthermore, the instruments may suffer from in-flight degradation and changes in their calibration characteristics. In-flight calibration is then needed during the Calibration/Validation (CalVal) and the operational periods of each space mission This can be done in different ways:

- Validation with ground-based and airborne observations. These observations may be performed during specific validation campaigns or using the data from monitoring network, for instance Total Carbon Column Observing Network (TCCON) for greenhouse gases and Network for the Detection of Atmospheric Composition Changes (NDACC) for ozone and chemical species. There is considerable room to improve the long-term relationships between space agencies and such networks with many potential win-wins. Access to sustained European Cal/Val facility for all satellite / in-situ comparisons as requested in the Global Climate Observing System Implementation Plan (GCOS-IP, Sterckx et al.,2020) would be strongly beneficial for the exploitation of EO missions.
- Cross-calibration between satellites measuring the same variables. In order to observe the same scene at the same time with the two satellites, it is needed to have cross-cutting orbits, for instance SSO and tropical orbits.

The long-term observation of Essential Climate Variables (ECVs) is required to monitor the evolution of the climate at global and regional scales and to evaluate the impact of human activities (see GCOS-IP 2022)[2]. Space data provide the main contribution to the survey of ECVs. Among the 54 ECVs identified by the GCOS, 60% can be only observed from space[3]. To perform this monitoring several conditions are required:

- High quality data of the same variables during several decades
- Each satellite has a limited lifetime. Long-term series are build using several different satellites. An intercalibration between satellite sensors during overlapping periods is needed.
- Long-term stability of the instruments.
- Gaps in data series need to be filled by ground observations.
- Reanalysis of past data to homogenise the series as it is made in Climate Change Initiative.

Reference

Sterckx et al., Toward a European service for earth observation, International Journal of Remote Sensing, Vol.. 41(12), 4496–4511, 2020.