Working Group on Calibration & Validation (WGCV) Report - CEOS Plenary 2026

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WGCV Overview

The mission of the CEOS Working Group on Calibration & Validation (WGCV) is to ensure long-term confidence in the accuracy and quality of Earth Observation data and products. WGCV provides a forum for the exchange of information on calibration and validation (cal/val), and coordinates cooperative activities among CEOS agencies and the broader EO community. Its six subgroups undertake activities focused on specific sensor types and technical areas, providing methodologies, guidance, reference data, and best practices.
In 2026, WGCV has progressed a number of initiatives. Select updates on key activities and achievements are provided below.

FRM Assessment Framework (CV-25-01)

The CEOS Fiducial Reference Measurement (FRM) Assessment Framework was developed by WGCV with the aim to provide a consistent and transparent approach for assessing the maturity and fitness-for-purpose of Cal/Val reference measurements against community-agreed criteria. The framework addresses the need for well-characterised, independent and traceable reference measurements that can provide confidence in the calibration and validation of Earth observation data products, particularly as the number of satellite missions and commercial data providers continues to grow. It uses a Maturity Matrix to assess FRMs across areas such as instrumentation, operations, data, metrology, coverage and verification. Following an initial pilot exercise, WGCV conducted a second assessment round in 2026 involving 19 measurement types in different domains, using the Maturity Matrix Tool and a combination of self-assessment and independent verification.

Feedback from FRM providers was collected at the WGCV-56 meeting. The FRM exercise provided valuable insights, highlighting the need to reduce subjectivity in the self-assessment process by requiring supporting documentation and references for each response and introducing an independent peer-review process. A tier-based approach was also suggested, with separate Maturity Matrices tailored to different processing levels of the measurements under assessment (e.g. L1 and L2). The Maturity Matrix tool was recognised as useful and user-friendly, although clearer guidance was recommended on the mandatory categories to be completed and on the interpretation of the Overall Classification. The scope of CEOS-FRM was clarified as applying exclusively to satellite calibration and validation (Cal/Val).
The roadmap towards operationalisation involves completing the second assessment exercise, refining the Framework guidelines and Maturity Matrix Tool, and confirming readiness through a pre-launch review.

SITSat Task Team (FRMSat Task Team)

The WGCV SI-Traceable Satellite (SITSat) Task Team continued its work in 2026 to develop the concept of spaceborne reference missions. Key goals for 2026 included establishing a public webpage, developing a communications strategy and refining key messages for presentations and agency leadership. At the WGCV-56 meeting, it was agreed to change the name from ‘SITSat’ to ‘FRMsat’ (Fiducial Reference Measurement Satellite) Task Team, as SI traceability alone was not considered sufficient to distinguish the reference sensors being described. The Task Team’s first priority is to establish a clear definition of an FRMsat and the minimum requirements needed to

evidence this status, building on the existing CEOS FRM definition and Assessment Framework. In support of this work, the Task Team is updating the dedicated webpage on the CEOS Cal/Val Portal under CV-26-07, which will introduce the FRMsat concept, its expected impact and future vision, and related datasets.

The Radiometric Calibration Network (RadCalNet)

RadCalNet provides satellite operators with SI-traceable Top-of-Atmosphere (TOA) spectrally resolved reflectances to support the post-launch radiometric calibration and validation of optical imaging sensor data. WGCV supports the network through the review and endorsement of new sites and the continued development of the service. The network currently comprises six instrumented reference sites: Railroad Valley Playa (USA), La Crau (France), two sites at Baotou (China), Gobabeb (Namibia), and Golmud (China). At WGCV-56, following a two-week review by WGCV members, the Golmud RadCalNet site was endorsed, and information on the newly endorsed site was subsequently added to the RadCalNet website.

Cal/Val Supersite Definition Work

Development of a consistent definition for 'supersite' within WGCV was prompted by the 2025 ESA Gobabeb Science and Cal/Val Activities Workshop, which highlighted the potential for Gobabeb to be recognised as a supersite and identified common characteristics such as sustained infrastructure, standardised measurements, multi-variable capabilities, and comprehensive site characterisation. In parallel, similar discussions had taken place in the atmospheric composition community and in particular at the IWGGMS-21/AC-VC-21/ACSG 2025 joint meeting, recognising that different definitions for supersites were needed to address different types of Cal/Val requirements. Following this, WGCV-56 tasked the Subgroup Chairs with developing a consistent definition. The work is in progress and aims to establish clear and meaningful criteria that distinguish supersites from conventional Cal/Val sites and can be applied consistently across WGCV domains, with the definition ultimately incorporated into the CEOS EO Glossary.

Expressing Uncertainty Information

A guidance checklist on expressing uncertainty information has been developed and added to the CEOS Cal/Val Portal, following a request from the commercial sector at WGCV-56. The checklist is based on USGS Landsat 8 OLI L1TP products and identifies the primary contributors to per-pixel radiometric uncertainty that should be measured or estimated to support the provision of per-pixel uncertainty information. This work addresses action WGCV-WGISS-2024-13, which calls for WGCV to provide guidance on what uncertainty information should be packaged within a dataset, with WGISS providing guidance on how this information should be presented to users. The guidance is also intended to inform future updates to the CEOS-ARD specifications.

In parallel, WGCV is coordinating the collection of case studies from member agencies to demonstrate the impact and value of providing uncertainty information with satellite data products. A number of expressions of interest have been received, with additional case studies being sought. This activity remains a work in progress.

GHG Cal/Val and Networks

Ground-based GHG networks continued to expand their stations, campaigns and CEOS-FRM self-assessments. In support of the GHG Task Team, work is also progressing towards a more operational GHG monitoring framework, including tracking Level 2 validation capabilities and developing a Cal/Val planning and ground-based network design tool for CO2M, with potential application to other missions.

A CEOS Best Practice for Quality Assessment

A significant milestone in early 2026 was the joint WGCV, LSI-VC and CEOS-ARD Oversight Group meeting held at USGS EROS in April. This was a critical milestone in the development of the 2026-2031 CEOS-ARD Strategy, with discussions held on each of the Strategic Pillars and the initiatives and activities needed to realise the Success Criteria and Outcome Signals identified therein were confirmed. The WGCV team worked with the LSI-VC and CEOS-ARD Oversight Group to develop a common understanding of the Quality, Integrity and Provenance Pillar in particular, identifying where the WGCV team and its various networks, activities, tools and other resources can be leveraged to achieve the ambitions of the Strategy.

A conclusion of this meeting was a general agreement to leverage the ESA-NASA Quality Assessment Framework (QAF) for the data quality aspects of the CEOS-ARD Framework. CEOS-ARD provides a means for documenting what is necessary to be considered 'ARD', and that certain quality measures should be provided, but not the specific methods nor objective quantities for those assessments. Data quality aspects of the PFS should point to the QAF for the specific processes, assessment criteria, and classification of quality level. This creates a clear delineation of roles between the CEOS-ARD specifications and the QAF. Connecting CEOS-ARD with the QAF was added to the list of 2026-2031 CEOS-ARD Strategy initiatives as a joint task with WGCV.

This discussion led to a further question posed to the SIT Technical Workshop in September about whether it would make sense to explore, through CEOS, broader space agency adoption of the Joint ESA-NASA-USGS Quality Assessment Framework (QAF). The reasoning being that the CEOS WGCV and experts from NASA, ESA and USGS have produced a mature and robust framework that is being used for operational data quality assessments and it makes sense for other CEOS agencies to leverage this extensive work and provide a common approach and consistency for both CEOS agencies and private sector data providers. Responses were unanimous that CEOS should adopt the ESA-NASA-USGS Quality Assessment Framework in some fashion.

Subsequent discussion concluded that CEOS should endorse the QAF (at a particular point in time) as an accepted CEOS best practice for quality assessment. This would maintain the independence of the ESA-NASA-USGS framework for their own purposes and not have CEOS take control of something that is critical to these agencies' internal business. This would be similar to how CEOS/WGCV endorses a reference solar irradiance spectrum. CEOS-ARD could then adopt the CEOS best practice for the data quality pillar of the new CEOS-ARD Strategy.

In 2027 WGCV will work towards adoption of the QAF as a CEOS Best Practice and work closely with the CEOS-ARD Oversight Group on implementing Pillar 2 of the new CEOS-ARD Strategy on data

quality. This work follows CV-26-01, which called for WGCV to provide data quality inputs to the new CEOS-ARD Strategy.

Surface Reflectance Quality and Consistency

WGCV is developing a guidance document on how to improve the consistency of surface reflectance products and enhance their interoperable use across sensors, platforms, and missions. This work is being undertaken under CV-25-02: *Develop a white paper for the Quality and Consistency of Land Surface Reflectance in the Solar Reflective Domain*.

The Surface Reflectance Quality and Consistency (SRQC) team is reviewing scientific literature and existing community approaches to identify areas of agreement and develop consensus recommendations. The team continues to refine the discussion questions and supporting material, and biweekly teleconferences are held to coordinate contributions and maintain progress. Most recently, the team has agreed on a qualitative framework to document the requirements for various time series applications, recognising that different applications will have very different requirements regarding measurement uncertainty, temporal consistency, and cross-sensor consistency.

This guidance will help data providers increase interoperability of surface reflectance products and may influence future choices for CEOS-ARD requirements. This is a critical piece of the interoperability puzzle, moving us further along the interoperability spectrum. As we see the rise of constellation architectures and the importance of integrating data from multiple sources, having a clear understanding of the important parameters and their influence will be critical.

CEOS-ARD Peer Review Assessments

WGCV continued to support the assessment of CEOS-ARD products, confirming THEOS-1 Surface Reflectance, RADARSAT-1 (NRB), Constellr LSTprecision, Synspective StriX Series NRB, and Sentinel-1 OPERA InSAR Surface Displacement as compliant in 2026.

The WGCV peer review team is also working through the steps to reintroduce the concept of partial CEOS-ARD Goal-level assessments, whereby data products are identified as having met some percentage of the Goal requirement. No data providers have reached full Goal compliance.

In line with the new CEOS-ARD Strategy, the WGCV peer review team is also working with the CEOS-ARD Oversight Group on increased automation and streamlining of the compliance process to ensure the CEOS-ARD Framework is scalable and responsive.

Subgroup Updates

WGCV has six subgroups, each focusing on specific technical areas related to calibration and validation. The following sections provide insight into some key activities from 2026.

Microwave Sensors Subgroup (MSSG)

Subgroup Chair: Xiaolong Dong (CAS)

The Microwave Sensors Subgroup (MSSG) supports cal/val of active and passive microwave sensors.

Progress continued on CV-23-05, which focuses on retrieving and validating high-wind observations using combined active-passive microwave measurements, with data collected for 2020-2025 and a technical report in preparation. CV-23-06 is developing all-weather ocean surface pressure retrievals from FengYun-3D observations to support extreme weather forecasting.

A new MSSG Task Team was proposed at WGCV-56, dedicated to GNSS Reflectometry Cal/Val. The team will work towards establishing a common benchmark for GNSS-R ocean normalised backscatter to support intercalibration across missions, with the longer-term goal of developing a GNSS-R virtual constellation. MSSG seeks contributors from WGCV and the wider CEOS community and coordinates with existing GNSS-R activities and relevant agencies.

Synthetic Aperture Radar Subgroup (SAR)

Subgroup Chair: Dirk Geudtner (ESA)

The Synthetic Aperture Radar (SAR) subgroup supports high-quality SAR data from airborne and space-borne systems through precision calibration in radiometry, phase and geometry, and validation of higher level products. One of the subgroup's initiatives, SARCalNet (CV-23-02) has progressed from its initial establishment to further development of its dedicated website and target database, supporting curated and standardised SAR Cal/Val information. A dedicated CEOS Analytics Lab environment is also being used for target curation and Cal/Val exercises, with shared SAR processing tools and reference datasets.

The 2026 SAR Cal/Val Workshop will be held in Perth, Australia, from 30 November to 4 December 2026. Registration and workshop information are available through the CEOS Cal/Val Portal.

Atmospheric Composition Subgroup (ACSG)

Subgroup Chair: Jean-Christopher Lambert (BIRA-IASB)

The Atmospheric Composition Subgroup (ACSG) supports the accurate and traceable calibration of radiance and irradiance data from atmospheric composition sounders and geophysical validation of atmospheric concentrations and higher-level products.

The 2026 ACSG meeting, held jointly with AC-VC-22, addressed Cal/Val needs for the atmospheric composition constellations, with focus on vicarious calibration, radiometric calibration networks, CEOS-FRM assessments, and validation of volcanic SO2 fluxes and of facility-scale CH4 missions. Following a cross-theme discussion on the potential use of RadCalNet, HYPERNETS and the future TIRCALNET for the calibration validation of atmospheric composition sounders, the subgroup agreed to establish a team to assess the requirements and compile a note for for enhancing these networks, including the desired spectral characteristics and site homogeneity.

The outcome of the AC-VC/ACSG joint effort on the harmonization and validation of satellite tropospheric ozone data (VC-20-01), set up at the space-based contribution to the second IGAC Tropospheric Ozone Assessment Report (TOAR-II), was published in an inter-journal special issue, and the resulting TOAR-II Satellite Tropospheric Ozone Assessment is in press.

Lessons learnt from the second exercise of CEOS-FRM evaluations highlighted the need to work more systematically on representativeness issues and to harmonize validation practices and metrics across the atmospheric constellations and networks. Accordingly, several key ground-based networks were reached out and work is continuing on CEOS-FRM evaluations with the needed domain-specific guidance.

Infrared Visible Optical Sensors Subgroup (IVOS)

Subgroup Chair: Nigel Fox (NPL/UKSA)

The Infrared Visible Optical Sensors Subgroup (IVOS) supports high quality calibration and validation of infrared and visible optical data from Earth observation satellites, as well as the validation of some higher level products.

Following the joint CEOS/GSICS Pre-flight Calibration and Characterisation Workshop (CV-14-03) held in November 2024 at ESA ESTEC, a good-practice guidance document is being developed based on the workshop's conclusions and recommendations. The guidance document will aim to define minimal and desirable calibration and characterisation requirements, recommended methods and facilities, and approaches for documenting and reporting pre-flight calibration information, including uncertainties and SI traceability. An executive summary is in final draft review in readiness for distribution to CEOS agencies and the wider community, after which the writing team will be reconvened to progress the guidance document.

Work continued on the development of the Thermal Infrared Calibration Network (TIRCalNet, CV-23-03), which aims to establish a network of sites capable of providing accurate Top-of-Atmosphere (TOA) brightness temperature measurements for vicarious calibration and validation of thermal infrared satellite sensors. The activity is being led through WGCV IVOS with support from LPV. A report, which will provide the roadmap towards an operational TIRCalNet, is underway.

The CEOS-PVP and RadVal tool, built at the request of the commercial sector to facilitate the provision of evidence of radiometric performance in a consistent manner, has been updated to include more transparent uncertainty information. A number of agencies and commercial operators are engaging and on-boarding their data.

At its most recent meeting, at ESA ESRIN in September 2026, discussions continued to refine recommendations on an optimum set of characteristics that should accompany, or be available, with satellite Level 1 data to support its usability. This includes a set of pre-flight and post-launch information, ranked as 'must have' or 'nice to have' depending on the intended nature of the applications. The group also discussed increased efforts and resources to support understanding of the value and means to assess and report uncertainty information and the uptake from agencies and in particular the commercial sector. It was also noted that with the expected transition of the current long-standing chair of IVOS to become WGCV Vice-chair a successor to the role needed to be found and a call for candidates has been announced.

Terrain Mapping Subgroup (TMSG)

Subgroup Chairs: Peter Strobl (EC-JRC), Leo de Laurentiis (ESA), Tom Maiersperger (USGS)

The Terrain Mapping Subgroup (TMSG) aims to ensure that characteristics of digital terrain models produced from Earth observation sensors at global and regional scales are well understood and that products are validated and used for appropriate applications.

The TMSG Digital Elevation Model Intercomparison eXercise (DEMIX) team set up jointly with the International Society of Geomorphometry (ISG) has completed and published its final report following six years of work (CV-20-03). The team assessed a range of widely used global DEMs using reference data covering different terrain and land-cover types. The exercise developed a consistent, statistically sound approach for comparing DEM products and evaluating their performance across different conditions. The work provides users with evidence to help identify the most suitable DEM for different applications, terrains and geographic areas, rather than assuming that a single DEM is appropriate for all uses. It also provides recommendations for DEM providers and practical resources, including open-source tools, to support future comparisons. The final results and resources are available to the wider community. The report has also been promoted through a CEOS news article and social media. The DEMIX group met in October 2026 and decided to continue the project with new activities and deliverables planned for 2027.

Another TMSG initiative is the Ground Control Point Intercomparison Exercise (GCPIX), which began in 2025 and is currently developing a technical note covering key definitions and best practices.

Finally, the Global Reference Grid Intercomparison Exercise (GRGIX) is working towards a common understanding of grid terminology. A preliminary classification and evaluation of global grids were presented at WGCV-56, with next steps now being progressed following the meeting.

Land Product Validation Subgroup (LPV)

Subgroup Chair: Fabrizio Niro (ESA)

In early 2026, the LPV subgroup developed a new four-year work plan covering 2026-2029. The plan focuses on developing and improving validation practices and tools, expanding the coverage and representativeness of reference data, strengthening collaboration with the user community, and increasing the focus on CEOS FRM and CEOS-ARD. It also aims to improve awareness and communication of LPV activities and resources.

The Leaf Area Index protocol, which was first issued in 2014, (CV-26-04) is being updated to add FCover and FAPAR variables and to better align with the latest GCOS 2022 requirements in terms of spatiotemporal resolution and CEOS-FRM principles. Protocols are also being developed for Fire Burnt Area (CV-26-05), Fire Radiative Power, Phenology and Vegetation Index (CV-24-03).

An updated list of LPV Supersites (CV-26-03) was endorsed by WGCV in April 2026. The updated list expands the existing network to cover additional variables, and assesses sites against CEOS-FRM principles. The supersites are well-characterised, long-term permanent sites that provide reference measurements for validating multiple satellite-derived land products. The updated assessment also considers the availability of ancillary measurements, spatial representativeness, and the range of variables that can be validated at each site. The work has been promoted through a CEOS news article and social media.

The Land Cover and Change Map Accuracy Assessment and Area Estimation Good Practices Protocol (CV-24-02) was endorsed at the CEOS SIT-41 Meeting in April 2026.

A workshop between WGCV LPV, LSI-VC GEOGLAM, and UN FAO is being planned for 8-9 February 2027 in ESA-ESRIN to review existing evapotranspiration (ET) products and Cal/Val practices, identify data and knowledge gaps, gather community input, and develop the good practices for validation of ET products (CV-26-06).



WGCV-56 meeting held at USGS Earth Resources Observation and Science (EROS) Center, Sioux Falls, South Dakota, USA in April 2026

Future Looking

At the 2026 CEOS Plenary, the WGCV Chair transitions from Cody Anderson (USGS) to Medhavy Thankappan (GA). Nigel Fox (UKSA) will join the WGCV leadership team as Vice Chair.

Medhavy's priorities for the WGCV Chair term align with Australia's 2026 CEOS Chair direction and the 2026-2031 CEOS-ARD Strategy. They focus on strengthening WGCV's role in supporting high-quality, interoperable and trusted Analysis Ready Data, with a particular emphasis on Cal/Val, data quality, uncertainty, traceability and cross-sensor consistency.

The next WGCV in-person meeting will be hosted by GISTDA on 16-19 February 2027 at the Space Krenovation Park in Thailand. A Thai New Space commercial engagement session is also being considered as part of the meeting.