CEOS-AC-VC WGCV

Committee on
Earth Observation Satellites

26th October 2023

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WGCV for Atmospheric Composition

1. Space agencies are responsible for instruments development, prelaunch and on-orbit calibrations and level 1 distribution.

2. Individual GHG and AQ sensors have different spectrometer designs : grating, and Fabry-Perot.

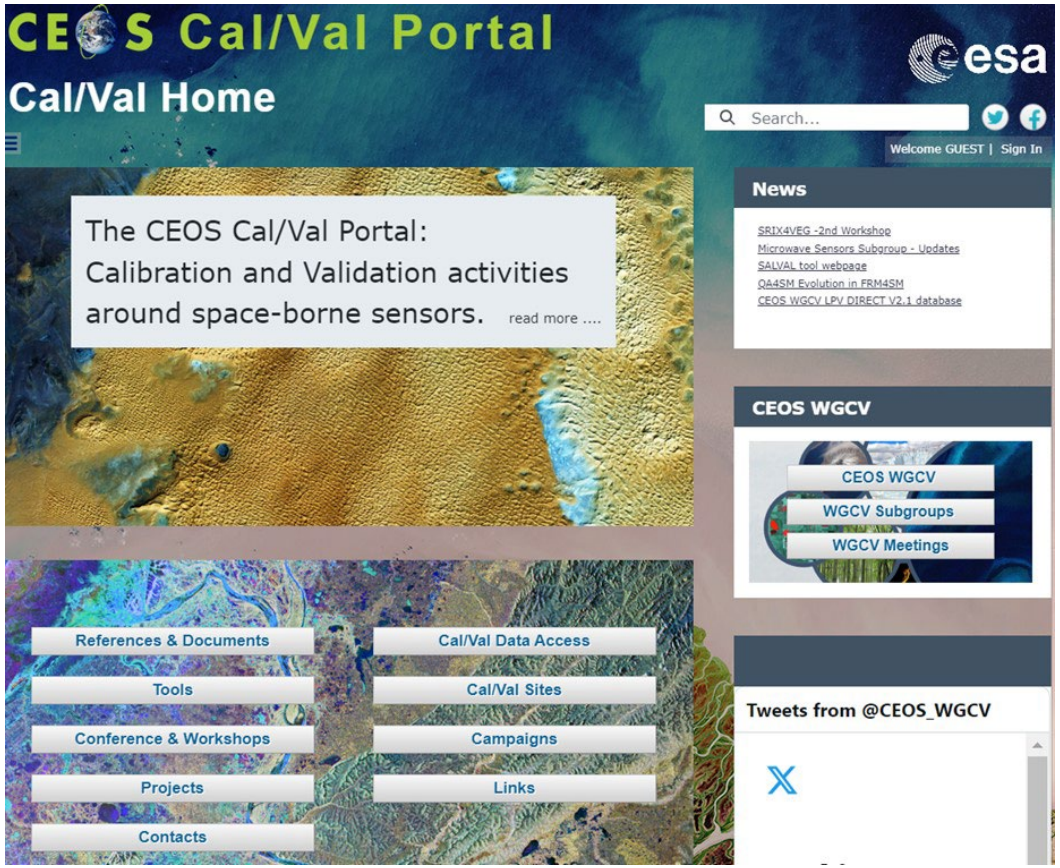
3. CEOS WGCV should continue looking after L1; this is mandatory also in line with CEOS virtual constellations and other CEOS groups.

WGCV Cal/VAL Portal

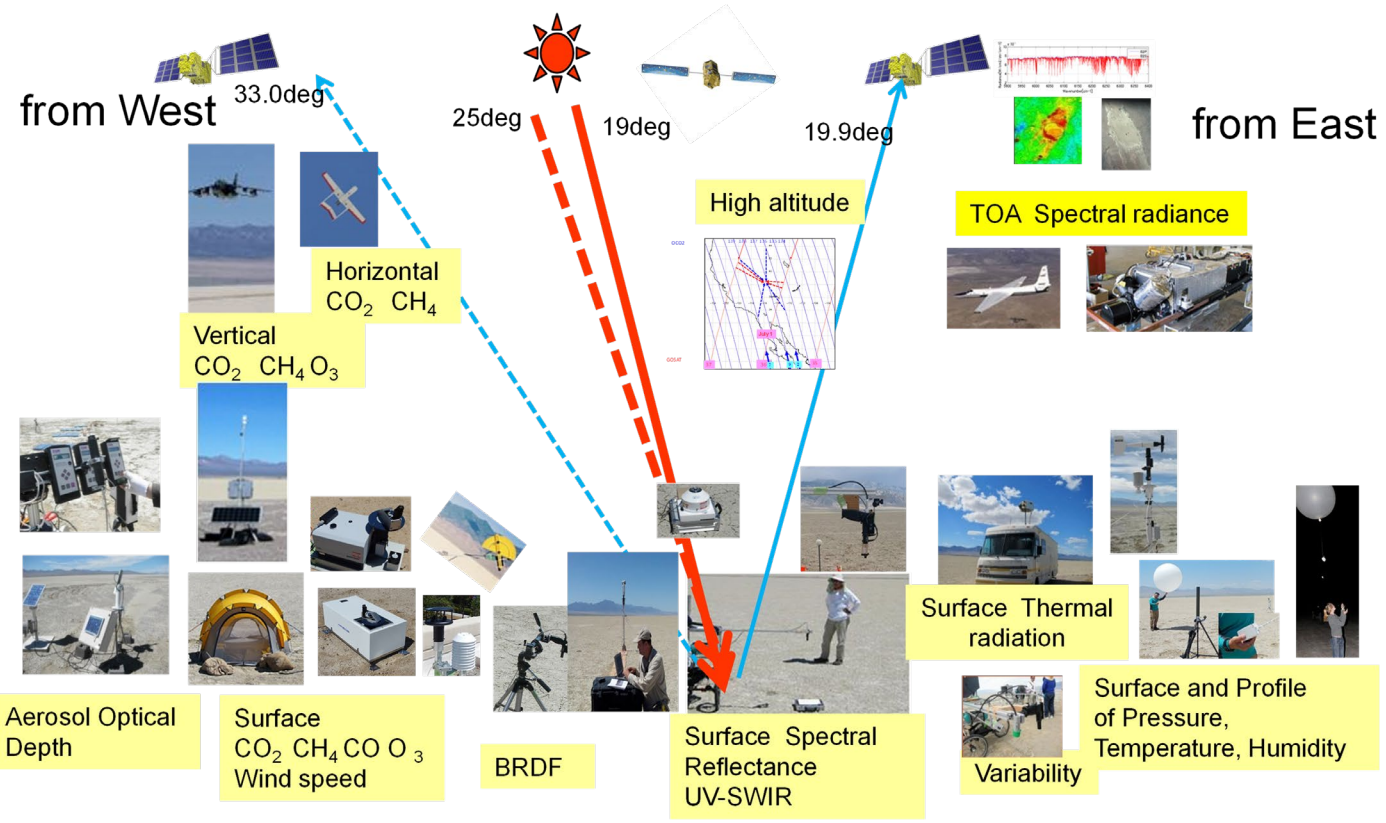
- The CEOS CalVal portal (https://calvalportal.ceos.org/) serves as the main forum for exchange and information sharing for the CEOS Working Group on Calibration and Validation.

- It provides access to agreed good practices and Cal/Val protocols to the wider Earth Observation community within CEOS and beyond.

- It connects users to reference data and networks and provides reliable, up-to-date and user-friendly information useful for Cal/Val tasks, facilitating data interoperability and performance assessment through an operational CEOS coordinated and internationally harmonised Cal/Val infrastructure.



Joint Campaign: Free and Open calibration and validation data for multiple AQ & GHG satellites



https://www.eorc.jaxa.jp/GOSAT/GHGs_Vical/index.html

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- Every year in June, 5 US-Europe-Japan sensors target the Railroad Valley (RRV) desert playa, in Nevada.
- RRV2023 campaign (Jun-Jul) added polarization measurements to estimate uncertainties in surface reflectance.
- From next year TEMPO from the geostationary orbit will be added. New Space Sensors are welcome.

Cal-VAL related meetings

1. International Coordination Workshop on Detection of Anthropogenic Methane Emissions from High-Resolution Satellites 7 – 8 June 2023 – Harvard University, the UNEP International Methane Emissions Observatory (IMEO), in collaboration CEOS and with support from the Global Methane Hub
2. NDACC-IRWG / TCCON / COCCON annual meeting hosted by the Royal Belgian Institute for Space Aeronomy (BIRA-IASB) June 12-16.
3. CGMS plenary and GSICS June 29-30 in Tokyo hosted by JMA and JAXA
4. 15th Joint vicarious calibration in Railroad Valley, NV between June 27 and July 2. (preparing a joint paper)
5. 19th IWGGMS meeting July 4-6 in Paris hosted by CNES
6. OCO-TROPOMI-GOSAT Calibration Team Meeting #8, September 15 , WEBEX
7. ACVC and WGCV joint meeting in Brussel Oct. 23-27
8. GSISCS/WGCV-IVOS Lunar calibration workshop (Several GHG related presentations) hosted by EUMETSAT, Dec. 4-8.
9. CEOS Preflight Calibration workshop, Nov. 19-21, 2024

Validation: NDACC-IRWG / TCCON / COCCON Draft Actions

1. **NETWORKS DESIGN AND EVOLUTION:** to support gap analysis studies with a view to tailoring existing monitoring networks to the Cal/Val needs of the GHG satellite constellation: land/ocean, low/high albedo…
2. **INSTRUMENT DEPLOYMENT:** (i) to further develop low-cost LR FTIR instruments; (ii) to support standardized production of enclosures for their deployment in the field; (iii) to maintain a supply of spare parts.
3. **CALIBRATION:** to support the development of and maintain mutually consistent calibration and QA/QC of the GHG networks. Key actions: (i) more regular and network-wide deployment of traveling standard; (ii) facilitate AirCore deployment; (iii) establish a central AirCore data archive.
4. **DATA PROCESSING:** to support GHG Cal/Val network data processing improvements needed to maintain FTIR data precision/accuracy and meet future goals: formal intercomparison exercise of the GGG and PROFFAST retrieval algorithms, development and standardization of profile retrievals, spectroscopy studies.
5. **DATA ACCESS:** to establish a central GHG Constellation Cal/Val data archive of tailored network data (co-located, traceable, metadata…) and 'hidden' data (e.g. campaigns)
6. **TIMELINESS:** to organize concertation between stakeholders and with networks data providers to support rapid and continuous availability and improved access to networks-wide GHG data.
7. **CENTRAL PROCESSING FACILITY (CPF):** to establish a central processing facility for network data which will directly support harmonized calibration **(3)**, data processing, QA/QC and tailoring **(4-5)** and timeliness **(6)**.
8. **GHG EMISSIONS AND ATTRIBUTION:** to support the development of new protocols for the Cal/Val of satellite derived GHG emissions, in collaboration with relevant bodies and initiatives (IMEO, global stocktakes, New Space) Consider co-located measurements of GHG and AQ data for better attribution.

Solar data: Total and Spectral Solar Irradiance Sensor-1 (TSIS-1) TSIS-1 Hybrid Solar Reference Spectrum (HSRS)

(1) WGCV-50 in March 2022: WGCV recommend TSIS-1 HSRS.

(2) Version 2 of the TSIS-1 HSRS and Extension to the Full Spectrum was published in 2023.

(3) The TSIS-1 HSRS observational composite solar irradiance reference spectrum spans 0.202–2.730 μm and encompasses more than 97% of the energy in the total solar irradiance (TSI).

(4) Full Spectrum Extension of 0.115–200 μm was developed by incorporating additional observations and theoretical knowledge.

(5) GHG sensors (TROPOMI, OCO, GOSAT) will support the long term and high spectrum resolution data from their solar calibration data.

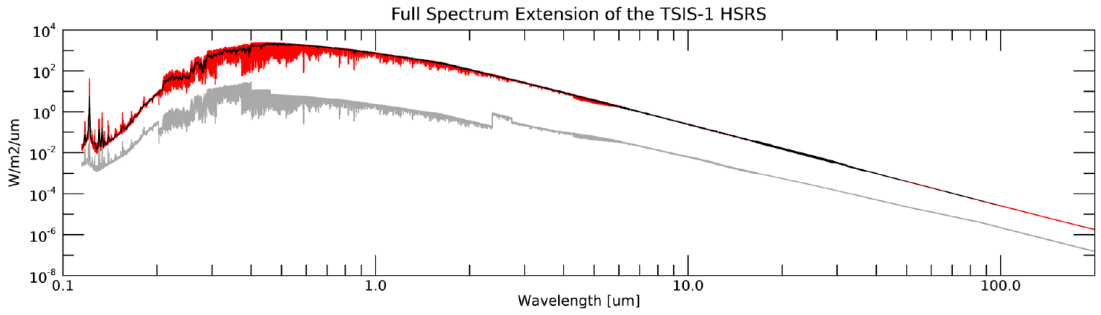
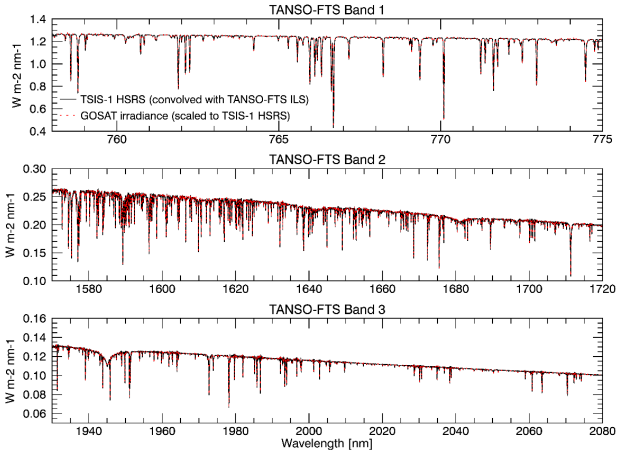


Figure 2. The Hybrid Solar Reference Spectrum (HSRS) Extension (red) and its associated uncertainties (gray) on a log-log scale. A variant of the HSRS Extension, integrated into 1-nm bins, is also shown (black).

Coddington et al., 2023 Earth and Space Science



Comparison with GOSAT, Codington et ai., GRL 2021

Lunar Calibration for GHG sensors

1. Uncertainties in relative calibration is smaller the one by solar calibration. No need for degradation and BRDF correction of solar diffusers.
2. GOSAT-2 solar diffuser calibration has been suspended since March 2021 due to a mechanical issue.
3. OCO-2 has both solar and lunar calibration, but OCO-3 has lunar calibration only.
4. Collaborating with Global Space-based Inter-Calibration System (GSICS)
5. Uncertainty discussion:

- Solar model in short wave infrared (SWIR)
- Lunar surface reflectance in SWIR (lunar phases of 7deg for GOSAT, 270 deg for OCO) and polarization sensitivity,
- Lunar targeting accuracy and fluctuation,
- Thermal environment difference between Earth and lunar views.