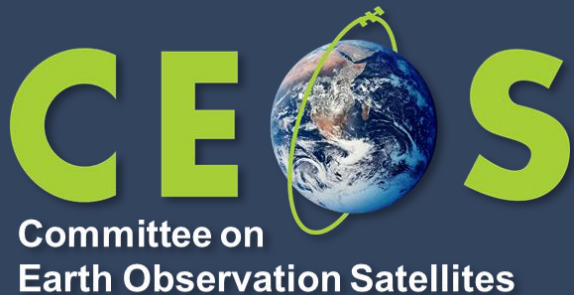


CEOS Working Group on Calibration and Validation (WGCV) *Overview*



Cody Anderson, USGS
WGCV Chair

Who is CEOS?



❖ 35 Members

→ Space Agencies

❖ 32 Associates

→ UN Agencies, Phase A programmes or

cooperation or external facilities



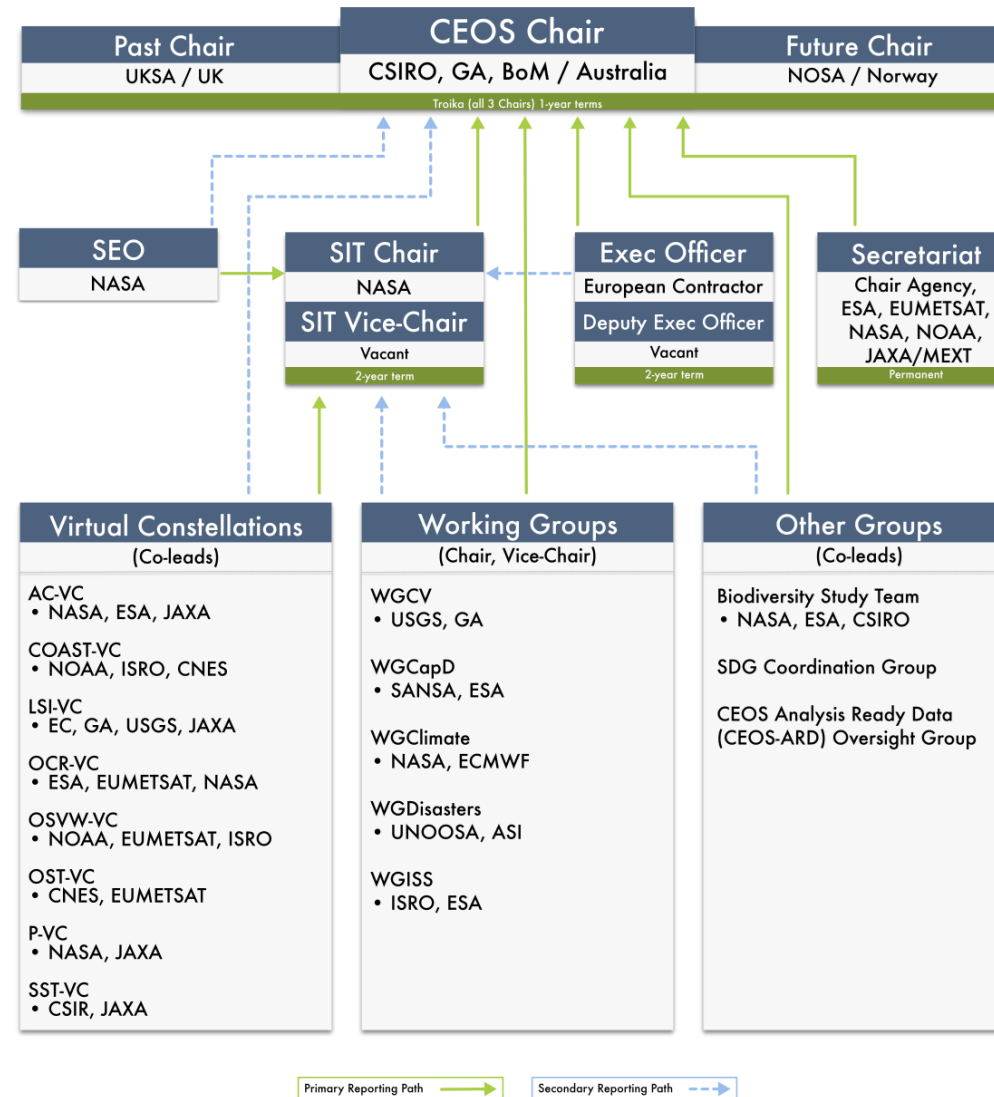
Mission: CEOS ensures **international coordination** of civil space-based Earth observation programs and promotes exchange of data to optimize societal benefit and inform decision making for securing a prosperous and sustainable future for humankind.

What is CEOS?



Working Groups:

- ❖ Calibration & Validation
- ❖ Capacity Building & Data Democracy
- ❖ Climate
- ❖ Disasters
- ❖ Information Systems & Services



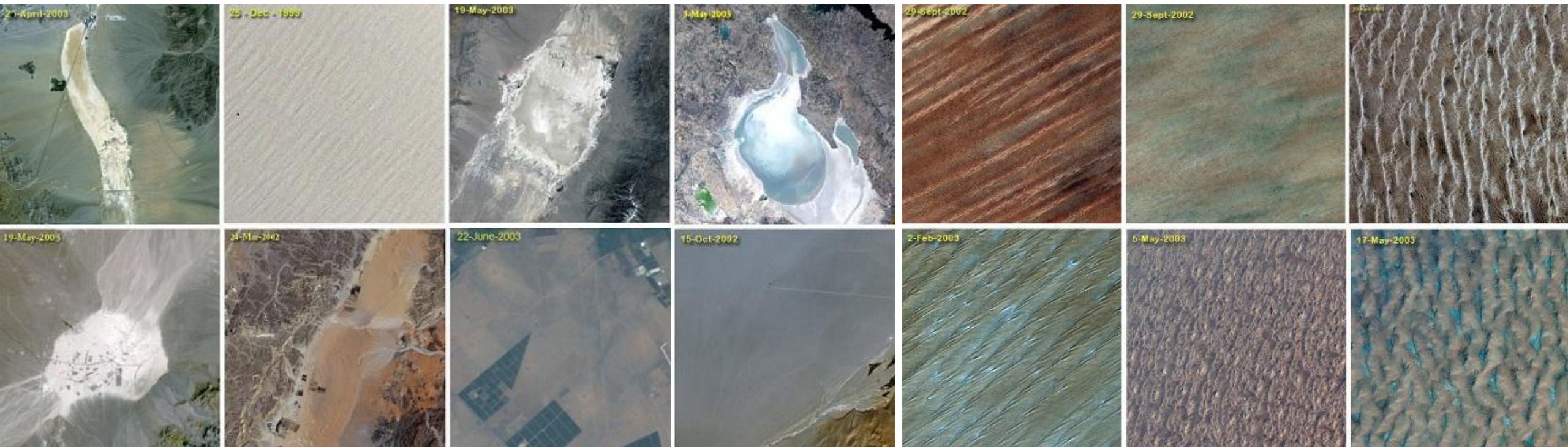
Virtual Constellations:

- ❖ Atmospheric Composition
- ❖ Coastal Observations Applications Services and Tools (COAST)
- ❖ Land Surface Imaging
- ❖ Ocean Colour Radiometry
- ❖ Ocean Surface Topography
- ❖ Ocean Surface Vector Wind
- ❖ Precipitation
- ❖ Sea Surface Temperature

CEOS Working Group on Calibration and Validation



- ❖ **WGCV mission:** Ensure long-term confidence in the accuracy and quality of Earth Observation data and products and to provide a forum for the exchange of information about calibration and validation, including the coordination of cooperative activities.



Organisation



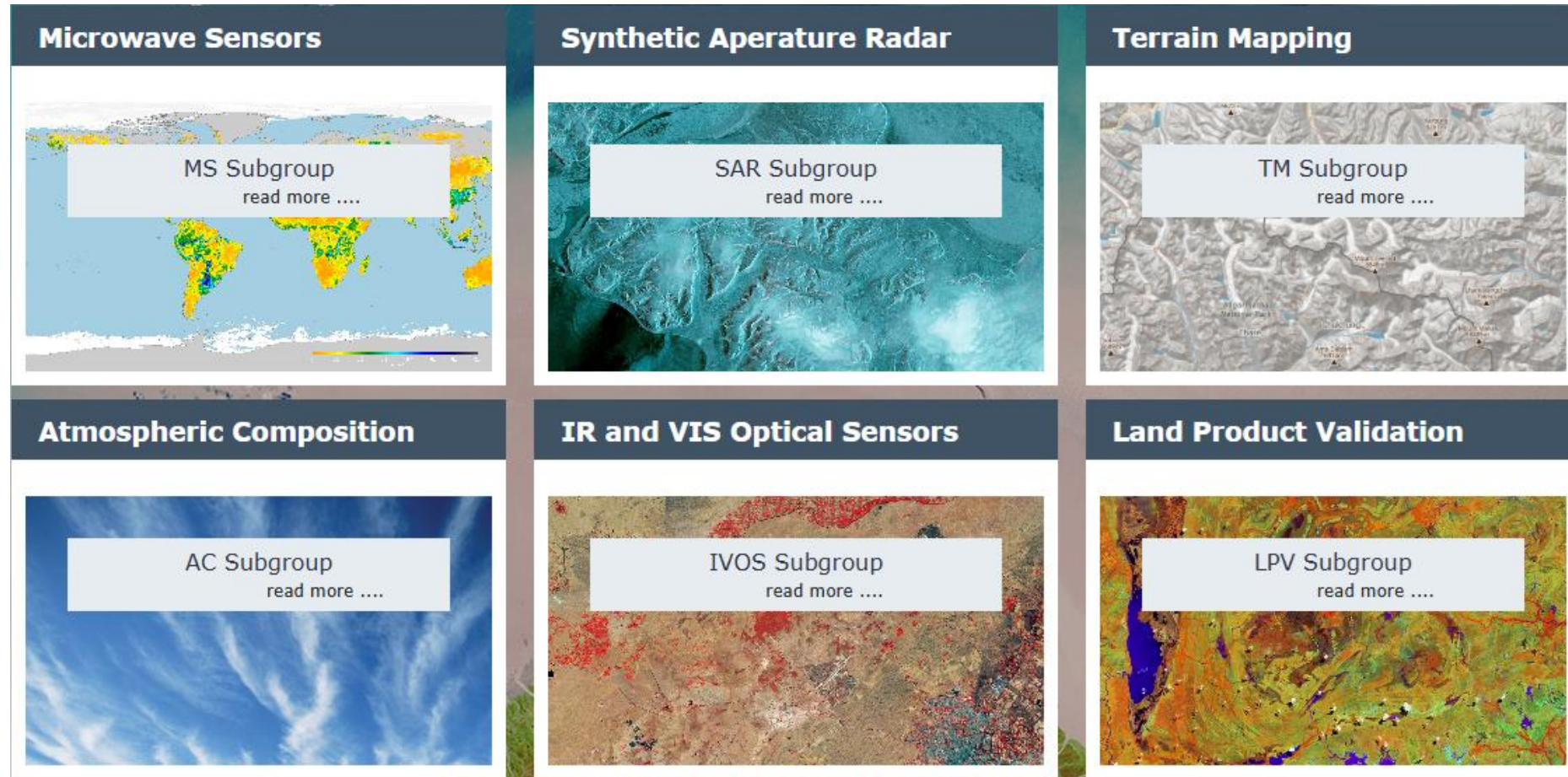
❖ **WGCV Chair:** Cody

Anderson (USGS)

❖ **WGCV Vice Chair:**

Medhavy Thankappan
(GA)

- ❖ The six subgroups of WGCV aim to **foster high quality Cal/Val** of data from Earth Observation sensors and **validation of higher level products** in each domain



Credit: Cal/Val Portal
(<https://calvalportal.ceos.org/wgcv>)

Meetings & Workshops



❖ **JACIE 2026:** 13–18 April, USGS Headquarters, Reston, USA



JACIE 2026

❖ **WGCV-56 / LSI-VC-19 Joint Meeting:** 20-24 April 2026, USGS EROS, Sioux Falls, South Dakota, US.



WGCV-56 2026

❖ **VH-RODA (annual):** 16-20 November 2026, ESA ESRI, Frascati, Italy

❖ **5th Lunar Calibration Workshop:** 16-20 November 2026, EUMETSAT, in Darmstadt, Germany – Co-branded with GSICS



VH-RODA 2025

❖ **WGCV Subgroup Meetings:** Typically annual, participation welcomed

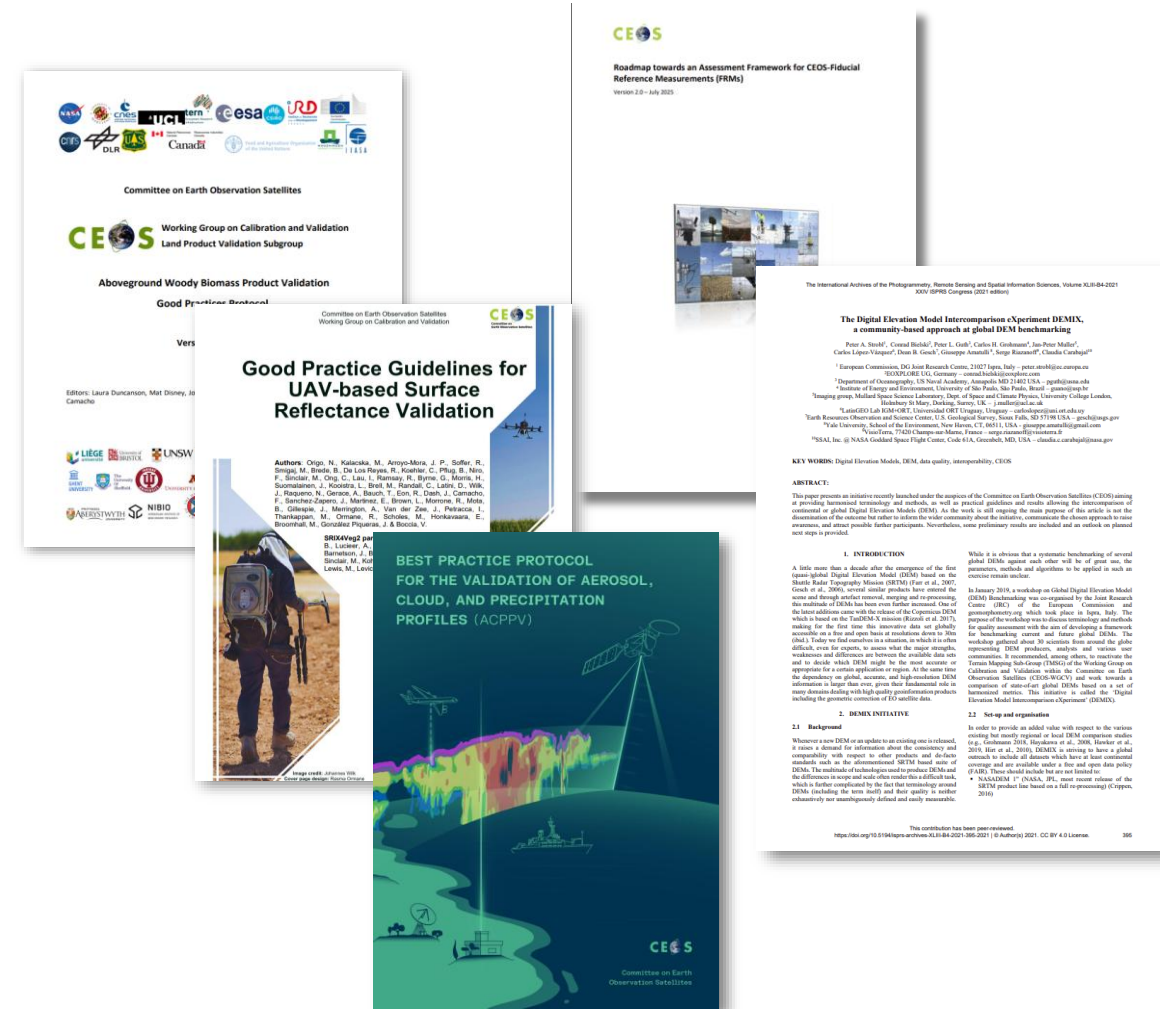
❖ **LPV Subgroup** Validation Protocols: [LC](#) (2025), [AGB](#) (2021), [SM](#) (2021), [Albedo](#) (2019), [LST](#) (2018), [LAI](#) (2014)

❖ **IVOS:** [Good Practice Guidelines for UAV-based Surface Reflectance Validation](#), Guidelines for pre-flight calibration (under development)

❖ **ACSG:** [Best Practice Protocol For The Validation Of Aerosol, Cloud, And Precipitation Profiles](#)

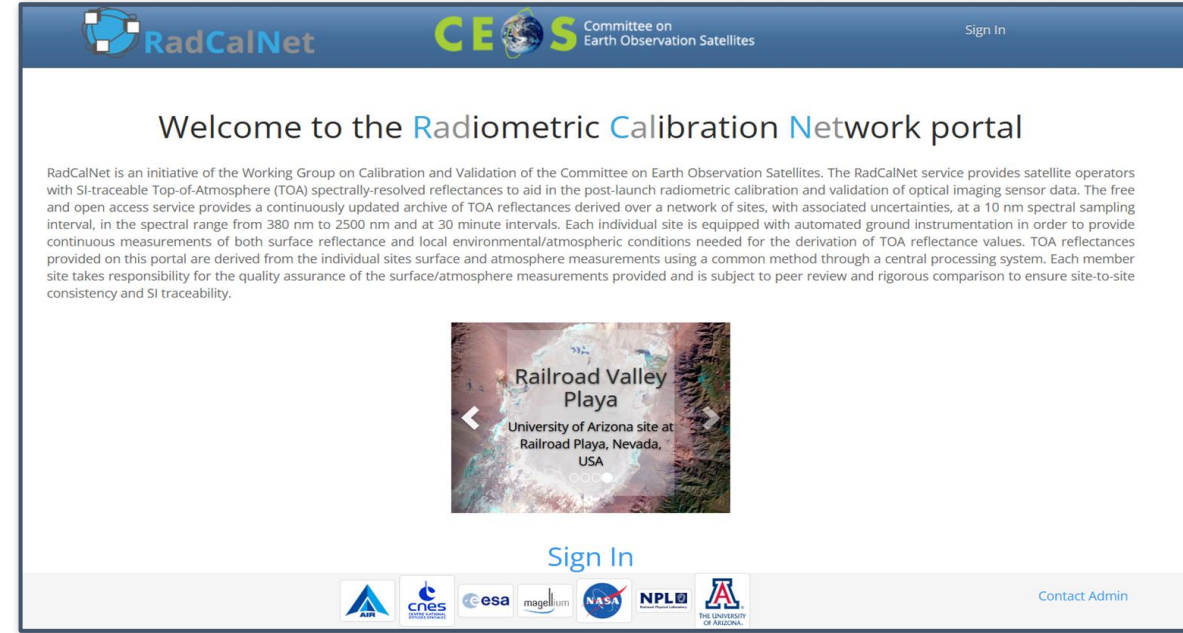
❖ **TMSG:** [DEMIX Conference paper](#)

❖ **FRM:** [FRM Assessment Framework guidelines V2](#)



Radiometric Calibration Network (RadCalNet)

- Free and open service providing continuously updated archive of TOA reflectances from a network of sites worldwide
- SI traceable, in-situ-derived data at 10 nm sampling interval provided every 30 minutes
- Suitable for VIS-SWIR sensors (380 - 2500 nm)
- >1500 registered users, 5 operational sites (3 under review), 12 year archive
- **Site submissions encouraged!**
 - [Contact Cody](#) or visit radcalnet.org



ERUS (South Dakota)



GHNA (Hypernet
Gobabeb)



GOCN (Gobi Desert)

SAR Calibration Network (SARCaINet)



- SARCaINet Database: consistent dissemination of reliable and standardised information about SAR calibration sites and targets
- SARCaINet Library: requirements for calibration and image analysis, sample datasets, tools, and a glossary of SAR terminology.
- >240 targets across 38 sites and ten countries
- Managed by the [WGCV SAR Subgroup](https://wgcv.org/)
- Self-assessment and submission criteria available at sarcalnet.org

The screenshot displays the SARCaINet website interface. The top navigation bar includes links for Home, Calibration Sites, Library, Glossary, Resources, and Contact, along with a user profile icon. The main banner features the text "SARCaINet Network of Calibration Sites for SAR" over a satellite image. Below the banner, a map shows the distribution of calibration sites across the globe, with numbered markers (1, 2, 3, 4, 5, 30) indicating specific sites. A legend at the bottom identifies "Site centroid (artificial targets)" with a blue pin and "Site centroid (natural targets)" with a green pin. A sidebar on the left contains filter options for Site active on, Characteristic, Endorsement level, Primary target type, Primary sensor, Responsible organization, and Target type, each with a dropdown menu and a question mark icon. A "Reset filters" button is located at the bottom of the sidebar.

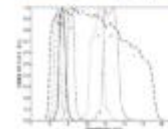
Thermal Infrared Calibration Network (TIRCalNet)



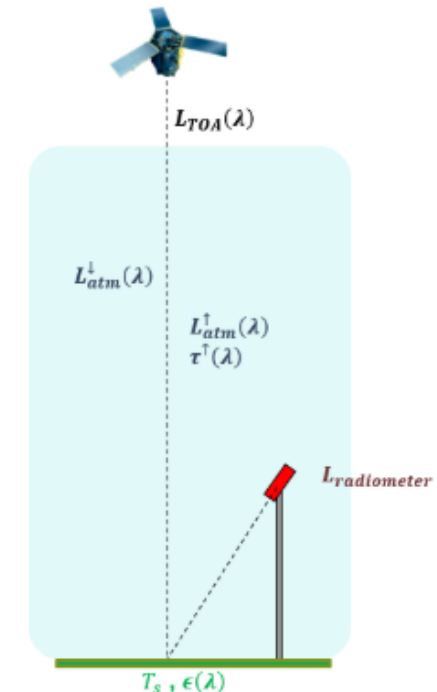
- Calibration network under development by [WGCV IVOS](#)
- Aims to collect surface temperature, emissivity, and atmospheric data to simulate and verify TIR satellite observations
- Prepare for future Cal/Val of TRISHNA and other TIR missions
- Site assessment protocols under development



Report from the Field Inter-Comparison Experiment (FICE) for Land Surface Temperature - Göttsche et al 2017



Candidate TIRCalNet site:
La Crau, France



- Platform for satellite providers to evidence the quality of their data through comparison to a community-agreed reference
- Hosts the Radiometric Validation and Analytics (RadVAL) tool to visually intercompare sensor performances.
- Hosted on the UK's National Earth Observation Data Hub
- Actively encouraging agency & commercial participation**

ceos.org/pvp

RadVAL
Radiometric Validation
AnaLytics Tool

Radiometric Calibration Sites

Site Name	Location	Site Type	Surface Type	Coordinates
RCN - GONA	Gobabeb, Namibia	Instrumented (RadCalNet) operated by European Space Agency (ESA) and CNES	Desert sand	23.6 S, 15.1196 E
RCN - RVUS	Railroad Valley Playa, USA	Instrumented (RadCalNet) operated by the University of Arizona	Clay-based playa	38.487 N and 115.690 W
RCN - Lake Tahoe	California, USA	Instrumented (RadCalNet) operated by NASA Jet Propulsion Lab (JPL)	Water	39.12468 N, 120.03827 W
Libya 4	Libya	Pseudo-Invariant Calibration Site (PICS)	Desert sand	28.55 N, 23.39 E
Libya 1	Libya	Pseudo-Invariant Calibration Site (PICS)	Desert sand	24.42 N, 13.35 E
Algeria 3	Algeria	Pseudo-Invariant Calibration Site (PICS)	Desert sand	30.32 N, 7.66 E

Powered by



**EARTH
OBSERVATION
DATA HUB**

NPL
National Physical Laboratory

Geometric Calibration Sites



Baotou Target

Location: Baotou City, Inner Mongolia, China
Operated by: Academy of Opto-Electronics, Chinese Academy of Sciences
Surface Type: Gravel
Coordinates: N 40.854, E 109.628



Shadnagar Target

Location: Hyderabad, Telangana, India
Operated by: ISRO National Remote Sensing Centre (NRSC)
Surface Type: Mixture of soil, stone and gravel
Coordinates: 17.093 N, 78.183 E



King Fahd Causeway

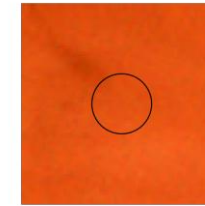
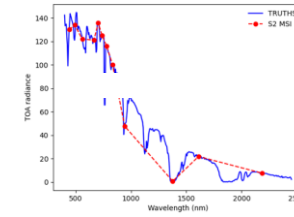
Location: Gulf of Bahrain, Saudi Arabia/Bahrain
Operated by: N/A
Surface Type: N/A
Coordinates: 26.182 N, 50.598 E



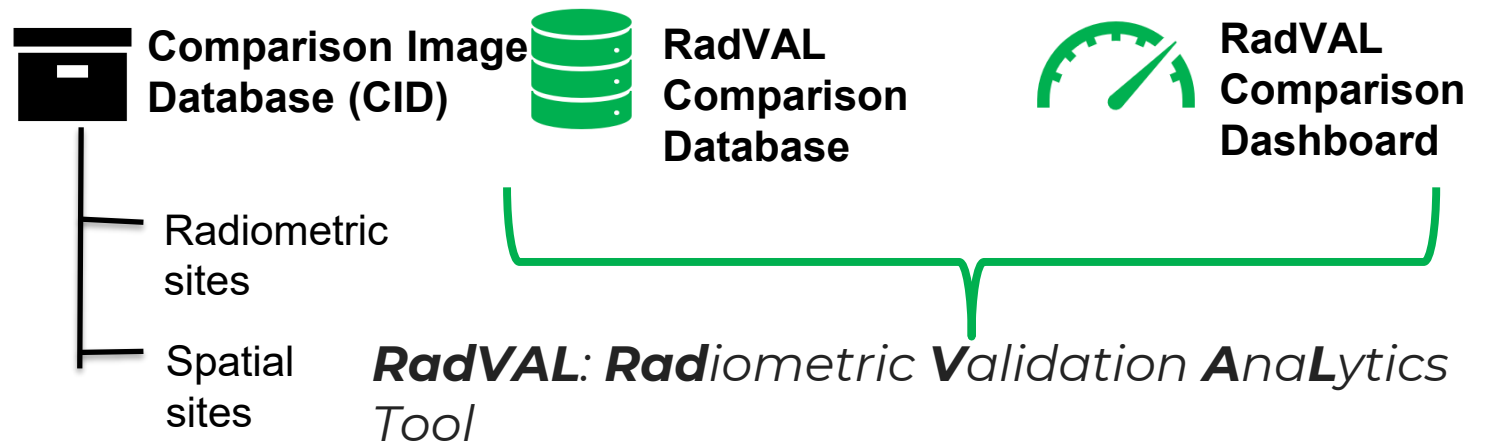
Lake Pontchartrain Causeway

Location: New Orleans, Louisiana, USA
Operated by: N/A
Surface Type: N/A
Coordinates: 30.212 N, 90.121 W

CEOS Product Validation Platform (CEOS-PVP)



PVP: Product Validation Platform



❖ CEOS Fiducial Reference

Measurements (CEOS-FRM) are

precise and **well-characterised**

measurements tailored for EO mission

Cal/Val. The CEOS-FRM Assessment

Framework assesses the maturity and

compliance of FRMs against

community-agreed criteria in a

transparent and **fair** manner.



Mandatory CEOS-FRM characteristics

- Traceability
- Independence from satellite under test
- Uncertainty budget
- Documented protocols
- Accessibility
- Representativeness
- Adequacy of uncertainty
- Utility (Return on Investment)

CEOS Fiducial Reference Measurements (CEOS-FRM): How it works



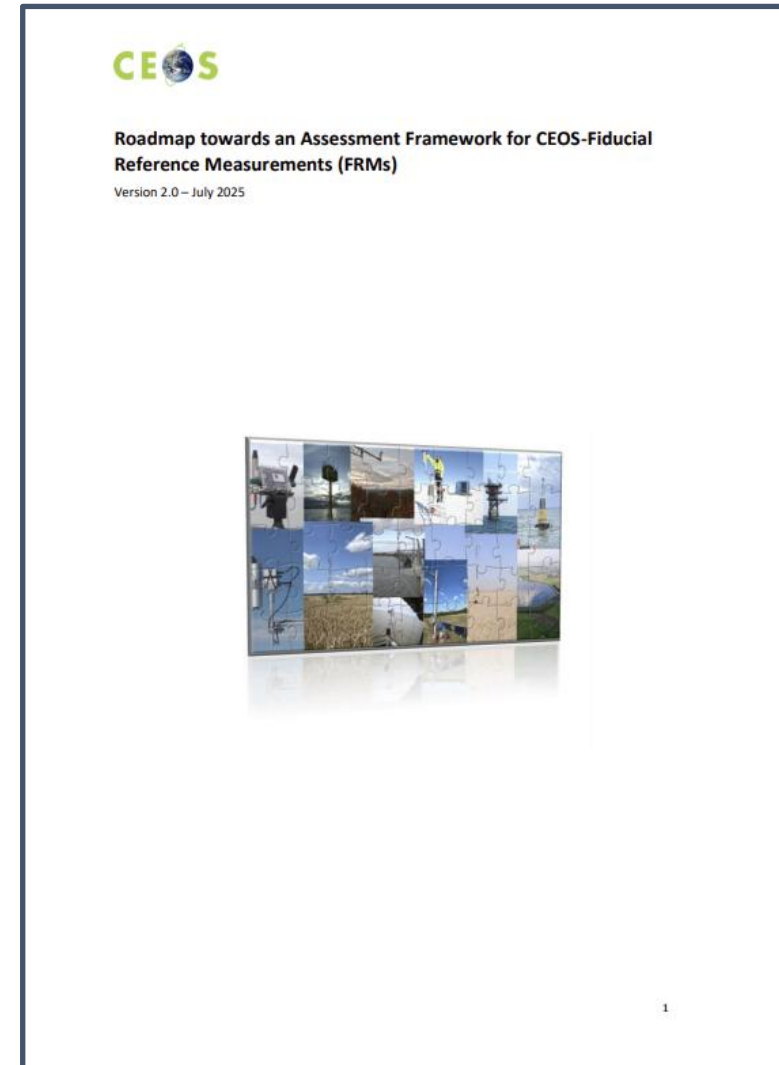
Assessment of fiducial reference measurements:

- ❖ Submissions are received via self-assessment and reviewed by a WGCV board
- ❖ Submissions are graded against criteria and presented alongside the degree of compliance in a maturity matrix

Self-Assessment						Independent Assessor
Nature of FRM	FRM Instrumentation	Operations/ Sampling (single instrument)	Data	Metrology	Completeness, coverage and distribution	Verification
Descriptor	Instrument documentation	Automation level	Data completeness	Uncertainty characterisation	Validation capacity	Guidelines adherence
Location/ availability of FRM	Evidence of traceable calibration	Measurand sampling/ representativeness	Availability and Usability	Traceability documentation	Geographical coverage	Utilisation/ Feedback
					Temporal sampling	
Range of sensors	QA Maintenance	ATBDs on processing/software	Data format	Comparison/ calibration of FRM	Centralized data, processing, quality assessment and adherence to community standards	Metrology verification
Complementary observations	Operator expertise	Guidelines on transformation to satellite sensor	Ancillary data	Adequacy for class of instrument/ measurand	Timeliness	Independent verification
FRM CLASSIFICATION						A B C D

Grade
Not Assessed
Not Assessable
Basic
Good
Excellent
Ideal
Not Public

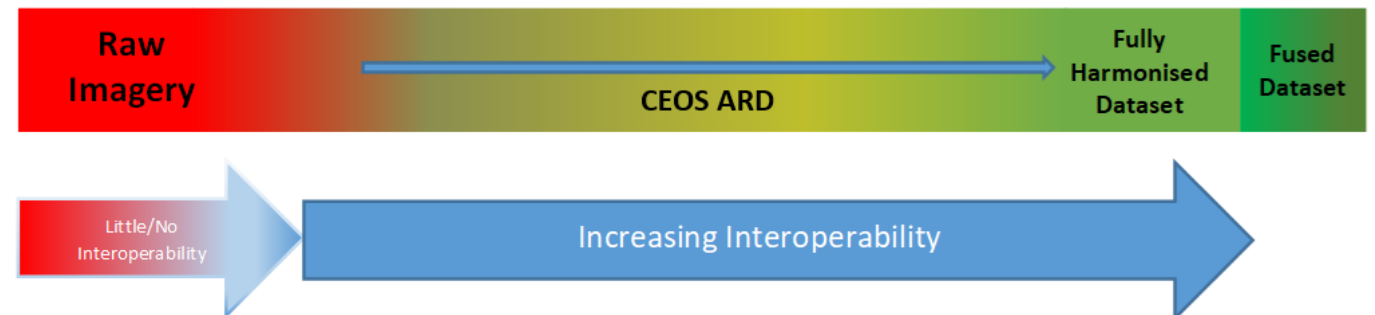
- ❖ Pilots for first CEOS-FRM Maturity Matrix Assessment Exercise: PGN, RadCalNet, ICOS, FRM4DOAS, BAQUINN, Brewer Spectrometer NO2 VCDs, FRM4GHG, CREGARS
- ❖ Welcoming volunteers to participate in second FRM assessment exercise
- ❖ Background and guidance for developing FRMs detailed in the document: *“Roadmap towards an Assessment Framework for CEOS-Fiducial Reference Measurements”*



WGCV Surface Reflectance Quality and Consistency

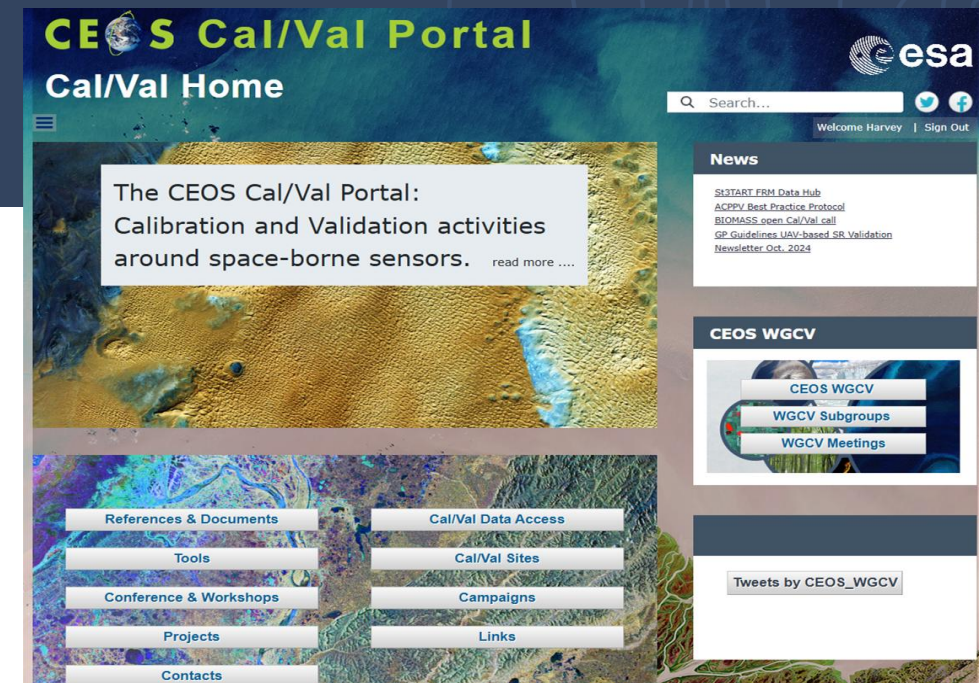


- Initiative within WGCV to advance the interoperability objectives of CEOS
- Builds on effort of CEOS Analysis Ready Data (CEOS-ARD) to achieve better harmonisation of multi-sensor data
- Aim to enable high-quality, radiometrically accurate, and temporally stable surface reflectance across sensors and missions.
- Developing dedicated **guidance**, an **unambiguous description of the SR measurand**, and a **set of inputs, corrections, and tolerances** for achieving SR consistency
- Welcoming expressions of interests and impacts/use cases.
Would the commercial sector find this useful?



CEOS Cal/Val Portal

- Forum for exchange and information sharing for CEOS WGCV
- Provides access to agreed good practices and Cal/Val protocols to the wider EO community
- Connects users to reference data and networks
- Facilitates data interoperability and performance assessment through operational CEOS coordinated Cal/Val infrastructure consistent with QA4EO principles.



AC subgroup	IVOS subgroup			LPV subgroup	MS subgroup	SAR subgroup
AC networks	Land Sites	Other Methods	Ocean Sites	LPV Supersites	MSSG test Sites	Targets Database
ACTRIS	PICS	ROLO	MOBY	ISMN		
AERONET	RadCalNet	GIRO	BOUSSOLE	NEON		
AGAGE	Sensor Characterization	LIME	AERONET-OC	TERN		
COCCON	MTF Ref. Dataset	FRM4ST5		ICOS		
CONTRAIL	USGS Catalogue			BSRN		
GAW	HYPERNETS			SURFRAD		
GRUAN				FLUXNET		
HATS				NPN		
IAGOS				PEP		
NDACC				PEN		
MPLNET				EnviroNet		
PGN				KIT		
SHADOZ				ForestGeo		
SolRad-Net				ForestPlots		
TCCON						
TOLNet						

Contact us



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MSSG Chair: Xiaolong Dong (CAS)

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