WGCV

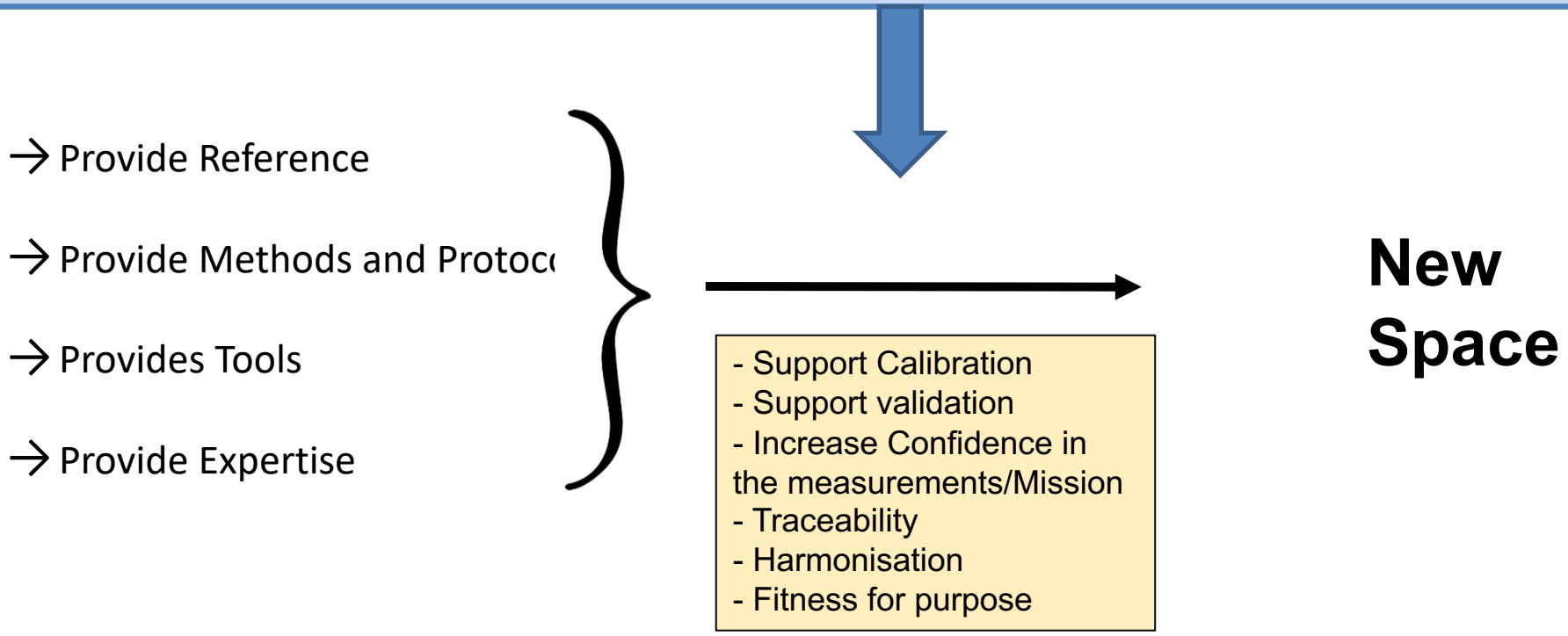
The mission of the CEOS Working Group on Calibration & Validation (WGCV) is to ensure long-term confidence in the accuracy and quality of Earth Observation data and products and to provide a forum for the exchange of information about calibration and validation, including the coordination of cooperative activities.

https://ceos.org/ourwork/workinggroups/wgcv/

http://calvalportal.ceos.org/

WGCV

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 and to provide a forum for the exchange of information about calibration and validation, including the coordination of cooperative activities.



New Space Consideration

Earth observation data without proper calibration has little value for most applications, because if the data cannot be trusted, no reliable information can be derived from it.

SmallSat/NewSpace missions in general cannot guarantee the same quality and reliability as Agencies/Institutional missions creating user community scepticism about their data quality and leading to useless data (ref. Millan et al., 2019). ForSmallSat to become valuable for space science, they must meet the quality requirements set by the science community.*

*R.M. Millan et al, Small satellites for space science: a COSPAR scientific roadmap, Adv. Space Res. 64 (2019) 1466–1517, https://doi.org/10.1016/j.asr.2019.07.035.

*SmallSat/NewSpace teams are interested in increasing the reliability of their data while ensuring a fast data delivery and return of investments. **WGCV Cal/Val support** helps to move forward and reach these goals. Providing such Cal/Val support will reduce their operating costs and add value to their end products. It will enhance their science/application/service capabilities and strengthen their competitiveness. It will shorten their start-up time and their time to market.*

Definition: to be agreed

A SITSat is a satellite-based sensor which can provide and verifiably- evidence, in a fully open and transparent manner, all significant contributions to the uncertainty of its measurements**, traceable to the international system of units, SI,** at the location and time from where they are made. In addition, this uncertainty must be at a level that is considered by the community to be of **'Fiducial reference'** quality, i.e. that for a defined spectral domain/application it can be considered 'state-of-the-art' and able to unequivocally serve as a **reference** for similar measurements from other sensors. Typically, a SITSat might be expected to have a measurement uncertainty of <0.5 compared to that of its peers.

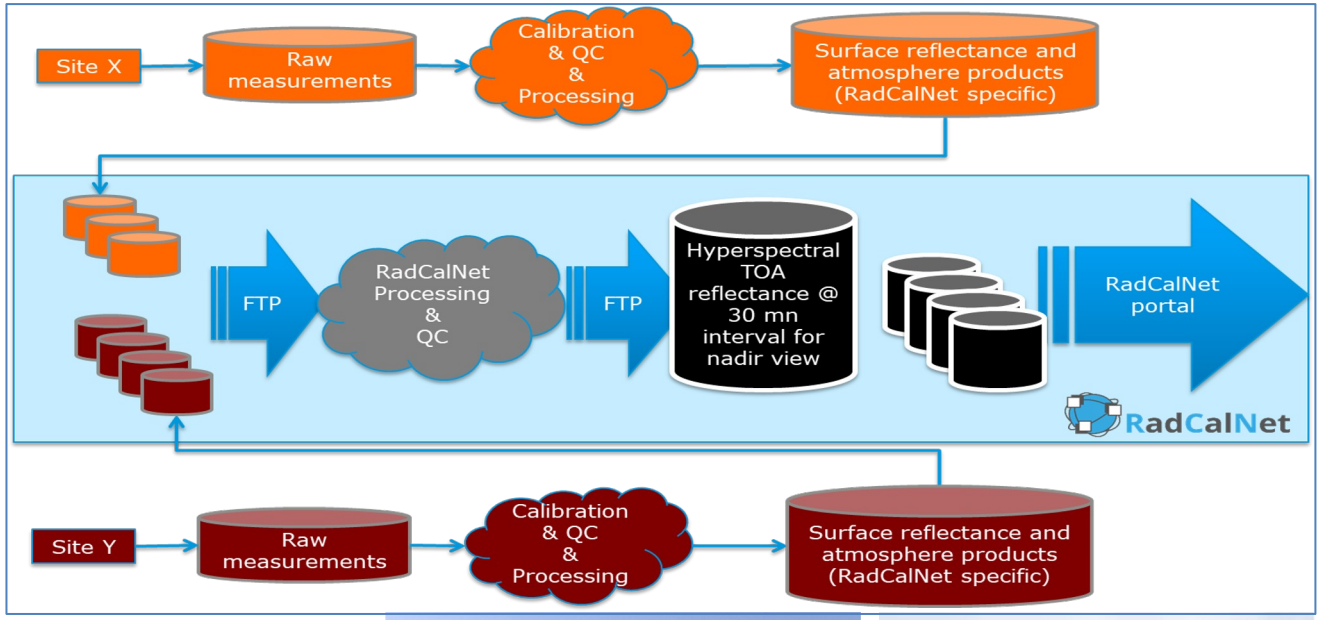
Note: if used as a reference, the method used to compare with other sensors and its associated uncertainty to SI, should also be fully documented and evidenced.

WGCV Reference

Radiometric Reference:

RadCalNet a CEOS WGCV Service

Network of test sites providing, via a common portal, Top Of Atmosphere @ Nadir Ref with uncertainties in range 400 - 2500nm (10 nm band) every 30 mins



WGCV Reference

SARcalnet

CEOS

There is a demand for well-defined calibration targets for SAR calibration

- Targets are used to calibrate the data from SAR missions
- Currently, in most cases these targets are defined differently for each SAR mission.
- There are three main category of targets
    - Natural Targets
    - Artificial Passive Targets
    - Artificial Active Targets
- "SARcalnet" is in the early stages of formulation by the **CEOS WGCV SAR subgroup**.
- It would be an established network of calibration sites that would facilitate collaboration between sensors by using the same calibration references.

AuScope Australian Geophysical Observing System C/X-band 1.5 m

2.8 m DLR reflector in stowed position

JPL P-band reflector 4.8 m at Rosamond Dry Lake

ESA Transponder

DLR Transponder

TIRCALNet Objectives

- To collect surface temperature and emissivity, and atmospheric data necessary for the simulation of observations by TIR optical sensors and thus verify their radiometric calibration
- To increase the number of matchups between in-situ measurements and space sensor observations and reduce the overall uncertainties, and reduce the efforts of individual agencies
- To ensure traceability of the space sensor radiometry to the “Système International” (SI)
- To support the establishment of the Global Earth Observation System of Systems by providing measurements to verify the radiometric consistency between EO space sensors
- The success and experience return from RadCalNet network dedicated to VNIR-SWIR optical sensors cal/val

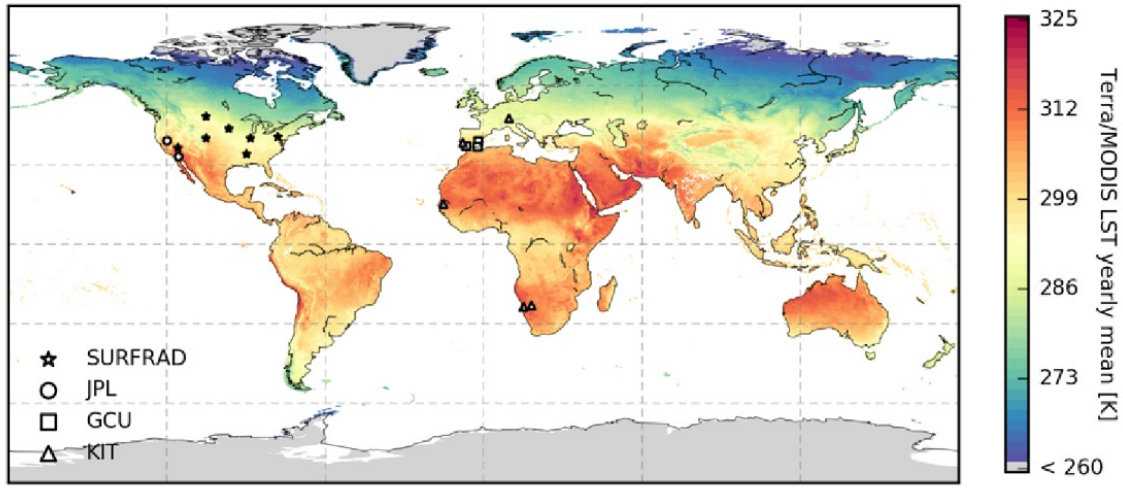
Site Study Objectives

- TRISHNA, LSTM, SBG
- Existing network for LST
- Need for a denser network
  - that provides L_{TOA}
  - with evaluated uncertainty for each site
  - with a demanding requirement on TOA radiance (0.5K)

- Impact of uncertainty sources ?
  - Atmosphere
  - Emissivity
  - Temperature (retrieved from radiometer measurements)

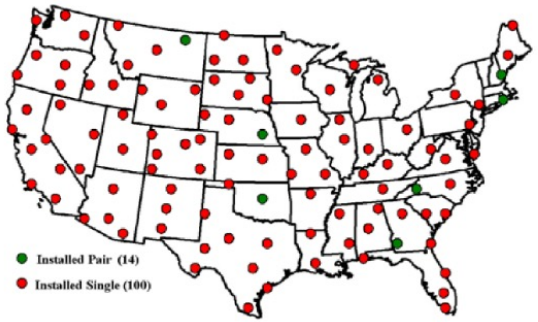
→ Study on LaCrau site

JPL TIR radiometer installed in LaCrau



SURFRAD: Surface Radiation, NOAA GCU: Global Change Unit, University of Valencia
JPL network KIT (Karlsruhe Institute of Technology) stations

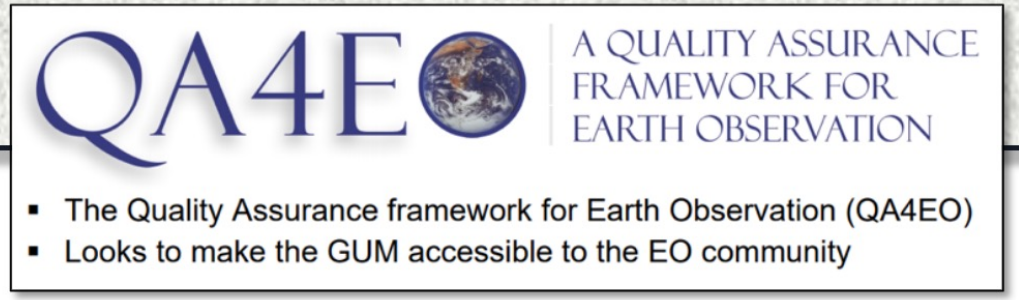
Location of ground observational networks currently used to validate standard LST products derived from US and European spaceborne instruments.



USCRN: US Climate Reference network

FRM Definition

Fiducial Reference Measurements (FRM) are a suite of independent, fully characterised, and traceable (to a community agreed reference ideally SI) measurements, tailored specifically to address the calibration and validation needs of a class of satellite borne sensor and that follow the guidelines outlined by the GEO/CEOS Quality Assurance framework for Earth Observation (QA4EO).



FRM Maturity Matrix

Self-assessment					Independent assessor
Nature of FRM	FRM Instrumentation	Operations/ sampling	Data	Metrology	Verification
Descriptor	Instrument Documentation	Automation level	Data completeness	Uncertainty Characterisation	Guidelines adherence
Location/ availability of FRM	Evidence of traceable calibration	Measurand sampling	Availability and Usability	Traceability Documentation	Utilisation/Feedback
Range of sensors	Maintenance plan	ATBDs on processing/software	Data Format	Comparison/calibration of FRM	Metrology verification
Complementary observations	Operator expertise	Guidelines on transformation to satellite Pixel	Ancillary Data	Adequacy for intended class of sensors	Independent Verificaton
				FRM CLASSIFICATION	**A B C D** (to be selected)

Grade
Not Assessed
Not Assessable
Basic
Good
Excellent
Ideal

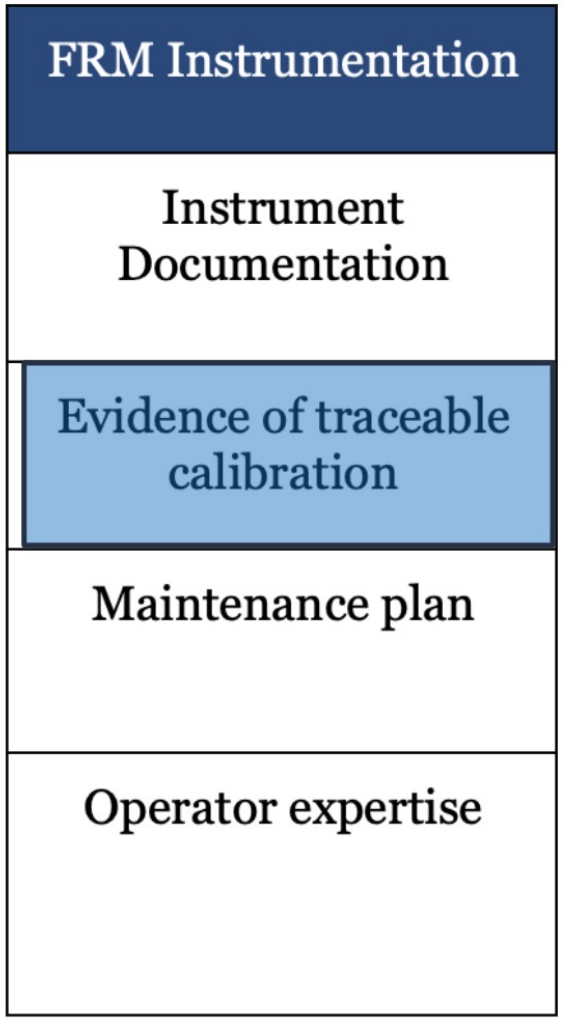
self-assessment FRM MM
FRM Instrumentation

FRM Instrumentation
Instrument Documentation
Evidence of traceable calibration
Maintenance plan
Operator expertise

Information related to the FRM instrumentation:

- Documentation, Technical Manuals: Hardware and software
- Documentation demonstrating traceable calibration of all appropriate FRM instrumentation, indicating achieved performances and detailed uncertainty budgets
- QA and Maintenance aspect and Operator expertise (months/years of experience, trained and number of personnel etc)

Traceable calibration



Grade	Criteria
Not Assessed	Assessment outside of the scope of study.
Not Assessable	Relevant information not made available.
Basic	Evidence of traceability and performance limited potentially to a pre-deployment calibration or manufacturers specification.
Good	Evidence of traceability available together with uncertainty budget but not necessarily independently reviewed or compared
Excellent	Adequate documentation to make clear the degree of traceability and associated uncertainty although comparison of peers not necessarily undertaken.
Ideal	Fully documented evidence of route of traceability and associated uncertainties (full breakdown including correlations) from the use of the instrument to make a measurement in support of FRM at location, back to its link to an SI or community agreed reference. This should be presented following the practises indicated by FIDUCEO, and available from the QA4EO website. This should be evidenced by an independent comparison of performance against as a minimum peers under full range of operational conditions of the instrument. Ideally this would all be carried out following equivalent to ISO 17025

Critical verification categories

GUIDELINES

Grade	Criteria
Not Assessed	Assessment outside of the scope of study.
No Assesable	Relevant information not made available.
Basic	All categories should be at least basic and if not there should be a clear strategy to progress within a short (<3 month) timescale. Those categories in basic should have a strategy to progress towards greater compliance.
Good	More than 80% must meet the good category and those in basic should indicate a strategy to progress. >30 % should be in the green classification. There should be no basic classifications in the metrology or Instrument columns and any in these columns indicating good should indicate a strategy to progress
Excellent	All categories are good or above with > than 80% in the green classification and those in the Metrology or instrument columns must meet excellent or above.
Ideal	All categories in the matrix fully meet the green classification i.e. Excellent or Ideal with at least half reaching the ideal category and of these half must include those in the metrology and FRM instrument column

Independent Verification

Grade	Criteria
Not Assessed	Assessment outside of the scope of study.
Not Assessable	Relevant information not made available.
Basic	Some comparison evidence but limited ability to confirm or otherwise the declared FRM uncertainty
Good	Full compliance of declared FRM uncertainties through comparison to a reference of good but higher uncertainty than the FRM or near but not full compliance against a reference of comparable or lower uncertainty.
Excellent	Full compliance of declared FRM uncertainties through comparison to a reference with comparable uncertainties.
Ideal	Full compliance of declared FRM uncertainties through independent comparison to a reference of lower overall uncertainty

Class A & B must achieve some form of Green for all categories,

FRM Overall Classification

To provide overall summary guidance to a user we have created the following four classes.

Class A – Where the **FRM fully meets all the criteria necessary to be considered an FRM for a particular class of sensor.**
It should achieve a class of Ideal in the 'guidance criteria' in the 'independent verification' section of the MM and green (at least excellent) for all other verification categories where these have been carried out.

Class B – Where the **FRM meets many of the key criteria and has a path towards meeting the Class A status** in the near term. It should achieve at least Excellent in the guidance criteria in the independent verification section of the MM and green (at least excellent) for all other verification categories where these have been carried out. Ideally it should indicate a path towards achieving the high class.

Class C – **Meets or has some clear path towards achieving the criteria needed** to reach a higher class and provides some clear value to the validation of a class of satellite sensors.
It should achieve at least Good in the guidance criteria in the independent verification section of the MM and at least good for all other verification categories where these have been carried out. Ideally it should indicate a path towards achieving the high class.

Class D - Is a relatively **basic adherence to the FRM criteria** but where this is a strategy and aspiration to progress towards a higher class. This can be considered an entry level class for those starting out on developing an FRM. It should achieve at least Basic in the guidance criteria in the independent verification section of the MM and at least Good for all other verification categories where these have been carried out. FRM owners/developers must indicate a path towards achieving the high class.