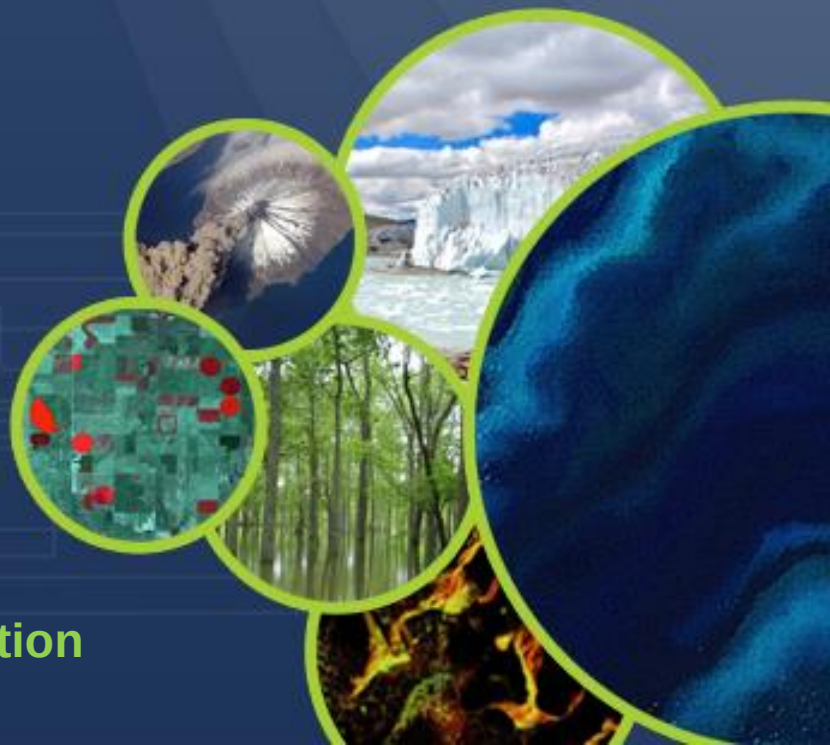
CEOS WGCV and Context of FRM4STS

N Fox (NPL supported by UKSA)

Chair CEOS WGCV IVOS sub-group

K Thome (NASA)

Chair of CEOS WGCV

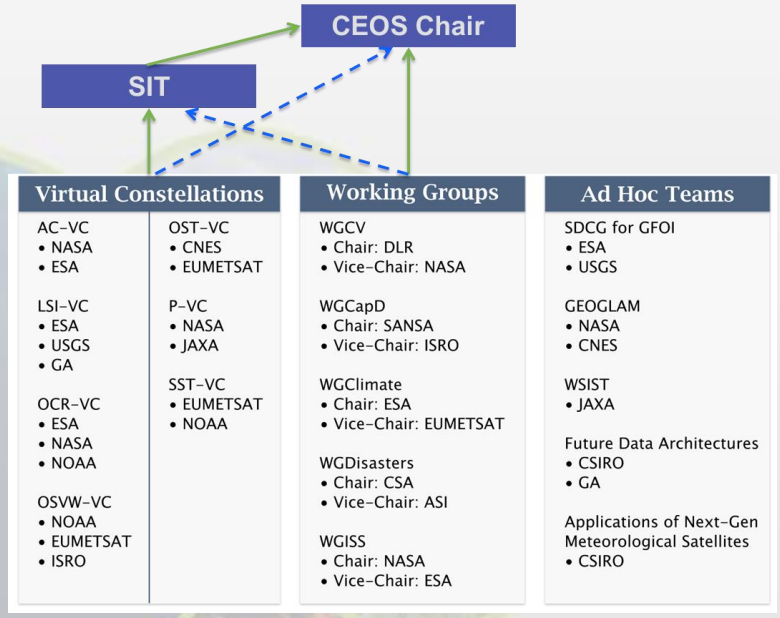


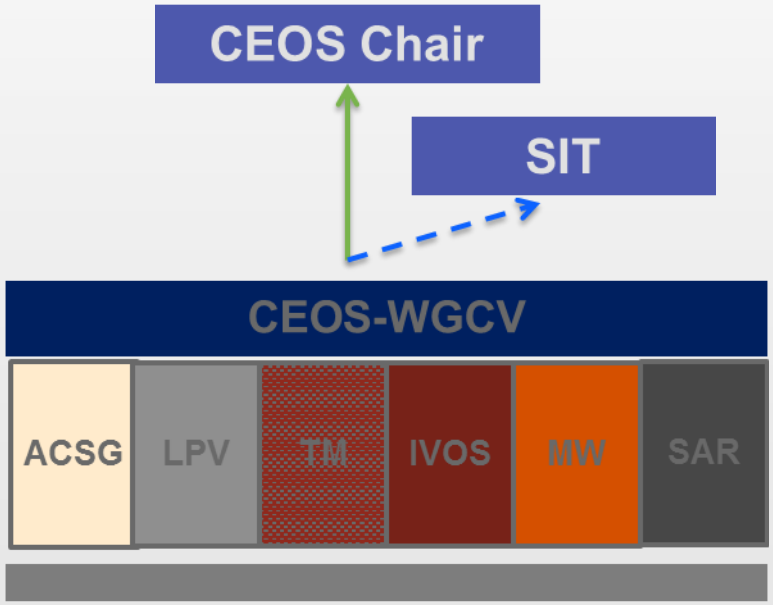
Working Group on Calibration and Validation

CEOS organization reminder

IVOS is one of six subgroups that are part of WGCV that reports to the Strategic Implementation Team and CEOS Chair

- Interaction with other CEOS bodies (Virtual Constellations, WGs)
- Interaction with other bodies (example: GSICS)
- Topics which are relevant for several subgroups
- General topics (for example: validation metrics, protocols,…)





CEOS WGCV

- Working Group on Calibration/Validation is to ensure long-term confidence in accuracy and quality of Earth Observation data and products
- Provide forum for exchange of information on Cal/Val, coordination, and cooperative activities
- Respond to and provide support to CEOS (SIT) and other WGs and VCs etc
- Chair: Kurt Thome (NASA) Vice Chair: Cindy Ong (CSIRO)
- Approx 9 monthly meetings

Interaction with CEOS bodies

"Nature" of CEOS WGCV typically leads to links with other Working Groups and Virtual Constellations

- Other working groups rely on data quality, characterization, metrics
  - WGClimate
  - WGISS (WG Information Systems and Services)
  - WGCapD (WG for Capacity Development)
- Virtual Constellations have direct connections to parts of WGCV through overlap in topics and reliance on data quality
  - Atmospheric Composition (AC-VC)
  - Land Surface Imaging (LSI-VC)
  - Ocean Colour Radiometry (OCR-VC)
  - Sea Surface Temperature (SST-VC)
- Metrics Indicator, Future Data Access, GEO work plan
- Link to GSICS has been established
- Fiducial Reference Measurements and other topics

IVOS: Vision

To facilitate the provision of 'fit for purpose' information through enabling data interoperability and performance assessment through an 'operational' CEOS coordinated & internationally harmonised Cal/Val infrastructure consistent with QA4EO principles.

- ***Pre-flight characterisation & calibration***
- ***Test – sites***
- ***Comparisons***
- ***Agreed methodologies***
- ***Community Best Practices***
- ***Interchangeable/readable formats***
- ***Results/metadata - databases***

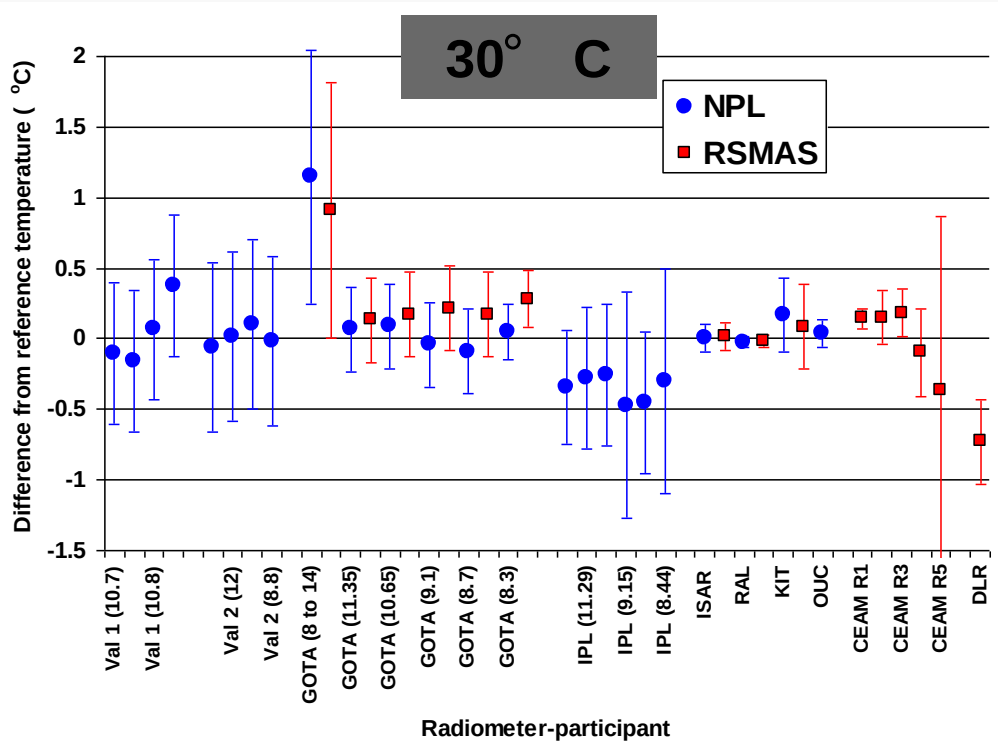
Key Infrastructure to be established and maintained independent of sensor specific projects and/or agencies

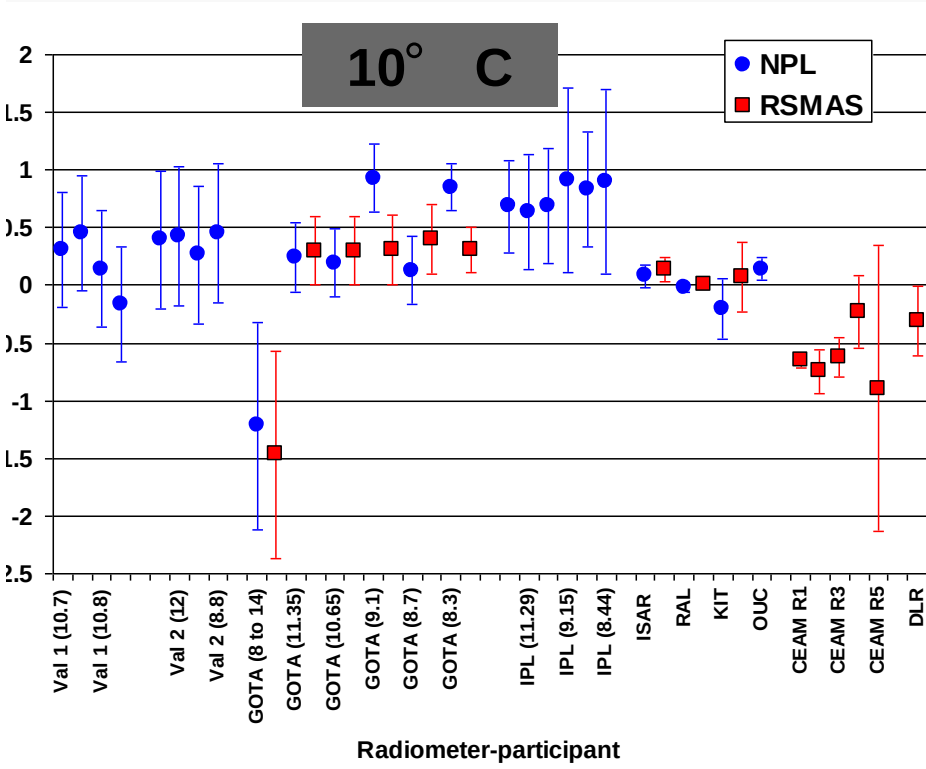
CEOS heritage MIAMI campaigns

Miami 3 Results of radiometers to a "standard black body" in Lab (NPL and RSMAS)

- Excellent agreement near ambient but increased variance between participants at cooler temperatures

- Results in UK and US consistent showing stability of radiometers and also agreement between NPL and NIST





Project 1: SST/LST Comparison Campaign Status

Cal/Val sensor comparison campaign in support of SST and LST measurements from space (support action for VC-SST and WGC)

(follows similar highly successful Tuz Golu campaign for surface reflectance and Miami 3 (2009) for SST (10 global participants) using QA4EO guidelines

Proposal

4th of ~5 yearly ('Miami' 1,2,3) WGCV comparisons for radiometers including black bodies

- **Phase1 (2014-2015): Laboratory based vs. SI traceable standards (radiometers and black bodies) (Land and Ocean applications)**
- **Phase 2A (2014 – 2018): Series of ship/ocean based radiometer campaigns**
- **Phase 2B (2015 – 2017): Field-based calibration of radiometers**
- **Participation open to all**

Background

- **Essential Climate Variables Sea Surface Temperature (SST) and Land Surface Temperature (LST) are both dependent on global satellite observations of surface emitted thermal radiation**
  - **Heritage long-time series of data from multiple sensors exists**
  - **New sensors soon to be launched e.g. Sentinel 3, JPSS-1**
- **International comparisons are essential to provide confidence in data, test innovation and facilitate capacity building and training**

Project 1: SST Comparison Campaign Proposal (continued)

- **ESA have agreed to provide funding to support the organisation, logistics and analysis of the comparison (For all phases 1 through to 2B)**

  <u>It will require</u>:

  - CEOS member agencies to support the participation (travel/subsistence ~2-3 wks to UK) and instruments transport of appropriate Cal/Val teams from their region of influence.
  - For Phase 2A, this will require radiometers to be deployed on ships for a few months (no cost for ship but for radiometer transport).
  - For Phase 2B, this will require support for radiometers and personnel (travel/subsistence ~2 wks) for appropriate teams from their region of influence to be deployed) to a field-site potentially in Namibia.

- **Benefits to CEOS agencies:**
  - Knowledge to remove and correct instrument biases enabling harmonised global satellite Cal/Val
  - Potential to learn and improve from peer interactions
  - Establishment of best-practises for instrument and product Cal & Val

Project 2: SST (pilot) 'Operational Validation Project' Proposal

Background:

- For SST validation (Operational and Climate) require network of high performance drifting Ocean Buoys for continuous monitoring of Ocean Temps, in addition to Ship borne radiometers analogous to 'test-sites' such as Aeronet and new LandNET
  - Key part of strategy to bridge 'data gaps' between sensors for climate
  - White paper drafted by VC-SST, GHRSST, WGCV-IVOS detailing background available
  - Existing networks not sufficient in number for necessary coverage

Request to agencies

- Agency (or group of) to provide resources to launch a set of high performance well-calibrated SI traceable drifting Ocean Buoys as an initial demonstration pilot project. Buoys can be built nationally to meet community defined specification
- Agencies to allocate resources to continue and where possible extend number of ocean borne radiometer cruises for SST validation - independent of specific satellite missions to facilitate improved management of 'data gaps' between missions for Climate.

Meeting Objectives

- Review state of the Art in Satellite derived surface Temperature measurements and their validation
- Consider Current and future science and operational needs
- Present and discuss outputs of FRM4STS project
  - Good practises proposed including protocols to ensure and evaluate ‘degree of equivalence’ and uncertainty to SI of validation measurements (FIDUCIAL References) (radiometers/Buoys)
  - Results of comparisons
- Establish a community strategy and roadmap for infrastructure and activities needed to meet long term Measurement and validation needs

Fiducial?

What are Fiducial Reference Measurements?

*"The suite of independent ground measurements that provide the maximum return on investment for a satellite mission by delivering, to users, the required confidence in data products, in the form of independent validation results and satellite measurement uncertainty estimation, over the entire end-to-end duration of a satellite mission" (*Sentinel-3 Validation Team)

An FRM must:

- Have documented evidence of its degree of consistency for its traceability to SI through the results of round robin inter-comparisons and calibrations using formal metrology standards
- Be independent from the satellite geophysical retrieval process
- Have a detailed uncertainty budget for the instrumentation and measurement process for the range of conditions it is used over.
- Adhere to community agreed measurement protocols, and management practises.

Session 1: Community Need and drivers

Questions

- Is current measurement capability and validation strategy adequate for:
  now?
  And future (5, 10 yrs)?
  (Uncertainty, sampling, retrieval algorithms ……?
- If not! What are priorities for action?
- How do we move forwards as a community

Session 2: Retrieving Surface Temperatures Questions

Is there community good practise to share/consolidate?

What are principle limitations? Challenges?

Session 4: METROLOGY FRAMEWORK Questions

- **Is Traceability and Uncertainty understood? (Cal/Val teams and users)**
  Do we need to provide training (for existing/new Cal/Val scientists)
  Is terminology understood and consistent

- **Are validation instruments/technologies adequate?**

- **Comparison protocols – are they fit for purpose?, what should change?**
  Can we consider them as a 'baseline' for future comparisons?

- **How do we ensure measurements are and remain 'Fiducial'**
  Evidence of uncertainty

Session 5: Validation methods and architecture

Questions

- **What does an ideal international validation framework look like?**
  Radiometers/Buoys?
  Locations, how many?

- **(Is/should/can) there be community good practises/protocols for satellite validation (of surface T)**
  Who should derive/endorse?

Session 6: Fiducial Reference Buoys Questions

How reliable (measurement stable) are Buoys?

What can we do to improve?

Can we consider non-returnable buoys 'Fiducial' i.e. Evidence of traceability

How many and where (per annum) do we need to deploy Buoys to support validation

- **for meteorology?**
- **for climate?**

What is optimum (considering limited financial resources)

- **A few 'very good' high accuracy, higher cost buoys**
- **A lot of 'lower accuracy' lower cost buoys**
- **A mix**

Session 7: A Strategy

1./ What are key (surface T) science/operational drivers (future)? And what does it require as a validation architecture? (performance/sampling….)

- what are consequence of not achieving?
- What are benefits of achieving?

2/ For (1) What research/activities are needed to achieve necessary validation architecture? and or confidence in satellite derived retrievals

- Measurement technologies?
- Ensuring Representativeness e.g. environmental/sampling considerations and methods?
- Satellite retrieval algorithms?
- Comparisons/Traceability ?

3/ For (2) prioritise independently in terms of importance/impact and degree of difficulty to achieve (if possible define a timeline when might be possible)

4/ How do we coordinate? Organisations, (by sub theme?), Proposals?