Level 1 Cal/Val infrastructure

CEOS
Committee on
Earth Observation Satellites

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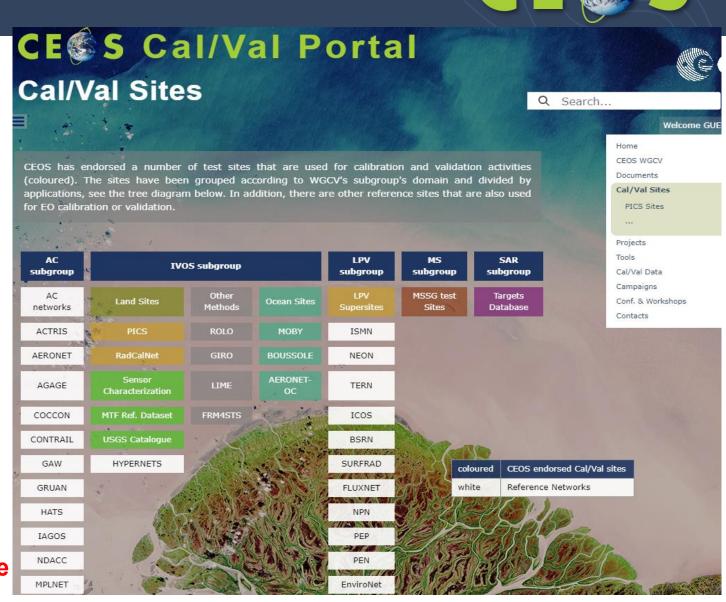**Samantha Malone**

CEOS reviewed L1 Vicarious Cal/Val infrastructure

- Post-launch Cal/Val essential element of satellite mission – particularly for IVOS sensors

- Many methods and variations of methods
  - Test-sites (RadCalNet, Hypernets, PICS, Campaigns)
  - Moon
  - Rayleigh
  - DCC
  - Flare
  - ……

- Community (Newspace, agencies) unclear as to what to use for what purpose?
  - Absolute gain, stability, relative gain, land/ocean applications ….

- Initiatives established to develop, coordinate, optimise and compare similar methods e.g. RadCalNet, PICSCAR
  - But difficult to compare between and also for new methods to demonstrate credibility

CalValPortal

❖ Provides info on methods

❖ Recommended Sites

❖ But no real figure of merit

❖ IVOS 34 discussion from Flare initiative led to request to establish means to evidence capabilities of a method

  ▪ Not necessarily 'endorse' but at least 'reviewed'

  ▪ Commercial and public allowed

  ▪ Need process for fair but not onerous review

Action for 'NPL' to propose a process & template

Process/Template

- **Method owner to complete a simple web form as an entry to a searchable database**
  - Accessible through Cal/Val portal

- Template to define in simple terms what the method does (Radiometric -gain, relative, stability, Potentially geometric etc)
  - Initially at this stage focus only on Radiometric L1 ToA gain
  - Type of sensor it is suitable for (GSD, spectral range)

- What is it capable of achieving (uncertainty) and evidence to support the claim

- Validation evidence of claim using a CEOS defined 'reference sensor'
  - Selected to cover spectral and spatial range and accessibility/acceptance
  - Evidence to be visible (accessible URL, document uploaded to Cal/Val Portal)

- **Completed form to remain private until reviewed by CEOS IVOS members (defined time frame)**

- **Following initial review entry becomes public and searchable**

- **Subject to continuous review by feedback**

Name of Method	RadCalNet (RCN) Gobabeb Site (GONA)				
Nature of calibration	*Radiometric gain,*				
Date of submission	08/09/2023		Date of last review/update	08/09/2023	
Contact details	Method owner phone email etc				
Spectral range of method	380-2500 nm				
GSD of method (all that apply)	<10 ☒	<50 ☒	<300 ☐	<1000 ☐	<10000 ☐
Method Theme	PICS, RadCalNet site, Hypernets site, Instrumented-site: radiometer, Water-base, Vegetation-based, Campaign, Sensor2Sensor, Instrumented-site: other, multi-meth.				
CEOS-FRM class	A, B, C, D none				
Description of method	From referenced paper: • Extract predicted TOA nadir reflectance values including uncertainties • Determine test sensor output for the site and associated uncertainties • Perform a temporal correction to the TOA reflectances • Determine the band-integrated TOA reflectance and associated uncertainty • Convert TOA reflectances and associated uncertainty to appropriate units for comparison with test sensor output • Compare imaging sensor output to corresponding RCN-based TOA reflectance and determine uncertainty associated with comparison **Reference:** Bouvet, M.; et Al https://doi.org/10.3390/rs11202401				

Estimated expanded uncertainty (k=2) for nominal spectral regions:	400-500	500-700	700-900	1000-1700	1700-2400	3000-5000	8000-12000
	~4.2%	~3.6%	~3.0%	~3.4%	N/A	N/A	N/A
Evidence of performance	As part of joining RCN, sites must prepare an uncertainty budget to demonstr[ate] their performance. The documents for the Gobabeb site (GONA) are as follow[s]: • BOA values are found in RadCalNet site uncertainty statement • TOA values calculated as described above in the referenced paper • RadCalNet site description document **URL or document stored on cal/val portal**						

Validation against reference sensor		Sentinel-2A		Sentinel-2B	Landsat 8		Landsat 9	MODIS/Aqua		N20 VIIRS	
	Date	May 2023		mm/yyyy	May 2023		mm/yyyy	mm/yyyy		mm/yyyy	
	Per band: Results of % difference obtained for sensor TOA rad/ref, compared to the sensor value as per agency specified value on given date.	B1	-2.1		B1	N/A		B9		M2	
		B4	-1.6		B4	N/A		B1		I1	
		B8	-1.9		B5	N/A		B16		I2	
		B11	3.5		B6	N/A		B6		I3	
		B12	N/A		B7	N/A		B7		M11	
					B10	N/A		B21		M12	
								B34		M16	
Comments from provider											
Comments from CEOS team											
User feedback comments											

Ranges and sensor bands to be indicative not comprehensive

Could be other sensors?