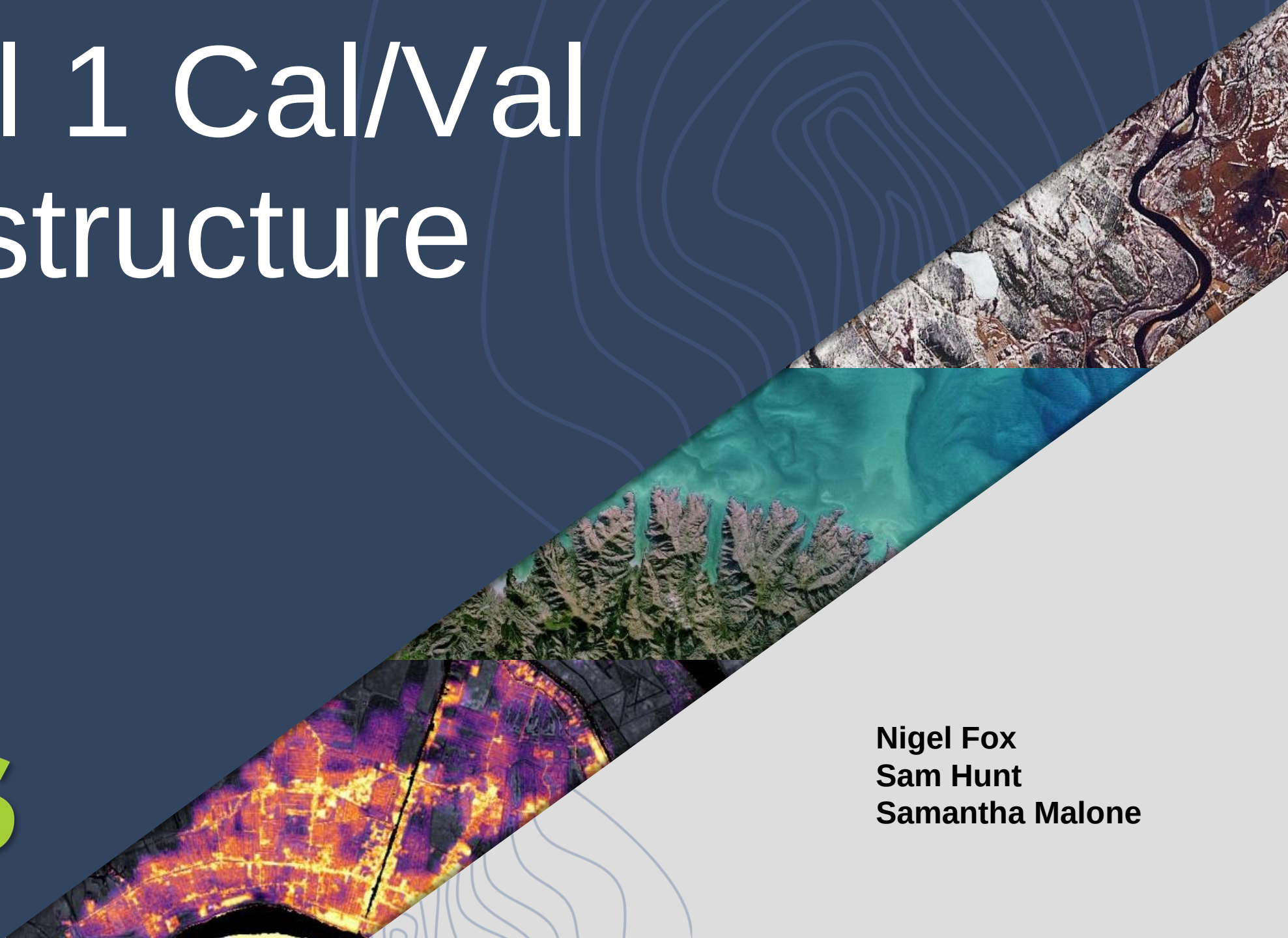
Level 1 Cal/Val infrastructure



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Sam Hunt
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Committee on
Earth Observation Satellites

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
  - ……

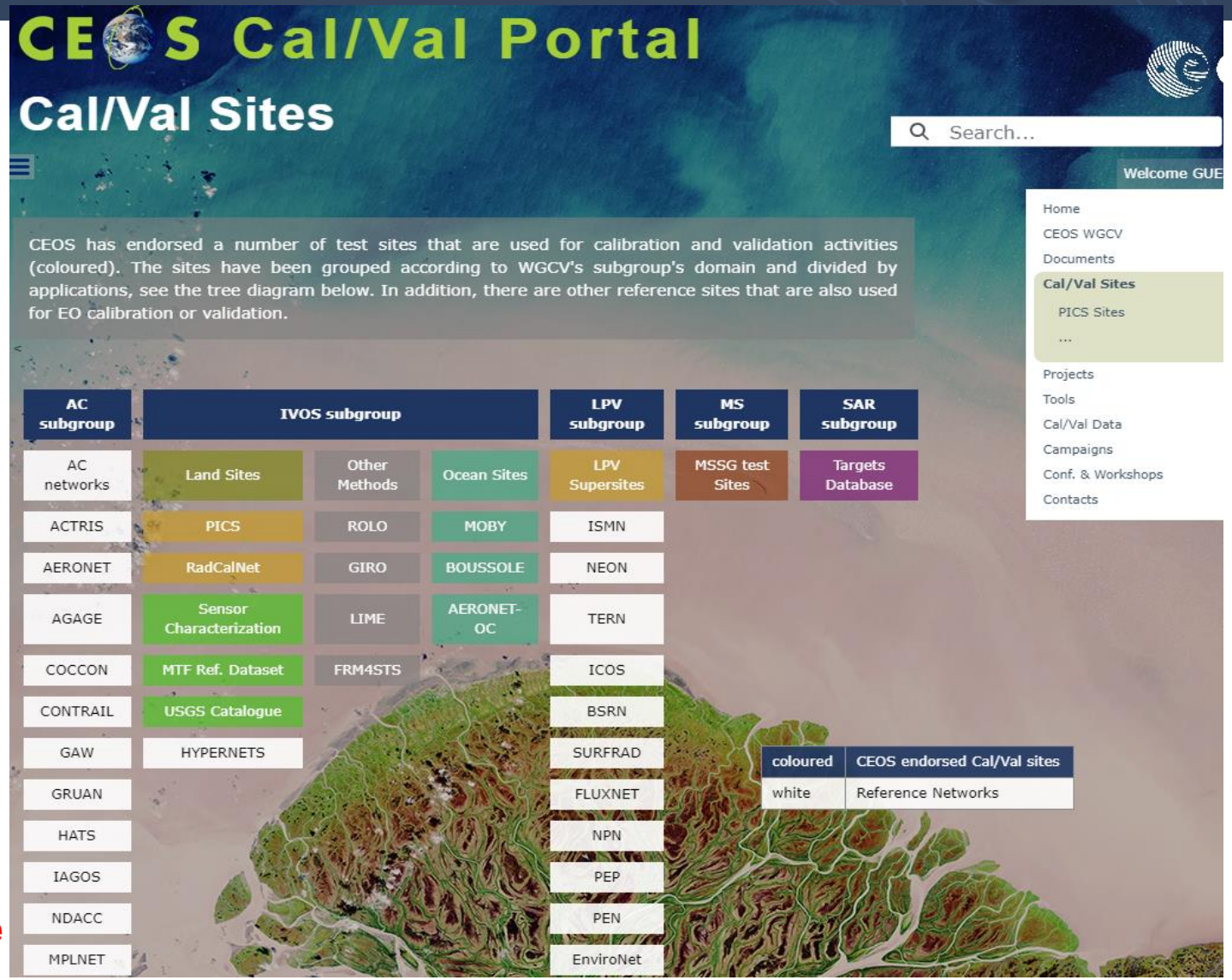
- Community (Newspace, agencies) unclear as to what to use for what purpose?
  - Absolute gain, stability, relative gain, land/ocean applications ….

- 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 email phone			
Spectral range of method	380-2500 nm			
GSD of method (all that apply)	<10 ☒	<50 ☒	<300 ☐	<1000 ☐	<10000 ☐
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.; Thome, K.; Berthelot, B.; Bialek, A.; Czapla-Myers, J.; Fox, N.P.; Goryl, P.; Henry, P.; Ma, L.; Marcq, S.; et al. RadCalNet: A Radiometric Calibration Network for Earth Observing Imagers Operating in the Visible to Shortwave Infrared Spectral Range. Remote Sens. 2019, 11, 2401. 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 their performance. The documents for the Gobabeb site (GONA) are as follow • 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?