

A Community Approach to The Standardised Validation of Ground Surface Reflectance

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Cindy Ong | 21 November 2019



Australia's National Science Agency

Rationale

To establish a repeatable, practical and traceable field validation procedure to achieve a lasting "infrastructure" for DEA Surface Reflectance validation and uncertainty. Key steps in the process include:

- the establishment of the calibration sites and associated infrastructure;
- the methodology behind the field calibration itself;
- the data processing and associated quality assurance and quality control;
- the establishment of an ongoing and repeatable validation program.







- Built on large bodies of work internationally and nationally;
- Living document refined as work progressed;
- 3 components;

A community approach to the standardised validation of surface reflectance data

A technical handbook to support the collection of field reflectance data

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Field Quick Guide A.1

Pre-visit:

- Check weather conditions. The following link will give you recent cloud prediction plots (https://drive.google.com/open?id=1RWgxUjSWFnwxmCz7LeS5raImUYEsiYmm). Also refer to windy.com, darksky.net and the other resources referred to in Section 2.4.
- Organise staff availability, travel arrangements, vehicles, equipment, accommodation and health and safety plans
- Inform landholders of intention to access.
- Pre-print field data recording sheets.
- Make sure all batteries are charged and spares for instruments (e.g. GPS and MicroTops) are packed
- Make sure that all relevant cables, adaptors, etc. are packed.
- Check the equipment list.

On arrival

- Ensure times on all devices have been set to LITC
- Select most suitable site (flat and uniform over at least 100 x 100 m). Evaluate height of vegetation and ease to walk through.
- If applicable to the surface and location, use marker pegs to mark off bounds (100 x 100 m) of site to be measured. Suggested orientation ~ 8° E of N. Use the GPS to measure the locations of the marker pegs
- D Place marker pegs at 20 m intervals along the 6 transects of the 100 x 100 m plot (see the set up in Figure 17)
- Take photographs of the surface and the surroundings sufficient to characterise the validation site, its scale and the context of its surrounding environment (slope, distance to horizons, sky, vegetation type and height, soil colour)
- Evaluate overhead atmospheric conditions. Take photos (preferably geotagged) of the overhead sky conditions
- Warm up spectroradiometer and prepare for measurements. Check the time on the computer has been set to LITC
- Prepare the MicroTops and GPS. Sync the MicroTops with the GPS. If no GPS is available to sync with the MicroTops ensure the correct coordinates are entered manually. Ensure the time on the MicroTons is set to LITC
- Set up the photometer and weather meters in continuous logging mode at a suitable distance away from any extraneous influences. Ensure the time on these devices is set to UTC.

A community approach to the standardised validation of surface reflectance data | 43

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Site Selection Criteria

Characteristics

- Use existing sites where possible;
- Scale and homogeneity;
- Site proximity;
- Site accessibility and local knowledge;
- Cloud cover and aerosols;
- Distance to the site for the site owners and associated instrumentation required;
- Geographic location of the site so that it forms a component of the overall aim of wide geographic coverage across the continent
- Cover type of the site so that it forms a component of the overall aim of a range of cover types across the continent;

Priority for planning field measurements (besides good weather conditions) are as follows:

- Concurrent L8 and S2a or S2b overpasses; ٠
- Consecutive L8 and S2a or S2b overpasses;
- A single L8, S2a or S2b overpass;



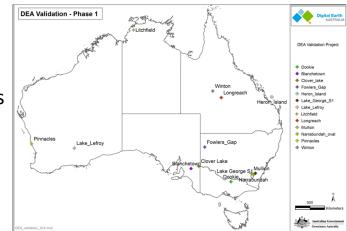






Site Selection Criteria

- Primary sites
 - Visited almost as frequently as there is a L8 satellite overpass, weather permiting, and can be done as a day trip;
 - Where there are concurrent overpasses and the next day's conditions are conducive for measurements, all attempts will be made to acquire data from the concurrent day as well;
 - For each primary site we envisage a total of 4-5 measurements in 3 months.
- Secondary sites
 - At least 1 visit at best twice;
 - Important in the long term to provide more comprehensive range of cover types, landscapes, geographic location and atmospheric conditions, etc;
 - Frequency of acquisitions/measurements.







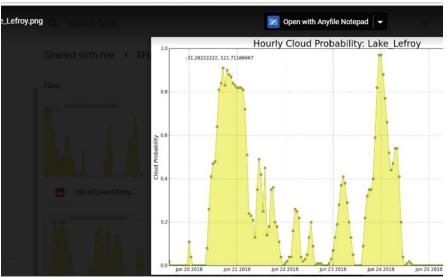
Instrumen	tatio	n	Mylar sheet for collecting wavelength calibration data	Myth Data Plans Absorption Protoines (vi. 6.0 and instantia tota since ingel (2017) - 2020 instantia tota since ingel (2017) - 2020 instantia tota since ingel (2017) - 2017 instantia tota since ingel (2017) - 2018 A 2018 A 2018 instantia tota since ingel (2018) - 2018 A
Spectroradiometer (recently wavelength checked and radiometrically calibrated) with Visible, Near Infrared (VNIR)-Shortwave Infrared (SWIR) wavelength range, such as an Analytical Spectral Device (ASD) FieldSpec Pro.		Portable sun photometer, such as a MicroTops (https://solarlight.com/product/microto ps-ii-sunphotometer/).	Bluetooth or hard wired GPS to spectrometer/controller.	
8 degree and Remote Cosine Receptor (RCR) foreoptics		Flags or pegs for marking corner points and transects. Coloured markers such as sand bags can be used where the surface is hard.	Temperature, humidity, barometer (calibrated) with logging capability (The MicroTops has these sensors, but will not log the data unless continuous measurements are collected)	
Boom pole (or monopod) for spectrometer head with	~	•	Fisheye sky camera or 360 degree camera.	
spirit level.		Note taking equipment and logging sheets (see appendices).	Dust blower (handheld bulb type, like ones used for cameras).	-
Spectralon [†] reflectance panel (recently calibrated), at 250 x 250 mm prefferred and tripod	X.	Camera for sky and site photos.	Square metre quadrat for taking standard photos of surface cover	
Method for levelling panel (spirit level, that does not touch the Spectralon part of panel).		Global positioning system (GPS) (+/- compass).	Small bottle of demineralised water for rinsing off the reflectance panel should it get dusty or dirty	
			 Sun disk for taking diffuse and direct irradiance measurements (See Appendix Error! Reference source not found.).	



Overpass Schedule & Cloud Forecast

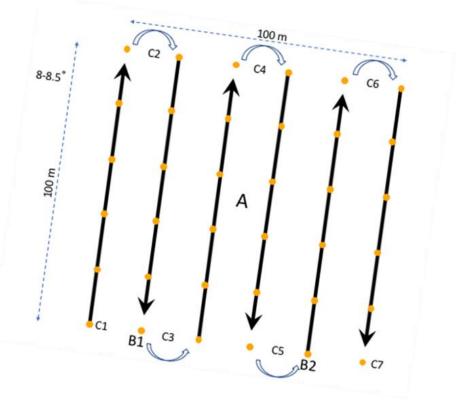
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			Tue	Wed	Thu	Fri	Sat	Sun	Mon
Cindy Ong	Pinnacles	LS			L8				
lan Lau		S2a			S2a				
Peter Fearns		S2b							
	Lake Lefroy	LS							L8
		S2a							S2a
				S2b					

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Experimental Set-up



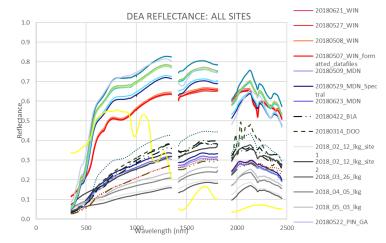






Working Data Storage, Naming Convention, File Structure, Final Archive

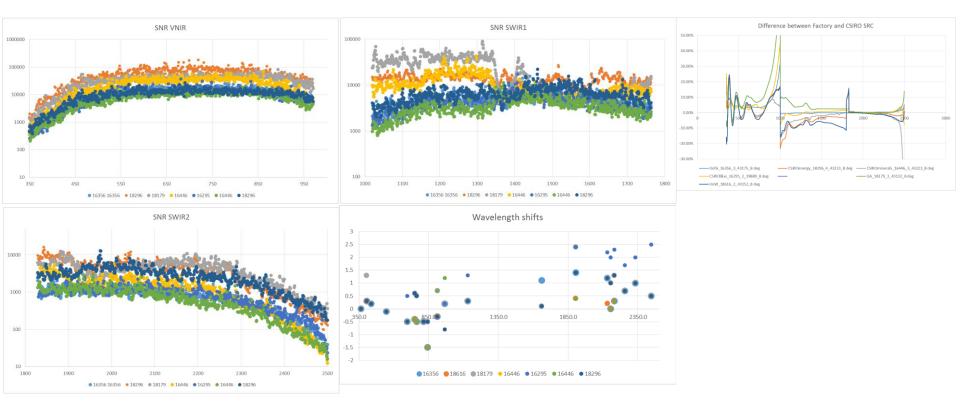
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Digital Earth AUSTRALIA

Instrument Calibration Check









• Selected uncertainties are ultimately combined and reported as campaign wide values, both as **spectral quantities** and as a spectrally averaged **Mean Total** Uncertainty $u = \sqrt{u^2 + u^2} + u^2 + u^2$

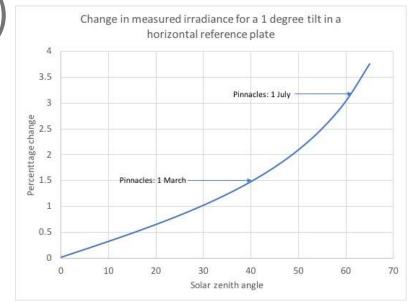
$$u_c = \sqrt{u_{tilt}^2 + u_{BRFtilt}^2 + u_{BRFcal}^2 + u_{MPV}^2}$$

- where
 - *u*_{tilt} is effect of **panel tilt** on total illumination flux
 - *u*_{BRFtilt} is panel **BRF uncertainty due to panel tilt**
 - *u*_{BRFcal} is panel **BRF calibration uncertainties**
 - *u_{MPV}* is "**Mean panel variability**" includes effects of spread in panel measurement data, misalignment of the panel throughout the campaign, changing atmospheric conditions



Tilt – Pinnacles (30.5° S)

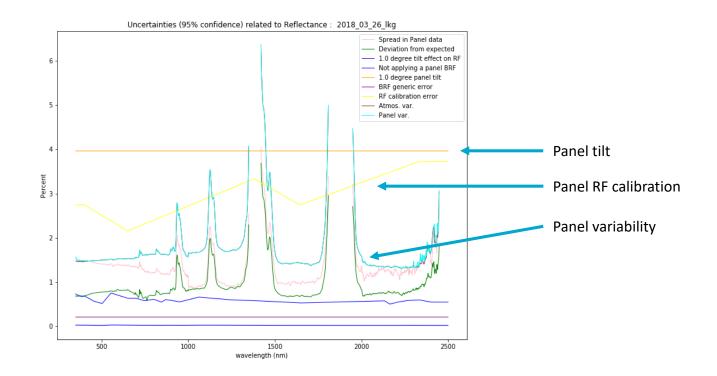
- Dependent on sun position
- Tilt error in mid-winter ~3%
- Solution: automated levelling





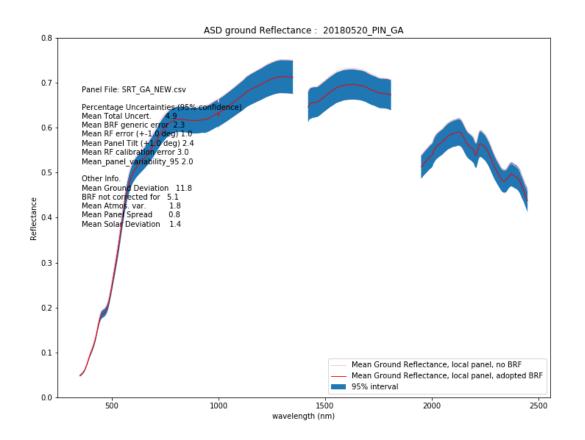


Read up with uncertainties expressed spectrally

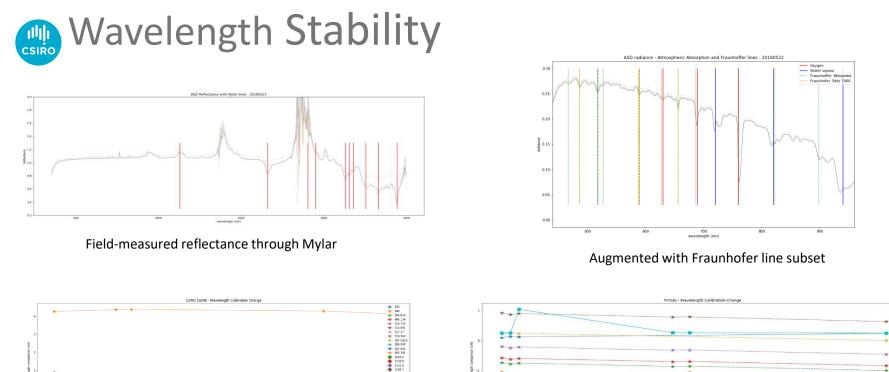


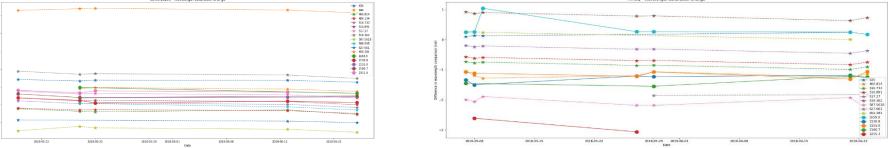












Wavelength stability over time in two field spectroradiometers



Monitoring wavelength stability through time



- Method repeatable despite time pressures
 - Would have been better with workshop to initiate;
- Field guide was refined and evolved as we learned new things;
- Panels the largest sources of error in field measurements
 - Absolute calibration, BRF;
 - Tilt;
- Points to the improved method
 - Laboratory calibration;
 - Leveling and orientation in the field.
- Field handbook publicly available: https://doi.org/10.25919/5c9d0ba9e9c12
 - Contributed to CEOS WGCV WP CV-17 (continental scale SR validation), currently in review and will soon be available on cal/val portal;
 - Extension to new SR validation WP for global scale protocol;







Thank You

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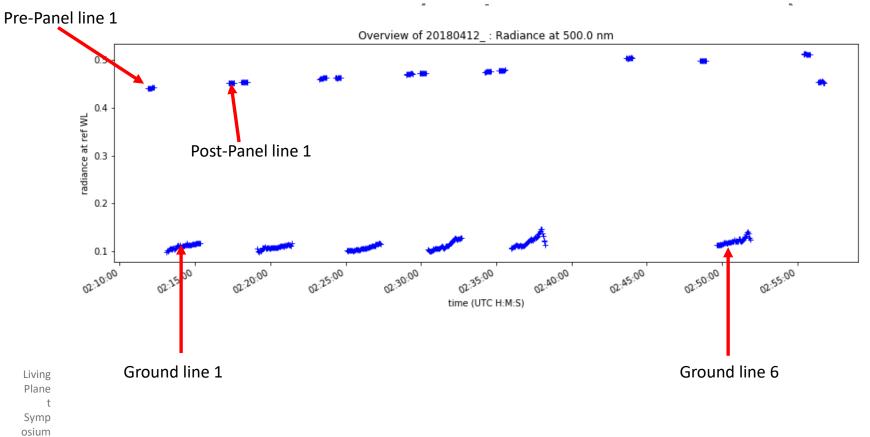
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Back ups

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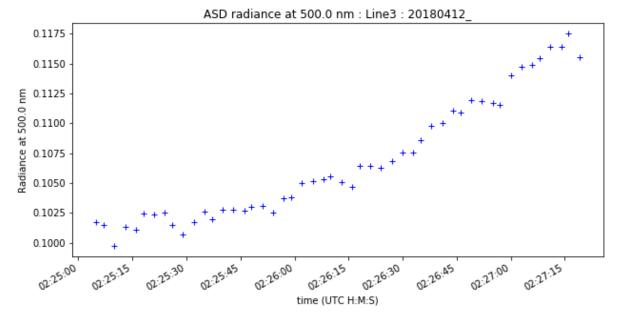


osium



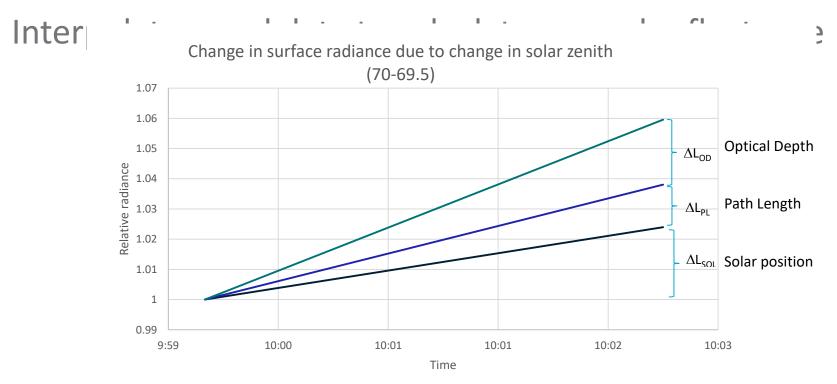
Groundstine 3 (radiance @500nm)

- Why is the curve not straight and flat?
- Does the ground get brighter?
- Is the sun rising slightly?
- Is the atmospheric path length decreasing?
- Is the atmosphere changing?



Living Plane t Symp osium

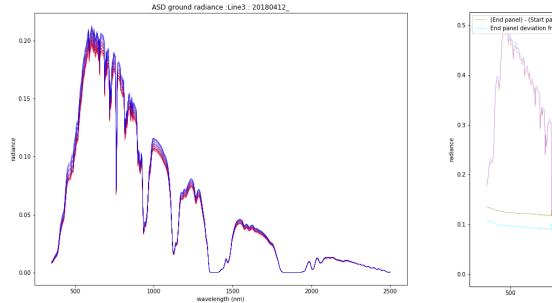


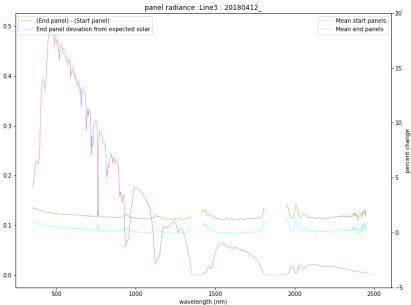


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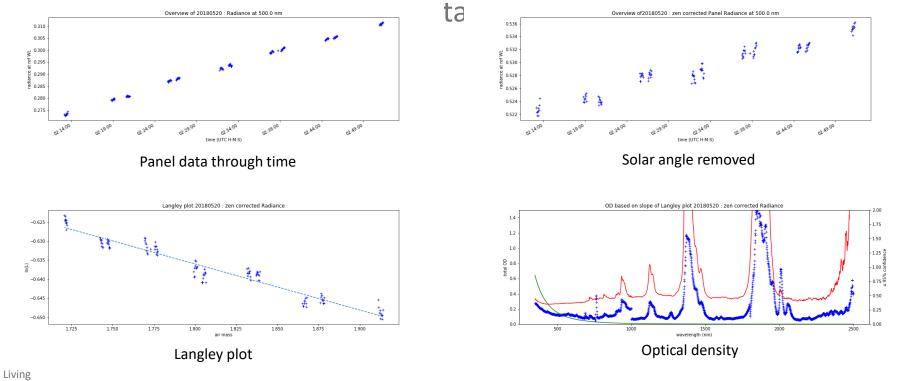




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