Field spectroradiometers and panel QAQC Underpinning optical EO Cal Val

IVOS 31

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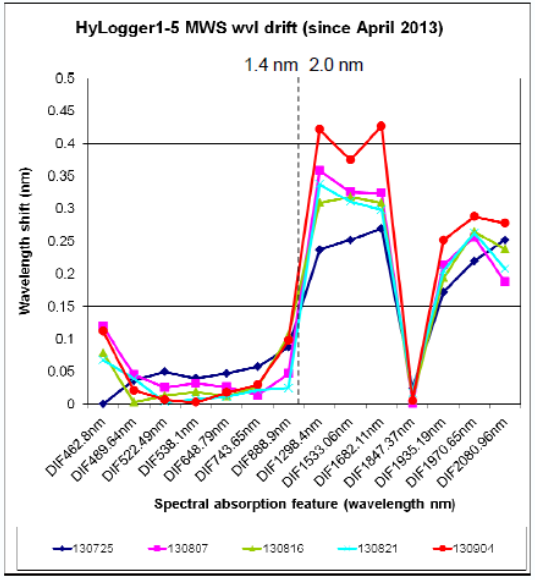
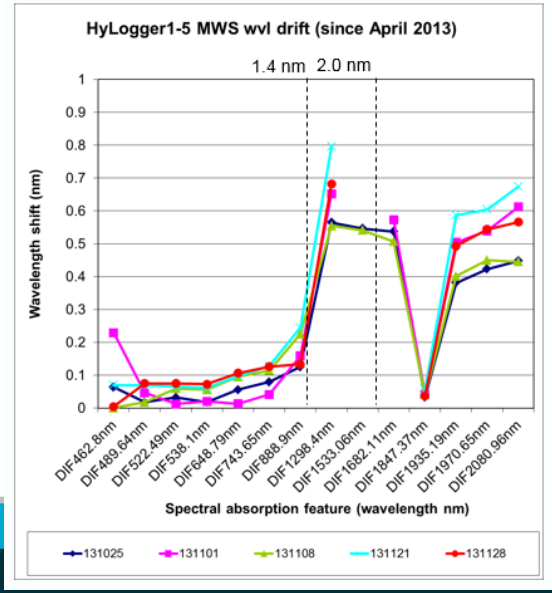
27th of March 2019

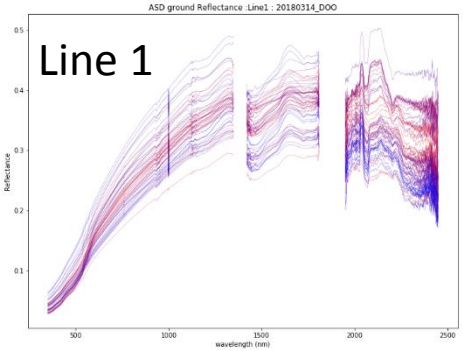
Why field spectroradiometer QC?

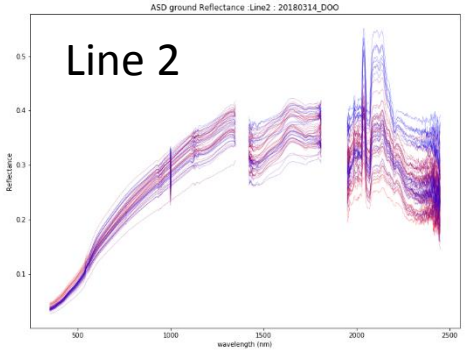
- Confidence in instrumentation
- Confidence in results
- Understanding limitations and identification of problems

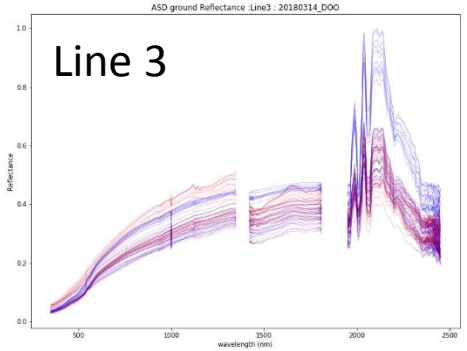


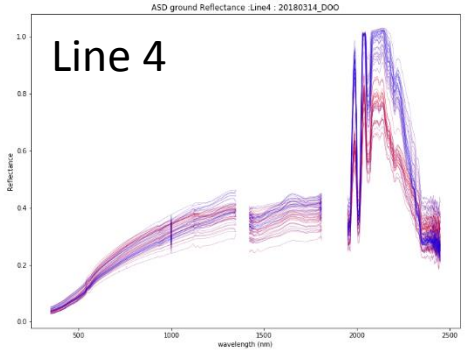


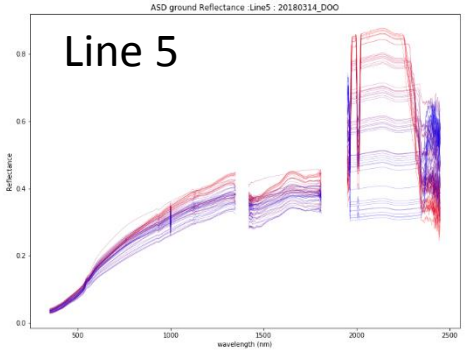
Instrument/operator failure during field measurements synchronous to an overpass

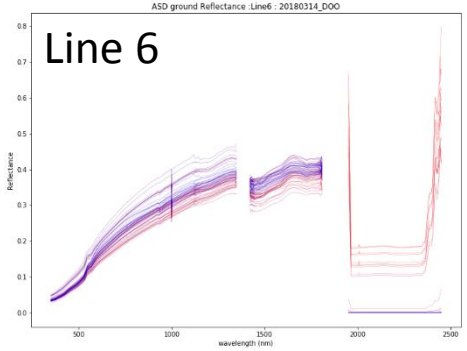




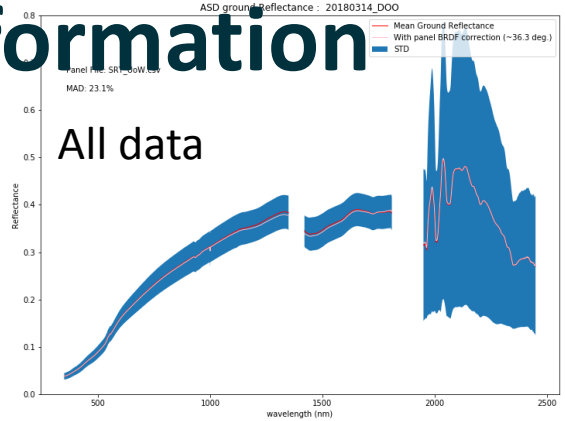


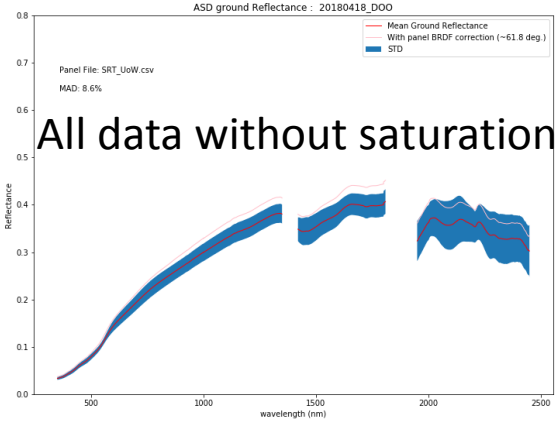


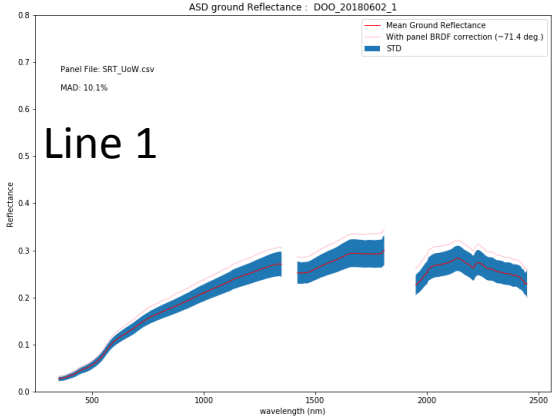


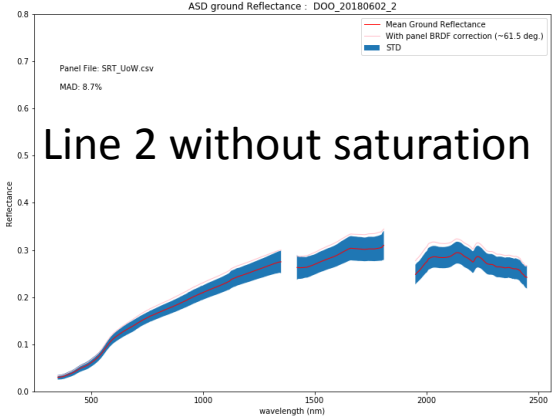


Salvaging information



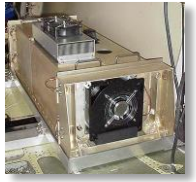


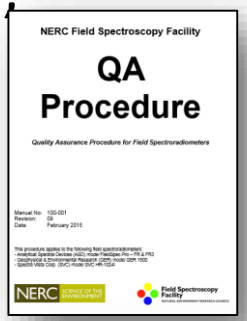




Field spectrometer QA

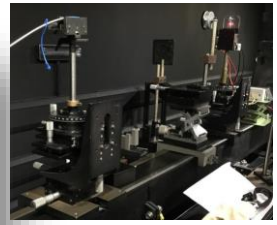
- Learning from the CSIRO fellows (MIRACO$_2$LAS, TIPS, OARS, HyLogger)
- Developing protocols and methods (NERC FSF, Uni of Edinburgh)
- Improved laboratory techniques (NPL)
- Improved characterisation of panels (Uni of Arizona)
- Laboratory measurements to build up baseline/thresholds

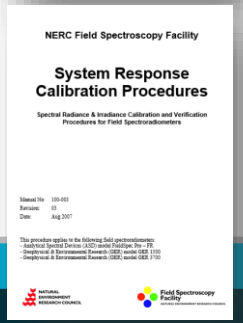





NERC Field Spectroscopy Facility

QA Procedure

Quality Assurance Procedure for Field Spectroradiometers



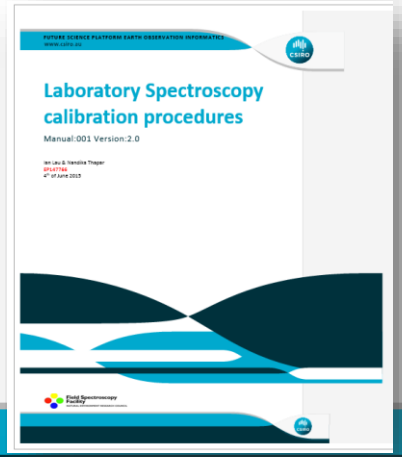


NERC Field Spectroscopy Facility

System Response Calibration Procedures

Spectral Radiance & Irradiance Calibration and Verification Procedures for Field Spectroradiometers

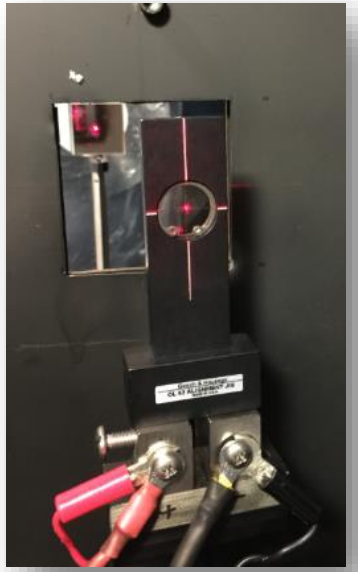
QC of instrumentation

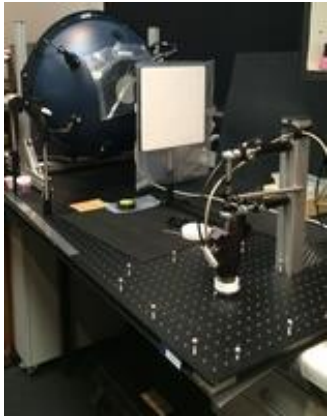
- Procedures for QC
- Measurements of panels by external laboratories
- Testing against other laboratories (OCR round-robin)
- Check of radiance/irradiance calibrations (CaTTSITTR)
- Monitoring stability (current, output)
- Repeatability of techniques
- Identifying damaged parts



Calibration labs (Perth & Brisbane)

- 20” Radiance source
- 2 x FEL irradiance source and constant current power supply
- 2 x BRF calibrated 10” Spectralon panels (10-80 deg)
- Gas emission lamps
- Optical bench and rails
- Self levelling laser
- Illuminance & Luminance Photometer



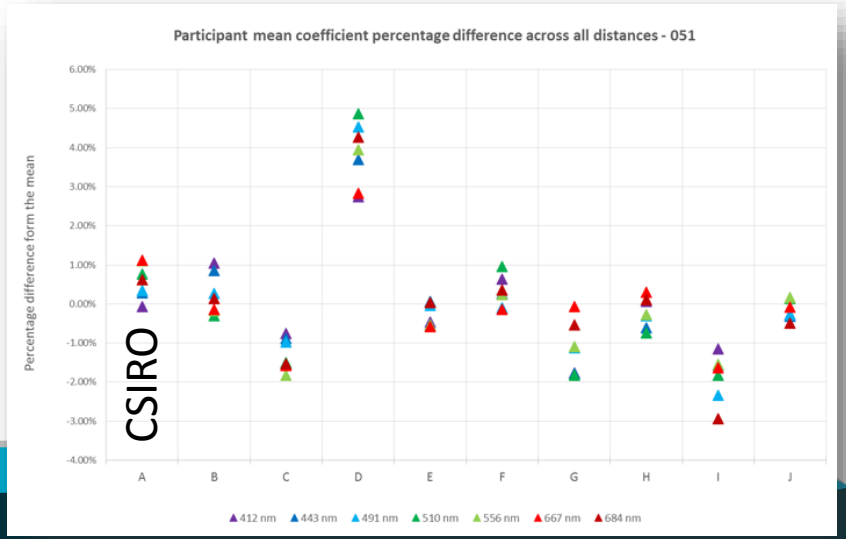


- Monochromator
- Calibrated 0.5 m stick
- Standard resistor
- 2 x BRF calibrated 10” Spectralon panels (10-80 deg)

Ocean Colour Radiometer round-robin

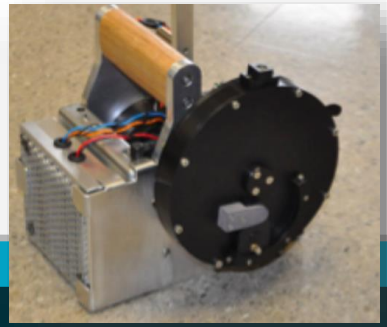
fiducial reference measurements for satellite ocean colour

- FRM4SOC LCE-1 - ESA Project
- 2 OCR instruments used to collect panel measurements with FEL lamps at 10 optical labs around the world.
- Results show CSIRO's calval lab was within the average.

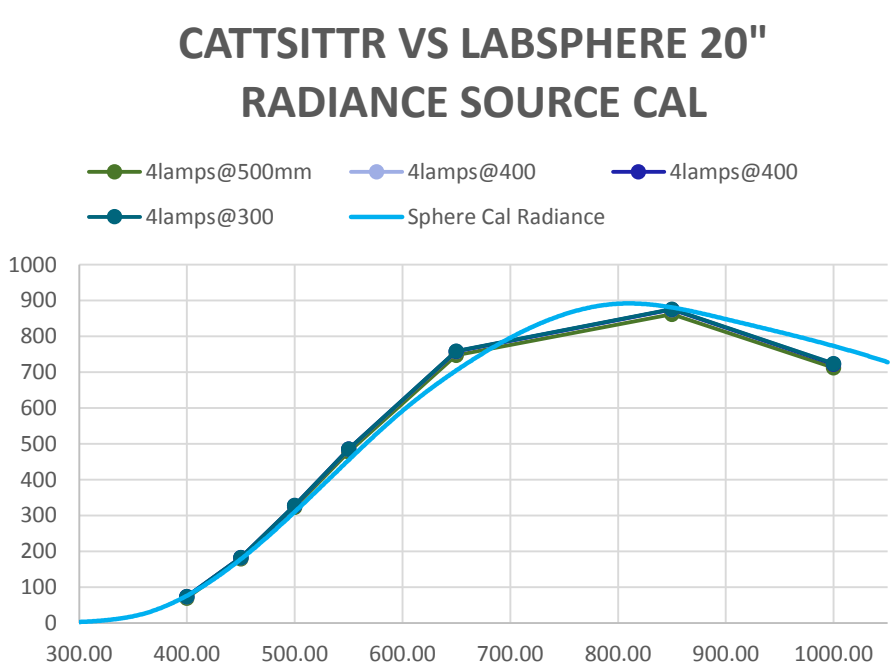


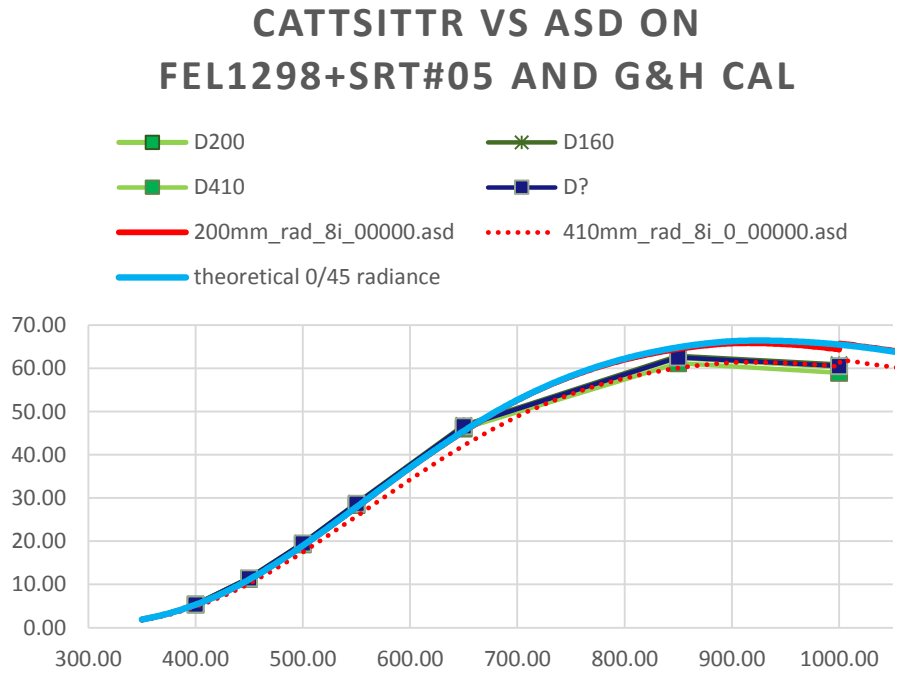
Transfer radiometer measurements (CaTTSITTR)

- 7 bands (400-1000 nm)
- Very stable Si detector
- Calibrated by University of Arizona
- NASA GSFC test of sending an instrument outside US and having it operated without direct training
- Measured CSIRO's spheres (both sites) and irradiance source
- Comparison to CSIRO's radiance calibrate ASDs to the CaTTSITTR

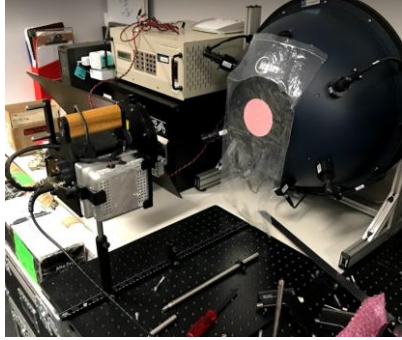


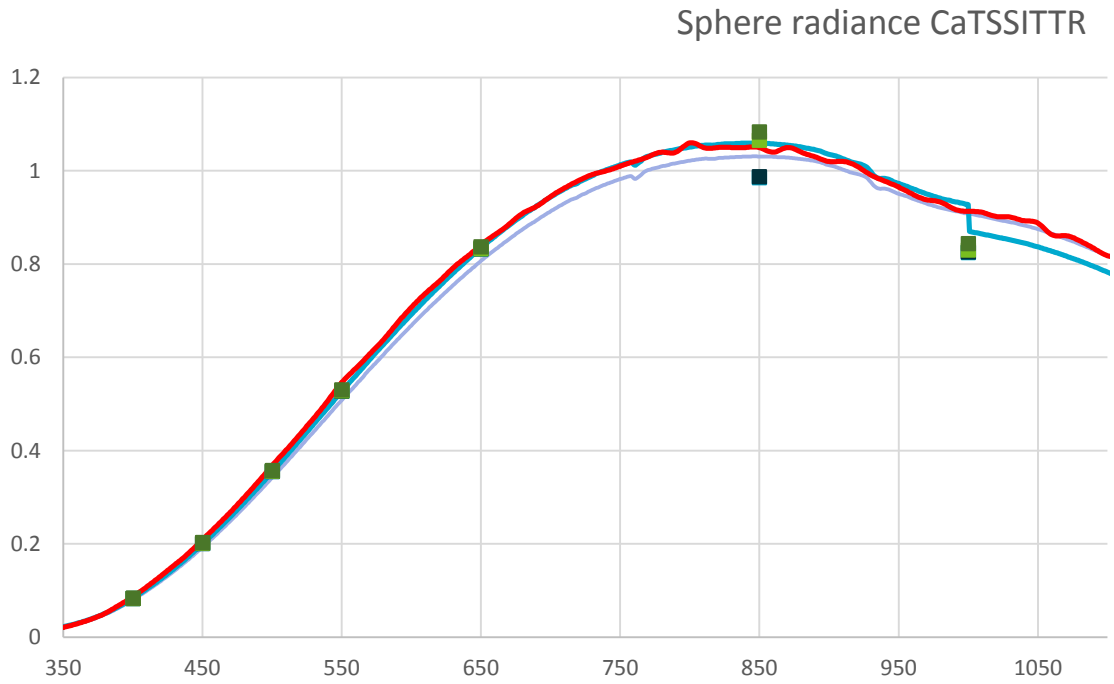
Sphere and FEL+Panel radiance results

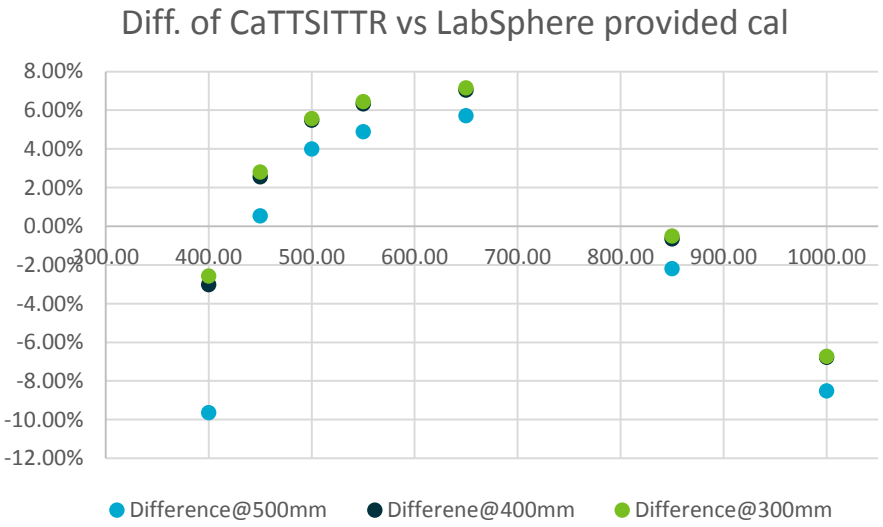


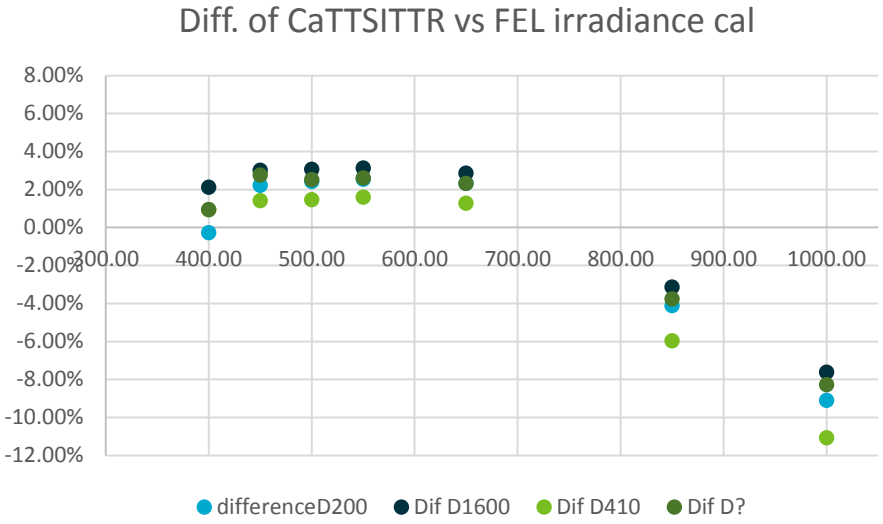


CaTTSITTR - Perth sphere



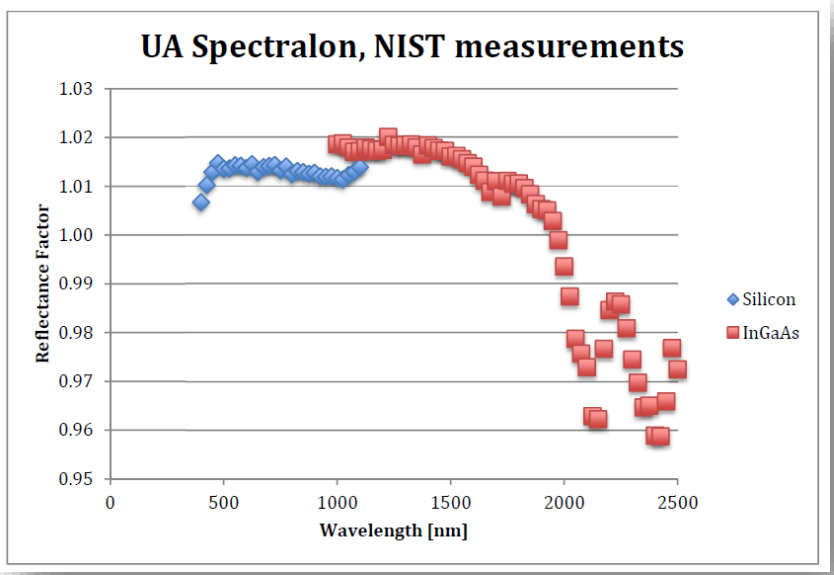


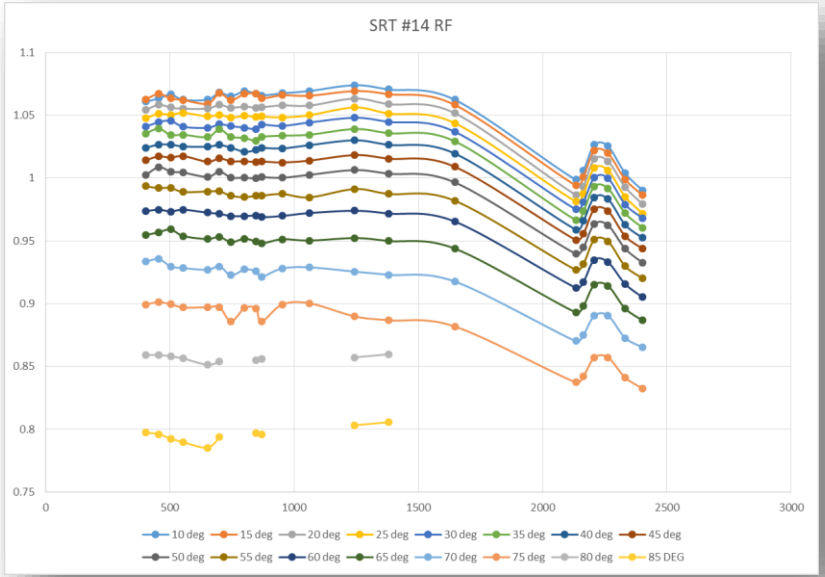

Diff. of CaTTSITTR vs LabSphere provided cal
8.00%
6.00%
4.00%
2.00%
0.00%
-2.00%
-4.00%
-6.00%
-8.00%
-10.00%
-12.00%
300.00
400.00
500.00
600.00
700.00
800.00
900.00
1000.00
Difference@500mm
Differene@400mm
Difference@300mm


Diff. of CaTTSITTR vs FEL irradiance cal
8.00%
6.00%
4.00%
2.00%
0.00%
-2.00%
-4.00%
-6.00%
-8.00%
-10.00%
-12.00%
300.00
400.00
500.00
600.00
700.00
800.00
900.00
1000.00
differenceD200
Dif D1600
Dif D410
Dif D?

BRF measurement of panels by Uni of Arizona

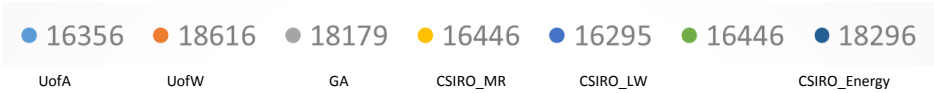
- 2 “used” 10 inch panels in 2015, 2 new panels in 2019

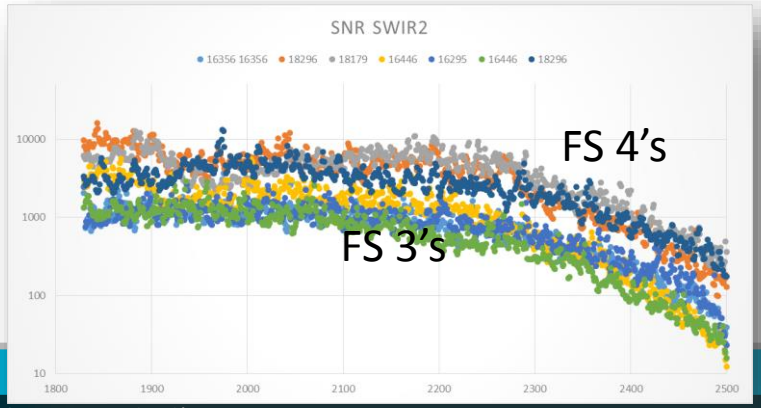


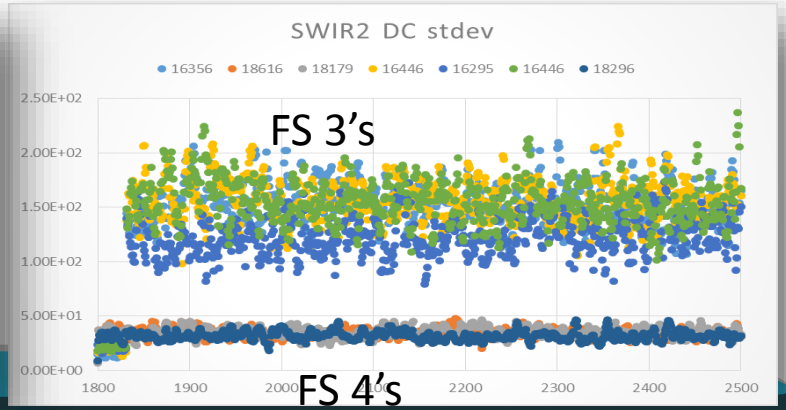


DEA validation project instrument QC

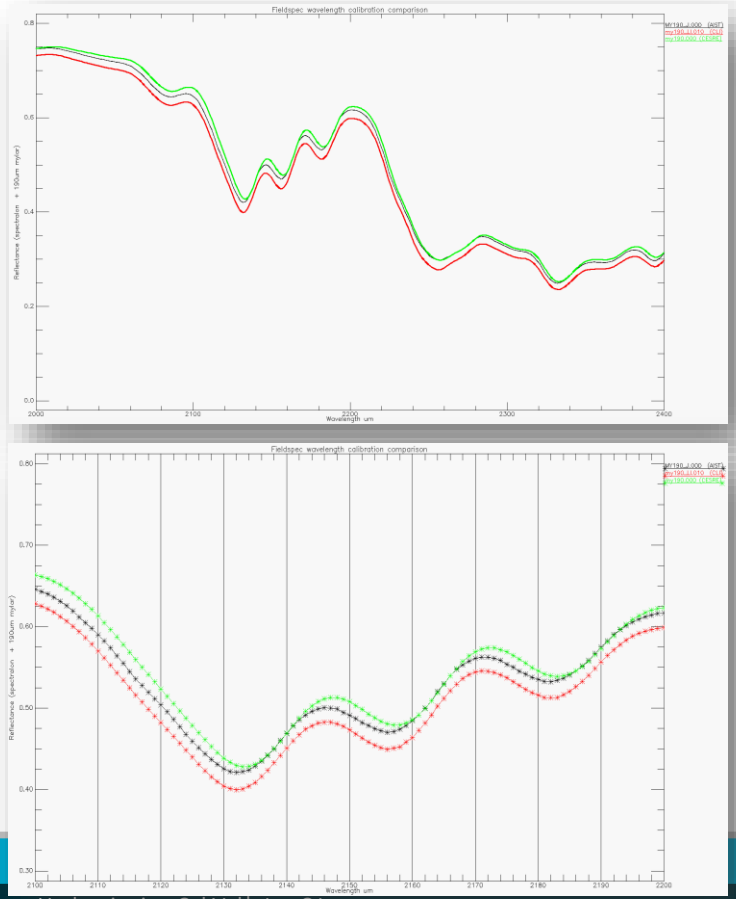
- 9 ASD FieldSpec Pro FR (3), 3 (3) and 4(3)
  - Dark Current
  - SNR
  - Radiance calibration
  - Wavelength calibration

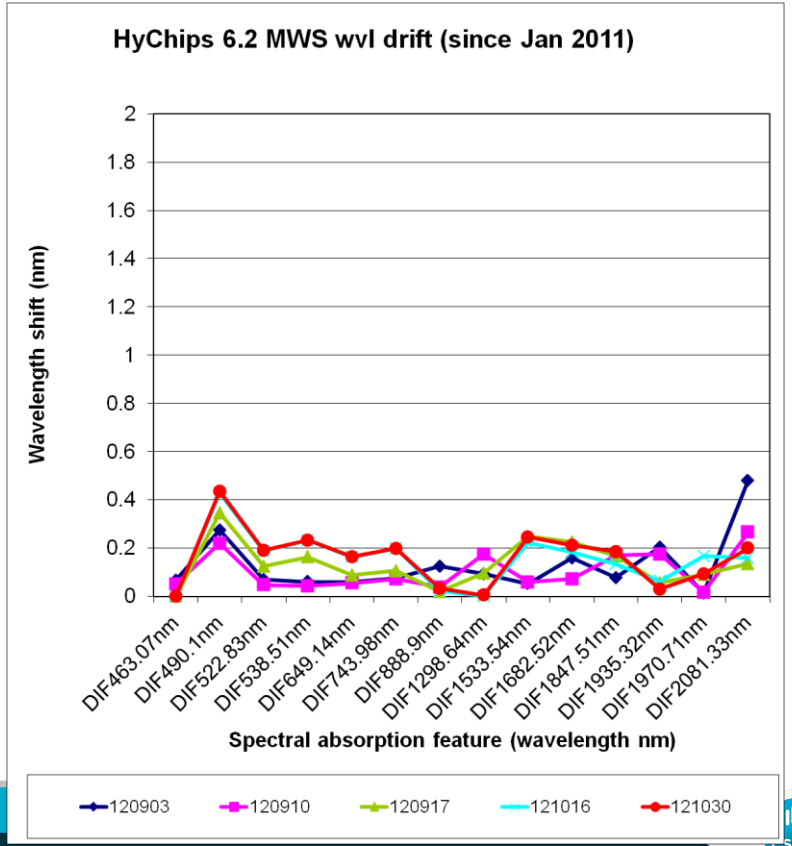




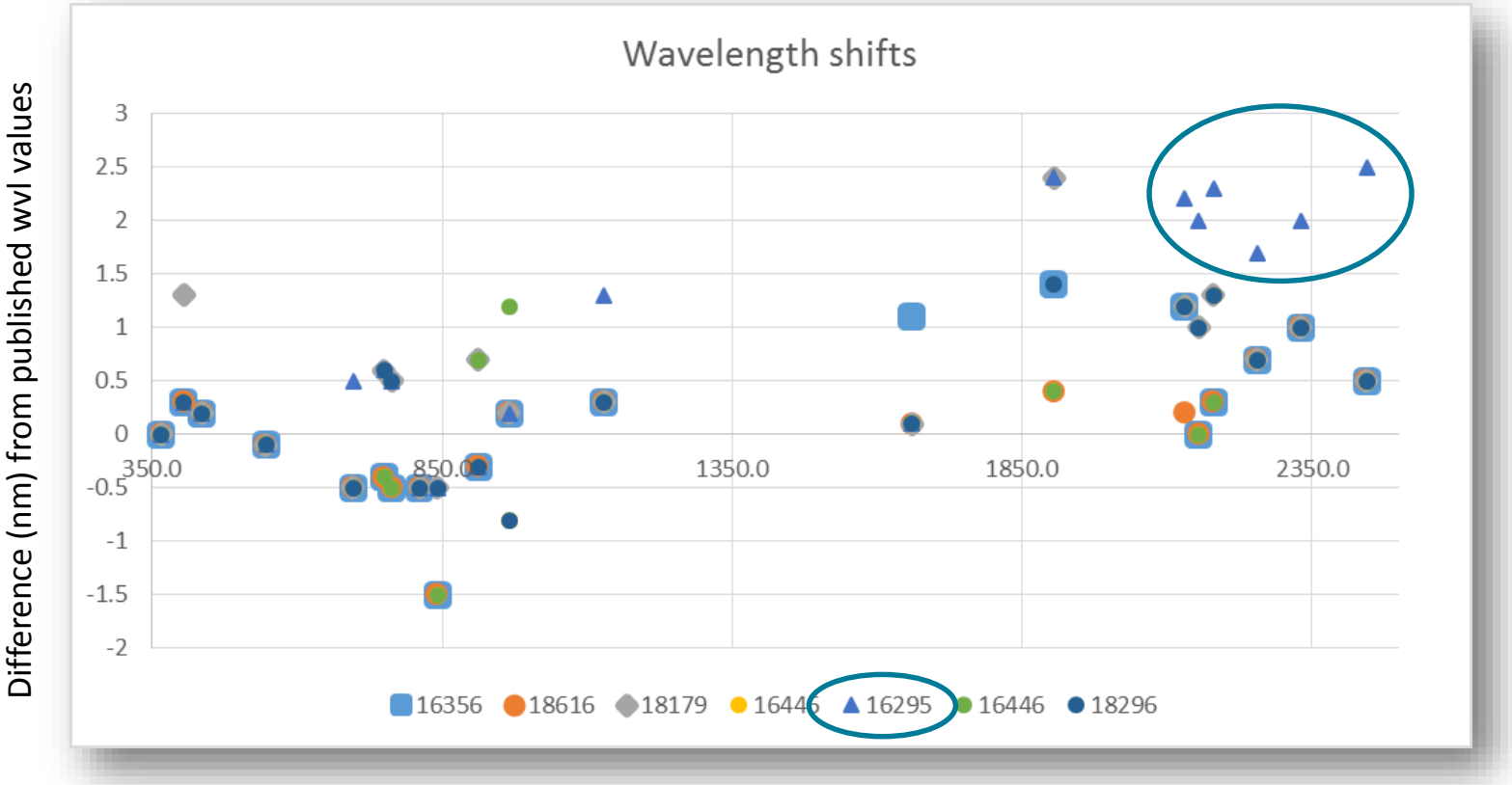


Wavelength calibration – Mylar and doped Spectralon



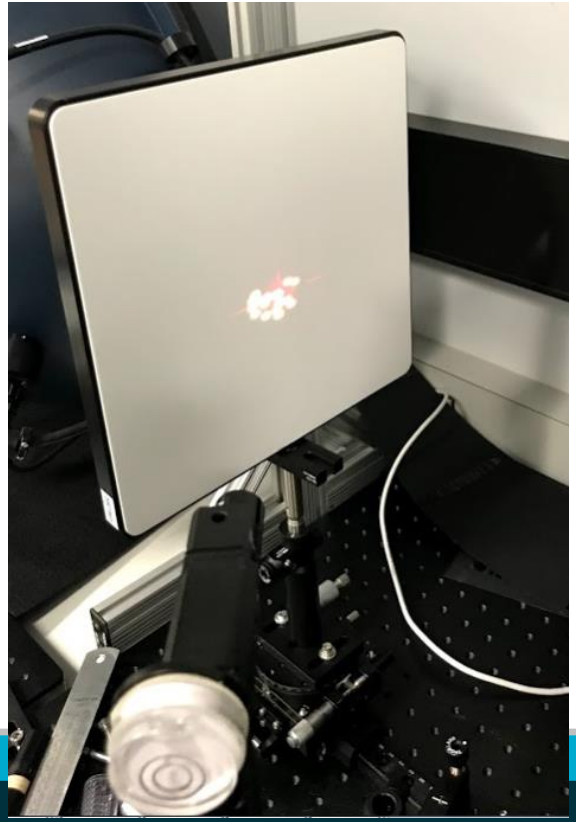


Wavelength calibration (HgAr and Mylar)

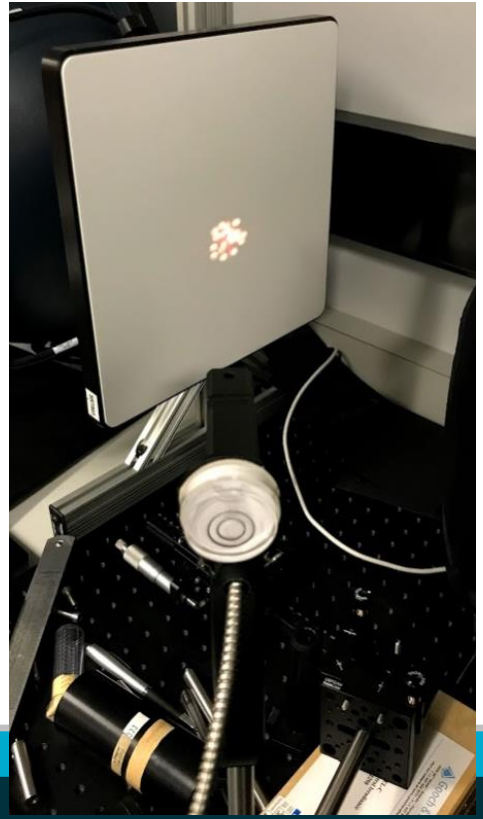


Fibre characterisation

VNIR 8 deg



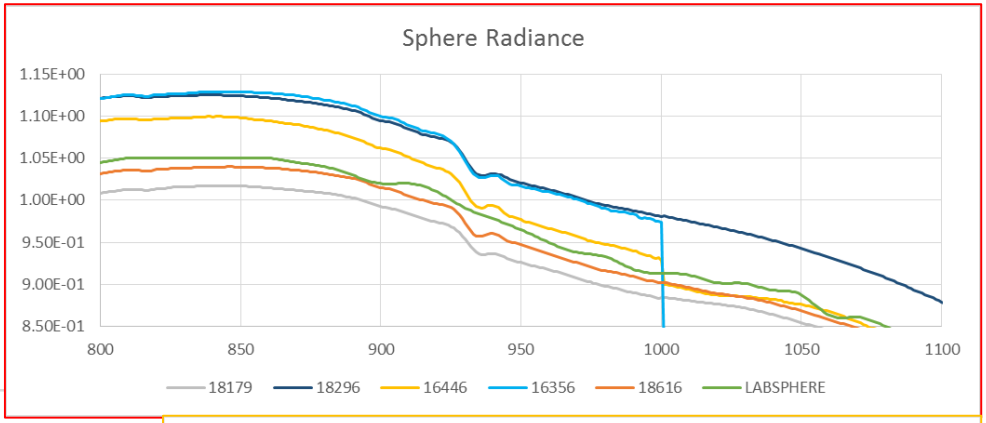
SWIR1 8 deg

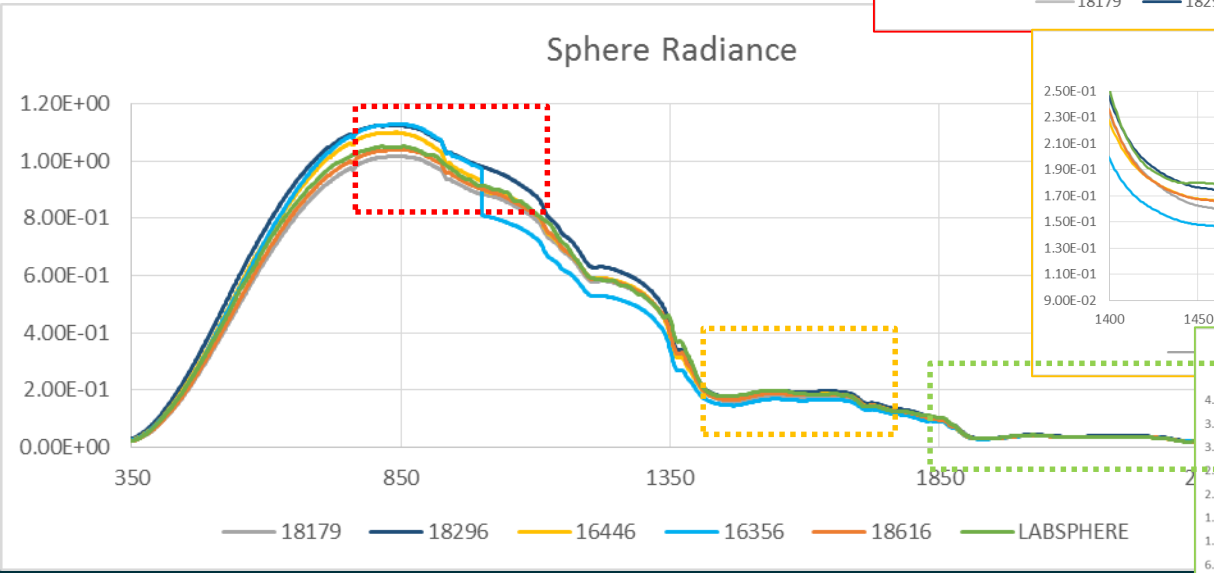


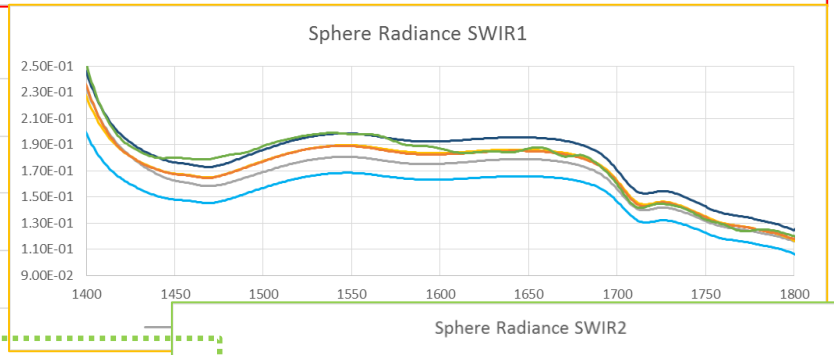
SWIR2 25 deg+ Scrambler

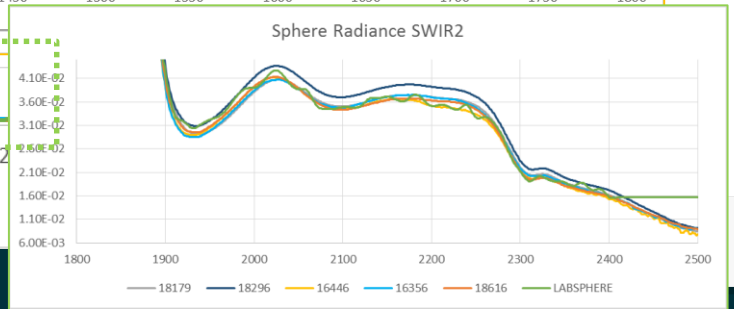
Sphere radiance

Factory calibration

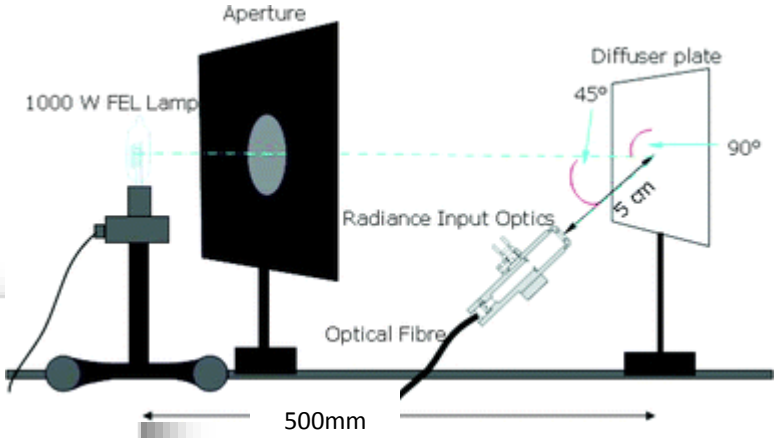


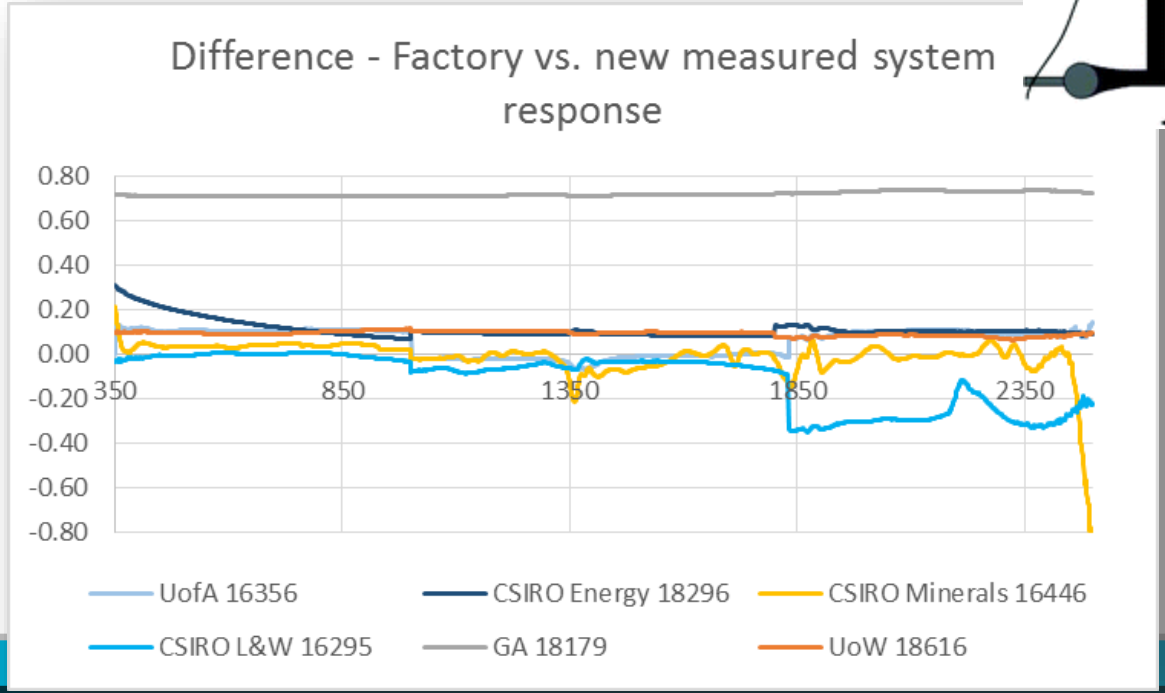




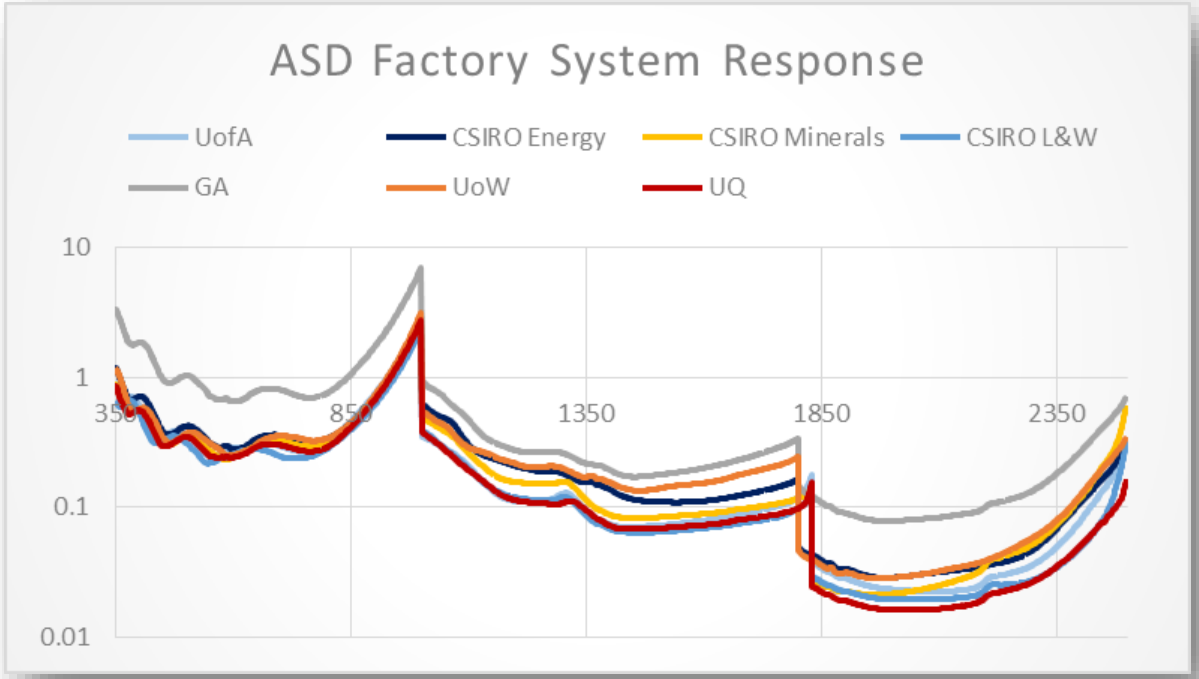


Radiance re-calibration

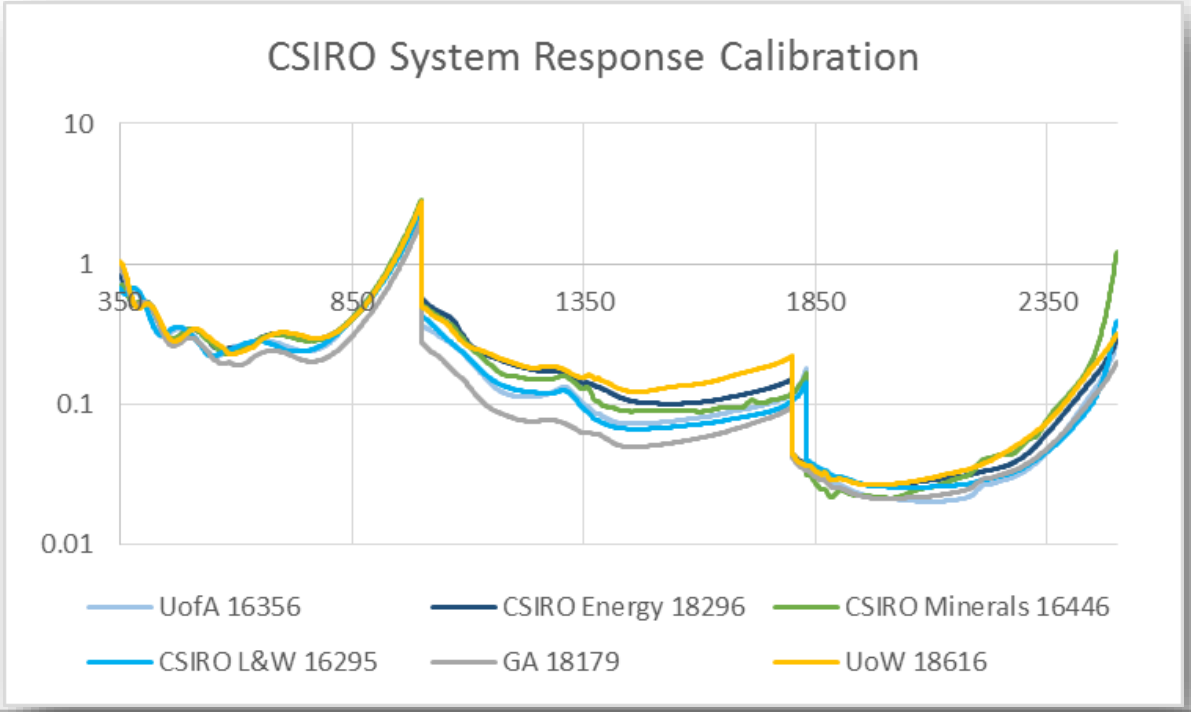




ASD Factory system response (radiance calibration)

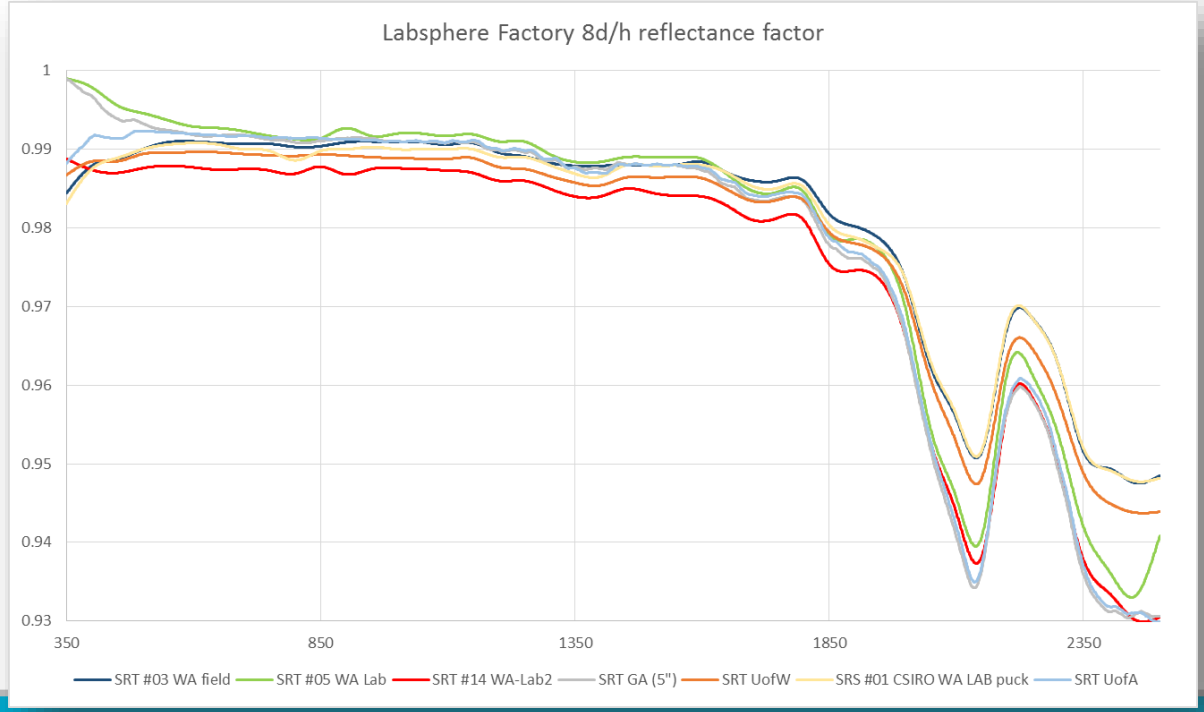


CSIRO-measured system response (radiance cal)

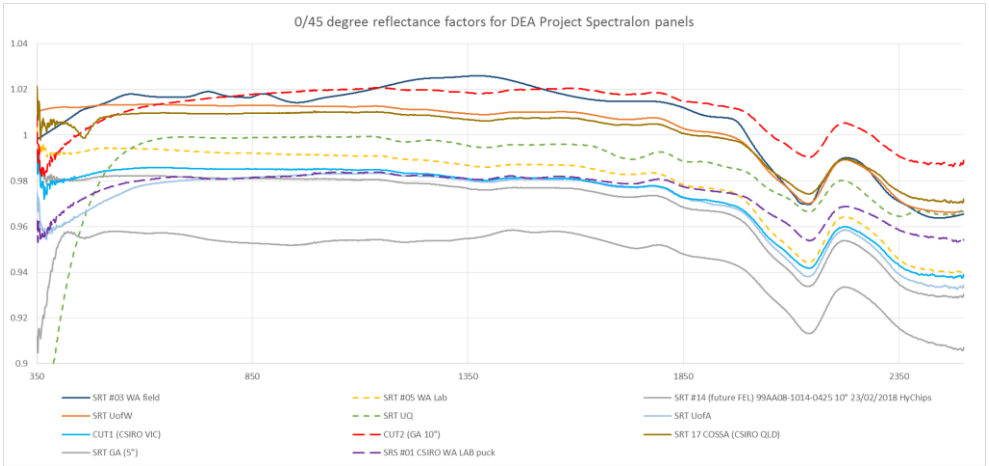


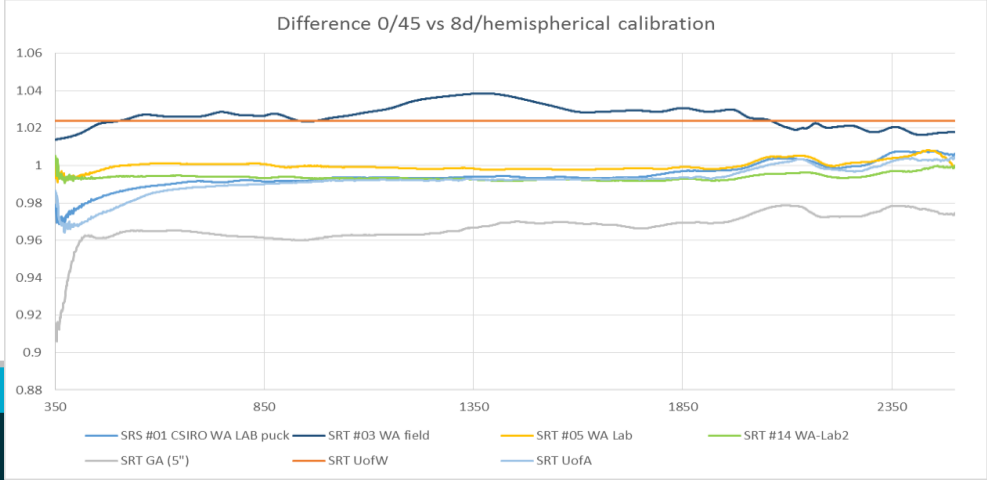
8 degree hemispherical reflectance

- 10 Spectralon panels (mostly 10”) – factory calibrations for newer

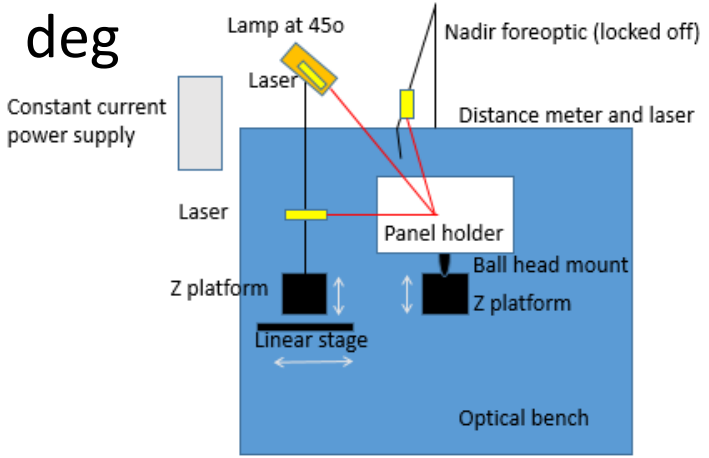


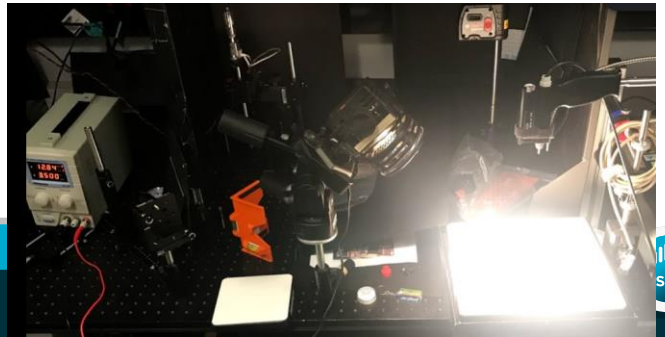
DEA validation project panel QC





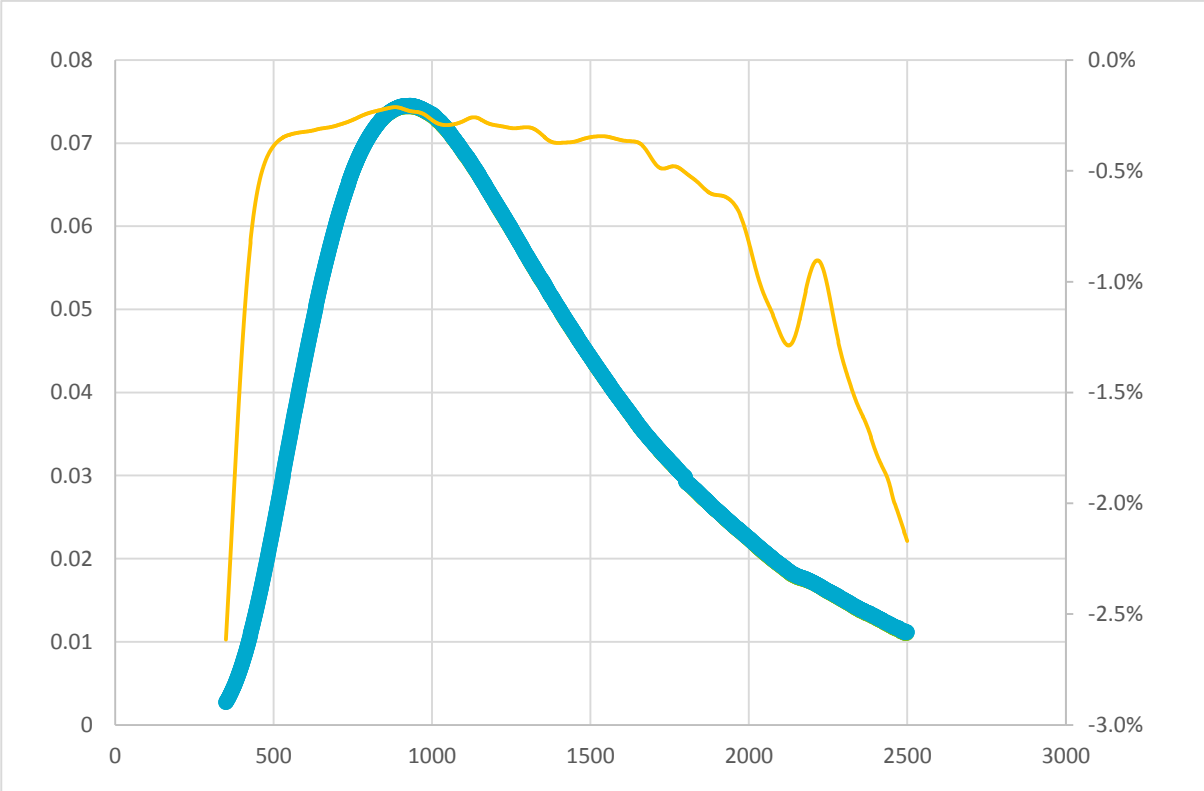
- Recalibration of RF 0/45 deg





Differences when wrong panel cal file is used:

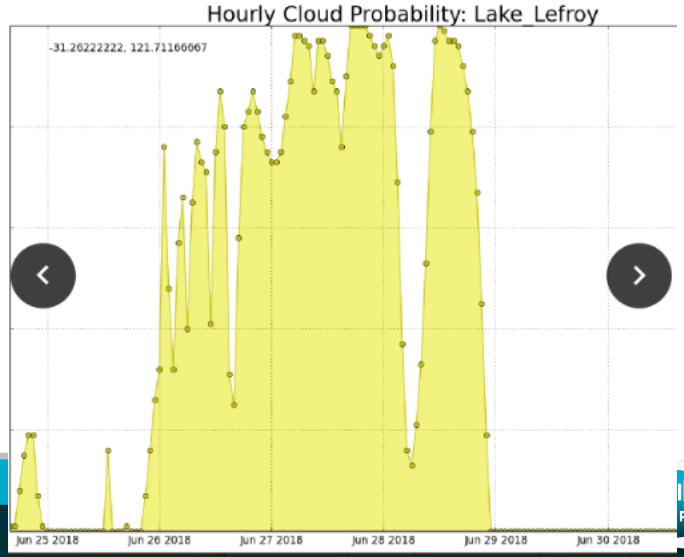
- Measurement of a panel at 45o with FEL lamp
- Blue dotted line - Radiance measured by RS3 using ASD radiance calibration
- Grey line -Radiance generated from the DN using incorrect panel file in the formula
- Orange plot is the difference from the RS3 (ASD) generated radiance



Lake Lefroy (25th of June 2018)

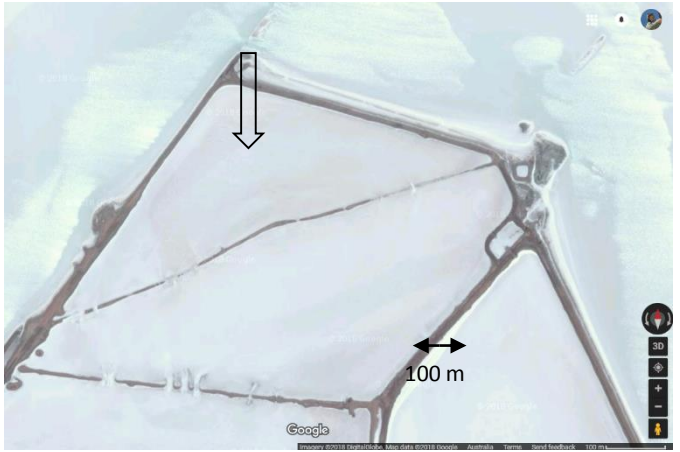
- CSIRO (Lau, Fearns)
- Salt lake (halite/sodium chloride) south of Kambalda.

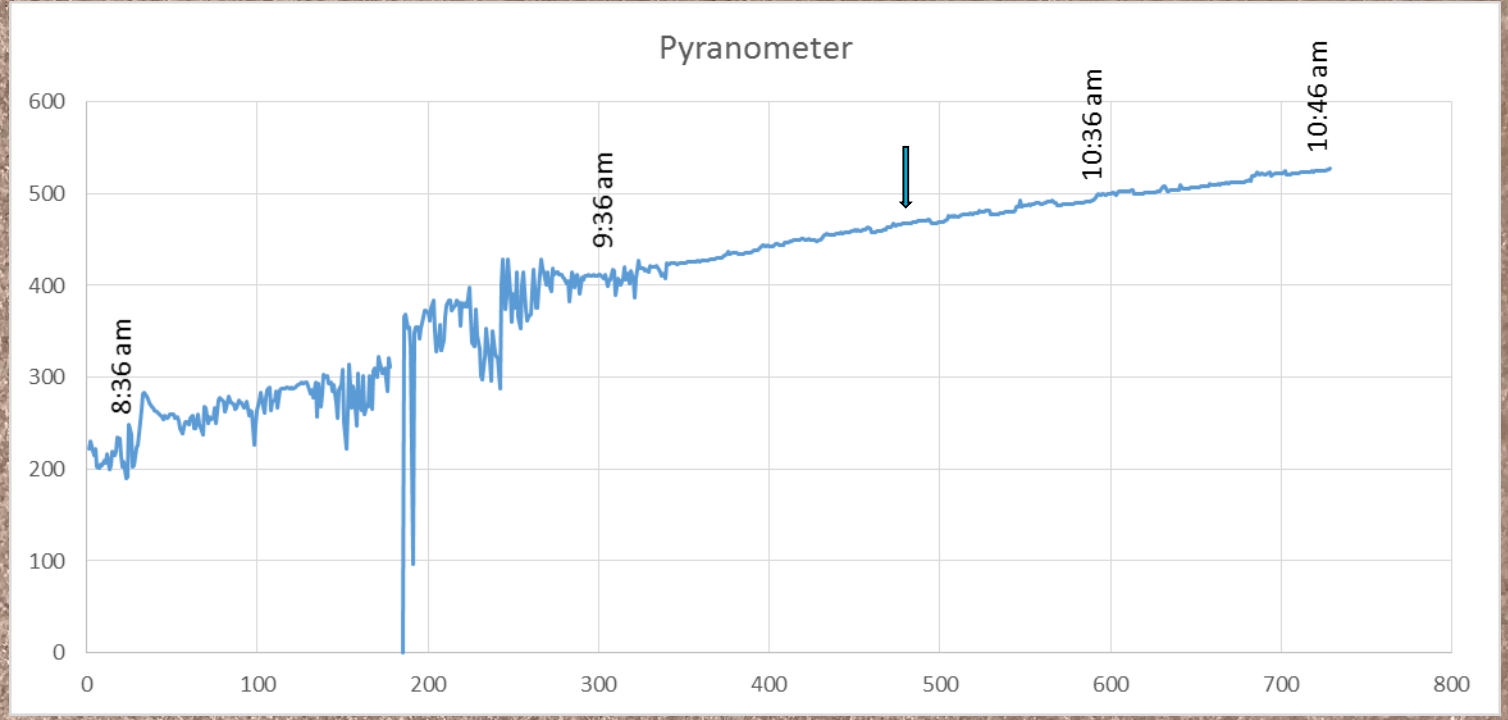
- 6 mm of rain in Kalgoorlie (50 km north) on the 19th of June.
- Very cloudy during setup but visible cloud overhead burnt off minutes before starting measurements. Cloud all around on the horizon.



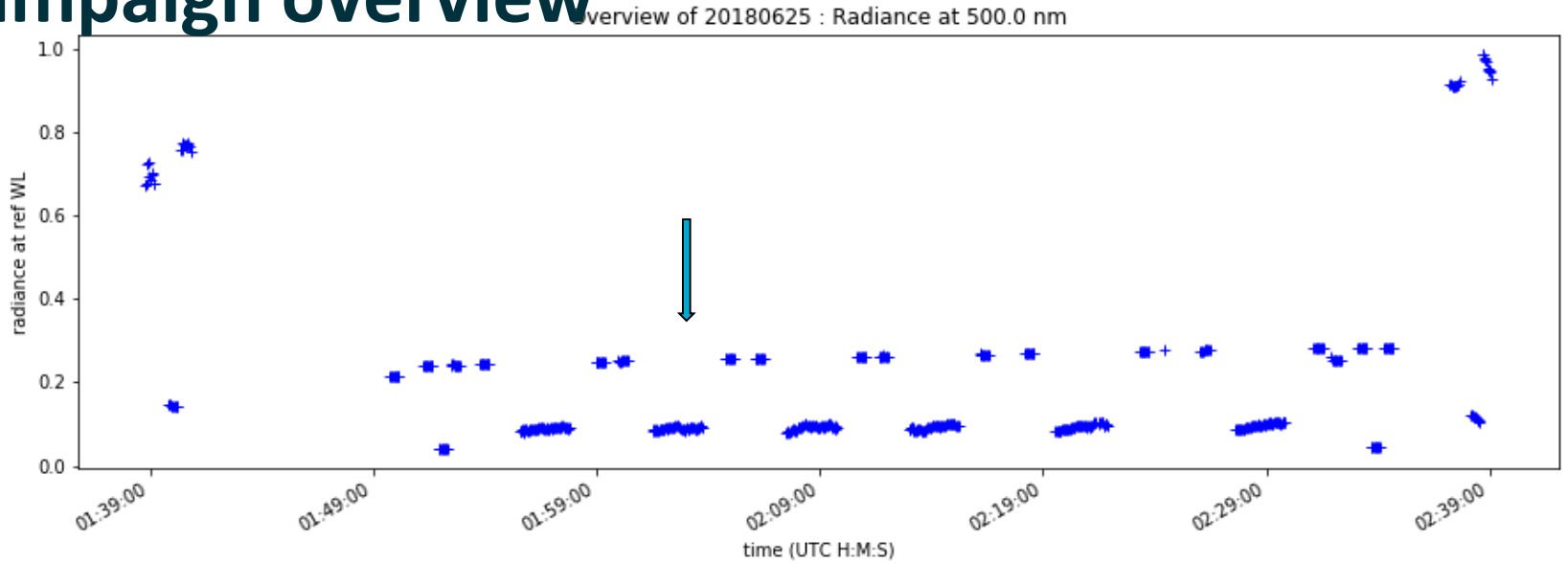

Geraldton
Cervantes
Kalgoorlie
Perth
100 km
Mandurah
Bunbury
Busselton
Esperance
Albany


100 m
Lake Lefroy
Western Australia
-31.341155, 121.647513

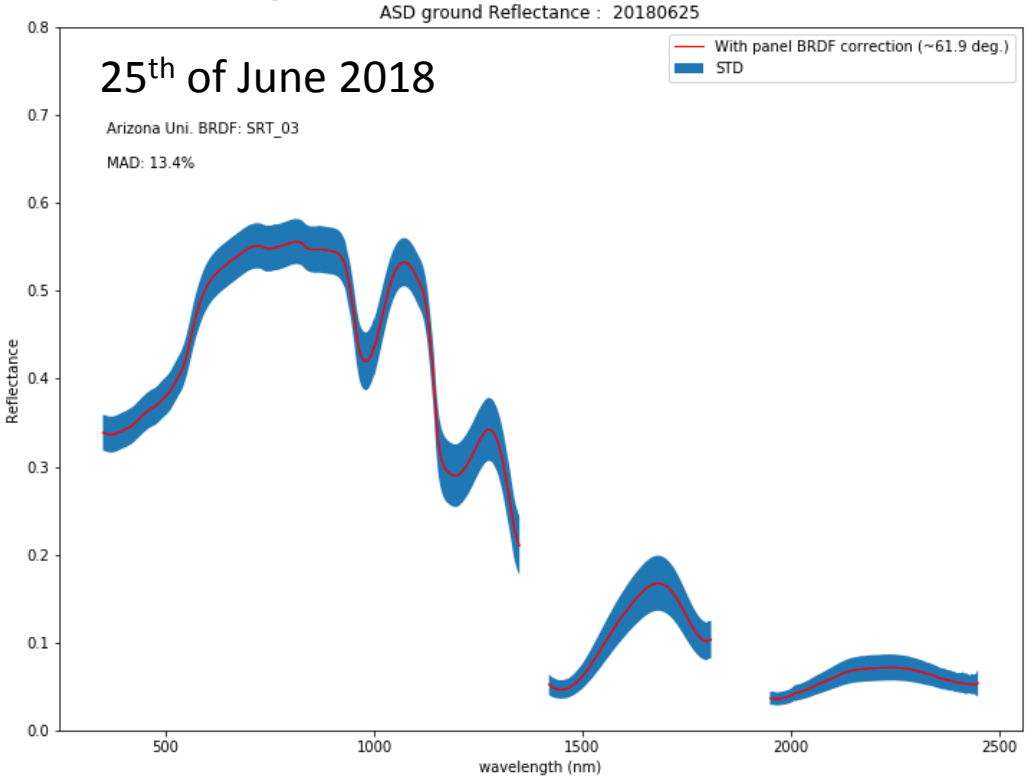

100 m
Google


Pyranometer
600
500
400
300
200
100
0
0
100
200
300
400
500
600
700
800
8:36 am
9:36 am
10:36 am
10:46 am

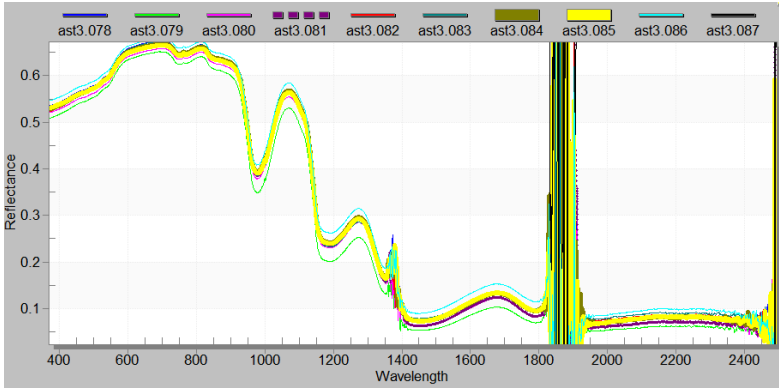
Campaign overview

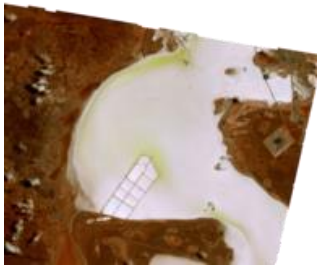


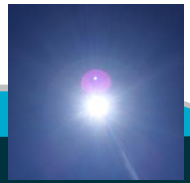
Whole plot reflectance



AIST/CSIRO ASTER campaign 29th
Nov 2014: ASD 16446
Uncorrected reflectance







Thank you

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