Calibration Support for VIIRS Ocean Earth Data Records Products by NIST

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August 27, 2015

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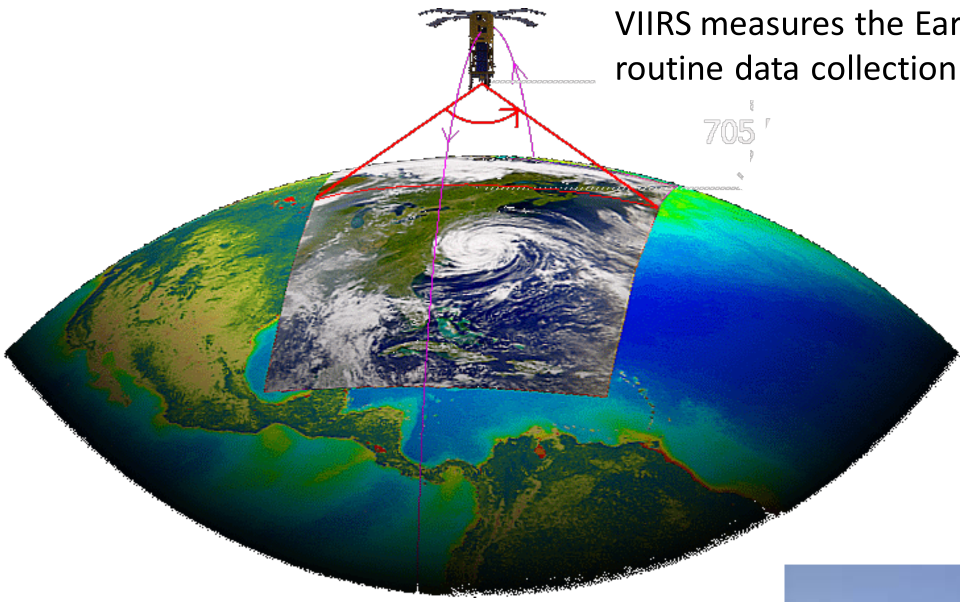
SeaPRISM080 is part of AERONET-OC



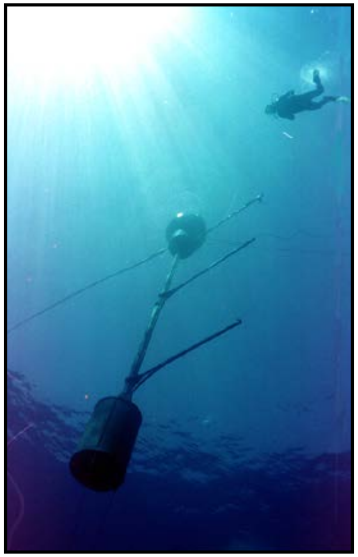
VIIRS measures the Earth for routine data collection

VIIRS measures the Moon – for mission drift corrections

Image Credit: SeaWiFS Project, NASA/GSFC, and GeoEye (oceancolor.gsfc.nasa.gov)

AERONET-OC: serves as a global validation network

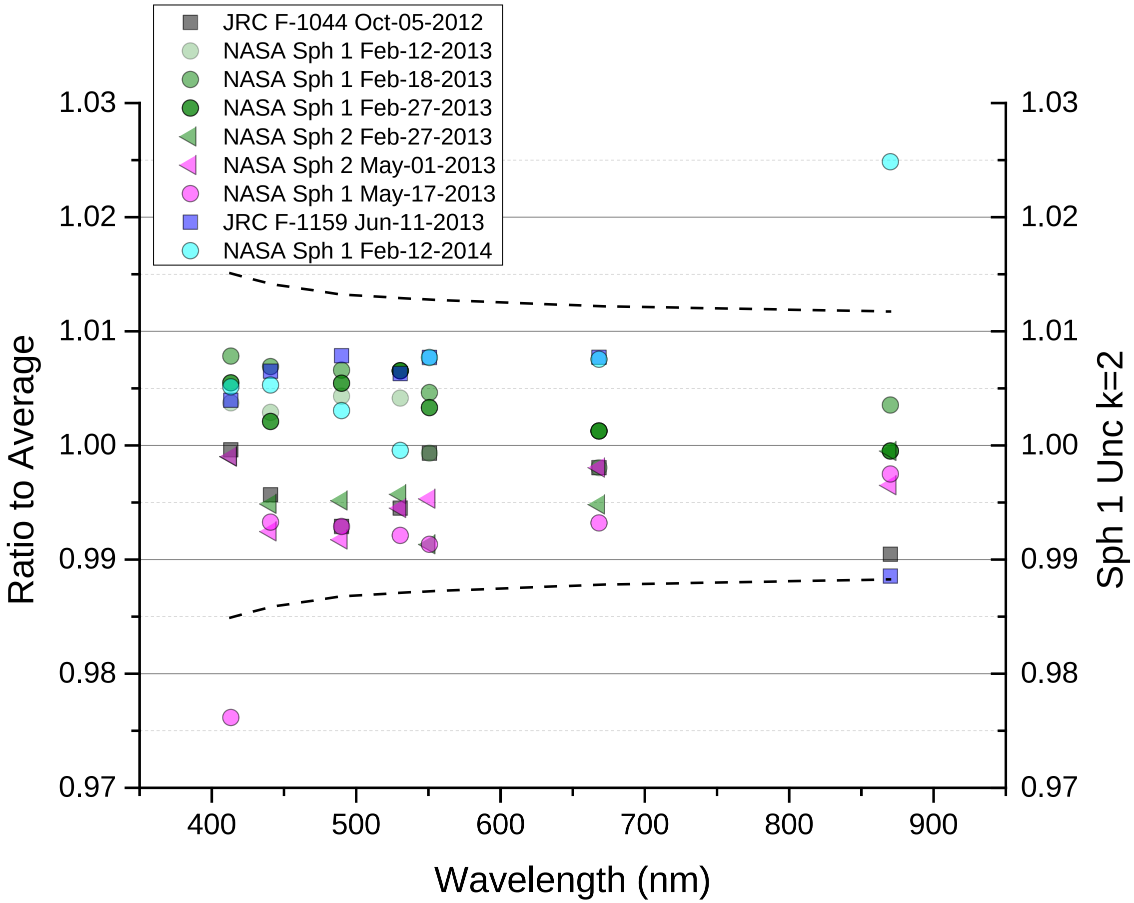
aeronet.gsfc.nasa.gov/new_web/ocean_levels_versions.html



MOBY provides the in situ $L_w(\lambda)$ for vicarious calibration

https://moby.mlml.calstate.edu/

SeaPRISM080 Calibration History

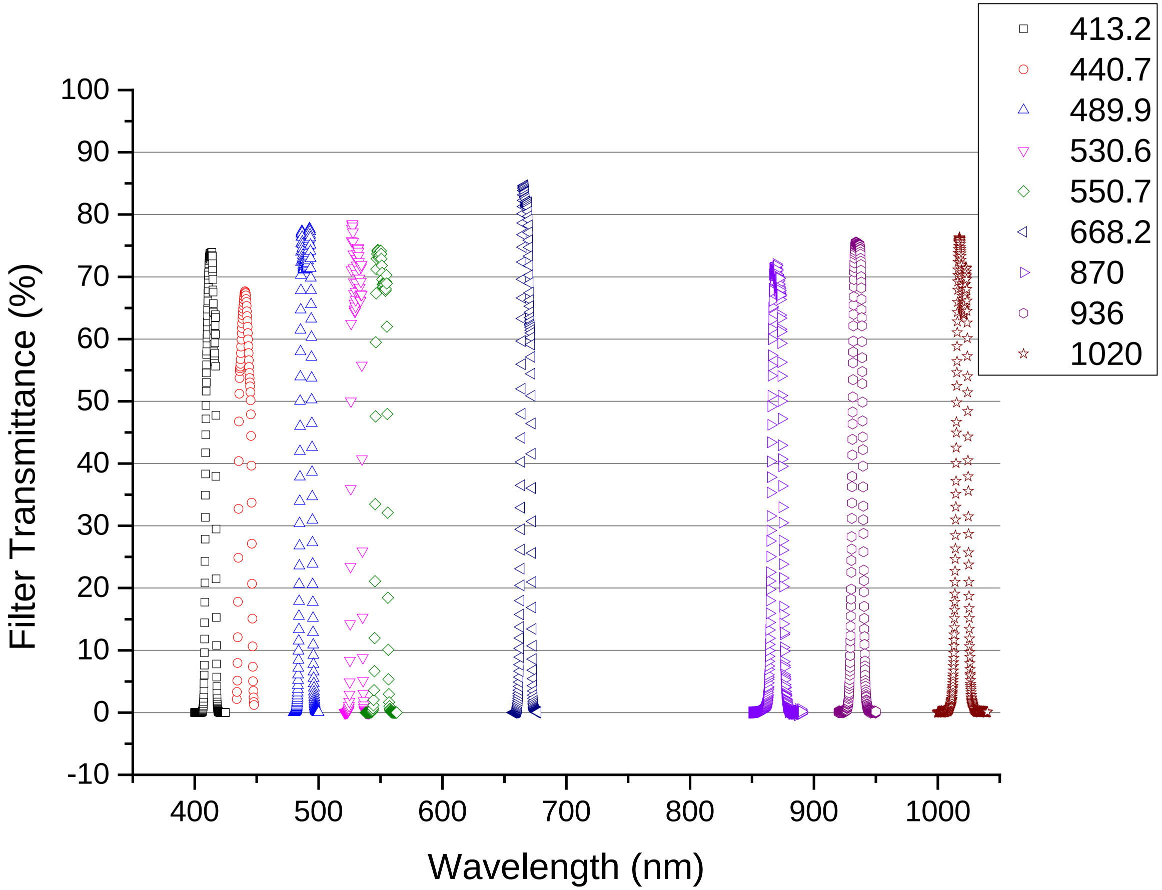


JRC's lamp/plaque (Credit: G. Zibordi, Joint Research Centre, Italy)

The agreement between GSFC and JRC for 080 for the radiance calibration is within +/- 1%.

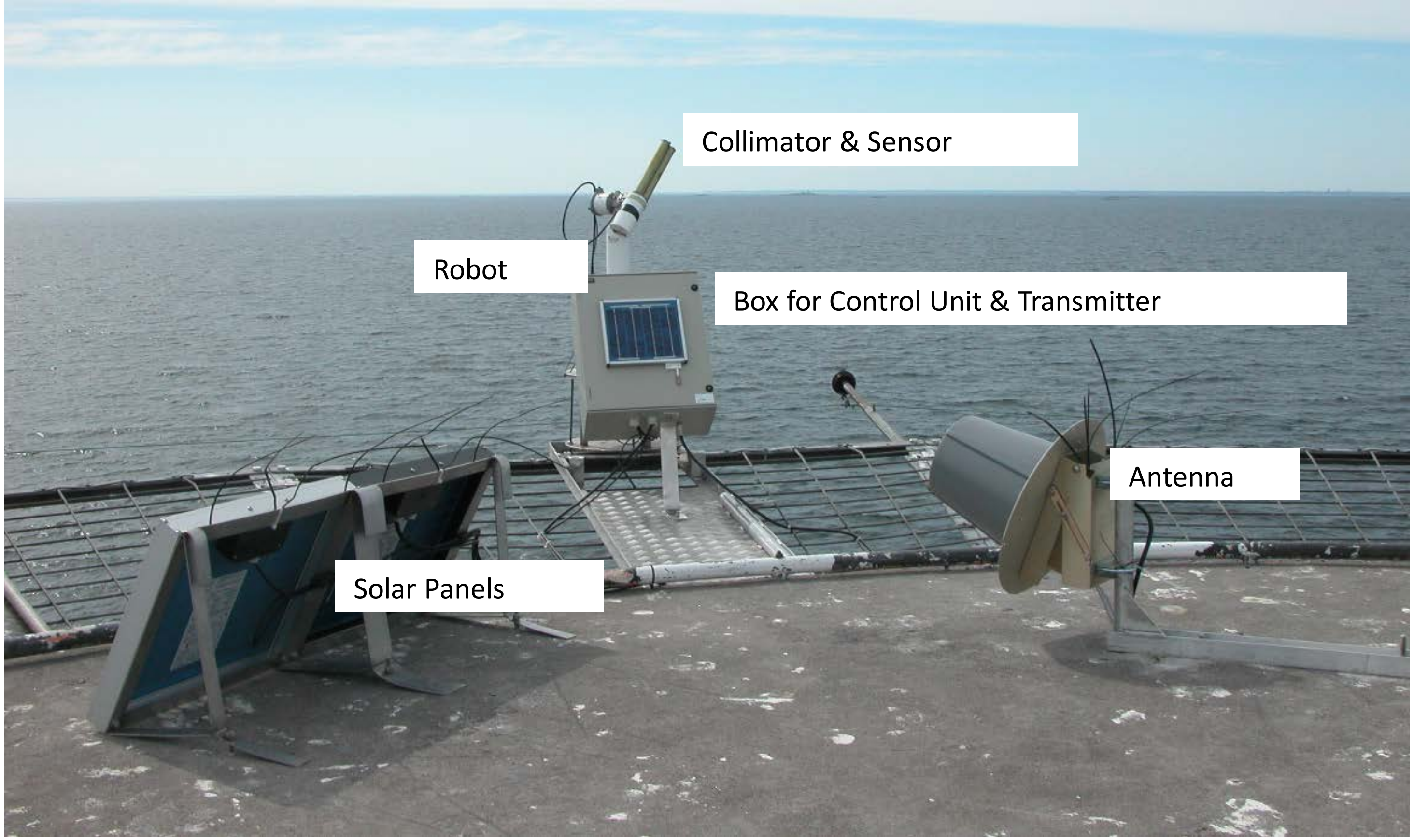
We wanted to know how these source-based calibration coefficients compared to SIRCUS.

Spectral Responsivity



GSFC provided spectral responsivities derived from the vendor-supplied filter transmittance data. We wanted to compare these to the system level radiance responsivities measured on SIRCUS. Inaccuracies will impact the GSFC or JRC broadband calibration factors and the derived ocean color products.

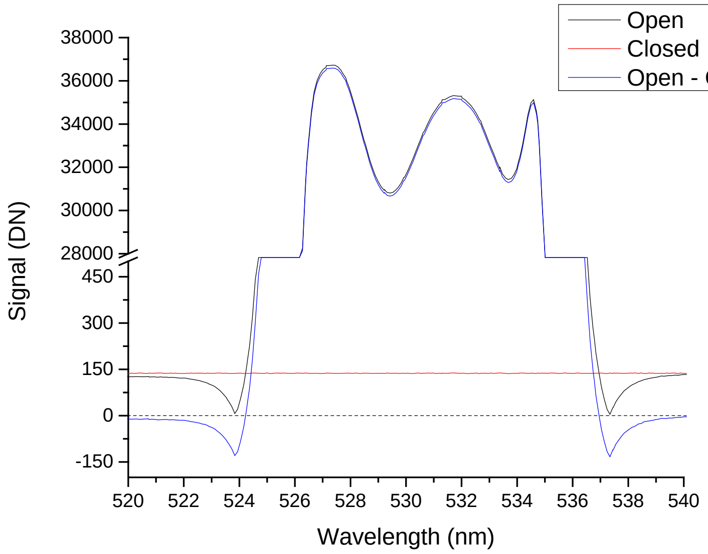
SeaPRISM in AERONET-OC



SeaPRISM at the Gustaf Dalen Lighthouse Tower in the northern Baltic. Credit: G. Zibordi, Joint Research Centre, Italy

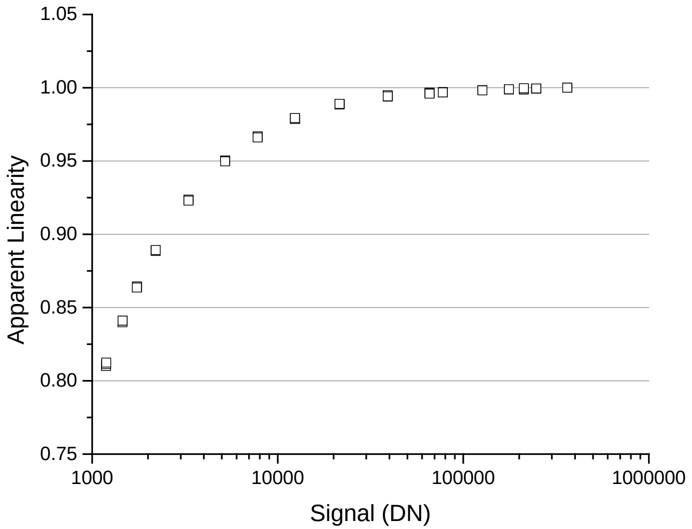
SeaPRISMs operate autonomously. For SIRCUS, we needed to control the foreoptic selection, filter selection, and gain using RS232 interface and the instrument's command set.

SeaPRISM Program vs RS232 Commands



Normalized by the SIRCUS sphere monitor photodiode, SeaPRISM signals from 364k DN to 1.2k DN demonstrated a 20% nonlinearity – something never observed during GSFC or JRC characterizations.

SIRCUS laser blocked gave an offset; laser open gave signals that decreased to zero and then increased; hence nets were negative – not physical behavior. The PRS mode on a broadband source gave 0 DN with the source blocked.

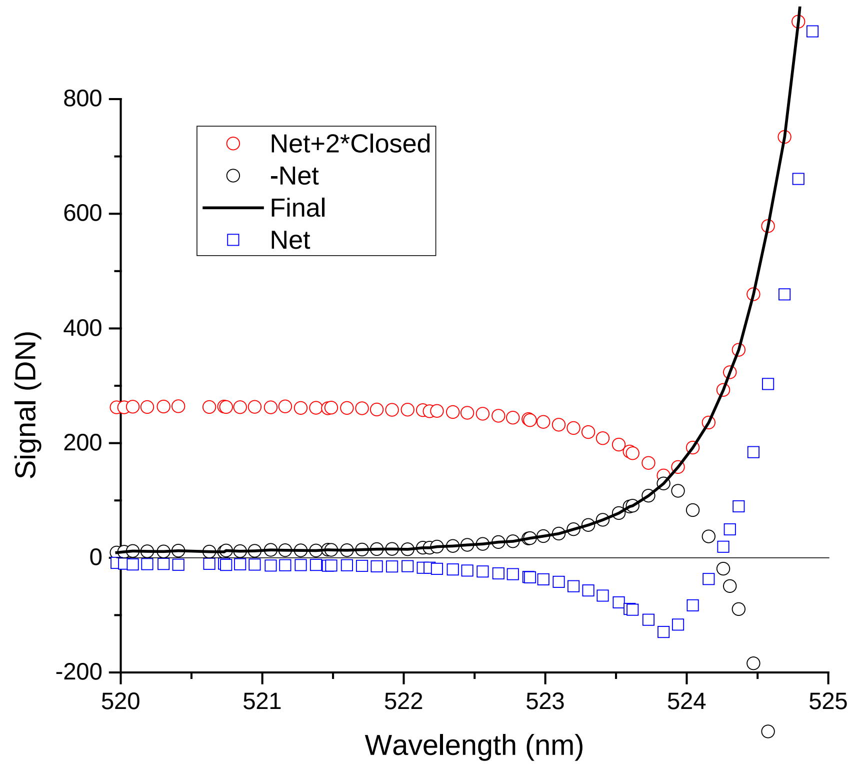


Measurement sequence: @, G, *i* then [Open, C, Close, C, step laser] x *N* times/band

Correction Model

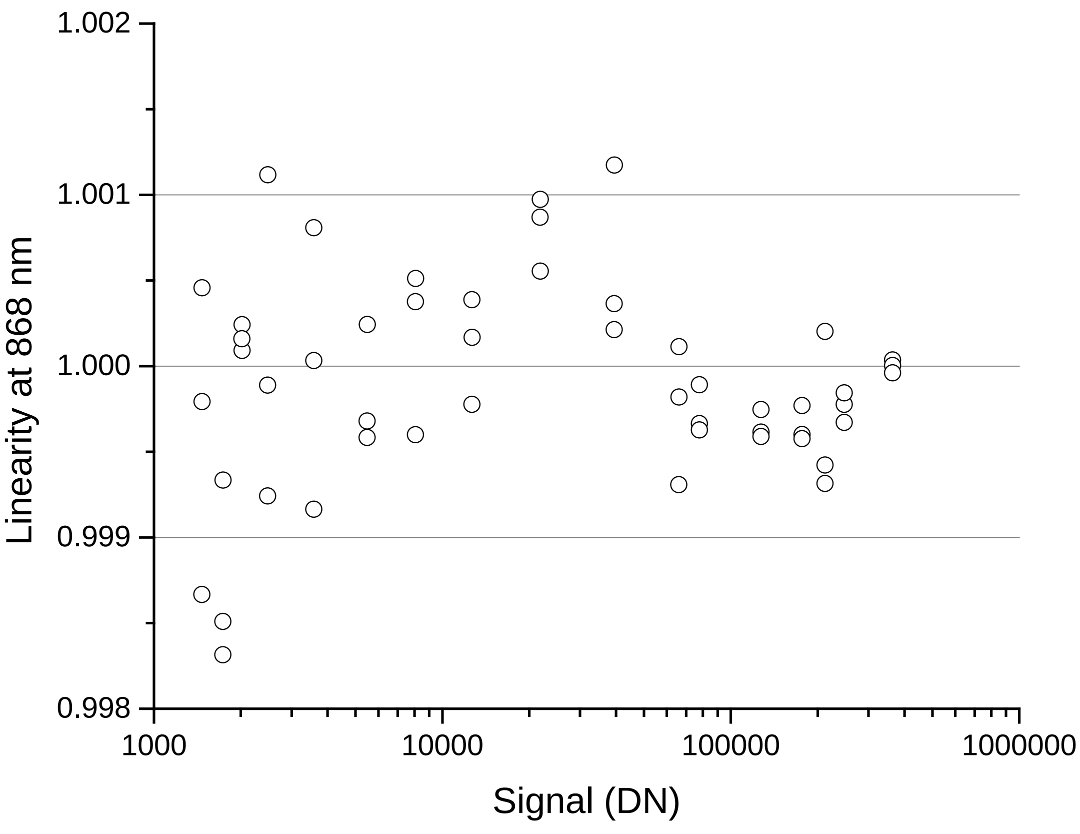
- What if
  - *There is an internal offset B_{int}, a positive value in units of DN, that is always subtracted prior to outputting the measurement result; and*
  - *if the result of this internal subtraction is negative, the sign is reversed so that only positive values are output.*
- Identifying S_{closed} with B_{int} allowed us to correct the SIRCUS data

Ambiguity Exists for Low DN Output



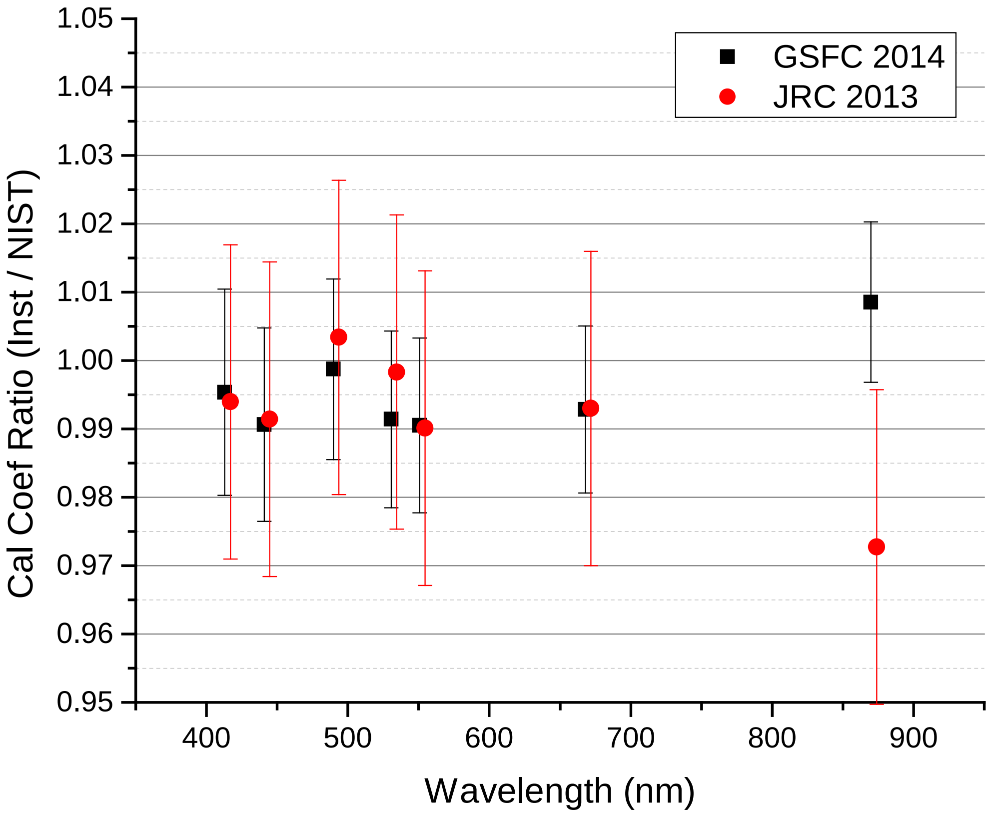
The ambiguity affects the spectral characterization: example: B_{int} = 138 DN, then an output of 2 DN means the signal was either 140 DN or 136 DN due to the internal subtraction and sign reversal. The relative error depends on the signal level – worse case is for zero or 2*B_{int}. This limits the dynamic range, and measurements of the out-of-band at the system level are not possible.

Corrected Linearity



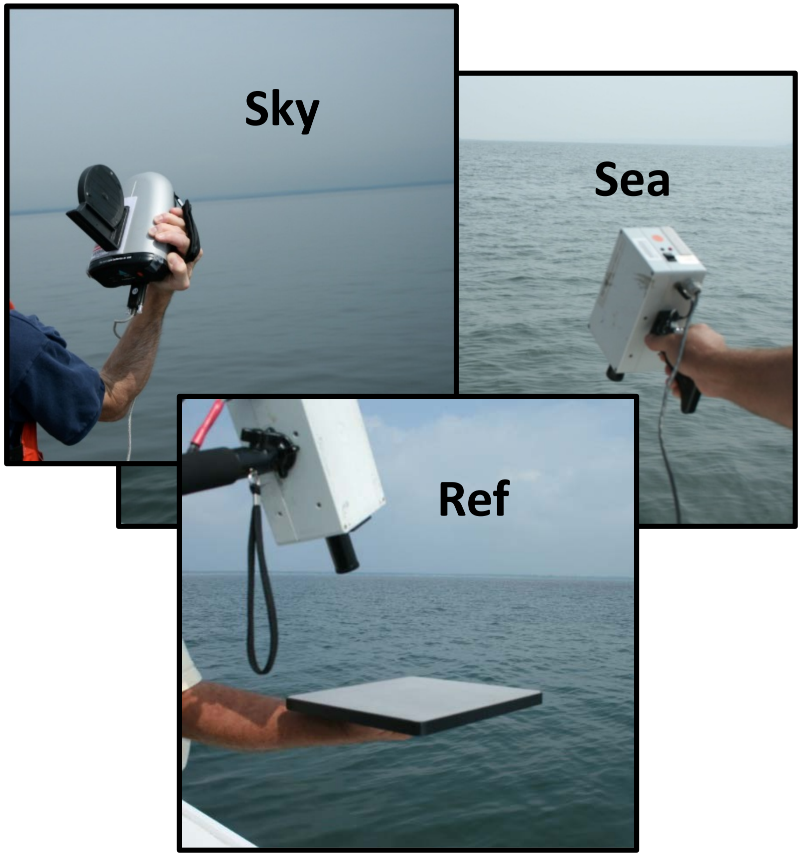
Apparent 20% at a laser wavelength of 868 nm for the 870 band is actually ±0.1%

Calibration Factor Comparison

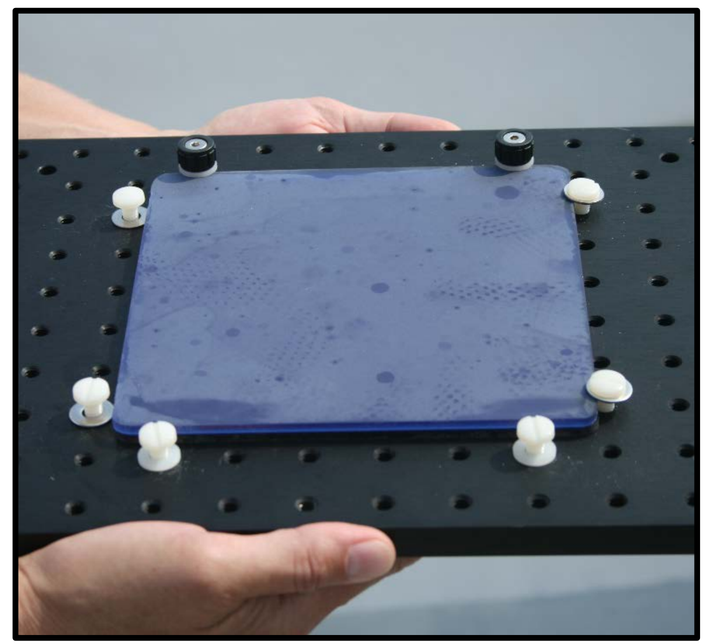


The uncertainties are estimates for the GSFC or JRC calibration factors.
A wavelength shift has been included for clarity. The agreement is excellent.

R_{rs} using Reflectance Standards

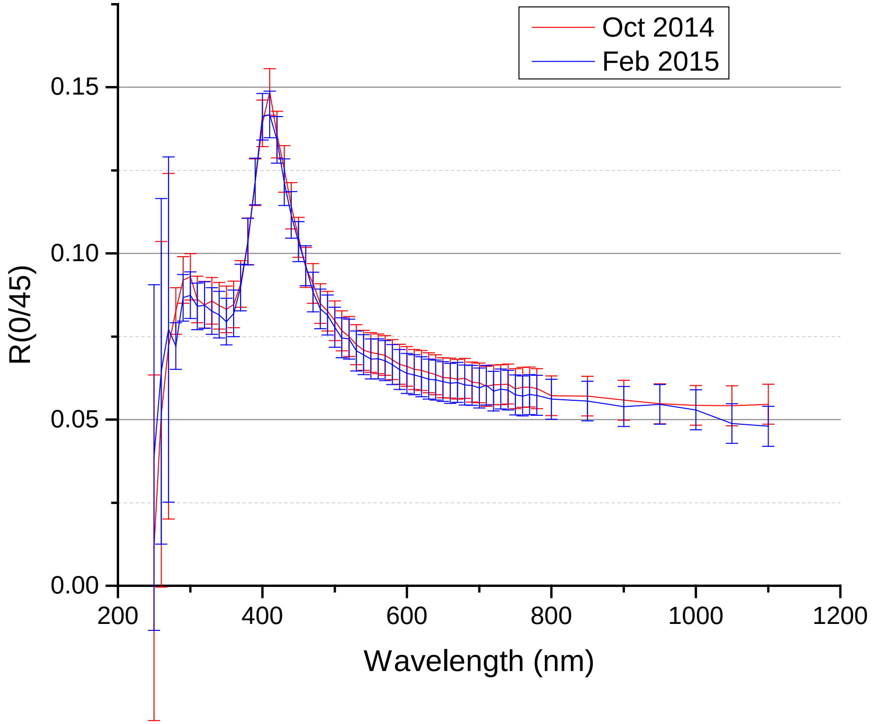


Question: Can we develop a faux reflectance target that mimics the water's spectral distribution, is Lambertian, and stable in time? Then, how well do all radiometers on a cruise agree with the faux target?



Prototype: ground blue glass, used in Long Island Workshop and Nov 2014 Nancy Foster cruise

Blue Tile 0/45 Reflectance Factor



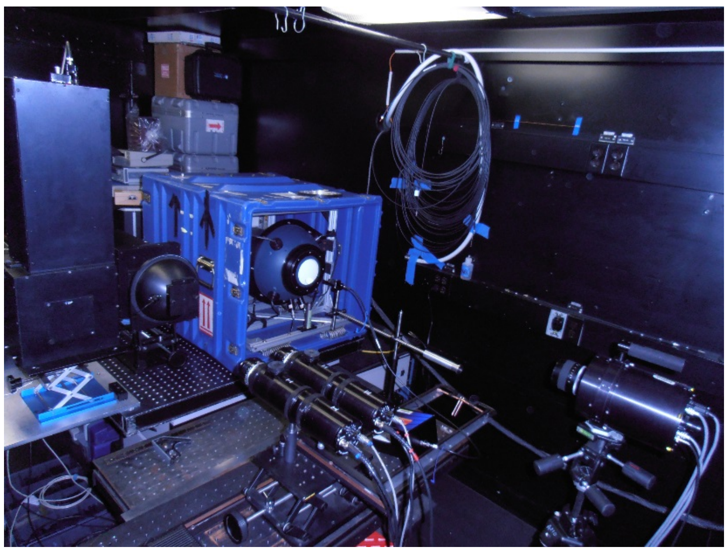
The NIST STARR facility measured the blue tile before and after the Nov 2014 cruise. The results agree within the uncertainties, so we can say the tile was stable.

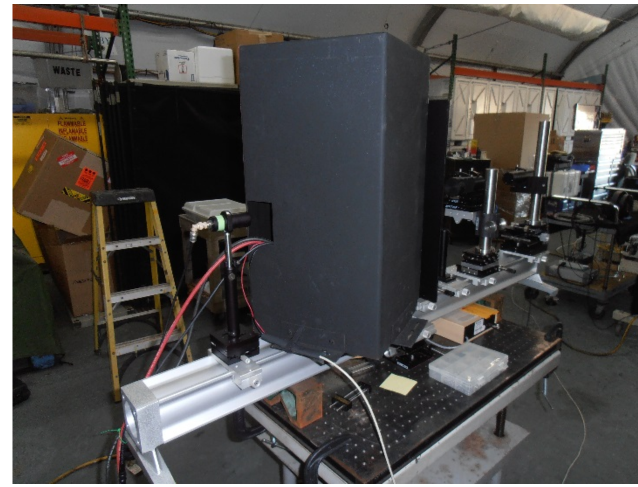
The largest uncertainty component is from the lack of spatial uniformity.

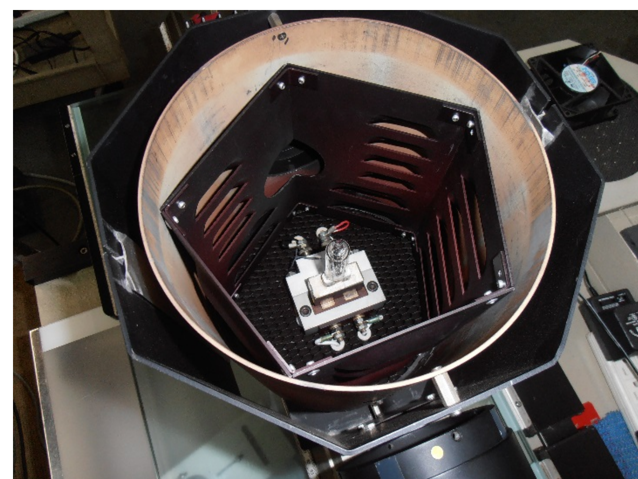
Validation for NESDIS/STAR Lab

Is being modeled after the MOBY validation program (Jan 2015 most recent trip), except we will bring the sources to NIST's RSL facility

Cal Van, MOBY facility - radiance







Tent, MOBY facility – irradiance NIST (top), MOBY (bottom)

Upcoming Work

- Measure SeaPRISM representative filters for out-of-band (component level test)
- Finish SeaPRISM080 archival paper (90% complete)
- Report on blue tile results for Nov cruise
- Continue investigation of best choice for colored “faux water” reflectance standards
- NESDIS/STAR irradiance and radiance source validation at NIST
- Colored radiance source for cruise validation at NESDIS