Appendix B to NOAA, MOU 18334
Validation of Ocean Color Up-welling Radiometer
NOAA's HyperOCR-R radiometer, S/N 206
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NIST is funded by NASA through interagency agreement NNH11AQ89I, "Uncertainty Analysis of the 13 Year Time Series for the in situ Vicarious Calibration of Ocean Color Satellite Sensors." Part of this effort involves field experiments in Case 1 waters off O'ahu. Michael Ondrusek, of NOAA/NESDIS, collaborated in the September 2012 effort, performing VIIRS validation activities and supporting the Uncertainty Project's instrument self-shading effort by sharing the data he collected using his HyperOCR systems.

The self-shading instrument, a fiber-coupled hyperstpectral multi-channel dual spectrograph system, was monitored during the experiment using a NIST integrating sphere, model OL455 (30.5 cm diameter, 7.62 cm diameter exit aperture) as a source to assess stability. The OL455 has not been calibrated on FASCAL, however in May 2012 during the validation of the MOBY radiometric scales, NIST used the Visible Transfer Radiometer (VXR) and the NIST Portable Radiance source (NPR) to transfer a scale to the OL455 at the six VXR wavelengths. The results are in Table B.1. The Level designation refers to the setting on a micrometer that controls the amount of flux coupled from the external lamp into the integrating sphere.

Table B.1. Spectral radiances of the OL455 at four levels as determined using the NPR, a NIST-calibrated integrating sphere source, and the VXR, a six channel filter radiometer.

Wavelength	Level "10"	Level "9"	Level "5"	Level "1"
nm	$\mu W/cm^2/sr/nm$			
411.64	2.33	2.33	0.995	0.0156
440.97	4.17	4.17	1.79	0.0282
548.22	15.6	15.6	6.72	0.107
661.10	31.0	31.0	13.4	0.213
775.17	43.4	43.4	18.7	0.299
869.54	49.8	49.8	21.4	0.344

On September 19, 2012 (GMT), during stability tests with the self-shading instrument and the OL455, the HyperOCR-R radiometer, S/N 206 measured the OL455 at Level "5". Michael Ondrusek supplied NIST with his spectral radiance values (from 352 nm to 799 nm), for in-air (e.g., without the normal correction for in-water immersion coefficient). This was done to validate the HyperOCR-R's spectral radiance calibration from the vendor, Satlantic. This work is not a calibration of the HyperOCR-R by NIST. The values, interpolated to the VXR wavelengths, are given in Table B.2. The ratios show the agreement is between -5 % and -0.3 %. Also included in Table B.2 are the estimated expanded uncertainties ($k = 2$) for the comparison. Michael Ondrusek reported the uncertainty in the calibration of the HyperOCR-R is 2 % ($k = 1$). The OL455 radiance uncertainties, derived using the VXR as a transfer radiometer and the NPR as the reference source in May 2012, depend on wavelength, varying between 1 % to 0.7 %

(k = 1). The components contributing to the OL455 uncertainty include the drift in the VXR since May 2012, its linearity, size-of-source correction, measurement precision, alignment to the spheres, drift in the OL455, and uncertainty in the NPR calibration.

Table B.2. Comparison of the spectral radiance of the OL455 using HyperOCR-R S/N 206, and the VXR.

Wavelength	VXR (May 2012)	OCR-R (Sep 2012)	OCR-R/VXR	Unc in ratio %, k = 2
nm	$\mu W/cm^2/sr/nm$		Ratio	
411.64	0.995	0.945	0.950	4.5
440.97	1.79	1.72	0.960	4.4
548.22	6.72	6.57	0.978	4.3
661.10	13.4	13.2	0.984	4.2
775.17	18.7	18.6	0.997	4.2
869.54	21.4	N/A	N/A	N/A