Technical Progress Report

Project Title: *Uncertainty Analysis of the MOBY 13 year Time Series for the in situ Vicarious Calibration of Ocean Color Satellite Sensors*

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Self-shading Experiment

A major aspect of the MOBY uncertainty analysis is quantifying the impact of instrument self-shading on the measured upwelling radiances. This uncertainty component is quantified using Monte Carlo methods validated with field experimentation. Collection and analysis of field validation data is our main contribution to this effort. Appendix 1 contains a summary of the experiment documentation. The complete and hugely voluminous documentation of this work, including experimental design, ongoing data analysis and results are available at: http://data.moby.mlml.calstate.edu/moby2_testing/20120903_shadowing/resonon/resonon.html

The Oahu-13 shadowing experiment was performed on 10 clear sky days during the period 5 to 19 September 2012. MLML cruise participants included: Mark Yarbrough – Chief Scientist and FISH system integration; Michael Feinholz – FISH Labview control software, optical calibration and data acquisition; Terrance Houlihan – GoPro video, Weather observations, AC-S deployment and measurement geometry documentation; Stephanie Flora – MatLab programming and daily data reduction; Darryl Peters – CTD and HyperPro radiometer deployment.

System integration

The Blue In-Line Spectrograph (BILS) and the Red In-Line Spectrograph (RILS) instruments were developed during earlier work as standalone systems. For this experiment, these instruments are integrated in the form of a ruggedized Dual In-Line Spectrograph bench unit (Figure 1) dubbed Field Instrument for SHadowing (FISH), suitable for field deployment aboard a 45’ research vessel. The optical components required to integrate the two systems were provided by NIST. The optical design couples the two 14-input spectrographs using fiber-coupled beamsplitters. Thirteen of the spectrograph input channels were fitted with beam splitter optics. The remaining input on each spectrograph was directly coupled via a bifurcated fiber to a Thor Labs stable LED reference source. The basic optical layout for one of the 14 input paths is shown in Figure 2. For this experiment, 50 meter long 600 um optical fibers are connected to the input collimator of 6 of the beam splitters for Lu and one of the inputs is connected via fiber optic to a gimbaled MOBY surface irradiance collector. The other beamsplitter inputs are not used and are kept blocked by the input shutters.

Each fiber optic input to the spectrographs are gated with a bi-stable multi-leaf shutter (Uniblitz DSS10). The Labview control software selects the open light paths as required for a measurement cycle. Only seven of the available fourteen light channels are used in the FISH configuration. Typically all seven active path shutters are open during the measurements but they must be individually controlled during certain characterization tests and dark measurements. Opening and closing of the shutters is accomplished using two MLML designed 14-channel H-bridge drivers interfaced to the FISH acquisition computer through two National Instruments USB-6501 digital I/O cards.

Several temperatures are measured within the FISH system. Such measurements can be useful in correcting thermal drifts if such problems are noticed during characterizations or in later analysis. The ambient, optical and CCD electronics temperatures are measured as well as humidity of the instrument chamber. National Instruments USB-6009 Analog to Digital conversion modules digitize the thermistor and humidity sensor voltage outputs.

One computer operates both the RILS and BILS optical detector systems, 28 shutters and ancillary sensors. These data streams are acquired and merged into one raw data file suitable acquisition display and post processing in Matlab. The shipboard FISH system is housed in a protective, light tight, air conditioned case.

Floating collector platform (Shadowing Fork)

Terry Houlihan was in charge of assembling the floating collector platform. The FISH shipboard instrument is fiber coupled to a surface flotation platform configured with five arms; one arm had two reference inputs (a bare fiber radiance collector at the surface and one at 0.25 m depth). The four outside arms allow mounting of opaque disks of various diameters, simulating a range of instrument shadowing conditions (Figure 3).

A small graduated sundial was attached atop the trailing arm and a GoPro camera is positioned to image the sun shadow angle on the dial face. Our intent is to use the sundial shadow to help position the frame into the sun during the measurement sequences. The GoPro camera images document this alignment to help with interpreting the data. This angle is also an input to the shadowing model. Two GoPro cameras are mounted below the water surface and aligned to image the disks/collectors attached to each arm. This information is helpful in determining the collector state during the measurements and is used to filter for bad data due to the collector jumping out of the water as waves pass under the frame.

Cameras were time synced to within the minute prior to deployment. In addition, a small clip of video was taken of a iPhone clock app with each camera just prior to deployment. The iPhone clock pictures allow us to sync the videos to within the one-second resolution of the iPhone clock.

Data Acquisition Software.

New software was required to run the two ILS CCD detector systems in parallel allowing for simultaneous measurements across the NUV to NIR spectral range (Figure 4). This software also controls the 28 input shutters and monitors the numerous ancillary sensors. Mike Feinholz was placed in charge of this effort at virtually the last minute. In a very short time, he was able to assemble a very capable LabView data acquisition system using the software development kit supplied by the vendor. We were unable to achieve full parallel operation of both systems but we were able to implement the main goal of a merged data file. COTS software does exist to allow operation of the individual spectrographs but a major benefit of the new software is the automatic merging of both detector data streams with the ancillary sensor data and file documentation header information. This automatic operation was a vital in our ability to collect and organize the necessarily large amount of data this experiment generates.

Starting in August 2012 Michael Feinholz worked to develop data acquisition and control software for the FISH PIXIS CCD detectors. This software was written in LabView Version 2011, running on a Windows XP 32 bit operating system, incorporating Roper Scientific (Princeton Instruments) Scientific Imaging ToolKit Version 3.0.10.0, SITK, over a USB hardware interface. NIST provided the SITK for this purpose. The LabView software replaced original WinView/32 software we had used during testing of the PIXIS cameras. Michael insured that WinView remained operational during installation and configuration of SITK drivers and libraries, and checked LabView outputs versus WinView throughout development. The purpose of the new software was to allow merged scan sets to be acquired and recorded with ancillary information compatible with Stefanie Flora's data processing structure– this was very cumbersome to achieve using WinView, and not practical in an operational mode.

Michael studied old WinView file headers to understand SITK parameters for camera settings, and developed our camera control sequencing based on WinView operation and on SITK examples. After he became proficient with communication / configuration / operation of a single camera he added capability for two cameras together. Presently we collect and save full CCD images from the PIXIS to binary .SPE files – all binning for individual fiber inputs are processed in post-acquisition MATLAB software. A separate ASCII header file is saved with each image file to record pertinent camera settings. The header also records ancillary data acquired with each image. Michael wired two National Instruments USB-6009 data acquisition (DAQ) devices and wrote code to acquire/record analog output from temperature and humidity sensors in/outside the Resonon spectrographs. Michael wrote software to interface with Mark's shutter controllers, in cooperation with Stephanie's MATLAB data processing.

Some outstanding issues with the LabView software remain to be resolved after their first field use. The two PIXIS cameras are run in serial rather than parallel fashion. I.E. the Blue spectra is acquired before/after the Red spectra. This may be fixable by triggering camera scans via an external signal through a DAQ. FISH shutter control is achieved via a separate computer. The subroutine to control Mark's USB-6501 digital I/O DAQ is under development. We may want to include on-chip CCD binning capability to reduce full-CCD-image file size and increase the dynamic range capability of the system. Michael and Dennis have a long wish list of real-time acquisition display/processing to enhance operator effectiveness.

Optical calibrations

It is vital to obtain an accurate radiometric response characterization for each of the Lu fiber inputs at various times throughout the experiment. As important, is repeatable tracking of the response rations between each input. The actual FOV of each fiber tip were measured and specially designed kinematic jig disks were built to facilitate repeatable calibration positioning of the 14 fiber input collectors (bare fiber tips). These concave jig disks are designed so that the FOV of each fiber tip encompasses the same area on the calibration source. In this case, a different jig disk is required for each anticipated sphere and fiber array configuration. An example of one of these fixtures is shown in (Figure 5). The FC fiber optic connectors in each jig are inherently kinematic and the jig disks were positioned at the sphere port using magnetic kinematic mounts.

In September Michael operated the FISH during pre and post-Oahu13 system calibrations, and during Oahu13's ten field stations. Michael assisted in ship-board operations during Oahu13 as needed. Radiance calibrations utilized the MLML OL420 and NIST OL455 integrating sphere sources. Surface-incident Irradiance calibration was via FEL-F600. Wavelength calibration was via Oriel emission lamps, with scans made of HeNe lasers and solar absorption lines as reference. Daily reference scans were made of a ThorLabs LED via Ocean Optics bifurcated fiber optic mounted inside the FISH enclosure. On day#5 we began taking reference scans of an Oceanoptics CoolWhite LED attached to the end of each Lu fiber. Michael also worked with Carol and Stephanie to transfer a radiance scale from the NIST NPR to the OL455 via VXR scans made in May 2012.

During October, November, December 2012 Mike continued post-Oahu13 calibrations of the FISH and worked with Stephanie, Carol and Al Parr, on data processing issues. We continued characterization of the Lu fiber's FOV, verified CCD linearity via a Gamma Scientific linearity assembly, looked at PIXIS saturation and CCD blooming issues, and took some occulted Es data to compare direct versus diffuse solar irradiance measurements with those of the Satlantic HyperPro system. In January 2013 Michael worked with Al Parr to refine the linearity experiment and understand propagation of uncertainties in the linearity characterization results.

Data Analysis

During the experiment Stephanie worked from shore writing Matlab processing software for the FISH raw data output by Michael Feinholz' Labview control/acquisition software. The MatLab programs read in the raw files, subtract the darks, divide by integration time and gain factor to product the Net data. The Net data are then converted using Michael's and Carol's reference lamp and calibration data. The data were quality checked and we got the first look at the shadowing effects. Websites were created to automatically present the daily data and specialized analysis to look at data from a particular experiment or characterization exercise. For example the field-of-view experiments, linearity experiments and LED stability checks. Stephanie also organized the other data sets collected, CTD, HyperPro, GOES images, Honolulu weather data, VOG images, Wave movies and 275 GB of GoPro images. Not only was this auxiliary data organized but Stephanie wrote programs to read the data in, plot it and create web pages so team members could browser the data, both during the cruise and after.

During the months following the cruise Stephanie continued to work on the FISH and auxiliary data sets. Stephanie continues to analyze data from the ongoing FISH characterization process. All data are published to the experiment web site for team member discussion. Stephanie also read in the HyperPro data plotted results and published the results to the web site. System responses for the HyperPro were created using Michael and Carol's calibration data.

After the cruise the GoPro image data were the first major coding project. All the images need to have their times converted to GMT and then the images closest to the FISH data needed to be moved to another directory. Each of these files was then cropped to show only the important section of each image. This help to reduce the size of the image making browsing them much faster. Web pages with the FISH data and it's GoPro data on one page were created so Dennis could use the GoPro images to do the more careful quality checking on the data. The webpage was organized by filename and has the percent standard deviation of each tracks data to provide a quick idea of how stable each file was and which days were worth using.

FIGURES

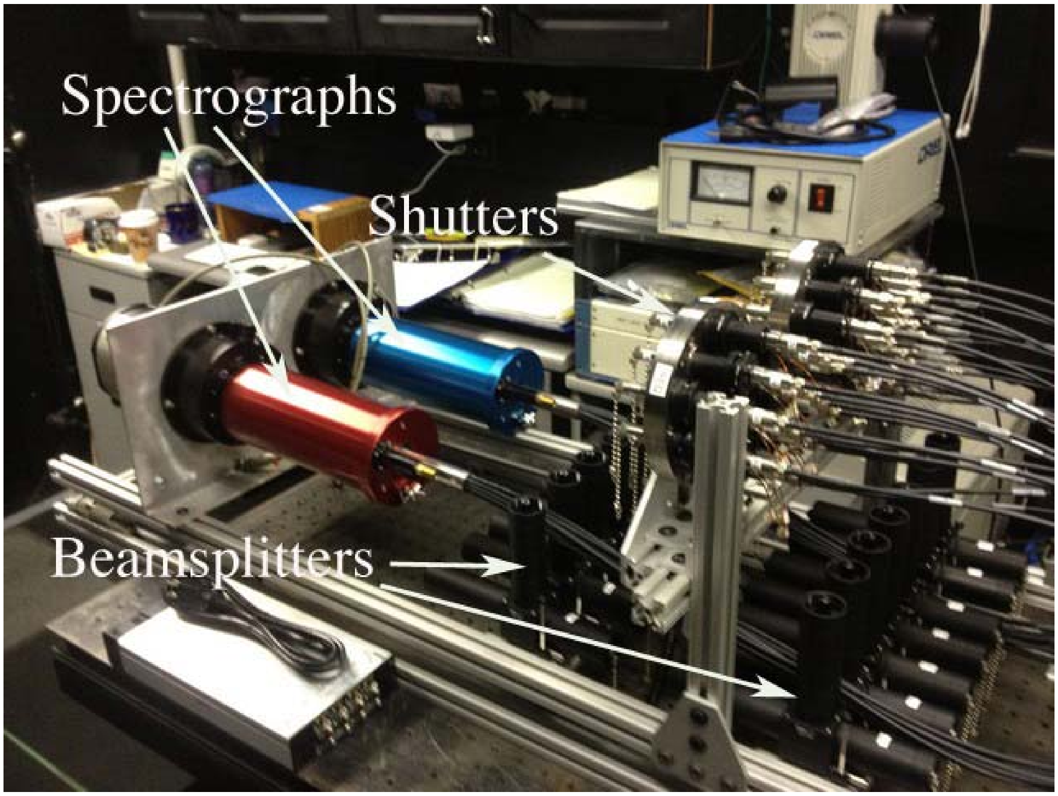

Figure 1. FISH Bench Unit.

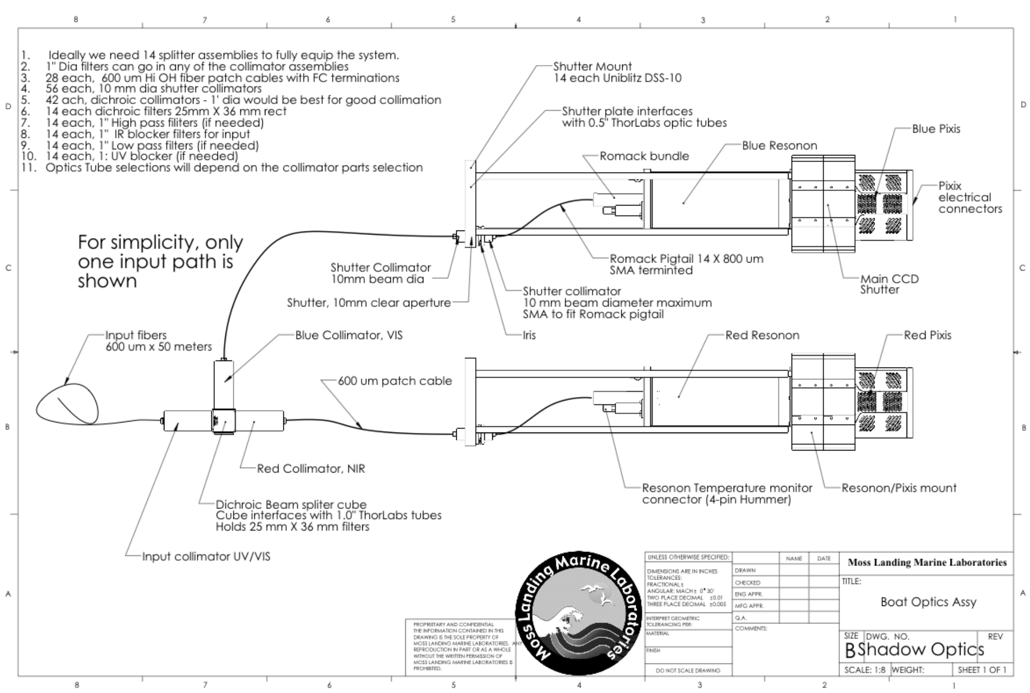

Figure 2. Dual In-Line spectrograph FISH optical setup.

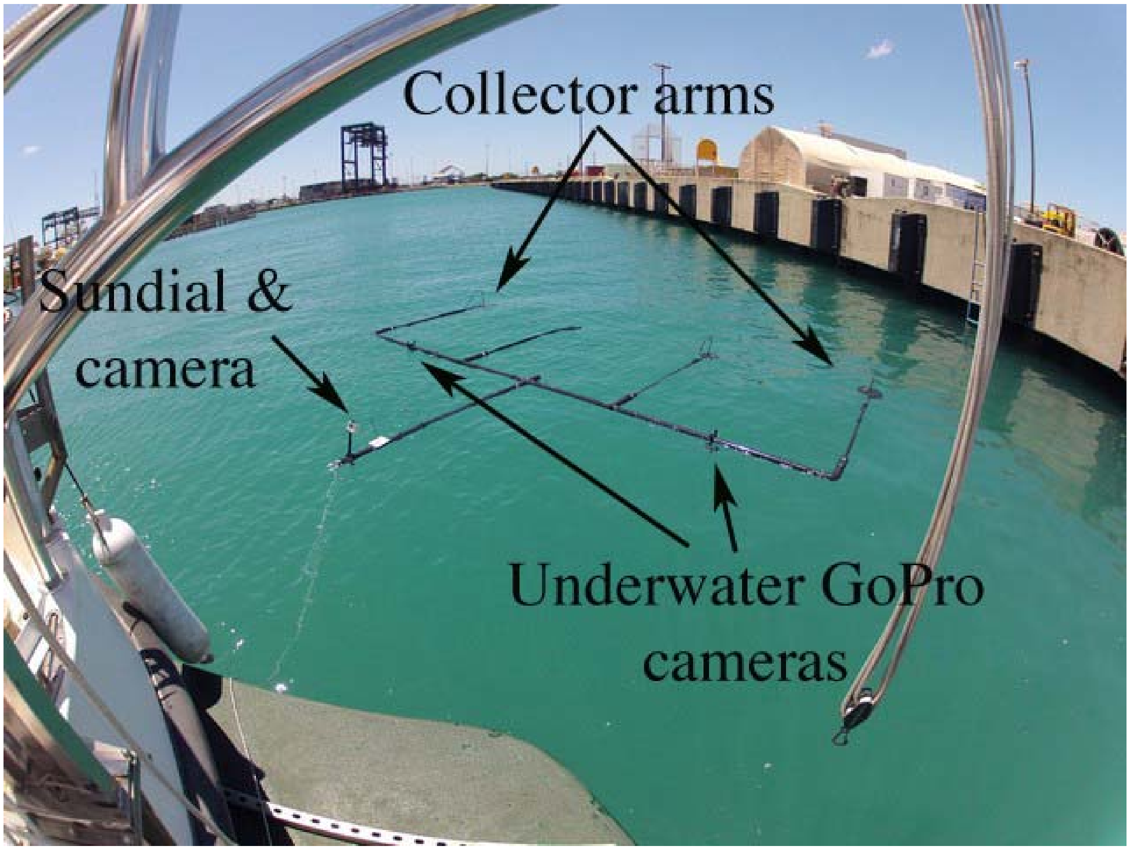

Figure 3. Floating collector platform.

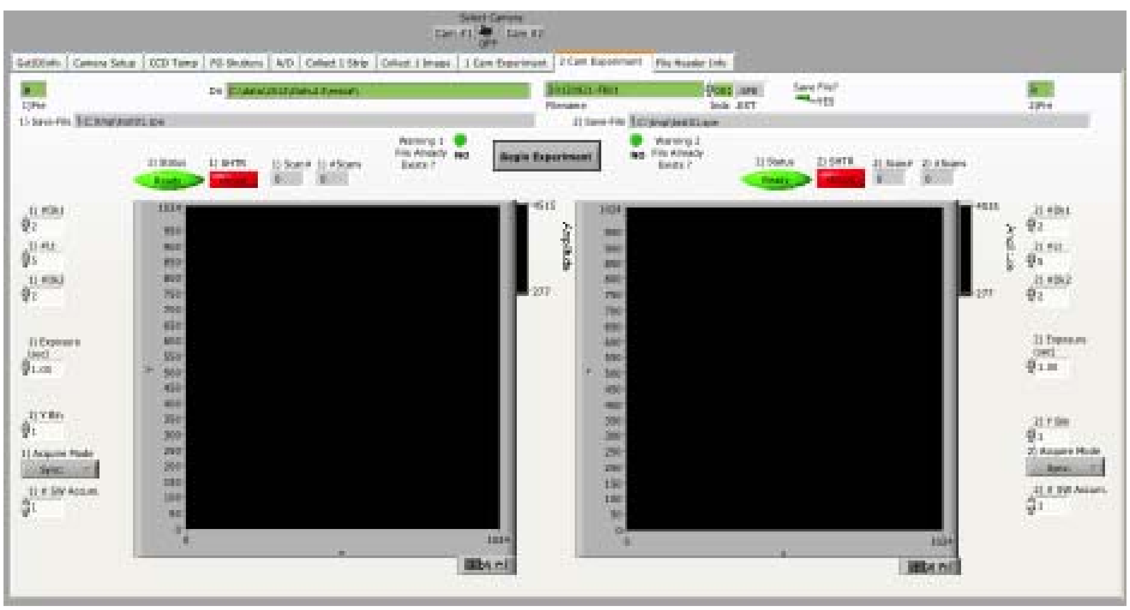

Figure 4. FISH data acquisition LabView front panel.

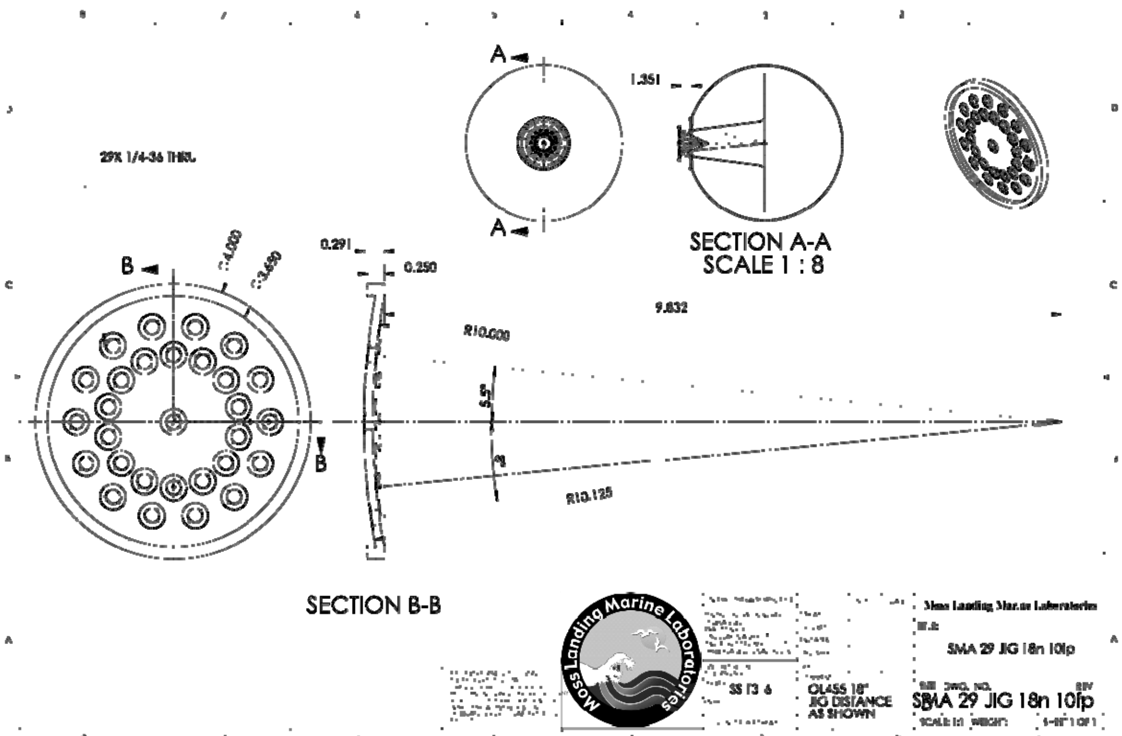

Figure 5. 28-port fiber optic connector kinematic Jig Disk for the 18” OL 455 calibration sphere.

Appendix 1.

Shadowing experiment documentation web site. (The links are inactive in this document. Visit web site listed on page one for active links to information)

MOBY2 Sept 2012 FISH shadowing data listing - OAHU-13

Doc#	Purpose	Link to Docs	Description
1.01	Channels	Channel assignments	PDF from Carol on Channel assignments
1.02	Write-up	Carol Shadowing Exp Writeup	Carol's start on a Experiment write up
1.03	Trip Report	Trip Report	Carol Trip report
1.04	Fork Layout	Fork Layout	Carols Fork measurements and layout
1.05	meeting	Meeting Topics	Sept 4th meeting topics (updated)
1.06	Res Logs	FISH log sheets	Mike's Log sheets from FISH Data collection
1.07	Boat Logs	Day 4-7 Boat forms	Terry boat logs with fork position and wind and wave conditions
1.08	CTD/Hyp logs	CTD/HyperPro/Filter logs	Mike O and Darryls data log sheets
1.09	OL455 cal	NIST OL455 Cal doc	Carol cal report of her OL455 source
1.10	Log data	Boat Forms and MikeO Aux data	Excel file with the boat form and MikeO logs entered
1.11	Gain	PIXIS-CofP-1205080003.pdf = Blue	Certificate of Performance (CoP) from Princeton Instruments (PI) = BLUE SPEC
1.12	Gain	PIXIS-CofP-2705090005.pdf = Red	Certificate of Performance (CoP) from Princeton Instruments (PI) = RED SPEC
1.13	FOV	Field-of-view document	Documentation of the 4 FOV experiments completed
1.14	OL455	OL455_leve05.xlsx	OL455 Radiances (Jan 14 2013)
1.15	OL455	Letter to Mike Ondrusek	Letter to Mike Ondrusek
1.16	OL455	Appendix B to NOAA, MOU 18334	Validation of Ocean Color Up-welling Radiometer
1.17	OL455	Calibration of NIST's OL455	Calibration of NIST's OL455 using the VXR for support of the FISH

FISH Data Listing (cals, LED, inwater)

Exp#	Experiment	Directory or Graphs	Description
1.01	LED stablity	LED stability	All the LED data stability starting on day 5 to present

1.02	Track stability	Track Stability	Track stability for all data to present
1.03	All darks	All darks verses int time	Plots of all the darks or Track 7 verses intergration time
1.04	Comp rsp	Comp. system responses	Compare the system responses from three different cals.
1.05	LED TS	LED time series plots	All LED data collected and plotted
1.06	Rel rsp	OL455 responses relative to Track 9	All OL455 rsp data relative to Track 9 (bare fiber)
1.07	Chose rsp	Chose an system response	Compare the system responses from three different cals.
			Daily Data - mean of 5
2.01	Daily in-water	13 Sept - Day 2 - cloudy	In-water data and Es with Ratios
2.02	Daily in-water	14 Sept - Day 3 - cloudy	In-water data and Es with Ratios
2.03	Daily in-water	15 Sept - Day 4 - sunny	In-water data and Es with Ratios
2.04	Daily in-water	15 Sept - Day 4B - sunny	In-water data and Es with Ratios
2.05	Daily in-water	16 Sept - Day 5 - sunny	In-water data and Es with Ratios
2.06	Daily in-water	16 Sept -Day 5B - sunny	In-water data and Es with Ratios
2.07	Daily in-water	17 Sept - Day 6 - cloudy	In-water data and Es with Ratios
2.08	Daily in-water	17 Sept - Day 6B - cloudy	In-water data and Es with Ratios
2.09	Daily in-water	18 Sept - Day 7 - sunny	In-water data and Es with Ratios
2.10	Daily in-water	18 Sept - Day 7B - sunny	In-water data and Es with Ratios
			Daily Data = indiv images
2.12	Daily in-water	14 Sept - Day 3 - cloudy	In-water data and Es with Ratios
2.13	Daily in-water	15 Sept - Day 4 - sunny	In-water data and Es with Ratios
2.14	Daily in-water	15 Sept - Day 4B - sunny	In-water data and Es with Ratios
2.15	Daily in-water	16 Sept - Day 5 - sunny	In-water data and Es with Ratios

2.16	Daily in-water	16 Sept - Day 5B - sunny	In-water data and Es with Ratios
2.17	Daily in-water	17 Sept - Day 6 - cloudy	In-water data and Es with Ratios
2.18	Daily in-water	17 Sept - Day 6B - cloudy	In-water data and Es with Ratios
2.19	Daily in-water	18 Sept - Day 7 - sunny	In-water data and Es with Ratios
2.20	Daily in-water	18 Sept - Day 7B - sunny	In-water data and Es with Ratios
3.01	Hyper Es	Day 5 Es data	HyperPro Es (direct and diffuse) and compared to FISH Es
3.02	Hyper Es	All HyperPro Es data (to date)	HyperPro Es time series
3.03	Hyper Es	All HyperPro Lu profile data (to date)	HyperPro Lu Profile data
3.04	Hyper Es	All HyperPro Es data with occulted ratios	HyperPro Es Profile data (occulted with ratios)
3.05	Hyper Es	All HyperPro Es data with occulted ratios - EAST COAST	HyperPro Es Profile data (occulted with ratios) - EAST COAST
3.06	Hyper Es	HyperPro Es data and model	HyperPro Es data and model to look a zenith angle effects
3.07	FISH Occult	Fish Dec 6occulted data	FISH occulted on
3.08	Mike comp	Mike comparison graphs	Mike comparison graphs of 4 instrument occulting
3.09	Satlantic	HyperPro occulted Es question	Glenn Davidson's documenation of the occulting questions
Exp#	**Experiment**	**Directory or Graphs**	**Description**
4.01	Day 7 data	All Day 7 data (FISH, CTD, Dennis's edits, HyperPro)	Only Day 7 data for Jim
Exp#	**Experiment**	**Directory or Graphs**	**Description**
FISH Data - Stability testing in Cal Hut (BSG and RSG not simultaneous and romack only, no beam spliter or long fibers)			
10	**OL420 #1**	**20120907_OL420**	**OL420 data (Track 3,5,7,9,11 and 13)**
10.01	trck def	• Using the Intial OL420	html and graphs

		data to check track definitions - BSG	
10.02	trck def	• Using the Intial OL420 data to check track definitions - RSG	html and graphs
11	**OL420 #2**	**20120908_OL420**	**OL420 and LED data (Track 3,5,7,9,11 and 13)**
11.01	comp days	• Compare the OL420 data from day1 and day2	html and graphs
11.02	comp days	• Compare the tracks to 2009, May 2012 and Jun 2012 - BSG	html and graphs
11.03	comp days	• Compare the tracks to 2009, May 2012 and Jun 2012 - RSG	html and graphs
11.04	readout err	• Track readout error found on one file	html and graphs
11.05	comp	• Compare the 3 OL420 data sets (on 2 days)	html and graphs
FISH Data - Long fibers, beam splitters and Track 14 led now on (in cal hut)			
12	**OL420 #3**	**20120910_OL420**	**OL420 data (Track 3,5,7,9,11 and 13)**
12.01	trck check	• Check the BSG track stability for first three days	html and graphs
12.02	trck check	• Check the RSG track stability for first three days	html and graphs
12.03	darks	• Quick looks at BSG darks	html and graphs
12.04	darks	• Quick looks at RSG darks	html and graphs

12.05	darks/tmp	• Quick looks at darks vs temperature	html and graphs
12.06	comp	• Compare day 1-3 OL420 data	html and graphs
12.07	comp	• Compare OL420 data stability (10 Sept)	html and graphs
13	**LED**	**20120909_LED**	**Cypress and Thorlabs T14 LED data (Track 3,5,7,9,11 and 13)**
13.01	comp	• Compare day 2-3 LED data	html and graphs
14	**Wavecal**	**20120910_Wavecal**	**Wave cal and laser data, one Es scan**
14.01	comp	• BSG Wavelength cal for T 1,3,5,7,9,11 and 13 (Hg and Ne lamps, Es with Fraun lines)	html and graphs
14.02	comp	• RSG Wavelength cal for T 1,3,5,7,9,11 and 13 (Hg and Ne lamps, Es with Fraun lines)	html and graphs
FISH fibers disconnected, instrument on the boat. Day 4 rsp track 9 11 and 13 changed by 10%.			
15	**In-water**	**20120912_Day01**	**In-water test with the fork, no disks**
16	**Plaques**	**20120913_Day02_Plaque**	**Fibers on deck grey plaque and tiles**
16.01	comp	• BSG plaque measurements comp (are they all measuring the same thing?)	html and graphs
16.02	comp	• RSG plaque measurements comp (are they all measuring the same thing?)	html and graphs
16.03	darks	• BSG look at darks which are too low (below zero)	html and graphs

17	**OL455 Es**	**20120913_Day02_OL455**	**NIST OL455 lamp and wavelength cal**
18	**In-water**	**20120913_Day02**	**In-water test with the fork, w/ disks (7, 16 24 and 32 cm)**
19	**Dark test**	**20120913_Day02_dark**	**Dark tests (Gain and ADC Rate)**
19.01	darks	• BSG look at darks which are too low (below zero)	html and graphs
20	**Dark test**	**20120913_Day02_winview**	**WinView used to check the darks**
21	**In-water**	**20120914_Day03**	**In-water test with the fork, with disks (7, 16 24 and 32 cm)**
Started taking some data with other Gain factors and ADC Rates			
22	**FEL Es**	**20120915_Day03_FEL**	**Es calibration (MLML FEL) and Es wavelength cal**
22.01	wavecal	• BSG Wavelength cal (pen lamps and Es data)	html and graphs
22.02	wavecal	• RSG Wavelength cal (pen lamps and Es data)	html and graphs
23	**In-water**	**20120915_Day04**	**In-water data with the fork, with disks (7, 16, 24, and 32 cm)**
24	**In-water**	**20120915_Day04B**	**In-water data with the fork, with disks (7, 16, 24 and 50 cm)**
25	**Dark test**	**20120915_Day04_darktest**	**Dark tests (Gain and ADC Rate)**
25.01	darks	• BSG darks relationship to Gain and ADC rate	html and graphs
25.02	darks	• RSG darks relationship to Gain and ADC rate	html and graphs
26	**In-water**	**20120916_Day05**	**In-water data with the fork, with disks (7, 16, 24, and 50 cm)**
27	**In-water**	**20120916_Day05B**	**In-water data with the fork, with disks (7, 16, 24 and 32 cm)**
28	**Dark test**	**20120916_Day05_darktest**	**Dark test of gain and ADC Rate and light leaks**
28.01	light leak	• BOTH Check for light leaks	html and graphs

29	**LED**	**20120917_Day05_LED**	**LED in each track to check Track changes including the Track 13 change**
30	**In-water**	**20120917_Day06**	**In-water data with the fork, with disks (7, 16, 24, and 32 cm)**
31	**In-water**	**20120917_Day06B**	**In-water data with the fork, with disks (7, 16, 24 and 50 cm)**
32	**LED**	**20120918_Day06_LED**	**LED in each track to check Track changes including the Track 13 change**
32.01	trck check	• CoolWhite LED to check day to day Track stability	html and graphs
33	**In-water**	**20120918_Day07**	**In-water data with the fork, with disks (7, 16, 24, and 50 cm)**
34	**In-water**	**20120918_Day07B**	**In-water data with the fork, with disks (7, 16, 24 and 32 cm)**
35	**In-water**	**20120918_Day07C**	**In-water data with the fork, with disks (7, 16, 24, and 50 cm) - BSG only**
36	**In-water**	**20120918_Day07D**	**In-water data with the fork, with disks (7, 16, 24, and 32 cm) - BSG only**
37	**LED**	**20120918_Day07_LED**	**LED in each track to check Track changes including the Track 13 change**
37.01	trck check	• CoolWhite LED to check day to day Track stability	html and graphs
38	**OL455**	**20120918_Day07_OL455**	**NIST OL455 lamp and wavelength cal**
38.01	dark prblm	• Looking at Dark data for the OL455 data set	html and graphs
38.02	blooming??	• Odd problem on BSG file 19	html and graphs
39	**FEL**	**20120921_FEL**	**MLML FEL lamp Es cal**
39.01	dark prblm	• Looking at Dark data for the FEL data set (checking if there is a problem)	html and graphs
40	**OL455**	**20121109_OL455**	**NIST OL455 lamp**
41	**OL455**	**20121114_OL455**	**NIST OL455 lamp**
42	**OL455**	**20121115_OL455**	**NIST OL455 lamp**

42.01	blooming	• Mike blooming experiment with different gains	html and graphs
43	**OL420**	**20121116_OL420**	**NIST OL420 lamp**
44	**OL420**	**20121120_OL420**	**NIST OL420 lamp - repeat**
45	**Occult**	**20121206_occult**	**FISH data with occulted Es**
45.01	es/model	• Mike's occulted FISH data compared to a model	html and graphs
46	**Linearity**	**20121209_linearity**	**Mike's Linearity test with GS5000-14 Linearity Assembly**
46.01	linearity	• Mike's linearity data set, red and blue spec	html and graphs
46.02	linearity	• Mike's linearity data set, red and blue spec - calculations #2	html and graphs
46.03	linearity	• Mike's linearity data set, %std and SNR for all data	html and graphs
46.04	linearity	• Linearity data processed using a least squares approach	html and graphs
46.05	linearity	• Understanding Linearity gizmo focus	html and graphs
46.06	linearity	• Linearity data processed using a least squares approach - wihout A,IA	html and graphs
47	**WV Bloom**	**20121211_winview_blooming**	**Mike's trying to replicate the blooming problem with WinView**
47.01	blooming	• Replicated the blooming problem with WinView	html and graphs
48	**FOV**	**20121212_FOV**	**Mike's FOV 1 and 2 experiment on**

48.01	FOV	• FOV experiment (2 versions) - BSG and RSG data FO#2	html and graphs
49	**FOV**	**20121214_FOV**	**Mike's FOV 3 and 4 experiment on**
49.01	FOV	• FOV experiment (repeat exp 2 - 12 Dec) - BSG and RSG data FO#7	html and graphs
50	**Linearity**	**20130124_linearity**	**Mike's Linearity test with GS5000-14 Linearity Assembly - part 2**
50.01	linearity	• Looking at the Darks during warm up and data collection	html and graphs
50.02	linearity	• Linearity data processed using a least squares approach (580,800 nm)	html and graphs
50.03	linearity	• Mike's linearity data set, %std and SNR for all data	html and graphs
50.04	linearity	• Mike's linearity email and graphs	html and graphs
50.05	linearity	• Uncertainty in using a least squares approach (inital coding)	html and graphs
50.06	linearity	• Comparison of Al's summing and Carol/Howard least squares approach	html and graphs
50.07	linearity	• Linearity data processed using a least squares approach (500,650 nm)	html and graphs
50.08	linearity	• Mike's linearity email	html and graphs

		and graphs - Feb 15	

Exp#	Experiment	Links	Fiber Images (FOV and light shape)
200.01	comp F1 F2	Compare F1 and F2 strt images	Compare the co-registered images of F1_Strt and F2_Strt
200.02	F1-7	Check F1-F7 strt images	Compare the shape of all the F1-F7 strt images
200.03	F7 strt/bent	Compare F7 straight and bent	Compare the straight and bent fiber images
200.04	F1-7	F1-F7 strt images converted	Convert the F1-F7 strt images to millimeters and degrees
200.05	F1-7	F1-F7 strt images converted/meaned	MEAND Convert the F1-F7 strt images to millimeters and degrees
200.06	F1-7	F1-F7 strt images intial contour	Intial attempt at a counter plot for F1-F7 strt images
200.07	F1-7	F1-F7 strt images intial contour - V2	Counter plots of red, green and blue fields for F1-F7 strt images
200.08	F1-7	F1-F7 strt images circle fit	Fit a circle to contour data F1-F7 strt images
Exp#	**Experiment**	**Links**	**Daily Goes Image (NRL)**
300.01	GOES	GOES images Day 10	NRL GOES images
300.02	GOES	GOES images Day 11	NRL GOES images
300.03	GOES	GOES images Day 12	NRL GOES images
300.04	GOES	GOES images Day 13	NRL GOES images
300.05	GOES	GOES images Day 14	NRL GOES images
300.06	GOES	GOES images Day 15	NRL GOES images
300.07	GOES	GOES images Day 16	NRL GOES images
300.08	GOES	GOES images Day 17	NRL GOES images
300.09	GOES	GOES images Day 18	NRL GOES images

Exp#	Experiment	Links	Description
400.01	Hono Wx	Plots of Honolulu Hourly weather	Honolulu Airport weather data
500.01	CTD	CTD soak and Profile images	CTD
600.01	GoPro	Go Pro images	GoPro camera images (sky, sun disk and in-water)
700.01	Wave movies	Movies of wave/fork conditions	Terry iPhone movies of wave conditions (every 30 minutes)
800.01	GPS data	Track plots from GPS data	GPS data for each day
900.01	ASD data	ASD data	MikeO ASD data
1000.01	Photos	Mike, Carol and Stephanie Photos	All photos taken
		20120903_Oahu13\Stephs	
		20120903_Oahu13\Carols	
		20120903_Oahu13\Mikes	
		20120903_Oahu13\Mike\Day05_in_water	
		220120903_Oahu13\Mike\Day06	
1100.01	VOG	VOG page	All VOG gif movies
1200.01	NDBC	NDBC buoy data	NDBC Station 51204 buoy off Barbers Point
1300.01	Pigments	Pigments from water samples	Mike Ondrusek's Pigment data