Sensing, Scattering and Surrogates: Analysis of Data from the Laser In-Situ Scattering and Transmissometry 100X Sensor on the *Dorado* Autonomous Underwater Vehicle

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Summer 2012

Keywords: LISST-100X, fluorescence surrogate, multiple sensor data analysis

ABSTRACT

Autonomous underwater vehicles with multiple particle sensors demonstrate tremendous capability to describe phytoplankton communities in the marine environment.
Objective: Analyze data from multiple sensors on the AUV to understand and describe communities of plankton in Monterey Bay. Analyzing data from multiple sensors on an underwater vehicle can inform sampling methods to target specific sizes of plankton.
This study shows that a combination of laser in-situ scattering and transmissometry (LISST) 100X size class channels can be combined as surrogates that reconstruct fluorescence data.

INTRODUCTION

Monterey Bay oceanography: productivity is driven by primarily by wind-driven coastal upwelling.
Monterey Bay experiences an upwelling shadow from cold, nutrient-rich waters that are upwelled off of Año Nuevo.

About the Dorado vehicle: upper-water-column, gulper system. Scientists at MBARI have developed an algorithm for tracking a front and triggering the gulpers to sample

around the front for an idea of the biological taxonomy of the species of plankton around that front.

About LISST-100X: Collimated laser diode that sends a laser beam through a sample of water and is scattered onto an annular ring disk with slots that detect 32 angles of diffraction. The sensor model on the Dorado vehicle is rated to 300 m depth, and detects particle sizes from 1.25 to 250 µm. After a data transformation processing step, the channel number is related to the size distribution of the particles. The instrument records supporting measurements of date and time, optical transmission, and water depth and temperature.

LISST-HOLO: combining AUV sensor data to understand and describe the planktonic communities of the bay.

MATERIALS AND METHODS

The data analyzed in this project came from multiple sensors on the Dorado upper-water-column AUV mission as part of the May 2012 Controlled, Agile and Novel Observing Network (CANON) experiment.

The routine for determining the combination of LISST-100X channels used to reconstruct the chlorophyll fluorescence data was developed by Dr Bellingham beginning in May 2012.

RESULTS

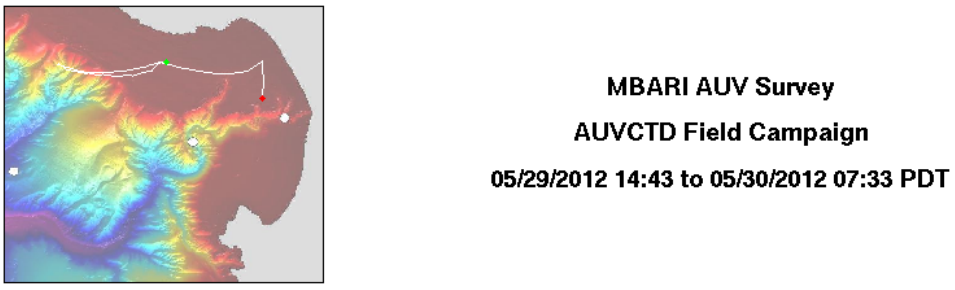

Figure 1a. Path of Dorado AUV from 29-30 May 2012 during CANON deployment. (Ryan, 2012).

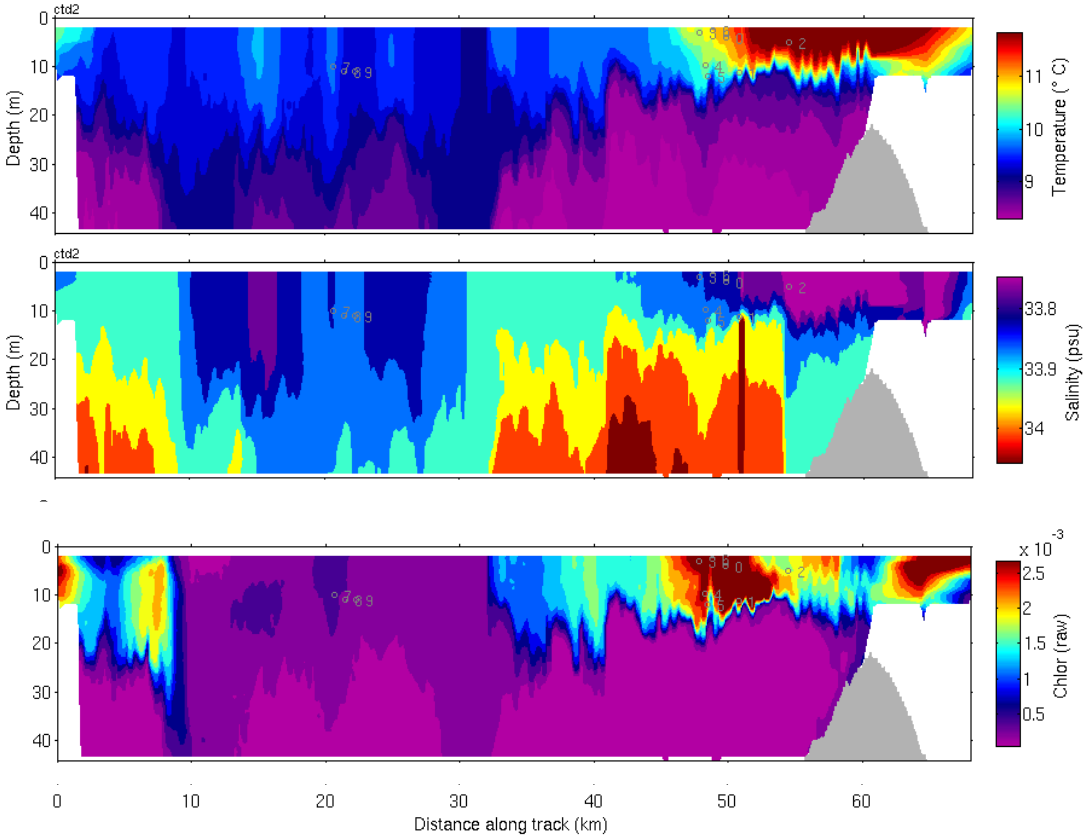

Figure 1b. Temperature, salinity, and chlorophyll with depth and distance along the vehicle track. (Ryan, 2012).

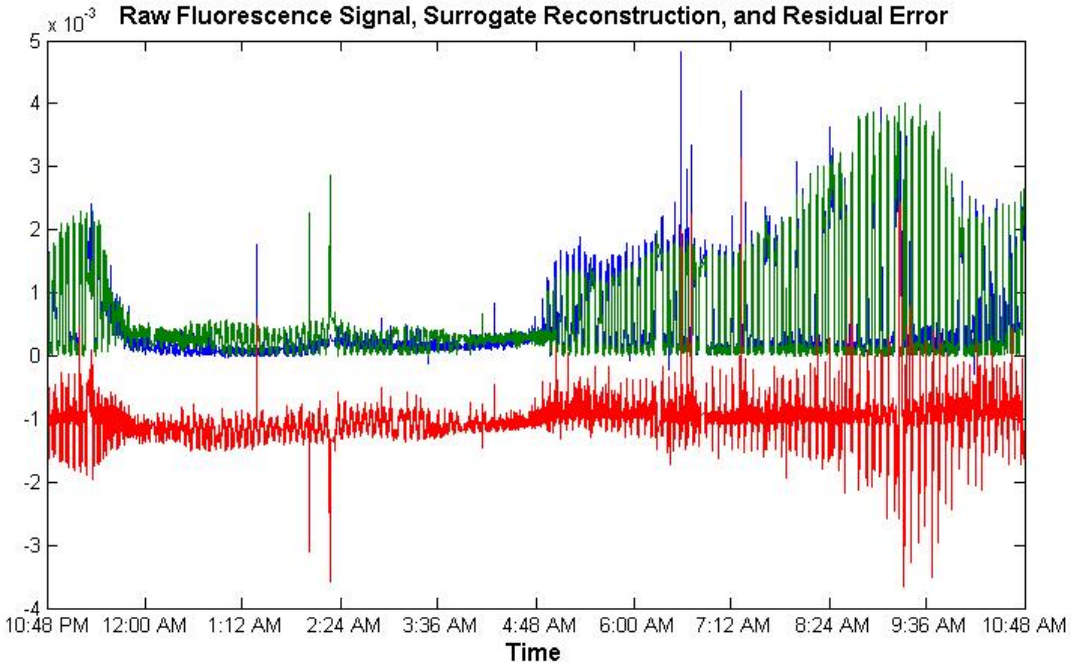

Figure 2a. Fluorescence signal data with LISST-100X surrogate reconstruction and residual error. Raw fluorescence measured at 700 nm.

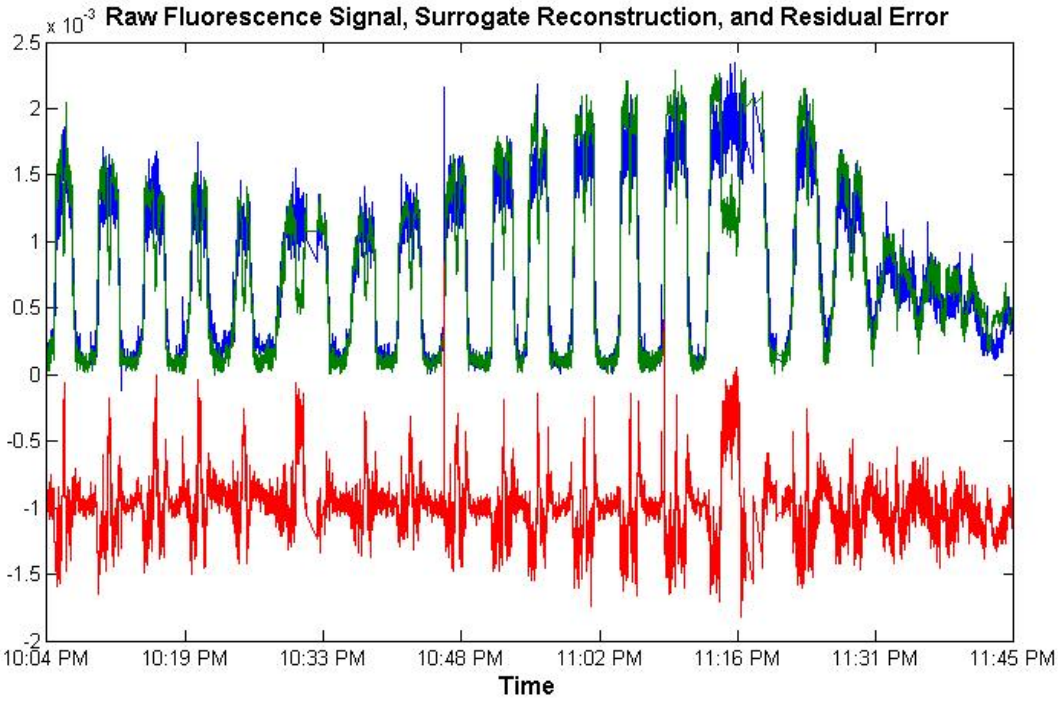

Figure 2b. Fluorescence signal data with LISST-100X surrogate reconstruction and residual error, first subset from 10:04 to 11:45 PM.

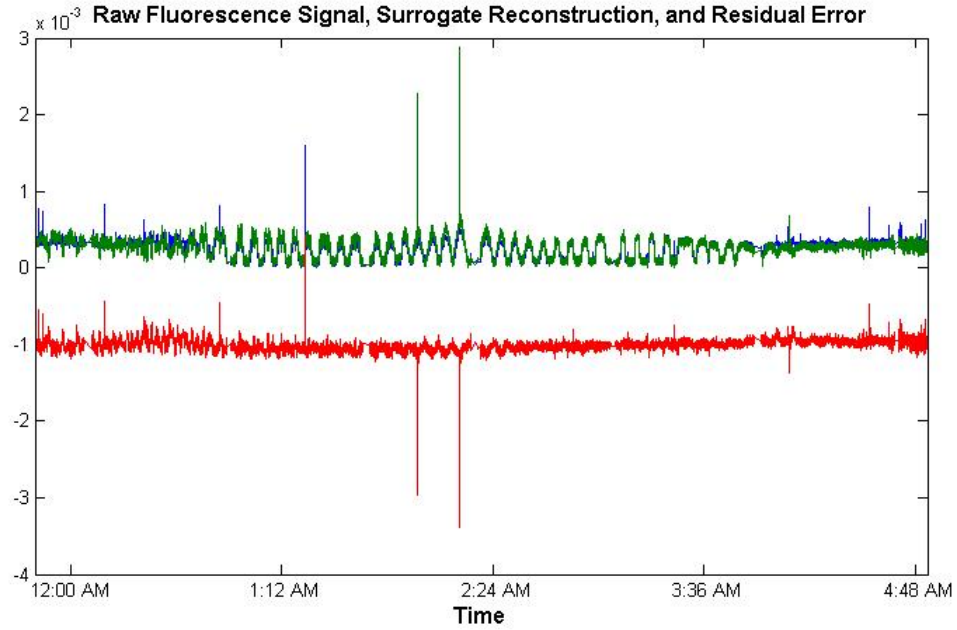

Figure 2c. Fluorescence signal data with LISST-100X surrogate reconstruction and residual error, second subset from 11:45 PM on 29 May 2012 to 5:00 AM.

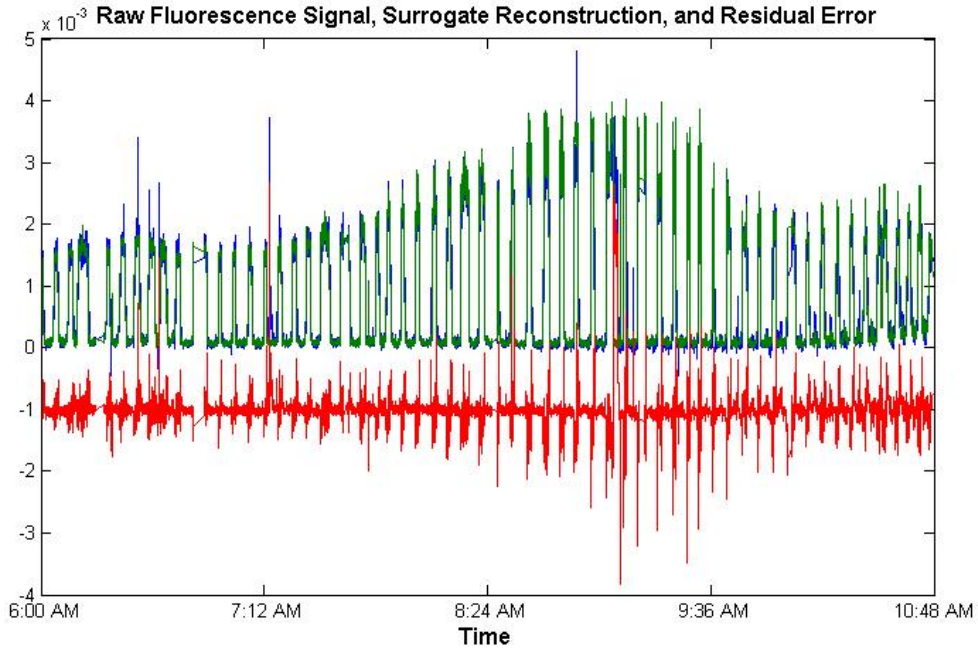

Figure 2d. Fluorescence signal data with LISST-100X surrogate reconstruction and residual error, second subset from 6:00 to 10:48 AM.

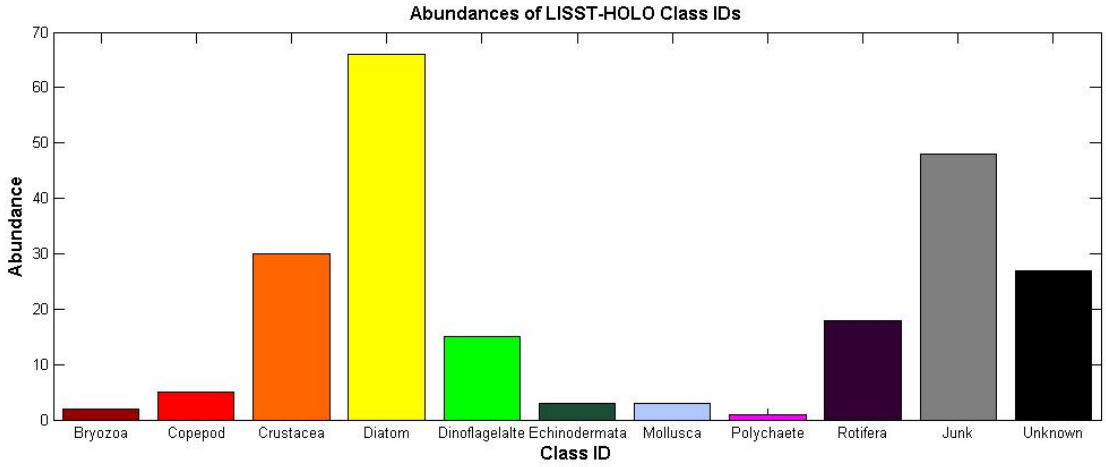

Figure 3. Abundances of LISST-HOLO class identification data from 30 May 2012 sampling.

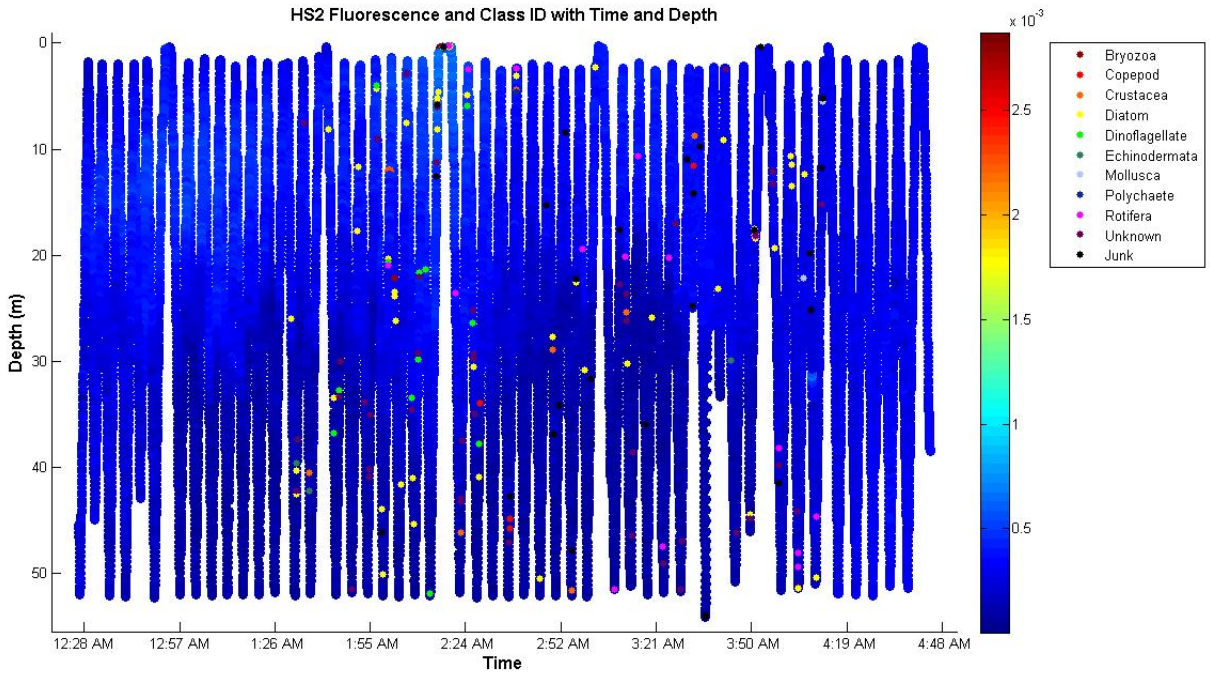

Figure 4. Fluorescence and class identification data with depth and time for 30 May 2012 sampling.

DISCUSSION

CONCLUSIONS/RECOMMENDATIONS

The findings in this project indicate that chlorophyll fluorescence signal can be reconstructed using a combination of LISST-100X channels. The combination of channels varied as the vehicle moved across a front, indicating differing dominant particle sizes for different levels of fluorescence signal. For data analyzed from the 30 May 2012 mission, the smaller size classes were associated with a lower fluorescence signal.

Future research possibilities include incorporating optical backscatter data from the LISST-100X sensor to further enhance understanding of particle identity in water masses.

ACKNOWLEDGEMENTS

There were many people who helped make this internship an incredible experience, and I will do my best to acknowledge them here. First and foremost, I would like to thank my mentor Dr Bellingham for inviting me to work with Dorado AUV data in the LRAUV lab, and for his tireless guidance, interest, and support of my work on this project. I would also like to thank Dorota Kolberg for her efforts in processing the data for analysis, and for sharing her extensive knowledge of MATLAB techniques for data analysis and presentation. Thank you to the Gashler family and to Friends of Moss Landing Marine Laboratories for your generous support of this internship. Thank you George Matsumoto and Linda Kuhnz for coordinating the program and for offering more incredible opportunities and delicious food than I could possibly have hoped for. I would like to thank my advisor at Moss Landing, Erika McPhee-Shaw for her guidance and support throughout the internship. Thank you to the members of the LRAUV lab for sharing your knowledge of LRAUV mechanics and data analysis, and for taking us out to deploy Daphne. Thank you to MLML Small Boats for use of the whalers in LRAUV deployments. Thank you to Dongsik Chang for your help with the intricacies of MATLAB, and for being a superb cubicle-mate. Thank you to the crews of the R/V's Fulmar and Zephyr for the day cruises, and for allowing me to clean solar panels and ride a buoy in the name of science. I would like to thank all the staff of MBARI for their support of the internship program, for being so welcoming, and for sharing their backgrounds and excitement for engineering and marine science research.

References:

Ryan, J. 2012. Oceanographic data from Dorado mission 150. Accessed from MBARI data server on 14 Aug 2012.