Automated ocean color product validation for the Southern California Bight

Curtiss O. Davis[a], Nicholas Tufillaro[a], Burt Jones[b], and Robert Arnone[c]

[a]College of Earth, Ocean and Atmospheric Sciences, Oregon State University, Corvallis, OR 97331, USA
[b]Department of Biological Sciences, University of Southern California, Los Angeles, CA, 90089, USA
[c]Naval Research Laboratory, Stennis Space Center, MS, 39529, USA

ABSTRACT

Automated match ups allow us to maintain and improve the products of current satellite ocean color sensors (MODIS, MERIS), and new sensors (VIIRS). As part of the VIIRS mission preparation, we have created a web based automated match up tool that provides access to searchable fields for date, site, and products, and creates match-ups between satellite (MODIS, MERIS, VIIRS), and in-situ measurements (HyperPRO and SeaPRISM). The back end of the system is a 'mySQL' database, and the front end is a `php' web portal with pull down menus for searchable fields. Based on selections, graphics are generated showing match-ups and statistics, and ascii files are created for downloads for the matchup data. Examples are shown for matching the satellite data with the data from Platform Eureka SeaPRISM off L.A. Harbor in the Southern California Bight.

Keywords: coastal, ocean, VIIRS, remote sensing, ocean color, SeaPRISM

1 INTRODUCTION

Ocean color remote sensing provides a synoptic view of phytoplankton biomass and productivity for large regions of the ocean. Developing a long term record of ocean color radiometry is a shared goal of the ocean color community. To do that requires using all available satellite sensors and cross calibrating that data to provide a consistent data set that can be used to assess short term (monthly and seasonal) and long term (annual to decadal) changes in the ocean. The Validator developed here is designed to provide that cross calibration for an important coastal region, the Southern California Bight (SCB). Several ocean color sensors image the SCB on a regular basis, including NASA's MODIS, the European Space Agency's MERIS and the recently launched JPSS VIIRS. The immediate focus is on the evaluation and validation of water leaving radiance and chlorophyll products from the new sensor VIIRS which is currently in its on-orbit validation phase.

The Southern California Bight is bordered by the recessed coastline from Point Conception to Ensenada Mexico on the North American West Coast. The region is characterized by a subarctic offshore current flowing south, and a subtropical nearshore current flowing north. The waters provide a rich biological transition zone. At its center lays the Los Angles Harbor. A snap shot of the region is shown in Figure 1. The region also includes Catalina and the Channel Islands. Chlorophyl levels vary seasonally, with levels reaching 5 mg/m^3 or higher during during spring blooms. There are several long terms regional data records available, such as those from the California Cooperative Fisheries Investigations (CalCOFI) which show typical mean chlorophyl-a ranges from 0.1 mg/m^3 to 2 mg/m^3 which varies both seasonally and spatially [1].

Working closely with the Ocean Remote Sensing Group at the Naval Research Laboratory at Stennis Space Center (NRL-SSC), and the Cooperative Remote Sensing Science and Technology Center (CREST) at the College University of New York (CNNY), we have developed a ocean color product validator for the US West Coast. In this report we focus on results using the validator for March of 2012 in the region of interest of the Southern California Bight. The validator has three main goals. First, to help with the initial calibration of the recently launched VIIRS ocean color imager,

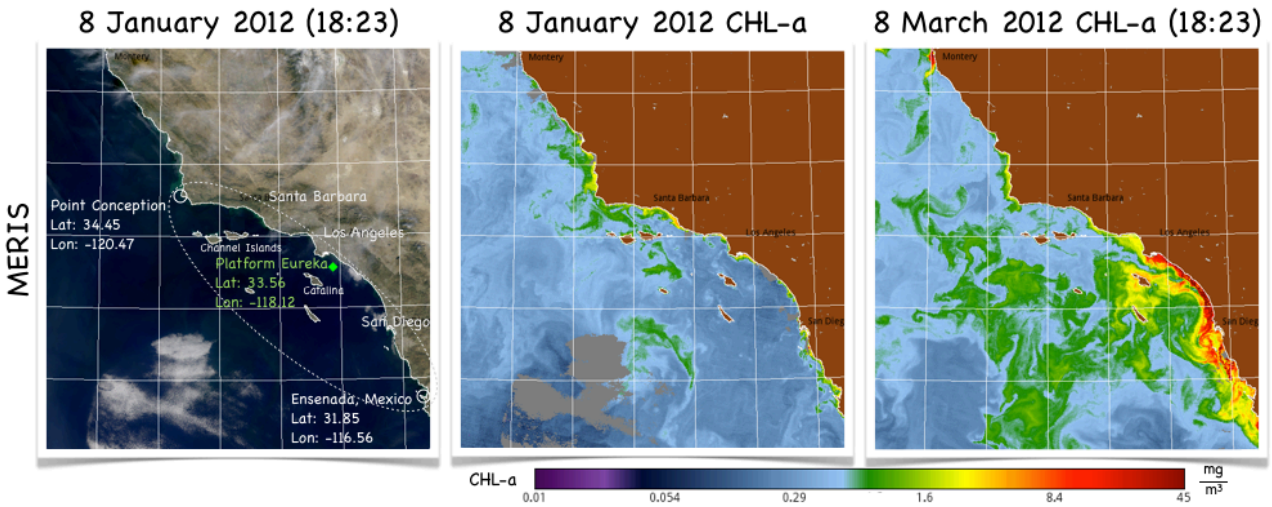

Fig. 1. MERIS images for the Southern California Bight. The NASA Aeronet Ocean Color site, 'Platform Eureka,' is shown in the center of the RGB image on the left. The winter season (middle image) shows relatively low chlorophyl levels compared to a spring bloom (right chlorophyl map).

second to assist with on-going calibration efforts with VIIRS, MODIS, and MERIS. And third, as a tool for researchers to quickly access and evaluate data from these sensors both for scientific studies and operational uses for government agencies such as NOAA or state environmental quality programs.

2. MEHODS

Data from the remote sensors VIIRS, MODIS, and MERIS for pre-specified 'golden regions' along the west coast are collected and added to a `mySQL' data base (Fig. 2).

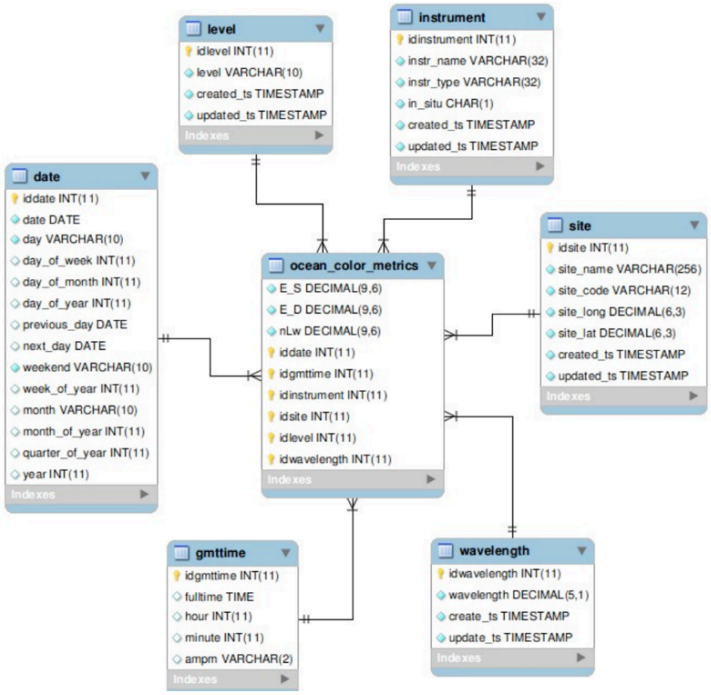

Fig. 2. Database schema used for the OSU Ocean Color Validator.

These regions are chosen because they are well monitored with cruise sampling, instruments on fixed moorings, and other ocean platforms. In particular, the SBC is studied here, in part, because it has a NASA calibrated spectrometer monitoring the wasters as part of NASA Aeronet monitoring program. The spectrometer is a SeaPRISM and allows us to `match-up' spectral data directly above the water with data collected from orbit from the remote sensors. The SeaPRISM is mounted on `Platform Eureka' shown in Fig. 3.

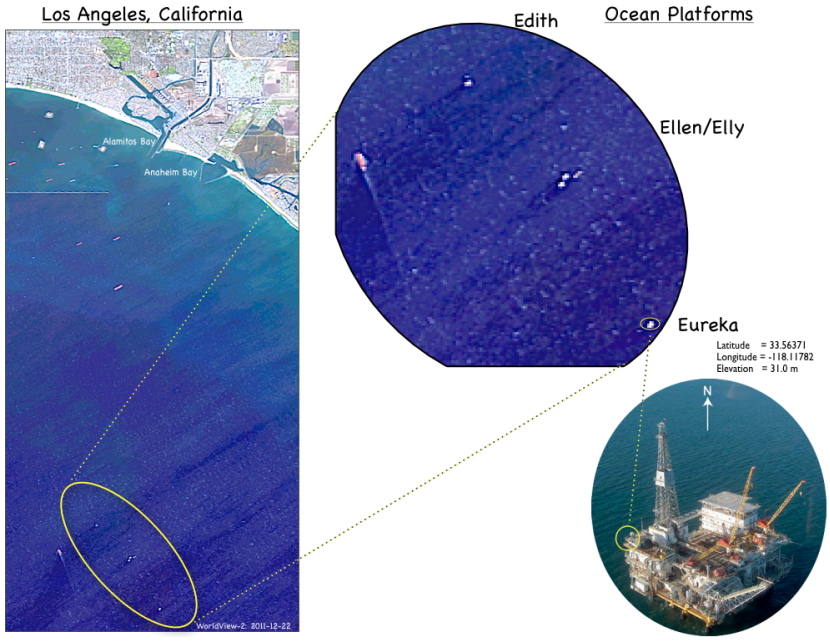

Fig. 3. The NASA Aeronet site on Platform Eureka administered by the University of Southern California.

Data from both Platform Eureka, and the remote sensing platforms, and any available cruise data which is usually collected on ship with a HyperPRO spectrometer, is added to the data base and is accessible for a web interface that queries for information about the desired data comparisons, and then produces information data sets and graphics which aid the the calibration of the sensors (Fig 4.).

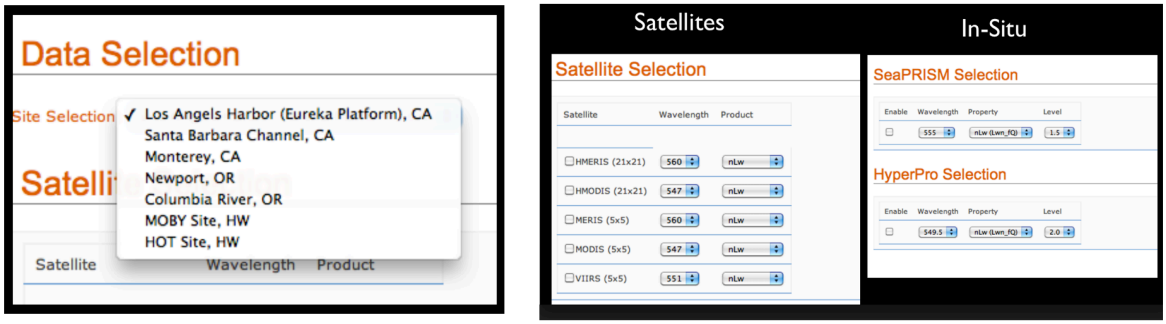

Fig. 4. The web interface for the OSU Ocean Color Validator.

3. RESULTS

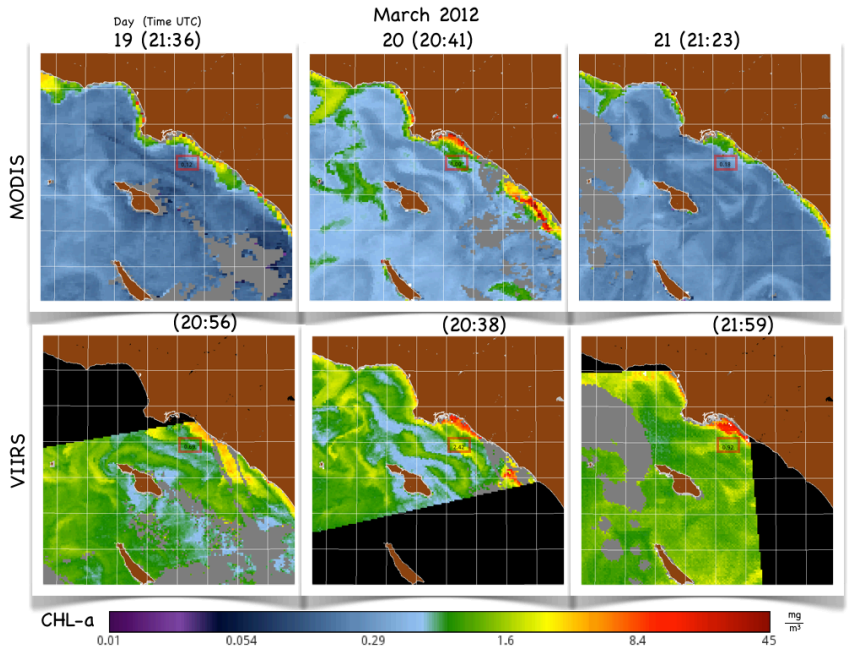

Fig. 5. Chlorophyl maps around `Platform Eureka' off the coast of Los Angeles, CA. Processing is done with NRL's APS system, and the image shows that the chlorophyl map for VIIRS is consistently higher than MODIS AQUA. VIIRS is currently in the early calibration phase and these are not official products.

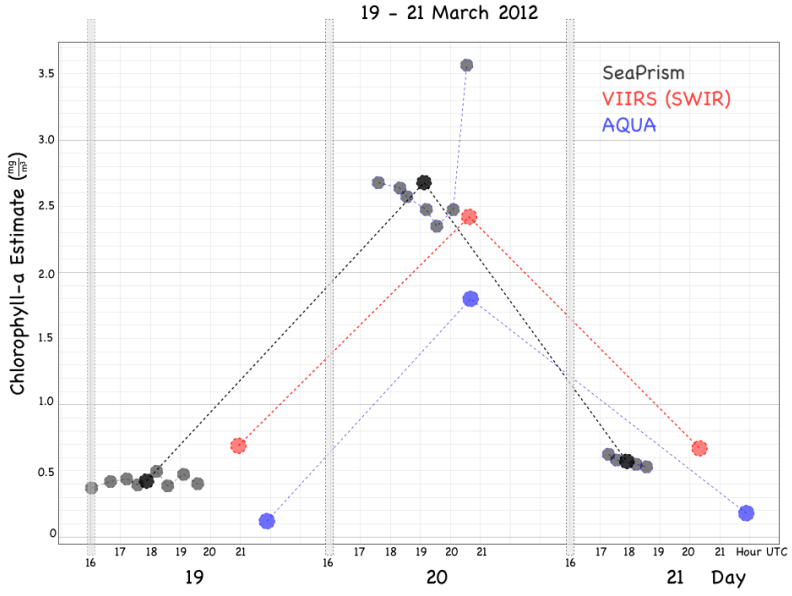

Fig. 6. Comparison between Chlorophyll derived from measurements taken by the SeaPRISM at Platform Eureka and estimates from remote sensing by MODIS AQUA and VIIRS.

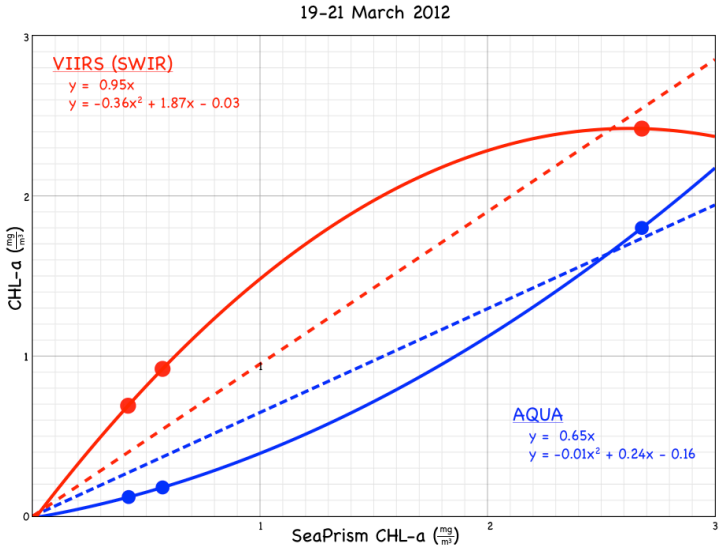

Fig. 7. Regression between SeaPRISM in-situ data and both VIIRS and AQUA. The atmospheric correction for VIIRS uses a SWIR based method and chlorophyl is estimated with OC-3 [3].

Results of data match-ups for March 2012 for the SBC are shown in Figures 5 - 10. The primary interest in March is the initial calibration and validation phase of VIIRS, both for the radiance data and the product generation. In Figures 5-7 we show both a qualitative and quantitative comparison of the both VIIRS and MODIS with the SeaPRISM, an above water radiometer [2]. The data shows the initial difference between the CHL-a product of VIIRS and MODIS. Further, a regression on both the in-situ data, and across VIIRS and MODIS, shows that the systematic difference between the two CHL products is about a factor of 2 (Fig 10). Data like this, in the early calibration and validation phase of a new sensor, is valuable for finding errors in product generation codes, and also tracking the short term changes in response of the sensors, especially in the period immediately after launch. The rapid assessment provided by ocean color validators greatly aids in improving the quality and accuracy of ocean color products reported by remote sensing platforms.

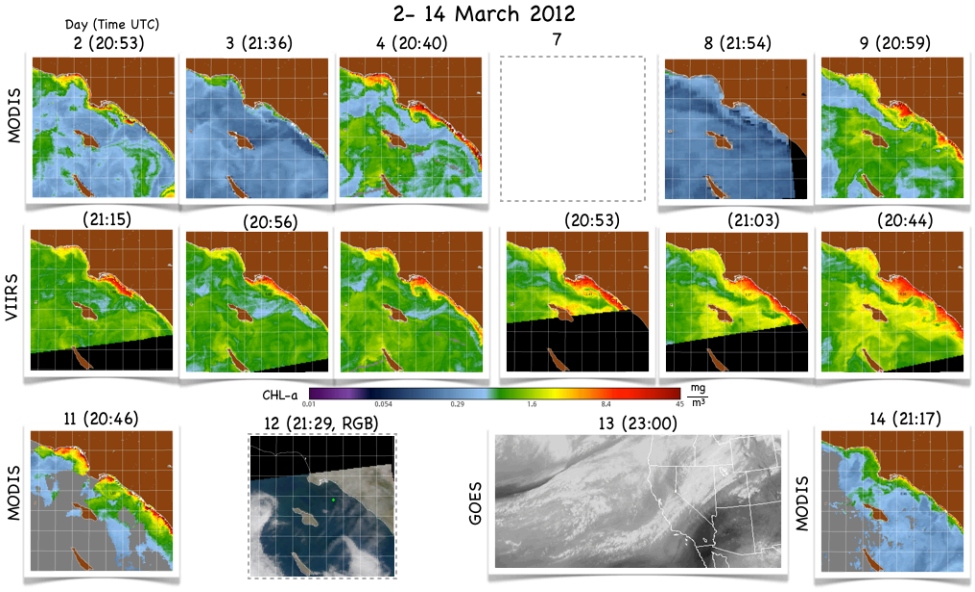

Fig. 8. Chlorophyll maps for both MODIS AQUA and VIIRS in early March. The chlorophyl concentration begins to rise near the coast as the month progress, but around the 13th of March a strong storm on the coast results in lower chlorophyl levels.

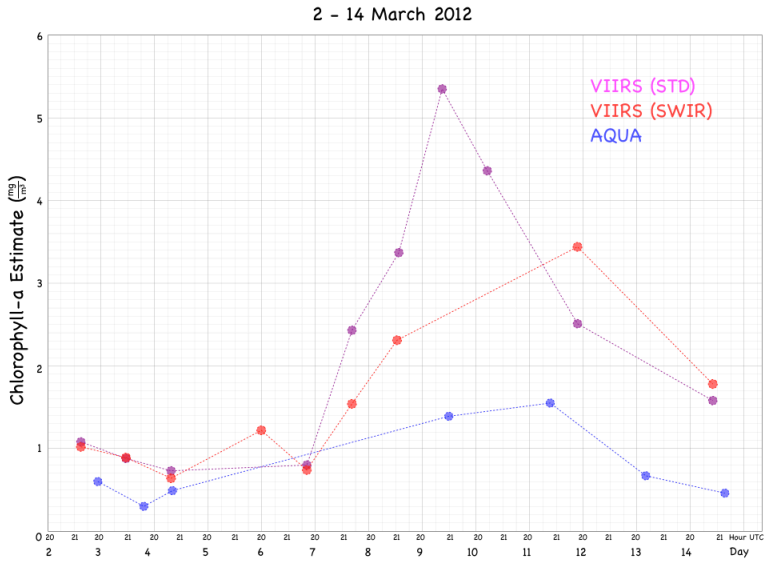

Fig. 9. A comparison of chlorophyl estimates for both VIIRS and MODIS AQUA during early March. All products where computed using NRL's Advanced Processing System (APS) [4].

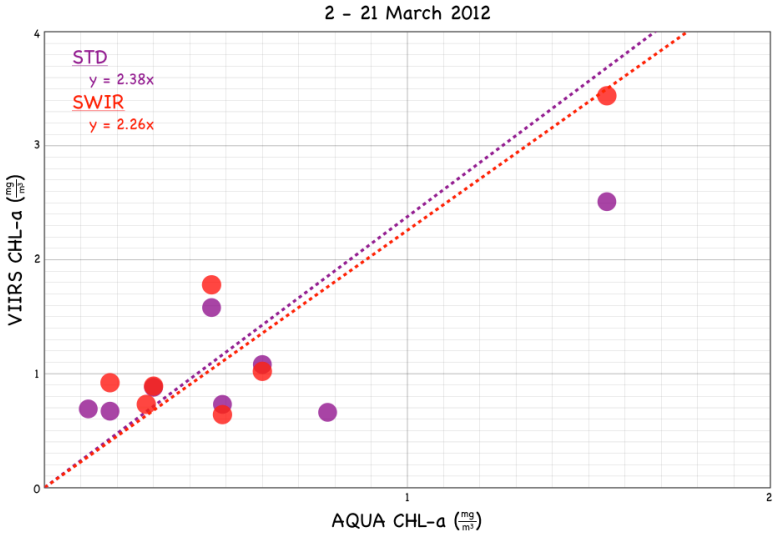

Fig. 10. Regression in early March between chlorophyl estimates from VIIRS and MODIS AQUA. VIIRS appears to provide an estimate about twice that of AQUA. This is during the initial calibration and validation phase for VIIRS when the sensor is still equilibrating to its on-orbit environment.

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