NATIONAL CONSORTIUM FOR REMOTE SENSING EDUCATION, RESEARCH, AND APPLICATIONS

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Improving Global Models of Remotely Sensed Aquatic Chlorophyll Content Using Partial Least Squares and Geographically Weighted Regression

Hamed Gholizadeh, Indiana University, Bloomington (E-Mail: hgholiza@indiana.edu)

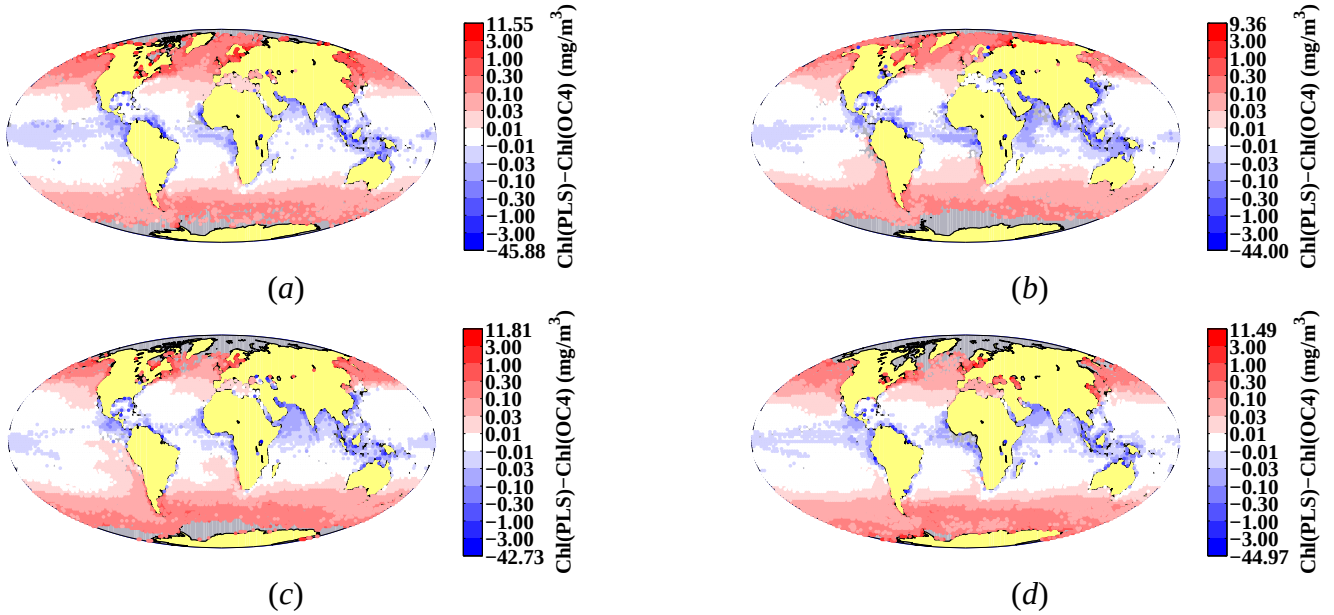

Figure 1. Global maps of the difference between the estimated chlorophyll contents from PLS and OC4: (*a*) spring 2007, (*b*) summer 2007, (*c*) autumn 2007, and (*d*) winter 2007.

Overview:

- Oceans are important pools of carbon.
- CO_2 is consumed by phytoplankton through photosynthesis process.
- One way to measure phytoplankton biomass is to estimate chlorophyll content.

Background: Empirical models have been widely used to estimate global chlorophyll content from remotely sensed data. Here, we focus on the standard NASA empirical models that use blue-green band ratios. These band ratio ocean color (OC) algorithms are in the form of fourth-order polynomials and the parameters of these polynomials (i.e. coefficients) are estimated from the NASA bio-Optical Marine Algorithm Data set (NOMAD). Most of the points in this data set have been sampled from tropical and temperate regions. However, polynomial coefficients obtained from this data set are used to estimate chlorophyll content in all ocean regions with different properties. Further, the polynomial terms in these models are highly correlated.

In sum, the limitations of these empirical models are as follows:

- The independent variables within the empirical models, in their current form, are correlated (multicollinear).
- Current algorithms are global approaches and are based on the spatial stationarity assumption, so they are independent of location.

Preliminary results: Multicollinearity problem is resolved by using partial least squares (PLS). Geographically weighted regression (GWR) is also used to investigate the validity of spatial stationarity assumption. Results show that the empirical method used in this study (i.e. OC4) underestimates chlorophyll content in high latitudes, including the Southern Ocean region, when compared to PLS (see Figure 1). It can be concluded that NASA's empirical models have not been parametrized appropriately. We should be cautious about using the same form of the polynomial for studying ocean regions with different water characteristics.

The funds provided by the IndianaView Consortium scholarship were used to support this project during summer 2015. The results of this research will be submitted to the *Remote Sensing of Environment* or *International Journal of Remote Sensing*.