Prediction of phytoplankton pigments in the Eastern tropical atlantic from multispectral and hyperspectral continuous remote sensing reflectance measurements

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The composition and abundance of algal pigments provide information on phytoplankton community characteristics such as photoacclimation, overall biomass, and taxonomic composition. In particular, pigments play a major role in photoprotection and in the light-driven part of photosynthesis. Most phytoplankton pigments can be measured by High Performance Liquid Chromatography (HPLC) techniques applied to filtered water samples. This method, as well as other laboratory analyses, is time consuming and therefore limits the number of samples that can be processed in a given time. In order to receive information on phytoplankton pigment composition with a higher temporal and spatial resolution, we have developed a method to assess pigment concentrations from continuous optical measurements. The method applies an Empirical Orthogonal Function (EOF) analysis to remote sensing reflectance data derived from ship-based hyper-spectral underwater radiometry and from multispectral satellite data (using the MERIS Polymer product developed by Steinmetz et al. 2011) measured in the Atlantic Ocean. Subsequently we developed multiple linear regression models with measured (collocated) pigment concentrations as the response variable and EOF loadings as predictor variables. The model results show that surface concentrations of a suite of pigments and pigment groups can be well predicted from the ship-based reflectance measurements, even when only a multi-spectral resolution is chosen (i.e. eight bands similar to those used by MERIS). The fitted model based on satellite reflectance data as input was applied to one month of MERIS Polymer data to predict the concentration of those pigment groups for the whole Eastern Tropical Atlantic area. The method allows for the derivation of time series from continuous reflectance data of various pigment groups at various regions, which can be used to study variability and change of phytoplankton composition and photo-physiology.