Characterization of phytoplankton communities by optical properties in the Atlantic Ocean

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The relationship between phytoplankton assemblages and the associated optical properties of the water body is important for the further development of algorithms for large-scale remote sensing of phytoplankton biomass and community composition. Optical in-situ measurements aid in the identification of phytoplankton groups with differing pigment compositions and are widely used to validate remote sensing data.

In this paper we present results from an interdisciplinary cruise aboard the RV Polarstern along a north-to-south transect in the eastern Atlantic Ocean in November 2008. Phytoplankton community composition was identified using a broad set of in-situ measurements. Water samples from the surface and the depth of maximum chlorophyll concentration were analyzed by high performance liquid chromatography (HPLC), fluorometry, flow cytometry, spectrophotometry and microscopy. Simultaneously, the above- and underwater light field was measured by various hyperspectral radiometers.

An unsupervised similarity-based cluster algorithm performed with the measured parameters provides insight about possible biooptical provinces, which are compared to ecological provinces proposed by Longhurst (2007). Longhurst's partition of the ocean into ecological biomes and provinces has been widely cited and used to describe or organize pelagic ecosystems. Longhurst points out that the position of the province borders is not static, but varies with seasons and years. Large scale variability of climate such as El Niño/Southern Oscillation or longer cycles may influence the occurrence and boundaries of provinces.

Here we organize existing in-situ measurements into the framework of Longhurst's provinces. A sampling scheme encompassing discrete surface water samples as well as CTD casts and continuous online measurements allows a good description of the water bodies crossed by the cruise track and enables us to detect some hydrographical features such as a tidal front near the western edge of the European continental shelf. The cluster analysis on the basis of pigment and other biooptical measurements was a key method to obtain information on the similarity of samples in terms of pigment composition, absorption or above and underwater light fields.

Reference:
Longhurst AR (2007) Ecological geography of the sea. Academic Press, San Diego, 542 pp.