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Variability in global ocean phytoplankton distribution over 1979-2007

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Recently, reanalysis of long-term ocean color data (CZCS and SeaWiFS; Antoine et al., 2005) has shown that world ocean average phytoplankton chlorophyll levels show an increase of 20% over the last two decades. It is however unknown whether this increase is associated with a change in the distribution of phytoplankton groups or if it simply corresponds to an increase of the productivity. Within the framework of the GLOBPHY project, the distribution of the phytoplankton groups was monitored by applying the PHYSAT method (Alvain et al., 2005) to the historical ocean color data series from CZCS, OCTS and SeaWiFS sensors. The PHYSAT algorithm allows identification of several phytoplankton, like nanoeucaryotes, prochlorococcus, synechococcus and diatoms.
Because both sensors (OCTS-SeaWiFS) are very similar, OCTS data were processed with the standard PHYSAT algorithm to cover the 1996-1997 period during which a large El Niño event occurred, just before the SeaWiFS era. Our analysis of this dataset (1996-2006) evidences a strong variability in the distribution of phytoplankton groups at both regional and global scales. In the equatorial region (0°-5°S), a three-fold increase of nanoeucaryotes frequency was detected in opposition to a two-fold decrease of synechococcus during the early stages of El Niño conditions (May-June 1997, OCTS). The impact of this El Niño is however not confined to the Equatorial Pacific and has affected the global ocean.
The processing of CZCS data with PHYSAT has required several adaptations of this algorithm due to the lower performances and the reduced number of spectral bands of the sensor. Despites higher uncertainties, the phytoplankton groups distribution obtained with CZCS is globally consistent with that of SeaWiFS. A comparison of variability in global phytoplankton distribution between 1979-1982 (CZCS) and 1999-2002 (SeaWiFS) suggests an increase in nanoeucaryotes at high latitudes (>40°) and in the equatorial region (10°S-10°N) for prochlorococcus and synechococcus during 1999-2002.
Our results show variability in global ocean phytoplankton distribution over a 20-year timescale. Strong variability observed over the inter-annual and inter-decadal scales are shown and tentatively explained using environmental variables.