Geophysical Research Abstracts
Vol. 13, EGU2011-885-1, 2011
EGU General Assembly 2011


# Inversion of sea surface data to retrieve the vertical distribution of phytoplankton using a statistical methodology

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The bio-geochemical activity of the oceans and the carbon cycle are two parts of a complex retro-feedback system. A change in climate and an increase of the quantity of available carbon affect the primary oceanic production, and in return a change in of bio-geochemical activity, affects, by modifying albedo and carbon fixation rates, the climate and carbon concentration. It is therefore important to be able to determine the oceanic primary production.

In recent years, many algorithms have been developed that infer the top of the ocean Chlorophyll-A concentration through satellite imaging (Brajard et al. 2008,Lathuiliere et al. 2007). It has also been proved that the vertical phytoplankton distribution, is correlated with surface data ( Uitz et al. 2006, Demarcq et al. 2008).

Standard modelling of the oceanic production has been proven to diverge from in situ measurements, (Kane et al. 2010). This is great part due to, either a lack of knowledge of all the links between the parameters influencing the complex nature of the oceanic primary production system, or the complexity of including them in a model.

The present research uses a statistical inversion approach towards determination of vertical phtyoplankton distributions through satellite imaging. The statistical instruments used are Self Organising Maps and Hidden Markov Models which create and permit the use of, the empirical links between the surface data and the vertical distribution of phytoplankton. This approach then, allows us to reconstruct a time-series of the vertical distribution of Chlorophyll-A based upon a time-series of sea-surface elevation, solar radiation flux, wind speed intensity, top of the ocean chlorophyll-a concentration, and sea-surface temperature.