Geophysical Research Abstracts
Vol. 13, EGU2011-11148, 2011
EGU General Assembly 2011

Phytoplankton distribution and variability sources Sicily Channel (Mediterranean Sea) from remote sensing data

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Phytoplankton production is limited by the availability of light and nutrients. In The Mediterranean Sea the nutrient availability has often be considered the main factor controlling phytoplankton production. Nutrient availability is linked to mixing below the upper mixed layer, to advection of nutrient-richer water masses, to atmospheric deposition or river runoff. In upwelling systems, in which colder and nutrient-richer waters reach the surface from below, SST can represent a good proxy of the nutrient enrichment process in surface waters. The analysis of the SL can provide a first order insight into the circulation patterns that may affect the phytoplankton dynamics shedding light on the role of water mass advection in the regulation of phytoplankton space-time variability. The aim of this work is thus to infer on the importance of these two physical forcings in controlling the biological variability over different temporal scales, from seasonal to interannual, by investigating the surface phytoplankton (CHL) space-time variability in relation with the variability of sea surface temperature (SST) and sea level (SL). SL has then been used to estimate the kinetic energy (KE) which better fits for our purpose. The Sicily Channel divides the Mediterranean Sea into two sub-basins: the eastern and the western. These are characterized by completely different trophic regimes; thus the Channel represents a crucial area for both understanding the basin scale variability, and for sustaining the economics of the countries bordering the Channel. Given their high resolution spatial and temporal coverage satellite observations represent the best data choice for exploring these issues. In this work satellite data are used to infer on both biological (ocean colour data) and physical (SST and KE) processes. One way of isolating single physical or biological processes hidden into data time series, and thus of determining their dominant modes of variability is to apply the principal component analysis (PCA or, equivalently, empirical orthogonal function, EOF) to such data time series. The dataset used in this study cover the time period spanning from January 1998 to December 2006. The 1/16° spatial resolution weekly averages were used as input of the Data INterpolating Empirical Orthogonal Functions (DINEOF) technique for data interpolation. DINEOF technique uses iterative EOF decompositions to estimate and thus filling in missing data. Interpolation with DINEOF was necessary because the EOF analysis requires a complete time series of input data, while CHL images present several data voids due to the presence of clouds or low data coverage. Moreover, in order to identify the longer time scale signals, the EOF analysis was also performed after high frequency signals were filtered out from the time series. The time filtering has been done removing first the weekly-climatology and then applying a low-pass filter of 12 months (running mean). Preliminary results evidenced that the advection of the Atlantic waters into the Channel plays a significant role in determining the CHL variability. Indeed, the high temporal correlation between the first modes of CHL and KE (r=0.75 with a time lag of roughly two months) and between the first mode of filtered CHL data and the third mode of filtered KE data (r=0.82 with a time lag of two and a half months) suggest that the advection of modified Atlantic waters from the northern coasts of Africa has a significant impact on the phytoplankton concentration inside the Channel, influencing the CHL variability both at annual and interannual time scales. On the other hand, our results show that the CHL variability is poorly influenced by the SST field over both temporal scales.