Geophysical Research Abstracts
Vol. 13, EGU2011-370, 2011
EGU General Assembly 2011

Black Sea biogeochemistry: the numerical model response to decadal atmospheric variability during 1960-2000

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Abstract
Long-term variability of the physical and bio-chemical structure of oxic and suboxic layers in the Black Sea is studied here based on analysis of numerical simulations with one-dimensional coupled hydrophysical and biogeochemical model. The focus is on the correlation between local responses and atmospheric forcing (2m air temperature, surface level pressure, surface wind), which in the studied area reflects large-scale atmospheric variability dominated by the North Atlantic Oscillation. The quality of model performance is demonstrated by the comparison of vertical and temporal distribution of biogeochemical variables simulated in the model against observed patterns. It is proved that during 1960-2000, the long-term variability of simulated winter-mean SST in the Black Sea is reasonably well correlated with the variability of 2m air temperature. Furthermore, it is demonstrated that the thermal state of the upper ocean impacts largely the variability of concentration of biochemical variables, such as oxygen, nitrate and phytoplankton. The tele-connection between North Atlantic Oscillation and Black Sea biogeochemistry manifests in a different way for three specific time-intervals during 1960-2000. The corresponding regime shifts are thus associated in a vital way with the large scale forcing. Sensitivity runs with modified forcing, which are carried out in order to identify the strength of different response types prove that oxygen content in the upper ocean is to a larger extent event driven. One such extreme event occurred in 1976 leading to a pronounced transition in oxygen and hydrogen sulfide state.

Key words: Black Sea; Biogeochemical model; Atmospheric forcing; Decadal variability; Oxygen