Variability of satellite-estimated Chlorophyll in Sofala Bank, Mozambique, and its relation to local and remote forcing parameters: El Niño/La Niña Effects

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Abstract

Sofala Bank is the most important fishing region in the continental shelf of Mozambique. The productivity of the Bank is mainly influenced by the entry of terrestrial nutrients from Zambezi River (one of the largest rivers in Africa) and the extensive mangroves that provide shelter for marine organisms. Apart from the river discharge, several other factors can control the productivity of coastal zones and continental shelves. These other factors include local currents, winds and global weather events such as El Niño Southern Oscillation (ENSO). The concentration of chlorophyll is widely used to access trophic conditions and productivity of estuaries, coastal waters and open sea. The concentration is generally proportional to phytoplankton biomass and can easily be measured by remote sensors onboard orbiting satellites. This study investigates the seasonal variability of the chlorophyll concentration measured by the MODIS sensor onboard of the Aqua satellite in the Sofala Bank, and its relationship with precipitation, Zambezi River discharge, wind speed and ENSO phenomenon during the period 2003-2013. Climatology of monthly averages of chlorophyll concentration and spatial correlation coefficients between each of the forcing parameters (precipitation, river discharge, wind intensity and Niño-3.4 index) and chlorophyll were determined. The results of the monthly climatological averages of chlorophyll concentrations indicates that the chlorophyll had two regimes. The high regime, with concentrations varying between 3.5 and 4 mg m^{-3} in the plume cores, occurs between January and April, a period characterized with high Zambezi River discharge. The low regime, with concentrations below 3 mg m^{-3} in the coastal plume nuclei, extended from May to December, the period of lower discharges in the Zambezi River. The spatial correlations of precipitation in the Zambezi River flow and chlorophyll concentrations shows that as precipitation influences chlorophyll concentrations along the entire Sofala Bank coast, the flow of the Zambezi River mainly influence in the central region. The spatial correlation between wind velocity and chlorophyll concentrations suggests that, although it is not the main forcing component, the south and southeast winds that dominate the wind field in the Sofala Bank may play an important role in the distribution of chlorophyll, pushing the offshore water poor in chlorophyll to the shore region. The Niño-3.4 index had negative and statistically

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significant correlations with chlorophyll concentrations in the central region of the Sofala Bank, influenced by the Zambezi River, suggesting that the ENSO signal in the Sofala Bank is brought by the Zambezi River flow. As a consequence of ENSO, chlorophyll concentrations in regions under the influence of the Zambezi River may decrease by more than 0.4 mg m^{-3} during El Niño and increase by a 0.4 mg m-3 during La Niña. The results of this study may help explain the spatial variations and inter-annual fluctuations of fish in the Sofala Bank.

Keywords: Sofala Bank, remote sensing, chlorophyll, discharge of the Zambezi River, wind speed, ENSO

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