

MOM4-TOPAZ Biogeochemical Modeling Update

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Given that the upper ocean circulation largely determines primary production in the euphotic layers, the upper ocean circulation anomalies associated with the natural climate variability may affect biogeochemical processes in the North Atlantic Ocean. Here the global ocean model with biogeochemistry (GFDL's MOM4.1 with TOPAZ biogeochemistry; Griffies et al. 2004; Gnanadesikan et al. 2006; Dunne et al. 2013) forced with the Coordinated Ocean-ice Reference Experiments surface forcing version 2 (CORE2, Griffies et al. 2009; Large and Yeager 2008) is used to simulate natural variability of biogeochemical processes in global ocean during 1948-2009. Preliminary results that the surface chlorophyll is overall underestimated in MOM4-TOPAZ, but its spatial pattern is reasonably realistic. There is high chlorophyll variability in the subpolar North Atlantic, northeastern tropical Atlantic, and equatorial Atlantic (see Figure). Further analysis shows that the chlorophyll variability is affected by long-term climate variability. For the subpolar North Atlantic region, the chlorophyll variability is light-limited and is significantly correlated with North Atlantic Oscillation (NAO, $r \sim -0.3$). A dipole variability of chlorophyll is found between northeastern tropical Atlantic and equatorial Atlantic. For the northeast North Atlantic, the chlorophyll variability is significantly correlated with Atlantic Meridional Mode (AMM, $r \sim -0.5$), and Atlantic Multi-decadal Oscillation (AMO, $r \sim -0.3$). During the negative phase of AMM and AMO, the increased trade wind in the northeast North Atlantic can lead to increased upwelling of nutrients. In the equatorial Atlantic region, the chlorophyll variability is largely link to the Atlantic-Niño and the associated equatorial upwelling of nutrients.

MOM4p1_TOPAZ: STD of Chl (mg/m^3)

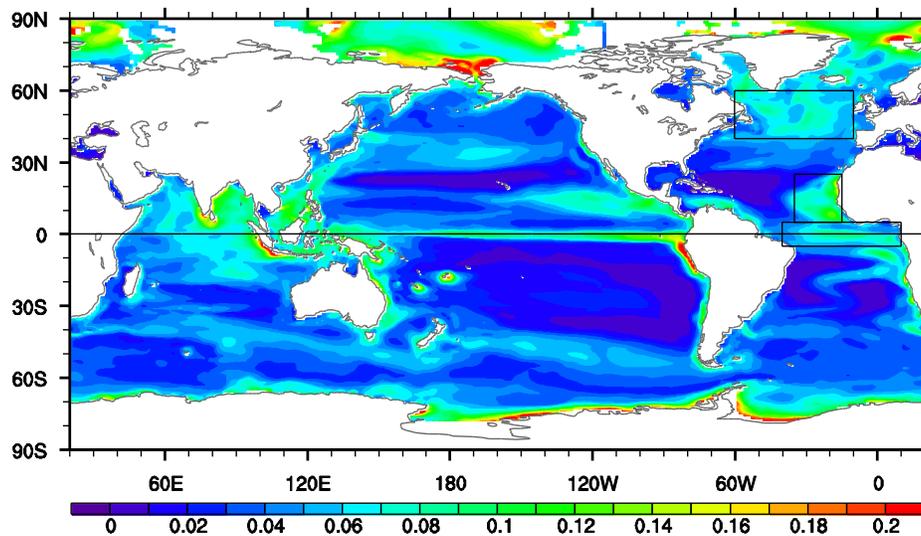


Figure 1. Standard deviation (STD) of chlorophyll variability during 1948-2009 obtained from MOM4-TOPAZ. The black boxes indicate the high chlorophyll variability region. The unit for the temperature is mg/m^3 .