Seasonal variability of upper-ocean primary production around the Kuroshio analyzed using a ROMS-NPZD model

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Biological processes have significant influences on the global carbon cycle on all time scales. In the coastal regions, nutrient supply to the surface by river discharge and coastal upwelling leads to active primary production. The Kuroshio, one of the strongest western boundary currents, flows off the Japan, accompanied by intense eddy activities influencing on biogeochemical processes around its path. In general, localized upwelling due to mesoscale cyclonic eddies brings nutrient-rich subsurface water to the nutrient-depleted upper ocean to enhance near-surface primary productivity. In the present study, a climatological ocean modeling is developed for the marginal seas along the Kuroshio off Japan based on ROMS (Shchepetkin and McWilliams, 2005; 2008) coupled with an NPZD biogeochemical model (Fasham *et al.*, 1990; Gruber *et al.*, 2006). The model domain encompasses both the Kuroshio and its Extension regions in a submesoscale eddy-permitting configuration with a horizontal grid spacing of 3 km. The simulation is conducted for 10 years and the results for the 10th year are used for our analysis. A nitrogen budget analysis indicates that nitrogen exists mostly in the phyto- and zooplankton compartments in both the Kuroshio and Kuroshio Extension regions during the spring bloom. The increased zooplankton further enriches detritus that settles down by about 100 m, leading to an increase of ammonium below the mixed layer. In winter, eddy-induced nitrate transport is enhanced in the region about 1˚ away from the Kuroshio axis. The baroclinic instability due to the surface cooling in winter generates meso- and submesoscale eddies and substantially promotes eddy-induced vertical nitrate transport.

Keywords: Kuroshio, eddy-induced nitrate flux, submesoscale eddies, baroclinic instability

