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Persistent phytoplankton bloom and surface cooling induced by the internal tidal mixing

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The persistent phytoplankton bloom and surface cooling isolated in the Sulu Archipelago are newly detected by the satellite remote sensing chlorophyll-a (Chl-a) concentrations and sea surface temperature (SST) images. Furthermore, a three-dimensional baroclinic nonlinear numerical model is employed to investigate the dynamic mechanisms. And the intense internal tidal mixing is identified as the vital dynamic factor triggering the nutrient pumping. Seasonal mean satellite data show that an isolated beam of lower temperature and higher Chl-a concentrations, 5-15 times higher than those in the adjacent seas, covers the Sulu Archipelago with the narrow fronts of 20-50 km. The modeling results indicates that the vigorous internal tides are generated over the abrupt Sulu Ridge with the beam of large major axes of tidal ellipses, radiating from the Celebes Sea propagating towards the Sulu Sea, which induce the energetic vertical shears and energy dissipations. It is the major dynamic mechanism to trigger the persistent behaviors in the Sulu Archipelago throughout the year. And the magnitude of vertical pumping velocities over a tidal cycle is more than one order of that in the traditional wind-driven upwellings.