The imprint of climate variability on the Maritime Continent surface ocean biology

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Understanding how the ocean surface biology will respond to climate variability is one of the important factors of climate change impact assessment, particularly the change in ocean biology represented by phytoplankton biomass or chlorophyll-a concentration (Chl-a). This is because phytoplankton are the base of the ocean food web from which carbon biomass and energy will be transferred to higher trophic level organism production (e.g., fish catch) hence affecting human life. Situated between Indian and Pacific Oceans, the Indonesian Maritime Continent (IMC) biophysical properties are greatly affected by both the Indian Ocean Dipole (IOD) and the El Nino-Southern Oscillation (ENSO) climate variations. All papers assessing the impacts of climate variability on Chl-a in the IMC were based on the datasets including the periods of concurrent IOD and ENSO events and mainly focused on the eastern Indian Ocean. The fingerprints of single IOD (positive or negative IOD) and single ENSO (El Nino or La Nina) events on surface ocean Chl-a have not been separately identified. Utilizing more than two-decade ocean color data we identified the fingerprint of climate modes, both during concurrent and single events. During concurrent positive IOD (+IOD) and El Nino years Chl-a mainly in the eastern Indian Ocean (west of Sumatra and south of Java), the Banda Sea, and the Arafura Sea tended to increase which was associated with upwelling as can be indicated by low sea surface height anomaly (SSHA). On the other hand, in the coastal areas surrounding Borneo, New Guinea, and the eastern coast of Sumatra, Chl-a tended to decline which was attributed to low rainfall. In contrast, during concurrent negative IOD (–IOD) and La Nina Chl-a in the eastern Indian Ocean, the Banda Sea, and the Arafura Sea tended to decline which was associated with downwelling indicated by high SSHA. On the other hand, in the coastal areas especially surrounding the Borneo, and the eastern coast of Sumatra, Chl-a tended to increase which can be attributed to high rainfall. The imprint of single +IOD (–IOD) on Chl-a resembled that of concurrent +IOD and El Nino (concurrent –IOD and La Nina) but with lower magnitudes of Chl-a changes. There was almost no distinct imprint on Chl-a associated with single El Nino and single La Nina events. The imprint of IOD on the IMC’ s Chl-a was obviously stronger than that of ENSO, even in the western Pacific Ocean where strong correlations between biophysical variables and Nino3.4 index were observed.

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