Impact of ENSO (El Nino / Southern Oscillation) on export fluxes in the western and central equatorial Pacific

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The fluxes of biogenic components and amino acids together with the related parameters show that the hemipelagic region is in sharp contrast with the oligotrophic and weak upwelling regions of the Western Pacific Warm Pool (WPWP), responding to the El Nino and La Nina. Average total mass and amino acid fluxes were relatively high during El Nino than those during La Nina in the hemipelagic region. However, in the oligotrophic and weak upwelling regions, they were higher during La Nina relative to those during El Nino.

An important scientific subject in the global carbon cycle is that atmospheric CO2 is now rapidly increasing due to human activities and threatens to cause major changes in the global climate. Marine biogeochemical processes may play an important role in regulating the atmospheric concentration of CO2 , through their mediation in air-sea exchange of CO2.

In this paper, we discuss the variations in biogenic components of settling particles at a variety of WPWP stations. The sampling sites were located in the hemipelagic region off New Guinea of the western WPWP (Sites N1, N2 and M1), in the oligotrophic region of the central and eastern WPWP (Sites N10 and M3) and in the equatorial upwelling region of the eastern WPWP (Sites N3 and M5). The data is important with respect to the El Nino and La Nina events as they might have influenced settling particle flux and its biogeochemical nature.

Factors such as surface currents, tropical instability wave (TIW), Kelvin wave, El Nino and La Nina, determine the vertical transport of nutrients and amount of light available to primary producers for photosynthesis in the equatorial Pacific. Under normal (non-El Nino and non-La Nina) conditions, the eastern edge of the WPWP, where Sites M5 and N3 were located, is characterized by weak equatorial upwelling, resulting in low to moderate primary productivity. In contrast, in the western sector of WPWP around Indonesian maritime continent (Sites M1 and N2), supply of nutrients through the Mindanao dome upwelling and terrestrial input due to tropical rainfall on the continent support high primary productivity. Lying between these two regions, the oligotrophic region (Sites M3 and N10) has the lowest primary productivity.

In the hemipelagic region, fluxes of biogenic components, AA and lithogenics were reduced during La Nina, compared to the higher fluxes recorded (Sites N1 and N2) during El Nino. Shoaling of nutricline is responsible for the higher fluxes during El Nino event, when lithogenic flux was also enhanced. High THAA-C%, THAA-N%, and AA/HA ratio indicated that the settling OM was more enriched in labile components during the La Nina than during the El Nino. In addition, lower OM flux was associated with less relative abundance of biogenic opal content during La Nina, which might be a result of less efficient organic carbon pump.

Oligotrophic region provides easily distinguishable influence of the El Nino and La Nina conditions. During El Nino event, Site N10 trap recorded lower fluxes of total mass, major components and AA. As evidenced by low THAA-C%, THAA-N%, and AA/HA ratio, the OM at Site N10 was less labile compared to that at Site M3 during La Nina. Although located in the same oligotrophic region, the considerable distance (ca. 1650 km) between the two trap sites cannot be ignored to have some influence on the studied parameters during the El Nino and La Nina changes.

The weak equatorial upwelling region, similar to the oligotrophic region, provides clear picture of variations in fluxes and labile nature of settling OM during El Nino and La Nina events. The two trap moorings (N3 and M5) were deployed at the same location. Together with other parameters, fluxes of total mass, biogenic components and AA were higher during La Nina than those during El Nino. Although biogenic opal contribution was also higher during La Nina due to the westward shift of the equatorial upwelling system, it made little difference to the organic carbon pump. In the eastern equatorial Pacific (Site C; 1N, 139W), 2 to 3 times higher biogenic particle flux was observed during the 1984 La Nina than that during the 1983 El Nino. This change in particle flux was attributed to change in primary production due to impact of the ENSO.