Impact of aerosol on biogeochemistry in the Bay of Bengal

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It has been reported that aerosol supplied from the land to the ocean affects ocean biogeochemistry. Not only in the modern age, but also during the glacier age, macro- and micro-nutrient in aerosol possibly increases ocean nutrients resulting in increases of primary productivity and settling particles. On the other hand, aerosol input possibly has negative impact: the harmful trace metals in aerosol might damage ocean primary producer and some chemical substances might accelerate the ocean acidification. The Bay of Bengal (BoB) is located in the northeast of the Indian Ocean. The BoB is semi-closed tropical maritime surrounded by the land on its north, east, and west. In addition to strong insolation, large amount of fresh water input from Ganges and Brahmaputra rivers that are one of largest river in the world and large precipitation during the boreal summer monsoon season strongly stratify the ocean. As a result, the supply of nutrient from the subsurface is strictly inhibited and the BoB is oligotrophic. As mechanisms of nutrients supply to the sun-lit layer in the BoB, in addition to passes of meso-scale cyclonic eddy and of meteorology turbulence such as cyclone, aerosol input is very important. Because of the unique monsoon system in the Indian Ocean, the northeast wind is pre-dominant during winter season. Thus, especially in winter, natural and anthropogenic aerosol that originates from the consumption of fossil fuel and the biomass burning are largely transported from the land to the BoB. Another characteristic of the BoB is that about one-quarter of the world population live around the BoB. Especially, Indo and Bangladesh are well known as a country that magnitude of air pollution (concentration of PM2.5) is quite high and gigantic anthropogenic aerosol are emitted. It is reported that , in spring, an amount of anthropogenic aerosol input to the BoB is much higher than that to the Arabian Sea. It has been reported that concentration of iron (Fe) in the anthropogenic aerosol that serves as micronutrient is higher and dissolved more easily (namely, more bioavailable) than that in the natural aerosol. Thus in future, increase of anthropogenic aerosol input might enhance ocean primary productivity in the pelagic ocean with Fe deficiency. Moreover, large amount of aerosol that is attributed to wildfire, volcanic explosion and biomass burning are emitted from Indonesia located in the southeast of the BoB. These aerosols possibly affect biogeochemistry in the BoB too. There is another negative feedback that irradiance to the BoB would decrease resulting decrease of primary productivity if large amount of aerosol were transported over the BoB. Therefore the BoB is a “hot spot” for the study on impact of aerosol on ocean biogeochemistry. This presentation reviews previous study on this issue and introduces a scientific cruise planned in 2018.

Keywords: Bay of Bengal, natural / anthropogenic aerosol, biogeochemistry

Physical-biogeochemical variability in the Sumatra-Java upwelling region

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The south of Sumatra-Java is one of the greatest upwelling regions in the southeastern tropical Indian Ocean (SETIO). The upwelling appear under the monsoonal wind, thus it dominates from September to November in usual. However, action-center of the Indian Ocean Dipole (IOD) events, which has interannual variability, also appears in SETIO. Then the seasonality of the upwelling should be modulated by IOD events. In general, the upwelling bring rich nutrient from deeper ocean to the surface, thus biological primary production becomes large at that time. This kind of biogeochemical response against physical condition should also be modulated by monsoon and IOD activities. Although the physical interpretations of IOD mechanism and ocean responses of the Monsoonal wind have been improved by development of observing system and numerical modeling technique in the past decade, understanding of the biogeochemical responses of that has not been so improved because of lack of in situ observations. At the present, the second international Indian Ocean expedition (IIOE-2) is conducted under the international observation efforts. It is good chance to progress our understanding of the physical and biogeochemical features at the Sumatra-Java upwelling region. In this presentation we will introduce our observational and numerical analysis results for the Sumatra-Java upwelling region, which mostly focused on the sea surface temperature and phytoplankton variability.

Keywords: Indian Ocean, Upwelling, IIOE2, EIOURI

International Indian Ocean Expedition-2 (IIOE-2) and Eastern Indian Ocean Upwelling Research Initiative (EIOURI)

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It has been half a century since the International Indian Ocean Expedition (IIOE) took place in 1960’s. Although in situ and remotely sensed observing technology have been improved significantly, our understanding of physical, chemical, and biological oceanography in the Indian Ocean is still quite limited. It has also benn discussed that recent human activities affect ocean environment, including conditions in the Indian Ocean. Considering such situations, the second IIOE (IIOE-2) was planned and launched in Dec. 2015 to investigate Indian Ocean conditions and their variations from physical, chemical, biological, and geological viewpoints and to understand their mutual interactions. Upwelling system is among important processes to be highlighted under IIOE-2, and Eastern and Western Indian Ocean Upwelling Research Initiatives (EIOURI and WIOURI) have been established as key research initiatives. Detailed descriptions of IIOE-2 and EIOURI will be presented.

Keywords: International Indian Ocean Expedition, Upwelling system, Interdisciplinary collaboration

