Aerosol absorption over Bay of Bengal during winter: Variability and sources

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1. Introduction

Atmospheric aerosols can scatter as well as absorb the solar and terrestrial radiation and exert a cooling effect on the Earth’s climate through direct and indirect effects which partially offset the warming caused due to greenhouse gases (Solomon et al., 2007). Once aerosols are produced, they can get transported from areas of high emissions to clean remote and marine environments under favorable wind conditions. The relative importance of scattering and absorption of radiation depends on the chemical composition and the size distribution of aerosols. Black carbon (BC) aerosols, produced from incomplete combustion, fossil fuel and biomass burning, can influence air quality and climate by absorbing the sunlight and thereby contribute to global warming. The radiative and climate impacts of BC are increasingly recognized as it is the second strongest contributor to global warming next to carbon dioxide (Ramanathan and Carmichael, 2008). BC emissions are reported to have varied in response to changes in the usage of fossil fuel and technology development, and the estimated BC emissions are found to be the highest in developing countries, especially China and India (Novakov et al., 2003). Venkataraman et al. (2005) have shown that large amount of biofuel combustion (especially wood) is a potentially significant source of atmospheric BC in south Asia. Lifetime of BC in the lower atmosphere is of the order of a week (Ramanathan and Carmichael, 2008). Because of their fine size and relatively longer residence time, BC can easily get transported over longer distances and can pollute a pristine atmosphere.

Bay of Bengal (BoB) occupies a special importance because of its proximity to the surrounding landmasses on its north, east and west which are densely populated and industrialized areas. In addition, BoB plays an important role in Indian summer monsoon system and precipitation pattern. A campaign for Aerosols, gases and Radiation Budget (ICARB) was conducted during the premonsoon season of March–May 2006 with an aim to identify the major sources of aerosols (natural and anthropogenic) and to characterize their role on regional climate over the Bay of Bengal, Arabian Sea and India through intensive simultaneous measurements (Moorthy et al., 2008). The campaign revealed the existence of large heterogeneity in aerosol characteristics, sources and size distribution over the BoB. In addition, a higher aerosol loading was observed with higher anthropogenic contribution over the Bay of Bengal when compared to the Arabian Sea during ICARB (Moorthy et al., 2008; Nair et al., 2008; Kalapureddy et al., 2009; Kedia and Ramachandran, 2008, 2009).

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