Role of Transported Anthropogenic Aerosols on Aerosol-Cloud-Precipitation Interaction Over Bay of Bengal

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The investigation of the vertical profile of aerosol characteristics is important to define the aerosol-cloud-precipitation interaction (Christensen et al., 2020). During 2007-2018 there is an indication of decreasing anthropogenic activity over the Bay of Bengal (BoB) based on the black carbon (BC) observation during the pre-monsoon period (March-May). The BC data have been collected under the Aerosol Radiative Forcing Over India (ARFI) network established by ISRO-GBP. The vertical profiles of extinction coefficient taken from cloud-aerosol lidar and infrared pathfinder satellite observation (CALIPSO) level 3 data indicate increasing polluted dust and smoke aerosol above the boundary layer height (> ~1.5 km). It was reported that the anthropogenic aerosol's heating efficiency increases at higher altitudes. So, the presence of smoke and polluted dust over the boundary layer can increase the heating resulting in a reduced temperature lapse rate. Reduction in lapse rate causes decreasing trend in convective available potential energy (CAPE). As a result, convective rain amounts were also reduced in the pre-monsoon during 2007-2018.

To look into the cloud parameters the profiles of hydrometeor density taken from the tropical rain measuring mission (TRMM) have been investigated. The result shows increased ice particle density at higher heights indicating an increase in the number of deep convective clouds during the study period. This phenomenon is usually connected to a longer cloud lifetime which may be related to the increased presence of polluted dust and smoke above the boundary layer hindering cloud to rain formation during pre-monsoon. The latent heat profiles from TRMM also show an increase at higher heights enhancing rain height and pointing towards the increase in the occurrence of tall clouds.

This study attempts to reveal the role of aerosol above the boundary layer in changing cloud formation over BoB. The presence of polluted dust and smoke decreases the lapse rate and convection resulting in reduced convective rain. Deep convective clouds have increased as revealed by TRMM hydrometeor and latent heat profiles. This indicates that the outflow from the mainland extends over BoB above boundary layer height. This modifies the aerosol-cloud-precipitation interaction, despite the reduction in BC concentration near the ground.

1. M. W. Christensen, W. K. Jones, and P. Stier, "Aerosols enhance cloud lifetime and brightness along the stratus-to-cumulus transition," *Proceedings of the National Academy of Sciences*, **117**(30), July 2020, pp. 17591-17598, DOI: https://doi.org/10.1073/pnas.1921231117.