Aerosol characteristics in the Indian Himalayan foothills: Implications to climate forcing

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Abstract

The Indo-Gangetic Basin (IGB) is located in the northern part of India and surrounded by the unique topography with the Himalaya to the north, moderate hills to the south, Thar Desert and Arabian Sea in the west, and Bay of Bengal in the east. Aerosols over the IGB region are highly associated with the emissions from various anthropogenic and natural sources, resulting in a large spatial heterogeneity in its distribution, in term of loading and type/composition. Due to combined effects of the IGB topography and the Himalayan orography, these aerosols are lifted up quite often to the high-altitudes and may impact the radiation budget of the climatically sensitive region of the Himalayas. In the present study, the impacts of aerosols on radiation budget were studied at Manora Peak, one of the sparsely inhibited high-altitude stations in the Indian Himalayan foothills, during the period from February 2006–May 2008.

In the absence of measured aerosol optical properties (crucial for radiative forcing estimations), measured aerosol chemical composition at Manora Peak were used in an aerosol optical model to obtain crucial optical properties of aerosols such as aerosol optical depth (AOD), single scattering albedo (SSA), asymmetric parameter etc. The monthly and seasonal variability of these optical properties were studied extensively over the station. The AOD was found to be varied from 0.04 to 0.45 during the course of study period and showed a slight increasing trend, mostly during the summer in each year, suggesting the relative influence of transported dust aerosols over the station. The SSA was found to be varied from 0.74 to 0.88, with slightly decreasing trend, suggested the enhancement in absorbing aerosols (dust/BC) over the region. The absorption Ångström exponent (AAE) was also estimated and ranged from 0.72 to 1.40, with higher magnitude (>1.0) during the summer, indicating the dominance of mixed aerosols over the region. The present study provides an additional evidence of the presence of strongly absorbing aerosols over the Himalayan region, which may affect the strength of Himalayan glaciers, monsoon circulation and precipitation over the Indian region. Further, these derived aerosol optical parameters were used in a radiative transfer model to estimate the associated radiative forcing to understand their possible impacts over the region and will be discussed during the conference.