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Investigation of Effects of Transported Aerosols over Semi-arid Region in Indian Subcontinent

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Semi-arid regions located in between arid and sub humid areas, mainly situated in the mid-latitude inner continental areas where potential evaporation dominates over the precipitation, play an important role in the climate change. Recent research works reported that semi-arid regions are sensitive areas for causing the climate change due to continuous changing in atmospheric composition by recent growing anthropogenic activities. This paper presents radiative effects of high altitude atmospheric aerosols using ground-based measurements over Mt. Abu (24.65^o N, 72.786^o E, 1.7 km asl) and multi-satellite observations over Indian semi-arid region centered over Mt. Abu during December 2006 - June 2007. Ground-based and space-borne measurements and back-trajectories analysis indicate that significant pollutants are transported to over the semi-arid region from Indo-Gangetic Basin (IGB) during Dec-Apr while desert dust dominated during Mar-Jun. Thereby, during Mar-Apr (MA), there is existence of both, dust and pollutants, at high-altitudes making the period very important to be investigated. Transported pollutants result in high BC of about 0.84 and 0.86 micro-g m^{-3} at Mt. Abu during Dec-Feb (DJF) and MA, and low of about 0.31 micro-g m^{-3} during May-Jun (MJ). However, AOD is observed to be a minimum of about 0.09 during DJF and maximum of about 0.18 during MA, followed by 0.16 during MJ. Mt. Abu experiences shallow winter-time boundary layer aerosols within 2 km which cause minimum AOD during DJF. However during MA, pollutants and desert dust are loaded within 6 km which maximize AOD at hill-top region while only desert dust contributes for AOD during MJ. The contribution of hill-top AOD to the total columnar AOD is only 10% during DJF while it is 55% and 50% during MA, and MJ, respectively, showing that pollutants and desert dust contribute maximum to AOD. In the present study, radiative transfer code is used to estimate high-altitude atmospheric aerosol radiative forcing and heating rate in fine atmospheric layers of 100 meter thickness and found to be about 4.6, 18.8, 13.8 Wm^{-2} and 0.2, 0.42, 0.22 K day^{-1} during DJF, MA, and MJ, respectively. The contribution of high-altitude aerosols to total columnar aerosol heating rate is found to be a maximum of about 30% during MA, followed by 25% during MJ and 15% during DJF. This high contribution in warming effect due to coexistence of dust and BC layers during MA can cause significant changes in hydrological cycle over the Indian subcontinent.

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