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Environmental Effects of Black Carbon on the Tibetan Plateau: View from the Observations

J. Ming (1,2), Z. Du (3), and S. Zhao (2)

(1) China National Climate Center, Beijing, China (petermingjing@hotmail.com), (2) State Key Laboratory of Cryospheric Sciences, Chinese Academy of Sciences, Lanzhou, China, (3) Institute of Atmospheric Physics, Chinese Academy of Sciences, Beijing, China

Black carbon (BC) is now well known by scientific societies for its complex environmental and climatic effects. The Tibetan Plateau (TP), an absolute highland on Earth, is usually encompassed by heavy pollutant emissions, such as black carbon, organic carbon, and other industry-related species. And South and East Asia are two strongly emitting regions neighboring the TP. Seasonal alternations of westerly and monsoon make the TP be a depositing receptor of BC aerosols. From the view of satellite monitoring, the TP is like a virginal island for the pollutants within the grey smog ocean, especially during winters. The TP is a primary distributing area of the mountain glaciers in the North Hemisphere. High elevated terrain (e.g., the Himalayas) cannot exclude the pollutants outside completely, but restrain them in some way. Two carbon-aerosol monitoring sites (Qilian in the northeast margin of the TP and Nam Co in the south hinterland) measured atmospheric BC during the past several years. The results at the Qilian station showed the average BC concentration was 45 ng m^{-3} during 2009-2011, and that at the Nam Co station was 80 ng m^{-3} during 2006-2009. The atmospheric BC levels at these two sites are significantly lower than that observed by the NCP-O GAW station on the south slope of Mt Everest. BC is believed to have the capacity to enhance snow-ice surface solar absorption and to accelerate melting. Measurements from snow and ice sampling in the TP glacial areas showed average BC concentration of snow and ice in the investigated glaciers of TP was about 40 ppbw, yielding a mean forcing of 5 W m^{-2}. The lowest BC concentration was deposited in the Himalayan glaciers due to highest elevation, while the highest concentration was in the central TP glaciers likely due to strong surface ablation. The present radiation observations on the TP glaciers show the ratio of BC forcing accounting for the total surface radiative absorption is about 5% in the glaciers of the TP, which does not contribute significantly to the melting of the High Asia glaciers.

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