Deciphering Climate Warming by Carbonaceous Aerosols from Two Decades of Observations in Asia

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Abstract

Besides reducing the co-emitted air pollutants, global greenhouse gas (GHG) mitigations toward carbon neutrality can also reduce air pollution by slowing climate warming, which alters the meteorology conducive to pollution production and/or accumulation. Reducing air pollution emissions toward carbon neutrality may either dampen or boost the effects of GHG mitigations. Understanding the long-term trends and climate impacts of carbonaceous aerosols, specifically black carbon (BC) and brown carbon (BrC), in Asia is crucial for accurately modeling and predicting climate change under continued warming. Asia accounts for nearly one-third of global anthropogenic BC and BrC emissions, mostly from energy-related industrial coal and residential fossil fuel combustion in East Asia and biomass/biofuel burning in South Asia. In this talk, a comprehensive analysis of the light-absorption properties and their contribution to atmospheric warming of BC and BrC across Asia from two decades of in-situ, remote sensing, and airborne observations will be presented, specifically focusing on absorption enhancement of BC by mixing with non-absorbing aerosols and the photo-bleaching effects of BrC during transport. Key information is obtained from the Gosan Climate Observatory (GCO) and Maldives Climate Observatory (MCO), which are strategically located to intercept the integrated outflow from major emission regions in East Asia and South Asia, repectively. The contribution of BC and BrC to total aerosol absorption was estimated to be 85-88% and 12-15%, respectively; BC contributed more to aerosol absorption in polluted areas, while BrC contribution increased in background sites. The details of how to incorporate the light-absorption properties and aging processes of BC and BrC, elucidated from two decades of observations, will be highlighted. Furthermore, investigating the aerosol-induced surface brightening resulting from the demasking effect due to reductions in light-absorbing aerosol emissions under the carbon neutrality scenario and sustained air pollution control measures will be discussed.

Early Career Scientist

NO, I am not an early career scientist.

IGAC Activities

ACAM: Atmospheric Chemistry and the Asian Monsoon, MAP-AQ: Monitoring, Analysis and Prediction of Air Quality

IGAC Regional Working Groups

MANGO: Monsoon Asia and Oceania Networking Group