Assessing the transport of Asian Pollution into the stratosphere through balloon-borne and satellite observations together with the GEOS-Chem Chemical Transport Model.

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Asian Pollution has grown at an unprecedented pace over the past few decades with alarming consequences on public health throughout Asia. The shift in the highest sulfur and nitrogen dioxide emissions between China and India could have implications for their transport at higher altitudes during the Asian Summer Monsoon (ASM). Satellite observations revealed that trace gases and aerosols are enhanced in the Upper Troposphere and Lower Stratosphere (UTLS) during the ASM. Deep convection during the ASM provides a transport pathway for boundary layer air to reach the UTL. In order to address this environmental problem, NASA and ISRO collaborate, since 2014, on the Balloon measurement campaign of the Asian Tropopause Aerosol Layer (BATAL) research program to assess the nature, origin and impact of anthropogenic and natural aerosols transported to the stratosphere during the ASM through balloon-borne and satellite observations. The balloon measurements have confirmed the presence of enhanced aerosol backscatter observed through satellites since the late 90's. The microphysical and chemical properties of the ATAL have been derived using balloon-borne payloads mounted on short- and medium-duration flights near the tropopause region. We show enhancement of aerosol concentration for particle radius greater than 0.1 micron of a factor of 10 or more when air masses are influenced by deep convection. Offline analysis of aerosols collected during the balloon flights reveals the dominant presence of nitrate/nitrite aerosols with concentration near 100 g/m^3 (for nitrate) with traceable content of calcium and potassium. Through model simulations, we separate the natural (lightning) versus anthropogenic sources of nitrate aerosols as well as the influence of source emissions in India and China. The BATAL results are used to formulate a new research campaign involving mid/high altitude aircrafts from NASA and ISRO, which will start in summer 2018 with the first flights of ISRO.

Key words: Pollution, Asia, Monsoon, Stratosphere.