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Inter-comparison of Speciated Aerosol Loading over India for Global and Regional Emission Inventory using a Chemical Transport Model

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Air quality of a region directly affects health of entire biotic and abiotic components of ecosystem. Exposure to particulate matter smaller than 2.5 μm (PM2.5) in atmosphere has been directly related to mortality and mobility in various studies. India is one of the aerosol hotspots globally with $\sim$0.8 million premature death attributed to exposure to ambient PM2.5. Robust long-term in-situ data of speciated PM2.5 is lacking in India. The problem cannot be resolved by utilizing satellite data as inferring composition is difficult. Therefore a modelling approach is required. We examine spatial and temporal distribution of PM2.5 and its constituent species with a regional and global inventory through chemical transport model (WRF-Chem) over India. The simulation is conducted with RADM2 chemistry and GOCART aerosol module for 8 years (2007-2014). Emissions are interpolated for domain from global anthropogenic emission inventory RETRO and EDGAR for species other than BC, OC and Sulfate. Results from GOCART global inventory are compared with results from a regional inventory for species OC, BC and Sulfate. Validation of CTM simulations against observations (ground based monitoring stations and satellite observations) demonstrates the capability of the CTM to represent space-time variation of aerosols in this region. For example, the build-up of aerosols over the eastern part of the Indo-Gangetic Basin (IGB) during winter (as observed by space-borne sensors) due to the meteorological influence is well captured by the CTM. A correlation of 0.51 and 0.52 has been observed between monitored and model simulated PM2.5 at the two big cities of India, New Delhi and Mumbai respectively. Distribution of PM2.5 is high in the Indo-Gangetic Basin (IGB) and distribution of OC and BC is also more in IGB region with both emission inventories. In the IGB region OC and BC contribute 8 – 20 % and 2.5 – 5 % to total PM2.5. Global and regional emission inventories are showing similar distribution pattern for OC, BC and Sulfate. GOCART emission inventory is underestimating BC and OC emission in comparison to IITB inventory by almost 50% over the IGB region. Better spatial resolution in the regional inventory may be the reason. WRF-Chem simulated OC and BC concentration is underestimated by 25% and 50% over the IGB region with GOCART inventory compare to regional inventory. In comparison to IGB region other parts of India has lower concentration and these reasons are showing comparatively less difference in concentration in both emission scenario. Vertical distribution of extinction coefficient showing that aerosol concentration is confined to lower levels in winter but it is geting elevated in summer. Our results provide a comprehensive picture of aerosol speciation over India and can be used for further climate and health impact studies.