Large-scale Chloride-depletion in sea-salt aerosols over Bay of Bengal: Implications to Climate forcing

ASHWINI KUMAR[1], M. M. SARIN[1], BIKKINA SRINIVAS[1], A. K. SUDHEER[1] and N. RASTOGI[2]

[1]*Physical Research Laboratory, Ahmedabad-38009, India*

[2]*Southern Ontario Centre for Atmospheric Aerosol Research, University of Toronto, Canada*

Sea-salt particles, constituting more than 40% of the global aerosol budget, provide an ideal surface for a host of chemical reactions to occur in the marine atmospheric boundary layer (MABL). Most importantly, sea-salts are involved in heterogeneous phase reactions with acidic components (e.g. HNO_3 and H_2SO_4), through reactions represented by the mass balance equation: $H_2SO_4 + 2NaCl = Na_2SO_4 + 2HCl_g$, resulting in the removal of gaseous chlorine to the atmosphere. Although the process of chloride (Cl)-depletion has been well understood, its quantification is most essential in order to constrain the model simulation for atmospheric chemistry. Our long-term study carried out in the MABL of Bay of Bengal, beginning 2001, provides unambiguous evidence for near-quantitative (80-100 %) depletion of chloride during the period of late NE-monsoon (Jan-March) when advective transport of pollutants from the Indo-Gangetic Plain and south-east Asia is predominant. The non-sea-salt sulphate (nss-SO_4^{2-}) constitutes a major fraction (55-65%) of the water-soluble ionic composition (WSIC) of aerosols and NO_3^- concentration is 5-10 times lower than nss-SO_4^{2-}. Furthermore, the magnitude of Cl-depletion (%) exhibits a linear increase with the mass fraction of nss-SO_4^{2-}; suggesting that sea-salts are a potential sink for anthropogenic SO_2 over the Bay of Bengal. The chemical reaction, as represented above, would alter the size-distribution of anthropogenic sulphate aerosols from fine to coarse mode and has implication for evaluating the climate forcing over Indian Ocean. In addition, the release of chloride from sea-salt particles undergoes direct photolysis to yield gas-phase chlorine radical, which in turn affects the chemistry of ozone and dimethyl sulphide in the MABL.