

Atmospheric Deposition of Nitrogen: South Asian Scenario

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In South Asia, significant progress in atmospheric deposition research has been noticed being steered by two major International programmes viz. Composition of Atmospheric Aerosols and Precipitation (CAAP) and Composition of Atmospheric Deposition (CAD). Currently, there is no network of atmospheric deposition measurements in South Asia. However, atmospheric deposition activity has recently become a part of the South Asian Nitrogen Centre's mandate.

Spatial and temporal variations of atmospheric reactive nitrogen (Nr)

In South Asia, India is the major contributor to the emission and deposition share of Nr in the region. Among $\text{NH}_3\text{-N}$, $\text{NH}_4\text{-N}$ and $\text{NO}_3\text{-N}$, gaseous NH_3 contributes the highest quantum of Nr to the atmosphere. A significant amount of gaseous NH_3 is contributed by multiple sources. At rural site, the high NH_3 levels can be attributed to fertilizers and biomass burning while at urban site, major sources of gaseous NH_3 include human excreta, municipality waste and vehicular traffic etc. (Singh and Kulshrestha, 2014). In addition, the high temperature of the atmosphere and alkaline nature of aerosols also support building up of NH_3 in the atmosphere in the Indian subcontinent (Singh and Kulshrestha, 2012). NH_3 concentrations have been reported higher during the night time as compared to the day, due to favourable meteorological conditions. Abundance and phase distribution studies show that particulate NH_4^+ is noticed lower than gaseous NH_3 at Delhi during all the seasons (Singh and Kulshrestha, 2012). Indo-Gangetic region has the highest wet deposition of $\text{NH}_3\text{-N}$. Wet deposition has higher as $\text{NH}_4\text{-N}$ than as $\text{NO}_3\text{-N}$ in the region (Fig. 1).

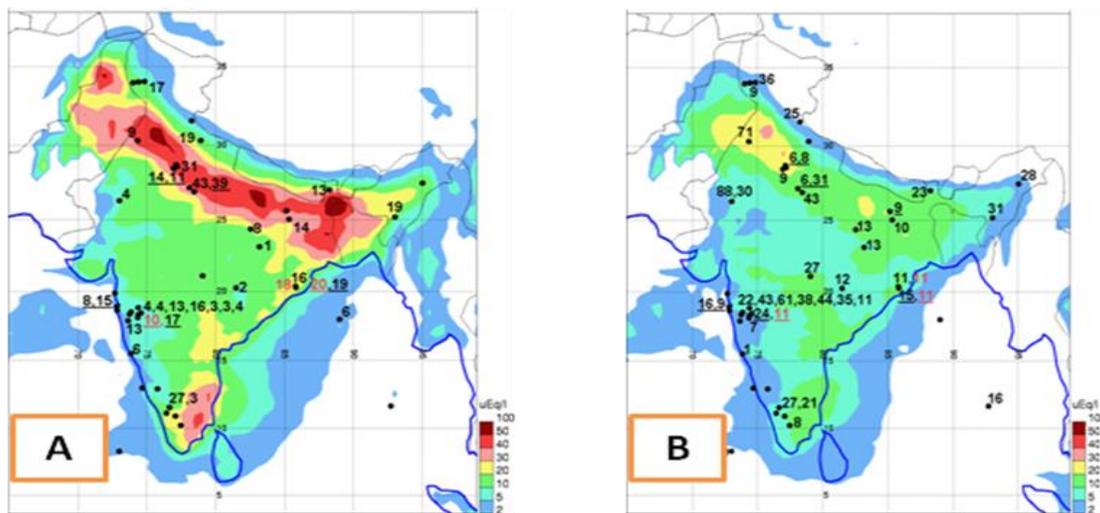


Fig.1. Concentrations of (A) NH_4^+ and (B) NO_3^- in rain water using bulk (black) and wet-only (red) collectors (Kulshrestha et al., 2005).

Effect of developmental activities

It has been reported that the wet deposition fluxes of NH_4^+ and NO_3^- are increased remarkably at Delhi during the past two decades which can be attributed to the increasing urbanization and industrialization (Singh et al. 2017). According to recent research, Long Range Transport (LRT) and Land Use and Land Cover (LULC) change processes significantly affect wet deposition of NH_4^+ and NO_3^- through snowfall in Himalayan region (Kumar et al., 2016a, b). These processes also affect the dry deposition of Nr species in the region (Tiwari and Kulshrestha, 2017).

Total emission vs total deposition

Recent estimates show that the total deposition of N (3.61 Tg) in India is almost 57% of the total emissions of Nr as N (6.24 Tg). The remaining 43% of N is distributed among various intermediate stages between emission and deposition (Kulshrestha, 2017).

Nr Study from Nepal

In Nepal, the precipitation is found to have significant influence of pollution even at remote site in the Khumbu region of the Himalayas where Shrestha and co-workers (2002) observed relatively high mean scavenging ratio of NO_3^- as compared to other ions. NO_3^- concentrations in aerosols were one third of NH_4 but in precipitation, the NO_3^- concentrations were greater than NH_4^+ due to the presence of gaseous HNO_3 in the air.

Scope of future atmospheric deposition research in South Asia

- A strong network of reactive nitrogen monitoring is necessary to cover several sites across South Asia. Such network should be supported for long term research.
- In order to understand local vs long range transport (LRT) of pollution, investigations are needed by using trajectory analysis coupled with deposition studies.
- More studies on gas-aerosol interactions are needed in the region.
- Dry deposition rates of NO_x and NH_3 gases needed to be quantified
- Studies about impact of high concentrations of gaseous NH_3 on various ecosystems are necessary.
- Impact of land use and land cover (LULC) change on Nr content of atmospheric dust and related aerosols needs to be investigated.

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