

RESEARCH HIGHLIGHTS

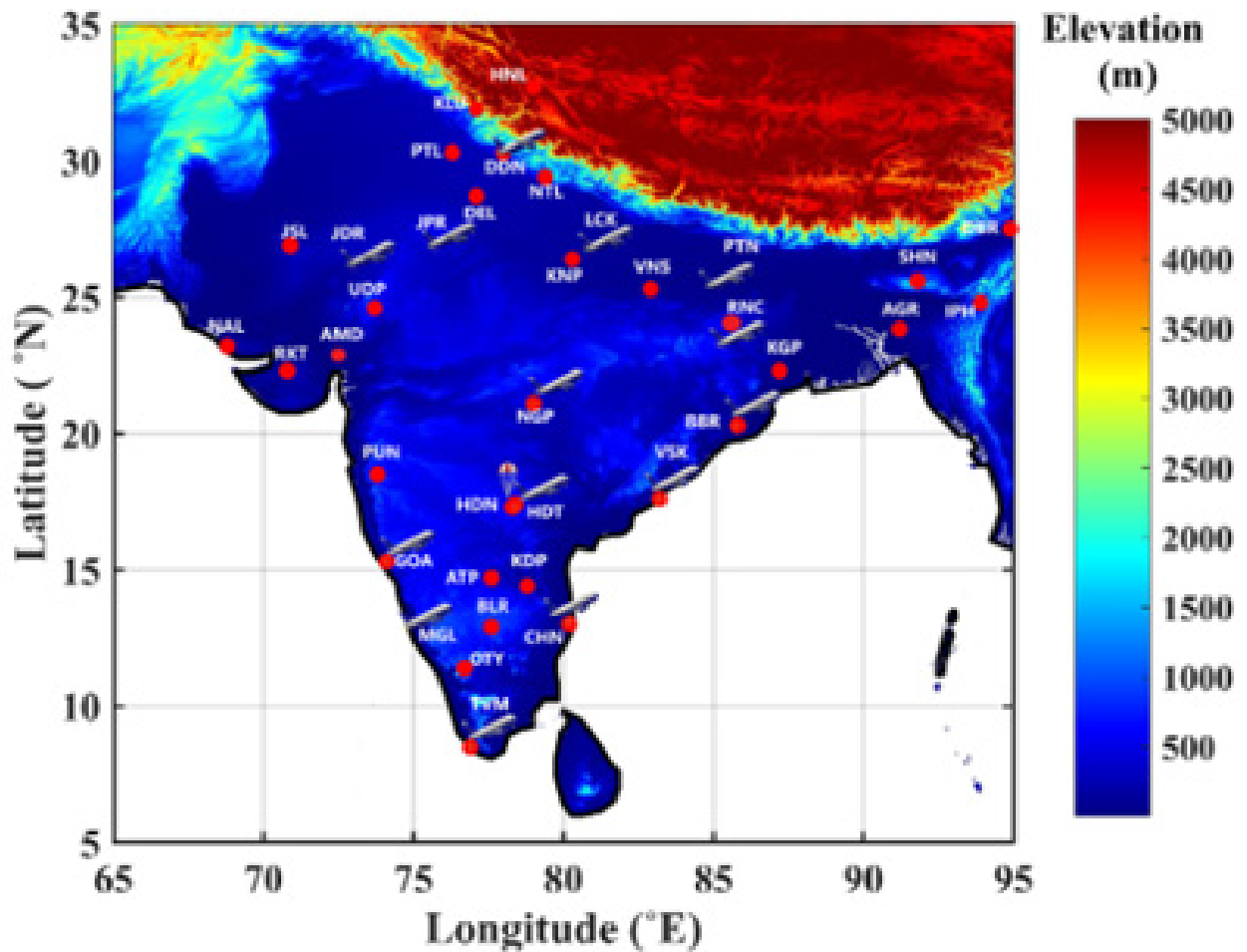
THREE DIMENSIONAL ASSIMILATION OF AEROSOL DATA

A three-dimensional (spatial and vertical) gridded data set of black carbon (BC) aerosols has been developed for the first time over the Indian mainland using data from a dense ground-based network, aircraft- and balloon-based measurements from multiple campaigns, and multi-satellite observations, following statistical assimilation techniques. The assimilated data reveal that the satellite products tend to underestimate (overestimate) the aerosol absorption at lower (higher) altitudes with possible climate implications.

The regional maps of BC-induced atmospheric heating derived using this data set capture the elevated aerosol heating layers over the Indian region along with the spatial high over the Indo-Gangetic Plain. It is shown that, over most of the Indian region, the incorporation of realistic profiles of aerosol absorption/extinction coefficients and single scattering albedo into the radiative transfer calculations leads to enhanced high-altitude warming. This could strongly influence the upper-tropospheric and lower-stratospheric processes, including the vertical transport of BC to higher altitudes, and thus have larger implications for atmospheric stability than what would be predicted using satellite observations alone.

This will have larger implications for atmospheric stability than what would be predicted using satellite observations alone and could strongly influence the upper-tropospheric and lower-stratospheric processes, including increased vertical transport of BC to higher altitudes. The 3D assimilated BC data set will be helpful in reducing the uncertainty in aerosol radiative effects in climate model simulations over the Indian region.

Reference: N. K. Kala, N.S. Anand, M.R. Manoj, S. Prasanth, H.S. Pathak, T. Prabhakaran, P. D. Safai, K.K. Moorthy, and S. K. Satheesh. 3D assimilation and radiative impact assessment of aerosol black carbon over the Indian region using aircraft, balloon, ground-based, and multi-satellite observations, *Atmospheric Chemistry and Physics*, 23, 12801–12819, 2023.



Map showing the locations of surface (red markers) and aerial (aircraft and balloon) measurements. The colour scheme in the background shows the elevation data. The aircraft and balloon symbols respectively mark the aircraft and high-altitude balloon measurement locations.