Abstract of Foundation Day Lecture by Prof S K Satheesh

## Short-lived Climate Forcers: Science and Policy

In recent years, there has been a substantial increase in interest in the climate impact of light absorbing aerosols due to their high atmospheric warming potential. Of special significance is black carbon (BC) aerosol, which is believed to have a warming effect second only to $CO_2$. Despite the general consensus among climate scientists on the significant role of aerosols on regional and global climate forcing, various studies and impact assessments provide widely differing and contrasting inferences and projections. Viewed in the above global backdrop, the South Asian region and India assume special significance due to the diverse geographical features, high population density, rapid urbanization and industrialization, leading to a highly complex aerosol system. In addition to exerting its own radiative impact, black carbon aerosols can substantially contaminate and also can get contaminated by other aerosol species thereby alter the radiative properties of the composite aerosol system. Consequently, there is still a great degree of uncertainty about the radiative effects of these aerosols. Some investigators argue that fossil fuel emissions contain significantly greater amounts of black carbon than scattering aerosols, making reductions of these sources as particularly powerful mitigation strategies. As a result there is a tendency to project mitigation of black carbon aerosols as a quick solution to mitigate global warming. However, our studies indicate that this may not hold good and in fact produce an opposite effect. Long-term observational data on aerosols from several climate observatories spread across the Indian subcontinent indicates an increasing trend in composite aerosol loading indicating that we are heading towards a 'dimmer' and 'warmer' world. Using data from a series of field campaigns on the vertical distribution of aerosols measured using a suite of instruments mounted in a research aircraft, we found the prevalence of elevated absorbing aerosol layers over the Indian mainland (around 2-4 km) during the summer and pre-monsoon seasons and a strong northward gradient in its position and its absorption characteristics. These findings have far-reaching climate significance on the regional scales and are expected to have strong influence on the Indian monsoon system. *In situ* measurements of black carbon mass concentrations carried out using a high altitude balloon have indicated the presence of substantial amount of BC even at free tropospheric altitudes. Radiative transfer simulations using these data indicate that large BC-induced absorption and subsequent atmospheric warming creates a stable atmospheric layer, thus creating “own home” up in the atmosphere. This raises several issues on the lifetime of elevated BC layers, climate effects and probable impacts on stratospheric ozone layer.