POTENTIAL CLIMATE IMPLICATIONS OF ELEVATED LAYERS OF SOOT FROM HIGH-ALTITUDE AIRCRAFT EMISSIONS

Soot is one of the primary air pollutants which absorbs the sunlight and consequently warms the atmosphere. In most parts of India we find a high concentration of soot near the ground on account firewood used for cooking and emissions from vehicles and coal power plants. Measurements of the altitude profiles of BC over Central Indian location, Hyderabad, using high-altitude balloon ascents, have shown occurrence

Figure 1: High altitude balloon facility used for the measurement of soot

of elevated layers of soot between 4 to 8 km above the ground (figure 2a) within which, the concentration of soot was very high, at times even surpassing the near surface values. Such a high concentration of soot well above the ground could not be attributed to sources near the ground. As a part of his doctoral work, Mr. Gaurav Govardhan, Grantham fellow, at Divecha Centre for Climate Change examined the hypothesis that this elevated soot layer may be on account aircraft emissions.

He used a chemistry transport model WRF-Chem to simulate the observed elevated layers of soot. The model simulated vertical variation of soot is shown in figure 2b. The red curve shows the model the variation of soot with height in the simulation that did not include aircraft emissions but included emissions near the ground. Note that there is no elevated layer of soot in this simulation. He then carried out one more set of model simulations, in which realistic emissions of soot from aircrafts were also included. The corresponding vertical profiles of soot from these simulations are shown by a black curve in figure 2b. The elevated sharp and confined layers of soot were simulated by the model upon prescription of such soot emissions from aircrafts flying over the study domain. The new simulations show an elevated soot layer although the maximum value is smaller than the observations. This provides a strong evidence for the emissions from aircrafts might be contributing significantly to the elevated soot layers in India. The discrepancy between model simulation and observation maybe on account of errors in the assumptions about emissions of the soot from aircraft.

The model simulations showed, further, that such elevated sharp and confined

layers of soot emitted by aircrafts can interact with strong convection occurring over the Indian region and can get lifted up. The model simulations and space based LIDAR observations showed that such lifted soot layers intrude into the stratosphere. Based on the previous reports, he further hypothesized that, such aircraft emitted soot can intrude into the stratosphere and can play a role in depletion of stratospheric ozone. Thus the study suggests that, the aircraft emissions of soot, apart from being responsible for the observed sharp and elevated layers of soot could also influence the ozone layer in the stratosphere.

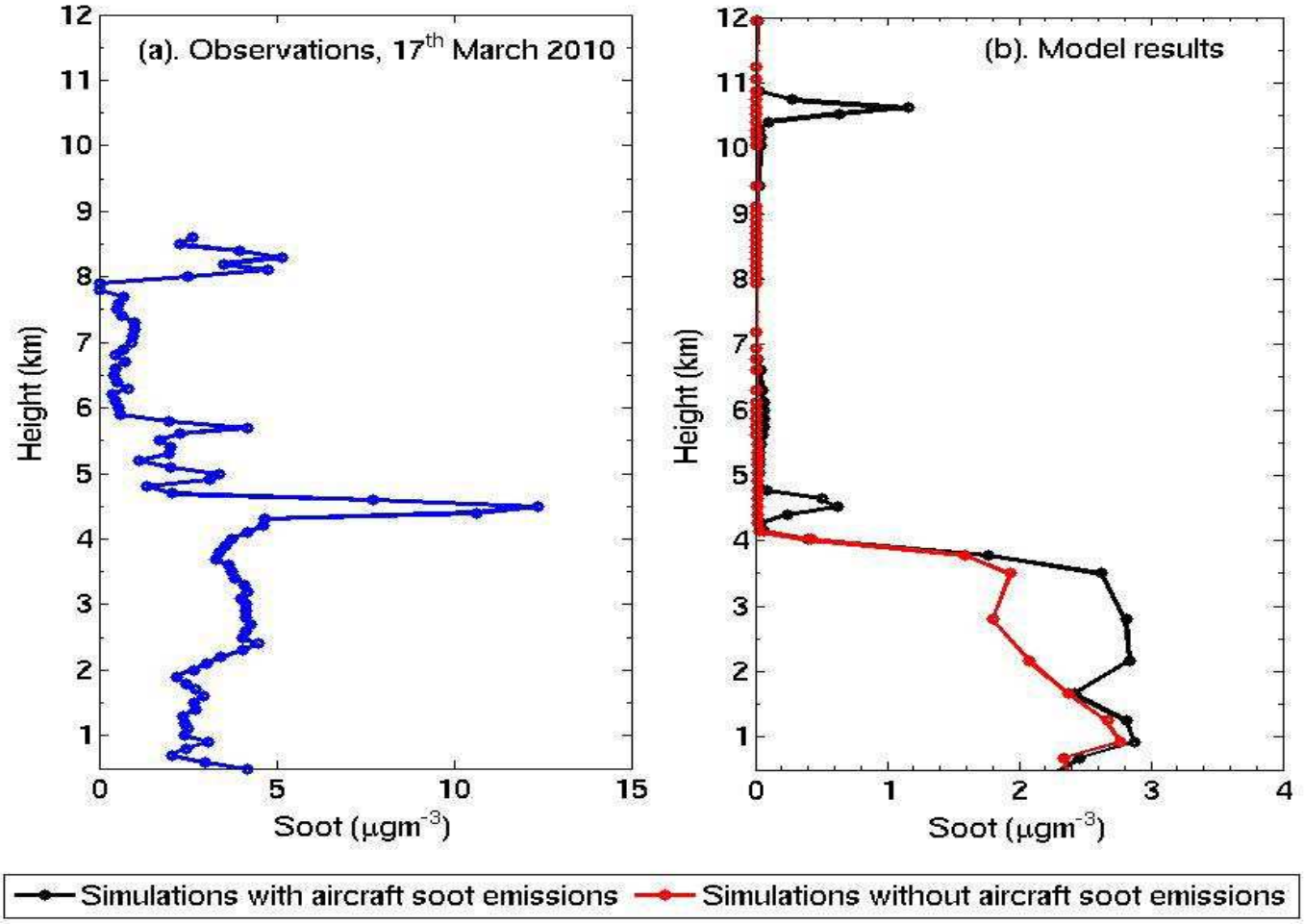

Figure 2: (a). Observed vertical profile of soot over Hyderabad, India obtained from balloon measurements during 17th March, 2010 (b). Model simulated vertical profile of soot for; the simulations without aircraft soot emissions (red line) and the simulations with inclusion of soot emissions from aircrafts (black line).

References:

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