Observations of Surface Ozone in the Central Himalayas and the Indo-Gangetic Plain region

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Tropospheric ozone is a secondary pollutant having deleterious health effects on living beings and vegetations. It plays vital role in atmospheric chemistry and Earth's radiation budget. Despite its importance, limited measurements of surface ozone are available over the Indian subcontinent, particularly over Northern India covering the Indo-Gangetic Plain (IGP) region. Space borne sensors have shown substantially higher levels of total tropospheric ozone over IGP region. In order to understand the spatial heterogeneity of ozone and different processes which control ozone over this region, simultaneous measurements of surface ozone are initiated at a high altitude site Nainital (29.37°N, 79.45°E, 1958 amsl) in the central Himalayas and two low altitude sites, Pantnagar (29.0°N, 79.5°E, 231 m amsl) and Dehradun (30.33°N, 78.05°E, 640 m amsl) in the IGP region. Nainital is far away from any major anthropogenic activities and thus will provide information about background levels in this region while the observations at Pantnagar and Dehradun will be useful for assessing the influences of local/regional pollution. Ozone observations at Nainital were initiated during September 2006, while at Pantnagar and Dehradun observations were initiated in 2008 and 2009 respectively.

Diurnal variations in ozone at Nainital do not show a daytime buildup in the levels which suggests that the role of in-situ photochemistry is not dominant at this site and ozone levels are mainly controlled by the transport processes. In contrast, ozone levels show daytime buildup at Pantnagar and Dehradun indicating the major role of in-situ photochemistry. Seasonal variation in ozone at Nainital shows a distinct maximum in late spring (about 65 ppbv in May) with values sometimes exceeding 100 ppbv and a minimum in the summer/monsoon season (about 25 ppbv in August). Ozone seasonal variation at other two sites Pantnagar and Dehradun are more-or-less similar to those at Nainital. However ozone levels are lower at Pantnagar (about 35 ppbv in May) and Dehradun (about 40 ppbv in May) when compared with those at

Nainital. Springtime ozone values in the central Himalayas are significantly higher than those at another high altitude site in the western part of India. During many occasions, ozone observations at Pantnagar and Dehradun show similar variations and enhancements suggesting the role of large scale dynamics.

Seasonal variations in ozone and the processes responsible for the springtime peak are studied using meteorological parameters, insolation, spatial and temporal classifications of air mass trajectories, fire counts, and simulations with a chemical transport model. Net ozone production over Northern Indian Subcontinent in regionally-polluted air masses is estimated to be ~ 3 ppbv/day in spring but no clear build-up is seen at other times of year. Regional pollution is shown to have maximum contribution to ozone levels during May-June and it is about 7 ppbv on annual basis. It is also seen that emissions from the IGP region can influence the pristine environment of Himalayan region, particularly during noon hours. Influence of long range transport and contribution of downward ozone transport are being investigated and more detailed results will be presented.

2