Assessment of Sensitivity of Tropospheric Ozone Production to NO_x and VOCs Emissions Using WRF/Chem Model for Megacity Delhi

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An increase in ozone build up in the recent years has been witnessed in Delhi, the capital city of India which is a cause of alarm due to the detrimental effects of ozone on public health. Regular monitoring of ozone concentrations revealed that an increase of 6 $\mu g\ m^{-3}$ from 2009 (35.3 $\mu g\ m^{-3}$) to 2012 (41.5 $\mu g\ m^{-3}$) was recorded (Gupta and Mohan, 2015) in Delhi and in summer 2015, exceedance of O_3 levels ranged from 92% - 97%. Tropospheric ozone is produced by a cycle of reactions involving two basic pollutants NOx and VOCs. Chemical regional transport models such as WRF/Chem are used extensively for modeling of ozone concentration. As ozone production has distinctive daytime and nighttime chemistry, Gupta and Mohan (2015) recommended that for Delhi model implementation shall be made for policy decisions cautiously with due consideration to the magnitudes of ozone levels. In order to implement control strategies it is conducive to understand whether the study area is NOx or VOC limited. This study focuses on the WRF/Chem model to simulate ozone concentration for megacity Delhi during summer conditions for three consecutive years. To understand the role of VOC and NOx in ozone formation model simulated VOC to model simulated NOx ratios were studied through scatter plots. Ozone production is considered to be VOC limited at low VOC to NOx ratio i.e. less than about 4 to 1 and for high ratio greater than about 15 to 1 the region is classified as NOx limited. There are various sources that contribute to VOC emissions such as vehicular pollution, refueling stations, industrial hubs, diesel generator sets etc. In Delhi overall about 26 to 54% of VOCs are due to the emissions from diesel internal combustion engine (Srivastava et al., 2005). Srivastava et al. (2005) reported source contribution to total VOC for a traffic junction in Delhi as 43% from diesel exhaust, 24% from gasoline, 19% from evaporative and 14% from other sources. As the ozone production is VOC limited for megacity Delhi, WRF/Chem model can be further used to apply control strategies. The response of reduction in VOC emissions from transport sector on ozone production can be modeled in order to formulate effective mitigation measures involving both VOC and ozone reduction.

References:
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