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Variations of surface ozone and its precursors over Kannur

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The concentrations of trace gases are quite low in the atmosphere, yet they play a vital role in varying the ambient air quality over a region. Moreover, their chemistry could effectively modulate radiative transfer which often results climate changes. Exploring the schemes of interactions among these gases is highly essential to understand their potential role in the radiative forcing that lead to the dynamics of the atmosphere. In addition to this, the secondary species produced from the pollutant trace gases impart environmental impacts that can be expected with modifications to their sources and sinks. Ozone (O_3) produced on the ground level is one of the important secondary pollutants in the atmosphere which has a strong influence on human health and agricultural crop yield. O_3 is produced in the troposphere when methane (CH_4), non-methane hydrocarbons (NMHCs) and carbon monoxide (CO) are photo-chemically oxidized in the presence of nitrogen oxides (NO_x) present in the ambient air. These precursors have a wide variety of sources by which they exhibit a non-linear effect on local O_3 production and its variation is strongly influenced by meteorological processes. The tropospheric O_3 concentration is determined by downward transport from the stratosphere, dry deposition to the Earth's surface and photochemistry in the troposphere involving its precursors. Being a strong oxidant in the atmosphere, tropospheric O_3 plays a significant role in the radiative balance of the atmosphere. Thus, the diurnal and seasonal variations of surface O_3 are quite significant to explore the chemistry and its impact on the radiative forcing of atmosphere. This would further lead to the investigation of the major role played by the efficiency of O_3 towards global warming and thereby the climate change. This study mainly focuses on to the seasonal variation of surface O_3 and its prominent precursors NO_x, CH_4 and total non-methane hydrocarbons at Kannur (11.9°N, 75.4°E, 5m asl), a rural location confined between the costal belt of the Arabian sea and Western Ghats in Kerala state. The study further revealed that O3 and NO_x have a very strong inverse correlation during the period of observations suggesting the possible VOC sensitive characteristics of the study location.

Investigations were extended to classify the photochemical production of O_3 from NO_2 during day time and a strong correlation between variations of $[NO_2]/[NO]$ and day time O_3 was obtained. Besides, monthly average, maximum and minimum CH_4 concentrations have been observed in December and in August in a year. The diurnal variations of CH_4 are quite similar to that of NOx and it has been found that CH_4 shows a gradual buildup in early morning hours of all days in a year due to the peak traffic emissions and boundary layer processes. CH_4 is observed to be fairly low during noon time and thereafter it starts increasing in evening hours of all months. The prominent organic species detected in the ambient air at this location throws light on the influence of complex chemistry involving VOC and its major role in the enhancement of O_3 at this site. This attempt could classify the variation of tropospheric O_3 concentration which acts as a tracer in the atmosphere to monitor the chemistry of trace gases over a rural location in Kerala.

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