URSI AP-RASC 2019, New Delhi, India, 09 - 15 March 2019

Tropospheric Ozone over South Asia: Climatology and Long-term Trend

Narendra Ojha* [(1)], Imran A. Girach[(2)], Sourita Saha[(1)], Som K. Sharma[(1)], Narendra Singh[(3)]
(1) Physical Research Laboratory, Ahmedabad, India, 380009, e-mail: ojha@prl.res.in; sourita@prl.res.in; somkumar@prl.res.in
(2) Space Physics Laboratory, Vikram Sarabhai Space Centre, Thiruvananthapuram, India, 695022, e-mail: imran.girach@gmail.com
(3) Aryabhatta Research Institute of Observational Sciences, Nainital, India, 263001, email: narendra@aries.res.in

Tropospheric ozone plays a key role in controlling the oxidation capacity of the atmosphere, and is a Short-Lived Climate forcing Pollutant (SLCP). Rapid changes in the emissions, land use, and regional climate are anticipated to intensify the tropospheric chemistry in South Asia during last two decades. Owing to the tropical convection together with strong horizontal winds aloft, the changes in tropospheric chemistry over South Asia influence the global atmospheric composition especially in the Upper Troposphere and Lower Stratosphere (UTLS). However, in situ observations in the free troposphere are highly sparse over South Asia to study the long-term changes in this region and their impacts downwind. Here, we combine satellite retrievals (Ozone Monitoring Instrument (OMI) and Microwave Limb Sounder (MLS) on board the Aura spacecraft), model reanalysis (MACC; Monitoring Atmospheric Composition & Climate), and a regional climate model (WRF-Chem; Weather Research and Forecasting coupled with Chemistry) to investigate the tropospheric ozone climatology and long-term trend over South Asia during 2005-2017 period. Satellite retrievals show elevated tropospheric ozone loading (~50 DU) along the Indo-Gangetic Plain (IGP) during both pre-monsoon and the summer monsoon, and reveal strong inter-annual variations of 10–15 DU. A general increase in the Tropospheric Column Ozone (TCO) is observed across the South Asia in all the seasons. Wintertime TCO shows an increase over the western India and Northwest Indo-Gangetic Plain (IGP) with a statistically significant ($p < 0.05$) trend of about 3% year^{-1}, which agrees with the changes in the anthropogenic emissions in the region. Interestingly, during the post monsoon, ozone trends are most pronounced in the central to Southern Indian regions, and over the marine regions adjoining India. These results are further corroborated with the long-term satellite retrievals and model reanalysis fields of CO, NO_2, and HCHO. Sensitivity simulations using a regional chemistry climate model (WRF-Chem) are being performed to analyze the role of large-scale dynamics, besides the regional photochemistry.