

Tropospheric and lower stratospheric ozone variations in India

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Seasonal and long-term ozone variations in the troposphere and lower stratosphere at three stations in India (New Delhi, Poona, and Trivandrum) are investigated using ozonesonde data between 1966 and 2006.

In the lower troposphere, ozone mixing ratios maximize in northern winter and spring and minimize in summer in all three stations. In the lower stratosphere, the phase of seasonal cycle differs at different stations: the mixing ratios maximize in winter (summer) and minimize in summer (winter) at New Delhi (at Poona and at Trivandrum).

Seasonal variations at three stations in different height regions are compared between the 1970s-1980s and the 1990s-2000s. General increase in ozone is observed from the former period to the latter at all stations in the lower troposphere to mid-troposphere. In the lower troposphere at Poona and Trivandrum, an increase in the amplitude of seasonal variation is observed. In the former period, the ozone mixing ratios are constant and low throughout the year, but in the latter period, ozone increases in northern winter when the convective activity is low.

Satellite trace gas data and air trajectories are analyzed to investigate the factors of these variations and changes. Mid-tropospheric CO mixing ratios measured by the Atmospheric Infrared Sounder (AIRS) onboard the Aqua satellite shows a maximum in northern spring and a minimum in summer over south Asia. The spring maximum coincides with that of ozone, indicating the primary contribution of biomass burning emissions to these constituents.

On the other hand, backward trajectories indicate lower tropospheric transport from the Indian Ocean to the stations in northern summer. This oceanic air transport contributes to the lower tropospheric ozone minimum in this season.