

Upper air ozone observations in Hanoi, Vietnam

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1. Introduction

Atmospheric ozone play an important role in determining dynamical and thermal structures of the atmosphere through radiative and chemical processes. Therefore, it is important issue to know 3-dimensional distribution of ozone and its spatial and temporal variabilities on the global basis. However, in the Indochina Peninsula region there have been no systematic upper ozone observations. We have performed continuous ozonesonde observations in Hanoi, Vietnam since September 2004 as an activity of SOWER/Pacific (Soundings of Ozone and Water in the Equatorial Region/Pacific Mission) project. In this brief article, we introduce preliminary results of the observations.

2. Observation

We have conducted monthly ozonesonde observations in Hanoi from September 2004 up to now. We performed once monthly observations until Jan 2006. The observation frequency has been increased to twice per month from February 2006, which has been partly supported by NOAA (National Oceanic and Atmospheric Administration).

We also conducted intensive observations three times in winter time. These observations were conducted as an activity of the SOWER MATCH campaign which aimed to obtain an evidence of dehydration in TTL (Tropical Tropopause Layer) region by multi-station balloon observations over the western Pacific, the Maritime Continent and the Indochina Peninsula.

3. Seasonal variation of ozone

For the stratospheric ozone, we find a clear seasonal cycle above 25 km height with maxima in summer and with minima in winter, while we don't find significant seasonal variation below 25 km. This clear seasonal cycle is consistent with well-known seasonal variation of stratospheric ozone.

In the upper troposphere (10-15 km), we find seasonal variation with maxima in summer and with minima in winter. Similar seasonal variation is found in lower troposphere below 5 km height. In the middle troposphere (5-10 km), a significant seasonal cycle is not seen. It should be noted that strong intraseasonal variation is found in whole height range.

4. Origin of low ozone in the upper troposphere

In order to investigate the reason of low ozone concentration in the upper troposphere in winter, we calculated backward trajectories. We compared the backward trajectories calculated when the low ozone concentration was observed with those calculated when the high ozone was observed.

For high ozone case, every air parcels were traced back to far western subtropics and mid-latitudes. On the other hand, for low ozone case, the upper tropospheric airs were transported from the Maritime Continent and the western Pacific, although the middle level trajectories were from subtropics and mid-latitudes similar to the high ozone case. Therefore, the air parcels with low ozone mixing ratio were probably transported from convective region over the Maritime Continent and the western Pacific. In the upper troposphere over the Maritime Continent, low ozone concentrations are frequently observed, and it is suggested that these air parcels were lifted up from the near surface.

5. Summary

We have conducted almost 2 years continuous ozonesonde observations in Hanoi, Vietnam. As preliminary results of the observations, seasonal variation of ozone were shown. Annual cycle with maxima in summer and with minima in winter is found in the lower and upper tropospheres and middle stratosphere. The upper tropospheric ozone minimum is probably due to low ozone advection from the Maritime Continent and the western Pacific.