

Seasonal variation of ozone over the Northern subtropical region revealed by ozonesonde observations in Hanoi

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It is important to observe the 3-dimensional ozone distribution on the global basis and continuously in order to understand the basic structure of the atmosphere and the climate change. However, there have not been continuous ozonesonde observations in the Indochina region. We have accumulated the ozonesonde data since September 2004 in Hanoi, Vietnam located on the base of the Indochina Peninsula. Here, we report new findings revealed by the accumulation of such a unique ozonesonde observation.

The characteristics of the season-height variation of the ozone mixing ratio from the near-surface up to the UTLS region are as follows:

i) In the UTLS region, the ozone mixing ratio shows a clear seasonal variation with larger values in summer and smaller in winter.

ii) During the summer time, ozone mixing ratio peaks in June and also in August. This double-peak variation corresponds to that of the summer monsoon rainfall seen over the Indochina peninsula, suggesting the close relationship between the tracer transportation and the monsoon circulation.

iii) The ozone mixing ratio in the lower troposphere has a peak in spring at about 3 km. This result suggests an importance to consider the 3-dimensional transport for understanding the spring maximum of the surface ozone that is a common feature over the east and the southeast Asian regions.

iv) In addition to the seasonal cycle, the intraseasonal variations in ozone mixing ratio also dominate through the near-surface to the UTLS region. In the UTLS region, the ozone variation has a time-scale of several days that agrees well with the meridional wind variation.

The detailed analysis concerning the result (iv) in the UTLS region was performed. It was found that the several days variation of ozone mixing ratio resulted from the difference in air mass sources. The difference was associated with the mid-latitude and sub-tropical disturbances. The structures of the disturbances were different between in winter and in summer. In winter, the eastward propagating Rossby wave trapped near the westerly jet (around 30N) was dominated, while the westward propagation in sub-tropics (around 20N) was found in summer time.