Japan Geoscience Union Meeting 2012
(May 20-25 2012 at Makuhari, Chiba, Japan)

AAS22-P15 Room:Convention Hall Time:May 21 17:00-18:30

Ozone variations over the northern subtropical region revealed by ozonesonde observations in Hanoi

OGINO, Shin-Ya[1*], FUJIWARA, Masatomo[2], SHIOTANI, Masato[3], HASEBE, Fumio[2], MATSUMOTO, Jun[4], HA Hoang Thi Thuy[5], THANH Nguyen Thi Tan[5]

[1]JAMSTEC, [2]Hokkaido University, [3]Kyoto University, [4]Tokyo Metropolitan University, [5]Aero-Meteorological Observatory, Hanoi

We have conducted continuous monthly ozonesonde observations and campaign intensive observations with a few-day interval every winter at Hanoi (21N, 106E), Vietnam since September 2004. By using the obtained data, seasonal and subseasonal variations in ozone mixing ratio (OMR) are investigated and the cause of the variations are discussed. A relative standard deviation (RSD), which is defined as a standard deviation divided by the mean value, is employed to evaluate the amplitude of variation in order to eliminate the rapid increase of the mean OMR with height.

In the lower and middle stratosphere (above about 20 km height), a clear seasonal variation is found with larger values in spring and summer and with smaller values in winter which is consistent with the well-known features of seasonal variation shown by previous studies.

A seasonal cycle with a winter minimum and a spring-summer maximum is also found in the UTLS region (10–20 km) with the larger RSD of 20-30%. Backward trajectory analysis shows that the winter minimum is due to the low OMR air mass transport form the tropical troposphere. This feature is commonly seen through the UTLS region in winter. On the other hand, the variation from spring to summer seem different between above and below the tropopause level at around 17 km. Below the tropopause level (upper troposphere around 14 km), the OMR peaks in late spring (May). This peak is consistent with the air mass transport from the mid-latitude stratosphere to the deep troposphere due to tropopause foldings. Above the tropopause level (lower stratosphere around 18 km), the OMR peaks in summer (July to August). This peak seems to be caused directly by the anti-cyclonic circulation associated with the Tibetan High, which is different from the upper tropospheric increase due to the tropopause folding. In mid-summer, the well-developed tongue-shape structure with high OMR air masses moves over Hanoi. As a result, the maximum OMR is considered to appear at around 18 km height in summer over Hanoi.

In the lower troposphere, the OMR has a clear maximum in March to April at about 3 km height. The maximum seems to propagate downward from 3 km height to the surface ozone maximum in May. The relation with surface ozone enhancement due to biomass burning is suggested, although the feature with downward propagation is inconsistent with the surface source. A tropopause folding is another candidate for producing the spring ozone maximum at 3 km.

Subseasonal variations in OMR show large amplitude in the UTLS region (around 15 km) and in the boundary layer (below 1 km) with the RSD of larger than 40¥%, which is comparable to that of mean seasonal variation of OMR. It is shown that the OMR variations in the UTLS region during the every winter campaigns have a negative correlation with the meridional wind. This relation indicates that the low OMR observed at Hanoi has been transported from the equatorial region, which is confirmed by backward trajectory analyses. This result supports the interpretation that the OMR winter minimum in UTLS is caused by the low OMR air mass transport from the equatorial region where the mean ozone concentration is low.

The mean OMR values during the winter campaigns suggest an existence of significant year-to-year variability in OMR at Hanoi. In January 2006, the convective center accompanied by the anti-cyclonic circulation as Rossby response moved westward due to the La Nina condition, which result in the more frequent arrival of low OMR air masses transported from the equatorial region to Hanoi. There is a possibility that a similar large-scale circulation change associated with the ENSO variation can strongly affect the ozone and other quantities over Hanoi.

Keywords: ozone, Stratosphere troposphere exchange, Indochina Peninsula, tropopause folding, Rossby wave breaking, biomass burning