Seasonal variation of tropospheric column ozone over the East Asia observed with GOME and ozonesonde measurements

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Tropospheric ozone plays an important role in controlling chemical compositions of the troposphere and influences on energy budget of the Earth atmosphere. A recent increase in energy consumption in Asia due to distinct industrialization caused rapid growth in Asian emissions of ozone precursors (hydrocarbons, CO, NOx) (Ohara et al., 2007). In particular, the NOx emissions from China increased very rapidly in the 1990s (Richter et al., 2005) and dominated the NOx emissions from other countries of Asia (Ohara et al., 2007). It is reported that tropospheric ozone concentration increased since pre-industrial times as a result of the enhancement of those precursors.

So far, the tropospheric ozone distribution was derived mainly from ozonesonde measurements. However, it is difficult to derive the spatial distribution of ozone from the measurements at the limited number of ozonesonde stations. On the other hand, satellite measurements have an advantage in continuous monitoring of atmospheric ozone over a wide spatial range. Unfortunately, however, separation of the relatively small tropospheric component (about ˜10 %) from the total column ozone has been a big challenge.

Recently, Liu et al. [2006] succeeded to derive tropospheric column ozone (TCO) directly from the Global Ozone Monitoring Experiment (GOME) ultraviolet measurements from 1996 through 2004. We analyzed the dataset focusing on the ozone distribution over the East Asia.

During the year around, an enhanced TCO belt was clearly observed in the mid-Northern latitudes. The enhanced TCO belt over the East Asia shifted north in summer and south in winter, corresponding to the Monsoon wind system. Comparison of GOME TCO with the ozonesonde data at four Japanese stations, including Naha, Kagoshima, Tateno and Sapporo, revealed clear seasonal variation of the location and concentration of the enhanced TCO belt. We discuss the seasonal variation of the TCO distribution connected with the anthropogenic emissions of precursors from Asia.