Continuous Measurement of Atmospheric Pollutants at Moshiri, Northern Japan: Influence of Anthropogenic Activity and Siberian Forest Fire (Extended Abstract)

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Continuous Measurement of Atmospheric Pollutants at Moshiri, Northern Japan : Influence of Anthropogenic Activity and Siberian Forest Fire (Extended Abstract)

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Introduction

East Asia has huge population and is keeping development. It will become a most important source region of atmospheric pollutants. To discuss the regional pollution in east Asia, background air information in this area is necessary. Moshiri is located at the northern part of Japan. In mid latitude in the northern hemisphere, westerly wind dominates. So Moshiri is not strongly influenced by the polluted air emitted from China, Korea, and Japan. Also the measurement site is not near from cities and local pollution is not important. Continuous measurement at Moshiri is expected to show typical seasonal variation of atmospheric species in east Asia region. Continuous ground-based measurements of atmospheric trace species have been carried out and seasonal variations of ozone (O_3), carbon monoxide (CO), and various hydrocarbons/halocarbons have been observed.

Experiment

O_3 is measured continuously by UV absorption (Dylec 1150) and CO is measured by IR absorption (Themo Environment Instrument Model 48C). Canisters are sampled once a week for hydrocarbon measurements. Using GC-FID (HP-6890) or GC-MS (HP5796) with pre-concentrator(Entech 7000), C2-C10 hydrocarbons, and halocarbons are analyzed. These measurements started from October, 2000.

Results and Discussion

Seasonal variation

The selected measurement results are shown in Figure 1. CO and O_3 show clear seasonal variation. Their maximum appear in spring and minimum appear in summer, as reported other remote sites. The maximum period of O_3 is later than CO. The

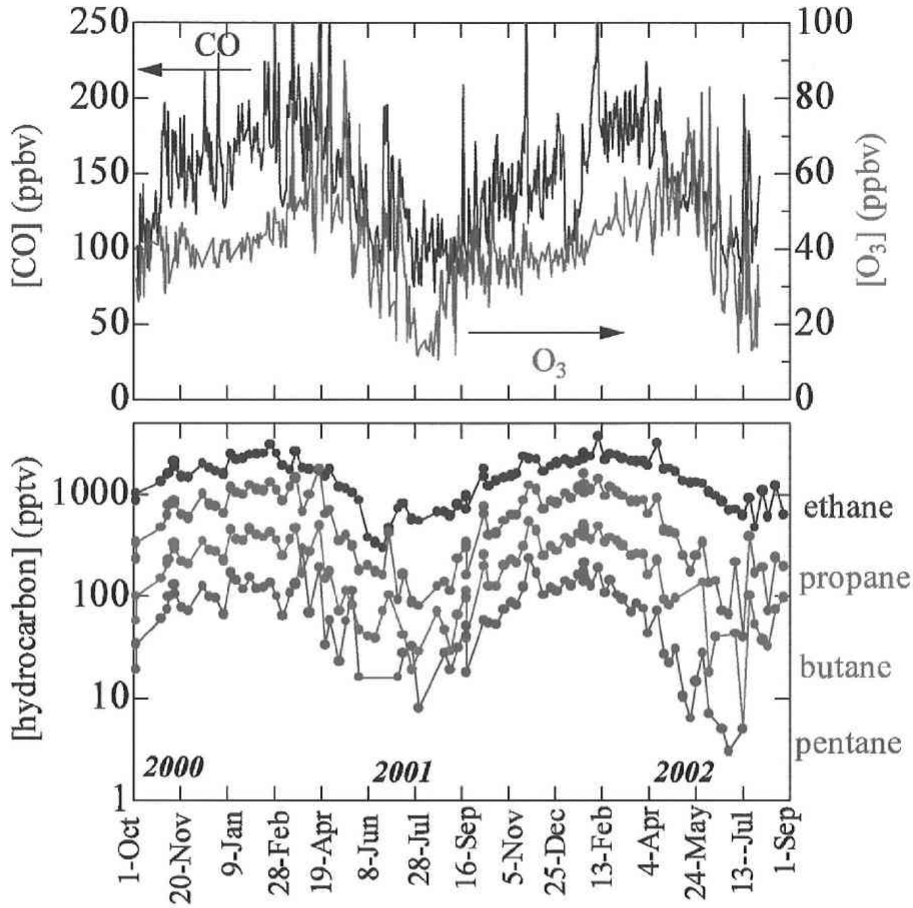

Fig. 1. Seasonal variation of CO, ozone, and hydrocarbons at Moshiri

seasonal variation of hydrocarbons are similar to CO. Their concentrations decrease as increasing of carbon number (and decreasing of the life time in the atmosphere). This indicates that the air at Moshiri is not affected by the local pollution strongly.

hydrocarbon ratio

Hydrocarbons are mainly removed by the reaction with OH radical in the atmosphere. If the hydrocarbon source flux is constant, hydrocarbon concentration in remote place should be controlled by OH radical concentration (main removal process is reaction with OH). When hydrocarbon ratio during winter/summer (maximum/minimum) are plotted against reaction rate constant of OH radical for each hydrocarbon species, there is a trend that more reactive species have larger winter/summer ratio. The influence by the reaction with OH is more significant during summer, when OH radical concentration is maximum. This correlation supports that hydrocarbon concentration and its seasonal variation are measured in a remote site.

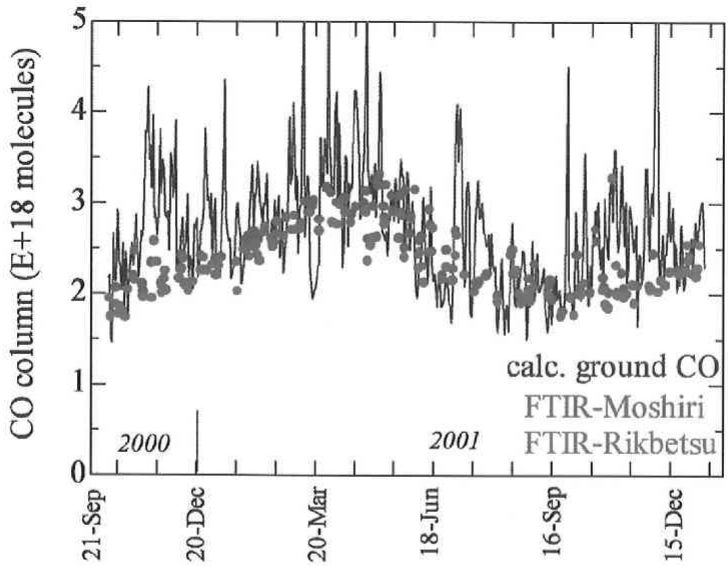

Fig. 2. Comparison between ground CO and column CO abundance

Correlation between CO and O_3

In the troposphere, O_3 is generated by the photochemical reaction with NOx and hydrocarbons. NOx is mainly emitted from urban area, where CO emission is also enhanced. Therefore, correlation between CO and O_3 will be good when photochemical production of O_3 is enhanced. On the other hand, O_3 will be decrease by the reaction with NO near the urban area in absence of photochemical reaction.

When CO and O_3 correlation are plotted in winter (December, 2000) and summer (July, 2001), slight negative correlation will be found in December. This indicate less photochemical activity to produce O_3, and rather some O_3 destruction by polluted air. On the other hand, there is clear positive correlation in July. However, Moshiri is not directly affected by the polluted air, this positive correlation between CO and O_3 indicate that O_3 production is enhanced by the long range transport, dispersion of polluted air over all east Asian region. When the slope and correlation factor (R^2) of O_3 vs CO plots were shown for each month, positive correlation during spring-summer and no correlation during winter are obvious.

Influence of Siberian forest fires

The deviation of ground measurement CO is caused by the polluted air transport from polluted area. But there are some cases that backward trajectories during such high CO concentration period did not come from polluted area. It was reported Siberia forest fire affect the CO and O_3 concentration at northern Japan (Kajii *et al.*, Kato *et al.*, Tanimoto *et al.*). For case study, the data in April, 2001 is picked up. High CO concentration period (A) and normal period (B) are compared. The corresponding backward trajectories indicate that air mass did not come from polluted area in high CO

period (A). This high CO would be originated from the biomass burning in Siberian forest. The TOMS aerosol index support the existence of fires. In the case of (B), air mass passed near Japan and transported from China, but CO concentration is normal.

Comparison with ground and FTIR CO measurements

CO column abundance has been measured at Moshiri and Rikubetsu, where is about 150 km east from Moshiri. So both sites show similar results. The ground measured CO is compared with FTIR results. When just comparing with column abundance and ground surface concentration, they have similar seasonal variations. Since they have different units, this is not absolute scale comparison. Larger deviation (high concentration peaks) is often observed on the ground, since transport of polluted air is only important at lower altitude. The other big difference is lower concentration of ground CO during summer. This would be explained by the boundary height variation. During summer, tropopause is higher than during winter. So arranged surface CO by boundary height are plotted. It has a same unit as column abundance assuming that the CO concentration under the tropopause is uniform and same as ground. The comparison of this calculated CO and FTIR results is fairly good.

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