Continuous measurements of atmospheric O_2 and CO_2 at Tokyo

*Yu Hoshina[1], Yasunori Tohjima[1], Yukio Terao[1], Keiichi Katsumata[1], Mai Ohuchi[1], Toshinobu Machida[1]

1. National Institute for Environmental Studies

High-precision measurements of atmospheric carbon dioxide (CO_2) in megacities are useful to validate the inventories of the fossil fuel-derived CO_2 emissions. In addition, recent studies suggest that combination of the atmospheric oxygen (O_2) and CO_2 measurements have potential for disaggregate the emissions of CO_2 into biosphere and fossil fuel combustions, which are coal, liquid fuel and natural gas. Since the exchange ratios between O_2 and CO_2 ($-O_2/CO_2$) are difference values for fossil fuel burning (1.17 for coal, 1.44 for liquid fuel and 1.95 for natural gas) and biotic process (1.0) due to depending on the elemental compositions. For a better understanding of the seasonal and long-term changes in CO_2 emission and contribution from fuels in the megacity, we started a continuous observation of atmospheric O_2 and CO_2 concentration at Tokyo Skytree in February 2017.

The observed CO_2 showed not only a seasonal variation but also short-term variations with amplitudes of more than several tens ppm, which were mirrored by the O_2 variations. The monthly averages of the $-O_2/CO_2$ ratios for the short-term variations, ranging from 1.35 to 1.63, were low in summer–autumn and high in winter. Since the short-term variations unclear correspond to the diurnal cycles, these variations may be attributed to the synoptic scale mixing of air. Examining the relation between CO_2 concentration and wind direction, we found that the high CO_2 concentration events with durations of several hours to few days were often observed when southwest wind blew. It should be noted that the $-O_2/CO_2$ ratio of such high CO_2 event tended to be high. This result seems to suggest that there are strong CO_2 sources with relatively high $-O_2/CO_2$ ratio, for example natural gas-fired plants, to the southwest of Tokyo Skytree.

