Climatology of spatiotemporal variations of tropospheric CO2 observed by CONTRAIL-CME

UMEZAWA, Taku[1]* ; MACHIDA, Toshinobu[1] ; SAWA, Yousuke[2] ; MATSUEDA, Hidekazu[2] ; NIWA, Yosuke[2]

[1]National Institute for Environmental Studies, [2]Meteorological Research Insitute

CONTRAIL is the ongoing project that measures atmospheric trace gases during intercontinental flights of Japan Airlines. Atmospheric CO_2 concentration is analyzed using Continuous CO_2 Measuring Equipment (CME) onboard the aircraft. From ~20 thousands of measurement flights since 2005, extensive number of CO_2 data (~2 millions) along level-flight and ascent/descent tracks have been obtained, enabling us to well characterize spatiotemporal distributions of atmospheric CO_2 covering large part of the globe especially the Asia-Pacific regions. In this study, we define $\triangle CO_2$ as a deviation from the long-term trend observed at a northern hemispheric baseline station Mauna Loa, Hawaii, to illustrate climatological CO_2 distributions including seasonal and shorter-term variations. For instance, over airports in Japan, $\triangle CO_2$ reaches seasonal maximum at the end of April with higher values near the surface. In this season, high $\triangle CO_2$ spreads east of the Asian continent in the upper troposphere over the northern Pacific. In contrast, seasonal minimum of $\triangle CO_2$ occurs in September with more depletion in the upper troposphere. The summertime low $\triangle CO_2$ in the upper troposphere appears to be more pronounced over the Asian continent than over the Pacific. Likewise, we present seasonal variations of vertical profiles of tropospheric $\triangle CO_2$ over various airports and of spatial distributions in the upper troposphere in large-scale perspective, and discuss them from viewpoints of seasonally varying continental sources/sinks and atmospheric transport.

Keywords: CONTRAIL, CO2, troposphere, seasonal variation, vertical profile