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Long-term Observation of Atmospheric Greenhouse Gases using Aircraft

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The more reliable prediction for future level of atmospheric greenhouse gases such as carbon dioxide (CO2) requires the quantitative understanding of global cycles in these gases. Comprehensive observation in atmospheric mixing ratios of trace gases can reduce the uncertainties of emission and absorption of these gases at earth's surface. The atmospheric observations, however, are not enough in several areas in the world, especially observations in upper atmosphere are quite limited compared to surface measurements.

Aircraft is one of the most reliable tools to observe the atmospheric compositions in troposphere and lower stratosphere. Several activities have been conducted to understand the 3-dimensional distribution and temporal variation of atmospheric greenhouse gases.

Mixing ratios of atmospheric CO2 have been measured from 200 to 10,000 m over Japan using chartered and commercial airliner since 1979 by Tohoku University (TU). Obtained data set is the longest record for CO2 mixing ratio in upper air. Latitudinal distributions of CO2 in upper troposphere are observed by commercial airliner operated by Japan Airlines (JAL) between Sydney, Australia and Narita, Japan, and Narita and Anchorage, USA from 1984 to 1985 by TU. The JAL observation in Australia-Japan route started again in 1993 using an Automatic Air Sampling Equipment (ASE) by Meteorological Research Institute (MRI). The new JAL observation named "Comprehensive Observation Network for Trace gases by AIrLiner (CONTRAIL)" have been done using improved ASE and Continuous CO2 Measuring Equipment (CME) since 2005 by National Institute for Environmental Studies (NIES) and MRI. Time series of CO2 mixing ratio in upper troposphere observed by old ASE and improved ASE are shown in the Figure. CONTRAIL-CME provides a large amount of CO2 data in upper air which contribute to solve global carbon cycle, atmospheric transport, model validation and satellite validation.

When dedicated aircraft is introduced in Japan, we propose to make a long-term observation for atmospheric greenhouse gases using above techniques and instruments.

Keywords: Greenhouse gases, Aircraft, CO2, Long-term observation, Troposphere