## Observations of Atmospheric Greenhouse Gases using Commercial Aircraft by CONTRAIL project

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To fill the gap of atmospheric CO2 observation in upper atmosphere, we developed the Continuous CO2 Measuring Equipment (CME) and the Automatic air Sampling Equipment (ASE) and installed them on commercial airliners operated by Japan Airlines (JAL) under the CONTRAIL project started in 2005. As of 2018, JAL prepared ten aircraft, eight of Boeing 777-200ER and two of Boeing 777-300ER, to be able to carry the CME. Five of 777-200ER can be equipped the ASE. When we need air samples on the routes where JAL does not operate 777-200ER, a Manual air Sampling Equipment (MSE) can be used instead of ASE. MSE consists of simply hand-operated pump and metal flasks.

To prepare the replacement of aircraft type in the next generation, we have been studying to modify Boring 787 aircraft to install CME and ASE. We are planning to finish the design and to modify JAL's 787 in these 3-4 years.

The CONTRAIL data can be distributed on the request of any researcher for any scientific purpose. Recently CONTRAIL-CME data are openly available with doi number: doi:10.17595/20180208.001.

キーワード:温室効果ガス、民間航空機、ボーイング777型機 Keywords: Greenhouse gases, commercial aircraft, Boeing 777