

MEASUREMENTS OF ATMOSPHERIC CO₂ USING COMMERCIAL AIRLINERS

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The two automated instruments of Continuous CO₂ Measuring Equipment (CME) and Automatic Air Sampling Equipment (ASE) for a Boeing 747-400 were developed and approved by the aviation regulatory agencies in US and Japan as Supplemental Type Certificate (STC), while the approval of the CME for a Boeing 777-200ER as STC was also obtained. CME observation has advantages to conduct high-frequency measurements in wide area coverage with detailed spatial distributions in CO₂. Despite the limited flight frequency, ASE observation provide the distributions in not only mixing ratio of CO₂ but also methane (CH₄), carbon monoxide (CO), molecular hydrogen (H₂), nitrous oxide (N₂O), and sulfur hexafluoride (SF₆) and stable isotope ratios of CO₂ and CH₄. The ASE and CME are installed on the racks in the forward cargo compartment and the air by-pass intake is mounted on the air conditioning duct upstream of the recirculation fan.

To extend the long observational record of CO₂ in the first phase of the JAL airliner project from 1993, the new ASE observation is made on the same flight route between Australia and Japan twice a month from December 2005. The obtained data show a good agreement between the CO₂ as determined for the ASE flask samples compared to the in situ measured values from the CME during the same flight, most of data being within ± 0.2 ppm (Fig. 1).

Latitudinal distributions of CO₂ at about 10 km from CME between Jakarta, Indonesia and Narita, Japan were observed during 6–10 November 2005. Quite similar patterns of the CO₂ distribution are observed for all of the level flights during this short period of time. All of the distributions clearly show a boundary with a large gradient of the CO₂ level around 2°N in the equatorial region over the western Pacific. Extremely high CO₂ mixing ratios were often observed near the airport in the vertical CO₂ profiles from CME. Except for these contaminated air masses, vertical profile shows positive gradient in autumn-winter seasons over the sites in northern mid-high latitudes, while almost constant values were observed over the tropics.

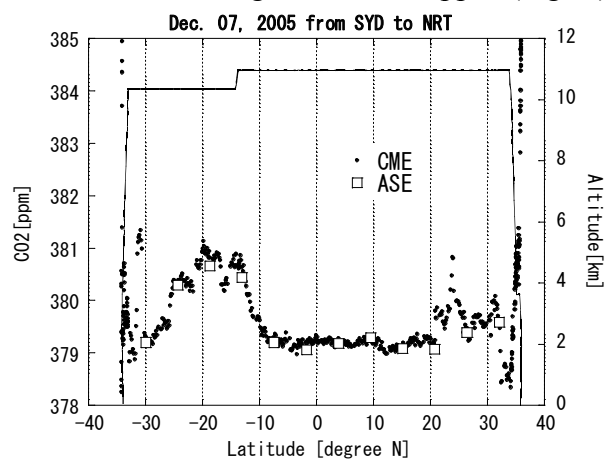


Fig. 1. Latitudinal distributions of CO₂ mixing ratios measured by ASE (open squares) and CME (black dots) Thin line represents the flight altitude.