

## Vertical and latitudinal differences of CO<sub>2</sub> seasonal variation observed by commercial airliners

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High-frequency observations of atmospheric carbon dioxide (CO<sub>2</sub>) have been conducted since November 2005 by using a newly developed Continuous CO<sub>2</sub> Measuring Equipment (CME) onboard commercial airliners. Two Boeing 747-400 aircraft and three 777-200 aircraft of Japan Airlines are operated to cover the wide regions from Japan to Europe, South-East Asia, East Asia, Oceania and North America. The CME can obtain high-resolution CO<sub>2</sub> data for the both vertical profiles every 10 seconds and horizontal distributions every 1 minute. We observed vertical profiles over 41 sites for 2 years and then the CO<sub>2</sub> seasonal cycles were well defined over 25 sites. Seasonal amplitudes at 2-4 km depend on latitudes, being 10.7 ppm over north Europe, 7.7 ppm over Honolulu and 3.1 ppm over Sydney. Vertical difference in seasonal amplitude is small in southern hemisphere and tropical regions, while seasonality in the northern mid-high latitudes largely decayed with altitude. In addition, short-term variability at 2-4 km over north Europe is larger by 3 times than that over Honolulu. These geographical differences can be used to provide a very powerful constraint to inverse CO<sub>2</sub> flux estimates.