CO2 column-averaged volume mixing ratio derived over Tsukuba from measurements by commercial airlines

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Column-averaged volume mixing ratios of carbon dioxide (XCO2) during the period from January 2007 to May 2008 over Tsukuba, Japan, were derived using CO2 concentrations measured by Continuous CO2 Measuring Equipment (CME). The CMEs were installed on Japan Airlines Corporation (JAL) commercial airliners, which frequently fly to and from Narita Airport. It was assumed that CO2 profiles over Tsukuba and Narita are the same. CO2 profile data for 493 flights on clear-sky days were analyzed in order to calculate XCO2 with one of two ancillary datasets: "Tsukuba observational" data (rawinsonde and meteorological tower), or "global" forecast/reanalysis and climatological data (NCEP and CIRA-86). The amplitude of the seasonal variation of XCO2 using the ancillary data measured in Tsukuba (XCO2 (Tsukuba observational)) was determined by a least squares fit using a harmonic function to roughly evaluate the seasonal variation over Tsukuba. The highest and lowest values of the obtained fitted curve in 2007 for XCO2 (Tsukuba observational) were 386.4 ± 1.0 and 381.7 ± 1.0 ppm in May and September, respectively, where the errors represent 1 standard deviation of the fit residuals. The dependence of XCO2 on the type of ancillary dataset was evaluated. The average difference between XCO2 from global climatological data, XCO2 (global), and XCO2 (Tsukuba observational), i.e., the bias of XCO2 (global) based on XCO2 (Tsukuba observational), was found to be −0.621 ppm with a standard deviation of 0.682 ppm. The uncertainty of XCO2 (global) based on XCO2 (Tsukuba observational) was estimated to be 0.922 ppm. This small uncertainty relative to the GOSAT precision suggests that calculating XCO2 using data from airliners and global climatological data can be applied to the validation of GOSAT products for XCO2 over airports worldwide.

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