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Global distribution of CO₂ in upper troposphere and lower stratosphere obtained by commercial aircraft observations

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We analyzed CO₂ distributions in the upper troposphere and the lower stratosphere obtained by Comprehensive Observation Network for TRace gases by AirLiner. More than 2 million in-situ CO₂ data from more than 3000 flights between Japan and Europe, North America, Australia, or Asia were collected during the period from November 2005 to November 2009. Observed mixing ratios were integrated in equivalent latitude and potential temperature grid for a reference year of 2008 to plot climatological distributions of CO₂. In the mid-, high latitudinal regions between Japan and Europe or North America, seasonal cycles with summer maximum and spring minimum were observed in lower stratosphere. Tropospheric CO₂ in these latitudinal bands showed strong seasonal cycles with springtime maximums and relatively sharp minimum in July. Longitudinal differences in CO₂ mixing ratios in the upper troposphere and lower stratosphere were relatively small but significant differences were found in the summer season at the potential temperature range of 340-350 K; lower CO₂ over the southern Eurasian continent and higher mixing ratios over the Northern Pacific. These differences may reflect the strength of CO₂ sink at the surface and its transport to the upper altitudes. CO₂ cross sections by using the flights between Japan and Australia or Southeast Asia show spread of high mixing ratios from the Northern Hemisphere to the Southern Hemisphere from April to June in the upper troposphere. This transport brings a unique seasonal peak in autumn in the Southern Hemisphere.

Keywords: CO₂, aircraft observation