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## A long-term change in north-to-south gradient of CO<sub>2</sub> in the upper troposphere

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Since April 1993, flask samplings for the JAL project had been made biweekly using a Boeing 747 passenger aircraft over the western Pacific between Japan and Australia. The air samples collected at 8-13 km were precisely measured for concentrations of CO<sub>2</sub> and other trace gases.

This JAL data is successful for completely describing time-series variations of upper tropospheric CO<sub>2</sub> for 12 latitudinal bands between 30N and 30S during the past 16 years.

Using the JAL observational record, we could analyze several characteristics of long-term changes in the spatial CO<sub>2</sub> distributions in the upper troposphere. In the present study, we present the latitudinal distribution of CO<sub>2</sub>, focusing on a gradual change of north-to-south gradient in the upper troposphere. This change is also evidenced when the CO<sub>2</sub> data observed in 1984 and 1985 by Nakazawa et al. (1991) are compared. It indicates a large impact of the increasing fossil fuel emissions on the global-scale CO<sub>2</sub> distribution.

Based on the extrapolated relation with the anthropogenic emissions, we deduced the natural latitudinal distribution of CO<sub>2</sub> in the upper troposphere when the fossil fuel emission is near zero during the pre-industrial age. Two key features of the natural distribution include: (1) CO<sub>2</sub> concentrations in the Northern Hemisphere that are lower than those in the Southern Hemisphere; (2) CO<sub>2</sub> concentration differences that are higher in the tropics than those currently measured.

Keywords: CO<sub>2</sub>, upper troposphere, north-to-south gradient