Trajectory-based reconstruction of the global distribution of CO_2

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In this study, we aim to reconstruct a new database of monthly zonal mean distribution of *carbon dioxide* (CO_2) at global scale extending from the *upper-troposphere* (UT) to the *stratosphere* (S). This product can be used for models validation in the UT/S, in particular, their ability to reproduce the plausible feature of the CO_2 inversion gradient occurring in the Northern Hemisphere lowermost stratosphere during summer. To do so, we investigate the ability of reanalysis-driven TRACZILLA trajectory model to construct the variability of CO_2 in the UT/S. Using 10 year backward trajectories and tropospheric observations of CO_2, we reconstruct upper-tropospheric and stratospheric CO_2 over the 2000–2010 period. The inter-comparisons of the calculated CO_2 with mid-latitude vertical profiles measured *in situ* from aircraft and balloons and, as well as, with reanalysis-driven CLaMS trajectory model exhibit a remarkable agreement. That demonstrates the potential of the TRACZILLA and CLaMS models to reconstruct CO_2 in the UT/S. The zonal mean distribution exhibits relatively large CO_2 in the tropical lower stratosphere due to the seasonal variation of the tropical upwelling of Brewer-Dobson circulation. During winter and spring, the tropical band is relatively isolated but is less confined during summer and autumn. Thus, high CO_2 values are more readily transported out of the tropics to the mid and high latitude stratosphere into the northern lowermost stratosphere around 15 km during summer and autumn. The shape of the vertical profiles suggests that relatively high CO_2 above 20 km altitude mainly enters the stratosphere through tropical upwelling. CO_2 mixing ratio is relatively low in the polar and tropical regions above 25 km. On average the CO_2 mixing ratio decreases with altitude by 6-8 ppmv from the UT to stratosphere (e.g. up to 35 km) and is nearly constant above 35 km.