Geophysical Research Abstracts
Vol. 21, EGU2019-4050-1, 2019
EGU General Assembly 2019

Comparison of atmospheric carbon dioxide, methane and carbon monoxide at two stations located in the Tibet Plateau in China

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Abstract: The Tibet Plateau is known as the core of 'the Third Pole of the Earth' and the 'water tower of Asia'. Due to the unique location and the sensitivity to the climate change, the research of greenhouse gases in this region is of great importance to understand and forecast the carbon cycle. In this study, Mole fractions of atmospheric carbon dioxide (CO_2), methane (CH_4) and carbon monoxide (CO) have been continuously measured since from July 2010 to December 2016 at the two stations located in the Tibet plateau in China, which are Mount Waliguan (WLG) and the Shangri-La station (XGLL). The WLG (36.29˚N, 100.9˚E, 3816 m a.s.l) is the only WMO/GAW global atmospheric station in China, located at the northeast of Qinghai-Tibet plateau in Qinghai province. The XGLL (28.02˚N, 99.73˚E, 3580 m a.s.l) is located at the southeast of the Qinghai-Tibet plateau, city of Diqing Tibetan autonomous prefecture in Yunnan province. The characteristics of diurnal and monthly variations, the influence of surface source and sink, the impact of long-distance transportation and the correlation analysis of these three greenhouse gases in the two stations were analyzed and compared. We analyzed the effects of long-distance transport on background values of atmospheric CO, CO_2 and CH_4 at the two stations, the results showed that nearly half of the tracks of WLG were from central Xinjiang province and northwest Qinghai province. About 30% of the clean air plumes in spring and winter comes from the Tibetan Plateau, passing through high pollution sources that increase concentration. XGLL is affected by the polluted air mass from northern Myanmar all year round, only 3% of the air mass comes from the Tibet Plateau in the spring and autumn, and the mole fraction is very low. The potential source contribution function (PSCF) further confirms the possible path and region of air mass transportation. The diurnal variation of CO_2 at XGLL is remarkable, the maximum appears at 8 (Local time). and the minimum at 17 LT, the maximum amplitudes (17.9$\pm$1.0 ppm) appears in summer, while the diurnal variation of WLG is very subtle. The prevailing easterly wind in summer brings high pollution gas to WLG. Meanwhile, XGLL is affected by the monsoon and regional transport, resulting in the seasonal changes of the two stations differs from that of MLO, RYO and UUM in the Northern Hemisphere. The correlation coefficient (R^2) of CO_2 and CO reached 0.888-0.94 in winter at WLG, which proved that they have obviously the same source and sink. The source and sink mechanism was relatively complex at XGLL because R^2 of CH_4 and CO_2, CO_2 and CO were basically less than 0.1. Relatively larger correlation between CH_4 and CO (R^2=0.28-0.82) prove that OH radical oxidation and regional transport such as fossil fuel combustion and biomass combustion are important sources and sinks at XGLL.