In situ measurement of vertical distribution of CO_2 and CH_4 in the troposphere by aircraft and tethered balloon

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Several satellites have been launched into space to monitore the greenhouse gases concentration, by observing the backscattered hyper-spectral radiance in the SWIR, in the atmosphere therefore the vertical profile of greenhouse gases, especially carbon dioxide, and aerosol could greatly modulate the retrievals. To investigate how the interplay process of the CO_2 and aerosol scattering in the atmosphere, which is blamed for the uncertainty of the retrieval results of satellite measurements. Therefore, knowledge of CO_2 vertical distribution is crucial for the development of satellite-borne retrieval methods and algorithm. Aircraft in situ measurements of carbon dioxide mixing ratio and methane over Jiansanjiang (46.77°N, 131.99°E) (August 2018) were conducted, and compared to the retrieval results of Orbiting Carbon Observatory 2 (OCO-2) and Chinese Carbon Dioxide Observation Satellite (TanSat). The aircraft measurements were carried out between altitudes of 0.6 to 7 km, and obtained vertical profile of CO_2 and CH_4 by an Ultra-Portable Greenhouse Gas Analyzer (Los Gatos Research, LGR). A constant increase of an averaged 15.26 ppm in CO_2 mixing ratio were observed between altitude 2 to 7 km during the flight period. The methane measurements shows an averaged 0.5 ppm in CH_4 mixing ratio increased below 2.0 to 0.6 km caused by the large emission from wide range paddy field below, and the mixing ratio above 2 km varies between 1.951 to 1.976 ppm without large mutation.

Another vertical profile measurements of CO_2 and CH_4 on tether-balloon platform was conducted on Changshou (107.00°E, 29.84°N) (January 2019). In this study, vertical profiles of CO_2 mixing ratio measurements was made at low troposphere within altitude 0 to 1000 km. A strong vertical mixture of CO_2 was observed between 0 to 700 km, and most profiles presents declining trends of CO_2 and CH_4 mixing ratio with the increase of altitude, since the experiment site located in an industrial park with a large greenhouse gases emission source. The results would enhance the understanding of the spatial variation of CO_2 and CH_4.

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