Analysis of methane concentration variation observed by GOSAT in Sichuan Basin, China and its relationship with local sources

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Atmospheric Methane (CH_4) is one of the most important greenhouse gases, and the greenhouse effect generated by unit molecule of CH_4 is about 23 times higher than that of atmospheric Carbon Dioxide (CO_2). Therefore, it will be more effective to reduce the CH_4 emissions to mitigate the potential global warming than reducing CO_2 emissions. The increase of global atmospheric CH_4 concentration is mainly due to agricultural activities, in which irrigated rice paddy is one of the most important sources. China is the world's largest rice producer, accounting for about 22% of the rice planting area in the world and 37% of the global production. Therefore, studies of China's regional CH_4 emissions and its driving factors are of importance to understand the regional and global carbon cycle and the changing climate. In this study, XCH_4 observations from GOSAT, spanning from January 2010 to December 2013, are analyzed to study the spatio-temporal variation of XCH_4 in China and its relationship with regional surface emissions. In further, we investigate the driving mechanism of XCH_4 spatio-temporal variations, especially for high XCH4 values shown over Sichuan Basin in south-west China, by combining the emission mechanism of rice planting process, the meteorology data, the surface emission data and the regional atmosphere dynamic transportation.

The results indicate that spatially the Sichuan Basin presents a higher XCH4 concentration than other regions in China and is 17 ppb higher than the paddy area in the same latitude zone. Seasonally, XCH4 in Sichuan Basin during rice harvest season is generally higher than that in early cultivation period. However, comparing to paddy area in the same latitude zone, Sichuan Basin shows a relatively higher XCH4 value during the winter of noncultivation period when the emissions from rice paddies are weak and surface air temperature is low. To further investigate the high XCH4 concentration during this low-emission period, we use the HYSPLIT model to simulate the atmosphere dynamic transport process, and the result suggests that the typical closed topography of Sichuan Basin, which may lead to CH4 accumulation and keep it from diffusion, is one possible reason for the high XCH4 value in winter.

Our result from studying the CH_4 variations in Sichuan Basin, especially the abnormal higher value during winter, and their driving factors demonstrate a certain potential of using GOSAT-XCH_4 for investigating the regional CH_4 changes. This study presents preliminary results of CH_4 in China, and a further investigation of the CH_4 in the basin is still necessary as more satellite observations of CH_4 with improving accuracy are available in the coming future to further study the CH_4 variations and regional emissions.

[1]Xiuchun Qin, Liping Lei, Zhonghua He, Zhao-Cheng Zeng, Masahiro Kawasaki, Masafumi Ohashi, and Yutaka Matsumi, “Preliminary Assessment of Methane Concentration Variation Observed by GOSAT in China”, Advances in Meteorology,2015, DOI: 10.1155/2015/125059

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