Satellite observes spatiotemporal variations in mid-upper tropospheric methane over China

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As a principal greenhouse gas, atmospheric methane is important to atmospheric chemical processes and climate change. In Vol. 56 of the *Chinese Science Bulletin*, a paper identified spatiotemporal variations of methane in the mid-upper troposphere over China using satellite observations.

Atmospheric methane (CH4), one of the main greenhouse gases, has increased dramatically worldwide since the pre-industrial era. However, much work is needed to build on intermittent and scattered observations since the 1960s and systematic study since the 1980s. Since 1983, the World Meteorological Organization (WMO) has coordinated global in-situ measurement of methane. Quantification of methane emissions still has large uncertainties, mainly because of undersampling over most regions of the globe by surface observation networks. In particular, spatiotemporal variations of mid-upper tropospheric methane in China are not well understood, because of limited in-situ measurements.

Dr. ZHANG Xingying and his group at the National Satellite Meteorological Center of the China Meteorological Administration tackled this problem using satellite observations. Using Atmospheric Infrared Sounder (AIRS) methane data from 2003 to 2008, they revealed spatiotemporal variations of mid-upper tropospheric methane in China.

Their study shows that in the mid troposphere, a center of low CH4

concentration is located over western China, attributable to minimal industrial and agricultural activity. The lowest CH4 mixing ratio in the upper troposphere is over southern China, related to atmospheric transport from the ocean.

A seasonal cycle of methane has been discovered. One peak in summer and the other in winter over eastern, northeastern and northwestern China. Only one peak (in summer) occurs over southern and western China.

Before 2007, CH4 mixing ratio was nearly stable. The average mixing ratio during the last 6 years over major northern hemispheric countries is similar. However, there has been a significant increase in tropospheric CH4 concentrations after 2007 in most northern hemispheric areas, with slightly larger increases over China.

Dr. ZHANG Xingying has stated that the trend of CH4 based on satellite observation is still somewhat uncertain, because of the short, 6-year dataset. More satellite data of higher quality are needed for further trend analysis.

To understand the profile of methane in China and provide data for validation of satellite products, Fourier Transform Infrared Spectroscopy (FTIR) measurements were made at a ground-based hyperspectral remote sensing laboratory at the National Satellite Meteorological Center. A Bruker FTIR instrument (IFS 120 M, made in Ettlingen, Germany) with 0.008 cm-1 spectral resolution, was used for observations. Several years of data have been collected.

Implementation and promotion of this work will publicize methane spatiotemporal variations and their potential sources. In so doing, informed efforts may be mounted to reduce methane emission and resulting global climate change.

The National Satellite Meteorological Center manages satellite climate products in China. Two payloads for greenhouse gas monitoring are in development for the next satellite. One of the payloads is similar to AIRS for mid-upper tropospheric greenhouse gases. The other is for low tropospheric greenhouse gases, and uses a near-infrared (NIR) spectrometer. Meanwhile, more in-situ measurements have been carried out in China for more detailed investigation of greenhouse gases.

Dr. XIONG Xiaozhen, an expert from NOAA, is in charge of AIRS methane product retrieval. He believes that this study is the first to use satellite data for analyzing mid-upper tropospheric methane over China, and represents important step in the study of climate change.

More information: Xingying Zhang, Wenguang Bai, Peng Zhang, 2011, Study on three-dimensional structure of tropospheric methane over China based on satellite observations, *Chinese Science Bulletin*?56(31): 3321-3327

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