P-07

Poster Session Day 1

Quantitative analysis of the contribution of methane oxidation to stratospheric water vapor using delta-D derived from ACE-FTS satellite remote sensing

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The amount of stratospheric water vapor has been increasing in recent years. Model calculations indicate that increased stratospheric water vapor leads to stronger radiative forcing [1]. Thus, stratospheric water vapor affects the global radiative budget. Stratospheric water vapor is mainly supplied by transport from the troposphere and by the oxidation of methane and hydrogen. We define the "methane oxidation region" as the region where only methane oxidation contributes to stratospheric water vapor production in the stratosphere. In the previous study in which investigated methane oxidation using ACE-FTS data observed in 2004, it was shown that there is a clear relationship between methane decrease and water vapor increase [2]. In this study, we extracted methane oxidation regions using ACE-FTS Ver. 5.2 data observed during 2004-2021 and analyzed the isotope ratios of water and methane; δD-H_2O and δD-CH_4 in the extracted regions.

We used the ACE-FTS data with a latitude range of 85°N-85°S, an altitude range of 10-33 km, observed in December, January, and February during 2004-2021. We extracted the methane oxidation regions, which are defined by the fact that the increase in water is twice the decrease in methane. We then calculated δD-H_2O and δD-CH_4 in the extracted regions to distinguish whether only methane oxidation controls water vapor production.

It is confirmed that the methane oxidation region extends over a latitude range of 25°N-85°N and an altitude range of 19-32 km. In this region, δD-H_2O is -682‰ at the lowest altitude, and δD-CH4 is 69‰ at the lowest altitude. From these values, the change in δD-H_2O due to the methane oxidation is estimated to be -441‰. This value is also consistent with the assumption that the increase in water is twice the decrease in methane. We will discuss the details in this presentation.

References

[1] S. Solomon et al., Science, 327, 1219-1223 (2010)
[2] R. Nassar et al., Geophys. Res. Lett., 32, L15S04 (2005)