

AAS021-07

Room:102

Time:May 23 10:00-10:15

Long-term trend of methane concentration in the lower stratosphere over Japan

Satoshi Sugawara^{1*}, Takakiyo Nakazawa², Shuji Aoki², Shinji Morimoto³, Shigeyuki Ishido⁴

¹Miyagi Univ. of Education, ²CAOS, Tohoku Univ., ³NIPR, ⁴AIST

Stratospheric methane acts as an important source of stratospheric water vapor and also a sink for chlorine radical. For predicting the future of the stratospheric chemistry and dynamics, as well as for evaluating strategies for limiting or reducing future emission of methane into the atmosphere, it is indispensable to figure out the past methane trend in both of stratosphere and troposphere accurately. Systematic collections of stratospheric air samples have been carried out over Japan since 1985, using a balloon-borne cryogenic sampler. The air samples collected were analyzed for the CH₄ and N₂O concentrations since 1988. Almost linear and compact relationship between CH₄ and N₂O concentrations was found for all observations. It is well known that tropospheric N₂O has been secularly increasing quite monotonously in recent decades. On the other hand, increase rate of tropospheric CH₄ has been varied complicatedly. Despite the fact that both concentrations have been increased independently in troposphere, there is no significant difference between the correlations of stratospheric CH₄ and N₂O concentrations in each year, at first glance. Considering this fact, the compact relationship obtained over Japan suggests that both CH₄ and N₂O are destroyed at similar rate in the lower stratosphere during the poleward transport of stratospheric air, although the chemical destruction processes of the two gases are quite different. Therefore, we employed N₂O-depressions, instead of N₂O concentrations, for examining correlations with CH₄ concentrations. This method cancels the effects of secular N₂O increase in stratosphere and enables us to detect possible change in stratospheric CH₄. Thus we found that stratospheric CH₄ shows a significant increase before 2000 and clear stagnation after 2000. We categorized CH₄ concentration data into different N₂O depression ranges, and calculated increase rates by applying the curve fitting procedure, taking into account the age of stratospheric air. Average increase rates were calculated to be about 0.4 and 0.1%/year before and after 2000, respectively, in the lower stratosphere. This rate is comparable with the results of 207 ppbv increase in the period of 1978 to 2003 in the lower stratosphere reported by Rohs et al.(2006). However, increase rate before 2000 obtained in this study is much smaller than the result of 1.95 and 0.87 %/year in 1985 and 1994, respectively, by ATMOS/ACE-FTS measurements (Rinsland et al., 2009).

Keywords: methane, stratosphere, trend