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Influence of the interannual variation of CH4 emissions and OH on recent atmospheric CH4

Heon-Sook Kim (1), Shamil Maksyutov (2), Prabir K. Patra (3), Kengo Sudo (4), and Gen Inoue (5)

(1) Research Institute for Humanity and Nature, Kyoto, Japan (heonsook.kim@chikyu.ac.jp), (2) National Institute for Environmental Studies, Tsukuba, Japan (shamil@nies.go.jp), (3) Japan Agency for Marine-Earth Science and Technology, Yokohama, Japan (prabir@jamstec.go.jp), (4) Nagoya University, Nagoya, Japan (kengo@nagoya-u.jp), (5) Research Institute for Humanity and Nature, Kyoto, Japan (inouegen@chikyu.ac.jp)

Atmospheric methane (CH4) has risen dramatically since preindustrial times and the growth rate has slowed since the early 1990s. The global growth rate has been increasing again after the steady state in 1999-2006. In 2007, the global mean CH4 exceeded the highest value of 2003, and the highest growth rate was observed since 1998. The growth rate of CH4 is determined by the balance between surface emission and chemical reaction with OH and its recent trend with apparent interannual variations (IAV) may be related to changes in the balance. The global CH4 budget has been assessed in many studies and the dominant sources have been identified, but there are still large uncertainties in their individual magnitudes and temporal and spatial distributions on regional scale. In this study, we estimate the year-to-year variation of CH4 fluxes based on Bayesian approach using NIES transport model and investigate the contribution of the variation of CH4 flux and OH to recent variability on the growth rate of CH4.
The NIES off-line transport model (Maksyutov and Inoue, 2000) is used to simulate 72 tracers representing a combination of 12 months and 6 emission categories for 6 years (2002-2007), with IAV of NCEP winds and OH fields. We use the monthly mean OH fields simulated by CHASER developed for studying atmospheric environment and radiative forcing (Sudo et al., 2002). EDGAR and GISS inventories are used as a prior flux with strengths for individual flux types described in Patra et al. (2009) and the IAV of a prior flux is not included in this study. Observations are taken from GLOBALVIEW-CH4 (2008).
In the year-to-year variation of regional CH4 flux anomalies estimated in inversions, we found that the northern regions show smother variations as compared with the tropical and the southern regions. However, there is good agreement in the year-to-year variation on between the northern regional flux anomalies and the global growth rate of CH4. In addition, we found that the variation of wetland emissions is the dominant contribution to the IAV of CH4 emissions. In the northern regions, a little variation of the estimated CH4 fluxes is shown in 2002-2005 and a large variation is shown in 2006-2007: a large positive anomaly is shown in 2007 with a large negative anomaly in 2006. It is shown more clearly in high northern latitudes where 24% of the estimated wetland emissions is emitted. The similar variation is shown in CH4 oxidation by chemical reaction in the northern regions. The column-averaged OH anomaly increases slightly in 2006 and decreases in 2007. It suggests that the decrease of OH and the increase of wetland emission in 2006-2007 can be a contributor to recent increase of CH4 growth rate.