Spatio-temporal variations of atmospheric methane concentrations over Japan: Data analysis of governmental monitoring and TROPOMI satellite from air pollution research viewpoint

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As being an important greenhouse gas as well as a short-lived climate forcer, sources of atmospheric methane need to be understood well toward effective mitigation of climate change. Our best practice is to build bottom-up emission inventories by compiling available socio-economic data and emission-relevant information to optimize control measures; however, the uncertainty in the inventories is large and thus independent information is required for their evaluation and improvement. Ground-based and satellite observations will serve for the purpose. In this study, we analyzed long-term methane measurement data contained in the governmental monitoring to elucidate features of spatio-temporal variations. Here, the measured methane concentration levels are generally only used to be subtracted from the total hydrocarbon concentrations to yield non-methane hydrocarbon levels, important to ozone chemistry - and thus the data set has seldom been analyzed. Among the available data at several hundreds of sites during FY2009-2016, data at 39 non-roadside sites were selected, where annual average concentrations ranked within top 20 at least once. The data during 6-9 LT were monthly averaged and their normalized seasonal patterns were analyzed. From cluster analysis, three distinct patterns were found: First pattern was with large increases in summer/autumn. Two sites (Toasa in Hokkaido and Narashino-Saginuma in Chiba) with very high monthly-averaged concentrations (>2.5 ppm) were categorized to this cluster, where very strong local emissions were suspected. Second pattern was with wintertime increases, to which 20 sites normally within Tokyo/Osaka metropolitan areas were categorized. The pattern was understood as general air pollution behavior in terms of dilution/diffusion, suggesting influence from urban sources. The third pattern was with summertime increases, particularly during June-August. The categorized 17 sites are mostly from rural regions and emissions from rice paddy fields were implied. We will show more results on correlations with wind and other pollutants (e.g., NOx, CO). Features from TROPOMI satellite observations of methane over Japan are also to be discussed together with the analysis of the ground-based observations.

Keywords: Atmospheric environment, climate change, methane, cluster analysis, seasonal patterns, source analysis

