

Methane emissions from populated areas of Tokyo and five prefectures: Emission ratios with NO_x and their trends over 2009-2018

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Regarding methane as an important greenhouse gas, national reports on its annual emission fluxes are mandated. However, the reported fluxes, based on socioeconomical statistics of activities and assumed emission factors, have seldom been evaluated from atmospheric observations of methane concentrations. On the implementation of Paris Agreement/global stocktakes, efforts in the emission reduction have to be repeatedly quantified, particularly using ground/satellite-based observations. To obtain relevant scientific information, we focused on analysis of CH₄ data included in the governmental air pollution monitoring. We identified positive correlations between methane and NO_x in Tokyo during winter of 2018, indicating presence of urban sources of methane. Regarding the slope of the regression line ($\Delta\text{CH}_4/\Delta\text{NO}_x = \text{ca. } 2.5$ ppm/ppm) as the emission ratio, we preliminary estimated methane emissions of 36 kt/y from Tokyo Metropolitan area. We then extended the analysis to other five prefectures (Chiba, Saitama, Kanagawa, Osaka and Aichi) and found similar positive correlations with regression slopes ranging from 1.5 to 4.5 ppm/ppm, implying regional commonality. The slopes per sites showed a positive correlation with population densities. The emission ratio had a significant long-term increasing trend of $\sim 4.1\%/y$ over 2009-2018. Considering NO_x concentrations had a $\sim 4.0\%/y$ decreasing trend over Tokyo, the methane flux was regarded as constant over the decade. Based on these analyses, we studied possibilities of leakage of methane distributed for residential use. As the upcoming satellite missions including GOSAT-GW aim combined, high-precision measurements of greenhouse gases and air pollutants, detectability of such sources from satellite CH₄/NO₂ measurements is also to be discussed.

Keywords: Atmospheric composition, Urban Area, GHG-AQ joint analysis, emissions