(30-220414-A) **Analyzing Long-term East Asia CH_4 Emission Changes Inferred from CH_4/CO_2 Mole Fraction Ratios Based on Observation and Modelling at Anmyeondo, South Korea between 2010-2020**

S.T. Kenea[1], H. Lee[1], P.K. Patra[2,3], S. Li[1], and S. Joo[1]

[1]National Institute of Meteorological Sciences, Innovative Meteorological Research Department, Seogwipo-si, Jeju-do, South Korea; +82-10-2328-0105, E-mail: samueltakele81@gmail.com
[2]Japan Agency for Marine-Earth Science and Technology (JAMSTEC), Department of Environmental Geochemical Cycle Research, Yokohama, Japan
[3]Center for Environmental Remote Sensing, Chiba University, Chiba, 263-8522, Japan

Characterizing the source regions of anthropogenic emissions of greenhouse gases (GHGs) and understanding its temporal changes can be beneficial to the effectiveness of carbon mitigation effort. Our Anmyeondo (AMY) observation site often captures synoptic scale variability (SSV) of CH_4 mole fractions that are mainly attributed to the transport of CH_4 from the source regions in East Asia, particularly, China as characterized by the simulated concentration footprints for AMY site using WRF-STILT model. We analyzed the temporal variations of winter period $\Delta CH_4/\Delta CO_2$ mole fraction ratios based on near-surface in-situ observations and modelling between 2010-2020. In global atmospheric chemistry transport model (ACTM), three CH_4 tracer simulation cases were carried out using different schemes of the prescribed surface fluxes indicated by *FixCoal*, *VisitCao*, *VisitWH*. We discerned a consistent temporal variation of $\Delta CH_4/\Delta CO_2$ ratios estimates between the observation and simulation case derived from *FixCoal* scheme. The observed $\Delta CH_4/\Delta CO_2$ mole fraction ratios was ranging from 4.2 ppb ppm^{-1} to 6.2 ppb ppm^{-1}, with the averaged value of 5.7 ± 0.93 ppb ppm^{-1}. This tracer ratio is in agreement with CH_4/CO_2 emission ratio of annual total fossil fuel emission (FF) estimates from China, which suggests that the change of FF emission from China is a major driver on the region. Between 2014 and 2018, both observation and simulation captured a slight decreasing trend, which is most likely ascribed to earlier onset of CH_4 emission relative to fossil-fuel CO_2, predominantly, due to CH_4 emission reduction from coal mining. This finding can support to validating the temporal variations of East Asia continental/regional major sectorial bottom-up/top-down CH_4 emission estimates.

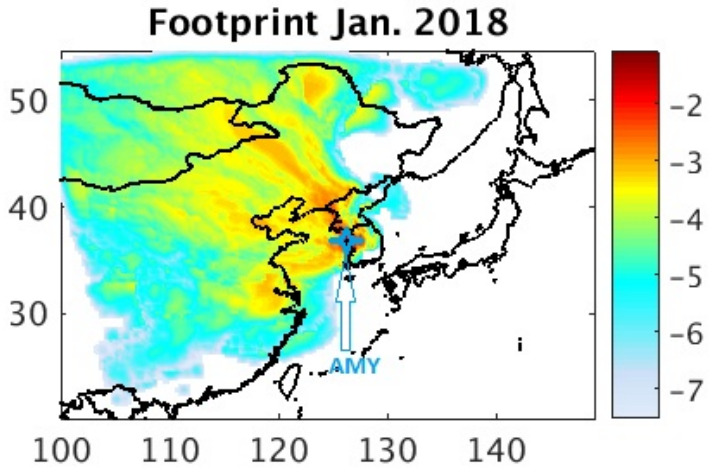

Figure 1. Simulated concentration footprints for AMY site (unit is expressed in $\log_{10}$ (ppm/µmol m^{-2} s^{-1})).

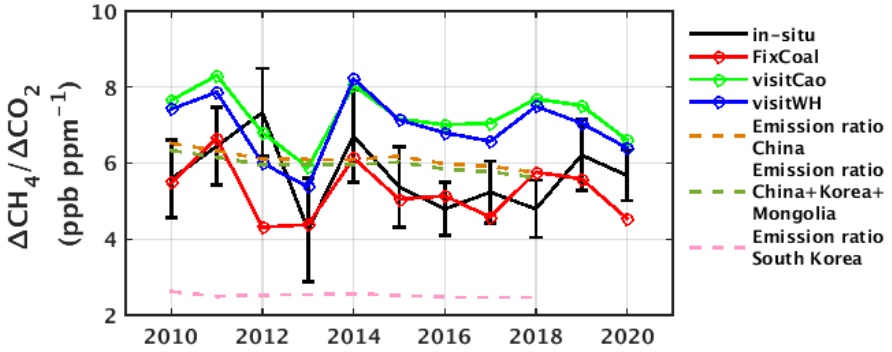

Figure 2. The time series of the slope of $\Delta CH_4/\Delta CO_2$ at AMY during winter 2010-2020 is shown. (black solid line represent observed and other solid lines are model simulation). Dashed lines denote emission ratios from EDGAR v6.