Methane emission estimate from South Asia: AMASA project

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Methane (CH_4) is the second most significant anthropogenic greenhouse gas (IPCC AR5, 2014) after carbon dioxide (CO_2). Large fraction of CH_4 emissions (~150 Tg of 550 Tg globally; $1Tg=10^{12}g$) occur in the Asia region. Much of CH_4 emissions from Asia are attributable to ruminant animals and rice fields, but the quantitative estimate of those emissions remains highly uncertain. To improve CH_4 emission estimate from South Asia, we started a project “Atmospheric Methane and Agriculture in South Asia (AMASA)”, which is sponsored by the Ministry of the Environment Japan. The first goal of the project is to develop high-resolution emission maps at regional scale and improve our understading of CH_4 emission distributions from South Asia by using remote sensing data of CH_4 from Japanese satellite Greenhouse Gases Observing Satellite (GOSAT), in-situ measurements at ground-based stations and atmospheric chemistry-transport model (ACTM) simulations. The second goal is to develop an emission mitigation proposal using results from India-specific rice field experiments for different management practices. Some emission mitigation scenarios will be developed based on the field data, and using the ACTM we examine to what extent the emission reductions are detectable by the measurement systems if the emission mitigation policy is realized.

GOSAT is the first satellite that is dedicated to greenhouse-gas-monitoring. The onboard Sensor TANSO-FTS (Fourier Transform Spectrometer) is designed to measure CO_2 and CH_4. GOSAT has collected data for about 8 years, and validation studies revealed sufficient reliability of GOSAT data for CH_4 cycling in the Earth’s environment (e.g., Morino et al., 2011, Inoue et al., 2014, Ono et al., 2015). The essential merit of satellite observation is wide spatial coverage. We found very high concentrations of CH_4 over Asia in GOSAT data, which seem to be connected to the high CH_4 emissions from this region. However, the connection is not straightforward because of complicated transport mechanisms. In particular, at the foothills of Himalaya Mountains, upwelling wind lift the CH_4 up to mid- and upper-troposphere during the monsoon season, resulting in the high columnar concentrations that can be observed from GOSAT (Chandra et al., 2017, paper in preparation). We are also conducting field measurements of atmospheric CH_4 at ground-based stations in Karnal, Sonepat, Nainital, and Comilla. Combined use of those satellite-based and ground-based measurements can give us spatial structure of CH_4 distribution, which would improve the emission estimate using an inverse analysis system.

To develop an emission mitigation proposal, we are conducting rice field experiments at the Tamilnadu Rice Research Institute, India by managing rice cultivars, water table and soil properties. The preliminary results suggest that CH_4 emission from rice cultivation can be reduced by half when applying proper cultivation managements. Based on these new findings, we are pursuing an appropriate mitigation proposal to reduce CH_4 emissions from South Asia.

References

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