Abstract for your presentation at WGIA16: about 400 words (one page)

Space based GHG monitoring with GOSAT satellite

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Abstract

Monitoring greenhouse gases (GHG) emissions from human activities is essential for verifying the efficiency of emission reduction efforts. The present estimates of the emissions of anthropogenic greenhouse gases are primarily based on bottom-up inventories based on statistical data. Inconsistencies between underlying country-level statistics of energy use and inaccuracies in the use of these data cause poorly quantified errors in bottom-up emission inventories. To quantify their errors, emission inventories need verification against independent data, which is made in several cases with atmospheric GHG observation network and modeling. While ground-based observation networks are often too sparse for monitoring these emissions, satellite observations can alleviate this limitation. We employed an atmospheric transport model to attribute column-averaged CO_2 mixing ratios (called X_{CO2}) observed by Greenhouse gases Observing SATellite (GOSAT) to emissions due to large sources such as megacities and power plants (Janardanan et al, 2016). X_{CO2} enhancements estimated from observations were compared to model simulations implemented at the spatial resolution of the satellite observation footprint ($0.1° \times 0.1°$). We found that the simulated X_{CO2} enhancements agree with the observed over several continental regions across the globe, for example, for North America with an observation to simulation ratio of 1.05 ± 0.38 ($p < 0.1$), but with a larger ratio over East Asia (1.22 ± 0.32; $p < 0.05$). The obtained observation-model discrepancy (22%) for East Asia is comparable to the uncertainties in emission inventories (~15%) suggested by recent reports. To evaluate anthropogenic methane emission inventory in various regions over the globe, we extract emission signatures from column-average methane observations (X_{CH4}) by GOSAT using high-resolution atmospheric transport model simulations (Janardanan et al., 2017). Reduction of observation error, which is large compared to local enhancements, is achieved by binning the observations over large region according to model-simulated enhancements. We found that the local enhancements observed by GOSAT scale linearly with inventory based simulations of X_{CH4} for the globe, East Asia and North America. Weighted linear regression of observation derived and inventory-based X_{CH4} anomalies was carried out to find a scale factor by which the inventory agrees with the observations. Over East Asia, the observed enhancements are 30% lower than suggested by EDGAR v4.2 emission inventory, implying a potential overestimation in the inventory. On the contrary, in North America, the observations are approximately 28% higher than model predictions, indicating an underestimation in emission inventory. Our results concur with several recent studies using other analysis methodologies, and thus confirm that satellite observations provide an additional tool for bottom-up emission inventory verification.

References/ Publications

Janardanan, R., S. Maksyutov, T. Oda, and coauthors, (2016), Comparing GOSAT observations of localized CO_2 enhancements by large emitters with inventory-based estimates, Geophys. Res. Lett., 43, doi:10.1002/2016GL067843.

Janardanan, R., S. Maksyutov, A. Ito, and coauthors, (2017), Assessment of Anthropogenic Methane Emissions over Large Regions Based on GOSAT Observations and High Resolution Transport Modeling, Remote Sensing, 9(9), 941.