Monitoring anthropogenic carbon dioxide and methane emission at regional scale using GOSAT observations

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Carbon dioxide (CO_2) and methane (CH_4) are the most important greenhouse gases in terms of radiative forcing. Anthropogenic activities such as combustion of fossil fuel (for CO_2) and gas leakage, animal agriculture, rice cultivation and landfill emissions (CH_4), are considered major sources of their emission. Emission data usually depend on national emission reports, which are seldom evaluated independently. Here we present results of a statistical method of comparing anomalies in global atmospheric CO_2 and CH_4 (2009-2014) fields due to anthropogenic activities, using GOSAT observations of column-average dry air mole fractions (XCO_2 and XCH_4) with atmospheric transport model simulations using high-resolution emission inventories. The CO_2 and CH_4 concentration enhancement due to anthropogenic activities, are estimated with the transport model for all GOSAT observations using high-resolution emission inventories (ODIAC and EDGAR respectively). Based on these values, anthropogenic greenhouse gas abundance is calculated using GOSAT observations as anomalies from clean background observations. These anomalies are binned and analyzed for continental scale regions and countries. For CO_2, we have found global and regional linear relationships between model and observed anomalies especially for Eurasia and North America. The analysis for East Asian region showed a systematic bias (around 15%) that is comparable in magnitude to the reported uncertainties in emission inventories in that region. In the case of CH_4, we found a good match between inventory-based estimates and GOSAT observations for continental regions. The inventory-based estimates over North American region is biased upward (around 35%) which is in agreement with recent reports. The results indicate the potential utility of GOSAT observations in monitoring reported anthropogenic emissions over different regions of varying spatial scales.

Keywords: anthropogenic emission, greenhouse gases, emission monitoring

