Estimating regional anthropogenic methane emissions with GOSAT satellite retrievals and ground-based observations

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GOSAT satellite observations of methane are being used for regional and national methane emission estimates in a number of studies using either high resolution regional inverse models or global medium resolution models. We perform global high-resolution methane flux inversion to estimate global methane emissions using atmospheric methane data collected at global in-situ network, which is archived at WDCGG and NIES, and GOSAT satellite retrievals. High resolution tracer transport is implemented by coupling Lagrangian model FLEXPART to a global atmospheric tracer transport model (NIES-TM) and its adjoint. Prior fluxes at 0.1˚ resolution were prepared for anthropogenic emissions (EDGAR 4.3.2), biomass burning (GFAS), and wetlands (VISIT). The inverse model based on NIES-TM-FLEXPART applies variational optimization to two categories of fluxes: anthropogenic and natural (wetlands). Bi-weekly emissions are estimated for years 2009 to 2017. To reduce GOSAT retrieval biases, the monthly mean difference between GOSAT data and the inversion-optimized forward simulation is estimated for each 5˚ latitude band and it is subtracted from GOSAT retrievals (NIES Level 2 retrievals, v. 02.72) before including them in the inversion. The bias correction is designed to remove large scale biases in GOSAT retrievals, while retaining local scale variability that contains most information on anthropogenic emissions from intense sources such as megacities. Estimated anthropogenic emissions over large regions (US, China, India) are compared to GCP-CH4 top-down estimates. The sensitivity of the estimated emissions to prior fluxes is tested by adjusting the prior fluxes to match UNFCCC reports for selected large countries.

Keywords: methane , inverse model, GOSAT, anthropogenic emissions

