Top-down estimates of methane emissions in West Siberia using regional tower network observations

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We apply a global high-resolution methane flux inversion model based on a Lagrangian-Eulerian coupled tracer transport model to estimate methane emissions in West Siberia using atmospheric methane data collected at the Siberian station network JR-STATION and data by the global in-situ network. We use a Lagrangian particle dispersion model FLEXPART to estimate the observation footprints at a 0.1º spatial resolution. FLEXPART is coupled to a global atmospheric tracer transport model (NIES-TM). An adjoint of the coupled transport model is used in an iterative optimization procedure. Biweekly flux corrections to prior flux fields are estimated for period of 2009 to 2015. High-resolution prior fluxes were prepared for anthropogenic emissions (EDGAR), biomass burning (GFAS), and wetlands (VISIT). High resolution wetland emission dataset was constructed using monthly emission data simulated by VISIT model and high resolution wetland area fraction by Global Lake and Wetlands Database (GLWD). Inverse model optimizes corrections to two categories of fluxes: anthropogenic and natural (wetlands). Based on fitting the model simulations to the observations, inverse model provides upward corrections to West Siberian anthropogenic emissions in winter and wetland emissions in the southern part in summer. The use of the high-resolution atmospheric transport in flux inversion, when compared to low resolution transport modeling, enables better fit to the observations, especially in winter, when anthropogenic emissions dominate variability of the near surface methane concentration.

Keywords: antropogenic emissions, methane, inverse modeling, wetlands