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Natural and anthropogenic methane emissions in West Siberia estimated using a wetland inventory, GOSAT and a regional tower network

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West Siberia contributes a large fraction of Russian methane emissions, with both natural emissions from peatlands and anthropogenic emissions by oil and gas industries. To quantify anthropogenic emissions with atmospheric observations and inventories, we must better understand the natural wetland emissions. We combine high-resolution wetland mapping based on Landsat data for whole West Siberian lowland with a database of in situ flux measurements to derive bottom-up wetland emission estimates. We use a global high-resolution methane flux inversion based on a Lagrangian-Eulerian coupled tracer transport model to estimate methane emissions in West Siberia using atmospheric methane data collected at the Siberian GHG monitoring network JR-STATION, ZOTTO, data by the global in situ network and GOSAT satellite observations. High-resolution prior fluxes were prepared for anthropogenic emissions (EDGAR), biomass burning (GFAS), and wetlands (VISIT). A global high-resolution wetland emission dataset was constructed using 0.5-degree monthly emission data simulated by the VISIT model and wetland area fraction map by the Global Lake and Wetlands Database (GLWD). We estimate biweekly flux corrections to prior flux fields for 2010 to 2015. The inverse model optimizes corrections to two categories of fluxes: anthropogenic and natural (wetlands). Based on fitting the model simulations to the observations, the inverse model provides upward corrections to West Siberian anthropogenic emissions in winter and wetland emissions in summer. The use of high-resolution atmospheric transport in the flux inversion, when compared to low-resolution transport modeling, enables a better fit to observations in winter, when anthropogenic emissions dominate

variability of the near-surface methane concentration. We estimate 15% higher anthropogenic emissions than EDGAR v.4.3.2 inventory for whole Russia, with most of the correction attributed to West Siberia and the European part of Russia. Comparison of the inversion estimates with the bottom-up wetland emission inventory for West Siberia suggests a need to adjust the wetland emissions to match observed north-south gradient of emissions with higher emissions in the southern taiga zone.