Sensitivity of optimized high-resolution North American CH$_4$ emissions to regional CH$_4$ boundary conditions

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Constraining CH$_4$ emissions at subcontinental scales is of great value, especially for quantifying local anthropogenic emissions. However, high-resolution emission estimates are more uncertain, particularly due to their relatively weak signature in the atmosphere and the uncertainty of the CH$_4$ measurements used to infer the emissions. In this work, we investigate the robustness of high-resolution North American emission estimates. We perform regional inversion analyses over North America using the Stochastic Time-Inverted Lagrangian Transport (STILT) model, with initial and boundary conditions imposed from the GEOS-Chem global chemical transport model, constrained by NOAA and Environment Canada CH$_4$ flask measurements and CH$_4$ columns measured using Fourier transform spectrometers at the University of Toronto Atmospheric Observatory and at the Total Carbon Column Observing Network (TCCON) Lamont station. We also perform STILT and GEOS-Chem inversions with pseudo in situ- and satellite-like measurements, respectively, to assess the seasonal sensitivity of optimized emissions to uncorrected biases in CH$_4$ boundary conditions. We show that, depending on the season, the sensitivity of the emissions to the biases varies by up to 40%.