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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%.