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Novel methane emission estimation method for ground based remote sensing networks

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In order to infer greenhouse gas emissions from a source region, several top-down approaches can confirm or constrain the existing emission inventories.

Due to the long-term stability of methane, the air holds a non-zero background concentration before it enters the domain of interest. This background concentration typically cannot be neglected and poses a major challenge in emission estimates from observations.

Inspired by a Bayesian inversion framework **[1]** which inverts the background concentrations *together* with the emissions, we will present a novel (non-Bayesian) inversion framework that estimates the background from the observations and derives the emissions from these calculated enhancements.

Background concentrations are estimated using a combination of measurements at multiple upwind sites, similar to mass balance approaches, but in a more sophisticated manner: The observed total column concentrations at the downwind site are considered to be associated with the concentrations at an upwind site if the backward trajectories calculated by STILT pass close to the respective upwind site. In a second step, the derived enhancements are attributed to the surface fluxes using the STILT calculated footprint.

Methane emission estimates are derived from the total column concentrations measured with six EM27/SUN FTIR spectrometers using ground based direct sunlight spectroscopy. The measurement campaign was carried out in the San Francisco Bay Area in 2016.

[1] Jones, T. S., Franklin, J. E., Chen, J., Dietrich, F., Hajny, K. D., Paetzold, J. C., Wenzel, A., Gately, C., Gottlieb, E., Parker, H., Dubey, M., Hase, F., Shepson, P. B., Mielke, L. H., and Wofsy, S. C.: Assessing Urban Methane Emissions using Column Observing Portable FTIR Spectrometers and a Novel Bayesian Inversion Framework, Atmos. Chem. Phys. https://doi.org/10.5194/acp-21-13131-2021, 2021.