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Assessing methane fluxes over Colombia and Panama using Lagrangian simulation and aircraft-borne measurements during TC4

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Methane accounts for ∼20% of the positive radiative forcing, making it the second most important long-lived greenhouse gas (GHG) in the Earth's atmosphere. Scientifically-sound GHG mitigation strategies require sufficiently accurate and detailed GHG source and sink estimations. While ∼2/3 of the global methane emissions are anthropogenic, the wetlands are the single largest source of CH4. Therefore, in many cases, wetland emissions must be included in inverse modeling calculations aimed at validating anthropogenic emission inventories from ambient air measurements.

High accuracy and precision CH4 measurements over Colombia and Panama carried out during NASA's TC4 mission revealed elevated methane enhancements, particularly over the Uraba region located near the Colombia-Panama border. These observations have not been properly reproduced by global models. Here we use STILT, a receptor oriented Lagrangian particle dispersion model, to estimate methane mixing ratios over Uraba, and other regions of Colombia and Panama. STILT was applied along with a priori anthropogenic and wetland emission inventories and assimilated meteorological fields in order to obtain modeled mixing ratios based on the influence of surface fluxes at regional level. The calculations were compared to measurements obtained during the 2007 TC4 mission. The results indicate that the a priori inventories underestimate the emissions, and suggest that the wetlands fluxes are the major source of uncertainty. The errors attributed to the meteorological fields and to the Lagrangian model itself also contribute to the discrepancy. Accordingly, we also comparatively evaluate the impact of various meteorological fields on the modeled methane concentrations, with the final aim of adjusting the inventories by inverse modeling. Besides the estimation of the wetland emissions, our research towards the development of a realistic anthropogenic emission inventory should contribute to the formulation of methane emission mitigation policies in Colombia.