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Evaluation of methane emission inventories at the European scale by comparing atmospheric transport models and measurements

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Methane (CH_4) contributes to Europe's greenhouse gas emissions by 11% in terms of radiative forcing and due to its lifetime of 8-10 years, it is an important target for short-term climate change mitigation. Efficient mitigation strategies can only be designed with an advanced understanding of the spatial and sectorial distribution and magnitude of CH_4 emissions. Two main approaches are used towards such knowledge: 1) bottom-up inventories using statistical information on emissions, and 2) top-down atmospheric inversions optimally merging atmospheric measurements and numerical models. But are these estimates accurate enough to be useful for mitigation purposes? In this work, we evaluate different emission inventories using atmospheric models and measurements to identify and separate sources of errors in bottom-up and top-down approaches. This is done in the wider framework of the EU project MEMO^2, which aims at improving a reference European CH_4 inventory through local-scale measurement campaigns, as well as a characterization of δ^{13}C signatures produced by the main sources of CH_4.

Forward simulations of CH_4 concentrations have been performed with the atmospheric transport models CHIMERE and LOTOS-EUROS, and forced by the EDGARv4.3.2 and TNO-MACC_III emission inventories. Simulated mixing ratios are compared to continuous measurements in Europe and the transport model skills are evaluated against higher resolution configurations of CHIMERE. This set of simulations and measurements allows us to identify the main sources of errors in inventories and transport models and to assess their impact when sampled by point measurements. Measurements and simulations of atmospheric isotopic ratio have been applied to investigate the potential of adding isotopes to gain more knowledge on the different emission sources.

We show preliminary inversion results accounting for uncertainties assessed by the above-mentioned model-measurement comparison.