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Evaluation of a high resolution atmospheric modelling system against observed data from a dense network of continuous CO_2 and CH_4 measurement stations across France

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In the context of greenhouse gas (GHG) emission reductions for the next decade, the European countries work together in order to develop robust methods for monitoring and verifying their sources and sinks. The implementation of dense atmospheric monitoring surface networks such as the Integrated Carbon Observation System (ICOS) provides novel data for emission quantification at national and sub-national scales. Data assimilation approaches using numerical atmospheric transport models together with observed atmospheric concentrations, are used to constrain GHG sources and sinks. The main advantages of the so called inverse methods is to bring an independent method for the verification of GHG inventories at the national scale. This study aims at developing an innovative inverse modelling framework using GHG measurements from the ICOS network, meteorological data and national emission inventories in order to improve the estimates of sources and natural sinks in France. The monitoring network provide a set of continuous measured data across France in near real time. We have access to 6 GHG monitoring stations in France including 3 near borders. We sudy the representativeness of GHG concentrations depending on the meteorological situation, with the objective to optimize the constrained GHG fluxes. A set of 8 forward simulations is performed using the Eulerian off-line chemistry-transport model CHIMERE with two meteorological fields, two biogenic models, and two anthropogenic inventories. The set of simulation is compared to measurements, in order to assess the sensitivity of simulated concentration to various input data at national and sub-national scales. In plains sites low resolution meteorological data (15 km) improves the simulated GHG concentrations compared to a high resolution model. However, at mountain sites the higher resolution model (2.5km) decreases the rmse compared to measurements, by 1 ppm for CO_2 and 10 ppb for CH_4.The 8 simulations are able to represent the weather regimes, and the way the atmospheric concentrations vary during specific events (e.g. heatwaves, anticyclonic events in winter during which an increase of pollutants and GHG concentrations is observed near the surface). This comparison between observations and the 8 forward simulations demonstrates the need to choose the best input data to insure a robust inversion system. Currently, we are evaluating the set of input data for CHIMERE, in order to provide the best couple of transport and fluxes for inverse simulations of GHG in France.