Evaluation of simulated CO2 and CH4 concentrations using CHIMERE transport model

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Résumé

In order to study the sensitivity of modelled CO2 and CH4 concentrations at the regional scale using different forcings, a set of direct simulations using the Eulerian off-line chemistry-transport model CHIMERE were implemented. We ran several configurations of CHIMERE using two meteorological fields, two anthropogenic emission inventories and two models of biogenic emissions. We performed simulations over France, from January to December 2014, at a 10-km resolution. The meteorological data used for this study was the analysis of the European Centre for Medium-Range Weather Forecasts (ECMWF) at 50-km resolution, and analysis of the meso-scale French model AROME at a 2.5-km resolution. Biogenic emissions were retrieved from the ECMWF model C-TESSEL, designed to describe soil and atmospheric exchanges. We have also tested also the biospheric model VPRM which provide high resolution of biospheric CO2 fluxes based on the MODIS satellite index. For anthropogenic emission inventories we used data from the Institute of Energy Economics and Rational Energy Use (IER) at a monthly timescale, and Emissions Database from Global Atmospheric Research (EDGAR) at a yearly timescale. All simulations were performed using CO2 and CH4 fields from the global model MACC as initial and boundary conditions. A total of 8 simulations were ran. For each simulation, we have tested CHIMERE with one meteorological field, one biogenic model, and one anthropogenic inventory. The comparison of modelled time series against observations at 4 French ICOS stations shows that the simulated concentrations were sensitive to the choice of the emission database. The use of a high resolved biogenic model improves the value of modelled concentrations. The four one year simulations using VPRM gave a root mean square error (rmse) between 0.2 to 2 ppm less than C-TESSEL model for CO2. The big differences were located in areas with high biospheric activity such as the Trainou station. Using AROME at a high resolution improves the modelled concentrations at high montain stations, the rmse was 1 ppm of difference for CO2, and up to 10 ppb of difference for CH4. The European meteorological model represents better the simulated concentrations in the lowlands. The influence of changing the anthropogenic emission inventories is not yet well analysed since the temporal resolution is very low for both inventories. The preliminary results, showed that IER database provided the best results, due to its higher temporal resolution. Currently, we are processing a higher temporal profiles for EDGAR that provide inventories at a one hour timescale instead of one year, and we plan to run it with CHIMERE to study the sensitivity of using high resolved anthropogenic emissions for CO2 and CH4 simulations.

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