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High-resolution simulations of atmospheric CO2: requirements for inverse modelling tools

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High resolution simulations of atmospheric CO2 with horizontal resolutions of 10 km have been performed with two modeling systems for a domain centered over Europe: WRF-VPRM, which combines the Weather Research and Forecasting model with a diagnostic biosphere driven by MODIS vegetation indices, the Vegetation Photosynthesis and Respiration Model, and STILT-VPRM, which combines the Stochastic Time Inverted Lagrangian Transport model, driven by ECMWF fields, with the same biosphere model. Both modeling systems use high resolution fossil fuel emission data and lateral tracer boundary conditions from global model runs based on TM3 transport. These simulations have been used in an attempt to reproduce the atmospheric tracer distribution on scales much closer to the actual footprint of remote sensing instruments than global transport model simulations allow. The model setup largely follows the TRANSCOM-continuous protocol, allowing for a comparison with a number of measurement sites, but also with a large number of models used for inversion studies. The high resolution surface fluxes in our simulations are made consistent with fluxes used in the global models on coarse scales, but have realistic fine-scale spatiotemporal variability. This allows partially isolating the effect of transport resolution from the effect of surface flux resolution on the overall model performance. Based on the performance assessments implications for the requirements to inverse modeling systems are discussed.