Regional CO_2 fluxes and climate-driven anomalies estimated with global high-resolution inverse model using surface and GOSAT data in 2010-2022

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Poster

We present a summary of top-down estimates made with high-resolution global inverse model NTFVAR (NIES-TM-FLEXPART-variational) of the regional carbon dioxide fluxes based on the GOSAT satellite and surface CO_2 observations in 2010-2022. We focus the present analysis on the benefits of high-resolution transport and the use of satellite data to better estimate seasonal and interannual variability of carbon fluxes. The transport model achieves high resolution by coupling the global tracer transport model NIES-TM (with 3.75° resolution) and the FLEXPART model operating at 0.1° resolution. The prior fossil emissions are provided by ODIAC, and fire emissions by GFAS, while land biosphere and oceanic fluxes are prepared via global upscaling with machine learning based on point observation data. The diurnal cycle of biospheric CO_2 exchange is simulated by combining data for the gross ecosystem production and ecosystem respiration. The addition of GOSAT satellite data improves the assessment of carbon flux changes driven by several large-scale climate anomalies, such as the 2010 heat wave in Europe, the 2015 El Nino in tropical Asia, and others. The continental partitioning of model-estimated fluxes for boreal regions agrees with sink patterns from bottom-up inventories. The high-resolution transport and inversion allow a better fit to the observations near the coasts and provide flexibility in applying flux corrections at scales of 100-300 km. The model was used in OCO-2 MIP intercomparison, where the high resolution provides the advantage of resolving more details in the satellite data, as satellite observations can be aggregated to 0.1° model grids rather than 2–3° boxes standard to global transport models. Following the intercomparison, the remaining biases in the posterior simulated CO_2 concentrations at several continental stations were reduced by adjusting prior flux uncertainties. Biases in simulated CO_2 concentrations are evaluated by comparison to the aircraft observations over Europe and North America

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