**GC31B-1169: Developing a high-resolution CO2 flux inversion model for global and regional scale studies**

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We develop and test an iterative inversion framework that is designed for estimating surface CO2 fluxes at a high spatial resolution using a Lagrangian-Eulerian coupled tracer transport model and atmospheric CO2 data collected by the global in-situ network and satellite observations. In our inverse modeling system, we employ the Lagrangian particle dispersion model FLEXPART that was coupled to the Eulerian atmospheric tracer transport model (NIES-TM). We also derived an adjoint of the coupled model. Weekly corrections to prior fluxes are calculated at a spatial resolution of the FLEXPART-simulated surface flux responses (0.1 degree). Fossil fuel (ODIAC) and biomass burning (GFAS) emissions are given at original model spatial resolutions (0.1 degree), while other fluxes are interpolated from a coarser resolution. The terrestrial biosphere fluxes are simulated with the VISIT model at 0.5 degree resolution. Ocean fluxes are calculated using a 4D-Var assimilation system (OTTM) of the surface pCO2 observations. The flux response functions simulated with FLEXPART are used in forward and adjoint runs of the coupled transport model. To obtain a best fit to the observations we tested a set of optimization algorithms, including quasi-Newtonian algorithms and implicitly restarted Lanczos method. The square root of covariance matrix for surface fluxes is implemented as implicit diffusion operator, while the adjoint of it is derived using automatic code differentiation tool. The prior and posterior flux uncertainties are evaluated using singular vectors of scaled tracer transport operator. The weekly flux uncertainties and flux uncertainty reduction due to assimilating GOSAT XCO2 data were estimated for a period of one year. The model was applied to assimilating one year of Obspack data, and produced satisfactory flux correction results. Regional version of the model was applied to inverse model analysis of the CO2 flux distribution in West Siberia using continuous observation data by CO2 tower network JR-Station.