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Estimation of regional CO_2 fluxes in 2009-2010 with GOSAT observations using two inverse modeling approaches.

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We provide inverse estimation of surface CO_2 fluxes using atmospheric transport model and GOSAT observations. The NIES-retrieved CO_2 column mixing ratio is used together with ground-based observations. The column averaged CO_2 mixing ratio (XCO_2) and column averaging kernel are provided by GOSAT Level 2 product and PPDF-DOAS method. Monthly mean CO_2 fluxes for 64 regions are estimated together with a global mean offset between GOSAT data and Globalview. We used the fixed-lag Kalman smoother to infer monthly fluxes for 42 sub-continental terrestrial regions and 22 oceanic basins. We estimate fluxes and compare results obtained by two approaches. In basic approach adopted in GOSAT Level 4 product we use aggregation of the GOSAT observations into monthly mean over 5x5 degree grids and fluxes are estimated independently for each region, and NIES atmospheric transport model is used for forward simulation. In the alternative method the model-observation misfit is estimated for each observation separately and fluxes are spatially correlated using EOF analysis of the simulated flux variability. Transport simulation is enhanced by coupling with Lagrangian transport model Flexpart. Both methods use using same set of prior fluxes and region maps. Daily net ecosystem exchange (NEE) is predicted by the Vegetation Integrative SImulator for Trace gases (VISIT) optimized to match seasonal cycle of the atmospheric CO_2. Monthly ocean-atmosphere CO_2 fluxes are produced with an ocean pCO_2 data assimilation system. Biomass burning fluxes were provided by the Global Fire Emissions Database (GFED); and monthly fossil fuel CO_2 emissions are estimated with ODIAC inventory. The results of the analyzing one year of the GOSAT data suggest that when both GOSAT and ground-based data are used together the fluxes change compared to using only ground-based data in the tropical and other remote regions, for those regions flux uncertainties are reduced when compared to ground-based data only case. Although the fluxes appear reasonable for many regions and seasons, there is still a need for improving the retrieval, data filtering and the inverse modeling method to reduce apparent estimated flux anomalies visible in some areas. We observe that application of spatial flux correlations reduces flux anomalies.