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Global CO_2 simulation using GOSAT-based surface CO_2 flux estimates

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Investigating the distribution and temporal variability of surface CO_2 fluxes is an active research topic in the field of contemporary carbon cycle dynamics. The technique central to this effort is atmospheric inverse modeling with which surface CO_2 fluxes are estimated by making corrections to a priori flux estimates such that mismatches between model-predicted and observed CO_2 concentrations are minimized. Past investigations were carried out by utilizing CO_2 measurements collected in global networks of surface-based monitoring sites. Now, datasets of column-averaged CO_2 dry air mole fraction (XCO_2) retrieved from spectral soundings collected by GOSAT are available for complementing the surface-based CO_2 observations. These space-based XCO_2 data are expected to enhance the spatiotemporal coverage of the existing surface observation network and thus reduce uncertainty associated with the surface flux estimates. We estimated monthly CO_2 fluxes in 64 sub-continental regions from a subset of the surface-based GLOBALVIEW CO_2 data and the GOSAT FTS SWIR Level 2 XCO_2 retrievals. We further simulated CO_2 concentrations in 3-D model space using the surface flux estimates obtained. In this presentation, we report the result of a comparison between the simulated CO_2 concentrations and independent surface observations. As part of an effort in inter-comparing GOSAT-based surface CO_2 flux estimates, we also look at results yielded with XCO_2 data retrieved with the PPDF-DOAS algorithm and those made available by the NASA Atmospheric CO_2 Observations from Space team. For this study, we used version 08.1 of the National Institute for Environmental Studies atmospheric transport model, which was driven by the Japan Meteorological Agency's JCDAS wind analysis data. The CO_2 forward simulations were performed on $2.5^\circ \times 2.5^\circ$ horizontal grids at 32 vertical levels between the surface and the top of the atmosphere. The a priori flux dataset used was comprised of the sum of four components: daily net ecosystem exchange predicted by a terrestrial biosphere process model VISIT (Vegetation Integrative SImulator for Trace gases); monthly ocean-atmosphere CO_2 fluxes generated with an ocean pCO_2 data assimilation system; monthly CO_2 emissions due to biomass burning stored in GFED (the Global Fire Emissions Database); and monthly fossil fuel CO_2 emissions obtained via merging the ODIAC (Open source Data Inventory of Anthropogenic CO_2 emission) high-resolution dataset and the Carbon Dioxide Information Analysis Center's monthly $1^\circ \times 1^\circ$ resolution dataset.