A global surface CO2 flux dataset (2015–2022) inferred from OCO-2 retrievals using the GONGGA inversion system

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Poster

Accurate assessment of the size and distribution of carbon dioxide (CO2) sources and sinks is important for efforts to understand the carbon cycle and support policy decisions regarding climate mitigation actions. Satellite retrievals of the column-averaged dry-air mole fractions of CO2 (XCO2) have been widely used to infer spatial and temporal variations of carbon fluxes through atmospheric inversion techniques. In this study, we present a global spatially resolved terrestrial and ocean carbon flux dataset for 2015–2022. The dataset was generated by the Global ObservatioN-based system for monitoring Greenhouse GAses (GONGGA) atmospheric inversion system through the assimilation of Orbiting Carbon Observatory 2 (OCO-2) XCO2 retrievals. We describe the carbon budget, interannual variability, and seasonal cycle for the global scale and a set of TransCom regions. The 8-year mean net biosphere exchange and ocean carbon fluxes were −2.22 ± 0.75 PgC yr−1 and −2.32 ± 0.18 PgC yr−1, absorbing approximately 23% and 24% of contemporary fossil fuel CO2 emissions, respectively. The annual mean global atmospheric CO2 growth rate was 5.17 ± 0.68 PgC yr−1, which is consistent with the National Oceanic and Atmospheric Administration (NOAA) measurement (5.24 ± 0.59 PgC yr−1). Europe has the largest terrestrial sink among the 11 TransCom land regions, followed by Boreal Asia and Temperate Asia. The dataset was evaluated by comparing posterior CO2 simulations with the observations from Total Carbon Column Observing Network (TCCON) retrievals and Observation Package (ObsPack) flask observations. Compared with CO2 simulations using the unoptimized fluxes, the bias and root mean square error of posterior CO2 simulations were largely reduced across the full range of locations, confirming that the GONGGA system improves the estimates of spatial and temporal variations in carbon fluxes by assimilating OCO-2 XCO2 data. This dataset will improve the broader understanding of global carbon cycle dynamics and their response to climate change. The dataset can be accessed at https://doi.org/10.5281/zenodo.8368846.

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