

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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