

A high-resolution fossil fuel CO₂ emission gridded dataset for tracer transport simulations and flux inversions: An overview, evaluations, applications and future perspectives

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Carbon dioxide (CO₂) emissions from fossil fuel combustion (Fossil fuel CO₂, FFCO₂) is the largest input to the global carbon cycle over the decadal time scales. FFCO₂ needs to be accurately quantified and monitored in order to deduce the carbon uptakes by natural sinks from atmospheric measurements as well as support the emission reduction and management. The Open-source Data Inventory for Anthropogenic CO₂ (ODIAC) is a global, high-spatial resolution (1x1km) gridded FFCO₂ emission data product. We first pioneered the combined use of the point source information and satellite-observed nighttime lights data for emission downscaling in order to achieve global 1 × 1 km spatial resolution emission fields. The use of nightlight data allows us to observe dynamic changes in emissions spatial distributions in a timely manner and incorporate these into the emission field. Since its establishment in 2009, ODIAC has been extensively used in global and regional flux inversions especially with CO₂ data collected by carbon observing satellites, such as the Japanese Greenhouse gas Observing SATellite (GOSAT) and NASA' s Orbiting Carbon Observatory 2 (OCO-2). ODIAC has been also successfully applied to studies for localized emissions point sources such as power plants and cities. In order to further improve the accuracy of the emission downscaling, we have examined NASA' s new Visible Infrared Imaging Spectrometer Suite (VIIRS) Nighttime Environmental Product. An accurate global emission disaggregation is one of the key elements of future Monitoring and Verification Support (MVS) scientific systems that consist of the carbon modeling and data assimilation. Our advanced satellite-based emission downscaling model holds the promise of playing a critical role in such future systems.

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