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Carbon dioxide (CO2) is the primary greenhouse gas emitted into the atmosphere, mainly resulting from anthropogenic activities. While CO2 is naturally present in Earth's carbon cycle, human activities strongly influence and impact the ability of natural sinks to reduce atmospheric CO2, thereby altering the carbon cycle. Thus, the precise, accurate, and long-term measurements of CO2 are important and are accomplished through satellite, airborne, and ground-based CO2 measurements.

The Orbiting Carbon Observatory-2 (OCO-2) was launched in 2014 and is NASA's first Earth-orbiting satellite dedicated to making observations of CO2 in the atmosphere. One important goal of the OCO-2 mission is to provide the column-averaged dry-air mole fraction of CO2 (XCO2) measurements with sufficient precision and accuracy to quantify carbon cycle fluxes at regional scales. In addition, with almost a decade of XCO2 observations, OCO-2 can help understand the seasonal and interannual variability in CO2.

In this work, we evaluate the new and improved version 11.1 (V11.1) XCO2 data from OCO-2 by comparison against independent datasets to identify potential biases and errors and establish its robustness for scientific use. Previously, accurate and precise column-averaged measurements of XCO2 from the ground-based Total Carbon Column Observing Network (TCCON) have been used to validate XCO2 measurements from OCO-2. Measurements of greenhouse gases from the COllaborative Carbon Column Observing Network (COCCON) using portable Fourier-Transform InfraRed (FTIR) spectrometers (EM27/SUN) have been a recent addition to the suite of independent validation datasets to compare OCO-2 XCO2 against. The excellent level of performance and stability shown in the EM27/SUN spectrometers has been demonstrated in several studies, and data from the COCCON network is becoming a vital source of validation measurements. The EM27/SUN measurements are beneficial in monitoring localized sources of greenhouse gases and can also operate as standalone instruments in regions where the TCCON spectrometers are underrepresented. With several global sites, both TCCON and COCCON are suitable for independently validating the satellite-based XCO2 measurements from OCO-2.

Comparison of OCO-2 measurements against data from TCCON and COCCON show generally consistent results. We show the results from the latest comparisons and discuss comparisons at specific sites.
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