Total Column Water Vapor from OCO-2

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Measurements of atmospheric water vapor provide useful information for a wide range of applications including hydrological cycle studies, radiation budget studies, weather forecasting, and climate change studies. While many existing ground-based networks provide highly precise and accurate measurements of water vapor, the large temporal and spatial variability of water vapor results in the need for additional information on a global scale. Currently, global spaced-based information on water vapor comes from a number of satellite instruments in the microwave (Special Sensor Microwave Imager [SSM/I], Advanced Microwave Scanning Radiometer for Earth Observing System 2 [AMSR-E/2], TRMM Microwave Imager [TMI]), thermal infrared (Atmospheric Infrared Sounder [AIRS], Infrared Atmospheric Sounding Interferometer [IASI], Cosmic Ray Isotope Spectrometer [CrIS], High-resolution Infrared Radiation Sounder [HIRS]), and visible (Moderate Resolution Imaging Spectrometer [MODIS], Medium Resolution Imaging Spectrometer [MERIS]). However, all of these have limitations in terms of both accuracy and spatial coverage.

In this work we investigate the accuracy of Orbiting Carbon Observatory-2 (OCO-2) total column water vapor measurements by comparing them to independent observations, including those from SuomiNet, which is a ground-based Global Positioning System (GPS) network. Though OCO-2's primary mission is to measure the total column of atmospheric carbon dioxide (XCO_2), it also measures total column water vapor with the NASA Atmospheric CO_2 Observations from Space (ACOS) XCO_2 retrieval algorithm using information contained in two near-infrared absorption bands at 1.6 and 2.0 μm. The information in these bands primarily concerns CO_2, but several water vapor lines in each band enable the retrieval of water vapor simultaneously with XCO_2. We assess the overall ability of OCO-2 to measure total column water vapor, and examine patterns and biases in both time and space. Initial results are promising, as they show an improvement relative to European Center for Medium range Weather Forecasting (ECMWF) Integrated Forecasting System (IFS) total column water vapor estimates.

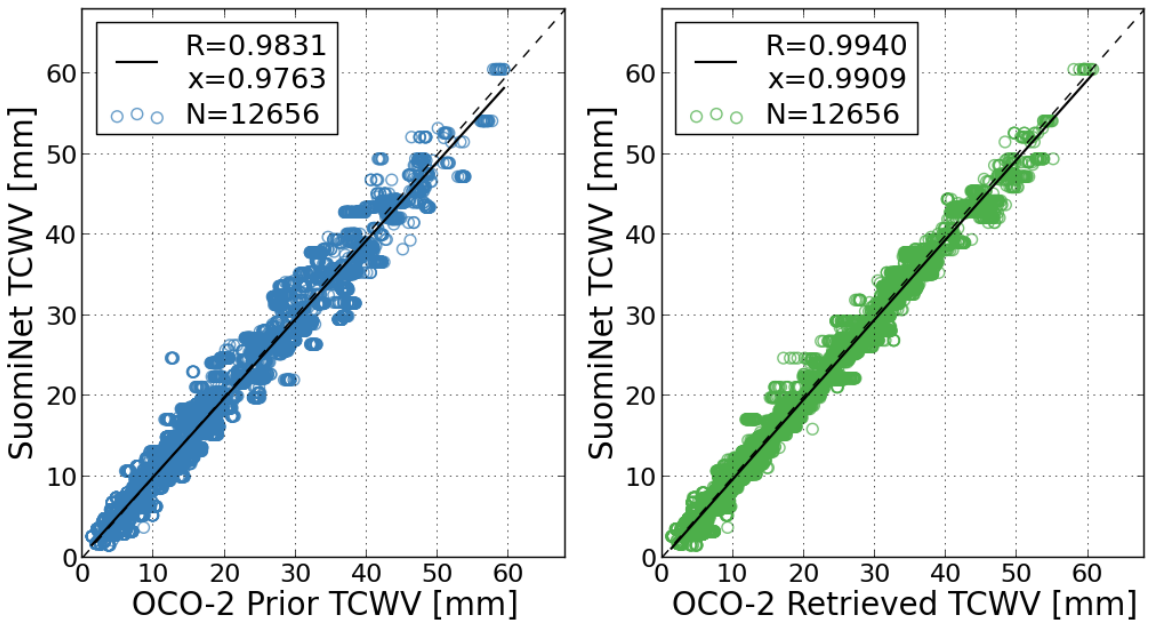

Figure 1. ECMWF IFS (used as the OCO-2 prior; left panel) and OCO-2 retrieved (right panel) total column waver vapor (TCWV) vs. SuomiNet TCWV co-located to within 0.1° and 30 min.