Geophysical Research Abstracts
Vol. 18, EGU2016-3644, 2016
EGU General Assembly 2016
© Author(s) 2016. CC Attribution 3.0 License.

3D Cloud Effects in OCO-2 Observations – Evidence and Mitigation

Sebastian Schmidt (1,2), Steven Massie (1), Hironobu Iwabuchi (3), Rintaro Okamura (3), and David Crisp (4)

(1) University of Colorado, Laboratory for Atmospheric and Space Physics, Boulder, CO, USA (sebastian.schmidt@lasp.colorado.edu), (2) University of Colorado, Department for Atmospheric and Oceanic Sciences, Boulder, CO, USA, (3) Center for Atmospheric and Oceanic Studies, Tohoku University, Japan, (4) Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA, USA

In July 2014, the NASA Orbiting Carbon Observatory (OCO-2) satellite was inserted into the 705-km Afternoon Constellation (A-Train). OCO-2 provides estimates of column-averaged CO_2 dry air mixing ratios (XCO_2), based on high spectral resolution radiance observations of reflected sunlight in the O_2 A-band and in the weak and strong absorption CO_2 bands at 1.6 and 2.1 μm. The accuracy requirement for OCO-2 XCO_2 retrievals is 1 ppmv on regional scales (> 1000 km). At the single sounding level, inhomogeneous clouds, surface albedo, and aerosols introduce wavelength-dependent perturbations into the sensed radiance fields, affecting the retrieval products. Scattering and shadowing by clouds outside of the field of view (FOV) may be a leading source of error for clear-sky XCO_2 retrievals in partially cloudy regions. To understand these effects, we developed a 3D OCO-2 simulator, which uses observations by MODIS (also in the A-Train) and other scene information as input to simulate OCO-2 radiance spectra at the full wavelength resolution of the three bands. It is based on MCARaTS (Monte Carlo Atmospheric Radiative Transfer Simulator) as the 3D radiative transfer solver. The OCO-2 3D simulator was applied to an observed scene near a Total Carbon Column Observing Network (TCCON) station. The 3D calculations reproduced the OCO-2 radiances, including the perturbations due to clouds, at the single sounding level. The analysis further suggests that clouds near an OCO-2 footprint leave systematic spectral imprints on the radiances, which could be parameterized to be included in the retrieval state vector. If successful, this new state vector element could account for 3D effects without the need for operational 3D radiative transfer calculations. This may be the starting point not only for the improved screening of low-level broken boundary layer clouds, but also for mitigating the effects of nearby clouds at the radiance level, thus improving the accuracy of retrievals in partially cloudy regions for passive spectroscopy of greenhouse gases and air quality missions in general.