Tommy
Taylor
Colorado State University, Cooperative Institute for Research in the Atmosphere (CSU/CIRA)
Christopher W. O'Dell, Colorado State University, Cooperative Institute for Research in the Atmosphere (CSU/CIRA)
Aronne Merrelli, Department of Climate and Space Sciences and Engineering, University of Michigan
Emily Bell, Science Systems and Applications, Inc., Lanham, MD and NASA Goddard Space Flight Center, Greenbelt, MD
Yuwei Zhang, Pacific Northwest National Laboratory, Richland, Washington
Sha Fang, Pacific Northwest National Laboratory, Richland, Washington
Ray Nassar, Environment and Climate Change Canada, Toronto, Ontario, Canada
Omid Moeini, Environment and Climate Change Canada, Toronto, Ontario, Canada
Robert Nelson, Jet Propulsion Laboratory, California Institute
of Technology, Pasadena, CA
Matthaeus Kiel, Jet Propulsion Laboratory, California Institute
of Technology, Pasadena, CA
Poster
This study uses realistic simulations of Orbiting Carbon Observatory-3 (OCO-3) Snapshot Area Maps (SAMs) to evaluate the ability to infer local and urban-scale fluxes from OCO-3 SAMs in the presence of realistic retrieval errors. The simulations are driven by high-resolution (dx = 2 km) meteorological and carbon dioxide (CO2) fields taken from Weather Research and Forecasting coupled with Chemistry (WRF-Chem) model runs, which are sampled, coincident in time and space, with real OCO-3 SAM measurements. Realistic instrument L1b spectra are generated using accurate, multiple-scattering radiative transfer, along with synthetic OCO-3 instrument noise. The version 11 (v11) Atmospheric Carbon Observations from Space (ACOS) Level 2 Full Physics (L2FP) retrieval algorithm, along with prior meteorology from both ``truth" (WRF) and Goddard Earth Observing System 5 Forward Processing Instrument Team (GEOS-5 FP-IT), is used to retrieve column-averaged dry-air mole fractions of CO2 (XCO2). A linear bias correction is applied to XCO2 following standard methodologies to provide highly realistic simulated retrieved values, which can be inter-compared as a function of input parameter adjustments and compared to actual operational OCO-3 results. Results are presented for 3 cities (Cairo, Egypt; Phoenix, USA; and Toronto, Canada) at various dates and times, providing a range of real-world geophysical conditions, e.g., varying sun and satellite geometries, surface conditions, and aerosol loading, all of which are parameters that have been previously shown to have significant effects on retrievals of CO$_2$ from space. It is demonstrated that in some cases, XCO$_2$ can be retrieved with high fidelity, but oftentimes the combination of random instrument noise and geometry, surface, and aerosol effects confound the retrieval at levels that may preclude accurate flux inferences.

The primary goal of this effort is a prediction of realistic potential correlated errors on the scale of an OCO-3 SAM over urban areas. A potential future application of this work would be to explore the effect of these retrieval errors on emission estimates using for example, a Gaussian plume model or the integrated mass enhancement method. It may be possible to explore questions related to understanding the lower limits of detectability of urban and point source, e.g., power plants, CO2 emissions relative to the ambient background XCO2 using this realistic simulation setup.
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