Multi-Spectral/Multi-Sensor Satellite Retrievals and Cross-Sensor Validation of Ozone and Carbon Monoxide within the TROPESS Framework

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Satellite-based monitoring of carbon monoxide and ozone is an integral part of the 2019 NOAA/NASA FIREX-AQ campaign. Key satellite sensors for FIREX-AQ are CrIS and OMPS on Suomi NPP, as well as the Sentinel 5P/TROPOMI: CrIS and OMPS observe ozone from the same platform but in different spectral regions (IR and UV) with different vertical sensitivities, and TROPOMI covers all major fire emission products in the UV to near-IR with high spatial resolution.

Differences in retrieval approach usually pose a challenge when combining and comparing retrieval products from different sensors. The TRopospheric Ozone and its Precursors from Earth System Sounding (TROPESS) framework is being developed at JPL as a continuation of atmospheric composition retrieval and validation tools developed for Aura/TES. Key elements of TROPESS are Reusable Framework for Atmospheric Composition (ReFRACtor), an extensible multi-instrument retrieval framework that facilitates data fusion of radiance measurements from different instruments (UV to thermal IR spectrum); and Multi-Spectral, Multi-Species, Multi-Sensors (MUSES), a retrieval code based on optimal estimation that has been applied successfully to joint AIRS/OMI observations. ReFRACtor/MUSES is designed to retrieve trace gas vertical profile concentrations and total column amounts in a consistent manner across spectral regions, by combining fast and accurate radiative transfer code with a non-linear optimal estimation solver. Inclusion of instrument-specific information allows the application of the same code base to different sensors for a consistent retrieval methodology across platforms, facilitating retrieval comparison across platforms. The goal is to extend single-instrument retrieval capabilities to joint multi-spectral retrievals like AIRS/OMI and CrIS/OMPS.

We present results on the concentration and vertical distribution of O_3 and CO, derived from the application of ReFRACtor/MUSES to AIRS/OMI and CrIS observations during 2019 FIREX-AQ, including comparisons with standard data products from OMPS and TROPOMI, pixel-matched OMPS/TROPOMI radiance calibration, and OMPS/TROPOMI tropospheric ozone comparisons with GEOS-Chem profiles.

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