Geophysical Research Abstracts
Vol. 13, EGU2011-144, 2011
EGU General Assembly 2011

Improving GOME-2 Tropical Formaldehyde Retrievals

Will Hewson, Hartmut Bösch, and Mike Barkley

Earth Observation Science Group, Department of Physics and Astronomy, University of Leicester, Leicester, UK. (wh18@le.ac.uk)

Biogenic Volatile Organic Compounds (BVOCs) emitted by terrestrial ecosystems impact surface air quality and climate. The most important BVOC is isoprene whose annual global emissions (400∼600 Tg C/year) account for around 50% of the total global BVOC budget. Tropical ecosystems are generally thought to be responsible for 70∼90% of the global isoprene budget. Satellite observations of formaldehyde (HCHO), a high-yield, short lifetime product of isoprene oxidation, provide top-down constraints on surface isoprene emissions. Differences between model and measurements during the wet and wet-to-dry seasons highlight major gaps in our current understanding of isoprene emissions and subsequent atmospheric chemistry.

Significant progress has already been achieved in satellite retrievals of HCHO, but errors in retrieved Slant Column Densities (SCD – density along the instrument's line of sight) are typically in the region of 40% for scenes with little cloud and aerosol contamination. Error sources arise due to instability in the Differential Optical Absorption Spectroscopy (DOAS) retrieval procedure, largely caused by the low signal to noise ratio frequently encountered with space-borne UV spectrometers, coupled with HCHO's faint absorption signal. The essential conversion of SCDs to Vertical Column Densities (VCDs – density in a vertical column extending from the surface), needed for application of retrieved HCHO values to geochemical modelling schemes, is a further significant contributor to product error (30∼60%), being strongly influenced by aerosol, cloud and albedo inhomogeneities at a sub pixel level. Over tropical landmasses, the above limitations combine to make satellite retrievals of tropospheric gases particularly difficult due to persistent cloudiness (especially during the wet season) and high aerosol loading (from biomass burning and to an unknown extent, secondary organic aerosol).

The launch of GOME-2 (Global Ozone Monitoring Experiment) aboard EUMETSAT's MetOp-A satellite in 2006 extends the data series of the original GOME instrument (launched 1996), as well as the more recent SCIAMACHY and OMI instruments. GOME-2's increased spatial and spectral resolution over GOME-1 allows for the mitigation of some of the significant error sources highlighted above, enabling improvements in cloud screening and trace gas derivation, offering a potentially improved HCHO retrieval. DOAS is applied to infer SCDs of HCHO from UV spectra acquired by GOME-2. Extensive sensitivity testing is conducted on DOAS retrieval parameters, providing a useful tool with which to derive optimised retrieval settings for subsequent work. Results of these tests are presented along with updated global HCHO SCD retrievals. Our global retrievals are compared with HCHO calculations from the GEOS-Chem model, as well as retrieval products from other research groups. For the critical, error-prone conversion of retrieved SCDs to vertical columns, Air Mass Factors (AMF) are derived from a combination of radiative transfer and chemical modelling schemes. Latest results are presented from an in progress study of AMF sensitivities to cloud, aerosol, albedo and associated influential variables, with the results being used to inform improvements in the AMF scheme over tropical regions.