Tropospheric ozone distributions and trends from IASI and CrIS

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ABSTRACT

Assessing the long-term tropospheric ozone (O_3) distributions and trends is critical for understanding the impact of human activity and climate change on atmospheric chemistry. The tropospheric O_3 budget derived from models and observations is in relatively good agreement according to the first Tropospheric Ozone Assessment Report (TOAR). This report shows an increase in ozone in the troposphere, with regional variations observed. Satellite observations can complement in situ measurements and provide a regional to global view of ozone trends. However, uncertainties persist as to the validity of trends deduced from satellite data, due to discrepancies between ultraviolet (UV) and infrared (IR) instruments. The UV instruments show a positive trend, while the IR instruments show a negative trend over the last decade.

Given uncertainties and our limited understanding of the evolution of tropospheric O_3, more O_3 measurements are needed, such as those from IR instruments which can measure ozone at all latitudes, day and night. In particular, ozone concentrations are retrieved from IASI radiances using the FORLI (Fast Optimal Retrievals on Layers for IASI) algorithm, which has been implemented at EUMETSAT (European Organization for the Exploitation of Meteorological Satellites). Recently EUMETSAT has been reprocessing the whole IASI O_3 dataset providing a homogenous Climate Data Record (CDR) for O_3 for the period 2008-present. Furthermore, the CrIS (the Cross-track Infrared Sounder) instruments onboard the Suomi-NPP and JPSS satellite series have been launched in 2011 and 2017, respectively. The TROPESS (TRopospheric Ozone and its Precursors from Earth System Sounding) team at JPL (Jet Propulsion Laboratory) processed ozone data from CrIS radiances for the period 2015-present.

Here, we use the long-term record of both IASI and CrIS O_3 datasets to analyze the spatio-temporal evolution of tropospheric O_3 concentrations. We compare tropospheric O_3 trends derived from IASI and CrIS for the common period 2015-present on global, hemispheric and regional scales. We also assess the trends derived from the satellite datasets by comparisons with ozonesonde measurements.