QOS2016-15-1, 2016
Quadrennial Ozone Symposium of the International Ozone Commission

Assessment of Errors in Satellite Total Ozone Measurements at Large Solar Zenith Angles

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The accuracy of satellite total ozone measurements at large solar zenith angles is difficult to establish using ground-based methods. Dobson data quality degrades at solar zenith angles above 70 degrees because of stray light, and while double Brewers can measure up to 80 degrees solar zenith angle, they do so along a line of sight that is significantly tilted with respect to the vertical. We use assimilated MLS data to study the performance of the OMI-TOMS V9 total ozone algorithm at large solar zenith angles where enhanced UV scattering and absorption reduce sensitivity to ozone in the lower atmosphere. Errors in total ozone at large solar zenith angles originate mainly in the lower region of the stratosphere at times when ozone is highly variable. Such conditions regularly occur during the high latitude spring. In the polar regions, errors are compounded by the decreased height of the tropopause which shifts the lower stratosphere to altitudes below where UV retrievals have good sensitivity. MLS data do not provide ozone information in the middle and lower regions of the troposphere, so we estimate those contributions to the total column error using ozonesonde data, in particular from Sodankylä. We demonstrate how the retrieval operators and diagnostic information reported in V9 enables this detailed error analysis. Reducing total ozone errors at large solar zenith angles with measurements alone may require information from wavelengths longer than the UV to avoid the strong effects of Rayleigh scattering. Our findings apply to UV total ozone measurements from geostationary orbit, where large measurement angles will be routinely encountered.