Evaluation of calibrations for limb scattering sensors

Natalya Kramarova¹, Pawan Bhartia¹, Glen Jaross¹, and Zhong Chen²

¹NASA GSFC, Greenbelt, MD, USA (natalya.a.kramarova@nasa.gov)
²SSAI, Lanham, MD, USA

The Ozone Mapping and Profiler Suite represents a new generation of the US ozone measuring instruments aimed to monitor the ozone recovery associated to the reduction in levels of man-made ozone depleting substances regulated by the Montreal protocol. The first OMPS was launched on board of the Suomi NPP satellite in October 2011. The Limb Profiler is a part of the OMPS instrumental suite, and it collects solar radiances scattered from the atmospheric limb in the UV and VIS spectral ranges. The next OMPS Limb Profiler is scheduled to launch in 2022 on board of NASA/NOAA JPSS-2 mission. These limb scattering measurements allow to retrieve vertical ozone profiles from the tropopause up to the mesosphere with a high vertical resolution (~2 km). The expected ozone recovery is almost three times slower than the ozone loss observed in 1980s and 1990s. To detect such small trends in ozone concentration, the instrument calibrations should be extremely accurate. Comparisons of ozone retrievals from OMPS LP with the correlative satellite measurements from Aura MLS and ISS SAGE III revealed that OMPS LP retrievals accurately characterize the vertical ozone distribution in different atmospheric regions which are most sensitive to changes in the stratospheric composition and dynamics. Between 18 and 42 km the mean differences between LP and correlative measurements are within ±10%, except for the northern high latitudes where between 20 and 32 km biases exceed 10% due to the measurement errors. We also found a small positive drift of ~0.5%/yr against MLS with a pattern that is consistent with the ~150-meter drift (over 7 years) in sensor pointing detected by one of our altitude resolving methods. The spatial patterns in the ozone biases and drifts suggest that remaining errors in the LP ozone retrievals are due to errors in altitude registration and instrument calibrations. We present a study where we evaluate calibrations of the OMPS LP by converting ozone differences between OMPS LP and Aura MLS into differences in radiances. Then these radiance differences are compared with the LP measured radiances to determine errors in OMPS LP calibrations. Since the OMPS LP has three slits, some of the errors, like a drift in the altitude registration, should be common across all three slits, but other errors will be unique for each slit, helping to isolate different sources of errors. This approach can be extended to earlier ESA’s limb scattering missions, like SCIAMACHY and OSIRIS, since MLS has long overlap with the ENVISAT and Odin missions.