Ozone profile products from the Suomi NPP OMPS Limb Profiler: overview of the quality of version 2.0 and a path for the updated version 2.5

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Suomi NPP OMPS Limb Profiler

- LP measures limb scattered radiation in the wavelength range 290-1000 nm, with variable resolution (1-25 nm);
- LP has three slits separated horizontally by 4.25 (about 250 km) to expand the sensor cross-track coverage;
- Altitude range: 0-80 km with 1 km sampling and ~2 km vertical resolution;
- LP collects radiance spectrum simultaneously from all altitudes;
- LP makes about 160–180 measurements per orbit (~1° latitude sampling) with 14 orbits per day.

OMPS LP ozone vertical profiles version 2.0
- O3 profiles are independently retrieved from UV and VIS spectral ranges;
- 43 UV pairs and 17 VIS triplets;
- measurements are normalized at 65 km for UV and 45 km for VIS ranges;
- Optimal Estimation technique + Tikhonov regularization;
- The aerosol correction module is turned off.

[D. Rault and R. Loughman, 2013]
Continuation of the ozone climate record

Ozone Time Series at 2 hPa, 30S-60S

SAGE II
Aura MLS
OMPS LP

JPSS-2 OMPS LP (2021)
ISS SAGE III (2016)
OMPS LP October 2011

Ozone volume mixing ratio

Time


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Stability of LP measurements: altitude (or tangent height) registration error is the main source of uncertainties in limb measurements. In addition to the star tracker readings, two methods for the altitude registration - RSAS and ARRM – have been tested and applied. By combining these two methods we can detect the tangent height with ±200 m uncertainties. The ARRM method detected a 100m shift in altitude registration in April 2013, later confirmed by the star tracker system. This 100m shift in April 2013 will be corrected in the version 2.5 processing of Level 1 data.

Ozone seasonal cycle: Aura MLS, MIPAS and OMPS LP

Amplitude of the Seasonal cycle MIPAS, nd(%)
Antarctic ozone measurements with OMPS: synergy between nadir and limb modules

2014 Antarctic ozone hole

Courtesy of C. Seftor
Look inside the ozone hole with OMPS

Total O3 increase

Ozone build-up due to strong dynamics

min profile O3

2015 O3 Hole is persistent

Weak dynamics
Quality assessment of OMPS LP v2

Mean Bias OMPS-LP v2 - Aura MLS v4, (%)
Quality assessment of OMPS LP v2

Relative drift OMPS-LP v2 - Aura MLS v4, (%/yr)

Latitudes and Drifts

90S-60S: Drift (%/yr) N= 48
60S-20S: Drift (%/yr) N= 53
20S-20N: Drift (%/yr) N= 53
20N-60N: Drift (%/yr) N= 53
60N-90N: Drift (%/yr) N= 52

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A path toward the version 2.5

OMPS-LP v2 algorithm
- 43 UV pairs and 17 VIS triplets;
- radiances are normalized at 65 km for UV and 45 km for VIS ranges;
- The aerosol correction module is turned off.

OMPS-LP v2.5 algorithm
- 3 UV pairs and 1 VIS triplets;
- radiances are normalized at 55 km for UV and 40 km for VIS ranges;
- Include the explicit aerosol correction by using LP aerosol v1.

• The stray light correction for the VIS wavelengths will be implemented in version 2.5;
• A 100 m shift in the altitude registration detected in April 2013 will be corrected;
• TH shifts between 3 slits will be removed (expect better agreement between slits);
• A new cloud height detection algorithm will be integrated in version 2.5 [Chen et al., AMT, 2016].
Future plans

• Account for horizontal inhomogeneity (2D effects) along the line of sight:
  ✓ 1. Near-term: apply the horizontal contribution function of the measurement vector to the retrieved profiles;
  ✓ 2. Long-term: collaborate with GMAO in assimilating cloud and aerosol corrected LP radiances using 2D RT model.

• Temperature profiles in the mesosphere and upper stratosphere can be retrieved from the LP measurements.