OMPS Limb Profiler - Daily Aerosol Product Description

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Introduction

This document describes the content and format of the daily aerosol product files created from Ozone Mapping and Profiler Suite (OMPS) Limb Profiler (LP) measurements. This product is referred to as LP-L2-AER-DAILY throughout this document. OMPS LP views the Earth's limb looking backwards along the orbit track, using three parallel vertical slits. One slit is aligned with the orbit track, and the other two slits are pointed 4.25° to each side, giving an effective cross-track separation of approximately 250 km at the tangent point. Each profile measurement takes approximately 19 seconds to complete, corresponding to along-track sampling of approximately 125 km. Further instrument technical details and retrieval algorithm description can be found in *Jaross et al*. [2012] and *Rault and Loughman* [2013].

1. LP-L2-AER-DAILY Product

The LP-L2-AER-DAILY product contains a subset of the retrieval information that is available in the orbital Level 2 LP_EDR_NASA data product. The orbital products are not currently released to the public. The daily product is simply an aggregation of retrieval results over all orbits whose starting time [UT] falls within a single calendar day. The aerosol product information consists of retrieved extinction coefficient profiles at each of the five measurement wavelengths for every observation (termed "event" in this document), together with appropriate geolocation information.

1.1 File Format

The LP-L2-AER-DAILY data files are provided in the HDF5 format. The hdf5 library is required to read the files. This library is available from http://hdfgroup.org. In addition to interfaces in C and FORTRAN which are developed and distributed by the HDF Group, there is a high quality interface for Python called h5py. These options are all open source format. The ability to read HDF5 files is also included in many common commercial data analysis tools, such as Matlab, IDL, TecPlot, and Mathematica. An HDF5 file consists of named groups (which

behave like folders or directories in a computer file system) and named datasets. Because the objects are named, they can be accessed by name rather than by file offset.

1.2 Groups and Datasets

The LP-L2-AER-DAILY data file consists of three primary groups (h5 space): the AncillaryData group, the DataFields group, and the GeolocationFields group. Each group contains multiple datasets that correspond to the group category. The contents of these groups are summarized in the following sections. Tables 1-3 provide a brief description for each dataset name. In many cases, this description matches the "long name" contained in the HDF5 file. Some descriptions have been simplified because the legacy long name transferred from L1B or L1G files is more difficult to understand. We anticipate revising the long names themselves for future releases.

1.2.1. AncillaryData Group

The AncillaryData group contains the background atmosphere pressure profile, the background atmosphere temperature profile, the terrain altitude, and the tropopause altitude datasets. The temperature and pressure profiles are interpolated in time from the closest GMAO gridded data profiles (see Release Notes for details) to the tangent point location of each OMPS LP event. The tropopause altitude is also determined from the external data. Table 1 summarizes the dataset name, description, units and dimension of these four datasets. In the following tables, note that while there are *ntime* observations during a given day, the dimension size *ntime**3 incorporates the three slits used by the LP instrument.

Dataset name	Description	Unit	Dimension
AtmospherePressure	Atmospheric pressure	hPa	(ntime*3, 41)
AtmosphereTemperature	Atmospheric temperature	C	(ntime*3, 41)
TerrainAltitude	Terrain altitude above mean sea level	km	(ntime*3)
TropopauseAltitude	Tropopause altitude	km	(ntime*3)

Table 1. The AncillaryData group contents: Dataset name, description, unit and dimension.

1.2.2. DataFields Group

The DataFields group contains the retrieved tropospheric cloud height (if any), the image number (referred to as "frame"), the slit number, the minimum and maximum tangent height, the extinction coefficient profiles and estimated precision, the measurement wavelengths, the quality flag, the sample table version, and the surface reflectance.

The cloud height is determined by the retrieval algorithm if a cloud is detected for that event.

The frame number represents the position of each frame during each orbit sequence, beginning at 1 and ending at the last frame for that orbit.

The quality flag is set to 0 for a successful retrieval, or 1 for an unsuccessful retrieval.

The slit number is defined as 1 = left slit, 2 = center slit, 3 = right slit. The sequence of values in this dataset for a given day is 1, 1, 1,…1 for *ntime* events, followed by 2, 2, 2,…2 and 3, 3, 3,…3.

The surface reflectance is the effective scene reflectance at 524 nm, considering any clouds as being present at the terrain height.

The retrieved aerosol extinction coefficient profile at each of five measurement wavelengths is reported, along with the estimated precision as derived by the retrieval algorithm.

The measurement wavelengths used for each event are reported. Nominal values are approximately 514, 526, 674, 748, and 865 nm.

Dataset name	**Description**	**Unit**	**Dimension**
CloudHeight	Cloud height	km	(ntime*3)
FrameNumber	Frame index for each orbit	unitless	(ntime*3)
QualityFlag	Quality flag for success of retrieval	unitless	(ntime*3)
SlitNumber	Slit index for each event	unitless	(ntime*3)
STBversion	Sample table version used for data collection	unitless	(ntime*3)
SurfaceReflectance	Mean surface reflectance	unitless	(ntime*3)
TH_retrieval_bottom_aerosol	Minimum tangent height used for aerosol retrieval	km	(ntime*3)
TH_retrieval_top_aerosol	Maximum tangent height used for aerosol retrieval	km	(ntime*3)
aerosolExtinctionPrecision	Extinction coefficient precision	km^{-1}	(ntime*3, 5, 41)
aerosolExtinctionValue	Extinction coefficient value	km^{-1}	(ntime*3, 5, 41)
aerosolWavelength	Measurement wavelengths for each event	unitless	(5)

Table 2. The DataFields group contents: Dataset name, description, unit and dimension.

1.2.3. GeolocationFields Group

The GeolocationFields data group contains the date and time of each measurement, the reference height scale, the orbit number, some individual event information flags, and the following values determined at 25 km tangent height: latitude, longitude, single scattering angle, and solar zenith angle.

The swath level quality flag contains five values in the form '*abcde*', with the following definitions.

a: SAA (South Atlantic Anomaly)
- 0 = estimated SAA effects at satellite location are < 5% of nominal maximum value, based on OMPS LP climatology
- 1 = estimated SAA effects at satellite location are 5-40% of nominal maximum value
- 2 = estimated SAA effects at satellite location are 40-75% of nominal maximum value
- 3 = estimated SAA effects at satellite location are > 75% of nominal maximum value

b: Moon
- 0 = does not appear in any slit (based on calculated ephemeris)
- 1 = appears in left slit
- 2 = appears in center slit
- 3 = appears in right slit

c: SolarEclipse
- 0 = none
- 1 = solar eclipse on day side of Earth at time of measurement

d: OtherPlanets
- 0 = does not appear in any slit (based on calculated ephemeris)
- 1 = appears in left slit
- 2 = appears in center slit
- 3 = appears in right slit

e: NonNominalAttitude
- 0 = nominal spacecraft attitude
- 1 = attitude shift due to planned spacecraft maneuver (such as roll or yaw) or other reason

The climatology for estimating SAA effects was developed using LP closed-door measurements of charged particle hits on the CCD made from November 2011 to January 2012. A two-dimensional Gaussian fit was used to parameterize the observations for operational use [*Jaross et al.*, 2014]. Please note that this flag is set during L1B processing based on spacecraft position,

rather than the tangent point location of any LP slit. A simplified representation of SAA geographic coverage for significant impact on the retrieved extinction coefficient profile is given by the following coordinates:

Latitude = [55°S, 10°N] Longitude = [115°W, 37.5°E]

Dataset name	Description	Unit	Dimension
Date	Date	YYYYMMDD	(1)
HeightScale	Reference height scale for retrievals	km	(41)
Latitude	Mean latitude at tangent height of 25 km	degrees	(ntime*3)
Longitude	Mean longitude at tangent height of 25 km	degrees	(ntime*3)
OrbitNumber	Orbit number	unitless	(ntime*3)
SingleScatteringAngle	Mean single scattering angle at tangent height of 25 km	degrees	(ntime*3)
SolarZenithAngle	Mean solar zenith angle at tangent height of 25 km	degrees	(ntime*3)
SwathLevelQualityFlag	Flags for satellite location and orientation	unitless	(ntime*3)
Time	Seconds since midnight [UT]	seconds	(ntime*3)

Table 3. The GeolocationFields group contents: Dataset name, description, unit and dimension.

1.3. Product Filenames

The product file name follows the pattern of the sample below for data collected on April 2, 2012:

OMPS-NPP_LP-L2-AER-DAILY_v2.0_2012m0402_2014m0611t144713.h5

---Product name--- ---Date--- ---Processing Time---

2. References

Jaross, G., G. Chen, M. Kowitt, J. Warner, P. Xu, T. Kelly, M. Linda, and D. Flittner [2012], Suomi NPP OMPS Limb Profiler initial sensor performance assessment, *Proc. SPIE, 8528*, doi:10.1117/12.979627.

Jaross, G., P. K. Bhartia, G. Chen, M. Kowitt, M. Haken, Z. Chen, P. Xu, J. Warner, and T. Kelly [2014], OMPS Limb Profiler instrument performance assessment, *J. Geophys. Res. Atmos.*, *119*, doi:10.1002/2013JD020482.

Rault, D. F., and R. P. Loughman [2013], The OMPS Limb Profiler Environmental Data Record Algorithm Theoretical Basis Document and expected performance, *IEEE Trans. Geosci. Rem. Sens., 51*, 2505-2527.