OMUFPMET and OMVFPMET README File

1. Summary of the OMI Ancillary Data Files

The OMI ancillary data products were developed to provide supplementary information for use with the OMI Collection 4 L1b datasets. This latest version of the OMI L1b data was released in OMI Collection 4 with an improved L0 to L1b processor and included an updated instrumental calibration to account for changes that occurred through the duration of the mission. The ancillary data provide information that have been omitted from the L1b files themselves for Collection 4 such as the snow/ice classification, as well as co-located meteorological fields and instrument monitoring data for the benefit of algorithm developers.

There are two types of ancillary products provided with the Collection 4 data. The first type provides meteorological fields from the Goddard Modeling and Assimilation Office (GMAO) which are co-located to the OMI Field of View (FoV). These are the OMUFPMET, OMVFPMET, OMUFPSLV, and OMVFPSLV products. The second class of OMI ancillary product provides information about the instrument data quality and surface information that are not derived from the GMAO products. These files, the OMUANC and OMVANC products, provide snow/ice classification, land type classification, terrain height data, row anomaly flags, pixel corner information, and spectral correlation flags.

The ancillary information provided in these products are collocated with the OMI measurements differently depending on whether the source product is reported at higher or lower resolution than the OMI FoV. GMAO meteorological fields and NISE snow/ice data used for southern Hemisphere are interpolated to the center of the OMI FoV since these sources of information are reported at a coarser resolution than the area of the OMI FoV. Products with higher spatial resolution than OMI, for example the IMS snow/ice data used in northern Hemisphere and the land type classification, are averaged over the OMI FoV. A list of all the ancillary fields and their associated products can be found at the end of this README document.

2. Overview

This document provides a summary of the OMUFPMET and OMVFPMET data products. These products supply 3-d meteorological (met) fields at OMI overpass positions from the Forward Processing for Instrument Teams (FP-IT) product produced by the Global Modeling and Assimilation Office (GMAO). FP-IT analysis products are produced in near real-time (NRT) by assimilating high quality observations available at the time into the Goddard Earth Observing System Model, Version 5 (GEOS-5). There is approximately a 6-hour latency in the production of the OMUFPMET and OMVFPMET products as the temporal interpolation requires FP-IT files after the overpass time. For OMUFPMET and OMVFPMET, the OMI Team has selected a subset of the FP-IT met fields from the instantaneous 3-hourly GEOS-5 FP-IT 3d assimilated state on native levels (DFPITT3NVASM) product. The subsets were selected for use in in OMI retrieval

algorithms as ancillary data, and for later data analysis. Separate products are provided for the OMI UV2 (Band 2) and VIS (Band 3) channels since they have slightly different geolocation. A corresponding product is not provided for the OMI UV1 channel.

2.1 Data

GEOS-5 FP-IT is a forward processing data assimilation system that produces analyses in near real time for use by NASA instruments teams. A fixed version of the GEOS-5 model (Lucchesi, 2013) is used to maintain consistent results for use in climate quality satellite retrievals. The spatial resolution of the GEOS-5 model in the FP-IT product is 0.5° latitude by 0.625° longitude on 72 vertical layers. The OMI instrument collects measurements in a swath of 60 across-track pixels dimensioned 13 km x 24 km at nadir with larger FOV observations off nadir. Figure 1 shows a comparison of the resolution of GEOS-5 FP-IT data grid cell centers compared to the center points of OMI measurements.

The co-located OMI/FP-IT product provides linearly interpolated data from FP-IT for the overpass time and locations of all usable pixels in the OMI swaths. The interpolated FP-IT data are processed only for orbits taken in OMI's global measurement mode. OMI zoom mode data were not processed. The products discussed here are reported on the native vertical resolution of the GEOS-5. Table 1 lists of the variables from FP-IT interpolated to the OMI measurement locations.

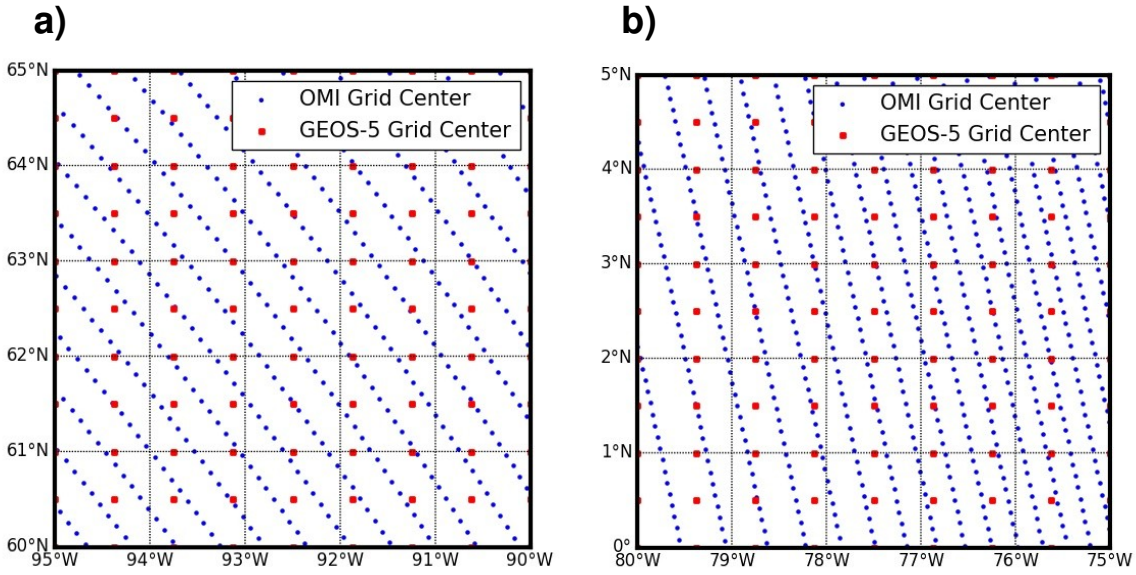

Figure 1. Comparison of the spacing of the FP-IT model grid center points with the FOV center points for OMI measurements. The FP-IT grid cells are lower

spatial resolution (0.5° lat x 0.625° lon) than OMI FOVs (13 x 24 km at nadir). The spatial density of the OMI and FP-IT data varies differently with latitude. Examples shown here for (a) 60-65° N and (b) 0-5°N.

Variable Name	Description	Dimensions	Units
DELP	Layer Pressure Thickness	(1,lev,scanline,ground_pixel)	Pa
latitude	Latitude (deg. north)	(1,scanline,ground_pixel)	deg North
longitude	Longitude (deg. east)	(1,scanline,ground_pixel)	deg East
PS	Surface Pressure	(1,scanline,ground_pixel)	Pa
T	Air Temperature	(1,lev,scanline,ground_pixel)	K
time_TAI93	Seconds Since 1993-01-01-00 UTC	(1,scanline,ground_pixel)	s
PHIS	Surface Potential	(1,scanline,ground_pixel)	m-2·s-2
PL	Mid-layer pressure	(1,lev,scanline,ground_pixel)	Pa
delta_time	Offset of the observation from reference start time of measurement	(1,scanline)	m·s-1

Table 1. List of FP-IT meteorological fields interpolated to the OMI grid in the OMUFPMET and OMVFPMET products. Abbreviations for the dimensions of the data fields are lev for vertical layers, ground_pixel for cross-track, and scanline for along-track.

2.2 Calculating Pressure Levels

As discussed above, the GEOS-5 models natively provide vertically dimensioned data on 72 pressure layers. GEOS-5 products report a data field called DELP, which is layer pressure thickness of each layer, or the pressure difference between bottom and top of the layer. The top level in GEOS-5 vertical grid represents the top of the atmosphere and is defined at 1 Pa. To compute the pressure at the bottom of the top layer, the first DELP is added to the 1 Pa top level. Moving downward, subsequent DELP values are similarly added to get the bottom pressure level of each remaining layer. The following equation can be used to compute the bottom level pressure for any layer, using the corresponding DELP.

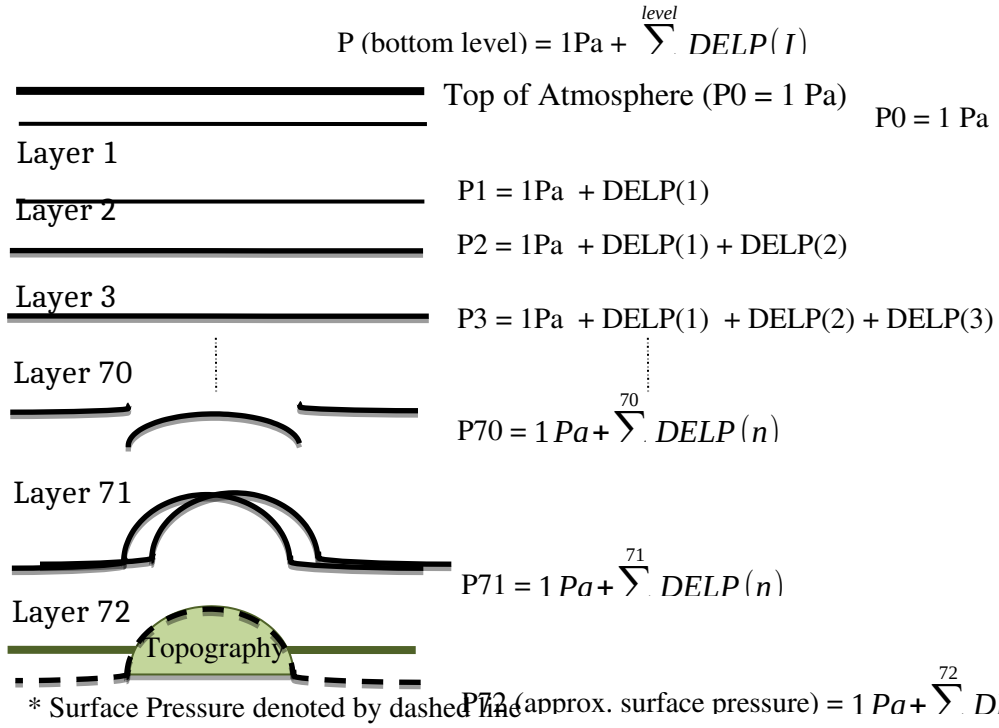

Figure 2. Diagram showing how pressure levels are calculated for vertical fields in OMUFPMET and OMVFPMET.

Note that the pressure level at the bottom of the atmosphere, of layer 72 will be very close to the reported surface pressure from the model, but it is not identical. The GEOS-5 model using a terrain following coordinate system, which means the vertical pressure grids do not sintersect the surface (for further explanation please see https://gmao.gsfc.nasa.gov/reanalysis/MERRA/pressure_surface.php). As a note, the pressure fields above the tropopause are fixed above the tropopause (beginning at 176 hPa). The surface pressure field, Ps, should be used as the model surface pressure. To calculate the DEM altitude of the FP-IT model, simply divide the surface geopotential by the gravitational constant 9.8 m/s^2.

2.3 File Format

Variable Name	Description	Ancillary Product
latitude	Latitude (deg. north)	OMxFPSLV
longitude	Longitude (deg. east)	OMxFPSLV
PBLTOP	PBL Top Pressure	OMxFPSLV
TROPPB	Blended Based Tropopause Pressure	OMxFPSLV
TROPPT	T-Based Tropopause Pressure	OMxFPSLV
TROPPV	PV-Based Tropopause Pressure	OMxFPSLV
PS	Surface Pressure	OMxFPSLV, OMxFPMET
TS	Surface Skin Temperature	OMxFPSLV
U10M	10-m Eastward Wind	OMxFPSLV
V10M	10-m Northward Wind	OMxFPSLV
time_TAI93	Seconds Since 1993-01-01-00 UTC	OMxFPSLV, OMxFPMET
delta_time	Offset of the observation from reference start time of measurement	OMxFPSLV
DELP	Layer Pressure Thickness	OMxFPMET
T	Air Temperature	OMxFPMET
PHIS	Surface Potential	OMxFPMET
PL	Mid-layer pressure	OMxFPMET
snow_area_fraction	Percent snow cover in OMI FoV	OMxANC
sea_ice_area_fraction	Percent sea ice cover in OMI FoV	OMxANC
snow_ice	Majority classification, definitions shown in Table 2	OMxANC
snow_ice_source	The source of the snow-ice flag (0-IMS, 1-NISE)	OMxANC
land_cover	Percent of each IGBP land cover type in OMI FoV	OMxANC
land_cover_mode	Top 3 land cover types in OMI FoV by area	OMxANC
row_anomaly	UV Residual Row-Anomaly Flags	OMxANC
decorrelation_index	Decorrelation index associated with the observation	OMxANC
terrain_height	Pixel-averaged terrain height (in m)	OMxANC
area_fov75	Mean area (in km) of the 75% field of view	OMxANC
latitude_bounds_fov75	Latitudes (in degrees) of corner coordinated of 75% field of view	OMxANC
longitude_bounds_fov75	Longitudes (in degrees) of corner coordinated of 75% field of view	OMxANC

Table 2. List of OMI ancillary datasets along with the description and specific product where the data can be found. Note the x indicates U or V for UV or VIS, respectively.

More details on the file format can be found in the file specification documents:
https://docserver.gesdisc.eosdis.nasa.gov/public/project/OMI/OMVFPMET.fs
https://docserver.gesdisc.eosdis.nasa.gov/public/project/OMI/OMUFPMET.fs

The data files are in netCDF4/HDF5 as recommended by NASA for Earth Science data (https://earthdata.nasa.gov/user-resources/standards-and-references/netcdf-4hdf5-file-format). The files can be read with netCDF4 readers as well as any HDF5 reader because of the general interoperability of netCDF4 and HDF5 low level file formats. The following documentation provides information about software to read netCDF4/HDF5 files.

Fortran netCDF4:
https://www.unidata.ucar.edu/software/netcdf/netcdf-4/newdocs/netcdf-f90.html

Fortran HDF5:
https://support.hdfgroup.org/HDF5/examples/f-src.html

Python netCDF4:
http://unidata.github.io/netcdf4-python/

Python HDF5:
http://docs.h5py.org/en/stable/

For questions related to the OMxFPMET algorithm and data quality please contact Zachary Fasnacht.

GEOS-5 FP-IT products:
https://gmao.gsfc.nasa.gov/

References:

Bosilovich, M. G., R. Lucchesi, and M. Suarez, 2016: MERRA-2: File Specification. GMAO Office Note No. 9 (Version 1.1), 73 pp, available from http://gmao.gsfc.nasa.gov/pubs/office_notes.

Lucchesi, R., 2015: File Specification for GEOS-5 FP-IT. GMAO Office Note No. 2 (Version 1.4), 64 pp, available at https://gmao.gsfc.nasa.gov/pubs/docs/Lucchesi865.pdf