



*National Aeronautics and Space
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Information and Services Center (GES DISC)*

README Document for the Multisensor Advanced Climatology Liquid Water Path Product

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| 1/1/2017 | Original Document | Thomas Hearty |
| 2/17/2017 | Added product update | Thomas Hearty |
| 2/17/2017 | Changed name of diurnal product | Thomas Hearty |

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1.0 Introduction

This document provides basic information for using the Multisensor Advanced Climatology Liquid Water Path products described by Elsaesser et al. (2017).

1.1 Dataset Description

The Multi-Sensor Advanced Climatology of Liquid Water Path (MAC-LWP) data set contains monthly 1.0-degree ocean-only estimates of cloud liquid water path (MACLWP_mean), total water path (MACTWP_mean) which includes both cloud and rain water, and monthly climatologies of cloud liquid water path diurnal cycle amplitudes and phases (MACLWP_diurnal). The MACTWP_mean field can also be used as a quality-control screen for the MACLWP_mean field as discussed in Elsaesser et al. (2017), where uncertainty increases as the ratio of cloud to total water path increases. The MAC-LWP algorithm uses as input the Remote Sensing Systems (RSS) Version 7 0.25-degree-resolution retrieval products (produced using the SSM/I, AMSR-E, TMI, AMSR-2, GMI, SSMIS, and WindSat satellite sensors), and performs a bias correction on all input RSS cloud water path products based on AMSR-E matchups to clear-sky MODIS scenes. The MAC-LWP algorithm ensures that spurious trends and variability in the cloud fields arising from drifting satellite overpass times are mitigated by simultaneously solving for the monthly average cloud and total water paths and monthly-mean diurnal cycles, as discussed in O'Dell et al. (2008). Additional details on the algorithm and data fields can be found in Elsaesser et al. (2017).

1.2 Product Table

The Multi-Sensor Advanced Climatology of Liquid Water Path is composed of 3 separate products described in Table 1.

Table 1.

| Dataset Title | Shortname | DOI |
|---|----------------|--------------------------|
| Multisensor Advanced Climatology Mean Liquid Water Path L3 Monthly 1 degree x 1 degree V1 | MACLWP_mean | 10.5067/MEASURES/MACLWPM |
| Multisensor Advanced Climatology Total Liquid Water Path L3 Monthly 1 degree x 1 degree V1 | MACTWP_mean | 10.5067/MEASURES/MACTWPM |
| Multisensor Advanced Climatology Mean Liquid Water Path Diurnal Cycle L3 Monthly 1 degree x 1 degree V1 | MACLWP_diurnal | 10.5067/MEASURES/MACLWPD |

1.3 Data Disclaimer

The data should be used with care and with the proper citations. Each product in the climatology may be cited using the DOIs listed in Table 1.

1.4 Dataset Update

The three datasets in Table 1 were updated February 11, 2017 to include all satellite datasets processed for year 2016 (AMSR-2, GMI, SSMIS and WindSat sensors). In addition, the Version 8 SSMIS F18 record from Remote Sensing Systems was made available (years 2010-2016) in early Feb. 2016, and these data have been incorporated. With the inclusion of a new satellite dataset in addition to another year of multisensor data, the diurnal cycle corrections to each product changes, which required a re-processing of the entire record. Changes to the record are minimal, however (e.g. cloud liquid water path changed by less than 0.01 mm for over 98% of the grid-boxes).

2.0 Data Organization

The data in all three products are averaged on a 1 degree x 1 degree grid. The values in MACLWP_mean and the MACTWP_mean products are reported once per month for each grid cell and the values in the MACLWP_diurnal product are monthly climatologies (i.e. an average over all years for the given month) for each grid cell. The fill values of -999.0 are used for grid cells with no valid data.

2.1 File Naming Convention

The file names of the Multisensor Advanced Climatology Mean Liquid Water Path L3 Monthly 1 degree x 1 degree V1 (MACLWP_mean) product are defined as follows:

maclwp_cloudlwpave_YYYY_v1.nc4

where YYYY is the 4 digit year.

The file names of the Multisensor Advanced Climatology Total Liquid Water Path L3 Monthly 1 degree x 1 degree V1 (MACTWP_mean) product are defined as follows:

maclwp_totallwpave_YYYY_v1.nc4

where YYYY is the 4 digit year.

The file names of the Multisensor Advanced Climatology Mean Liquid Water Path Diurnal Cycle L3 Monthly 1 degree x 1 degree V1 (MACLWP_diurnal) product are defined as follows:

maclwp_cloudlwpdiurnal_MM_v1.nc4

where MM is the 2 digit month.

2.2 File Format and Structure

The files are stored in netCDF-4 format.









3.0 Data Contents

Spatial Grid: 2D 1 degree grid (Lon and Lat are 1D)









Dimension of other variables: Lat = 180, Lon =360

Time dimension: The MACLWP_mean and MACTWP_mean have an extra dimension for each month.

Data Fields in the MACLWP_mean product:

| Name | Long Name |
|--|--|
| ▼  maclwp_cloudlwpave_2002_v1.nc4 | maclwp_cloudlwpave_2002_v1.nc4 |
|  cloudlwp | Monthly Average Cloud Liquid Water Path |
|  cloudlwp_error | 1-sigma Error on Monthly Average Cloud Liquid Water Path |
|  lat | latitude |
|  lat_bnds | lat_bnds |
|  lon | longitude |
|  lon_bnds | lon_bnds |
|  time | Month index (0-11); 0=January, ..., 11=December |

Data Fields in the MACTWP_mean product:

| Name | Long Name |
|--|---|
| ▼  maclwp_totallwpave_2003_v1.nc4 | maclwp_totallwpave_2003_v1.nc4 |
|  lat | latitude |
|  lat_bnds | lat_bnds |
|  lon | longitude |
|  lon_bnds | lon_bnds |
|  time | Month index (0-11); 0=January, ..., 11=December |
|  totallwp | Monthly Average Total Cloud+Rain Liquid Water path |
|  totallwp_error | 1-sigma Error on Monthly Average Total Cloud+Rain Liquid Water path |

Data Fields in the MACLWP_diurnal product:

| Name | Long Name | Type |
|--------------------------------------|---|------------|
| ▼ macclwp_cloudlwpdiurnal_01_v1.n... | macclwp_cloudlwpdiurnal_01_v1.nc4 | Local File |
| amp1 | Diurnal Cycle Fitted A1, the first harmonic a... | Geo2D |
| amp2 | Diurnal Cycle Fitted A2, the second harmoni... | Geo2D |
| error_amp1 | Statistical Error on A1 (the first harmonic a... | Geo2D |
| error_amp2 | Statistical Error on A2 (the second harmonic... | Geo2D |
| error_correlation_A1_A2 | Statistical Error Correlation on A1 and A2 | Geo2D |
| error_correlation_A1_T1 | Statistical Error Correlation on A1 and T1 | Geo2D |
| error_correlation_A1_T2 | Statistical Error Correlation on A1 and T2 | Geo2D |
| error_correlation_A2_T2 | Statistical Error Correlation on A2 and T2 | Geo2D |
| error_correlation_M_A1 | Statistical Error Correlation on M and A1 | Geo2D |
| error_correlation_M_A2 | Statistical Error Correlation on M and A2 | Geo2D |
| error_correlation_M_T1 | Statistical Error Correlation on M and T1 | Geo2D |
| error_correlation_M_T2 | Statistical Error Correlation on M and T2 | Geo2D |
| error_correlation_T1_A2 | Statistical Error Correlation on T1 and A2 | Geo2D |
| error_correlation_T1_T2 | Statistical Error Correlation on T1 and T2 | Geo2D |
| error_meanfit | Statistical Error on M (the mean CloudLWP) | Geo2D |
| error_phase1 | Statistical Error on T1 (the first harmonic ph... | Geo2D |
| error_phase2 | Statistical Error on T2 (the second harmonic... | Geo2D |
| lat | latitude | 1D |
| lat_bnds | lat_bnds | 2D |
| lon | longitude | 1D |
| lon_bnds | lon_bnds | 2D |
| meanfit | Diurnal Cycle Fitted M, the mean CloudLWP | Geo2D |
| nfit | Fitting Order performed. 0: M only; 1: {M,A1,... | Geo2D |
| npoints | Number of Satellite Overpasses contributin... | Geo2D |
| phase1 | Diurnal Cycle Fitted T1, the first harmonic ph... | Geo2D |
| phase2 | Diurnal Cycle Fitted T2, the second harmoni... | Geo2D |

4.0 Options for Reading the Data

4.1 Command Line Utility

ncdump

The ncdump tool can be used as a simple browser for HDF data files, to display the dimension names and sizes; variable names, types, and shapes; attribute names and values; and optionally, the values of data for all variables or selected variables in a netCDF file. The most common use of ncdump is with the -h option, in which only the header information is displayed.

```
ncdump [-c|-h] [-v ...] [[-b|-f] [c|f]] [-l len] [-n name] [-d n[,n]] filename
```

Options/Arguments:

[-c] Coordinate variable data and header information

[-h] Header information only, no data

[-v var1[,...]] Data for variable(s) <var1>,... only data

[-f [c|f]] Full annotations for C or Fortran indices in data

[-l len] Line length maximum in data section (default 80)

[-n name] Name for netCDF (default derived from file name)

[-d n[,n]] Approximate floating-point values with less precision filename File name of input netCDF file

4.2 A tool for simple visualization

Panoply, developed at the Goddard Institute for Space Studies (GISS), is compliant with NetCDF Climate and Forecast (CF) Metadata Convention that is gaining popularity. A strength of the tool is that data can be previewed “remotely” over the network – i.e. user can preview file content of HDF files stored on a remote site, without downloading them. Panoply is available from GISS:

<http://www.giss.nasa.gov/tools/panoply/>

4.3 Programming Languages

The data can be read using major programming languages such as Fortran, C, Java, IDL, Matlab, and Python.

5.0 Data Services

Data services and access methods can be found on the dataset landing pages.

http://disc.gsfc.nasa.gov/datacollection/MACLWP_mean_1.html

http://disc.gsfc.nasa.gov/datacollection/MACLWP_diurnal_1.html

http://disc.gsfc.nasa.gov/datacollection/MACTWP_mean_1.html

If you need assistance or wish to report a problem:

Email: gsfc-help-disc@lists.nasa.gov

Voice: 301-614-5224

Fax: 301-614-5268

Address:

Goddard Earth Sciences Data and Information Services Center NASA Goddard Space Flight Center Code 610.2 Greenbelt, MD 20771 USA

7.0 Acknowledgements

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References

- Elsaesser, G. S., C. W. O'Dell, M. D. Lebsock, R. Bennartz, T. J. Greenwald, and F. J. Wentz, 2017: The Multi-Sensor Advanced Climatology of Liquid Water Path (MAC-LWP). *J. Clim.*, **in review**.
- O'Dell, C. W., F. J. Wentz, and R. Bennartz, 2008: Cloud Liquid Water Path from Satellite-Based Passive Microwave Observations: A New Climatology over the Global Oceans. *J. Clim.*, **21**, 1721–1739.