# CIPS Level 3a Data: Daily Daisies

Last Updated May 2020

## 1. Introduction

This document gives a brief overview of the CIPS level 3a data, which are daily PMC maps that are informally referred to as "daily daises". At the time of this writing, the current level 3a data version is v5.20, revision 05. The level 3a data are provided for qualitative assessments of the global PMC cloudiness on any particular day. See Bailey *et al*. [2008], Benze *et al*. [2008; 2011], McClintock *et al*. [2008], Merkel *et al*. [2008], Rusch *et al*. [2008], and Lumpe et al. [2013] for descriptions of the instrument, observation technique, retrieval algorithm, and evaluation of the version 4 data. Manuscripts describing the version 5 retrieval algorithm and validation are currently in preparation. The level 3 data are based directly on level 2 data, so users of the level 3a data are strongly encouraged to read the level 2 documentation for information on issues related to data quality.

*Level 3a NetCDF files*

One level 3a NetCDF file (~15 MB) is produced for each day; it contains the level 3a cloud albedo (radiance/solar irradiance in units of $10^{-6}$ $sr^{-1}$) for that day on a standard latitude/longitude grid with 56 $km^2$ resolution. Table 1 at the end of this document defines the variables in the level 3a data files. Note that the NetCDF files with the level 3a albedo do not contain the actual latitude/longitude grid points; rather, they contain bounding box information that enables calculation of the grid. Separate files with the latitude and longitude grids, in both NetCDF or IDL save formats, are available for direct download along with the albedo data (one file per hemisphere; the grid is constant with time). All level 3a data files are available at http://lasp.colorado.edu/aim/download-data-L3A.php.

The daisies are made by combining the measured albedo values from all of the individual orbit strips (level 2 data) on a given day into a single image covering the summer polar region. Where pixels from different orbits overlap, which occurs poleward of about 75° latitude in each hemisphere, the brightest pixel (not the average) is used unless the data quality flags of the overlapping pixels are different. If the QF values are different, the pixel with the lowest (best) QF value is used (see Table 1). Invalid data, which correspond to QF=255, are assigned albedo=0 in the daisies. As illustrated in Figure 1, this can result in sharp discontinuities at the edges of orbit strips. Note also that both the ascending and descending node data are combined in the level 3 data product, so local times are not meaningful.

The decisions to use the brightest of overlapping points and to combine data from both nodes were made with the philosophy that the level 3a data are intended for qualitative use. These data quickly show users where PMCs are present each day, provide an overall morphology on any given day, and show how PMCs change over the season. Users interested in diurnal variations or any other quantitative analysis are encouraged to use the CIPS level 2 data.

Just as in the level 2 data, the level 3a cloud albedos that are reported are normalized to a nadir (0°) view angle and 90º scattering angle. The view angle correction is accomplished by removing the sec(θ) geometry factor to account for the view angle dependence in path length (where θ, the view angle, is the angle between the satellite and zenith directions, as measured from the scattering

volume). The scattering angle correction is accomplished by obtaining the best fit of the observed phase function (albedo vs. scattering angle) to a set of assumed scattering phase functions that are constrained by lidar data. Here we make the assumptions that the ice particles have an axial ratio of 2 and a distribution width that varies approximately as 0.5×radius. The albedo at 90° scattering angle from that best fit is the value to which the view angle correction is applied. (See Hervig *et al*. [2009] and Baumgarten *et al*. [2010] for more information).

*Level 3a png files*

In addition to the NetCDF files with the numerical data, one png file (< 1MB) is produced for each day; this png file shows a polar projection map of the cloud albedo using a blue/white color scale. The maps employ a low-latitude cut-off of 50° in the summer hemisphere. The png files are produced primarily as a "quick-look" or "browse" data product. Each individual map uses a color scale appropriate for that day, so the color scale changes from day to day.

## II. Daily Daisy Maps

In this section we show examples of the daily daisies. The level 2 documentation describes a number of artifacts that appear in the CIPS level 2 orbit strip images; these of course will also appear in the daisy maps, and are thus not repeated entirely here. There are a few characteristics that are worth emphasizing, so we highlight these here.

*"Normal" Daisy*

Figure 1 shows an example of a daisy that we consider to be "normal"; i.e., lacking in any obvious artifacts. This daisy is for 1 July 2011. The dark blue background shows the locations that CIPS observed on this day; black areas represent no data. Relative cloud brightness is represented by different shades of blue, ranging from the dimmest clouds in dark blue to the brightest in

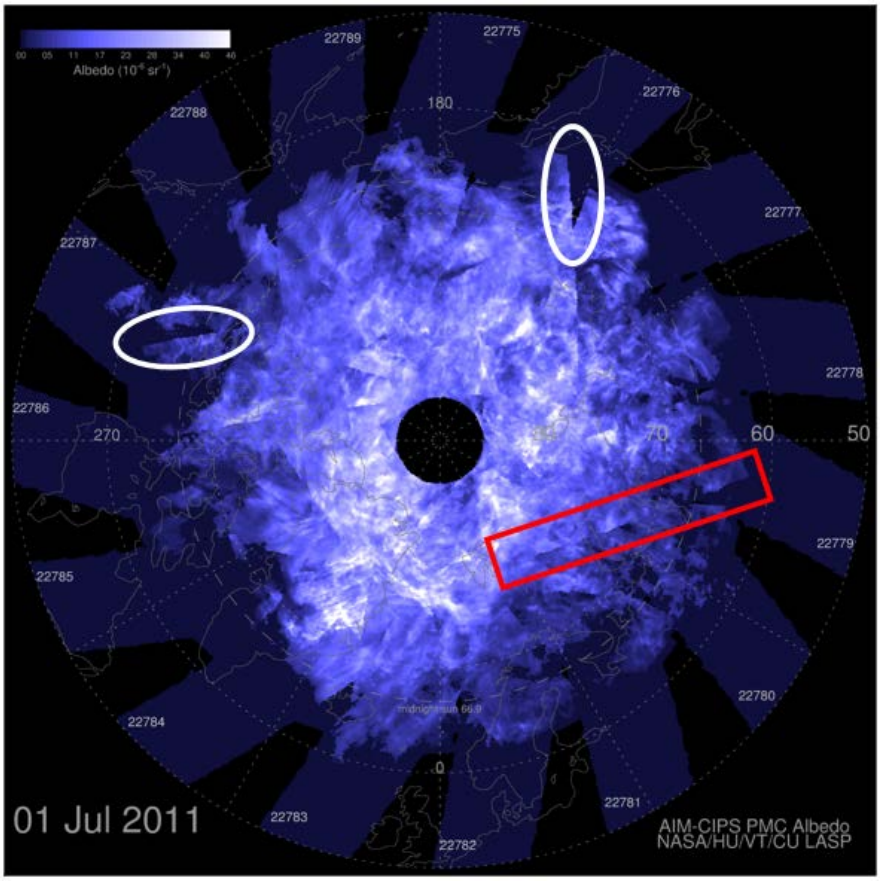


**Figure 1.** CIPS daily daisy for 1 July 2011. White ovals show regions at the edges of orbit strips that are adjacent to regions for which QF=255 (often this is because the solar zenith angle was greater than 94°). The sharp cutoff of clouds here is due to data screening, since CIPS retrievals require sunlight, and should not be interpreted as a geophysical discontinuity. The red rectangle also shows the edge of an orbit strip. The apparent discontinuity here is because the clouds change from orbit to orbit.

white. There is a wealth of structure in the clouds on this day, most of which is geophysical. The white ovals show orbit strip edges separating regions of valid and invalid retrievals (commonly caused by a solar zenith angle that exceeded 94°). For the latter, the cloud albedo is defined to be zero in level 3a; these regions are thus included in the dark blue background. Clouds were likely present in the dark blue regions surrounding these edges; i.e., there was probably not an actual edge to the clouds as shown here.

The red rectangle in Figure 1 also shows the edge of an orbit strip. In this case, the cause of the apparent discontinuity is that clouds change from orbit to orbit. This does ***not*** indicate an error in the retrievals. Since PMCs will often change during the ~90 minutes between orbits, the same geographic location can be brighter or dimmer on successive orbits, depending on the changes that occur. Thus it is expected that at the edges of orbits, the data from one orbit to the next will not merge smoothly. This characteristic is enhanced by the decision to include the brightest, rather than the average, of the overlapping pixels. However, using the brightest pixel better highlights the locations of clouds.

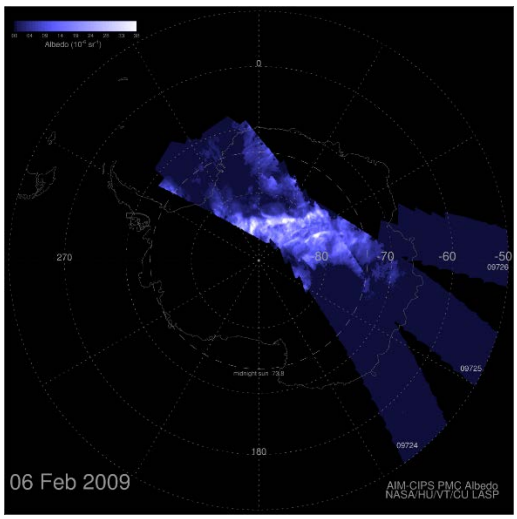


**Figure 2.** Daily daisy for 6 February 2009, showing missing data.

*Missing Data*

Some daisies are missing individual images or even entire orbits, leading to large black areas in the maps. Missing data can occur because of a number of reasons, including downlink issues, calibration issues and satellite pointing errors. Figure 2 shows an example of missing data on 6 February 2009. In this case, AIM went into a safe hold after getting only 2 orbits on this date.

**Table 1.** Variables in the CIPS level 3a data files. Fill value is NaN.

| Variable Name | Units | Type/Dimension | Description |
|---|---|---|---|
| **Albedo** | $10^{-6}$ $sr^{-1}$ | Float / [xdim,ydim] | Cloud albedo |
| **Latitude** | Degrees | Double / [xdim,ydim] | Latitude of each grid point, where xdim and ydim are the number of grid points in the (arbitrary) x and y directions. Same for all daisies. |
| **Longitude** | Degrees | Double / [xdim,ydim] | Longitude of each grid point, where xdim and ydim are the number of grid points in the (arbitrary) x and y directions. Same for all daisies. |
| **UT_Date** | yyyymmdd | Long / 1 | UT Date |
| **Version** | | String / 1 | Retrieval version number |
| **Product_Creation_Time** | yyyy/doy-hh:mm:ss | String / 1 | String containing UT time at which data file was produced |

| | | | |
|---|---|---|---|
| **Dependent2a Version** | | Byte / [norbits] | Version of lower level 2 data used to produce this data set. One value per orbit (each orbit forms a "petal" in the daisy). |
| **Hemisphere** | | String / 1 | N (north) or S (south) |
| **Center_Longitude** | Degrees | Float / 1 | Center longitude of the grid |
| **Petal_Start_Time** | microseconds | Double / [norbits] | GPS start time of each orbit (microseconds from 0000 UT on 6 Jan 1980) |
| **First_image_start** | microseconds | Float / 1 | GPS start time of first orbit (seconds from 0000 UT on 6 Jan 1980); redundant with first element in petal_start_time, but floating point |
| **Km_Per_Pixel** | km | Float / 1 | Linear dimension of square pixel occupying area of CIPS resolution element |
| **BBox** | Index | Long / [4] | Bounding Box: Bottom-Left and Top-Right indices of the smallest rectangle which both circumscribes a set of cells on a grid and is parallel to the grid axes |
| **Orbit_Numbers** | | Long / [norbits] | Number of each orbit |
| **Quality_Flags** | | Byte / [xdim,ydim] | Indicator of data quality. For each pixel, this is the QF value of the data point plotted. In v4 QF is determined by NLayers as follows: NLayers > 5, QF=0. NLayers = 4 or 5, QF=1. NLayers < 4, QF=2. For level 3a only valid data with QF = 0 or 1 are selected. In v5 QF = 0 for all valid data, based on a formal error analysis. All other pixels in v4 and v5 have the default value 255. |

## References


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Created by Cora Randall, August 2011.