

CIPS RAA Level 3A Data

Last updated February 2023

Introduction

CIPS Rayleigh Albedo Anomaly (RAA) files are provided for levels 2A, 2B, 2C, and 3A. At the current time, the retrieval version is being updated from v1.10r06 to v1.10r07. This document describes the level 3A data product for v1.10r07. Before analyzing level 3A data, users should also read the CIPS instrument overview, data overview, RAA level 2A, and RAA level 2B documents (see <https://lasp.colorado.edu/aim/documentation>).

Briefly, CIPS RAA Level 2A data files contain CIPS RAA data (RAA, RAA variance, wave properties) in a scene-by-scene format, where a CIPS scene contains simultaneous images from the four CIPS cameras. Users interested in conducting a quantitative analysis of GW properties are encouraged to use the level 2A data product. The wavelength, amplitude, and phase speed direction of identified waves are provided only in the level 2A data product.

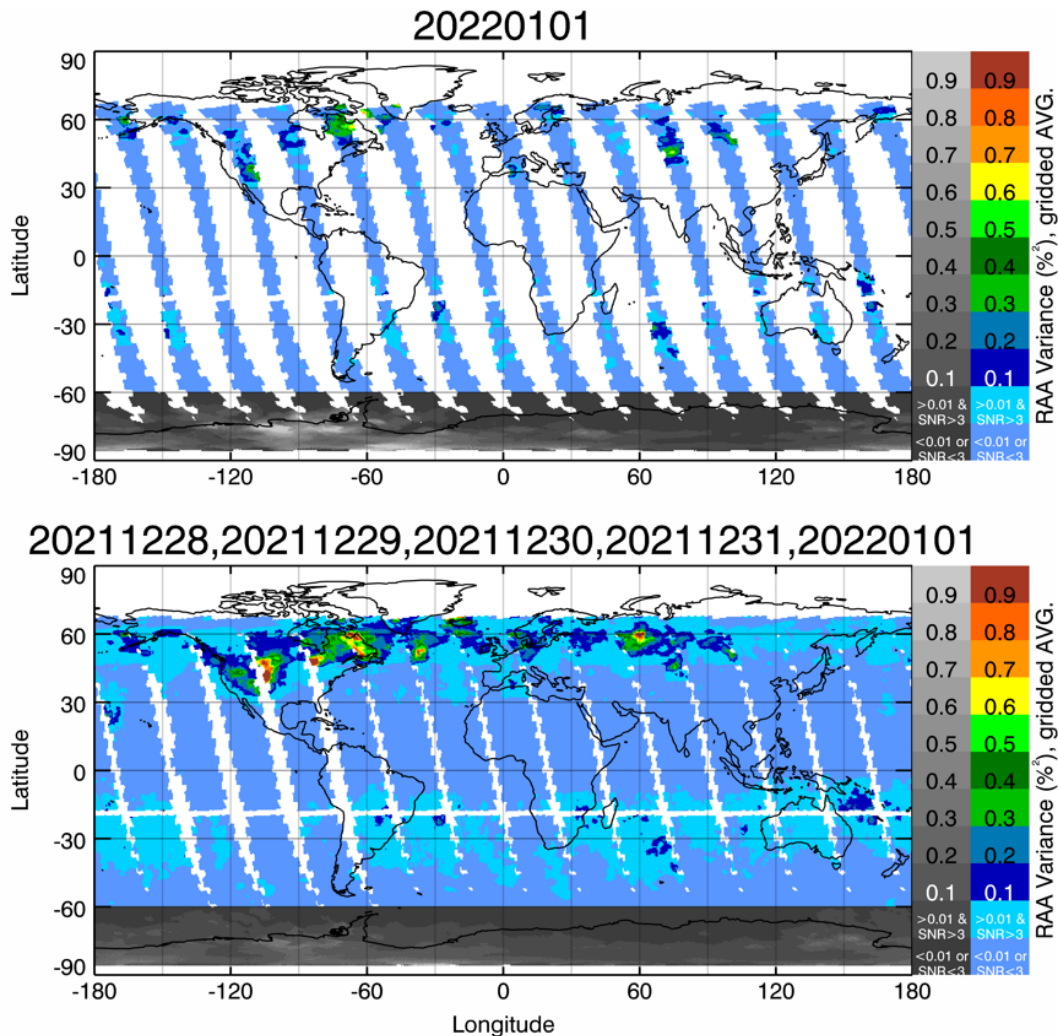
Level 2B data contain RAA and RAA variance data in an orbit-by-orbit format, merging the level 2A RAA (or RAA variance) data for all scenes in a given orbit via noise-weighted averaging of overlapping pixels from different scenes. The level 2C data product is for visualization purposes only and consists of daily maps in which the level 2B RAA and RAA variance data for all orbits on the day in question are overplotted. Users interested in a qualitative view of the wave morphology, but not the wave properties, are encouraged to use the level 2B and 2C data products, which provide a global context for individual orbits, and often show waves in multiple scenes.

The level 3A data product consists of global maps of gridded ($0.5^\circ \times 0.5^\circ$; lat x lon) RAA variance. Each grid point contains the average of the level 2B variances in all pixels within that grid cell. Users interested in statistical analyses of GW occurrence frequency and location are encouraged to use the level 3A data product. The level 3A data files do not include the RAA itself, since the high-resolution wave structures do not lend themselves to the relatively coarse level 3A grid. However, the gridded RAA variance maps facilitate analyses of large volumes of data.

Both one-day and five-day maps are provided in a single level 3A file for each day, in numerical (NetCDF) and graphical (png) formats. The five-day map corresponding to day "x" contains mean variances in each grid cell from day "x-4" to day "x". Maps are made for each day, with whatever data are available for day x on the one-day map and days x-4 to day x on the five-day map. Maps are available, but are blank, if all data are missing. The decision to include days x-4 to x for the five-day maps was to enable these maps to be produced within 2 days of data acquisition, in concert with the one-day maps and files for other data levels. Users who wish to use a time-centered map for day x should choose the map for day x+2, which will include days x-2 to x+2.

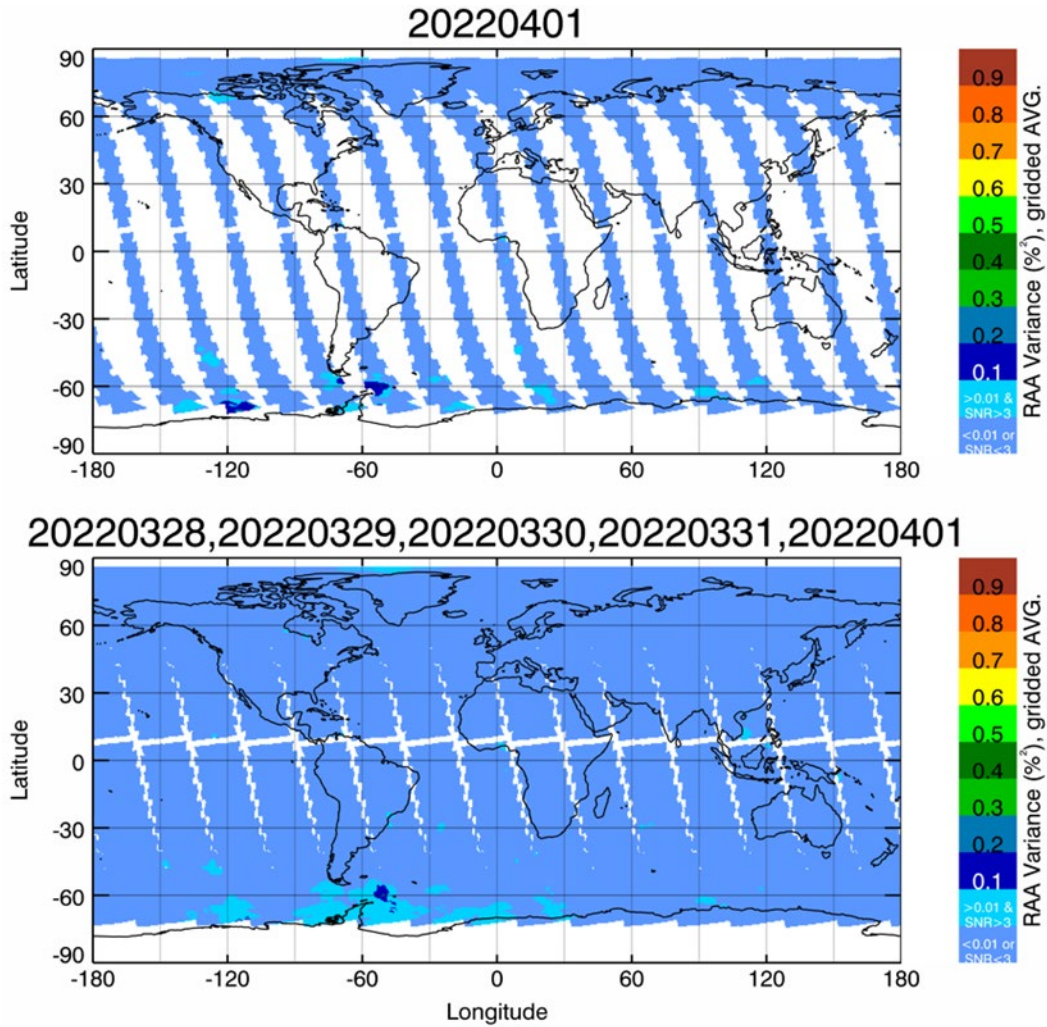
Variables contained in the NetCDF file are described in a table at the end of this document. There are ~15 orbits per day, which precess in location from day to day. The one-day maps thus contain gridded data for ~15 orbits for which the center longitudes are equally spaced by ~24°, while the five-day maps contain data for ~75 orbits, filling in most of the global map. The maps include only

those level 2B pixels with solar zenith angle less than 90°. Gaps between orbits are left blank; they are *not* filled with any interpolation. The figures below show representative examples of maps from the level 3A png files for 1 January, 1 April, 1 July, and 1 October of 2022.



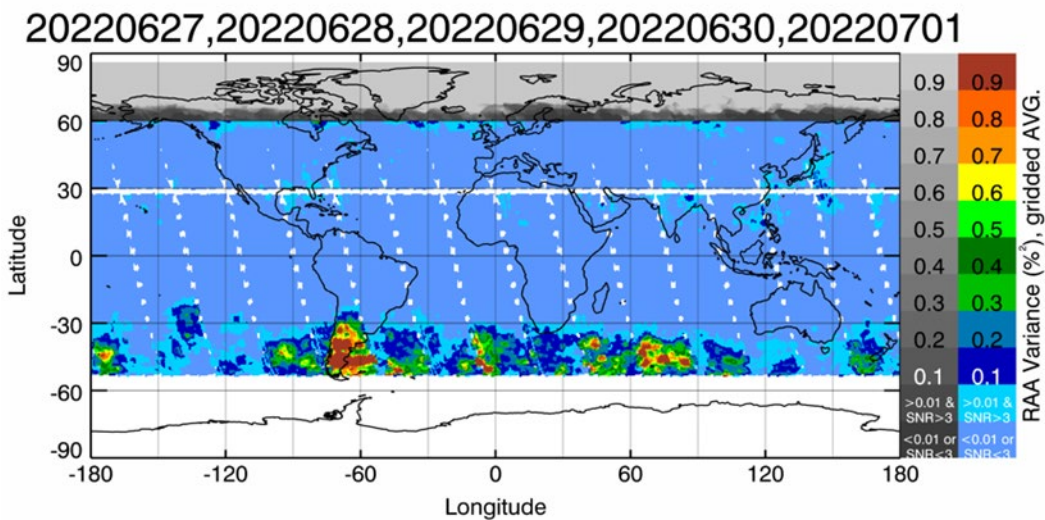
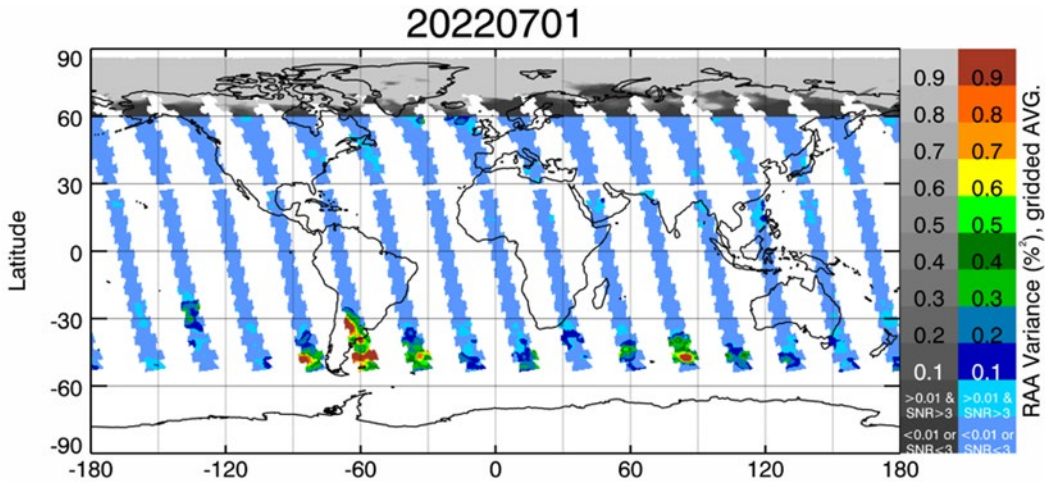
v01.10_r06 orbits included in the bottom figure:
 80521, 80522, 80523, 80524, 80525, 80526, 80527, 80528, 80529, 80530, 80534, 80535, 80536, 80537, 80538,
 80539, 80540, 80541, 80542, 80543, 80544, 80545, 80546, 80547, 80548, 80549, 80550, 80551, 80552, 80553,
 80554, 80555, 80556, 80557, 80558, 80559, 80560, 80561, 80562, 80563, 80564, 80565, 80566, 80567, 80568,
 80569, 80570, 80571, 80572, 80573, 80574, 80575, 80576, 80577, 80578, 80579, 80580, 80581, 80582, 80583,
 80584, 80585, 80586, 80587, 80588, 80589, 80590, 80591, 80592, 80593, 80594, 80595, 80596

Figure 1. One-day (top) and five-day (bottom) CIPS level 3A maps of RAA variance for 1 January 2022. The days included in the 5-day map are listed in the map title; the orbits included in the 5-day map are listed below the map. White regions indicate data gaps. Slanted vertical white regions are due to gaps in data coverage between orbits. The high-latitude white region is due to lack of sunlight. The horizontal gap near 20°S is due to the satellite yaw. The gray color scale is used to denote the nominal PMC region, which we define as extending from 60° to the pole in the summer hemisphere, from ~15 May through August in the north and ~15 November to late February in the south. Users should exercise caution when interpreting PMC region data. Caution is also warranted when interpreting data for which the RAA variance signal-to-noise ratio (SNR) is less than 3 or the variance itself is less than 0.01%². See also the level 2A documentation.



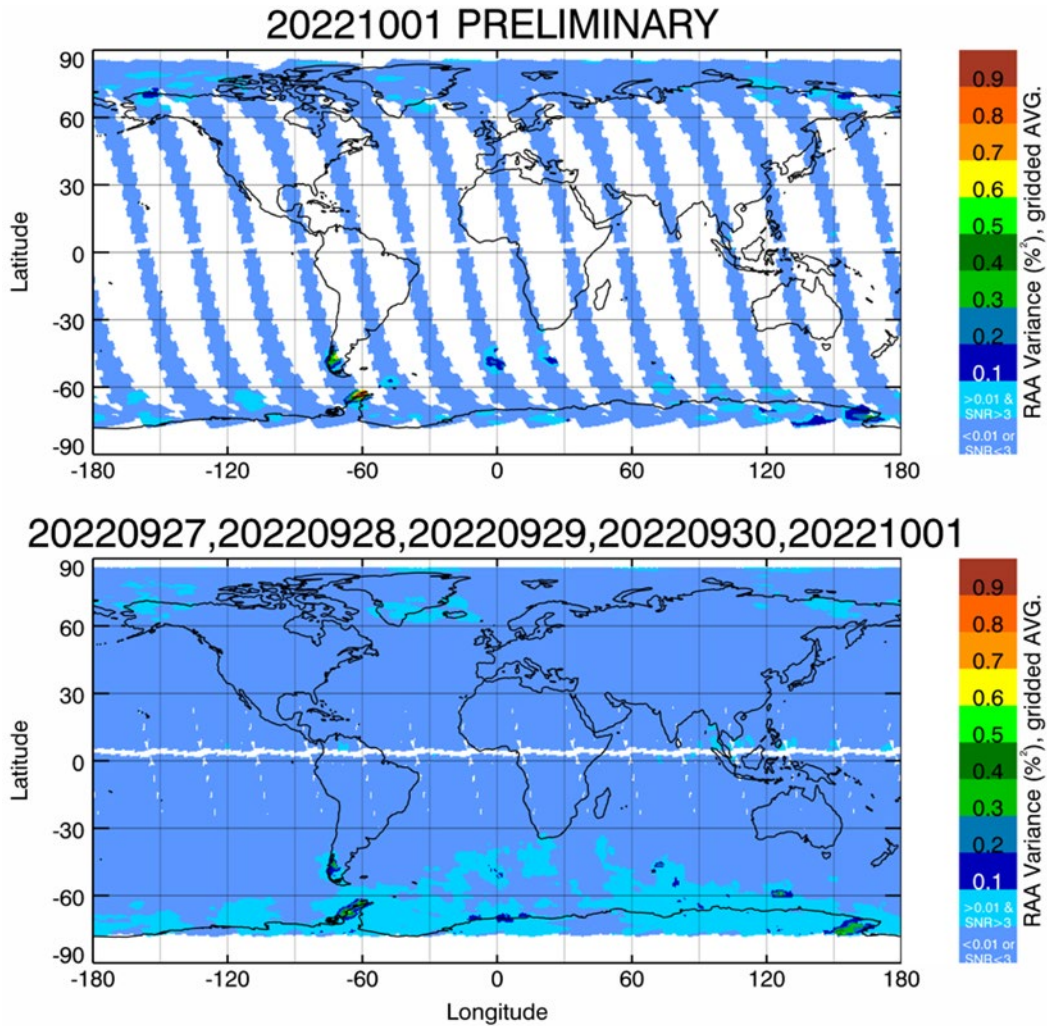
v01.10_r06 orbits included in the bottom figure:
 81884, 81885, 81886, 81887, 81888, 81889, 81890, 81891, 81892, 81893, 81894, 81895, 81896, 81897, 81898,
 81899, 81900, 81901, 81902, 81903, 81904, 81905, 81906, 81907, 81908, 81909, 81910, 81911, 81912, 81913,
 81914, 81915, 81916, 81917, 81918, 81919, 81920, 81921, 81922, 81923, 81924, 81925, 81926, 81927, 81928,
 81929, 81930, 81931, 81932, 81933, 81934, 81935, 81936, 81937, 81938, 81939, 81940, 81941, 81942, 81943,
 81944, 81945, 81946, 81947, 81948, 81949, 81950, 81951, 81952, 81953, 81954, 81955, 81956, 81957, 81958,
 81959

Figure 2. Same as Figure 1, but for 1 April 2022, and the yaw is near 5-10°N. Since this is outside the PMC season, there is no gray shading.



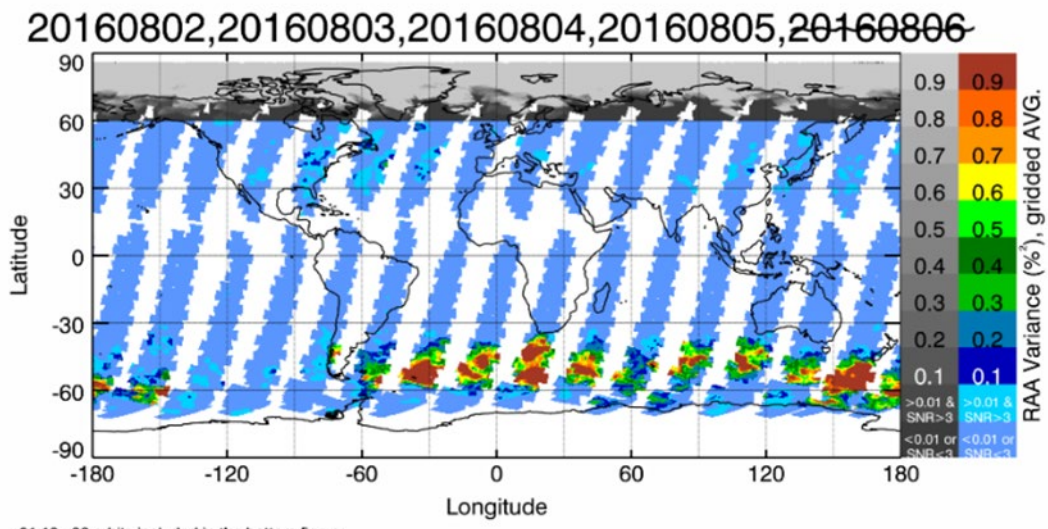
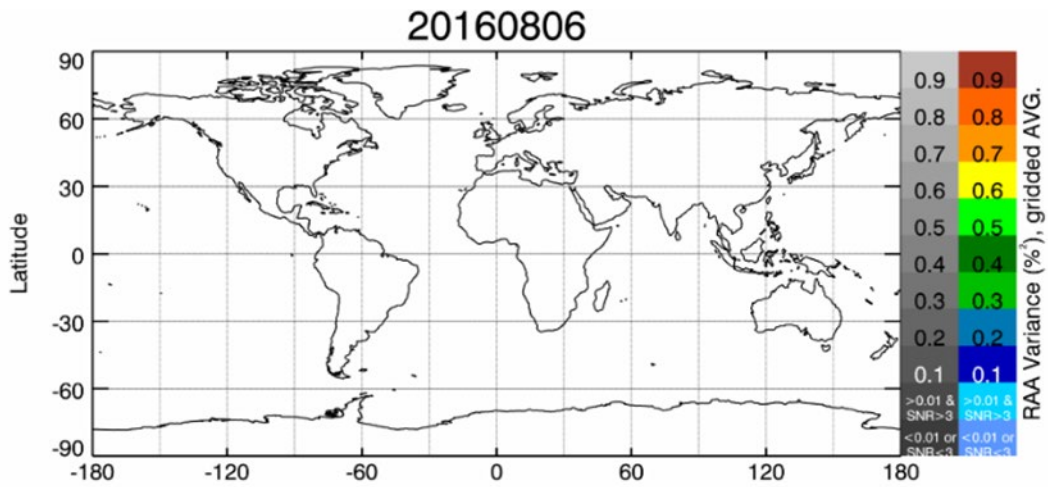
v01.10_r06 orbits included in the bottom figure:
 83264, 83265, 83266, 83267, 83268, 83269, 83270, 83271, 83272, 83273, 83274, 83275, 83276, 83277, 83278,
 83279, 83280, 83281, 83282, 83283, 83284, 83285, 83286, 83287, 83288, 83289, 83290, 83291, 83292, 83293,
 83294, 83295, 83296, 83297, 83298, 83299, 83300, 83301, 83302, 83303, 83304, 83305, 83306, 83307, 83308,
 83309, 83310, 83311, 83312, 83313, 83314, 83315, 83316, 83317, 83318, 83319, 83320, 83321, 83322, 83323,
 83324, 83325, 83326, 83327, 83328, 83329, 83330, 83331, 83332, 83333, 83334, 83335, 83336, 83337, 83338,
 83339

Figure 3. Same as Figure 1, but for 1 July 2022, and the yaw is near 30°N. The PMC season is in the north.



v01.10_r06 orbits included in the bottom figure:
 84660, 84661, 84662, 84663, 84664, 84665, 84666, 84667, 84668, 84669, 84670, 84671, 84672, 84673, 84674,
 84675, 84676, 84677, 84678, 84679, 84680, 84681, 84682, 84683, 84684, 84685, 84686, 84687, 84688, 84689,
 84690, 84691, 84692, 84693, 84694, 84695, 84696, 84697, 84698, 84699, 84700, 84701, 84702, 84703, 84704,
 84705, 84706, 84707, 84708, 84709, 84710, 84711, 84712, 84713, 84714, 84715, 84716, 84717, 84718, 84719,
 84720, 84721, 84722, 84723, 84724, 84725, 84726, 84727, 84728, 84729, 84730, 84731, 84732, 84733, 84734,
 84735

Figure 4. Same as Figure 1, but for 1 October 2022, and the yaw is near the equator. Since this is outside the PMC season, there is no gray shading. This is marked "Preliminary" since the post-season processing had not yet been conducted at the time of this writing (see the level 2A documentation).



v01.10_r06 orbits included in the bottom figure:
 50672, 50673, 50674, 50675, 50676, 50677, 50678, 50679, 50680, 50681, 50682, 50683, 50684, 50685, 50686,
 50687, 50688, 50689, 50690, 50691, 50692, 50693, 50694, 50695, 50696, 50697, 50698, 50699, 50700, 50701,
 50702, 50703, 50704, 50705, 50706, 50707, 50708, 50709, 50710, 50711, 50712, 50713, 50714, 50715, 50716,
 50717, 50718, 50719, 50720, 50721, 50729

Figure 5. Same as Figure 1, but for 6 August 2016. This is an example of a day for which no data was acquired, but data was available for the previous 4 days (2-5 August). This is indicated by the blank one-day map (top), and crossed-out label for 20160806 on the five-day map (bottom). Likewise, the orbit list includes only orbits from 2-5 August.

NetCDF Files

The level 3A NetCDF files are provided to facilitate statistical analyses of the CIPS RAA data by showing when and where waves are present. The table below summarizes the contents of each data file and provides a description of all parameters and arrays.

A note about the file name convention: Each file has a day-of-year included in the file name. This is the UT day corresponding to the ascending node equator crossing time of each orbit included in the file. When the equator crossing time is shortly prior to midnight UT on a given orbit, some or all of the data in that orbit might have been acquired on the day after the day in the filename. In addition, when the ascending node equator crossing time on a given orbit is on the sunlit side of the orbit, some of the data in that orbit might have been acquired prior to this time.

Table 1. Variables in the CIPS Level 3A file. Fill value is NaN.

Variable Name	Units	Type/Dimension	Description
LATITUDE	Degrees	Float / [Xdim,Ydim]	2D latitude grid of the 1-day and 5-day maps; ranges from -89.75° to 89.75° in 0.5° increments
LONGITUDE	Degrees	Float / [Xdim,Ydim]	2D longitude grid of the 1-day and 5-day maps;; ranges from -179.75° to 179.75° in 0.5° increments
ORBITS	N/A	String ^(a) / [Norbits]	Orbit numbers followed by the day number from -4 to 0; orbits on day 0 are in both the 1-day and 5-day maps
XDIM	N/A	Integer / 720	X dimension of the map grids
YDIM	N/A	Integer / 360	Y dimension of the map grids
DATE_1DAY	YYYYMMDD	Long / 1	Date of the 1-day map
DATE_5DAY	YYYYMMDD	Long / [5]	Dates of days included in the 5-day maps; -99 if no data are available
NUM_PIXELS_1DAY	N/A	Integer / [Xdim,Ydim]	Number of 2B pixels in each 3A grid cell for the 1-day map
NUM_PIXELS_5DAY	N/A	Integer / [Xdim,Ydim]	Number of 2B pixels in each 3A grid cell for the 5-day map; total for all days
RAA_VAR_1DAY	% ²	Float / [Xdim,Ydim]	1-day map of RAA variance
RAA_VAR_5DAY	% ²	Float / [Xdim,Ydim]	5-day map of RAA variance
RAA_VAR_UNC_1DAY	% ²	Float / [Xdim,Ydim]	1-day map of RAA variance uncertainty
RAA_VAR_UNC_5DAY	% ²	Float / [Xdim,Ydim]	5-day map of RAA variance uncertainty

^(a) Depending on the read software, this variable might appear as Byte rather than string. If so, it should be converted to string.