Summary Information for the GPM Constellation Conically-Scanning Radiometers as Quarter-degree Gridded Text Product

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1. Background

The Global Precipitation Measurement (GPM) mission partner imaging radiometer quarter-degree gridded-text product has a similar file format and a similar purpose as the Tropical Rainfall Measuring Mission (TRMM) 3G68 quarter-degree product. The GPM partner radiometer textgrid format is an hourly summary of surface precipitation retrievals from Goddard Profiling (GPROF) algorithm as applied to the observations from partner-provided conically scanning constellation radiometers. The product also includes the GPROF retrieval from the GMI instrument on the GPM core satellite. While the data are reported in hourly grids, all hours for a day are packaged into a single ASCII text file that is gzipped to reduce file size and to speed up downloading. The data are reported on a 0.25° x 0.25 ° grid.

A line in this document is defined as being all text from the first character encountered until and including the new-line character at the end of the block of text. The files are readable by any program or utility that is capable of reading ASCII text lines. This obviously includes all text editors and spreadsheets as well as more sophisticated analysis software.

2. Metadata Header Lines Content

The first 5 lines in the file are header lines that contain metadata, as listed below:

(1) ProductID AlgorithmVersion GPMdataCredit GenerationDate ShortDOI LongDOI

(2) (Universal grid:) Rows Columns MinimumLatitude MinimumLongitude GridResolution ObservationDate

(3) (For GPM observations:) MinimumLatitude MaximumLatitude

MinimumLongitude MaximumLongitude

(4) Grid_First_Row Grid_Center_Latitude Grid_First_Column Grid_Center_Longitude Grid_Cell_Resolution Duration

(5) (Variable names for data lines:) hour minute row column

GMI_{ totalPixels | precipPixels | meanPrecip | convFraction | liquidFraction | retrievalQuality }

AMSR2_{ totalPixels | precipPixels | meanPrecip | convFraction | liquidFraction | retrievalQuality }

F16_{ totalPixels | precipPixels | meanPrecip | convFraction | liquidFraction | retrievalQuality }

F17_{ totalPixels | precipPixels | meanPrecip | convFraction | liquidFraction | retrievalQuality }

F18_{ totalPixels | precipPixels | meanPrecip | convFraction | liquidFraction | retrievalQuality }

F19_{ totalPixels | precipPixels | meanPrecip | convFraction | liquidFraction | retrievalQuality }

F20_{ totalPixels | precipPixels | meanPrecip | convFraction | liquidFraction | retrievalQuality }

3. General Data Line Format

There is one data line per grid box, each hour. Each data line starts with the hour and minute of the first pixel accumulated into that gridbox for that hour. The next two fields in the line provide the row and the column identifiers for the gridbox within a global 0.25° x 0.25 ° grid. The remaining fields of each data line provide the following precipitation information for the following combinations of instruments:

Combination of instruments	Data values for each combination of instruments
• GMI • AMSR2 • SSMIS F16 • SSMIS F17 • SSMIS F19 • SSMIS F19 • SSMIS F20	• Count of all pixels in cell • Count of precipitation pixels in cell • Mean precipitation rate (mm/hr) • Fraction of precip. calculated to be convective • Fraction of precipitation calculated to be liquid • Retrieval quality indicator *Currently F20 is placeholder with missing data and 0 only, as it has not been launched.*

All data is presented on the universal grid. In this universal grid, 90S 180W is located at the

southwest corner of the southern-most row. Similarly, 90N 180E is the northeast corner of the northern-most row. In the universal grid, the row index represents latitude such that the grid cells in row 0 cover 90.00S to 89.75S. The row index increases northward to the maximum 719, which covers 89.75N to 90.00N. In the universal grid, the column index represents longitude such that the grid cells in column 0 cover 180.00W to 179.75W. The column index increases eastward to a maximum of 1439, covering 179.75E to 180.00E.

4. Data Line Content Details

Each data line has a value for each item named in line 5 of the header and described in section 3. Hour values start at 0 as do minutes. Time in this product is presented in UTC. As a reminder, the grid-cell row index for the hourly grid matrix starts at 0 as does the grid-cell column index.

Users can be assured that each data line has the same number of fields on it, but users should check whether a field contains the missing-data value (-9) before using that field in their calculations. If any instrument group has a 0 value for the total-pixels field that would indicate that the instrument group has no observations falling within that grid box for that hour. In this situation, the textgrid has the precip-pixels field set to zero and all subsequent fields for that instrument group set to -9. Any occurrence of -9 always indicates that a value is not available for this item for the particular grid box and hour. When a level 2 retrieval product does not provide the information necessary for determining the field value in the gridded text product then the missing value indicator is used for the field.

Currently, the GPROF retrieval quality flag for the grid is determined by the pixel with the lowest retrieval quality (i.e., rotten apple selection), which maps to the highest integer value of the data-quality flag. For the “at launch" version the GPROF algorithm currently being run at PPS in July of 2015, the retrieval quality is set to 2 everywhere. It is anticipated that future versions of the GPROF algorithm will provide values of 0, 1, or 2, as defined in the table below. The GPROF retrievals from all the constellation conically-scanning radiometers use the same retrieval quality indicators.

GPROF retrieval quality
0 = Retrieval is good for climate research
1 = In general, the quality is suitable for weather applications but not climate applications
2 = The user must keep in mind the limitations of this retrieval when using it for research

5. Calculation of Data Lines

All calculations are done in hourly quarter-degree grid cells. The hourly grids are maintained separately but then packaged into a single daily text file. The calculations for the textgrid are done in two steps. The first step is to accumulate each appropriate pixel of a swath into the appropriate hour and grid location (Equations 1-2). The second step is to calculate the appropriate mean for mean precipitation, convective fraction, and liquid fraction (Equation 3). Figures 1-4 show comparisons between the textgrid and other GPM data products as well as

consistency of the radiometer retrievals within the text product itself.

Eq. 1. Pixel count for the gridbox at row = i and column = j

$$totalPixels_{ij} = \sum_{n=1}^{n_{max}} pixel_{n_{ij}} \qquad (1a)$$

$$totalPrecip_{ij} = \sum_{n=1}^{n_{max}} precipRate_{n_{ij}} \qquad (1b)$$

Eq. 2. GPROF accumulations

$$precipPixel_{ij} = \sum_{n=1}^{n_{max}} pixel_{n_{ij}}[prob > .5] \qquad (2a)$$

$$convective_{ij} = \sum_{n=1}^{n_{max}} precipRate_{n_{ij}} \; convFraction_{n_{ij}}[type = conv] \qquad (2b)$$

$$liquid_{ij} = \sum_{n=1}^{n_{max}} precipRate_{n_{ij}} \; liquidFraction_{n_{ij}}[species = liquid] \qquad (2c)$$

Eq. 3. Grid cell values

$$meanPrecip_{ij} = totalPrecip_{n_{ij}} / totalPixel_{n_{ij}} \qquad (3a)$$

$$convFraction_{ij} = convective_{n_{ij}} / totalPrecip_{n_{ij}} \qquad (3b)$$

$$liquidFraction_{ij} = liquid_{n_{ij}} / totalPrecip_{n_{ij}} \qquad (3c)$$

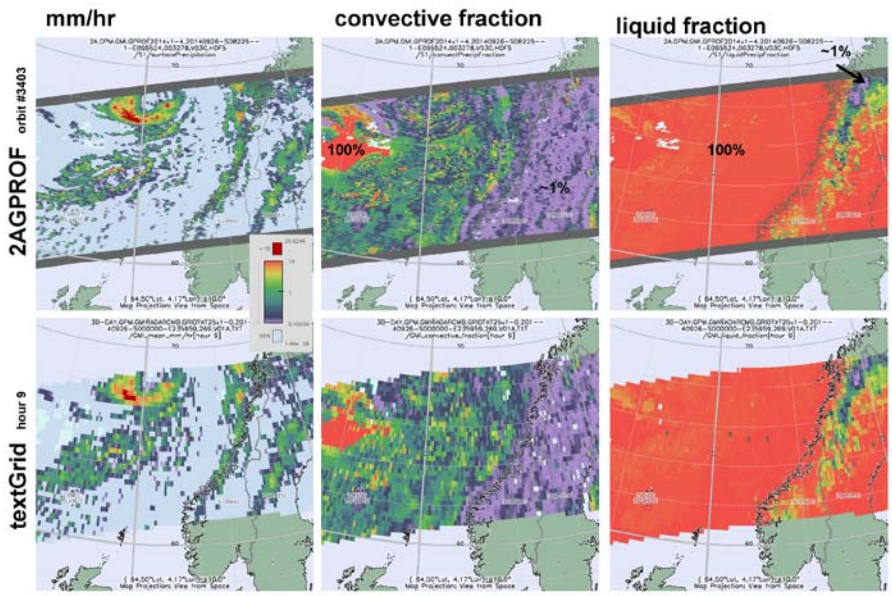

Fig. 1. Comparison of the textgrid with the GMI swath product. At 9 UTC on 26 Sept 2014, GMI observed this synoptic cyclone with a rainband over Norway. Source: http://pmm.nasa.gov/articles/gpm-satellite-sees-windstorm-over-norway

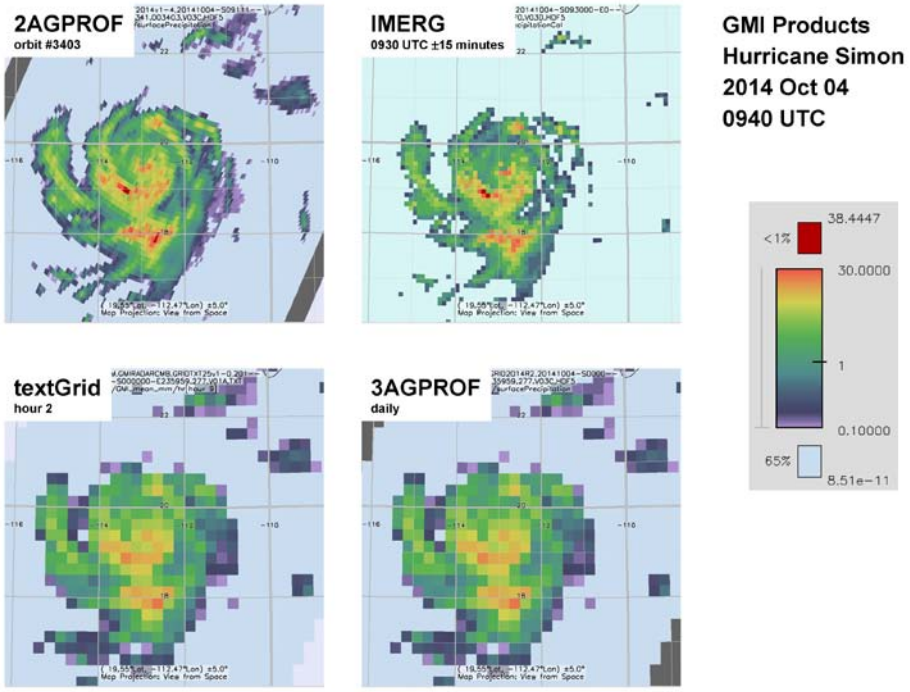

Fig. 2. Comparison of the textgrid with swath and gridded products. At 0940 UTC on 4 Oct 2014, GMI observed Hurricane Simon rapidly intensifying west of Mexico. Source: http://www.nasa.gov/content/goddard/nasas-gpm-satellites-find-before-hurricane-simon-was-caught-rapidly-intensifying/

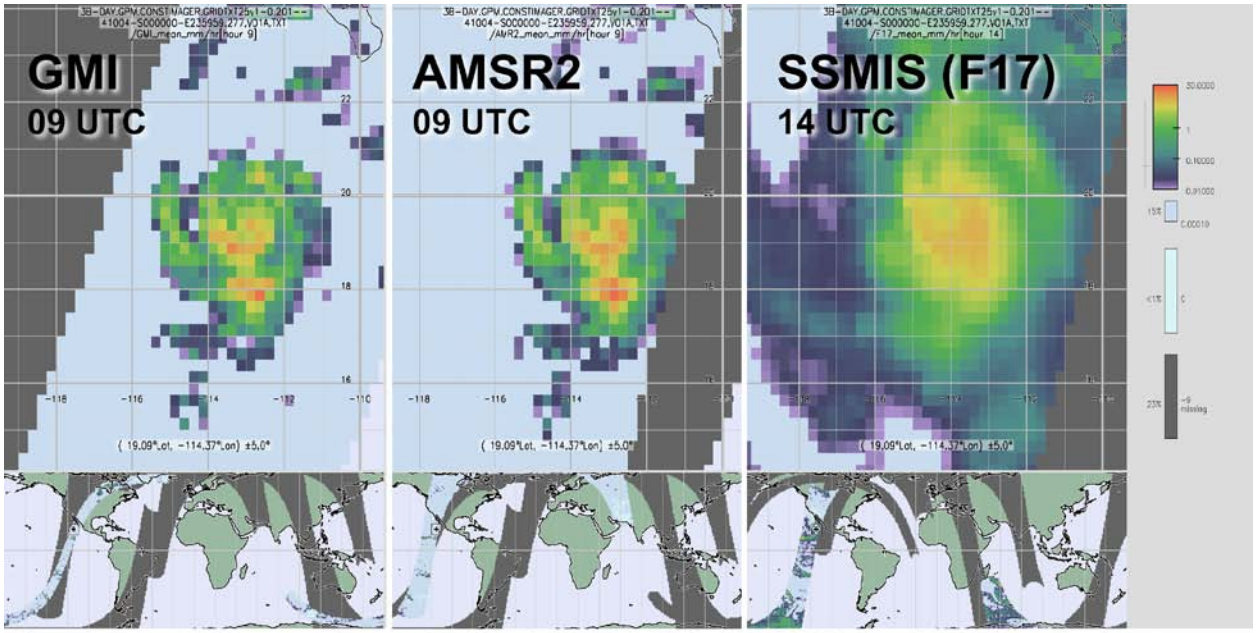

Fig. 3. The TextGrid representation of individual overflights of Hurricane Simon by GMI, AMSR2, and the SSMIS on F17.

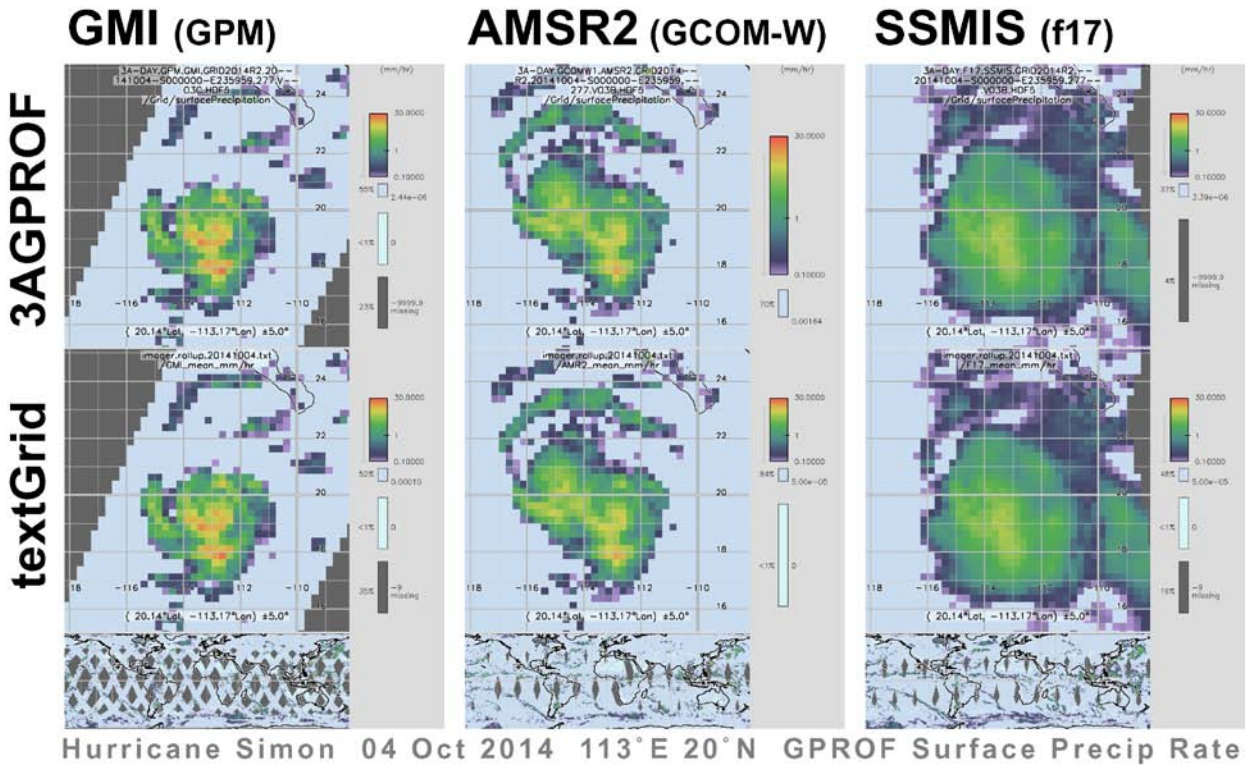

Fig. 4. A daily summary of Hurricane Simon observations, confirming the TextGrid representation to the nearly identical representations in the daily 3AGPROF products.

6. Obtaining the Data

The GPM gridded text product may be retrieved using FTP to arthurhou.pps.eosdis.nasa.gov or using the Science Team Online Resource Module (STORM). Within STORM, users may find and order the gridded product based on the time range desired, and they may establish standing orders for the product so that they are notified via email when the textgrid is produced. The notification email also includes scripts for retrieving the product from the PPS server. The URL for STORM is http://storm.pps.eosdis.nasa.gov. For the imager TextGrid product, look for the 3GIDEGGPM_DAY entry in STORM's Product Type Table.

Prior to retrieving data from the FTP site or via STORM, a user must register with PPS at http://registration.pps.eosdis.nasa.gov. Users are asked for their email address, their affiliation, and their data access interests. Next, the user will receive an email and be asked to verify that the email was received. Each time that the user downloads data files, the user will be asked to enter the registered email address as both the user name and password. For users desiring FTP access and using either Linux or Mac OS, they may make a .netrc entry for the PPS server; this will allow them to have scripts that do not require the manual input of username and password. For the imager TextGrid product, visit the pub/gpmdata/yyyy/mm/dd/textgrid directly on the **arthurhou** FTP server. Partner Imager TextGrid product names contain the string "CONSTIMAGER" which is an shortening of *Constellation Imager*.

For additional information, please contact Dr. Erich Franz Stocker at NASA/GSFC Code

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7. Software Tools

Perhaps the most useful tool for display and simple analysis of the gridded text product is the PPS data viewer THOR, which may be downloaded from http://pps.gsfc.nasa.gov. Also available is a C program that takes a list of daily gridded text files and combines all of the files in the list into a single gridded text file, either maintaining the hourly grids or collapsing all of the hours into a single hour. This C program provides a simple way to aggregate many daily gridded text files (e.g., into a monthly product).