National Aeronautics and Space Administration Goddard Earth Science Data Information and Services Center (GES DISC)

README Document for Arkin and Janowiak Global Precipitation Index (GPI)

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Revision History

Revision Date	*Changes*	*Author*
June 16, 2016	This document was first created	Zhong Liu
October 5, 2016	Added more contents from another document	Zhong Liu
March 26, 2021	GES DISC Help Desk new email address; http in the footer; data policy URL	Zhong Liu

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1.0 Introduction

This document provides basic information for using Arkin and Janowiak Global Precipitation Index (GPI) product.

The Arkin and Janowiak Global Precipitation Index (GPI) consists of infrared-based monthly rainfall estimates, which form an intermediate product of the GPCP.

1.1 Dataset/Mission Instrument Description

1.1.1 Dataset/Instrument

This data set is one of the Global Precipitation Climatology Project (GPCP) products. The GPI data are infrared-based monthly rainfall estimates, which form an intermediate product of the GPCP, a World Meteorological Organization/World Climate Research Program (WMO/WCRP) effort.

Basic characteristics:

Variable name: Accumulated surface precipitation (monthly means)

Units: mm/day

Data range: 0-35 mm/day

Date range: January 1986 - December 1995

Spatial coverage: Global (40 degree north to 40 degree south and in longitude from 180 degree west to 180 degree east)

Spatial resolution: 2.5 degree latitude x 2.5 degree longitude grids

Projection: Cylindrical Equidistant.

File size: ~4.4 Mb.

1.2 Algorithm Background

The monthly rainfall estimates are based on infrared radiometer measurements which form an intermediate product of the WMO/WCRP effort (See Janowiak and Arkin (1991) for a general description of the method). The rainfall data file consists of 2.5 degree latitude by 2.5 degree longitude gridded monthly accumulations of estimated rainfall. Richards and Arkin (1981) determined that this spatial resolution yielded the highest correlation between fractional coverage of "cold" clouds and observed rainfall. The primary source of information over the tropical oceans is infrared (IR) data from polar-orbiting and geostationary satellites. The estimates are generated using a simple cloud top temperature-thresholding algorithm. This method of using satellite-observed cloud top brightness temperatures to infer areas of deep convection was demonstrated by Arkin (1979) using data from the Global Atmosphere Research Program - Atlantic Tropical Experiment (GATE) (See Hudlow and Patterson (1979)). The estimates are valid for the tropics and the warm season extratropics, and will overestimate rainfall in regions of persistent, thin, high cirrus.

A reduction correction has been applied to the GPI estimates produced from geostationary IR coverage at large zenith angles (e.g., 33 degrees). A systematic bias was found by comparing GPI estimates computed separately from each geostationary satellite's IR data in overlap regions. The satellite with a larger zenith angle yielded a larger amount of clouds colder than the GPI's temperature threshold of 235 K, compared with the amount of clouds derived from satellites with smaller zenith angles. This correction at least partially removed this bias.

The monthly rainfall estimates were generated using geostationary satellite data. Arkin (1979) investigated the relationship between cloud-top brightness temperatures and observed rainfall using data from GATE (Hudlow and Patterson, 1979). This work indicated a high correlation between the fractional coverage of "cold" clouds and observed rainfall. The work of Richards and Arkin (1981) determined that the highest correlation between the parameters was produced using a 2.5 degree latitude/longitude spatial scale. An estimation method using linear regression was developed. The regression procedure yielded the simple estimation equation:

R = [3 mm h-1] X [frac] X [hours]

where R is the rainfall estimate in millimeters; frac is the fractional coverage of cloud-top temperature < 235K for the desired 2.5 degree latitude/longitude region; and hours indicate the number of hours in the observation period.

The estimation technique was applied to the cloud-top brightness temperatures for GMS, GOES, and Meteosat geostationary satellite data in order to estimate the monthly accumulated rainfall in the global tropics.

Special corrections/adjustments: A reduction correction has been applied to GPI estimates produced from Geostationary IR coverage at large zenith angles (i.e. > 33 deg). A systematic bias was found by comparisons of GPI estimates computed separately from each Geostionary Satellite's IR data in overlap regions. The satellite with the larger zenith angle yielded a larger amount of cloud colder than GPI's temperature threshold of 235 K relative to other satellite. This correction removes (partially at least) this bias.

Limitations: The rainfall estimates are valid for the tropics and warm season extratropics, and will indicate rainfall in regions of persistent thick cirrus. The estimates are only valid in these regions because temperature is the only parameter used in the estimation scheme.

Applications of the dataset: Applications of this data set include the exploration of the rainfall variations in the tropics over a long time period (1986 to 1995), the relationship between the rainfall variations and the El Nino Southern Oscillation (ENSO) conditions that occur in the Pacific during that time period, and as supplemental information to conventional rainfall data which are often scarce in the tropics.

1.3 Data Disclaimer

1.3.1 Acknowledgement

Please see, https://disc.gsfc.nasa.gov/information/documents?title=data-policy

1.3.2 Contact Information

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For assistance with our data and services, please write or call us at:

Email: gsfc-dl-help-disc@mail.nasa.gov

Voice: 301-614-5224

Fax: 301-614-5268

2.0 Data Organization

The data consist of monthly precipitation in mm/day in one ASCII file.

2.1 File Naming Convention

The data are stored in one ASCII file, gpi_mth_sat-merged_mmday_asc_0186-1295

Size: 4.4 Megabytes (ASCII)

2.2 File Format and Structure

Each rainfall field within the file begins with a four-digit integer month identifier (e.g., 8601 = January 1986), followed by a 144 by 32 array of monthly rainfall estimates (in mm/day). Each value represents the estimated areal average rainfall for a 2.5 degree by 2.5 degree grid cell. Missing values are flagged by "9999". The data grid ranges in latitude from 40 degree north to 40 degree south and in longitude from 180 degree west to 180 degree east. The array structure is given in Table 1.

Examples:

Element (1, 1) contains the mean for the grid cell centered at 38.75 degree north latitude and 1.25 degree east longitude.

Element (144, 32) contains the mean for the grid cell centered at 38.75 degree south latitude and 1.25 degree west longitude.

```
                           Table 1.


40N    -------------------------       ---------------------
       |       |       |       |       |         |         |
       | (1,1) | (2,1) | (3,1) |  . . .| (143,1) | (144,1) |
       |       |       |       |       |         |         |
37.5N  -------------------------       ---------------------
       |       |       |       |       |         |         |
       | (1,2) | (2,2) | (3,2) |  . . .| (143,2) | (144,2) |
       |       |       |       |       |         |         |
       -------------------------       ---------------------
                                   .
                                   .
37.5S  -------------------------       ---------------------
       |       |       |       |       |         |         |
       | (1,32 | (2,32 | (3,32)|  . . .| (143,32)| (144,32)|
       |       |       |       |       |         |         |
40S    -------------------------       ---------------------
       |       |       |       |       |         |         |
       0      2.5E    5E     7.5E      5W       2.5W       0
```

Sample data record:

9406 0.53 0.69 0.65 0.47 0.25 0.26 0.29 0.19 0.06 0.08 0.07 0.06 0.09 0.14 0.15 0.19 0.29 0.35 0.32 0.36 0.64 0.67 0.68 0.43 0.13 0.05 0.21 0.76 1.33 1.95 2.30 2.09 1.86 1.73 1.73 1.91 1.73 2.42 4.15 5.37 4.88 3.43 3.36 4.17 4.96 5.06 3.57 3.10 3.15 2.93 3.62 4.56 4.06 3.48 3.10 3.03 3.04 2.92 3.32 5.03 6.21 6.98 6.96 7.60 6.27 6.38 5.95 5.18 5.38 5.21 5.17 5.01 5.44 8.29 8.77 7.22 6.68 5.32 3.26 2.36 2.02 1.93 1.83 1.49 1.21 1.08 0.87 0.62 0.50 0.64 0.57 0.34 0.26 0.22 0.22 0.76 1.51 1.33 1.87 1.75 1.35 2.37 3.81 5.83 6.03 5.27 5.28 5.20 3.69 3.34 2.81 3.17 2.51 1.73 1.23 2.00 2.72 3.10 2.98 2.77 2.26 1.56 1.84 1.84 1.96 1.93 2.16 2.65 3.53 1.36 0.93 0.62 0.60 0.77 0.54 0.18 0.03 0.04 0.08 0.14 0.25 0.48 0.74

2.3 Key Science Data Fields

Accumulated surface precipitation

3.0 Data Contents

3.1 Dimensions

See Sec. 2.

3.2 Global Attributes

See Sec. 2.

3.3 Products/Parameters

Product name: Arkin and Janowiak Global Precipitation Index (GPI)

Parameter name: Accumulated surface precipitation

4.0 Options for Reading the Data

4.1 Command Line Utilities

4.1.1 more

more is a command to view (but not modify) the contents of a text file:

$more gpi_mth_sat-merged_mmday_asc_0186-1295

4.1.2 vi

vi is a text editor to view and modify the contents of a text file:

$vi gpi_mth_sat-merged_mmday_asc_0186-1295

4.2 Tools/Programming

A sample program in Fortran:

```
      real precip (144, 32)
      character*50 infile
      data infile / 'gpi_mth_sat-merged_mmday_asc_0186-1295' /
      open (unit=20, file=infile, form='formatted',
     +      access='sequential', status='readonly')
      do 100 irec=1, 150
        read (20, 1000, end=9999) iyymth, precip
        write (6, *) 'Data read for time period ', iyymth
100   continue
1000  format (i4 / (144f8.2))
9999  write (6, *) 'End of file reached.'
      stop
      end
```

5.0 Data Services

If you need assistance or wish to report a problem:
Email: gsfc-dl-help-disc@mail.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

6.0 More Information

N.A.

7.0 Acknowledgements

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Janowiak, J.E. and P.A. Arkin, 1991.Rainfall variations in the tropics during 1986-1989, as estimated from observations of cloud-top temperatures.J. Geophys. Res., ***96,*** *Supplement, 3359-3373.*

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