GPCP One-Degree Daily (1DD)

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DESCRIPTION

The 1DD uses the "best" quasi-global observational estimators of underlying statistics to adjust quasi-global observational datasets that have desirable time/space coverage. Specifically,

1. Special Sensor/Microwave Imager (SSM/I; GPROF algorithm) provides fractional occurrence of precipitation, and
2. GPCP Version 2 Satellite-Gauge (SG) combination provides monthly accumulation of precipitation to algorithms applied to
3. geosynchronous-orbit IR (geo-IR) Tb histograms,
4. low-orbit IR (leo-IR) GOES Precipitation Index (GPI), and
5. TIROS Operational Vertical Sounder precipitation (TOVS; Susskind algorithm).

Although microwave precipitation estimates and gauge analyses do not explicitly appear in this list due to sampling limitations, the calibration of the 1DD to the Version 2 monthly SG ensures that they do have a strong influence on the overall scaling. The differences between the IR and TOVS datasets required that the 1DD be formulated in two parts, with smoothing over the latitude band 40-50 in each hemisphere to patch the data boundary.

In the band 40N-S the Threshold-Matched Precipitation Index (TMPI) produces approximate instantaneous precipitation from the geo-IR Tb with fill-in by rescaled leo-IR GPI. The TMPI is a GPI-type algorithm with locally-calibrated Tb threshold and rainrate. To do this, time/space-matched geo-IR Tb and GPROF-SSM/I estimates of fractional coverage by precipitation are used to set the Tb threshold each month in each gridbox such that instantaneous geo-IR fractional coverage equals that of the GPROF-SSM/I estimates. Then a single rainrate for "raining" geo-IR pixels is computed for each grid box that makes the full month of TMPI sum to the local SG (monthly) value. Mismatches in geo-IR and GPROF-SSM/I precipitation cause some unrealistic TMPI conditional rain rates, so an "auditing" technique was developed to fill in reasonable values and re-estimate the geo-IR threshold. A less tractable problem is that the warmest geo-IR histogram bin starts at Tb=270K, which prevents correctly setting the threshold in regions with warm-top clouds. In parallel, individual leo-IR GPI values used for fill-in are scaled by the (local) ratio of the SG monthly value to the monthly sum of the leo-IR GPI. TMPI estimates are made for each 3-hourly synoptic time, then all available data in a gridbox are summed for the UTC calendar day (00, 03, ..., 21Z).

The original TOVS dataset tends to exhibit a very high number of rain days and a correspondingly low conditional rain rate. To overcome this, each month in each hemisphere the local number of TOVS rain days was reduced by the ratio of the total number of TMPI and TOVS rain days at latitude 40. The remaining non-zero daily rain amounts are rescaled to start at zero and sum over the particular month to the (local) SG value.

Digital data:

http://www1.ncdc.noaa.gov/pub/data/gpcp/1dd/data/

Example GIF images and QuickTime movies:
http://precip.gsfc.nasa.gov/rain_pages/daily_choice.html

Detailed documentation and programming examples:
http://www1.ncdc.noaa.gov/pub/data/gpcp/1dd/doc/1DD_doc

Reference:
Huffman, G.J., R.F. Adler, M. Morrissey, D.T. Bolvin, S. Curtis, R. Joyce, B. McGavock, and J. Susskind, 2001: Global Precipitation at One-Degree Daily Resolution From Multi-Satellite Observations. *J. Hydrometeor*., **2**(1), 36-50.

SPECTRAL INTERVALS AND APPLICABLE SATELLITES

The input to 1DD is a mix of pre-computed precipitation estimates and single-sensor data. It includes:

1. SSM/I-GPROF instantaneous precipitation estimates, which use all SSM/I channels on the DMSP F13, F14, and F15.
2. GPCP Version 2 monthly SG precipitation estimates, which use all SSM/I channels on DMSP F13; geo-IR Tb data from GOES-E, GOES-W, GMS, METEOSAT-5, and METEOSAT-7; leo-IR data from the NOAA-series; and rain gauge analyses produced by the Global Precipitation Climatology Centre.
3. Geo-IR 3-hourly Tb histograms from GOES-E, GOES-W, GMS, METEOSAT-5,and METEOSAT-7.
4. Leo-IR 3-hourly GOES Precipitation Index (GPI) precipitation estimates, which use all NOAA-series leo-IR Tb's.
5. TOVS-Susskind daily precipitation estimates, which use Microwave Sounding Unit and High-resolution Infrared Sounder data from NOAA-series satellites.

This approach is equally applicable to other reliable sources of instantaneous precipitation occurrence and monthly precipitation accumulation and/or other sources of IR Tb data and high-latitude precipitation estimates.

SPATIAL SCALE

1×1-deg latitude/longitude

TEMPORAL SCALE

Daily

ANCILLARY DATA

None

ADDITIONAL COMMENTS

Introduction

This data set is a companion to the GPCP Version 2 Monthly Satellite-Gauge Combination (which the reader should see for descriptions, including references). The 1DD is computed by the research team led by Dr. Robert Adler in the NASA/GSFC Laboratory for Atmospheres. This takes place 2-3 months after the end of the month, once all input data sets become available.

File Contents

The data set archive consists of unformatted REAL*4 binary files with ASCII headers. Each file holds 28-31 daily fields. Each file occupies about 8 MB. The grid on which each field of values is presented is a 1x1-degree latitude/longitude (Cylindrical Equal Distance) global array of points. It is size 360x180, with X (longitude) incrementing most rapidly West to East from the Prime Meridian, and then Y (latitude) incrementing North to South. Whole- and half-degree values are at grid edges:
First point center = (89.5N, 0.5E)
Second point center = (89.5N, 1.5E)
Last point center = (89.5S, 0.5W)
Missing values are denoted by the value -99999., and the units are mm/day.

Dataset Validation

The instantaneous TMPI show good consistency from one time to the next and with the daily TMPI, GPI, and rescaled TOVS fields. A month of 1DD estimates correctly sum to the monthly SG, except in the subtropical highs where geo-IR threshold saturation becomes a problem. Even before smoothing, there is good continuity across the 40 N and S data boundaries, perhaps in part because the IR and TOVS datasets both largely represent clouds. This dependence on scaled cloud information implies that users should expect larger errors in the individual daily values, and preliminary validation results support this view. Space and/or time averages should be more reliable.

Dataset Status

The current data set extends from October 1996 - present (with some delay to allow input fields to be computed).
It is expected that the 1DD will see extensive development work. This may include: diurnally varying calibrations; extension back in time; additional sensors; direct use of microwave estimates; and refined combination approaches.

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