Extreme Precipitation as Depicted in the TMPA and GPCP 1DD

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1. Introduction

It is interesting to compute extremes in satellite data sets in order to
- gain an understanding of the climatology of the metrics
- gain an understanding of the satellite data set limitations

The precipitation group in the NASA/GSFC MAPL is responsible for two high-resolution precipitation products
- TRMM Multi-satellite Precipitation Analysis (TMPA)
- GPCP One-Degree Daily (1DD)

Neither data set is specifically designed for extremes

There is also a scale mismatch
- TMPA is averaged to UTC days, since that is the conventional minimum period for extremes, and matches the 1DD time
- TMPA is computed at both 0.25° and 1° resolution for information about scale dependence

As well, 1DD provides information at high latitudes

Seasonal behavior is a key part of the climate signal

The globe is broken into regions for easier viewing

2. TRMM Multi-satellite Precipitation Analysis (TMPA)

3-hr 0.25° grid, 50°N-S

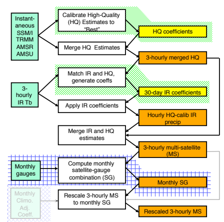
Microwave precip:
- intercalibrate, combine

IR precip:
- calibrate with microwave

Combined microwave/IR:
- IR fills gaps in microwave

Final:
- accumulate combined 3-hr precip for the month
- weighted combo. with gauge analysis
- rescale 3-hr precip to sum to the monthly sat-gauge combination

Real-time version faded out



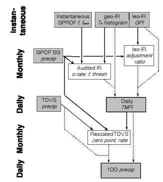
3. One-Degree Daily (1DD)

1-day, 1° grid, 90°N-S

40°N-S:
- Threshold-Matched Precip Index (TMPI)
- month of coincident GPROF-SSMI precip, geo-IR Tb data to set precip fraction (at 1° resolution) --> local IR Tb threshold
- local conditional rate from GPCP monthly
- Like GPI with IR threshold, single conditional rate varying by month, location

Outside 40°N-S:
- daily TOVS/AIRS precip occurrence scaled to TMPI occurrence at 40°N,S
- daily TOVS/AIRS rates rescaled to sum to GPCP monthly locally

Final:
- local linear fade from TMPI to rescaled TOVS/AIRS precip by day, 40-50°

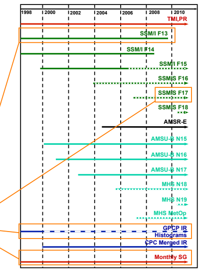


4. Data Sources

A diverse, changing set of input precip estimates – various
- periods of record
- regions of coverage
- sensor-specific strengths and limitations

TMPA designed to give the "best" instantaneous estimate
- input data sources vary
- short dashes indicate data being used in the new Version 7
- monthly TMPA SG
- 0.25°, 50°N-S, 3-hr→daily

1DD more approximate, relatively homogeneous
- match-up of single SSM/I (soon SSMIS), geo-IR
- monthly GPCP SG
- 1°, 90°N-S, daily



5. Climate-oriented Indices

Acknowledge CCl/CLIVAR/JCOMM Expert Team (ET) on Climate Change Detection and Indices (ETCCDI) concept of "core indices"

Chose to compute
- Ravg *Avg. daily precip (=PTOT/365)*
- Rfrac *Avg. fraction of days with precip (> 0.5 mm/d)*
- R95p *95th-percentile precip rate*
- CDD *Avg. annual maximum length of dry spell (<1 mm/d)*
- CWD *Avg. annual maximum length of wet spell (≥1 mm/d)*

Record is too short to compute sophisticated metrics!

Note the paradox of "climate" variables depending on fine-scale estimates
- "extremes" easily contaminated by analysis artifacts
- R95p is computed because it is well-correlated to 99th percentile and maximum values, and is more stable

Introduce a dryness index:
- f2mm *Avg. fraction of days with precip ≤ 2 mm/d*
- rough lower limit of agriculturally relevant event
- less sensitive to analysis artifacts than CDD

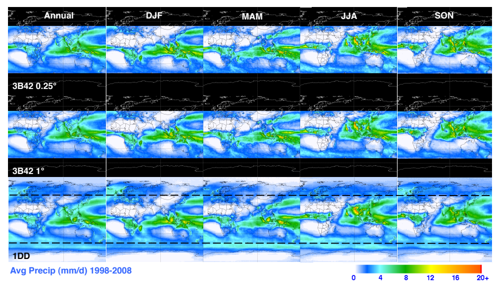
	Eastern Hemisphere	Pacific	Americas and Atlantic

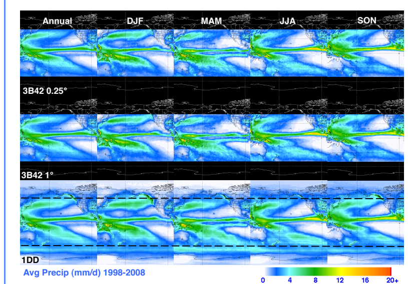
6. Results – Seasonal Ravg

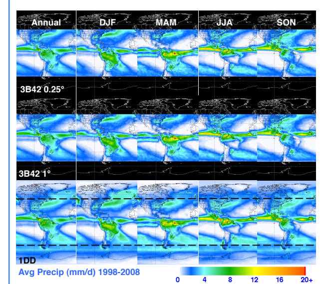
Minimal scale dependence

Algorithm similarities
- Southern Ocean minimum DJF, maximum MAM-JJA
- Tasman Sea, New Zealand minimum DJF, maximum JJA
- expected summer monsoon cycle in S. Asia
- break in ITCZ off C. America JJA-SON
- double Pac. ITCZ MAM

Algorithm differences
- Tasmania, New Zealand much wetter in 1DD
- N. Pac. storm track wetter in 1DD JJA-SON
- Patagonia and offshore wetter in 1DD
- low-precip artifact off Newfoundland in TMPA





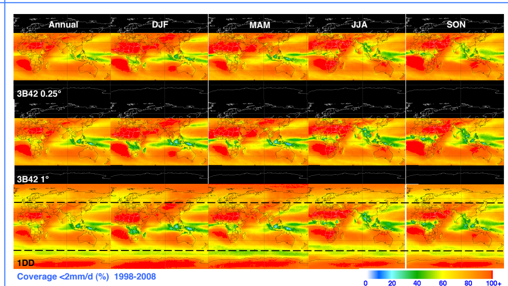


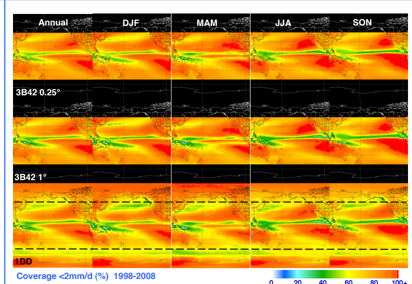
7. Results – Seasonal f2mm

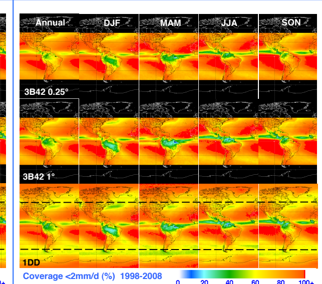
Moderate-strong scale dependence (note Borneo)

Algorithm similarities
- Southern Ocean minimum MAM, maximum SON-DJF, leads Ravg
- eastern Indian Ocean has a decent seasonal cycle, unlike Ravg
- strong seasonal cycle in central Africa, Asian monsoon regions
- minimum offshore of N.E. Brazil JJA when onshore region has a maximum

Algorithm differences
- 3B42 higher in Southern Ocean
- Tasmania and New Zealand stick out in 3B42, don't in1DD







8. Results – Seasonal R95

Strong scale dependence

Algorithm similarities
- peaks tend to be in phase with Ravg
- peaks around Darwin, offshore of S.E. Asia and the Philippines, southwest of C. America are unlike Ravg
- strong maxima in la Plata basin, S. America; note seasonal shift in location

Algorithm differences
- Tasmania, New Zealand much wetter in 1DD, as with Ravg
- 1DD tends to higher minima, particularly in subtropical highs
- bigger break across S. Andes in 3B42, except DJF
- 1DD has a break at 40°S, less so at 40°N