Performance of the Version 1 Reprocessed, Bias-Corrected CMORPH in Depicting the Warm Season Extreme Precipitation Events

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Objective

• To examine the capacity of the version 1 reprocessed, bias corrected CMORPH in detecting and quantifying extreme precipitation events;

• Version 1 CMORPH: CMORPH_CRT in our ftp site
Version 1 CMORPH Processing System

- A Two-step approach
  - Integrating information from all satellites (LEO PMW + GEO IR)
  - Removing bias in satellite estimates through calibration against gauge data

Joyce et al. (2004); Xie and Joyce (2017)
Version 1 CMORPH Products

We have two series of CMORPH global precipitation products

- Bias Corrected CMORPH (CMORPH_CRT)
  - Native resolution: 8kmx8km over 60°S-60°N; 30-min interval from 1998
  - Product resolution: 8kmx8km; 0.25°lat/lon
    30-min; hourly; 3-hourly; daily;
  - Real-time updates: 2-hourly latency,
    refined continuously until 12-hour latency
  - Post-processing: Manually once a month at ~3 month latency

- Gauge-CMORPH Blended Precipitation (CMORPH_BLD)
  - Bias corrected CMORPH further combined with CPC daily gauge analysis
  - Resolution: 0.25°lat/lon over the globe (90°S-90°N)
  - Real-time updates: 1-2 days latency
  - Post-processing: Manually once a month at ~3 month latency

- Associated Climatology
  - Daily Precipitation climatology defined on 0.25°lat/lon with the 20-year data (1998-2017)
  - Mean precipitation, 99-, 95-, 90-percentiles, frequency of raining days
Climatology of Mean and Extreme Precip.

- Climatology defined for CMORPH using data for 1998 to 2017
- Mean, percentage of raining time, 99, 95, 90 percentiles
- Sample 99 percentile precipitation for pentad 37 (June 30–July 04)
CMORPH Performance in Detecting / Quantifying Heavy Rainfall

Methodology

• Examine performance of the bias corrected CMORPH (CMORPH_CRT) in detecting and quantifying extreme precipitation events of various time / space scales;
  – Time Scale: 1-, 2-, 3-, 5-, 7-, 10-, 30-day
  – Space Scale: 0.25°, 0.5°, 1.0°, 2.0°, 5.0° lat/lon

• This is done through comparison of the CMORPH_CRT against CPC gauge-based analysis of daily precipitation over the CONUS east of 105°W;

• CPC gauge-based analysis is defined through interpolation of quality controlled gauge reports from a very dense station network;

• Warm Season (May-Sept.) data for 2006 – 2017 are used
CMORPH Performance in Detecting / Quantifying Heavy Rainfall

Detecting Extreme on daily / 0.25°lat/lon scale

- Overall pretty good agreements between CMORPH_CRT and gauge analysis on 0.25°lat/lon;
- PDF of CMORPH_CRT matches almost perfectly with that of gauge analysis, a result of bias correction through PDF matching;
- However, CMORPH_CRT still tend to under-/over-estimate heavy /light rainfall;
- HSS decreases with increasing threshold precipitation intensity but still very high for detection of precipitation $\geq$50mm/day.
CMORPH Performance in Detecting / Quantifying Heavy Rainfall

Detecting Extreme on 5-day / 1.0°lat/lon scale

- Overall pretty good agreements between CMORPH_CRT and gauge analysis on 1.0°lat/ion;
- PDF of CMORPH_CRT matches almost perfectly with that of gauge analysis, a result of bias correction through PDF matching;
- However, CMORPH_CRT still tend to under-/over-estimate heavy /light rainfall;
- HSS decreases with increasing threshold precipitation intensity but still very high for detection of precipitation >=50mm/day.
CMORPH Performance in Detecting / Quantifying Heavy Rainfall

Heavy Rainfall Detecting Skills
(left: 95 percentile; right: 99 percentile)

- left=Hit Rate; middle=False Alarm; right=HSS
- Heavy rainfall detecting skill improves with increasing time / space scales, especially the spatial scale
- HSS reaches >0.8 for CMORPH_CRT to detect heavy rainfall event of 95 percentile or higher accumulated rainfall at (5°lat/lon;30-day) scale (large-scale lasting flooding)
CMORPH Performance in Detecting / Quantifying Heavy Rainfall

Applications of CMORPH_CRT in detecting and quantifying heavy rainfall event

Daily precipitation for Nov. 18, 2014 from CMORPH_CRT

(top-left) Total precipitation (mm)
(top-right) Ratio to the 20-year mean
(bottom-left) Daily precip percentiles
(bottom-right) Ratio to 99th percentile

• Daily precipitation for Nov. 18, 2014 is higher than the 95 percentile over a wide area over the eastern shore of Malaysia
CMORPH Performance in Detecting / Quantifying Drought

Methodology

- Anomaly and SPI computed from CMORPH_CRT and compared against those from CPC gauge analysis over grid boxes with reporting gauges
- Comparisons conducted over SE Asia in association with a WMO demonstration program (SEMDP)
- SPI computed for 30-, 60-, and 90-day mean precipitation using statistics derived from 1998 – 2017 data
CMORPH Performance in Detecting / Quantifying Drought

Sample for the week of Jan.13-19, 2014

(top) Total precip (mm)

(bottom) Anomaly

Overall quite good agreements among CPC gauge analysis, CMORPH_CRT, and CMORPH_BLD
CMORPH Performance in Detecting / Quantifying Drought

*SPI derived from CMORPH_CRT agrees very well with that based on CPC gauge analysis*

Correlation for SPI-30, SPI-60, and SPI-90 reaches 0.7 – 0.8

Drop in correlation for SPI-90 probably caused by unstable statistics defined using 20-year data
CMORPH Performance in Detecting / Quantifying Drought

Applications of CMORPH derived SPI in detecting drought

ending at 2014-03-09

(upper-left) 30-day SPI

(upper-bottom) 60-day SPI

(lower-bottom) 90-day SPI
Summary

• 1st generation bias corrected CMORPH reprocessed for a 20-year period from 1998 to the present and updated on a quasi real-time basis

• Mean and extreme precipitation climatology constructed using CMORPH data for a 20-year period from 1998 to 2017

• CMORPH presents good skills in detecting and quantifying both the heavy rainfall and drought for tropical / warm season precipitation

• CMORPH are available through ftp at:

ftp://ftp.cpc.ncep.noaa.gov/precip