

Improving Real-Time Production of CMORPH2

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CMORPH2

1) Overview

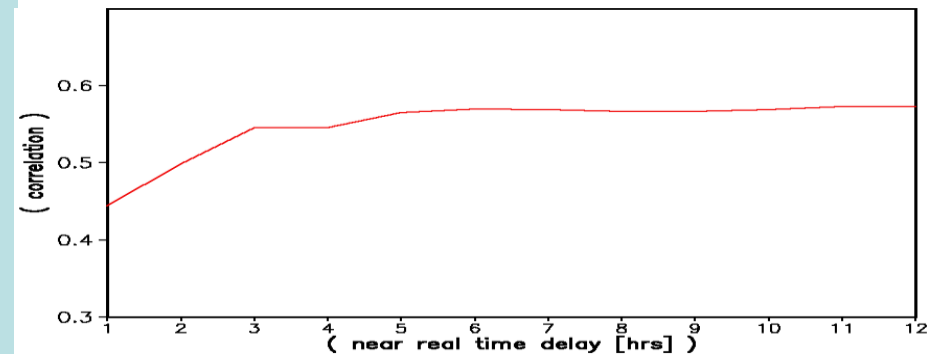
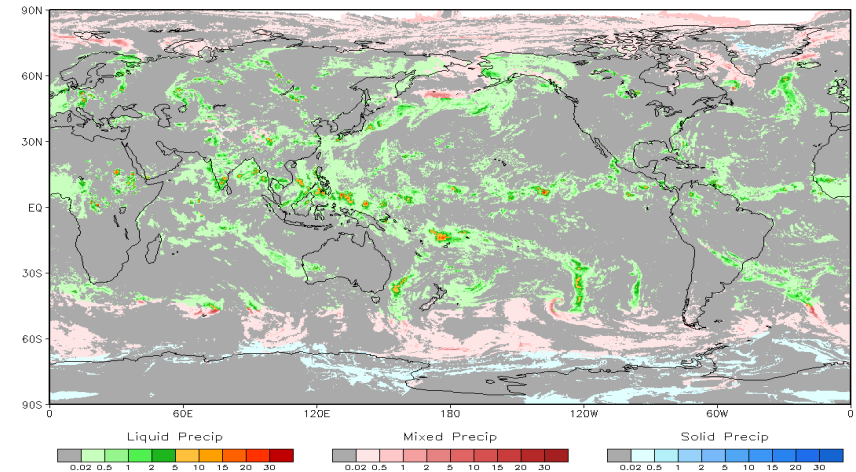
- **CMORPH2 (2nd generation CMORPH)**
 - *CPC Morphing technique;*
 - *High-resolution global precipitation estimates constructed by integrating information from multiple GEO and LEO satellites;*
- **Algorithm Strategy**
 - *Combining level 2 PMW precipitation retrievals from multiple (>10) LEO satellites with precipitation estimation derived from GEO and LEO IR (TBB) measurements;*
- **Products**
 - *High spatial resolution (0.05°lat/lon) covering the entire globe (90°S-90°N);*
 - *In a 30-minute interval starting from 2017 (backward extension in process);*
 - *Real-time production at an initial latency of one hour, refreshed once every 30 minutes until 12 hours latency;*
 - *Greatly improved representation of cold season precipitation (snowfall);*

CMORPH2

2) Real-Time Production

- **A processing system has been installed on an NWS 7/24 operational environment (the Compute Farm, CF-2) to generate the CMORPH2 integrated satellite global precipitation estimates on a near-real-time (NRT) basis;**
- **(top-right) sample results;**
- **Production Schedule**
 - *Generated at a latency of **one hour**;*
 - *Updated once every 30-minute with newly available inputs until 12 hours latency;*
- **Shortcomings**
 - **(bottom-right) Quality of NRT CMORPH2 as a function of production latency**
 - *Quality of CMORPH2 NRT compromised at short latency (<5-6 hours) due to the limited availability of L2 PMW retrievals and the less-than-desirable of operational version GEO IR based precipitation estimates (GPE);*
 - *Bias correction is not included in the NRT production;*

CMORPH-2 Precip Rate @ 2024.07.12 15:00~15:29Z (mm/hr)



Comparison of the NRT CMORPH2 generated at various latency levels against the MRMS radar precipitation for July, 2019, over CONUS land. Comparisons are conducted for hourly precipitation on a 0.25°lat/lon grid box.

Our Efforts to Improve CMORPH2 NRT Production

- **Improving Geostationary IR based precipitation Estimates (GPE)**

Improving the real-time version GPE to fill in the missing gaps of the PMW level 2 precipitation retrievals;

- **Infusing Direct Broadcast (DB) of PMW Retrievals**

Infusing the direct broadcast (DB) MiRS Level 2 PMW precipitation (Rain rate + Snowfall rate) retrievals to broaden the spatial coverage of the PMW L2 retrievals at short latencies;

- **Conducting bias correction for the purely satellite based raw CMORPH2**

Bias correction executed through comparison against CPC daily gauge analysis over land and through adjusting against the GPCP monthly merged analysis (V3.2) over ocean;

Improving GPE Real-Time Production

- **Inputs**

Merged global GEO TBB at 0.05°lat/lon over the globe (60°S-60°N)

- **Algorithm**

–Localized calibration of TBB against the combined inter-calibrated PMW retrievals (MWCOMB) through PDF matching;

Land / Ocean; 0.5°lat/lon resolution; diurnal cycle in TBB-Precip relationship;

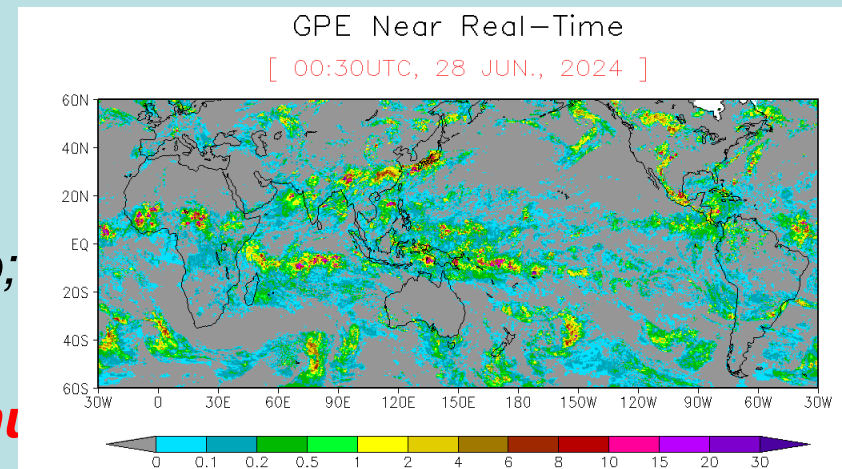
–Data taking strategy to better capture rapid weather regime changes;

- **Data Acquiring and Algorithm Implementation Strategy**

- *To get the input TBB data quickly (15 minutes);*

- *To generate the GPE with the up-to-date TBB-precip relationship;*

→ facilitate the production of CMORPH2 at a latency down to ~16 min



Infusing DB PMW Retrievals

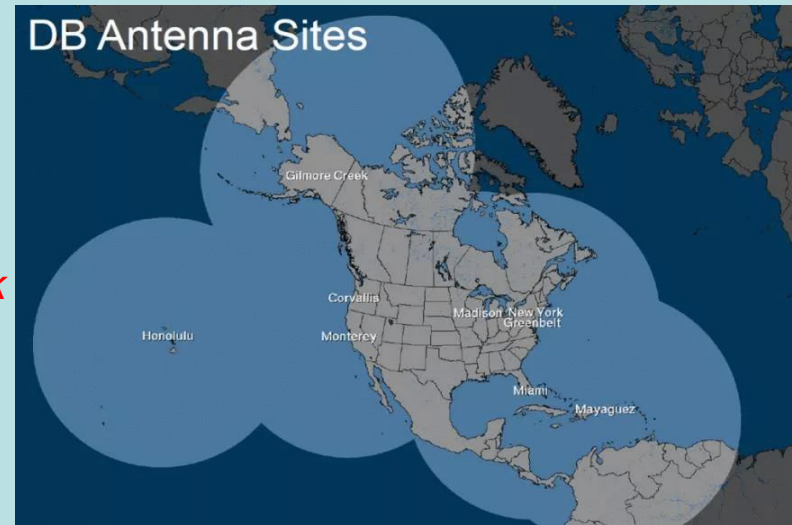
1) Background

- **The NOAA DB Network**

- NOAA maintains a network of ground stations receiving data directly from the satellite broadcast;
- These DB raw data are sent to SSEC and GINA where Level 2 precipitation retrievals are produced (with the MiRS algorithm) and released at a very short delay;

- **NOAA DB Ground Station Network**

- **DB data latency (in minutes)**

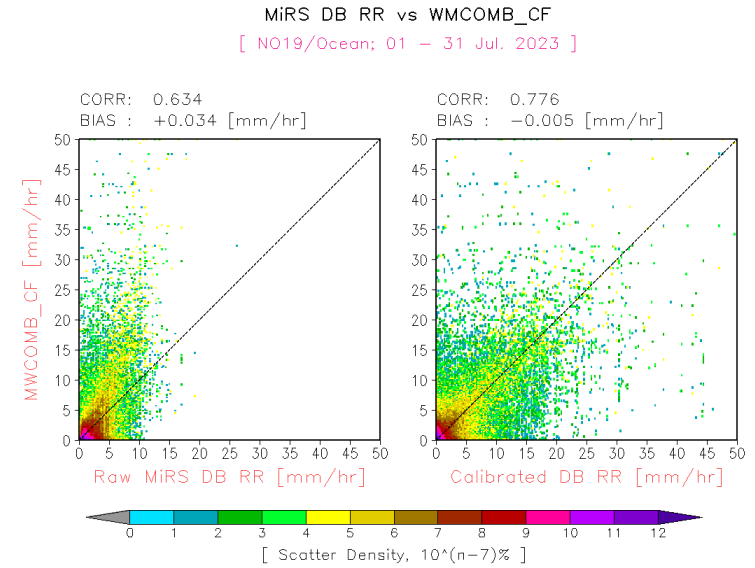


Satellite	SSEC	GINA
SNPP	8.7	11.7
METOP-B	16.3	15.3
METOP-C	16.4	19.6
NOAA-19	12.8	12.9
NOAA-20	9.9	18.4

Infusing DB PMW Retrievals

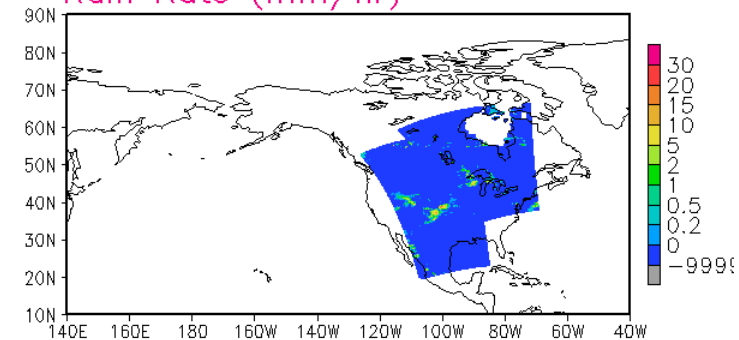
2) Algorithm and Implementation

- *DB precipitation retrievals (Rain rate + SFR) decoded and mapped to the CMORPH2 grid of 0.05°lat/lon;*
- *DB precipitation retrievals calibrated against the MWCOMB (created using regular version PMW retrievals) using co-located data pairs over the past 30 days;*
- *Calibrated DB retrievals infused to fill in the gaps of the MWCOMB;*
- *DB retrievals over-written by regular version PMW retrievals available at a later time;*



MWCOMB-DB MiRS Retrievals
[02:30-03:00UTC, 20 Jul., 2023]

Rain Rate (mm/hr)



Bias Correction

1) Algorithm and Implementation

- **Over land**
 - *PDF matching of co-located CMORPH2 and CPC daily gauge analysis using data over the past 30 days;*
 - *Correction ratio calculated for daily / 0.25° lat/lon down-scaled to hourly / 0.05° lat/lon;*
- **Over ocean**
 - *Correction ratio calculated against GPCP V3.2 (Regular / Interim);*
 - *Ratio calculated from historical data utilized for recent days with no GPCP monthly;*
 - *Ratio down-scaled from monthly / 0.5° lat/lon to hourly / 0.05° lat/lon;*
- **Acknowledgements:**

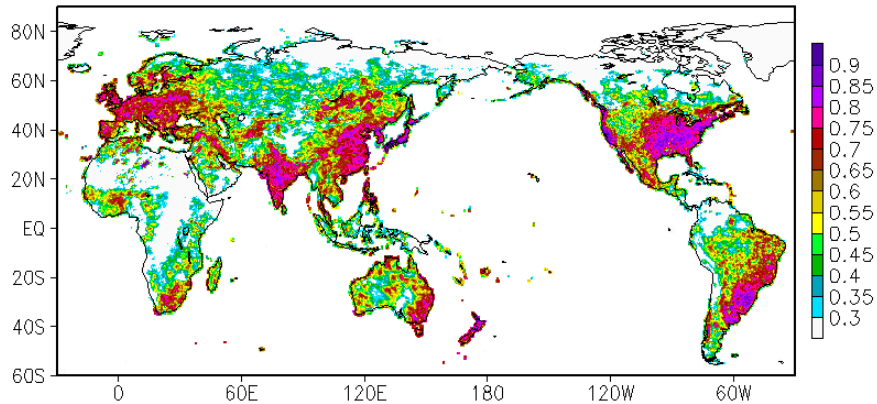
Thanks to R.Adler, G.Gu, G.Huffman, D. Bolvin and A. Behrangi for kindly providing us with the GPCP V3.2 data!!

Bias Correction

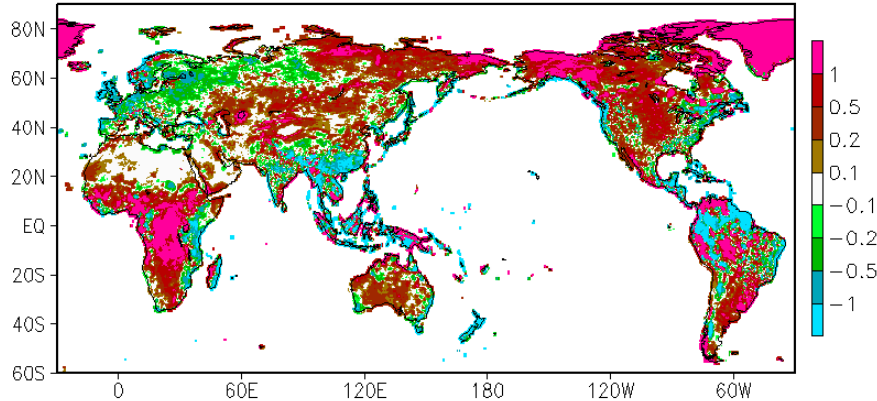
2) Evaluation over Land

CMORPH2x_NRT_RAW vs CPCGAG_ADJ
[Jan.2021 – Dec.2023]

Correlation

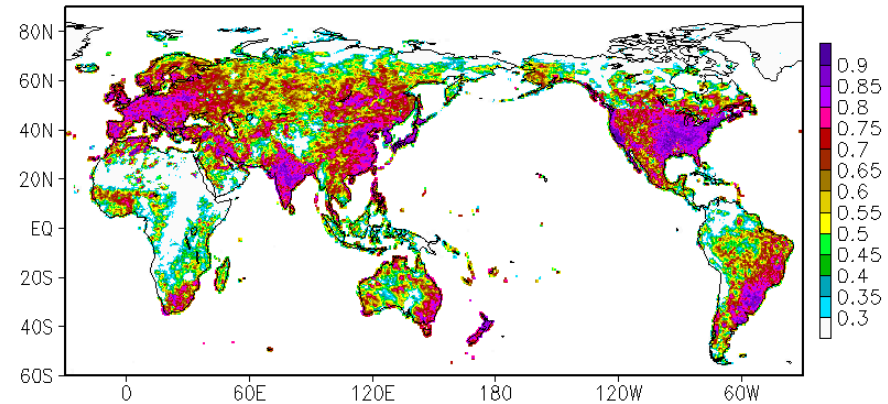


Bias [mm/day]

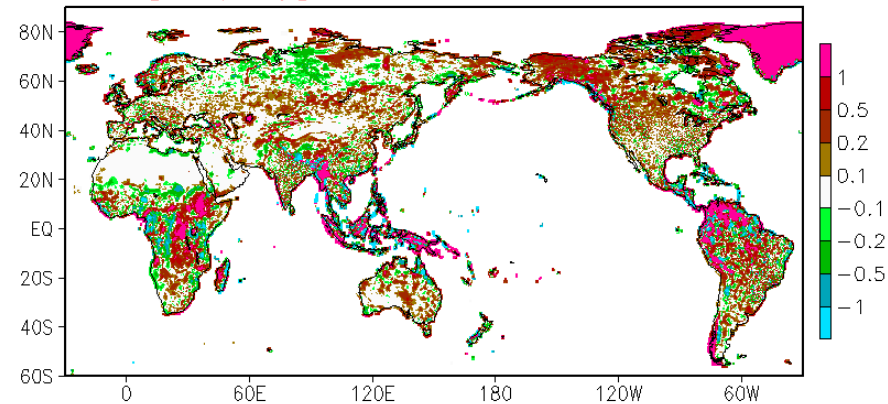


CMORPH2x_NRT_ADJ vs CPCGAG_ADJ
[Jan.2021 – Dec.2023]

Correlation



Bias [mm/day]

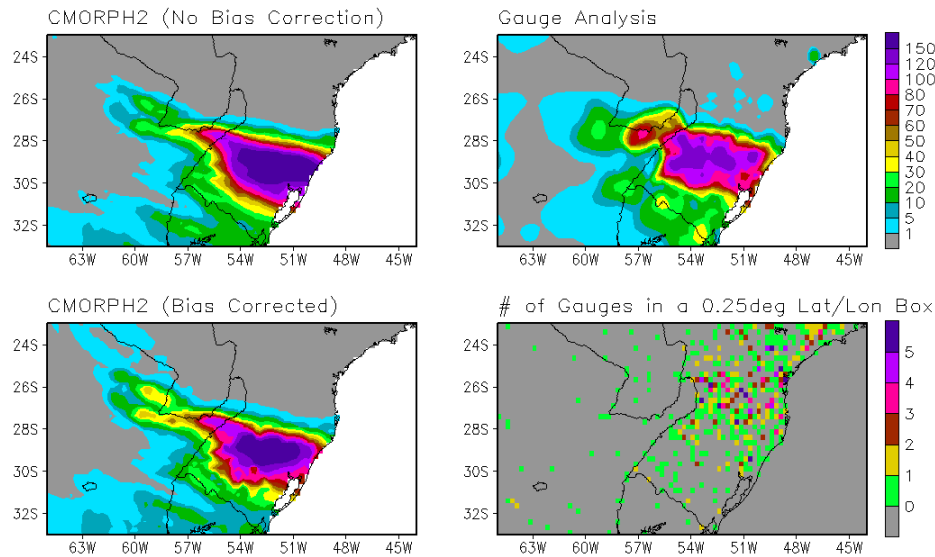


Bias Correction

3) Recent Flooding over Southern Brazil

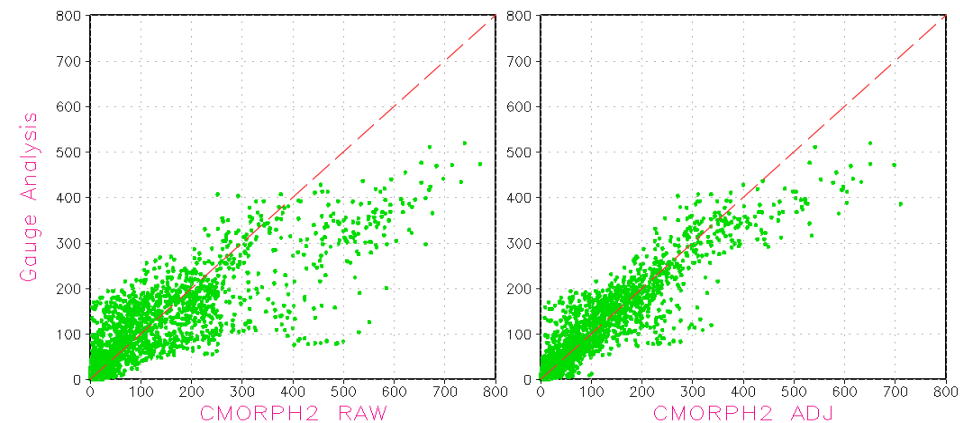
Comparison of Daily Rainfall [mm]

[02 May, 2024]



Comparison of Accumulated Rainfall [mm]

[24 Apr – 07 May, 2024]



- *(Top)* Daily rainfall for 2 May, 2024 (the day with the heaviest rainfall);
- *(bottom)* Scatter plots of rainfall accumulated for the entire period from 24 Apr to 7 May, 2024;
- CMORPH2, especially after the bias correction, captures the flooding causing heavy rainfall very well;
- CMORPH2 shows over-estimation against gauge analysis (kind of unusual);
- **Any issues in the input gauge reports?**

Summary

- CMORPH2 satellite precipitation estimates are produced on a 7/24 environment at a latency of one hour;
- We have completed the offline development work to improve the CMORPH2 real-time production by:
 - *Improving geostationary IR based precipitation estimates (GPE);*
 - *Infusing direct broad cast (DB) of PMW Level 2 precipitation Retrievals; and*
 - *Including bias correction for the raw CMORPH2;*
- We are in the process of installing the CMORPH2 NRT production system with all the enhancements to a new NWS operational environment, the Computer Farm 3 (CF-3);
- **CMORPH2 real-time data is available at:**
 - *NOAA/CPC FTP SITE:*
<https://ftp.cpc.ncep.noaa.gov/precip/CMORPH2/CMORPH2NRT/>
 - *NESDIS/STAR Data Portal:*
https://www.star.nesdis.noaa.gov/jpss/EDRs/products_blended_cmorph.php