

# CMORPH:

## A Multi-Sensor, Multi-Platform Blended Product of Global High-Resolution Precipitation

*Pingping Xie*  
NOAA Climate Prediction Center

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# Overview

- CMORPH: CPC Morphing Technique
- Basic Notion

*To construct high-quality, high-resolution global precipitation estimates through integrating information from ALL available sources:*

- *Level 2 PMW precipitation retrievals from all relevant LEO satellites*
- *IR precipitation estimates from GEO & LEO platforms*
- *Precipitation fields generated by numerical models*
- *Measurements from gauges and other in situ instruments (e.g. buoys)*
- *.....*

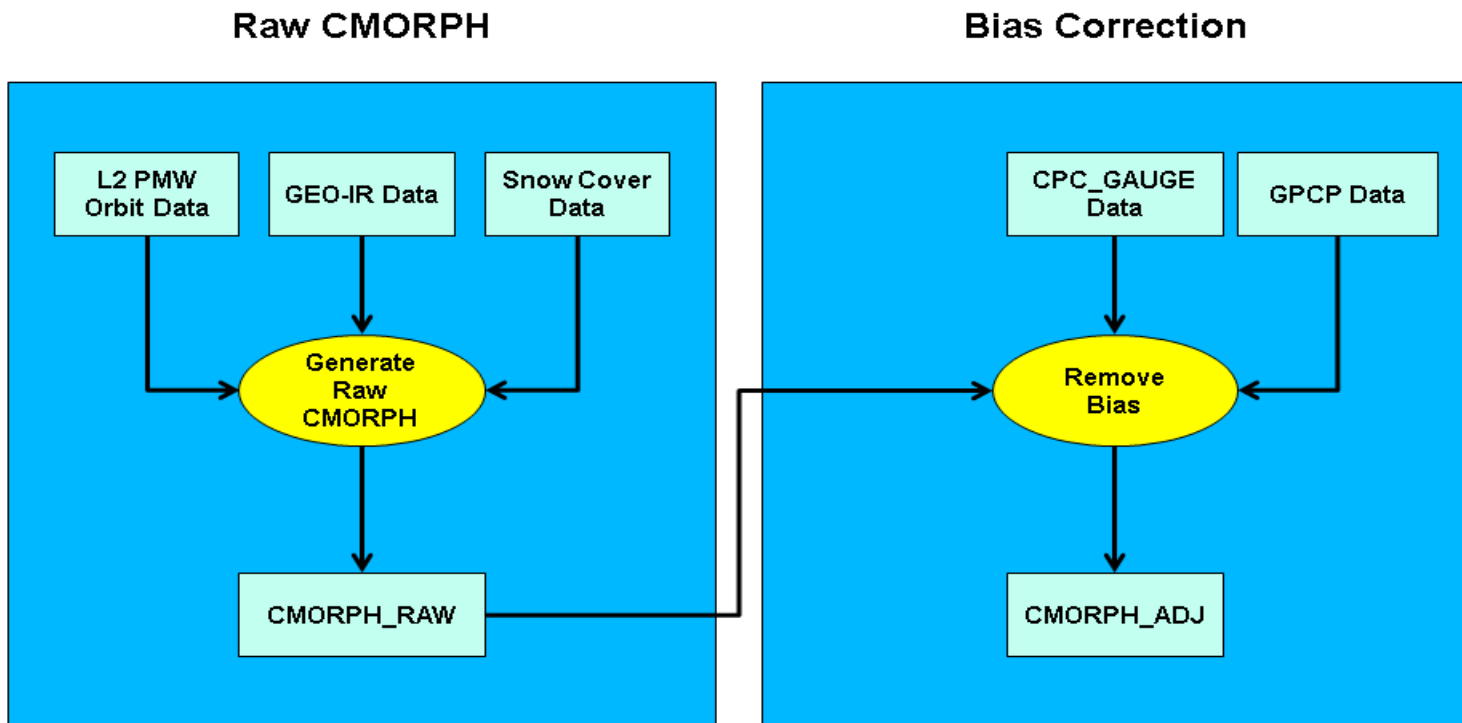
- Timeline

- *2002: Version 0 started real-time operation*
- *2009: Version 1 algorithm and system finalized*
- *2014: Version 1 reprocessing completed for 1998 ~ present*
- *2015: Version 2 prototype algorithm developed*
- *2017: Version 2 test real-time production started*

# 1st Generation CMORPH

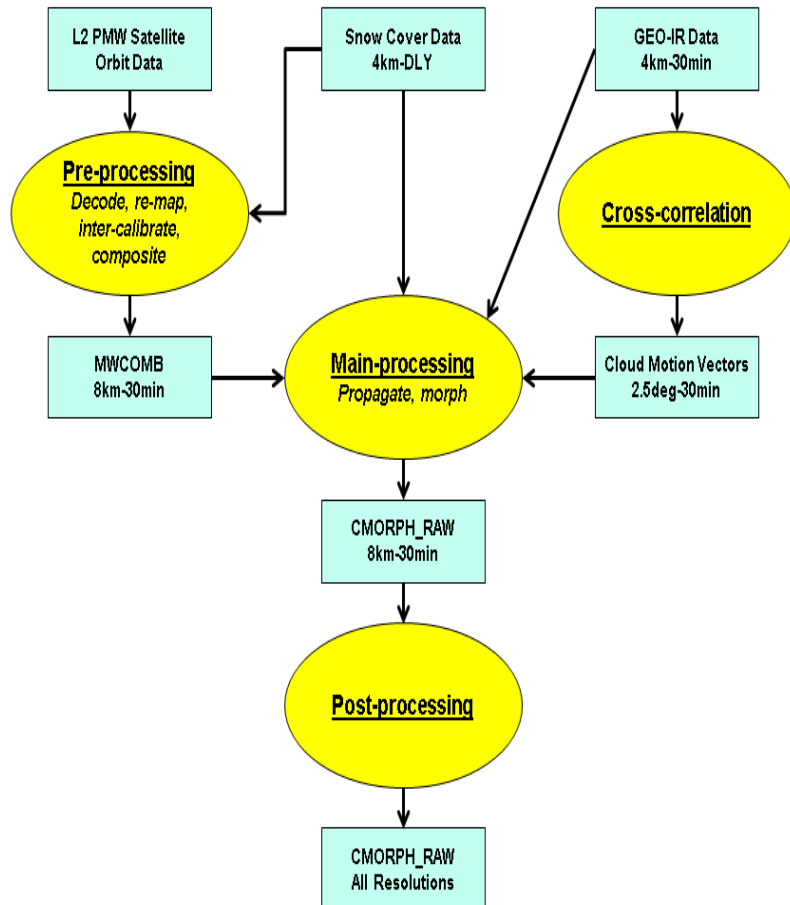
## [1] Overall System Structure

- 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)



# 1st Generation CMORPH

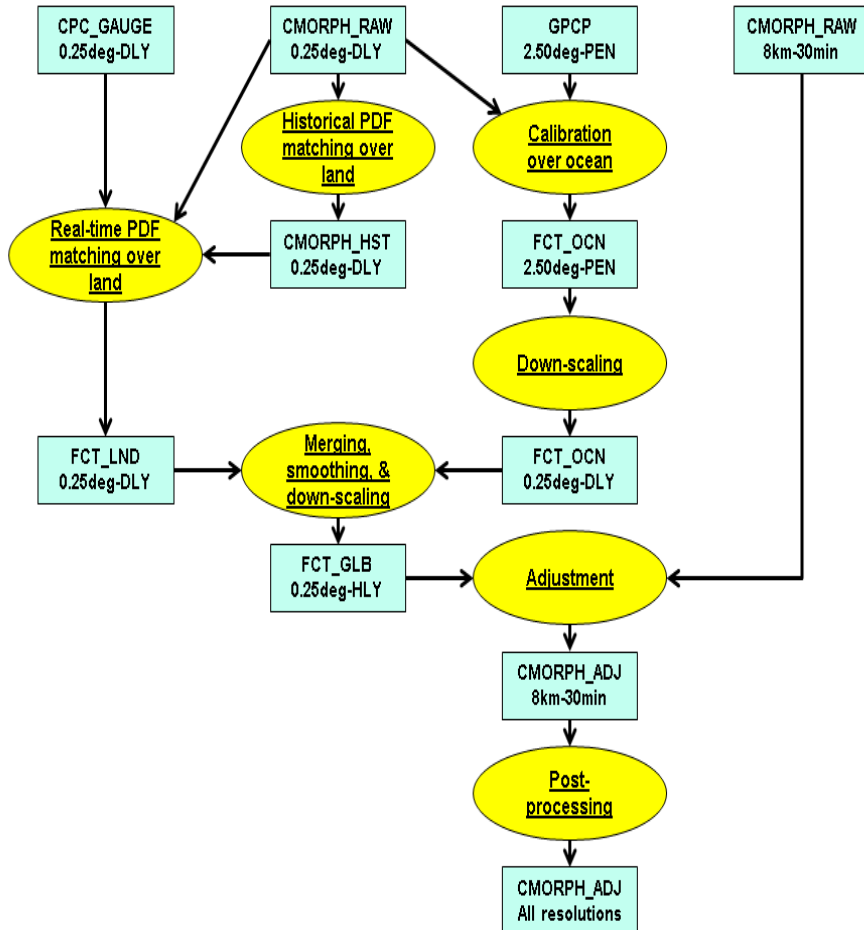
## [2] Purely Satellite-Based Estimates



- PDF inter-calibration against a common reference (TMI)
- Propagation of L2 PMW retrievals from respective observation times to target analysis time along cloud motion vectors
- Cloud motion vectors computed from two consecutive GEO IR images 30-min apart using maximum cross correlation (MCC) technique
- Propagation performed in both forward & backward directions and the purely satellite-based raw CMORPH is defined as weighted mean of the two propagated PMW.

# 1st Generation CMORPH

## [3] Bias Correction



- Over land:  
PDF matching against  
CPC gauge analysis

- Over ocean:  
Adjustment against  
pentad GPCP

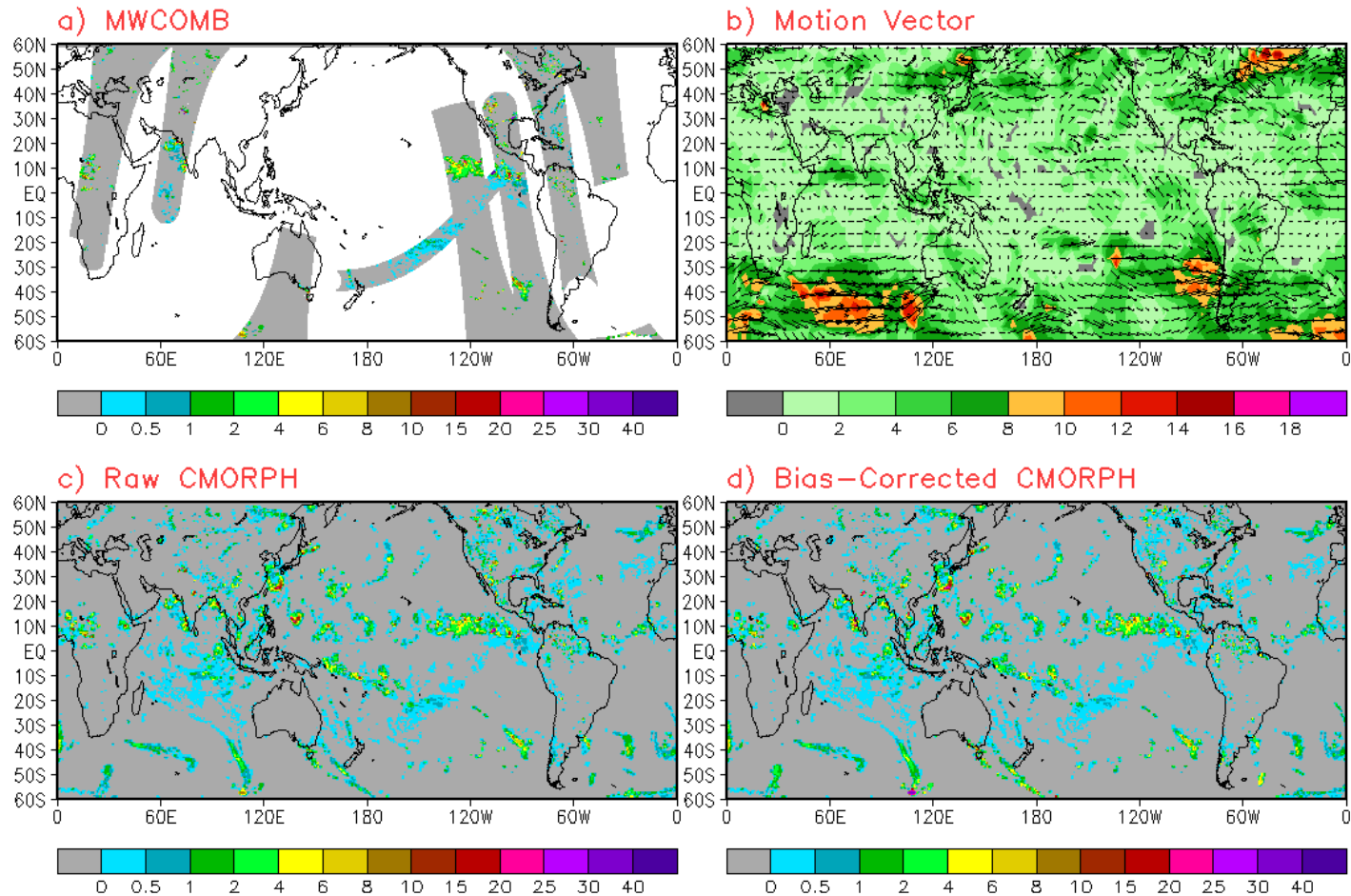
### Final Outputs:

- 8kmx8km over the globe (60°S-60°N)
- 30-min interval from 1998 to the present
- Real-time operation at a latency of 2 hours

# 1st Generation CMORPH

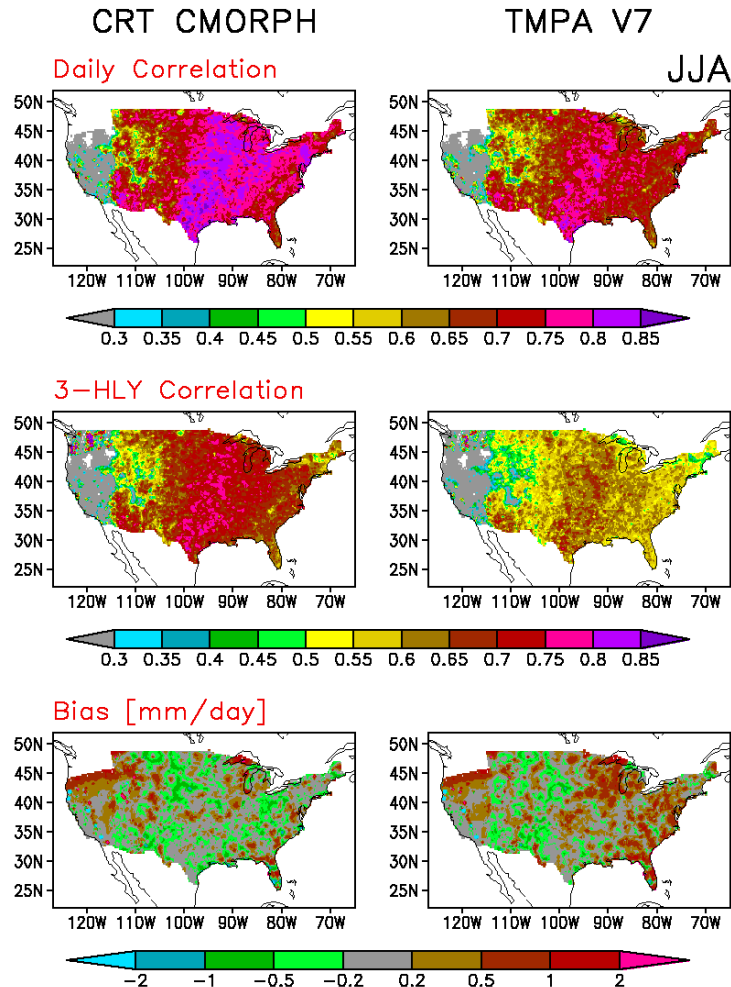
## [4] Sample

2014-Aug-01 00:00Z



# 1st Generation CMORPH

*[5] CMORPH V 1 Outperforms TRMM/TMPA V7*

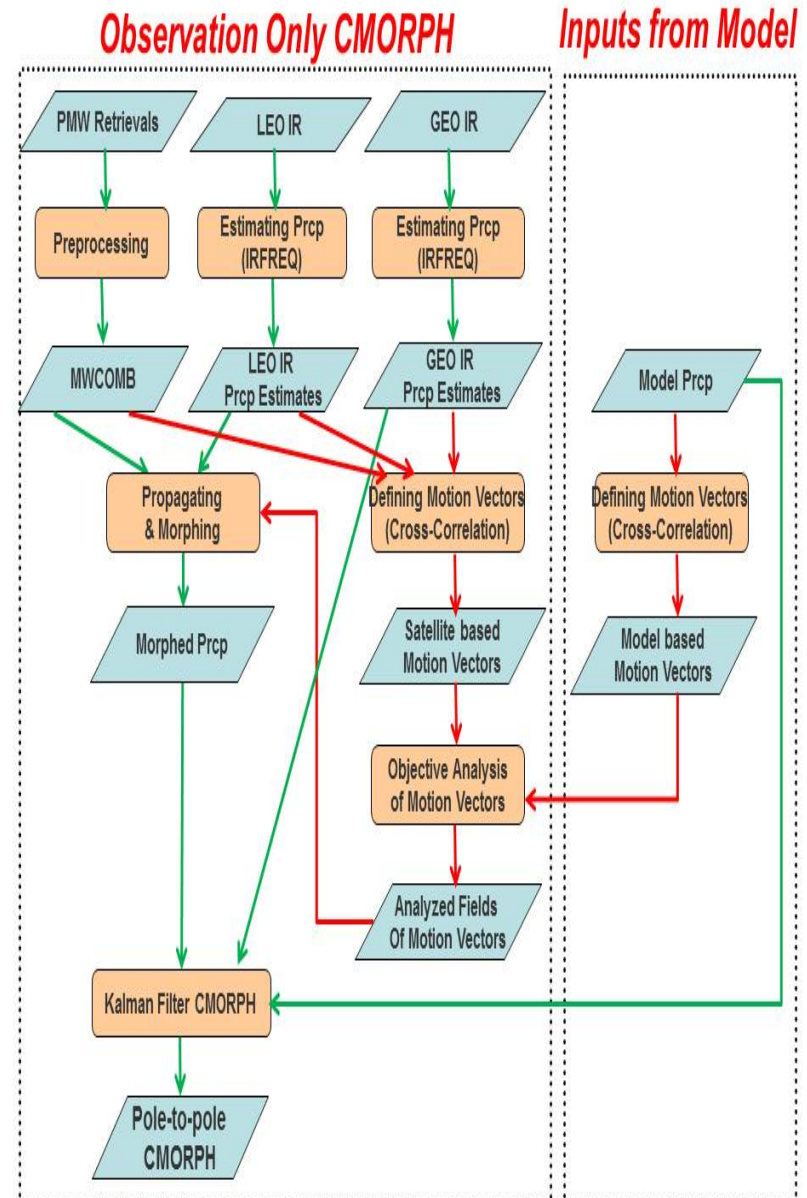


- Comparison of CMORPH V1 / TMPA against Stage IV radar over CONUS

# 2nd Generation CMORPH

## [1] Overall System Structure

- Developed with support from JPSS
- Upgrades upon CMORPH1
  - Pole to pole global coverage
  - 0.05°lat/lon grid
  - Improved **snowfall rate**
  - Better accuracy
  - Reduced latency (<1 hour)
- Strategy
  - **Inputs from more sources**
    - PMW SFR retrievals
    - GEO/LEO IR precip estimates
    - Model precipitation fields
  - **Vectors**
    - 2DVAR combining vectors from model and satellite estimates
  - **Integration framework**
    - Kalman Filter

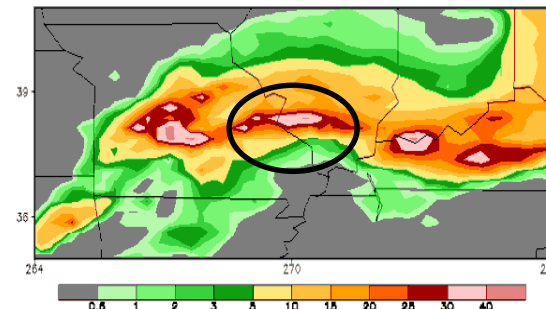
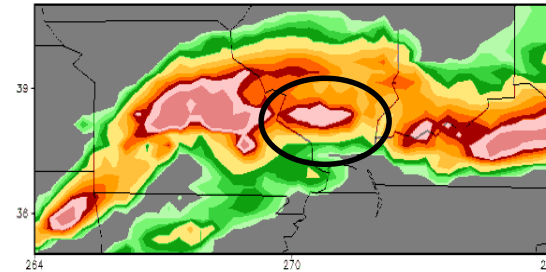
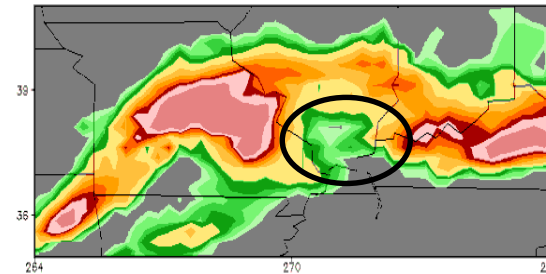
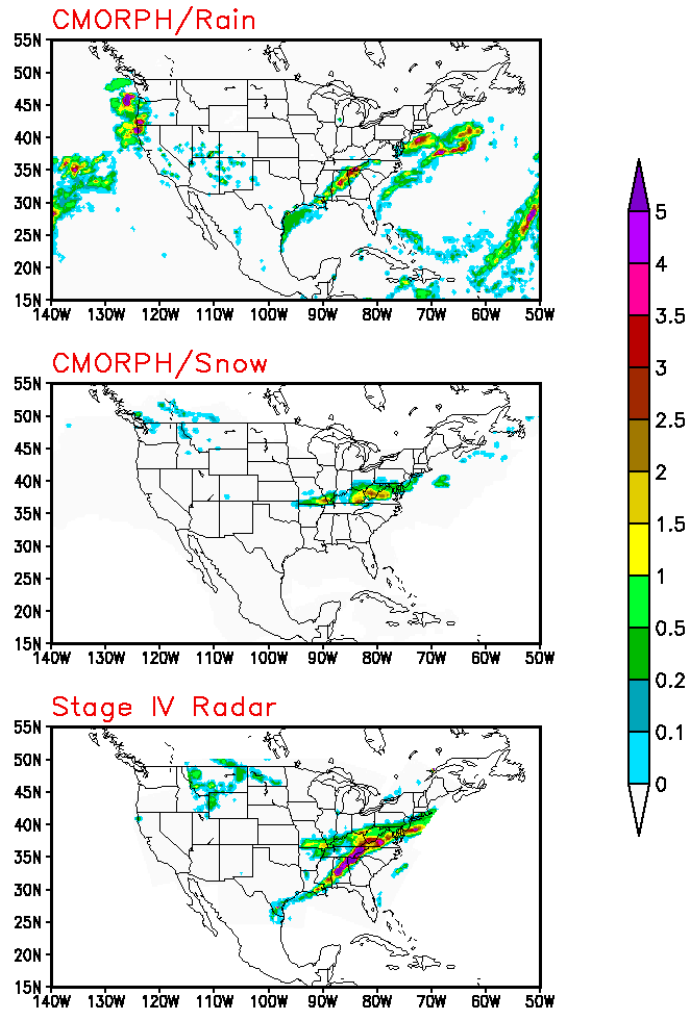




# 2nd Generation CMORPH

## [3] Improved SFR and Strong Convection Representation

2014-03-03 10:00-11:00UTC



# Summary

- We appreciate it very much JPSS support to our CMORPH development work!
- Synthesizing information from different sources is demonstrated an effective mean to construct high-quality, high resolution precipitation estimates
- CMORPH has a track record of leading the world in the technology development and operational production
  - *The NASA/GPM IMERG core algorithm (integration part) is adopted from CMORPH through code migration*
  - *The Japanese GSMaP is a variation of the CMORPH algorithm*
  - *The full-resolution IR created at CPC and used as input to the CMORPH is also used by IMERG and other global satellite precip products;*
  - *The MWCOMB, inter-calibrated PMW maps, is also used by several other precip products*
- **WE ARE THE FIRST TO PRODUCE BLENDED PRECIP ESTIMATES POLE TO POLE!**