Recent Progress on the 2nd Generation CMORPH

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1. Background and Objective

- Prototype system developed for the 2nd generation CMORPH
  - *Xie and Joyce (2014)*
  - *0.05°lat/lon grid covering the globe from pole to pole*
  - *Rainfall as well snowfall*
  - *30-min interval updated at a reduced latency*
- Objective of this work
  - *To refine the system piece by piece for improved quantitative accuracy and computational efficiency*

2. 2nd Generation CMORPH Flow Chart

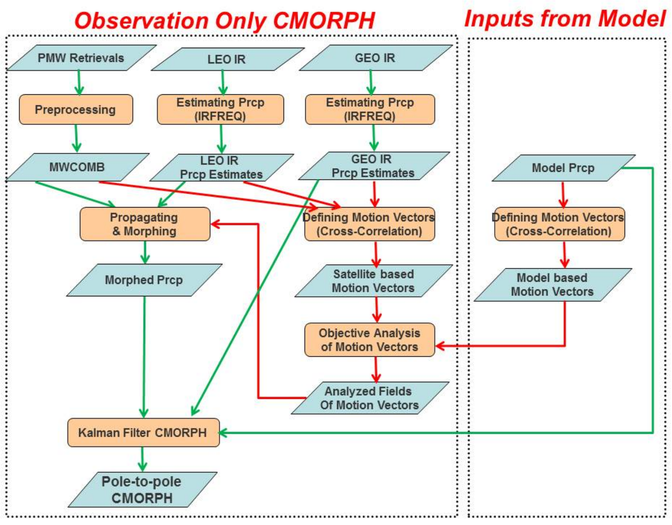

Fig.1: 2nd generation CMORPH flow chart.

- INPUT Precipitation
  - *PMW L2 from multiple satellites inter-calibrated to form MWCOMB*
  - *GEO/LEO-IR based precip estimates derived through calibration against MWCOMB and CloudSat radar precipitation*
  - *CFSR precip fields provide useful info over mid and hi-latitudes*
- Precipitation motion vectors
  - *First: separate vector data sets computed each from satellite and CFSR precip data*
  - *Satellite and CFSR based vectors blended through 2D-VAR*
- Integration Framework
  - *Kalman Filter based algorithm*

Targets of this work

- *IR-based precip estimates*
- *Sub-system to define motion vectors*

3. GEO IR Precipitation Estimates

- Modifying the IRFREQ for post-process
  - *Still based on PDF matching against MWCOMB*
  - *TBB – precip relationship established for each 1°lat /lon grid using data over a 7-hour window centering at the target hour and over a 15-day period ending at the target date*

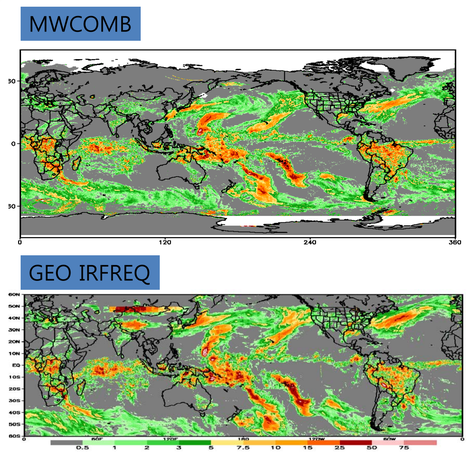

Fig.2: March 1-5, 2014 mean precipitation (mm/hr) derived from MWCOMB (top) and GEO IR based estimates (bottom).

- Modifying the IRFREQ for Real-Time
  - *Problem*

    PDF matching using data up to a day ago can not capture the rapidly evolving TBB – precip relationship sometimes
  - *Bottleneck*

    MWCOMB is available several hours later and therefore can not be used to update TBB – precip relationship in real-time processing
  - *Solution*

    Using 2 hour delay near real time QMORPH for recent hours when MWCOMB is not available

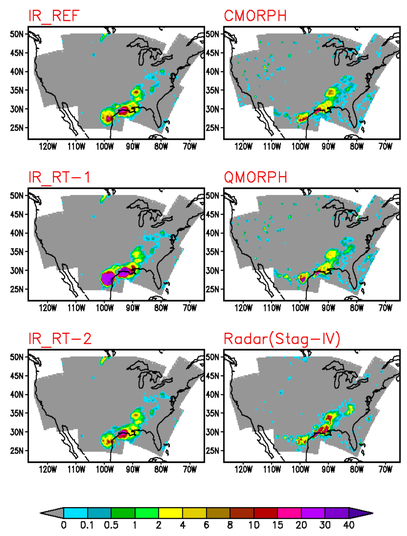

Fig. 3: Hourly precipitation (mm) for 14UTC, 18 July 2014, derived from (left, top) post-processed IRFREQ , (left, middle) IRFREQ based on PDF tables established using data over a 15-day period ending the day before the target date, (left, bottom) IRFREQ based on PDF tables using MWCOMB over the 15-day period and QMORPH for recent hours, (right, top) CMORPH, (right, middle) QMORPH, and (right, bottom) STAGE IV radar estimates.

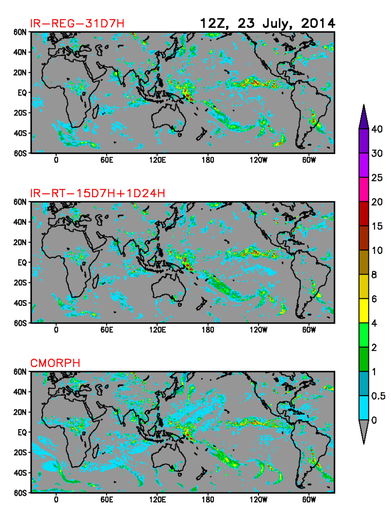

Fig.4: 30-min precipitation (mm/hr) For 12UTC, 23 July 2014, from the post-process version IRFREQ (top), real-time version IRFREQ (middle), and CMORPH (bottom).

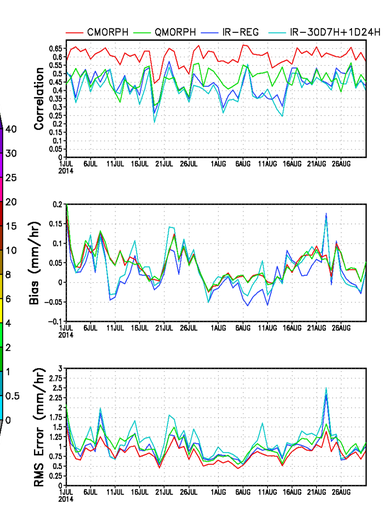

Fig.5: Performance statistics for the CMORPH (red), QMORPH green), post-process version IRFREQ (blue), and real-time version IRFREQ (light blue), Compared against STAGE-IV radar over CONUS.

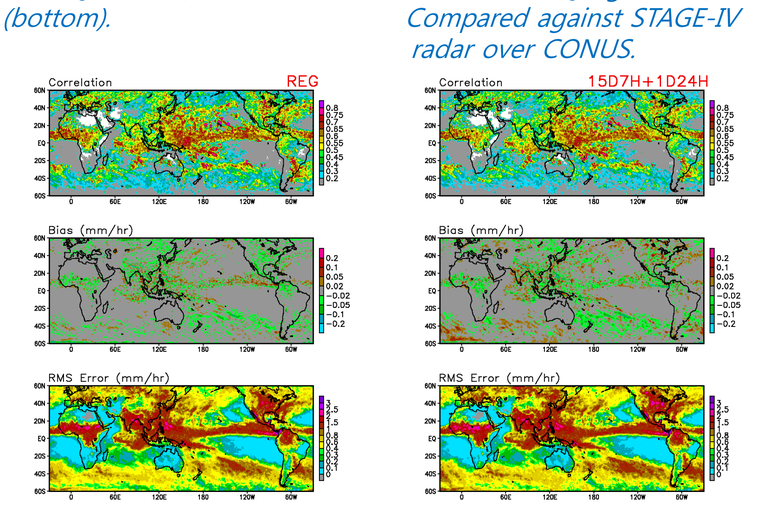

Fig.6: Performance statistics for 30-min precipitation estimates of the post-process (left) and real-time version (right) IRFREQ, compared against the MWCOMB for July and August 2014.

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- ***Both the post-process and real-time versions of the IRFREQ show reasonable skills***

References

Xie, P., and R.J Joyce, 2014: Integrating Information from Satellite Observations and Numerical Models for Improved Global Precipitation Analyses: Exploring for an Optimal Strategy. In "Remote Sensing of the Terrestrial Water Cycle", AGU Geophysical Monograph, Vol. ***206****, 43-59.*

4. LEO IR Precipitation Estimates

- Methodology

  a) Extending the MWCOMB to the entire globe

  b) PDF calibration of AVHRR TBB against MWCOMB

  c) Constructing maps of CloudSat based precipitation retrievals

  d) PDF calibration of AVHRR TBB against CloudSat Precip

  e) Final AVHRR TBB based precipitation fields are a weighted mean of the MWCOMB and CloudSat calibrated estimates, with the MWCOMB and CloudSat dominating the weights over tropics and high latitudes, respectively.
- Results

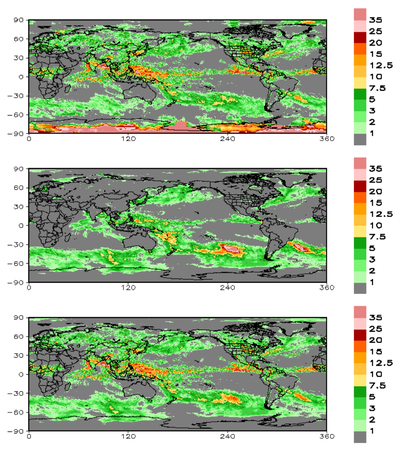

Fig. 7: AVHRR TBB based precipitation estimates (mm/day) for 1-15 July 2009, derived through (top) calibration against MWCOMB, (middle) calibration against CloudSat, and (bottom) combination of the above mentioned estimates.

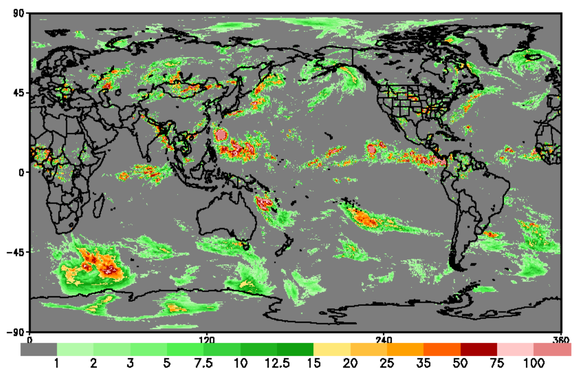

Fig. 8: AVHRR TBB based IRFREQ precipitation estimates (mm/day) for 5 August, 2009, derived through combining calibrations against the MWCOMB and the CloudSat retrievals.

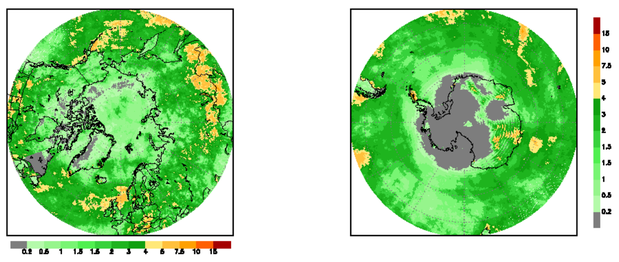

Fig. 9: AVHRR TBB based IRFREQ precipitation estimates (mm/day) over the north (left) and south (right) polar caps, averaged for July and August of 2009.

5. Precipitation Motion Vectors

- Methodology

  Deriving vectors from individual sources (CFSR hourly precip; GEO IR precip estimates) then combining them through 2DVAR
- Target of this round

  Improve computational efficiency

  Optimize analysis parameters
- Sample results

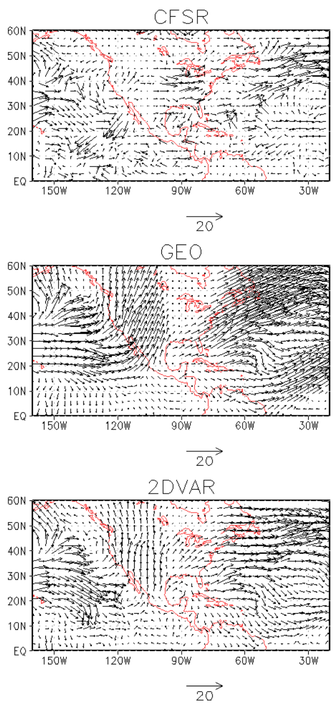

Fig.10: Precipitation motion vectors for 00:00UTC,1 March, 2014, derived from (top) CFSR hourly precipitation fields, (middle) GEO IR estimates; and (bottom) the combination of the two through 2D-VAR.