Recent Progress on the Second Generation CMORPH

Pingping Xie[1], Robert Joyce[1,2], and Shaorong Wu[1,2]

[1] NOAA/NCEP/Climate Prediction Center; [2] INNOVIM, LLC

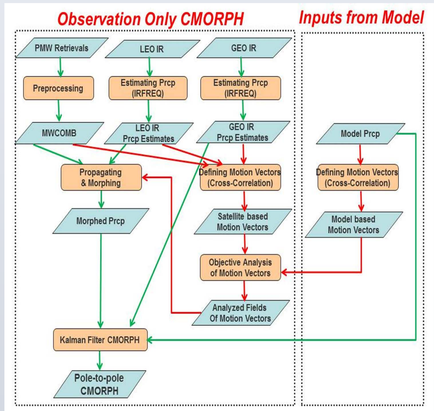
Background and Objective

- ❑ Conceptual model developed for the 2nd generation CMORPH
  - 0.05º lat/lon grid covering the globe from pole to pole
  - Snowfall as well as rainfall
  - 30-min interval updated at a reduced latency
- ❑ Objective of this work

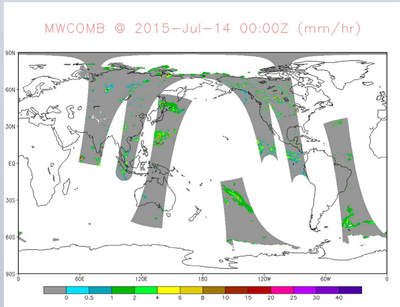
  To construct and refine the operational processing system
  - Refining technical components (IR-based precipitation estimates and cloud motion vectors)
  - Optimizing the system for improved quantitative accuracy and computational efficiency

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
  - GFS precip fields provide useful info over mid and hi-latitudes
- ❑ Precipitation motion vectors
  - First vectors computed separately from satellite and GFS precip data
  - Satellite and GFS based vectors blended through 2D-VAR
- ❑ Integration framework
  - Kalman filter based algorithm

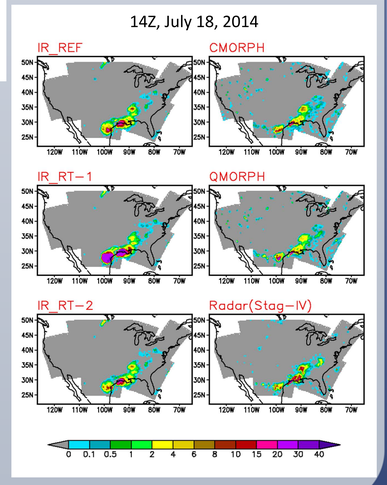


Inputs



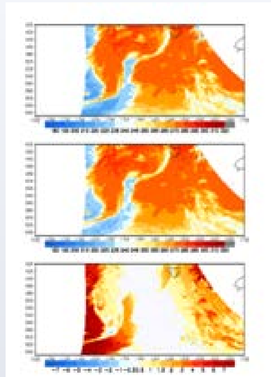
Pole-to-pole MWCOMB for a 30-min slot beginning from 00:00Z, July 14, 2015

- ❑ PMW precipitation retrievals
  - Extend the PMW coverage from 60ºS-60ºN in the first generation to 90ºS-90ºN in the second generation
  - Constructing MWCOMB PDF calibration of PMW retrievals from individual sensors against a common reference (TMI for now)

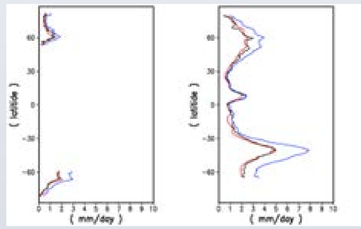


- ❑ GEO IR based precipitation estimates
  - Based on the IRFREQ technique PDF calibration against MWCOMB
  - Modification to better capture the rapidly changing TBB-precip relationship Taking advantage of the QMORPH for recent hours

- ❑ LEO IR based precipitation estimates
  - Limb correction needs to be applied to the AVHRR IRTB to remove the effects of limb darkening (cooling) caused by satellite viewing geometry
  - We developed a method to correct the IRTB limb effects through PDF matching
  - PDF tables of the IRTB at various viewing angles are matched against those for the IRTB at nadir using historical data
  - Correction is performed using PDF tables constructed for different viewing angles, seasons, latitudes, and surface types

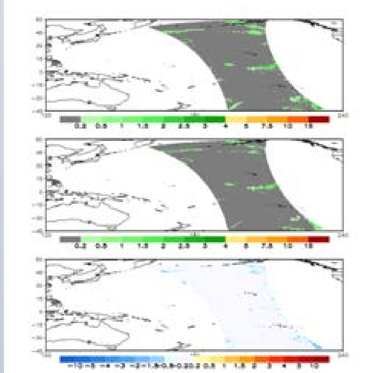


An example of instantaneous uncorrected (top), corrected AVHRR IRTB (middle), and their differences (bottom) for NOAA-18



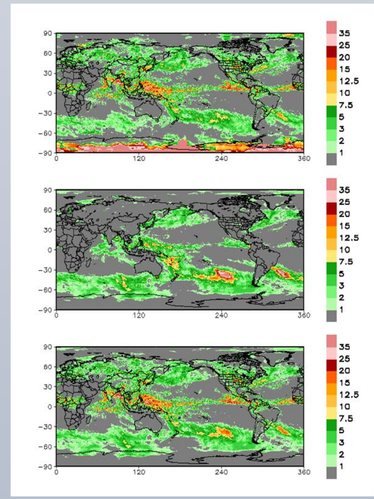
Latitudinal profiles of 2007-2008 JJA zonal mean precipitation derived from CloudSat radar (black), estimates based on uncorrected IRTB (blue), and corrected IRTB (red) over snow and sea ice cover (left) and over ocean (right)

- Precipitation estimates are generated from IRTB through PDF matching against CloudSat radar and MWCOMB
- Limb correction greatly improves the IRTB and removes the wet bias in the IRTB based precipitation estimates



Sample precipitation estimates for 00:30Z, July 01, 2007, derived from uncorrected (top), corrected IRTB (middle), and the differences between them (bottom)

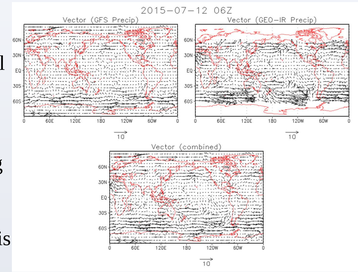
- Combining IRTB precipitation estimates based on calibration against the CloudSat and MWCOMB yield improved quality over various places of the globe
- Precipitation estimates over mid and hi-latitudes improved substantially through calibrating against CloudSat retrievals



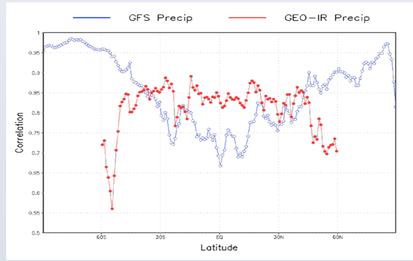
AVHRR based precipitation estimates for July 01-15, 2009, derived using calibration against MWCOMB (top), CloudSat (middle), and their combination (bottom)

Precipitation Motion Vectors

- ❑ How
  - Derive motion vectors through comparing the precipitation patterns in two consecutive global fields through the so-called cross-correlation technique
  - First derive the cloud motion vectors from individual global precipitation fields, including GEO IR based estimates, GFS forecast et al.
  - Combine the motion vectors derived from individual sources through an objective analysis technique (2D-VAR)



Sample global field of motion vectors (top-left: vectors from model precip, top-right: vectors from GEO-IR precip, bottom: combined vectors)

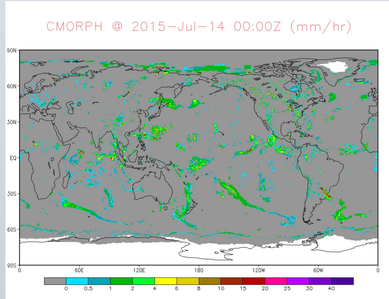


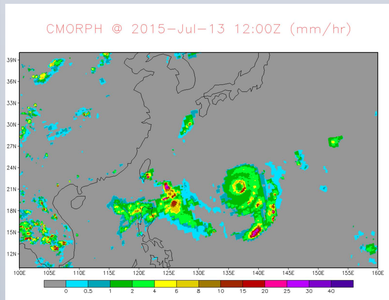
Correlation between precipitation fields propagated from the previous time step and simulated/estimated fields, using motion vectors derived from model (blue) and GEO-IR (red) precipitation fields

- ❑ What are new
  - Covering the entire globe
  - Defined on 0.25º lat/lon resolution instead of 2.5º lat/lon
  - 2D-VAR utilized to optimize the combined motion vector fields
  - HUGE amount of computation (need to refine the implementation to ensure computational efficiency)

The 2nd Generation CMORPH

- ❑ System test run
  - Pole-to-pole CMORPH for 00:00Z, July 14, 2015
  - South polar region set to missing, waiting for inputs from LEO IR based precipitation estimates





- ❑ Typhoon
  - With motion vectors defined on a much finer resolution (0.25º lat/lon), the rotational component of the precipitation movements is much better captured

Summary

- ❑ Component algorithms refined for improved accuracy and computational efficiency
- ❑ A prototype processing system is being constructed to produce the second generation CMORPH on an operational mode
- ❑ New components being added into the system:
  - LEO IR based precipitation estimates to fill in gaps over high latitudes
  - Vectors derived from MWCOMB/LEO-IR precip
  - Snowfall rate retrievals
- ❑ More work is needed to further refine the algorithms and their implementations as new problems/issues emerge in the test run

Acknowledgements

- ❑ NOAA/OAR Climate Program Office (CPO)
- ❑ NOAA/NESDIS JPSS Risk Reduction Program
- ❑ NOAA HMT Program

RESEARCH POSTER PRESENTATION DESIGN © 2015
www.PosterPresentations.com