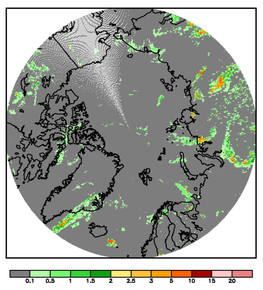
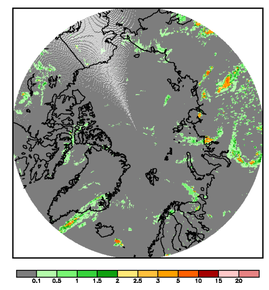


CMORPH Extended Pole to Pole: Preliminary Tests for Summer

Pingping Xie and Robert Joyce

NOAA Climate Prediction Center

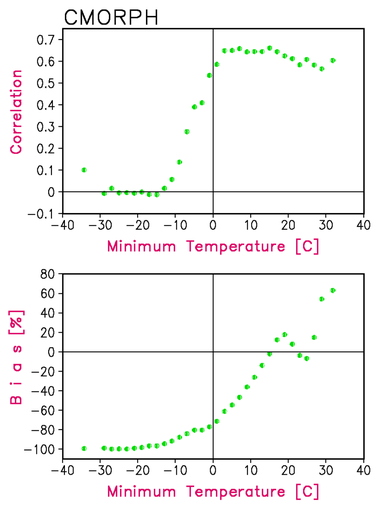


1. Current CMORPH Algorithm

- IR images from geostationary satellites to derive motion vectors of cold clouds
- L2 retrievals of instantaneous precipitation rates from PMW observations from all low earth orbit satellites
- Propagate the PMW retrievals from their respective observation times to the target analysis time
- Products
  - 8kmx8km over the globe (90°S-90°N)
  - From Jan.1, 1998 to the present
  - Updated on a real-time basis

2. Restrictions and Shortcomings

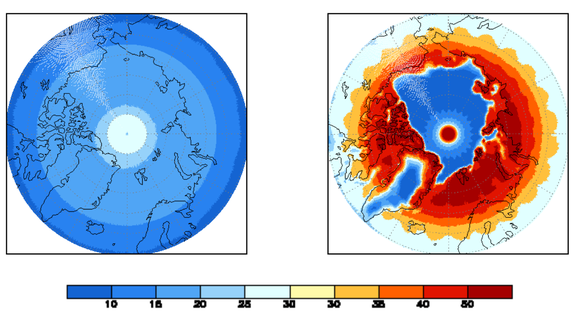
- Poor quality over mid-latitudes and during cold seasons
  - CMORPH performance as a function of surface air temperature
- Covers only 60°S-60°N
  - Use of GEO/IR to derive motion vectors
  - Coverage of PMW retrievals over high latitudes



3. Key Challenges for the Polarward Extension

- Source information for mid- and hi-latitude PRECIPITATION (rainfall + snowfall)
  - PMW: *How good are they?*
  - IR: *Something is better than nothing?*
  - Model / Reanalysis: *Are they good enough?*
- Motion vectors over high latitudes
  - Derive motion vectors over regions with no GEO IR data
  - *Is it possible to derive the vectors from PMW/IR/ Model precipitation fields?*
  - Smooth transition from tropics, subtropics and mid-, and hi-latitudes

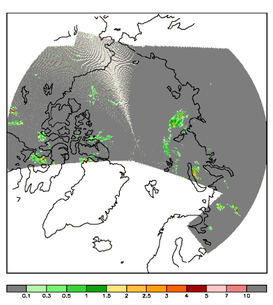
4. Spatial Coverage of Satellite Observations



- Percentage of 30-minute time slots covered; a) (left) by AVHRR IR observations from a single satellite (NOAA-18); and b) (right) by PMW observations from all eight LEO satellites over a two-month period from July 1 to August 31, 2009.
- PMW data are insufficient even during summer time , we will need sampling from IR observations aboard LEO platforms

5. Performance of Precipitation Estimates from LEO/IR

Satellite Estimates	Land	Ocean
PMW retrievals from NOAA 18	0.380	0.353
IR-based estimates from NOAA 18	0.227	0.318



- Precipitation estimates derived from LEO IR perform reasonably well over high latitudes at least during warm seasons
- IR-based precipitation estimates provide useful information over high-latitude

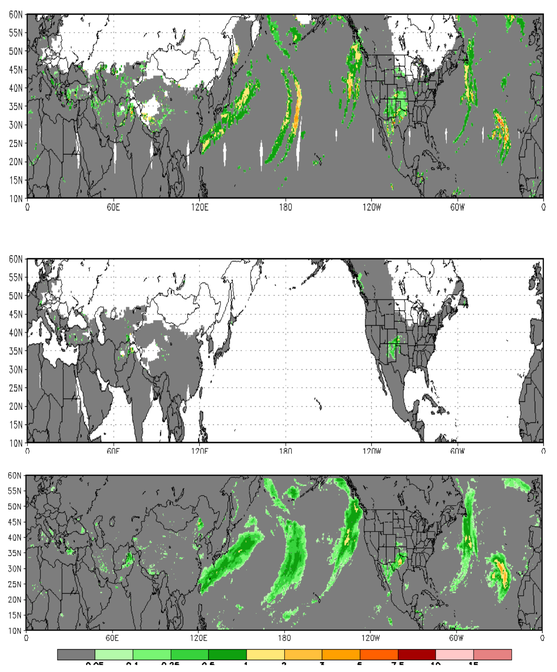
6. Early Results from NESDIS PMW Snowfall Retrievals

Jan.28, 2010

N18 MHS Rain

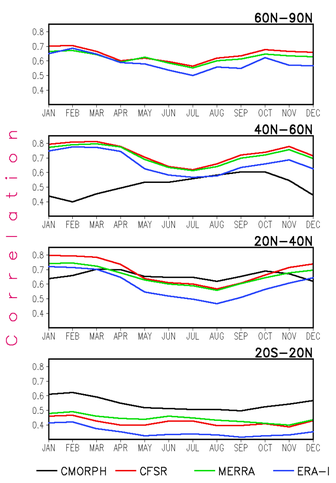
N18 MHS Snow

Current CMORPH



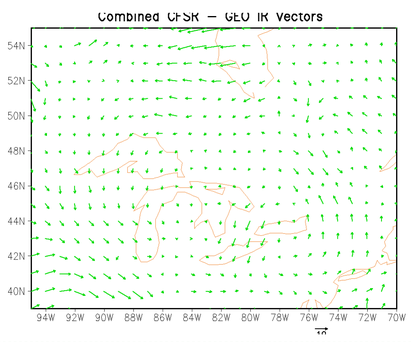
7. Performance of the New Hi-Resolution Reanalyses

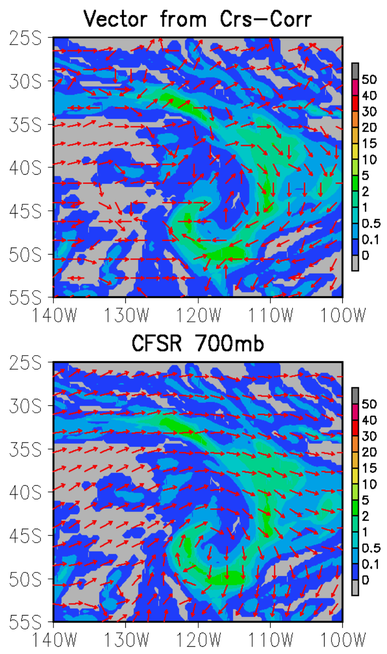
- Three sets of global reanalysis at high-resolution
  - CFSR
  - MERRA
  - ERA-I
- Compared against daily gauge analysis for a 12-year period from 1998 to 2009
- CMORPH out-performs the reanalysis in capturing precipitation over tropics and during warm seasons over sub-tropics
- Reanalysis precipitation fields perform very well over mid- and hi-latitudes and over cold seasons over sub-tropics



8. Defining Cloud Motion Vectors over High latitude

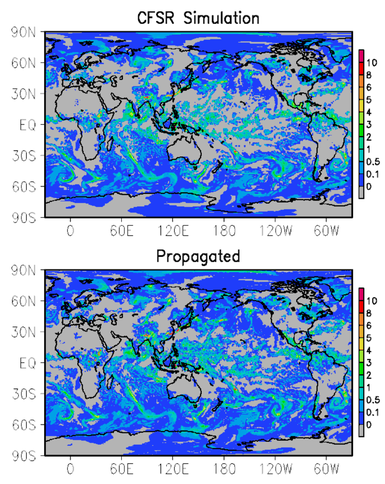
- Defining motion vectors through computing cross-correlation between precipitation fields at two cl ose time steps
- Motion vectors can be derived from PMW/IR based precipitation fields only over part of the grid boxes with consecutive coverage;
- Cloud motion vectors derived from CFSR hourly precipitation fields present reasonable quality





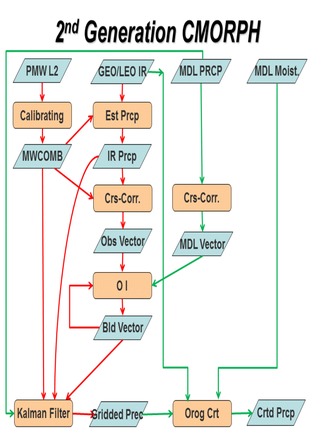
9. Constructing a Global Field of Precipitating Cloud Motion Vectors

- Satellite-based vectors
  - GEO-IR derived precipitation fields (60°S-60°N)
  - LEO-IR based precipitation estimates (global)
  - PMW based precipitation estimates (global)
- CFSR-based vectors
  - Derived from CFSR hourly precipitation fields
- A global analysis of precipitating cloud motion vectors through blending information from satellite observations and CFSR
  - 2D-OI
  - CFSR vectors as first guess
  - Satellite-based vectors as observations



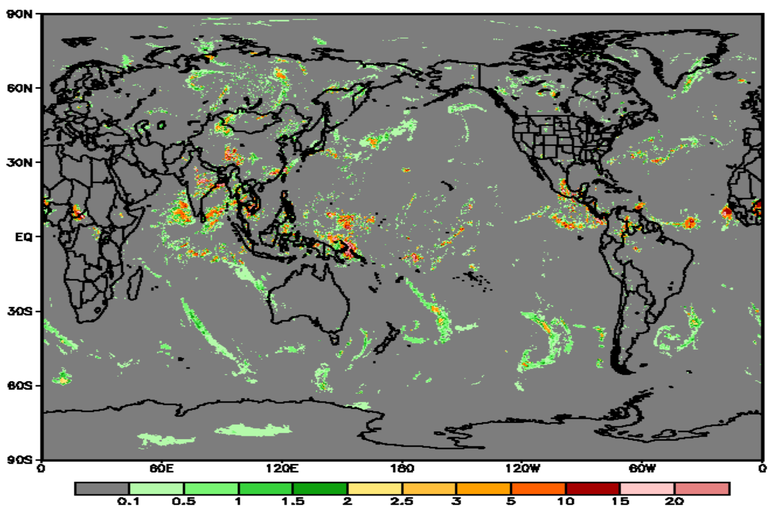
10. Flowchart for the 2nd Generation

- InputT Precipitation
  - PMW L2
  - GEO/LEO IR-based estimates
  - (optional) CFSR
- Cloud motion vectors
  - Cross-correlation from GEO/LEO IR based precipitation
  - Cross-correlation from CFSR (optional)
  - Blended analysis through OI
- Integration Framework
  - Kalman Filter based algorithm
- Other components
  - Orographic effects



11. Preliminary Results

10:00Z, July 1, 2009



- Cloud motion vectors based on CFSR and GEO IR only
- Forward propagation of PMW and AVHRR precipitation

12. Summary

- Potential inputs examined for the definition of precipitation estimates and cloud motion vectors
- Algorithm strategy designed for the construction of the pole-to-pole global CMORPH
- Test algorithm being developed to examine the feasibility of the designed strategy for summer 2009
- Preliminary results are very encouraging