Reprocessed and Bias-Corrected CMORPH Global High-Resolution Precipitation Estimates for Weather, Climate, and Hydrometeorological Applications

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Background and Objectives

- CMORPH started real-time operations from December 2002
  - Many changes in algorithms & inputs
  - Discontinuities
  - No bias correction

- Reprocessing performed and bias correction implemented for CMORPH for the entire TRMM/GPM era from January 1998

- Introduce the 17-year high-resolution global precipitation data set and illustrate its applications
CMORPH Reprocessing

1) Algorithm and inputs

**Algorithm**
- CMORPH algorithm as of 2009
- No KF enhancements

**Inputs**
- PMW L2 retrievals (GPROF 2004)
- CPC Geo sat IR at 4km (Janowiak et al. 1999)
- NESDIS daily snow maps

Current Generation CMORPH

- PMW Retrievals
  - Preprocessing (Decoding, QC, Mapping, Calibrating)
  - MWCOMB
  - Propagation & Morphing
  - CMORPH

- GEO IR
  - Defining Motion Vectors (Cross-Correlation)
  - Motion Vectors
CMORPH Reprocessing

2) Products

- 8km x 8km / 60°S-60°N
- 30-min interval / January 1998 to the present

CMORPH 3-hourly Precip for 1998. 2. 1. 0Z
CMORPH Bias Correction

1) Bias in the raw CMORPH

Regionally different
Temporally changing
  • Seasonal
  • Year-to-year variations
  • Sub-monthly components
Non-linear function of precip intensity
CMORPH Bias Correction

2) Strategy

• Over Land
  – PDF matching against daily gauge analysis
    – PDF tables established as a function of region and season
    – Bias correction performed in two steps using PDF tables
      based on historical and real-time data, respectively

• Over Ocean
  – Calibration against a long-term record
    (pentad GPCP) with stable quality but
    coarser resolution (2.5°lat/lon, 5-day)
CMORPH Bias Correction

3) Results over land

Comparison with daily gauge (1998-2012)

2000-2009 Annual Mean
CMORPH Bias Correction

4) Results over land

60S–60N
Applications

1) 6-hourly Precipitation in CMORPH and Reanalyses

- Examining 6-hly precip from CFSR, MERRA and ERA-I
- The three reanalyses capture large-scale structure quite well
- Under-/over-estimate strong/weak precipitation
- Raining area too wider
- CFSR closer to observations
Applications

2) Seasonal mean precipitation

- JJA Mean for 1998 – 2010
- Spatial pattern of precipitation, especially that associated with topography, well reproduced by the reanalyses
- Larger oceanic precipitation in CFSR and ERA-I
- Weaker precipitation over mid-latitude compared to the CMORPH
- Heavier rainfall over Maritime-continent
Applications

3) Diurnal variations of JJA precipitation

- Standard deviation of 24 hourly means for 1998-2010 (mm/day)
- Diurnal amplitude in CFSR is very similar to that in the observations but presents smaller / larger over ocean, extra-tropical land / tropical land
- Diurnal amplitude in MERRA is generally smaller than that in the observations over tropics and extra-tropics in northern hemisphere and is almost diminished over extra-tropics in southern hemisphere
Applications

4) Diurnal Cycle over Selected Regions

- Peak in the reanalyses comes earlier
- Amplitude in the reanalyses is larger / smaller over tropical land / ocean
Combining Bias-Crtd CMORPH with Gauge

1) Strategy

• Combining the bias-corrected CMORPH with gauge observations through the Optimal Interpolation (OI)

• Bias-corrected CMORPH as the first guess

• CPC gauge data used as observations to update/refine the first guess

• Xie and Xiong (2011)
Combining Bias-Crted CMORPH with Gauge

2. Example for January (left) & July (right), 2010
Summary

• Three sets of gauge-satellite precipitation analyses
  • Reprocessed, Bias-corrected Satellite Estimates
    • Global
    • 8kmx8km; 30-min
    • 1998 to the present
  • Gauge-satellite combined analyses
    • Global (?) / Regional
    • 0.25°lat/lon; daily
    • 1998 to the present
• ftp.cpc.ncep.noaa.gov/precip/CMORPH_V1.0
• 2nd generation CMORPH under development / tests (details in talk 9.6 by Joyce and Xie)