Gauge-CMORPH Blended Analysis: A Long-Term Record of High-Resolution Daily Precipitation over the Global Land from 1998

Pingping Xie1 and Shaorong Wu1,2
1 NOAA/NCEP/Climate Prediction Center; 2 INNOVIM, LLC

Objective
To construct an analysis of daily precipitation over the global land with improved quality through blending gauge data with CMORPH satellite estimates
- 0.25° lat/lon over the global land from 90°S to 90°N
- Daily resolution from January 1, 1998 to the present

Inputs
(1) General description
- Gauge data
  - CPC Unified Gauge Analysis (CUGA) of daily precipitation (Xie et al. 2010)
  - CMORPH satellite estimates
- Sample blending processes
  - 30-minute interval from January 1, 1998
- Quality is good over regions with dense gauge network but less than reasonable over places of poor station coverages
- Daily gauge reports collected from different countries are basically for a 24-hourly period ending at 12Z of the stamped date
- This map shows the daily precipitation End of a Day (EOD) time in UT
- Sparse gauge coverage over equatorial Africa, Amazon and majority of Asia
- Detailed precipitation distribution over regions of dense gauge networks, while unreliable analysis over equatorial Africa

(2) CPC daily gauge analysis – 1
- Sample gauge analysis for July 1, 2003
  - Dense gauge networks over CONUS, western Europe, eastern and western Australia and South Africa
  - Sparse gauge network over regions of sparse gauge network

(3) Definition of a day over different regions
- Daily gauge analysis over tropical and subtropical land is defined by combining information from gauge and satellite data, exhibiting quite reasonable quality over most places
- Over high latitudes is derived from gauge observations only, showing smooth distribution patterns due to lack of satellite data over regions of high station density to quantify their error
- Analysis over high latitudes
- Analysis over high latitudes is defined by combining information from
- Smooth transition across latitude bands across 60°N even when large precipitation is observed over both sides

(4) CPC daily gauge analysis - 2
- Gauge analysis error is quantified as a function of precipitation intensity and local gauge network density through simulation experiments using data from a very dense network over Korea (Xie and Xiong 2011)
- Error variance of the gauge analysis linearly proportional to the precipitation intensity and inversely proportional to the local gauge network density measured by the Number of Equivalent Gauges (Neg)
- An empirical relation established between the error variance and the precipitation and the Neg:
  \[ E^2 = \frac{a+b R}{Neg+1} \]
  \[ A=0.15 \text{(mm/day)}^2 \]
  \[ B=4.09 \text{(mm/day)}^2 \]
- The two inputs are combined through the optimal interpolation (OI) with the bias-corrected CMORPH as the first guess and the gauge data as the observations to refine the precipitation amount

Blending Algorithm
(1) General description
- Analysis over tropical and sub-tropical land
  - Over latitude band 60°S to 60°N where/where both the gauge analysis and the CMORPH satellite estimates are available
- The Blended analysis is updated on a quasi real-time basis at NOAA Climate Prediction Center
- The blended analysis combines the strength of the quantitative accuracy of gauge data with the quasi complete spatial coverage of bias-corrected CMORPH and compared to the ‘truth’ at the grid box over Seoul, Korea
- The blended analysis has been constructed on a 0.25° lat/lon grid over the global land for a 19-year period from 1998 to the present
- The blended analysis improves the correlation especially over regions of sparse gauge network
- Analysis over tropics well depicted by the blended analysis
- The blended analysis is updated on a quasi real-time basis at NOAA Climate Prediction Center

Resulting Blended Analysis
(1) Example for January, 2010
- Analysis over tropical and sub-tropical land is defined by combining information from gauge and satellite data, exhibiting quite reasonable quality over most places
- Analysis over high latitudes
- Analysis over high latitudes is defined by combining information from
- Smooth transition across latitude bands across 60°N even when large precipitation is observed over both sides

Summary
- A gauge-satellite blended analysis of daily precipitation has been constructed on a 0.25° lat/lon grid over the global land for a 19-year period from 1998 to the present
- The blended analysis combines the strength of the quantitative accuracy of gauge data with the quasi complete spatial coverage of bias-corrected CMORPH and compared to the ‘truth’ at the grid box over Seoul, Korea
- The blended analysis is updated on a quasi real-time basis at NOAA Climate Prediction Center
- Please contact the authors for data availability

1 pingping.xie@noaa.gov
2 shaorong.wu@noaa.gov