Evaluation of TRMM Products Using a Gauge-Based Gridded Daily Precipitation over China

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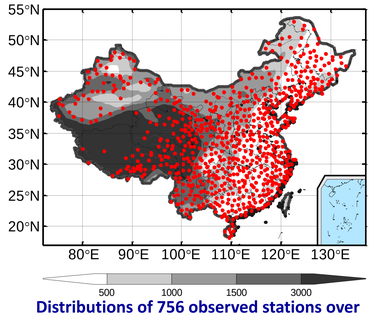
Objective

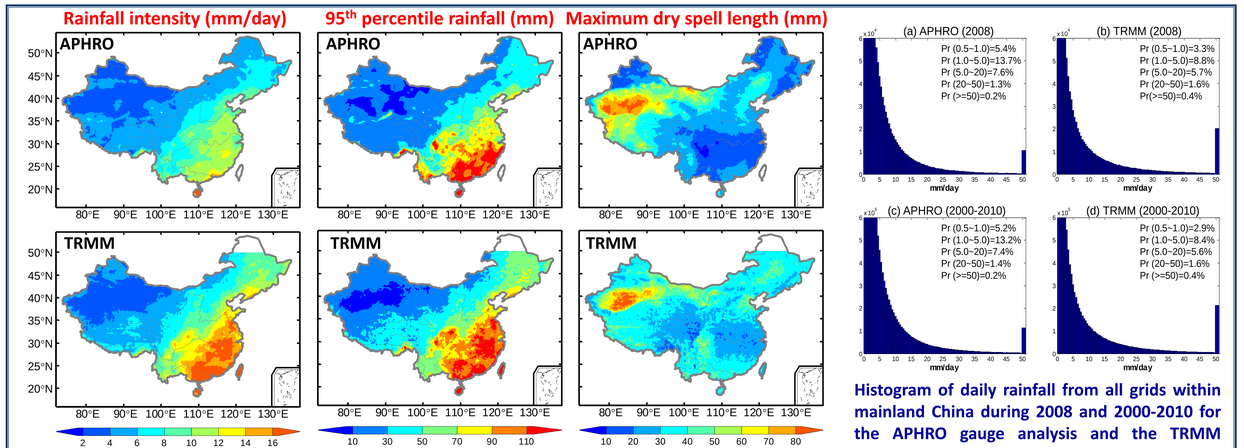
Accurately determining of spatial and temporal distribution of precipitation is crucial to detect the effect of climate change on water resource and hydrological cycle. Therefore, application of high-resolution gridded analysis of precipitation data based on high quality rain gauge based observations, satellite and radar estimation, climate model and etc. are efficient tools. In this study, the Tropical Rainfall Measuring Mission (TRMM), a joint mission between NASA and the Japan Aerospace Exploration Agency (JAXA), merged high quality (HQ)/infrared (IR) precipitation products using algorithm 3B-42 (TRMM 3B42) was evaluated using a new gauge-based gridded analysis of daily precipitation over China, which is important for the intelligent utilization of the TRMM product over East Asia monsoon region.

Method

- **A daily precipitation about 756 Chinese stations during the period 1951-2009 was compiled by the National Meteorological Information Center (NMIC) of China Meteorological Administration (CMA);**
- **The daily observations has undergone a series of robust quality control (QC) and were constructed high-resolution grid analysis datasets (0.25 latitude-longitude grid) using the APHRO system (APHRO_V0908) developed by Yatagai, et al. 2009. The crossing test show that the APHRO system has a good performance for constructing high-resolution grid analysis of daily precipitation**

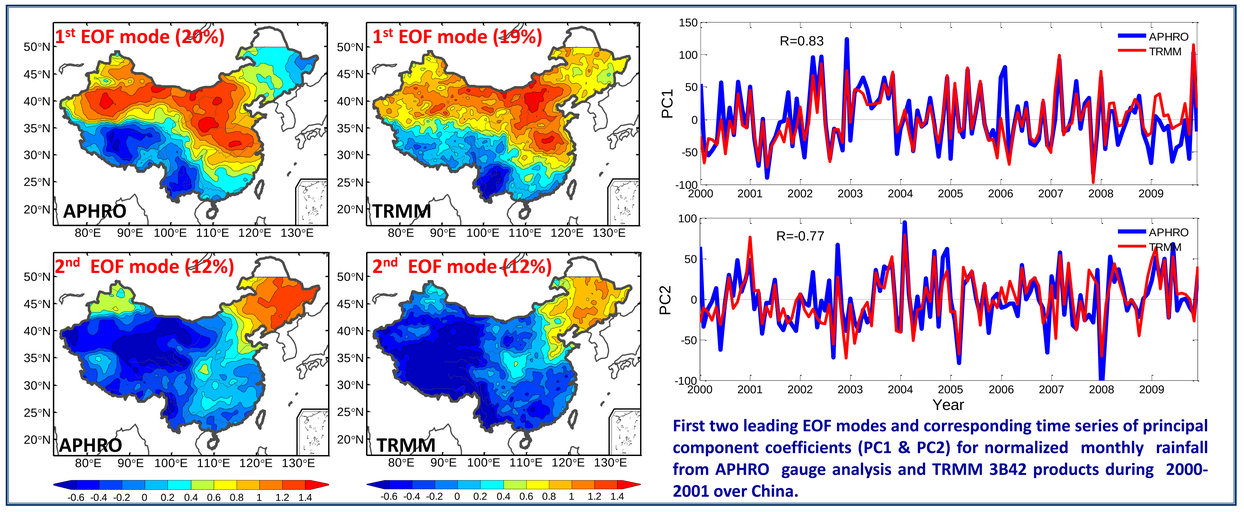


Distributions of 756 observed stations over China with topography (m)

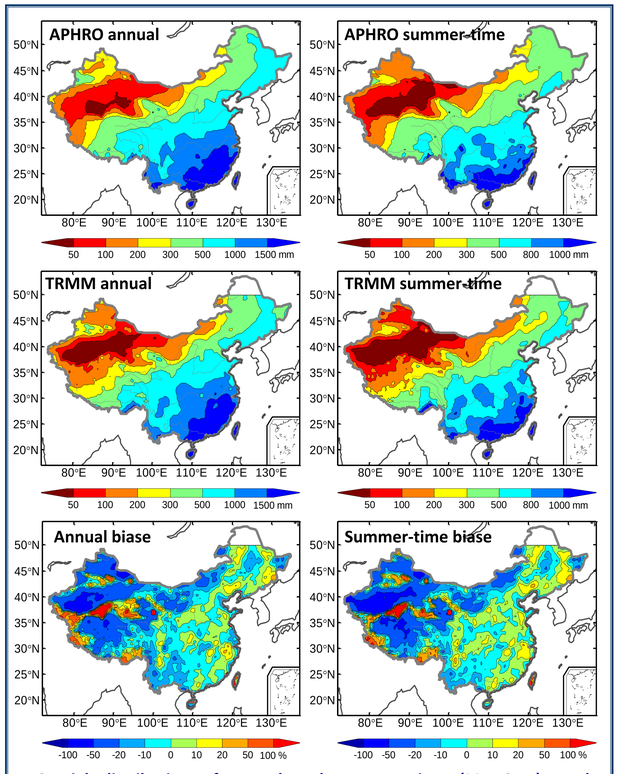


Rainfall density (mm/day), 99th percentile rainfall (mm) and the maximum dry spell length (day) averaged from 2000 to 2010 for the APHRO gauge analysis and TRMM products.

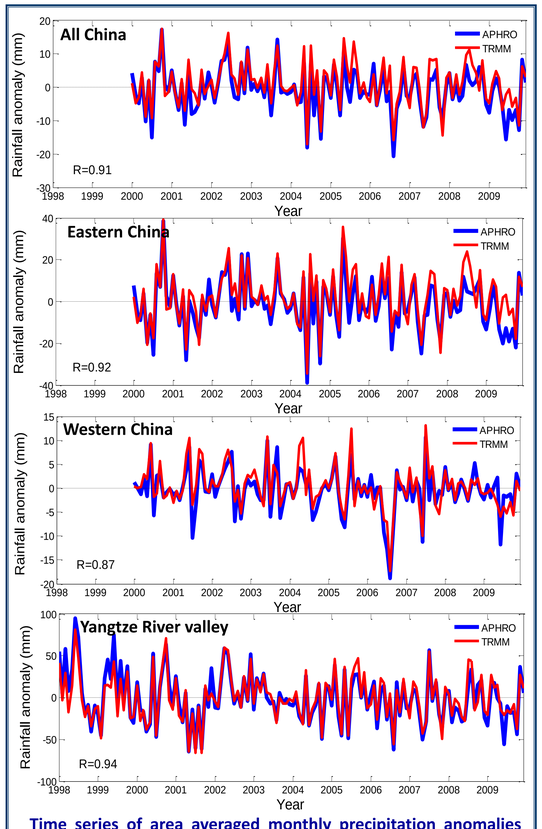
Histogram of daily rainfall from all grids within mainland China during 2008 and 2000-2010 for the APHRO gauge analysis and the TRMM product. The precipitation rate (Pr) is binned at 0.5 mm/day interval and defined as five classes.



First two leading EOF modes and corresponding time series of principal component coefficients (PC1 & PC2) for normalized monthly rainfall from APHRO gauge analysis and TRMM 3B42 products during 2000-2001 over China.



Spatial distribution of annual and summer time (May-Sep.) total precipitation (mm) averaged from 2000 to 2009 from APHRO gauge analysis and TRMM 3B42 product over China, and the percentage biase ((TRMM-APHRO)/APHRO*100%) between them. The correlated coefficients of annual and summer-time patterns between them can approach 0.98 and 0.96, respectively.



Time series of area averaged monthly precipitation anomalies (mm) from APHRO gauge analysis and TRMM product over all China, eastern China (east of 105ºE), western China (west of 105 ºE), and the Yangtze River valley (27-34ºN, east of 110ºE).

Results and conclusions

➢Through an inter-comparison between the gauge grid analysis and the TRMM product, the result indicates that the TRMM product has a good ability to describe the observed precipitation spatial climatology and seasonal and annual variations, and the observed variability and trends for most areas of over China, especially to well describe the evolution of the summer-time rainfall belt in the Yangtze River valley. The differences between them are no more than 20% over the most areas of east China, but the TRMM product is less than the observed analysis about 20%~50% for the most western China, particularly in the Xinjiang province and the Tibetan Plateau.

➢ the TRMM product shows a good performance to depict the main features of the evolution of observed daily rainfall belt during the summer-time over the Yangtze River valley. The TRMM product can certainly capture the observed rainfall signals on a synoptic scale and sub-synoptic scale, but has a limitation to accurately display the rainfall magnitude and the exact day the rainfall happened.

➢This satellite-based precipitation estimates produces a little more the heavy and extreme rainfall for the most of southeastern China but makes underestimations for the light and moderate-light rainfall over the most of northwestern China. Consequently, the TRMM product would be cautioned to use as reference data to monitor the drought over arid and semi-arid areas and the extreme rainfall for the most eastern China, especially in southeastern China.

➢An Empirical Orthogonal Function (EOF) analysis shows that the TRMM products has a good ability to depict the temporal-spatial evolution of the observed rainfall for most areas of China, especially for the eastern China.