Evaluation of biasness in satellite rainfall estimates

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Abstract

A general approach towards rainfall measurement is in-situ rain gauges. The rain gauges provide point data on field that used to calculate areal average rainfall in a watershed and serve as a major input to drive the hydrologic model. However, in-situ rain gauges need to be installed at ample locations to cover the spatial variability. Rolling terrains require greater density of rain gauges to cover spatial variations. The main drawback of using in-situ rain gauge data is its incapability to measure rainfall over water bodies.The human and other errors involved in the operation makes it more inefficient. An alternate to counter these issues is Satellite Rainfall Estimates (SRE). SRE are available globally including remote terrains and water bodies. Since satellite covers large area on a single pixel, estimates obtained may be less credible over in-situ point data. Thus the reliability of satellite rainfall needs to be assessed before being applied for hydrological assessment and weather predictions. In third world countries where installation of rain gauges is practically difficult due to cost-economic issue, satellite data can be of worth if its adequacy is checked and evaluated. The main objectives of this research study are (i) to evaluate biasness in the CMORPH rainfall estimates (ii) to identify the window size that reduces bias in the CMOPRPH data (iii) to assess the performance of bias corrected CMORPH rainfall estimates.

The study area is the Gilgil Abbey Basin in Ethiopia (Latitude: 10°56′ N-11°22′ N & Longitude: 36°49′ E-37°24′ E). As per Köppen climate classification, the basin is mainly dominated by temperate and warm climatic conditions. For this study, the in-situ rain gauge data is considered as reference and CMORPH SRE as raw data that needs to be assessed and then corrected. The study area has 10 in-situ rain gauge stations that provide data at daily temporal resolution.CMORPH SREs are available at 8km-30 minutes spatial and temporal resolution respectively.

Consistency of in-situ rain gauges data is assessed through double mass curve analysis and coefficient of determination is found to be greater than 0.99. Due to existence of error in the SRE, bias factors are estimated for 2, 4, 6, 8, 10 up to 20 days using sequential window analysis through multiplicative shift technique. Bias factors for overlain pixels are interpolated through inverse distance weighted interpolation to generate bias factor field for the entire basin. The reliability of applied interpolation scheme is assessed through leave one out cross validation method. The generated bias field is multiplied with raw CMORPH SREs to acquire bias corrected CMORPH estimates.

Results showed biasness in raw CMORPH SREs. The average Root Mean Square Error (RMSE) between in-situ rainfall records and raw CMORPH estimates is found to be 9.62 mm. It is observed that 6 days sequential window performs best for bias correction. Statistical indices like RMSE, Correlation coefficient and Standard deviation (Taylor's diagram) showed improved performance for bias corrected CMORPH estimates.