Hydrological Evaluation of Satellite Precipitation Products on Upper Blue Nile Basin: A Case study of Gilgel Abbay

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Introduction

Prediction of streamflow simulation in ungauged basins of the East African highlands is a challenging task due to the absence of reliable ground-based rainfall information. The region has no any ground-based radar for rainfall measurement, the rain gauge network is very sparse to evaluate the water resources for sustainable management. However, there are different global high-resolution satellite precipitation products and these products will be evaluated how the products of precipitation simulate streamflow in the Greater Horn of Africa Blue Nile Basin. (Bitew, 2011)
Streamflow simulations are carried out for various precipitation products that include in-situ gauge observations, gauge-adjusted CMORPH and TMPA 3B42v7 (TRMM) with in a grid resolution of 0.25^0. The aim of this study is to assess the performance of various satellite precipitation dataset for water resources application in the Upper Blue Nile basin, Ethiopia. Coupled Routing and Excess Storage (CREST) distributed hydrological model is setup for Gilgel Abbay watershed (Area = 1664 km^2) in the upper Blue Nile Basin.

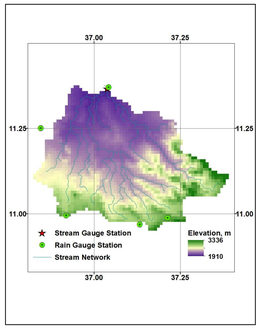
CREST

The **C**oupled **R**outing and **E**xcess **ST**orage (CREST) distributed hydrological model is a hybrid modeling strategy developed by the University of Oklahoma (http://hydro.ou.edu) and NASA SERVIR Project Team
CREST's distinguishing characteristics include:

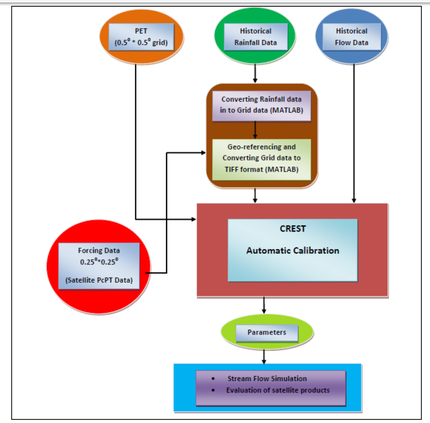
1. Distributed rainfall–runoff generation and cell-to-cell routing;
2. Coupled runoff generation and routing via three feedback mechanisms; and
3. Representation of sub-grid cell variability of soil moisture storage capacity and sub-grid cell routing (via linear reservoirs) (Wang, 2011)

Location

Gilgel Abbay catchment which has a drainage area of 1664 km^2 is located in Blue Nile Basin, in the Ethiopian part of East Africa highlands between $36^048'$ E–$37^024'$E and $10^056'$ N–$11^023'$N. The landscape is complex topography with elevation range between 1910-3336m and the climate is semi-humid with mean annual rainfall of 1300mm.

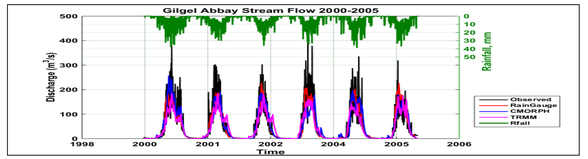


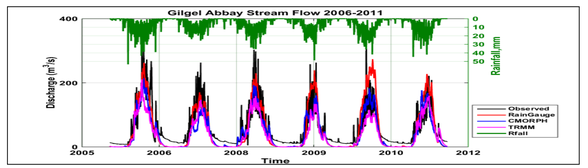
Methodology

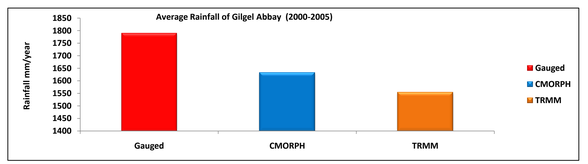


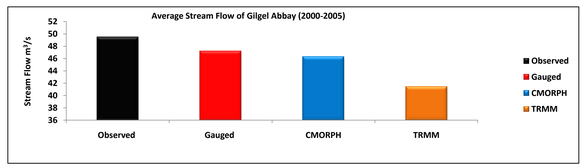
Result

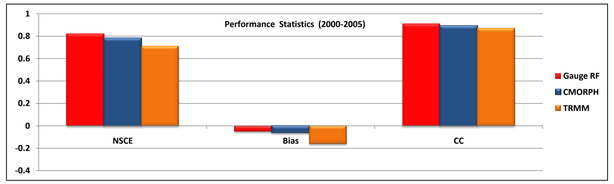
Results show that the gauge-based precipitation data reproduce the runoff very well as compared to the observed daily discharge at the outlet of the watershed with Nash-Sutcliffe Efficiency (NSCE) of 0.82 for calibration and 0.70 for validation periods for in-situ rainfall observations. The results from CMROPH precipitation data reproduced the runoff with NSCE of 0.79 for calibration and 0.71 for verification periods. Similarly, the skill of the TMPA 3B42v7 (TRMM) precipitation data is also encouraging with NSCE of 0.71 and 0.66 for the calibration and verification periods respectively

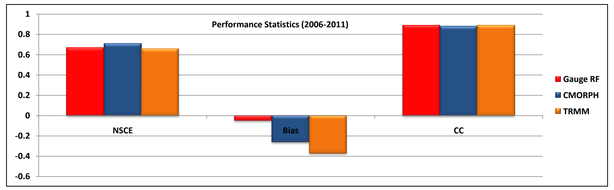












Conclusion

The gauge-based precipitation data reproduce the runoff very well as compared to the observed daily discharge at the outlet of the watershed. The results from CMROPH precipitation of simulated flow tries to capture the shape of the hydrograph and show better Statistics performance than the TMPA 3B42v7 satellite product. However, the TMPA 3B42v7 results reveal encouraging Statistics performance

References

Bitew, M. M. (2011). Assessment of satellite rainfall products for streamflow simulation in medium watersheds of the Ethiopian highlands. *Hydrology and Earth System Science* .
Wang, J. (2011). The coupled routing and excess storage (CREST) distributed Hydrological model. *Hydrological Sciences Journal* .

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