

DESIGN AND PERFORMANCE ANALYSIS OF A REAL-TIME CORRECTION SYSTEM FOR IMERG ESTIMATED PRECIPITATION IN GANGES-BRAHMAPUTRA BASIN



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Introduction

Satellite Observations today provide a platform for better understanding of hydrological processes by overcoming the traditional difficulties of in-situ measurements as well as sampling limitations of observations, institutional issues particularly when it comes to the developing world. Ganges-Brahmaputra river basins are the classic example of the most populous basins of the world with very less amount of in situ observations of hydrological phenomena. Hydrologists of this region are using near real-time satellite based estimations in their daily operational purposes to minimize the difficulties related to ground-based hydrological measurements. Integrated Multi-Satellite Retrievals for GPM (IMERG) estimated precipitation is becoming progressively popular among the decision makers of this region due to its derivation algorithm designed to consider all satellite microwave precipitation estimates. Despite the advancements, quality of satellite data can often become unacceptable with unrealistic simulation which renders it useless in decision making. To improve the quality of IMERG-Early run product and filter out unrealistic predictions, an automated system is developed to apply a real-time correction on the daily basis based on the ground measured rainfall in Ganges and Brahmaputra Basin.

Objective

Development of an online based realtime correction system that leverages the public domain based in-situ observations to correct satellite based IMERG precipitation through web-analytics.

Study Area

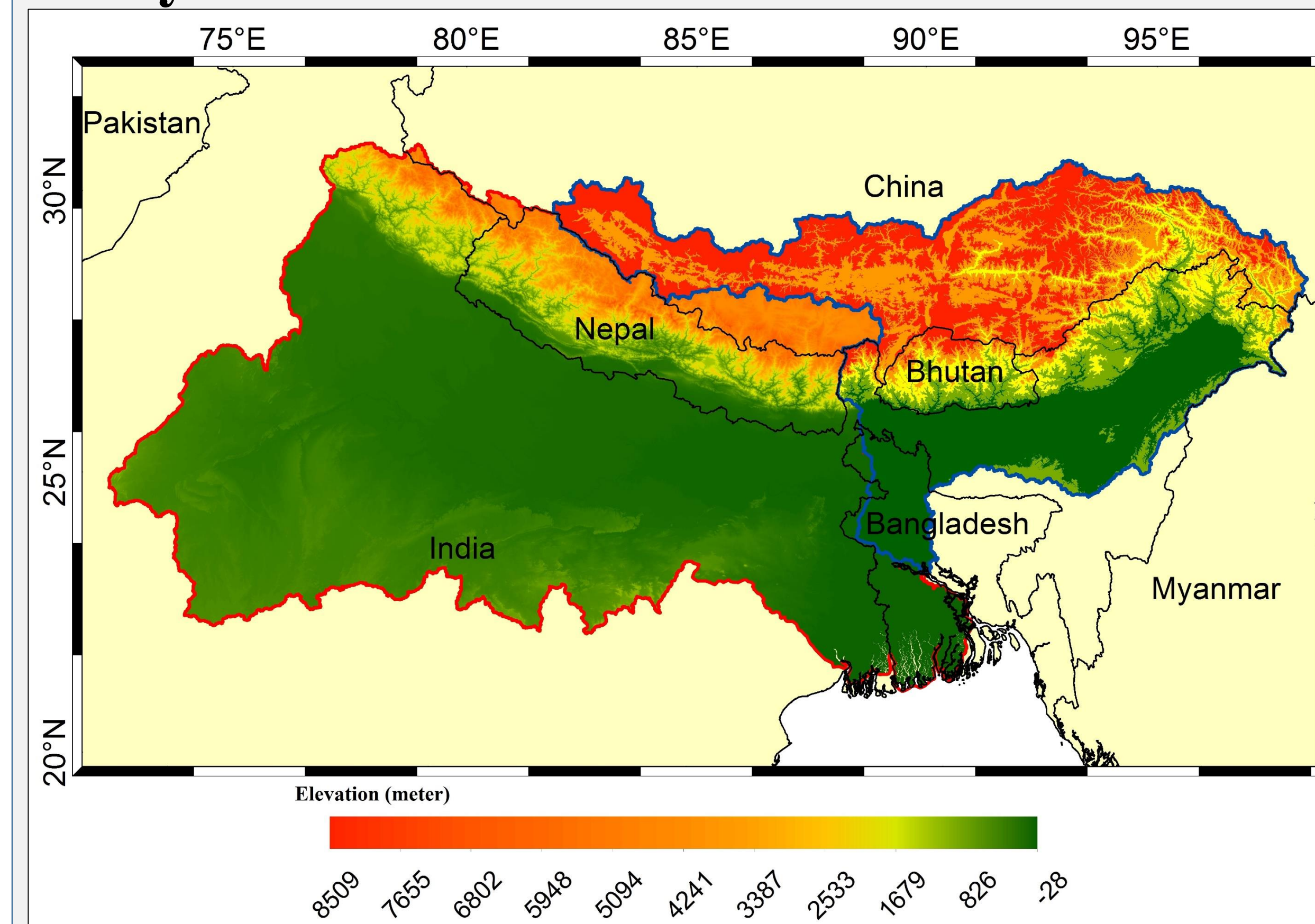


Figure 1: Ganges-Brahmaputra Basin

List of Public Domains used in Correction

IMD City Weather, India: <http://14.139.247.11/citywx/citywxnew.php>
 CityWX Weather, India: http://202.54.31.7/citywx/city_weather.php
 CityWX Weather New, India: http://202.54.31.7/citywx/city_weather1.php
 Weather Underground Page: <http://www.wunderground.com>
 Meteorological Forecasting Division, Nepal: <http://www.mfd.gov.np/>
 Flood Forecasting and Warning Center, Bangladesh: <http://www.ffwc.gov.bd/>
 Department of Hydrology and Meteorology, Nepal: <http://hydrology.gov.np/>
 Regional Meteorological Center, New Delhi, India: <http://amssdelhi.gov.in>
 RMC 2, New Delhi: <http://121.241.116.157/dynamic/weather/delhiregion.html>
 RMC, Gangtok, India: http://www.imdsikkim.gov.in/daily_Forecast.pdf
 NCR Delhi News, India: <http://121.241.116.157/dynamic/weather/Delhi.pdf>
 Guwahati Weather in PDF, India: <http://www.imdgwahati.gov.in/dwr.pdf>
 Bangladesh Meteorological Department: <http://www.bmd.gov.bd/>
 Central Water Commission, India: <http://www.cwc.gov.in/>

Methodology

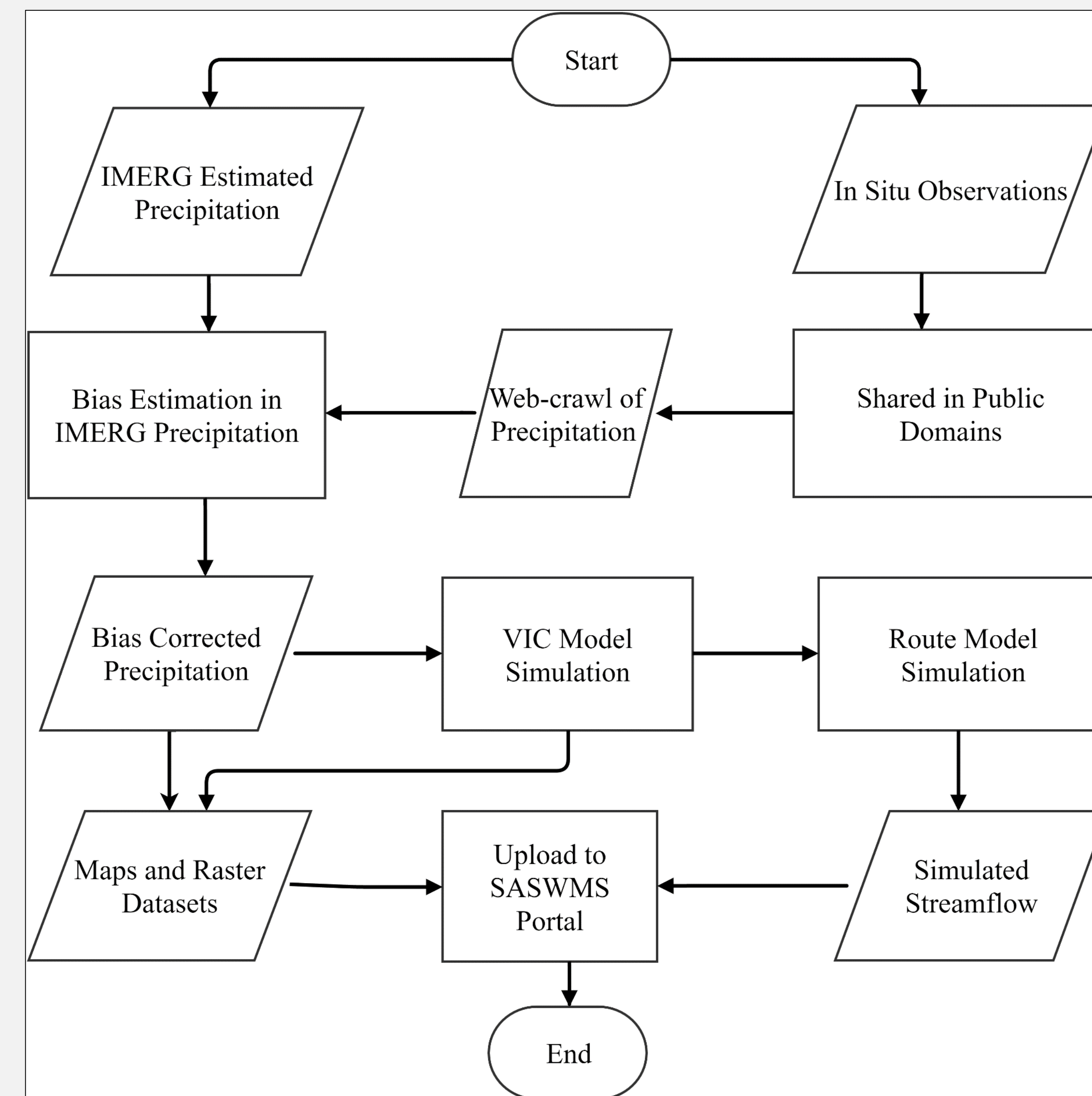


Figure 2: Methodology of Web Based Correction System

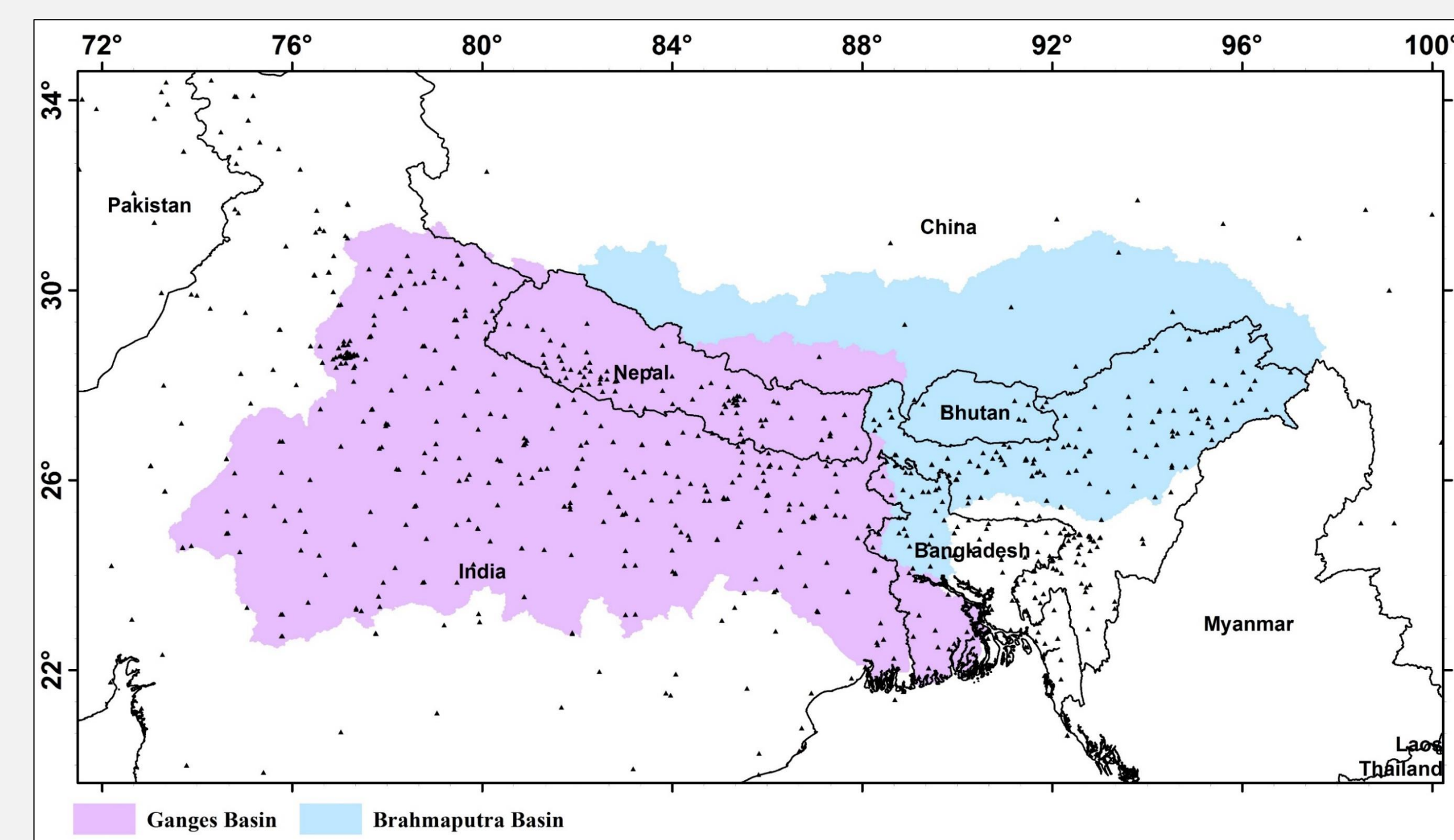


Figure 3: Spatial Distribution of In Situ Stations included in the web-crawler based dynamic Correction System

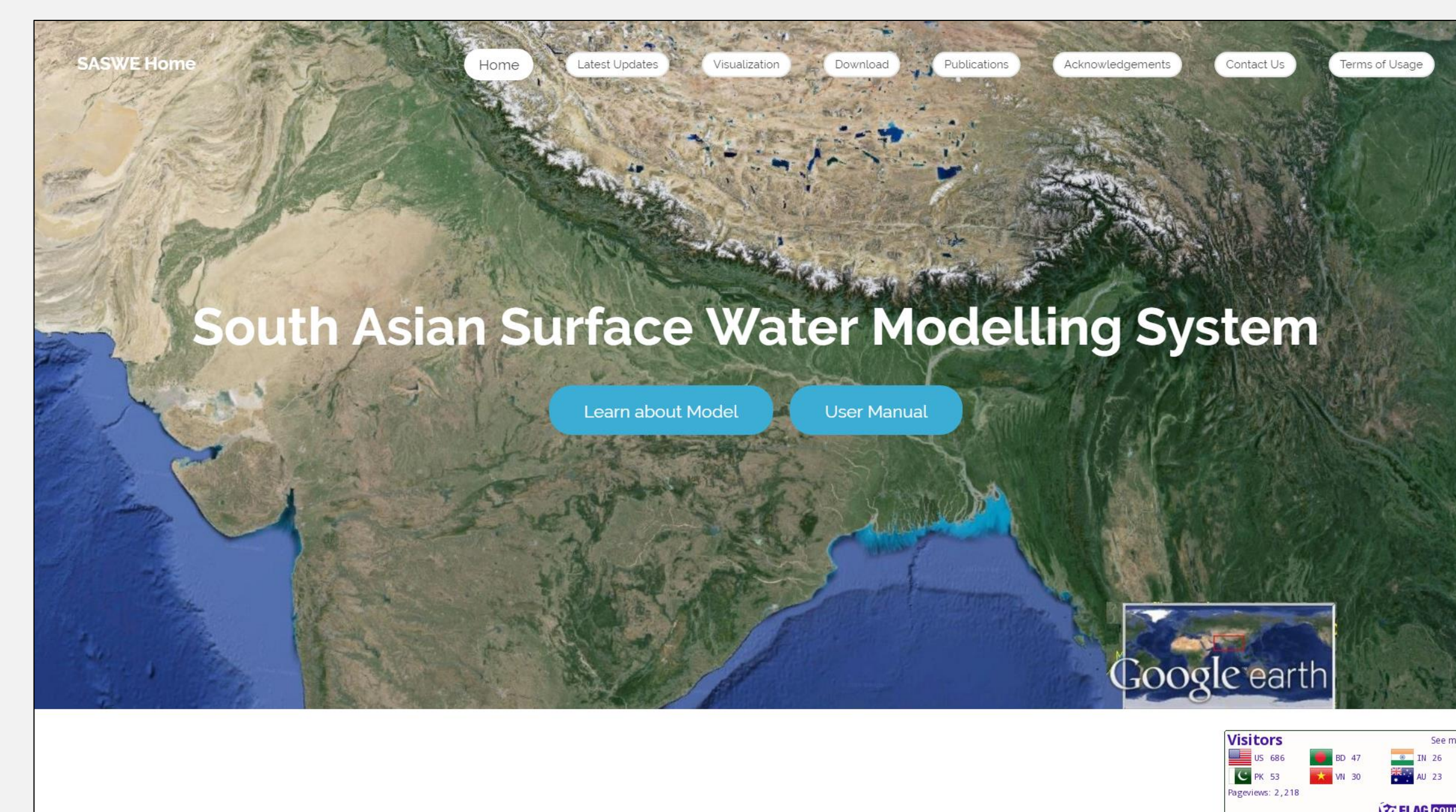


Figure 4: South Asian Surface Water Modelling System Portal where corrected realtime precipitation of Ganges-Brahmaputra Basin is posted (<http://depts.washington.edu/saswe>)

Analysis

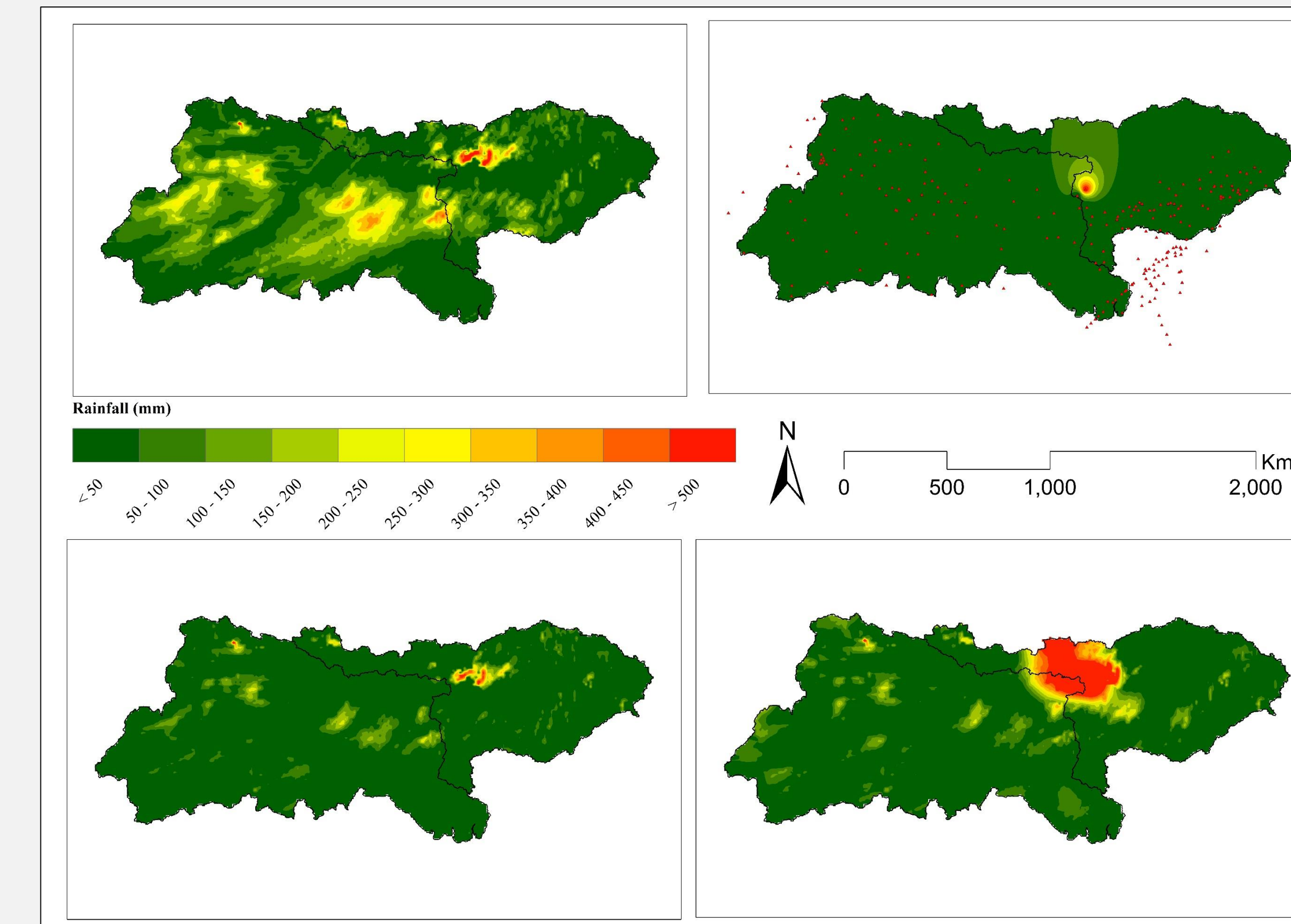


Figure 5: Example of correction of IMERG-RT precipitation of 28 July 2016 of Ganges-Brahmaputra Basin, upper left: IMERG-RT precipitation, upper right: In situ stations and interpolated precipitation, lower left: corrected precipitation by IDW method of bias interpolation and lower right: corrected precipitation by spline method of bias interpolation

Comparison of Monthly Precipitation

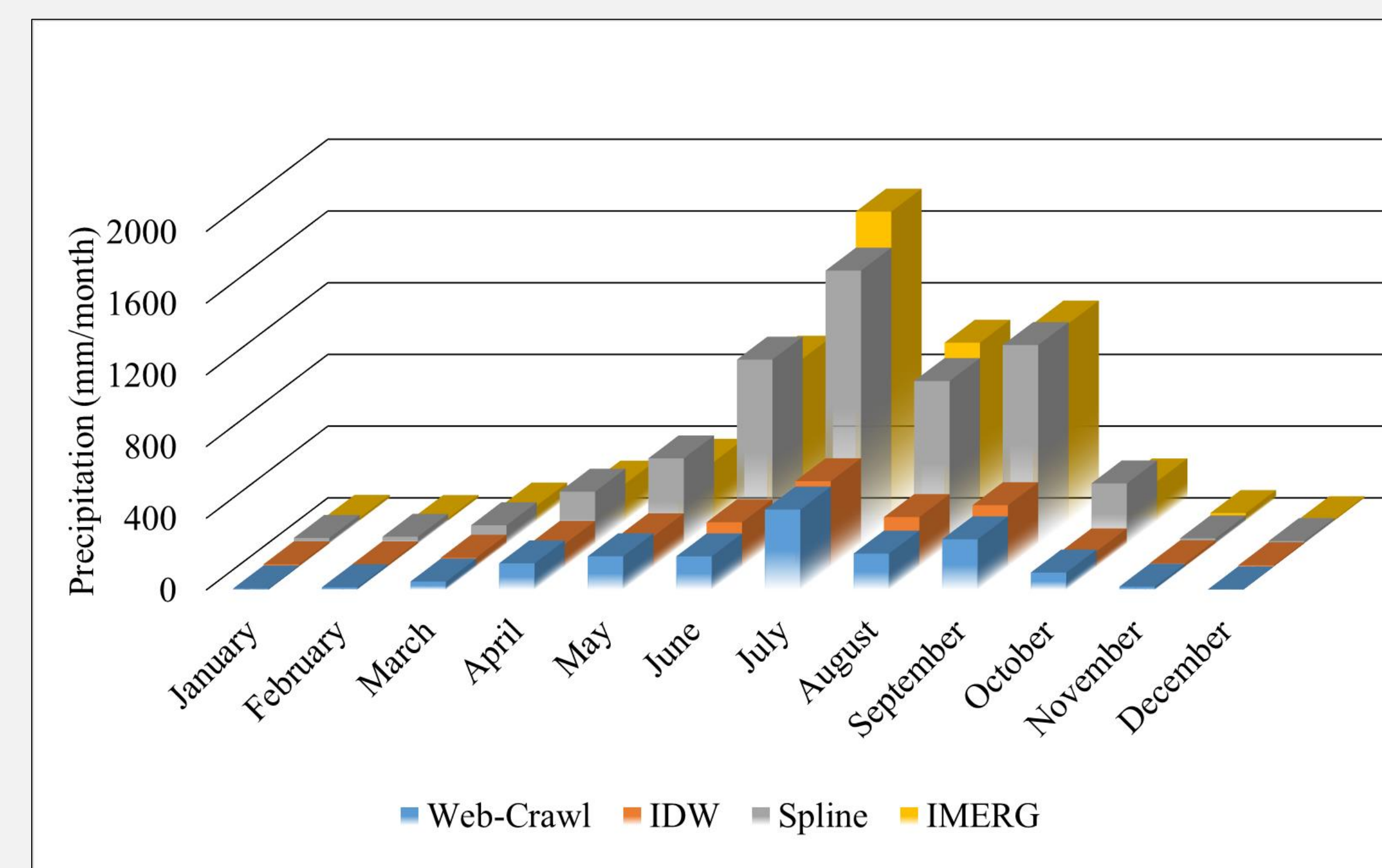


Figure 6: Comparison of Monthly Average Precipitation of Brahmaputra Basin

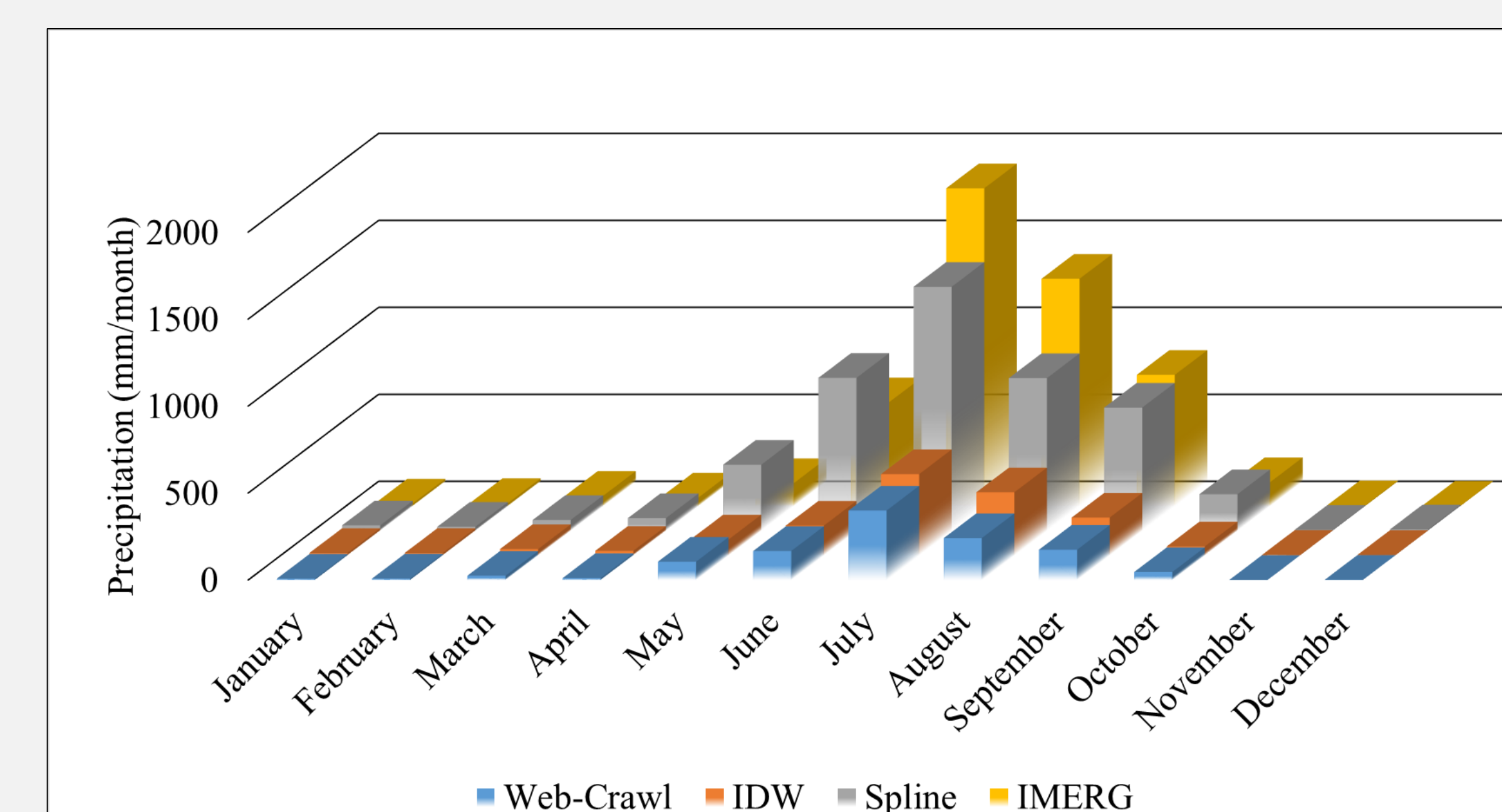


Figure 7: Comparison of Monthly Average Precipitation of Ganges Basin

Simulated Streamflow Comparison

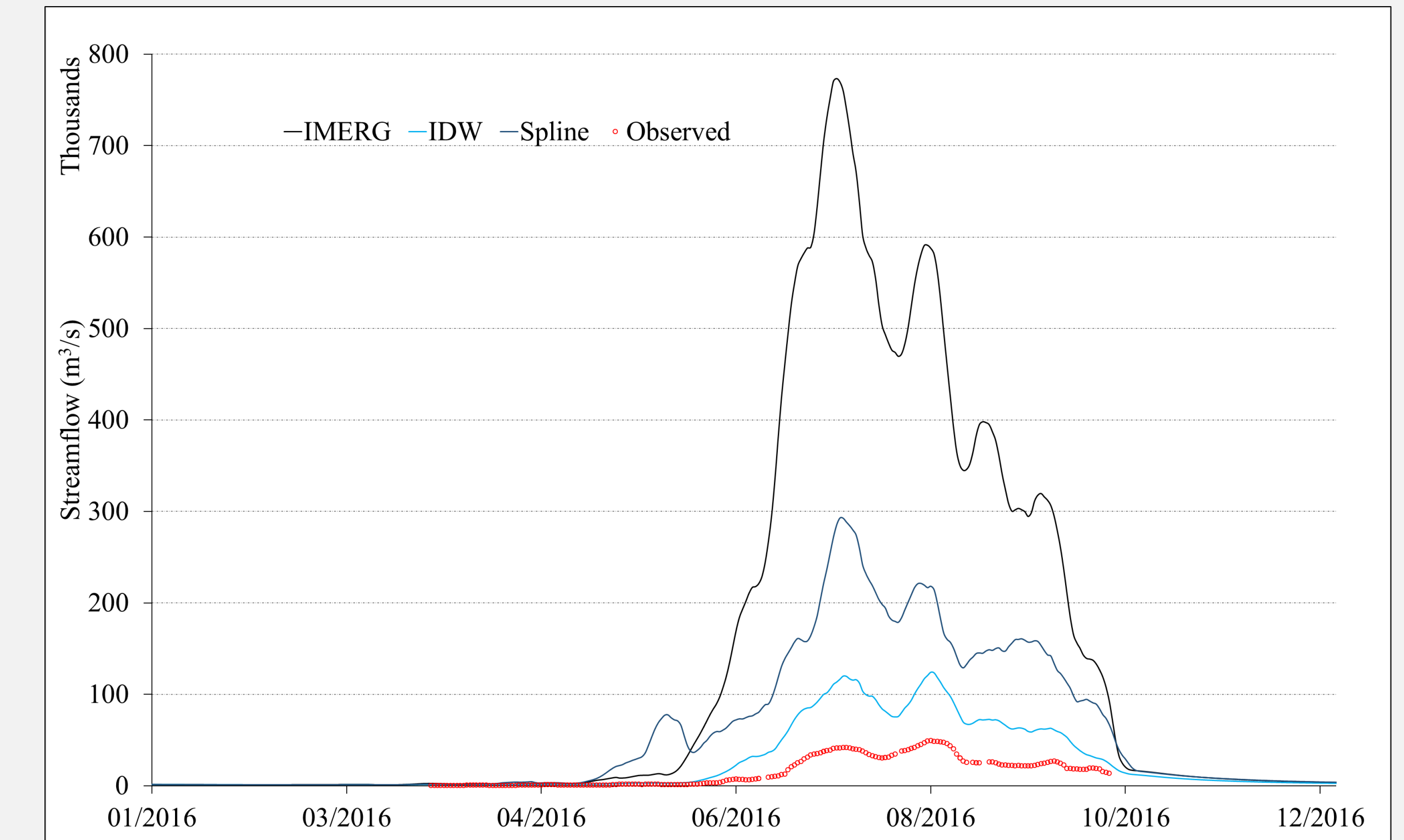


Figure 8: Streamflow Comparison of Ganges Basin at Hardinge Bridge

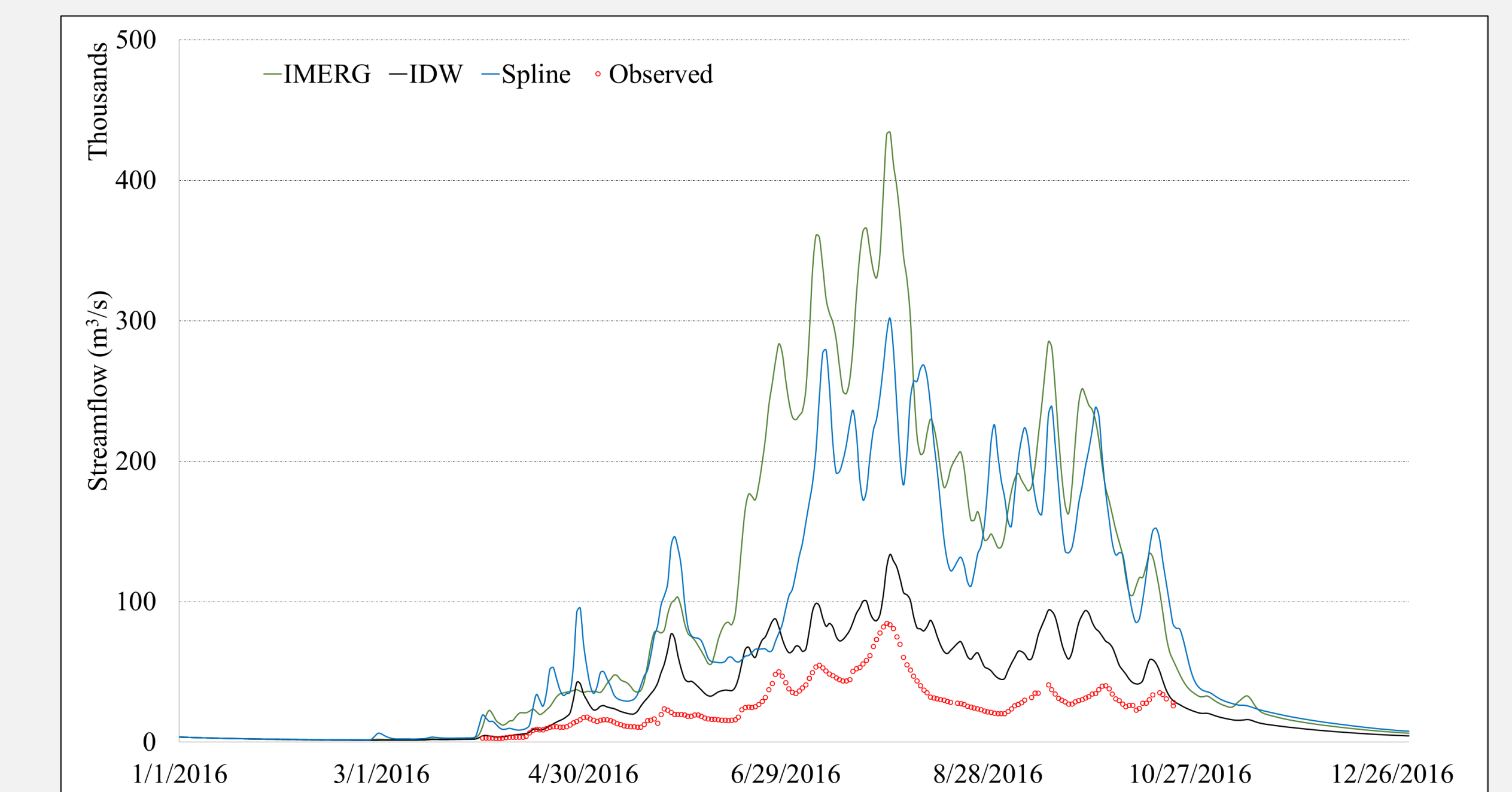


Figure 9: Streamflow Comparison of Brahmaputra Basin at Bahadurabad

Table 1: Streamflow Skill Assessment of Precipitation Correction System

Basin	Error Metrics	Precipitation Bias Correction		
		IMERG-RT	IDW Method	Spline Method
Brahmaputra	RMSE (Cumecs)	158568	31306	115655
	Correlation Coefficient	0.94	0.90	0.80
	NSE	-82.03	-2.24	-43.17
Ganges	RMSE (Cumecs)	316566	36188	107239
	Correlation Coefficient	0.93	0.98	0.94
	NSE	-406.9	-4.3	-45.8

Conclusion and Future Scope

- More than 80% reduction in RMSE in simulated Streamflow achieved by using this system of Correction application.
- Sometimes the correction system worsen the quality of satellite estimated precipitation during no rain or low-rain situation
- In the dry period, Government agencies do not maintain the practice of posting realtime precipitation information.
- The web portals and the list of stations included in the system is static.
- Other methods of realtime bias correction of satellite estimation that have not assessed during bias correction application.
- Such an issue can be solved through more dynamic and intelligent search engine optimization.

Reference

Biswas, N. and Hossain, F., (2016). "A Scalable Open-source Web-analytic Framework to Improve Satellite-based Operational Water Management in Developing Countries", *Environmental Modeling and Software* (In review).

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