

# ADVANCEMENT OF SATELLITE RAINFALL APPLICATIONS FOR HYDROLOGIC MODELING WITH EMPHASIS ON FLOOD MONITORING

## Reporting

### Project Information

FLOODSAT

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## Final Report Summary - FLOODSAT (ADVANCEMENT OF SATELLITE RAINFALL APPLICATIONS FOR HYDROLOGIC MODELING WITH EMPHASIS ON FLOOD MONITORING)

The overarching objective of the FLOODSAT project is to advance the utility of satellite-based precipitation estimates for hydrologic modeling, specifically for flood monitoring. The main objectives include evaluation of the satellite-based precipitation (SBP) products over the Western Black Sea Region in Turkey using the rain gauge network (Figure 1), devising a bias-adjustment algorithm for the SBP products and implementation of a hydrologic model in a selected watershed. An improved methodology for calibration and evaluation of the hydrological model utilizing streamflow observations measured at the outlet and interior points will be devised. The performance of the hydrologic model driven by satellite-based and ground-based observations will provide further insights into the value of existing and adjusted satellite-based precipitation estimates for basin-scale streamflow simulations.

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The Satellite-based precipitation (SBP) products utilized in this study include The Tropical Rainfall Measuring Mission (TRMM) Multi-satellite Precipitation Analysis (Version 7) including real time (TMPA-7RT) and gauge adjusted (TMPA-7A) products; Climate Prediction Center Morphing Technique (CMORPH) and the Multi Sensor Precipitation Estimate (MPE) of the European Organization for the Exploitation of Meteorological Satellites (EUMETSAT). The study area is characterized by a complex topography, marked by Northeast-Southwest aligned mountain ranges running parallel to the shoreline. Hence orographic precipitation is very characteristic at the windward (North) side of the mountains. A rain gauge-based gridded precipitation product was constructed considering the “physiographic similarity” concept in which a locally weighted linear rainfall-elevation relationship was used for precipitation estimation at 0.05o grids. The weights of the rain gauges were established using a combination of a set of physiographic descriptors including distance, elevation, coastal proximity, facet and effective terrain height.

Evaluation of the SBP products indicated that the orographic controls on the precipitation influences the performance of the SBP products (Figure 2). Evaluated SBP products generally had difficulty in representing the precipitation gradient normal to the orography. TMPA-7RT, TMPA-7A and MPE products underestimated precipitation along the windward region and overestimated the precipitation on the leeward region, more significantly during the cold season. CMORPH product underestimated the precipitation on both windward and leeward regions regardless of the season. Further investigation of the datasets used in the development of these SBP products revealed that, although both infrared (IR) and microwave (MW) datasets contain potential problems, inability of MW sensors to detect precipitation especially in cold season was the main challenge over this region with complex topography.

A new bias adjustment methodology (BAPS) for the satellite-based precipitation products has been devised based on the “physiographic similarity” concept. In the proposed procedure, SBP estimates are adjusted based on a weighted scheme using rain gauges. Rain gauge weights were calculated based on physiographic similarity concept which is more suited to the complex terrain as opposed to the commonly used proximity concept. Comparison of SBP products before and after bias adjustment with BAPS algorithm indicated that the adjustment procedure successfully corrected for the precipitation detection problems. The bias adjustment procedure resulted in significant improvements in the performance of the CMORPH and MPE products with less significant improvements in TMPA-7RT product showing high spatial heterogeneity in precipitation estimates (Figure 3). Comparison of the BAPS algorithm with the baseline Inverse Distance Weighted Algorithm (IDW) using two independent stations showed that the BAPS algorithm generally provided better statistics.

## Related documents

 [final1-floodsat-277183-finalreport-publishable-summary.docx](#)

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