

M.Sc. Thesis

**MULTIREGIONAL EVALUATION OF SM2RAIN SATELLITE
BASED PRECIPITATION PRODUCT IN PAKISTAN**



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ABSTRACT

Satellite precipitation products are being used at a global scale for rainfall estimation and mostly providing a reliable opportunity in in-situ data sparse region. Tropical Rainfall Measuring Mission version-07 (hereafter TRMM) and its successor Integrated Multi-Satellite Retrievals for Global Precipitation Measurement (hereafter IMERG) are currently used state-of-the-art satellite products and are based on 'top to bottom' approach. In addition to above products, SM2RAIN-ASCAT (hereafter SM2RAIN) is a novel satellite-based precipitation product which gives the rainfall estimates from the knowledge of soil moisture state and is based on 'bottom to top' approach. A comparative assessment of newly developed product e.g., SM2RAIN or a new version of the product is quite vital for algorithm developers and users. Hence, this research work was carried out to evaluate the accuracy and applicability of SM2RAIN, in comparison to in-situ data, TRMM, and IMERG in diverse regions of Pakistan. The current study consist of three main component i.e., climatic zoning using geo spatial analyst tool in GIS, evaluation of performance of selected products based on the performance metrics, and to check whether the performance metrics are statistically significant or not. Moreover, the comparative analysis was performed on temporal scale (daily and monthly) and seasonal scale (spring, autumn, summer, and winter) using five performance metrics namely, root mean square error, correlation coefficient, false alarm ratio, the probability of detection, and critical success index.

Using 30 years data of mean annual temperature, Pakistan was divided into four different climatic zones. Based on precipitation data of various stations from each zone, the comparative results showed that (1)-SM2RAIN is a better rainfall estimation product and it gave promising rainfall estimates in the dry region of

Pakistan, however, less effective in hilly and mountainous terrain having high rainfall intensity, (2)- SM2RAIN provides more satisfactory estimates in winter and autumn seasons, while relative poor in the summer season when most parts of Pakistan observe heavy rainfall due to monsoon, (3)- SM2RAIN performs better in terms of rainfall detection in all considered cases i.e., different zones and temporal scales, (4)- Wilcoxon Signed rank sum test resulted that there is a statistical significant difference between the SM2RAIN and all selected satellite products in terms of POD and FAR with a p value less than α , except CSI, (5)- The overall performance of SM2RAIN is very convincing and it was concluded that SM2RAIN can also be a feasible satellite product for most of the areas of Pakistan. It is noteworthy here to mention that this could be the preliminary assessment of SM2RAIN in diverse climatic zones of Pakistan.