The application of three Satellite-based Precipitation Products in Hydrological Modeling Across Five Northern Moroccan Catchments (Oral)

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ABSTRACT

Water resource management is a critical challenge in many developing regions, including Morocco, where traditional ground-based precipitation monitoring networks are often sparse and unevenly distributed. This scarcity of reliable rain gauge data hinders effective monitoring of precipitation patterns over time, which is essential for managing water resources sustainably. Satellite-based Precipitation Products (SPPs) provide a valuable alternative due to their extensive coverage, high temporal resolution, and free accessibility. However, despite these advantages, SPPs have several limitations and uncertainties. These issues stem from sampling errors, calibration problems, deviations, and algorithmic constraints, which can affect their accuracy for hydrological applications. Therefore, it is essential to validate SPPs before using them. This study examines the application of three well-established satellite precipitation products (SPPs)—GPM, TRMM, and CHIRPS—in hydrological modeling using HEC-HMS across five catchments in northern Morocco. The performance of these SPPs is assessed by comparing simulated streamflow using SPPs data against observed discharge collected from the outlets of each catchment. The evaluation includes a 10-year calibration period (2000–2010) and a 5-year validation period (2010–2015), with performance measured using four statistical metrics: NSE, R^2, RMSE, and Pbias. Results indicate that (1) the simulation performed better in catchments with higher elevations. (2) TRMM consistently outperformed the other SPPs during the calibration period. However, during the validation phase, CHIRPS demonstrated superior performance, particularly in higher altitude and semi-humid regions, which could explain its better performance in this study. At the same time, GPM struggled to perform as well. (3) The highest simulation accuracy was observed in the BFR and TMZ catchments, while performance was relatively poor in the JBR and OGN catchments, where low NSE values and high biases were noted. The findings highlight the variability in SPP performance across different modeling phases and catchment characteristics. This study is particularly crucial due to Northern Morocco's hydrological significance, characterized by higher precipitation, greater water availability, and the potential to sustain the arid southern regions through water transfer projects. However, this importance necessitates the implementation of robust management and adaptation strategies to address the anticipated effects of climate change on these vital water resources.

Keywords: -HMS, Hydrological modeling, Satellite-based precipitation products, Streamflow, Morocco