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Application of satellite and reanalysis precipitation for hydrological modeling in data-scarce Porijõgi catchment, Estonia

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The lack of adequate and reliable gauge observations has long been a major obstacle for hydrological modeling. This study focuses on a comprehensive evaluation of hydrological applicability of satellite and reanalysis-based precipitation products (IMERG, ERA5, PERSIANN-CDR, SM2RASC, and CMORPH-CRT) in Porijõgi catchment, Estonia. The evaluations were carried out in two parts: 1) evaluating the quality of satellite and reanalysis-based precipitation products relative to gauge observations, 2) comparing gauge-simulated streamflow with satellite and reanalysis-based simulations using the SWAT model. Results show reasonable variation in the detection capability of satellite and reanalysis-based precipitation products with further influence on the streamflow simulations. IMERG, ERA5, and PERSIANN-CDR show better detection capability for the monthly precipitation and demonstrated reliable performance in simulating the monthly streamflow. However, SM2RASC and CMORPH-CRT products have a common tendency to underestimate the gauged precipitation and fail to show satisfactory performance in streamflow simulation. Overall, our findings suggest that satellite and reanalysis-based precipitation products can be a priori alternative sources of precipitation data for hydrological applications in poorly gauged areas. However, along with the efforts to improve satellite and reanalysis-based precipitation products, it is important to develop more effective bias adjustment techniques at a daily scale.

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