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Hydrological Evaluation of Satellite-Based Precipitation Products over the Volta and Baro-Akobo Basin

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How useful are satellite-based rainfall estimates (SRFE) as forcing data for hydrological applications? Which SRFE should be favoured for hydrological modelling? What could researchers do to increase the performance of SRFE-driven hydrological simulations? To address these three research questions, four SRFE (CMORPH, RFE 2.0, TRMM-3B42 and PERSIANN) and one reanalysis product (ERA-Interim) are evaluated within a hydrological application for the time period 2003-2008, over two river basins (Volta and Baro-Akobo) which hold distinct physiographic, climatologic and hydrologic conditions. The focus was on the assessment of: a) the individual and combined effect of SRFE-specific calibration and bias-correction on the hydrological performance, b) the level of complexity required regarding bias-correction and interpolation to achieve a good hydrological performance, and c) the hydrological performance of SRFE during high- and low-flow conditions. Results show that 1) the hydrological performance is always higher if the model is calibrated to the respective SRFE rather than to interpolated ground observations; 2) for SRFE that are afflicted with bias, a bias-correction step prior to SRFE-specific calibration is essential, while for SRFE with good intrinsic data quality applying a SRFE-specific model calibration is sufficient; 3) the more sophisticated bias-correction method used in this work (histogram equalization) results generally in a superior hydrological performance, while a more sophisticated interpolation method (Kriging with External Drift) seems to be of added value only over mountainous regions; 4) the bias-correction is not over-proportionally important over mountainous catchments, as it solely depends on where the SRFE show high biases (e.g. for PERSIANN and CMORPH over lowland areas); and 5) the hydrological performance during high-flow conditions is superior thus promoting the use of SRFE for applications focusing on the high-end flow spectrum. These results complement a preliminary “ground truthing” phase and provide insight on the usefulness of SRFE for hydrological modelling and under which conditions they can be used with a given level of reliability.