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Multivariable hydrological model performance assessment with remotely sensed evapotranspiration and rainfall in the Incomati River Basin

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We investigate whether remote sensing rainfall and total evaporation estimates can be integrated into a rainfall model (TOPMODEL) in order to improve the predictions of hydrological behavior of the Incomati River Basin. A series of available MODIS 1b level satellite images over the Incomati River Basin in Mozambique, South Africa and Swaziland are used for the period between 2010 to 2017 were used to retrieve evapotranspiration through the surface energy balance system algorithm (SEBS). The rainfall satellite estimate product were derived from the National Oceanic and Atmospheric Administration's (NOAA) climate prediction center (CPC) morphing technique (CMORPH) of 8km spatial resolution and 30 min interval aggregated to daily time step. TOPMODEL is modified to integrate the remotely sensed data as input and used to compute the streamflow in the same period of time. Comparison between satellite derived inputs (rainfall and evapotranspiration) and model-derived actual evapotranspiration and point-measured rainfall, was done using the 36 rain gauges around the three countries, 6 weather stations and 4 streamflow time series data. The results showed that spatial resolution plays a critical role in the accuracy estimation of surface energy fluxes and evapotranspiration across large and heterogeneous catchment such as Incomati River Basin. The spatial variation is also influenced by the lower coarse spatial resolution images (MODIS). The TOPMODEL efficiency by integration of the remotely sensed evapotranspiration and satellite rainfall estimated showed good approximation with the observed flows (NSE 0.7 and 0.74 respectively). The findings of this study address the weakness of the simulation from TOPMODEL based in the model derived actual evapotranspiration and poor ground measured data. This underscores the importance of the remotely sensed products at the catchment scales within the poor gauged catchment for water resources management.