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Quantifying uncertainty in the hydrologic simulation of a catchment with potholes using spatial calibration approach through the Soil Water Assessment tool

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The presence of potholes in a catchment creates intermittent surface water connectivity and reduces the contributing area, which has significant impact on stream flow at the outlet. The aim of this study is to assess the capability of the Soil Water Assessment Tool (SWAT) model in simulating the hydrology of the Upper Assiniboine River basin located in the Prairie region of Canada. The presence of a large number of potholes, lakes and wetlands has made the region known as the graveyard of hydrologic models. The size of the Upper Assiniboine catchment at the hydrometric station at Kamsack is 13054 Km2. In this study, we divided the catchment into nine sub basins. The digital elevation model (DEM), land cover map, land-use map and a map for the non-contributing areas were obtained from the open data portal of the government of Canada. The catchment has only three active meteorological stations. Therefore, we used Climate Forecast System Re-analysis (CFRS) climatic data from 1994–2013 available at a spatial resolution of 0.38 degree. Simulated discharge was evaluated using the observed stream flow at five gauging stations in the study area. The focus of our analysis is to identify the dominant hydrologic processes, the most sensitive parameters, quantify the uncertainty of each parameter, find the best range for these parameters at sub basin scale and then route these result at outlet to increase the performance of the model. The model was calibrated and validated using observed stream flow data for the period of 1994-2007 and 2008-2013 respectively, using the sequential uncertainty fitting version-2 technique of SWAT-Calibration and Uncertainty Program (SWAT-CUP). We evaluated the performance of models at different scales using two indices, the p-factor (observation bracketed by the 95 percent prediction uncertainty) and the r-factor (relative width of 95 percent probability band). We used the coefficient of determination (R2) and the Nash-Sutcliffe (NS) as objective functions to optimize the parameters. The results obtained through this research will lay the foundation for further identifying the parameters that have the most influence on the hydrologic predictions for the Upper Assiniboine catchment.