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Modeling the land surface water and energy cycle of a mesoscale watershed in the central Tibetan Plateau with a distributed hydrological model

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The Tibetan Plateau (TP) is the highest plateau in the world with the average elevation of 4000 m and plays an essential role in the Asian monsoon development and the concurrent water and energy cycle. In this study, a Water and Energy Budget-based Distributed Hydrological Model (WEB-DHM) was calibrated and used to simulate the water and energy cycle in a central TP watershed (Naqu River Basin). The model was first calibrated at the point scale (BJ site). The simulation results showed that the model could successfully reproduce the energy fluxes and the soil surface temperature with acceptable accuracies. Then, the model was further calibrated at the basin scale using the discharge data at the Naqu gauge in the summer of 1998 and the whole year of 1999. The model successfully reproduced the discharges near the basin outlet. At last, the model was validated using the MODIS land surface temperate (LST) data and the measured soil water content (SWC) at 15 points within the watershed in 2010. The simulation results showed that the model successfully reproduced the spatial pattern and the means of LST at both nighttime and daytime. Furthermore, the model can generally reproduce the SWC at the four layers for the 15 measurement sites with small BIAS and RMSE. Despite of the absence of the long term discharge data for model verification, we validated the model using the MODIS LST and the measured SWC data. This showed that the WEB-DHM could be used in the poorly-gauged or ungauged areas such as TP. This will improve our understanding of the water and energy cycle in these areas.