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Long-term streamflow forecasting using SWAT through the integration of a Random Forest Precipitation Generator

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Long-term streamflow forecasting is of great significance to the optimal management of water resources. Thus, one important task for hydrologists is establishing suitable long-term streamflow forecasting models that can meet their specific precision requirements. However, the forecast lead time of long-term streamflow forecasting is relatively long compared to the temporal scales of most flood events. Because forecasted precipitation has inherent uncertainty, long-term streamflow forecasting has major challenges. In this paper, a hybrid forecasting model is developed to improve the accuracy of long-term streamflow forecasting by combining an intelligent forecasting method (random forest, RF) and the Soil and Water Assessment Tool (SWAT). The RF model was used to forecast monthly precipitation. Precipitation was further downscaled to a daily dataset according to the hydrological similarity principle for use in the SWAT model of the Danjiangkou Reservoir basin, China. The performance of this hybrid model was compared to that of the seasonal autoregressive (SAR (P)) model, which is frequently used for long-term streamflow forecasting. The results showed that the RF precipitation generator yielded accurate predictions at the monthly scale, and the hybrid model produced acceptable streamflow series in long-term forecasting cases. In addition, the comparison showed that in the Danjiangkou Reservoir basin, the hybrid model performed better than the SAR (P) model, with average Nash-Sutcliffe efficiency (NSE) values of 0.94 and 0.51, respectively. This study provides a method of improving the accuracy of long-term streamflow forecasting.