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Forecasting Daily Discharge in the Upper Euphrates Basin Using Snowmelt Runoff Model with Estimated Snow Depletion Curves

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Streamflow occurring mainly due to snowmelt during spring and early summer months in the mountainous eastern part of Turkey is important as it constitutes approximately 2/3 of total annual volume of runoff. Monitoring snow covered areas and modeling snowmelt forms the backbone of the forecasting studies in terms of effective management of water resources in the Euphrates Basin, where large reservoirs are located. In this study, the Upper Euphrates Basin (10 250 km2) selected as a pilot basin is divided into five elevation zones between 1125-3487 m. The main motivation of the study is to evaluate the ability of the Snowmelt Runoff Model (SRM) to forecast daily discharges with estimated snow covered depletion and numerical weather prediction data. Moderate Resolution Imaging Spectroradiometer (MODIS) daily and 8-daily snow cover products with 500 m spatial resolution are analyzed for the snowmelt season (late February through June) from 2006-2010 and snow cover depletion curves are derived for different elevation zones. SRM model requires several parameters and three basic variables (precipitation, temperature, snow cover depletion) as input. Main variables need to be forecasted one or two days ahead, in order to use the model to forecast the daily discharge. Numerical weather prediction data of Mesoscale Model 5 (MM5) is used for temperature and precipitation forecasts in the study. The values are subjected to certain modifications before to be used in the model to improve the consistency of predicted values with observed values. Forecasting of snow covered area (SCA) is one of the most challenging part of the study. Four different approaches were used to see the impact of each one on the forecast of daily discharge. In the first one, snow depletions of each zone is taken as the average of four years. In the second approach, regression analyses were used to compare daily average snow covered area and temperature data (coefficient of determination between 0.6-0.9). The relations are derived between temperature and snow covered area for each zone and according to daily zonal average temperatures SCA is estimated for each day. Thirdly, stochastic approach is used applying ARIMA model. Then, snow cover depletions are forecasted with predetermined equations applied on the time series of SCA. Finally, probabilistic approach is used to obtain the frequency of snow cover for each pixel of the basin. Using these SCA datasets, SRM was applied to forecast the snowmelt runoff with optimized model parameters. Daily discharge values are forecasted for the snowmelt period between February - June of the years 2009-2010. Model results provide promising results for forecasting of daily discharges with an overall evaluation of Nash-Sutcliffe model efficiency greater than 0.7 during melting period.