Modeling Small Watershed Snowmelt Hydrographs Using Snow Telemetry Data

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Abstract. To refine water supply forecasting procedures, we took advantage of the daily time step of the National Resources Conservation Service (NRCS) Snow Telemetry (SNOTEL) station data to estimate components of the snowmelt-dominated hydrograph. We examine two small watersheds in Colorado (8.8 and 16.0km^2) and one watershed in Wyoming (59km^2); each SNOTEL-streamflow station pairing had 33 years of data that were divided into calibration and evaluation periods. Beyond the volume of water, i.e., total runoff, we estimate the timing of 20, 50, and 80% (t_{Q20}, t_{Q50}, t_{Q80}) of the annual streamflow to pass the gauge using a multi-variate regression model. The structure of the model was derived from analysis of snow water equivalent (SWE) data measured at the Joe Wright SNOTEL station using the Joe Wright Creek streamflow data. The model components were then retained for the other two watersheds. The Joe Wright model with its basin specific coefficients was also applied to the other two basins to evaluate direct transferability.

Peak SWE, date of peak SWE, and number of consecutive days with snow on the ground up to the date of peak SWE had the strongest correlation to streamflow, and thus formed the basis of the models. The optimal model configuration performed quite well for the t_{Q20}, t_{Q50}, runoff volume (Q_{100}) and peak streamflow (Q_{peak}). Model performance was less for t_{Q80}. Applying the Joe Wright Creek coefficients directly to the other watersheds yielded reasonable results; the hydrograph components for the larger Wyoming basin were better than the smaller Colorado basin due likely to the orientation of the basins.

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