Evaluating the spatial variability of snowpack properties across a northern Colorado basin

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Abstract. Characterizing the spatial distribution of snow water equivalent (SWE) in mountainous terrain is challenging due to complex topographic heterogeneity and inherent spatial variability of the snowpack. Understanding the distribution of seasonal mountain snowpack at the basin or mesoscale is crucial for accurate forecasting of water availability, as well as available input for regional climate and hydrologic models. Due to their sparse distribution, operational snowpack measurements from the SNOTEL and snow course network cannot accurately characterize the spatial variability of the snowpack at the basin scale, yet few studies have attempted to describe snowpack variability using a combination of field-based and operational data at this scale. One approach to reducing the sampling effort needed at the larger scale is to use snow depth as a surrogate for SWE by developing a set of equations for snow density. Here we investigated the variability of snowpack properties within the upper Cache la Poudre basin of northern Colorado. Historic operational data from 10 SNOTEL stations and 17 snow courses within the study area were used to develop a set of regression equations for estimating snow density. We used field-based snow surveys conducted during the 2010/2011 snow season and operational measurements to analyze how topographic and biological variables influence the distribution of snow at the basin scale. Multivariate regression and binary regression tree analysis were used to understand how parameters are driving spatial variability at this scale.