Persistence of Topographic Controls on the Spatial Distribution of Snow in Rugged Mountain Terrain, Colorado, USA

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Abstract.
We model the spatial distribution of snow depth across a wind-dominated alpine basin using a geostatistical approach with a complex variable mean. Snow depth surveys were conducted at maximum accumulation from 1997 through 2003 in the 2.3-km² Green Lake Valley (GLV) watershed in Colorado. Three deterministic models of the snow depth trend were considered, differing in how they model the effect of terrain parameters on snow depth. The terrain parameters considered were elevation, slope, potential radiation, an index of wind sheltering, and an index of wind drifting. When nonlinear interactions between the terrain parameters were included, all five terrain parameters were found to be statistically significant in predicting snow depth when a multi-year dataset was analyzed, yet only potential radiation and an index of wind sheltering were found to be statistically significant for all individual years. Of the five terrain parameters considered, the index of wind sheltering was found to have the greatest effect on predicted snow depth. The methodology presented in this paper allows for the characterization of the spatial correlation of model residuals for a variable mean model, incorporates the spatial correlation into the optimization of the deterministic trend, and produces smooth estimate maps that may extrapolate above and below measured values. These characteristics are an improvement over previous methods of distributing snow depth in basins with rugged topography.