Scaling snow observations from the point to the grid-element: implications for observation network design.

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Abstract. In spring 2001 and 2002 monthly snow surveys (i.e. April, May, and June) were undertaken to assess the spatial and temporal representativeness of snow water equivalent (SWE) values recorded at six snow telemetry (SNOTEL) stations in the Rio Grande headwaters. Snow depth data were interpolated using binary regression tree models and combined with snow density data and remotely sensed snow covered area to estimate the spatial distribution of SWE surrounding the SNOTEL sites. A physically based energy and mass balance snowmelt model was used to simulate the depletion of snow cover throughout the snowmelt season. Relative to the entire watershed, SNOTEL site locations are not representative of physiographic variables known to control snow distribution (i.e. elevation, slope, and incident solar radiation). At the watershed scale (3419 km^2) SNOTEL sites are located toward the western boundary of the watershed, an area of high snow cover persistence. Even relative to the 16, 4 and 1 km^2 areas that surround them, SNOTEL stations are not representative of the physiographic variables known to control snow distribution. These physiographic biases vary from site-to-site, with five of six sites located on relatively flat terrain and hence having a positive solar radiation bias. For the two water years studied, certain sites showed consistent overestimates of SWE relative to the surrounding 16, 4, and 1-km^2 areas. Other sites showed variability in SWE bias during the two years, as regression-tree model results suggested that different physiographic variables controlled snow distribution during the two water years. The results presented here will improve the ability to upscale SNOTEL data for evaluating and calibrating remote sensing algorithms and initializing, evaluating, and updating modeling efforts at the regional scale. Additionally, a statistically unbiased approach for selecting the most representative locations for future automated snowpack observations is provided.