



Estimating future snowpack conditions using thermal infrared heaters and a physically based snowmelt model: results from Niwot Ridge, Colorado, USA

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At Niwot Ridge, CO, near-infrared (IR) heaters are being used to investigate future snow accumulation, snowmelt, and soil microclimate conditions associated with a hypothetical four degrees C increase in temperature. Over the 2010 and 2011 snow seasons, maximum snow accumulation was 42 percent lower and snow disappeared 18 days earlier on average in the heated versus control plots. Soil temperature was 2.6 degrees C greater and soil moisture was 12 percent lower on average in heated plots compared to control plots. In order to estimate differences in snow-atmosphere energy and mass exchange in control versus heated plots, the one-dimensional, physically based snowmelt model, SNOWPACK, was used. Model results indicate considerable alteration to the partitioning of available energy, with decreases in sensible heat flux and increases in latent heat flux in heated versus controlled modeling scenarios. As a result of the increased latent heat flux, sublimation losses to the atmosphere increased by 60 percent and 38 percent on average in heated versus control plots during winter and spring periods, respectively. Results of this study aid in the interpretation of climate manipulation experiments and modeling as they pertain to snowpack, and contribute to a better understanding of the interactions between climate, hydrology, and ecological processes.