A statistical validation of the snowpack model in a Montana climate

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ABSTRACT. Recently, a computer model has been developed by the Swiss Federal Institute for Snow and Avalanche Research that simulates the evolution of a natural snow cover. Using common meteorological parameters as input, SNOWPACK predicts characteristics such as snowpack temperature and density, in addition to snow microstructure and layering. An investigation was conducted to evaluate the effectiveness of SNOWPACK in a Montana climate. A weather station was constructed in the Bridger Mountains near Bozeman, Montana, to provide the meteorological parameters necessary to run SNOWPACK. Throughout the 1999-2000 winter, weekly snow profiles were performed in undisturbed snow to provide a benchmark for the model output. Density, grain size, and crystallography were recorded on 10-cm intervals over the full snow depth, and the temperature profile was monitored with a thermocouple array. Finally, the meteorological parameters were input into SNOWPACK, and a statistical comparison was performed comparing the predicted snowpack to the observational data. Snowpack temperatures are predicted reasonably accurately by SNOWPACK. The modeled and observed densities correlated well, but the model typically underestimates snowpack settlement. Comparison of grain size and shape was problematic due to different definitions utilized by the model and observer, but still demonstrated some agreement.

Keywords: Snowpack modeling; Snow metamorphism; Model validation; Snowpack evolution