Probabilistic model for estimating snow cover duration from ground temperature measurements in the Austrian Alpine region

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Snow cover duration represents a key climate parameter. Trends in the seasonal snow cover duration can be linked to changes of the mean annual air temperature and precipitation pattern and, therefore, can serve as a sentinel for climate change. Snow cover duration is commonly inferred from snow depth or snow water equivalent measurements provided by ground observations or satellites. Recently, methods have been developed to estimate the presence or absence of a snow cover from daily ground temperature variations. This method commonly includes the definition of station-specific thresholds. In our study, we propose to use a probabilistic model for determining a single threshold for the whole dataset. The model takes the daily range and/or the daily mean of ground temperature at 10 cm depth as input and is further calibrated with in situ snow depth observations. Applying the model to 87 measuring sites in the Austrian Alps, we showed that the snow cover estimation was improved when combining the daily range and the mean of ground temperature. Our results suggest that ground temperature records are a valuable source for the validation of satellite-derived snow cover, complementary to traditional ground-based snow measurements.