O-008

Application of a numerical snowpack model to estimate full-depth avalanche danger

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Many full-depth avalanches occur in temperate, snowy regions such as the northern part of Honshu, Japan. Such avalanches threaten infrastructure and communication lines in mountain communities. Despite these threats, numerical snowpack modeling has mainly focused on dry-slab avalanche danger. Predicting wet snow avalanches has been difficult because of model oversimplification of the water transport process in snow. Recently, however, a water transport model for snow was developed using the experimental results of a gravity drainage column experiment and the van Genuchten-Mualem model. This model was incorporated into the larger numerical model, SNOWPACK. This study attempted to estimate full-depth avalanche danger in terms of slope stability using a modified SNOWPACK model. In the simulation, liquid water pooled at the boundary between snow and ground during a melt or rain period. The water then infiltrated the soil. During liquid water pooling, a low stability index was calculated at the bottom layer of snow.

In cooperation with local governments, we gathered information on full-depth avalanches and compared it with the result of the modified SNOWPACK model. This comparison showed that the natural stability index at the snowpack bottom is a useful factor for estimating full-depth avalanche danger by implementation of the water transport scheme.