

Implementation of Depth Hoar Factor Into the SNOWPACK Model

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In the SNOWPACK model, shear strength has been estimated as a function of the snow density using expressions depending on grain types. Therefore, the shear strength changes discontinuously in the model when the grain type changes from rounded grains to faceted grains (and vice versa), although the shear strength changes more gradually in nature.

To express the transition process, we introduced the 'depth hoar factor' on the basis of the result of an experiment on the growth of depth hoar. The depth hoar factor, one of the parameters for the expression of shear strength, is a function of the water vapor transport amount under the temperature gradient condition. It ranges from 0 (rounded grains) and 1 (depth hoar) depending on the metamorphic stage of snow.

In this study, we implemented the depth hoar factor into the SNOWPACK model to calculate the successive change of the shear strength during metamorphosis.

The calculated shear strength using the improved SNOWPACK model agreed well with that measured in the cold room experiment using artificial snow. This model, which can calculate gradually changing shear strength, is expected to improve the accuracy of avalanche forecasting.