降雪系弱層形成に関する気象数値モデルを用いた再現実験
Numerical weather simulation addressing weak layer formation due to transition of snow crystal characteristics

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A new approach is proposed for evaluating a risk of surface avalanches caused by heavy snowfall. In the new approach, a numerical weather prediction model provides the information about snow crystal characteristics such as crystal habits and riming proportion as well as snowfall amount, air temperature, wind speed and so on. For this purpose, new prognostic variables representing depositional growth amount and riming amount of ice particles are incorporated into the Japan Meteorological Agency’s non-hydrostatic model (JMA-NHM).

Using the new model, a snowfall event in Japan that caused avalanche disasters is simulated. In the snowfall event, a developing cyclone passing the south coast of Japan brought heavy snowfall over mountain areas in the Pacific side of Japan from March 26 to 28, 2017. Surface avalanches occurred killing or injuring tens people in the mountain area in Nasu town and near the summit of Mt. Adatara on March 27, According to the reports from the urgent in-situ snow pit surveys conducted within two days after the avalanche, these avalanches were classified as a dry snow surface avalanche. The weak layer identified at the vicinity of the avalanche site in Nasu town was composed of weakly rimed planar crystals, in contrast to the upper and lower layers which were composed of more rimed crystals.

According to the simulation results, at the avalanche site in Nasu town, riming ratio drastically decreases in the midnight of March 26 as is expected based on the snow pit survey. At the observation site near Mt. Adatara, the model shows pristine or lightly rimed crystals during the snowfall event, which is qualitatively consistent with the observation. Giving the new snow density that temporally changes depending on the crystal features simulated by the model to a simple snow densification model, the calculated snow hardness decreases as observed in the weak layer. These results show a potential of the weather model for providing the information about crystal features to a snowpack model in the avalanche risk evaluation.

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