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新雪粒径の与え方が積雪変質モデル SMAP の計算精度に与える影響
Impacts of new snow grain size setup on the performance of a physical snowpack model SMAP

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The snow albedo is a key parameter that controls energy exchanges between the snow surface and the atmosphere. Essentially, the near-infrared albedo is strongly affected by (optically equivalent) snow grain size, while the visible albedo depends on snow impurities. Recently we developed a multilayered 1-D physical snowpack model called Snow Metamorphism and Albedo Process (SMAP) that considers the physical nature of snow albedo explicitly. SMAP calculates temporal evolution of snow grain size as a function of snow metamorphic regimes, namely equi-temperature metamorphism, temperature gradient metamorphism, and wet snow metamorphism. In these processes, tendencies of snow grain sizes are diagnosed every time step, implying that new snow grain size should be provided realistically for accurate simulations of not only snow grain size but also snow physical states. At present SMAP calculates new snow grain size as a function of only air temperature. However, new snow grain size could be affected by the shape of new snow, wind speed, and relative humidity in addition to air temperature. Therefore, the present formulation might cause error in simulation results. In the present study, we investigated impacts of new snow grain size on snow physical states at Sapporo, Japan (Institute of Low Temperature Science, Hokkaido University (43^{o} 05' N, 141^{o} 21' E, 15 m a.s.l)) during 2007-2013 winters by two types of sensitivity tests with SMAP driven by in-situ meteorological and snow data, where we set the new snow grain size to be de facto minimum and maximum values. In the first test new snow grain size was always set to be 20 μm (Test-1), while we set it to be 65 μm in the second test (Test-2). Using the obtained simulation results we examined yearly mean differences of simulated snow depths between Test-1 and Test-2 cases during whole winter period (November to April). As a result, we found significant yearly mean differences that ranged between 2 and 7 cm during the six winters. This result highlights that uncertainties in simulation results traceable to new snow grain size cannot be ignored, and physically based formulation for new snow grain size should be developed in order to improve SMAP model performances.

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