Improvement of snow metamorphism process in Snow Metamorphism and Albedo Processes (SMAP) model

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Since the visible and near-infrared albedos of snow strongly depend on snow grain size and impurity concentration, respectively, those effects should be incorporated into snow albedo model to calculate accurate snow albedo. We developed snow metamorphism and albedo process (SMAP) model, which mainly consists of a snow metamorphism process to calculate snow grain size and a physically based snow albedo model (PBSAM) scheme. Snow albedo is calculated from snow grain size simulated in SMAP together with snow impurity concentrations externally given from aerosol transport model. SMAP simulates snowpack structure with four primary parameters; grain size, bond size, sphericity, and dendricity. To calculate these parameters, the value of new snow grain size (rg_{new}) is required. At first, we took the value of rg_{new}= 0.044 mm from snow pit work observation performed at Sapporo, Japan. However, modeled near-infrared albedo at the coldest period using the value of rg_{new} we employed was underestimated, because calculated snow grain size is overestimated. The reasons are thought that rg_{new} is too large, and kinetic growth metamorphism works too much. In this study, we will discuss the impact of changing the value of rg_{new}, and introducing a formula of rg_{new} which depends on air temperature. We will also discuss the impact of kinetic growth metamorphism near snow surface layers with some sensitivity tests (for example, forcing the process off at near snow surface layers).

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