Simulation of snow algal blooming in the global scale using a land surface model

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Snow algae are cold-tolerant photosynthetic microbes growing on snow and ice during the melting season. The blooms of red snow algae (Sanguina nivaloides) changes the snow surface to red color due to carotenoid pigments in their cells, causing a reduction of the snow surface albedo and acceleration of the melting. Although the red snow phenomena have been reported on the snowfields and glaciers from the Arctic to the Antarctic by in-situ and satellite observations, it is still unclear how the species dispersed globally. Therefore, it is important for biegeosciences to reconstruct their blooming in the global scale. However, the snow algae model, which was proposed previously based on the in situ observations on a snowpack in Greenland, could not reproduce the timing of algal blooming in other areas worldwide, especially in the locations where the snow event frequently occurred or the day-night cycle is apparent during snow melting season. We incorporated the effect of snowfall and day-light length during the algal growth at the locations to the model. To evaluate the performance of the updated snow algae model, we conducted the model validation at fifteen sites from the Arctic to the Antarctic. The improvements enabled to reconstruct the snow algal blooming well reported previously in the various locations worldwide. Based on the model validation, we incorporated the updated snow algae model into a land surface model MATSIRO and performed a global simulation. The global snow algae model (Bio-MATSIRO) is useful to understand the global distribution of snow algal blooming, to evaluate their impact on the snow melting rate globally and to quantify carbon amount in the cryosphere.

Keywords: Snow algae, Numerical modeling, Land surface model

