

Introduction of Future Changes in Japan's cCimate and Impact of snow cover changes on Local Climate through the Surface Energy Balance

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Global warming caused by changes in the Earth's radiation balance alters temperature, precipitation, and snowfall/snow cover on a global scale. In Japan, unprecedented heat waves and heavy rainfall events have been occurring due to global warming. As global warming progresses further, an increase in more extreme weather is projected. This presentation provides an overview of the future climate changes projected in Japan. In particular, we focus on changes in snow in Japan and discusses how future changes in snow cover can affect local weather through surface heat balance processes.

Significant decreases in snow cover have been observed along the Sea of Japan side from the past to the present. The reduction in snow cover is larger in western Japan and smaller in northern Japan. Simulations using a regional climate model shows that decreases in snow cover in mountainous regions are less pronounced than in plains. As global warming continues in the future, the maximum annual snow depth is projected to decline substantially, not only in plains but also in mountainous areas.

In regions with winter snow cover, snow reflects sunlight and prevents the warming of land surface. As a result, the near-surface layer cools through radiative cooling, forming a strong stable layer (a surface inversion layer). Within this stable layer, winds are weak, which further promotes surface cooling. In contrast, when global warming reduces snow cover and exposes the ground surface, solar heat is absorbed by the ground and accelerates the surface warming. Consequently, air temperature rises rapidly, the strong stable layer breaks down, and winds near the ground become stronger. These results suggest that changes in snow cover due to global warming can create new changes in radiation and heat balance, potentially altering local weather conditions.

Keywords: global warming, snow cover changes, surface energy balance, regional climate model