

Effect of Global Environmental Change on Snowfall and Snow Cover in Japan

Abstract

A method to estimate the variation of snowfall and snow cover in Japan caused by global environmental change was developed. In the estimated results based on the local climate scenario, the total snowfall depth in the next 100 years will decrease except in the Hokkaido and Honshu mountain regions, and the maximum snow depth will also decrease countrywide. However, no snow cover will form on the plains of the Sea of Japan side, south of the Hokuriku region.

Research Institute

Hokuriku National Agricultural Experiment Station

Background and Purpose

Snowfall and snow cover has a very strong impact not only on the agriculture production environment in winter but also on the local community in terms of water resources and snow removal and on the ecosystem. By clarifying snowfall and snow cover during a change in the global climate, we can obtain more knowledge about what will happen in the future.

Achievements and Features

1. A method to estimate the variation of snowfall and snow cover in Japan caused by global environment change was developed. From a scenario of average monthly temperature and monthly precipitation, first in an empirical model, we first predicted snowfall (water equivalent of snow) from monthly precipitation, then converted this into monthly snowfall depth, and finally estimated the maximum snow cover depth and snow-depositional environment (grain shape) based on snowfall depth and temperature.
2. With the local climate scenario as input data, we divided the whole of Japan from east to west and south to north into 10×10 km meshes, and then estimated the variation of snowfall depth, maximum snow cover depth, and grain shape decade after decade, between now and in the century ahead. From this scenario, the temperature rise will become prominent after 50 years, and the national average temperature in January will increase to 4.4°C after 100 years. The national average precipitation will change within about 10%. However, there is no definite

changing trend.

3. In the century ahead, the total snowfall depth from December to March will decrease except in the Hokkaido and Honshu mountain regions (Figure 1). At the same time, the maximum snow cover depth will decrease countrywide. In mountain areas except the Tohoku region, the snowfall depth and maximum snow cover will be reduced and grain shape will change from dry snow to wet snow. On the plains of the Sea of Japan side, south of Hokuriku region, because the temperature will rise, there will be no snowfall, so no snow cover will form. These characteristics will become much more pronounced after 50 years.
4. Calculating the respective sums of solid precipitation (value from multiplying the water equivalent of snow by area) in Hokkaido and the south of Honshu, no change will happen in Hokkaido. However, a great decrease will be found in the south of Honshu (Figure 2).

Application and Notes

1. The results can be used to estimate the future, not only the positive side of things such as water resource from snowfall, power energy, and cold source, but also the negative side of things such as the impact on agriculture and forestry, disasters including snowslides, and snow removal from houses and roads, as well as the impact on the ecosystem, water cycle, and climate change.
2. The local climate scenario used in the input was data from the National Institute for Agro-Environmental Sciences based on experimental results of the Meteorological Research Institute of the Japan Meteorological Agency with a 1% annual compound interest increase for concentration of carbon dioxide in the atmosphere.

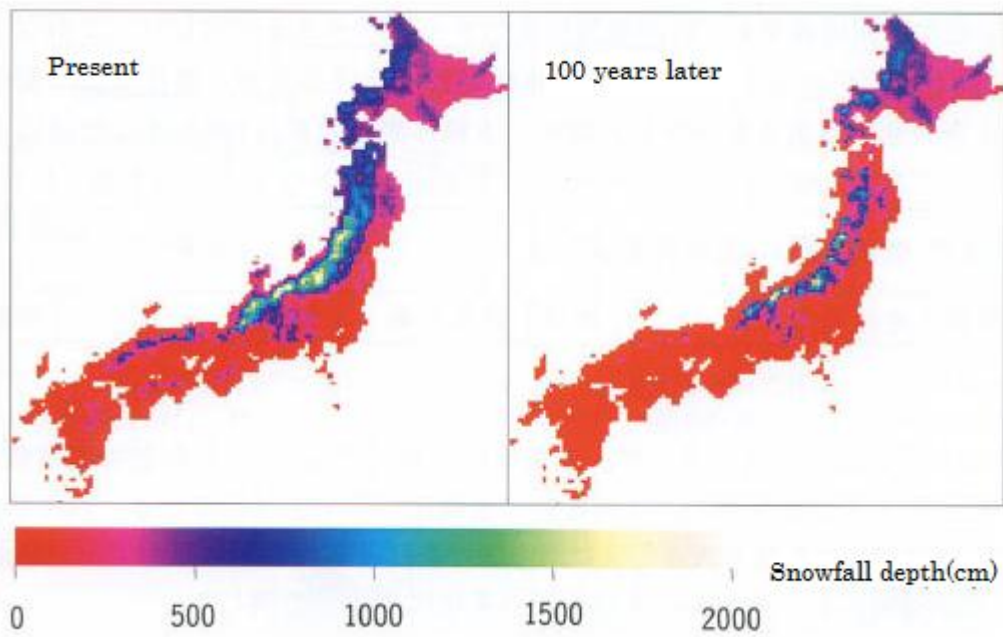


Figure 1. Variation of total snowfall depth from December to March

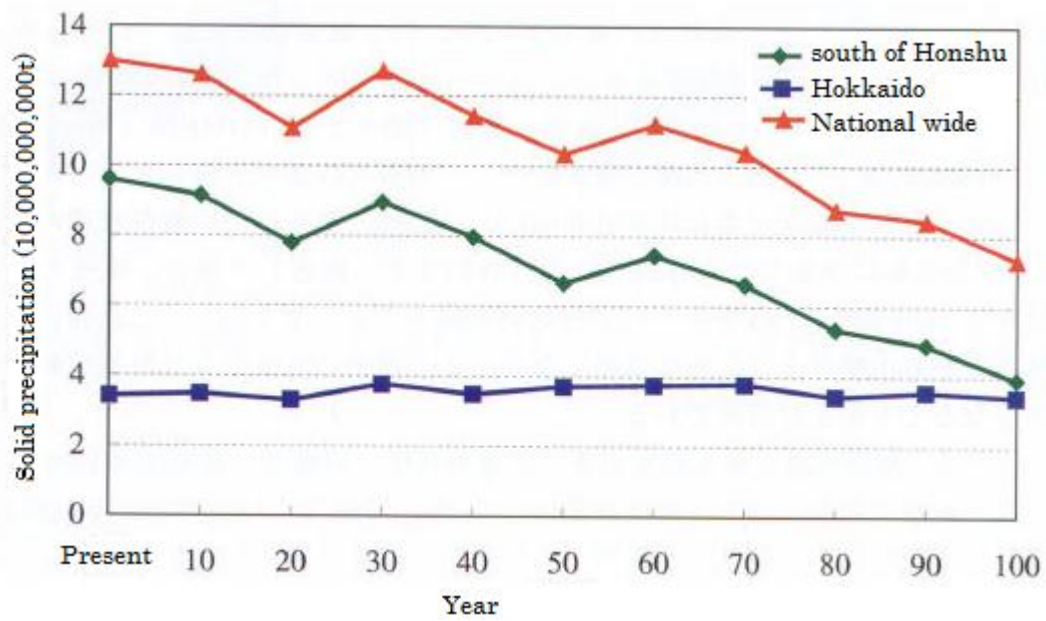


Figure 2. Transition of solid precipitation from December and March