# Changes in Snow Depth Variability over Northeast Asia: Observed and Projections through Coupled Climate Models

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## 1. Introduction

The inter-annual and decadal variability of observed snow depth over northeast Asia during the period 1881 through 1995 is examined in the light of the recent climate change issues. The outputs from the coupled climate models available under the Intergovernmental Panel on Climate Change Fourth Assessment are extracted. For selected models the snow-depth data is used to examine the projections of snow over Mongolia-Northeast Asia region during the 21st century under the doubling CO2 scenario. Implications of projected snow changes on the monsoon variability over East Asia are also determined.

## 2. Data Models and Results

The observed snow data consists of the historical Soviet snow depth data product developed at the National Snow and Ice Data Center, Boulder Colorado, USA, under the bilateral data exchange agreement with the State Hydro-meteorological Service, Obninsk, Russia. The original data are for 284 stations over the former Soviet Union with data periods varying from 1881 to 1984 (version 1) updated till 1995 (version 2). The monthly products i.e. the mean of the snow depth values for a given month are used. More details can be found in Kripalani et. al. (1999, 2002).

The model data consists of the outputs of the coupled climate models assessed as part of the Intergovernmental Panel on Climate Change Fourth Assessment (IPCC AR4). Twenty-three modeling groups from USA, UK, China, Canada, Norway, France, Australia, Germany, Korea, Russia and Japan performed climate change experiments for the 20th and 21st century based on different greenhouse gas warming scenarios. The IPCC AR4 standard output is collected and archived at the Lawrence Livermore National Laboratory, USA. More details can be found in Kripalani et. al. (2007a, b). These datasets are now designated as WCRP CMIP3 (World Climate Research Program Coupled Climate Model Inter-comparison Project Phase3) dataset.

Results reveal that the observed snow depth shows random fluctuations on inter-annual time scale, however on the decadal time scale there are epochs (lasting a few decades) of above and below normal snow depth. Increase in snow depth after 1970s is evident just north of Mongolia. This recent increase in snow depth could be due to the atmosphere warming as greenhouse gases build up and hold more moisture producing heavier snow.

To examine this issue projected snow depth at the time of $CO_2$ doubling is examined from the outputs of the coupled models. The models do project an increase in snow over some parts of Mongolia and north of the Korea-Japan peninsula during the 21st century. However over Korea-Japan a decrease in snowfall is projected

at the time of CO2 doubling. Due to this projected snow distribution the summer monsoon rainfall over China-Korea-Japan is also projected to increase significantly due to the intensification of the North Pacific Sub-tropical High and *Meiyu-Changma-Baiu* front.

## References

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