Abstract

Study of the Regional Climate Model (RCM) has been conducted at the Meteorological Research Institute (MRI) since 1990. The current study introduces a description of the Non-hydrostatic Regional Climate Model (NHRCM) and the projection of future climate changes using the RCM.

Chapter 2 illustrates the projection system used in "The projection of future climate change due to global warming Vol 8" published by the Japan Meteorological Agency (JMA, 2013). The global model, which is the driving force for the NHRCM, is explained, and the NHRCM and the MRI/JMA Simple Biosphere model (MJ-SiB) are described. The names of output variables and file sizes are mentioned for users, and a coordinate transformation is described for using wind data.

Chapter 3 discusses the reproducibility of the NHRCM. The bias of temperature is almost within ±1 degree at each observation site except at high mountainous and urban areas where the biases are approximately -3 degrees, as compared with Automated Meteorological Data Acquisition System (AMeDAS) observation. The precipitation ratio of NHRCM against AMeDAS is less than 20% at almost all observation points. However, there are somewhat large negative biases on the coast of the Japan Sea side and Nansei Island, and positive biases at steep slope areas. The reproducibility of wind and snow depth is also good as compared with the Atmospheric General Circulation Model (AGCM), which drives NHRCM. All models have more or less of some amount of biases. Capturing the features of the model is useful for conducting high accuracy projection.

Chapter 4 introduces projections using NHRCM. The projection of temperature is improved using the bias correction, which is more important for projecting the frequency of days when the temperature rises above 25℃, 30℃ and so on. Total precipitation does not significantly change in almost all future months. However, monthly precipitation in February is projected to significantly increase. Winter monsoons are projected to weaken in the future, and a storm track located on the Pacific Ocean will shift northward. The shift of the storm track brings about the increase in precipitation along the coast of the Pacific Ocean. The underestimation of snow depth along the coast of Japan Sea side is resolved using the bias correction applying the regional frequency analysis, and reasonable projection of snow depth can be conducted.

The expectations for the predictability of local wind increase as the resolutions of models increase. Chapter 5 presents examples of predictability. All the phenomena investigated here are well reproduced in the present climate and projected qualitatively in the future. However, enhancing the resolution is necessary for the model to quantitatively project the phenomena.

The ensemble experiments for evaluating the uncertainty were conducted by the Ministry of Environment, Ministry of Education, Culture, Sports, Science & Technology and JMA. Chapter 6 presents the analyses of the experiments. The temperature is projected to increase in any calculation condition in the future. The rate of increase depends on the strength of the radiative forcing. The annual precipitation does not show distinct change in the future as compared to inter-annual variability.

Lastly, Chapter 7 describes progress for improving the MJ-SiB and urban canopy model. Both processes are considered to play important roles in increasing the degree of model perfection.