

Hydrologic Prediction under Global Warming at Tone and Yodo River Basins using the Output of Global 20-km Mesh GCM

○Sunmin KIM, Yasuto TACHIKAWA, Kaoru TAKARA and Eiichi NAKAKITA

1. Introduction

Global warming is an unequivocal phenomenon at this moment, and the majority of climate scientists agree that it is primarily caused by human activities such as fossil fuel burning and deforestation. According to the latest report of the Intergovernmental Panel on Climate Change (IPCC), there has been a tendency for an increase in heavy rainfall events in many regions. Although precipitation has increased in many areas of the globe, the area under drought has also increased. Future projections from many climate models also show the worldwide unusual precipitation pattern.

Among many climate change impacts on the general hydrology, to estimate the effect of climate change on flood events is one of the most important issues, since the timing and magnitude of floods are needed for design purposes. This study sets out to investigate the possible impacts of climate change on flood producing mechanisms in two main river basins of Japan: the Tone and the Yodo river basins. The most realistic and widely used approach to simulate the hydrological impacts of climate change is to combine the output of the GCMs with a deterministic or conceptual hydrological model that contains physically-based mathematical descriptions of hydrologic phenomena.

2. Methodology

This study uses the output of very high resolution atmospheric models (20-km in spatial and 1 hour in time resolution), which is running under the Innovative Program of Climate Change Projection for the 21st Century (or Kakushin Program) of the Ministry of Education, Culture, Sports, Science, and Technology (MEXT) of Japan (<http://www.Kakushin21.jp>). The given output from the atmospheric model for the three representative periods are 1979~2003 for

the present, 2015~2039 for the near future and 2075~2099 for the end of this century.

Hydrologic models using the OHyMoS library of Kyoto University has composed for the Tone river basin (8,555 km² at the Yattajima gauging station) and the Yodo river basin (7,281 km² at the Hirakata gauging station). Both river basins are commonly located on the upper area of two biggest cities in Japan, Tokyo and Osaka, respectively, and, by this reason, these major basins are regarded as the primary concern for the water-related problem under the future climate change condition.

The hydrologic models are calibrated under the present conditions using the recent observed hydrologic data, and the current dam operation rules for the flood control function are also considered. Based on the given condition, the model simulates long-term discharges for several critical points in the basins using the output of the GCM. The simulated outputs for the three different terms – present, near future and the end of the century – will be examined in a statistical way to find any change of flood pattern in the future. The current dam operation rules are also the subject to be reconsidered whether it is capable of carrying out its function in the changed hydrologic conditions.

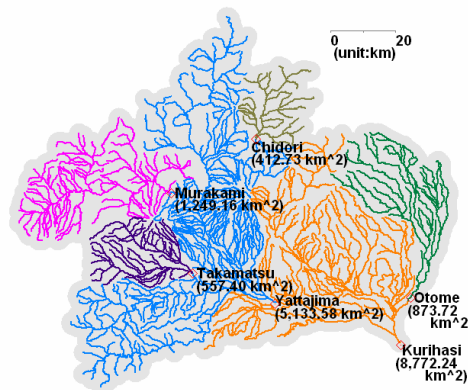


Fig. 1 Tone river basin and the selected sub-basins