第Ⅱ部門

Incorporation of Bias Correction and Spatial Downscaling to Reduce Uncertainty of Hydrologic Impact Projection from Climate Change At Indochina Peninsula

Kyoto University, Student Member ○ Patinya HANITTINAN
Kyoto University, Member Yasuto TACHIKAWA
Kyoto University, Member Yutaka ICHIKAWA
Kyoto University, Member Kazuaki YOROZU

1. Introduction

Water is critical to human survival, sustaining socio-economic development, and the functioning of ecosystem. It also has a close relationship with climate via hydrologic cycle. Any disruptive changes to the climate system are likely to intensify hydrologic cycle and have significant impacts on water resources distribution in time, space, quantity, and quality.

According to Hartmann et al. (2013) [1]; warming of the climate system is unequivocal, many of the observed changes are unprecedented over decades or millennia. Therefore, it can be concluded that climate change is a widely accepted as a scientific fact.

The Indochina Peninsula is vulnerable to climate change and its variability, including rise in sea level, shift of climatic zone, and occurrence of extreme events such as fluvial or coastal floods. It covers from latitude of 5°N to 34°N and from longitude 91°E to 109.5°E, which lies southwest of China and east of India. This region consists of several river basins, e.g., Mekong, Irrawaddy, Chaophraya, Red River etc.

The Objective of this study is to incorporate bias correction and statistical downscaling to help improve the reliability of climate change impact assessment on river discharge in the Indochina Peninsula.

2. Methodology

Precipitation and Runoff Generation data from Global Circulation Models (GCMs), developed by the Meteorological Research Institute (MRI),namely, 60-km resolution, MRI-AGCM 3.2H were obtained and analyzed on the purpose of hydrologic simulation in the Indochina Peninsula during present period (1979-2009) and future period (2075-2104). From this process, changes in annual extreme, mean discharge, shape of probability density function, and uncertainties of present and future 60-km river discharge projections will be evaluated. For the model calibration and verification of historical model simulations, discharge in selected river basins will be compared to Global Runoff Data Centre observations.

Despite being important tools to project the expected future discharge scenarios, GCMs contains systematic biases when compared to observed data due to parameterization of sub-grid scale phenomena and large grid size. Furthermore, gap still exists in developing proper techniques to minimize these biases and to downscale the spatial resolution of runoff generation output from MRI-AGCM 3.2H. Development of proper methods is necessary to minimize the effect of these drawbacks and also improve reliability of GCMs predictive power at local scale.

Bias Correction and Spatial Downscaling (BCSD) method proposed by Wood et al. (2002) [2] using the concept of probability mapping approach to correcting bias and discrete multiplicative cascade model for downscaling are utilized in this study by incorporating bias-corrected and downscaled runoff data into the 1K-FRM, which is the physically-based, distributed flow routing model developed by Tachikawa et al. (2010) [3].

3. Results and Discussion

In this paper, spatial distribution of multi-physics ensemble mean of annual precipitation between Kakushin

Patinya HANITTINAN, Yasuto TACHIKAWA, Yutaka Ichikawa, and Kazauaki YOROZU
hanittinan.patinya.77a@st.kyoto-u.ac.jp

and SOUSEI datasets are compared and discussed.

Figure 1 illustrates the difference of rainfall at the present period, which SOUSEI clearly showed larger precipitation amount than Kakushin datasets up to 4.38% at most of the northern Myanmar, southeast of China, central plain and southern portion of Thailand, as well as the Mekong delta area. On the other hand, the southern part of Irrawaddy river basin and also red river basin in northern Vietnam showed 6.63% less precipitation of SOUSEI than Kakushin.

Figure 2 illustrate comparison of changes in future annual precipitation compared to the present period between SOUSEI and Kakushin. Result showed that the future annual precipitation will increase up to 34.69% from the present period at southeast of China and less increase in northern Myanmar, lower Chao Phraya River Basin, and most of the lower Mekong River Basin. However, 8.08% less precipitation is projected at Yunnan province in China, Red River Basin in Vietnam, Southern Myanmar and Southwest Coast River Basin in Thailand.

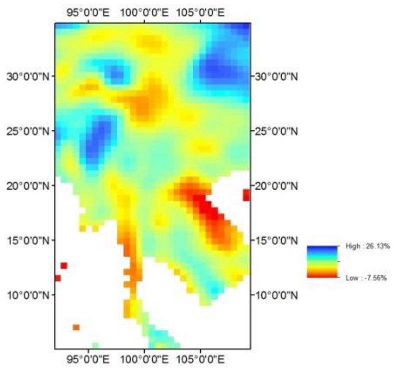
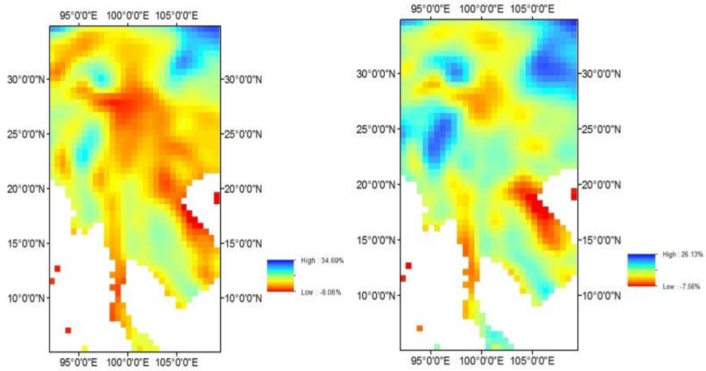


Figure 1. Spatial distribution of annual rainfall difference between ensemble SOUSEI and Kakushin datasets at the present period (1979-2009)

Meanwhile, annual precipitation of Kakushin datasets largely showed similar spatial pattern with SOUSEI datasets, but with lesser degree. For instance, results showed that the future annual precipitation will increase up to 26.13% from the present period at southeast of China and northern Myanmar. Smaller increases are projected at the Greater Chao Phraya River Basin, and most of the lower Mekong River Basin in Cambodia and Vietnam. However, 7.56% less precipitation is projected at Yunnan province in China, Red River Basin in Vietnam, Southern Myanmar and Southwest Coast River Basin in Thailand. Major difference in projected precipitation between SOUSEI and Kakushin occurred around the upper Mekong River Basin in Yunnan Province of China and Northern region of Laos, where SOUSEI projected a small decreased in precipitation, but Kakushin projected a small increase.



(a) (b)

Figure 2. Spatial distribution of annual rainfall difference comparison between ensemble SOUSEI (a) and Kakushin (b) datasets at the future period (2075-2100) compared to the present period (1979-2009)

4. Reference:

1. Hartmann, D.L., A.M.G. Klein Tank, M. Rusticucci, L.V. Alexander, S. Brönnimann, Y. Charabi, F.J. Dentener, E.J. Dlugokencky, D.R. Easterling, A. Kaplan, B.J. Soden, P.W. Thorne, M. Wild and P.M. Zhai (2013) Observations: Atmosphere and Surface. In: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S. K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. *Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA*.
2. Wood, A.W., 2002. Long-range experimental hydrologic forecasting for the eastern United States. *Journal of Geophysical Research*, 107(D20), p
3. Tachikawa, Y., Hunnukumbura, P. B., Yorozu, K., and Apipattanavus, S. (2010) Projection of River Discharge in Thailand under Climate Change and its Impact on Water Resources, Proc. of 2010 AIT-KU Joint Symposium on Human Security Engineering, Bangkok, Thailand, November 25-26, pp. 102-108