Hybrid downscaling using high-resolution RCM information and rainfall-runoff-inundation model simulations

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The statistical downscaling is calculated with lighter computational costs for various patterns of climate states in future which are needed to estimate uncertainty of regional climate change. However, the estimation accuracy is low in areas of poor observations. On the other hand, dynamical downscaling with high-resolution regional climate model (RCM) use huge computational costs, whereas climatological features are well reproduced even in areas of poor observations. A statistical downscaling method as a hybrid-downscaling making use of the advantage of super high-resolution dynamical downscaling is proposed.

The downscaling processes are divided into horizontal interpolation (HI) and bias correction (BC). The corrections for statistical values such as mean precipitation and temperature are applied for every time-step data of coarse-resolution RCM results. The HI model for climatological variables is learned by using the high-resolution RCM result. In BC, correction ratio/difference of high-resolution data are estimated by a generalized linear model with predictors of geographical elements. In addition, quantile-mapping like correction has been also applied for correction of precipitation.

The hybrid-downscaling has been applied for RCM with pseudo-global-warming based method (InDDAS). Multiple future climate simulations had been performed with 24 and 6 km grid sizes, but only one simulations with 2 km grid size had been calculated. Climate information with 2km grid size for multiple future states are estimated by the hybrid downscaling. The estimation errors of the hybrid-downscaling results for mean and extreme values from 24 km (6km) RCM results were large (small).
The downscaling results had been used for simulations of rainfall-runoff-inundation (RRI) model with the target area of Kinu river basin, Japan. The water levels estimated by RRI model with dam controls had been significantly corrected by the BC. By using the hybrid-downscaling results, the number of specific water levels associated with flood risks was estimated to increase due to global warming.

Keywords: Downscaling, Regional climate model, rainfall-runoff-inundation model

