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Potential increase of flood hazards over Korea due to global warming simulated by the RegCM3 double-nested system

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A number of recent studies based on the observation and climate modeling have reported that Korea is regarded to be a highly vulnerability region in response to global warming, in particular for water resources. As Korea is readily exposed to flood hazards due to both nature and human factors such as concentrated receiving approximately two thirds of its annual precipitation during the summer season and intensive land-use changes by urbanization, the modulation of hydrological cycle due to enhanced water holding capacity in warmer atmosphere can result in the complex and non-linear response in terms of mean as well as extreme precipitation changes.
Although the mean characteristics in the average climate might provide the first glance for a changing climate, they are less sufficient to explain the extreme behaviors, which bring major economic damages and negative impact on society and ecosystems. Mean precipitation averaged over relatively long period (e.g. season or annual) impose the limitation of accurate interpretation of the changes in the frequency and intensity of individual extreme events. For example, several researches showed that an increase in precipitation intensity may occur even in areas that on average are getting drier, as the rainfall is projected to be concentrated into more intense events, with longer dry spells in between. It implies that an increase of the total precipitation amounts due to the contribution of heavy rainfall does not necessarily mean less intense drought conditions, thus will not be helpful for water resource management.
To estimate how extreme precipitation events will be changed in a future warmer climate over Korea, we analyze dynamically downscaled results with 3-hour interval simulated by the RegCM3-ECHAM5 model chain under A1B emission forcing. Since extremely heavy rainfall events mostly range from several hours to one day, we focus on the changes in the return period of precipitation intensity occurring within one day. Intensity-duration-frequency (IDF) curves obtained by fitting the Generalized Extreme Value (GEV) distribution are applied to estimate the return periods of extreme precipitation. Based on the IDF curves derived from our projection, significant reductions in return periods of extreme precipitation across various durations (from 3h to 24-hour) are seen. An interesting point is that the intensity of extreme precipitation is not linearly proportional to the annual precipitation amount. The intensity of extreme precipitation (from 3h to 24-hour) continuously increases regardless of the increasing or decreasing trend of annual precipitation. It implies the possibility that global warming can cause an increase flood hazards occurring within short period, even in the absence of large changes in mean precipitation.