Analysis of South Korean basin hydrologic cycle using structural equation model

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Abstract: Hydrometeorological changes such as temperature and precipitation due to global warming have been observed worldwide. An increase in temperature is the most direct effect, but changes in rainfall patterns caused by increased temperature have also been witnessed in various regions of the globe.

It is well known that changes in rainfall patterns affect water cycle processes in watersheds. However, it is not clear whether the effect is simply an increase in rainfall and runoff. The increase in average temperature has resulted in more intense rain, but this phenomenon does not lead to an increase in peak runoff. Rather, there is a possibility that the total amount of runoff may decrease, which may cause problems in securing future water resources (Hettiarachchi et al. 2019; 2022). These results imply that secondary effects such as vegetation change, evapotranspiration, soil moisture, and groundwater level should not be neglected when discussing hydrological changes due to global warming.

In the case of South Korea, it is also important to consider changes in watershed characteristics, such as forests, in addition to changes in temperature or rainfall characteristics. Korea's forest area ratio is 65%, which is one of the highest among nations. This means that evapotranspiration in the watershed has a significant effect on the hydrological cycle, simply making it more difficult to determine the increase in runoff. For example, in climate conditions such as Korea, the activity of plants tends to be proportional to the increase in temperature, so the increase in evapotranspiration will become steeper due to global warming. These changes will be accelerated due to global warming, and the impact will be reflected in changes in the hydrological cycle.

In this study, changes in the hydrologic cycle shown in the observation data were detected and the hydrological processes of the basin were modelled for an in-depth understanding of the watershed hydrological cycle. A structural equation model was selected as a method for modelling the watershed hydrologic cycle. In particular, selecting a model that can appropriately reflect the causal relationship and indirect effects between hydrological cycle processes is also one of the factors considered important.

Based on the analysis of observational data, this study provides a basis for establishment of a structural equation model that can overcome the limitations of given observational data and expresses the causal relationship between various hydrologic components and the evaluation of the resilience of watersheds using it. In particular, the evaluation of changes in the watershed hydrologic cycle when considering climate change is also an important issue to be addressed in the future.

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