Evaluating the impact of climate change on the natural flow regime of rivers

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(Key words) Climate change, climate model, drought

1. Introduction

Climate change will greatly change future rainfall patterns in Japan. It is feared that declining snow accumulation and earlier spring thaw than in the past may increase the risk of droughts. The NILIM has, as part of the Innovative Program of Climate Change for the 21st Century, obtained climate model based predictions as information which contributes to evaluating impact on water resources and studying the application of countermeasures, translated these into hydrological information for regions throughout Japan, and analyzed change of the flow regimes of rivers flowing into dams distributed in climate zones throughout Japan in the future (end of 21st century) and near future (30 years from now). This was accompanied by the presentation of differences in the change of flow regimes revealed by the results of four different climate models, in order to be able to resolve the uncertainty of climate models.

2. Climate models used

The climate models used to calculate future river flow regimes are the four models shown in Table 1 considering the fact that they output values throughout the year and that they satisfy the spatial resolution (about 20km) necessary to calculate a river flow regime.

Table 1. Climate Models Used

Climate model	Emission scenario	Calculation period		
		Present	Near Future	Future
Reform Stage 2: GCM20	A1B	1979-1998	2015-2039	2075-2099
Reform Stage 1: GCM20	A1B	1979-2003	2015-2039	2075-2099
Coexistence: GCM20	A1B	1979-2003	–	2075-2099
Meteorological Agency RCM20	A2	1981-2000	2031-2050	2081-2100

3. Estimating the river flow regime

The flow regimes of the flow into reservoirs in the future and the near future were calculated for 15 dams which are the furthest upstream dams in their respective rivers throughout Japan. The rainfall values used for the calculation are climate prediction model values with their biases corrected by AMeDAS observed values. And the rainfall and snow were again distinguished based on ground surface temperature, then corrected so they were in harmony with the observed accumulated snow depth value. The quantity flowing into the dams was estimated using a four-level tank model, and the discharge caused by the spring thaw was handled as the quantity flowing into the top level tank.

The results of the analysis show that in the near future and future, tendencies common to the four climate models will appear: large annual fluctuation as the flow rate falls during years of light rain and rises in years of heavy rain, accompanied by a remarkable fall of the summer flow rate beginning in May at dams in Hokkaido, Tohoku, Kanto, and Hokuriku, where the spring thaw runoff is remarkable. Because similar trends appeared in all four climate models, it is hypothesized that it seems to be quite certain that these trends will appear in the future. Figure 1 shows an example of calculation results (inflow into a dam on the Japan Sea coast side of Hokkaido).

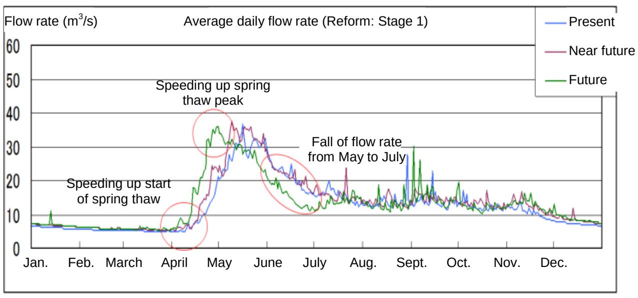

Figure 1. Estimated River Flow Regime (Dam on the Japan Sea Coast of Hokkaido)

4. Future endeavors

In the future, examples of proposed application measures will be presented by analyzing differences between the change of regional flow regime trends and by assessing drought risk including predicted change of water use.

[Reference]

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