平成 23 年度　環境科学院　修士論文の要旨

# “Analysis of a possible impact of global warming on Ishikari River runoff by sensitivity experiments using a hydrological model

(水循環モデルを用いた石狩川の流出量に対する地球温暖化影響の感度実験)

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Global warming makes a serious negative impact on natural system on the earth including hydrological cycle. In particular, hydrological cycle in snowy region will be significantly changed by variation in timing of snowmelt and snow/rain ratio. Runoff in such region decreases in spring, and increases in winter. Increased temperature results in earlier snowmelt in spring, and reduces precipitation as snow in winter. The Ishikari River basin in Hokkaido is the study area of this research. It represents a huge basin in snowy region and includes mountainous area such as Mt. Taisetsu and vast area of paddy field in the Ishikari plain. It is essential to analyze how increased temperature impacts on hydrological cycle and river runoff in this area.

The objective of this study is to analyze a possible impact of global warming on Ishikari River runoff using a hydrological model. In order to quantitatively investigate a role of increased temperature on hydrological cycle, a sensitivity experiment focusing on temperature increase is implemented. The changes caused by increased temperature are analyzed in terms of variation in hydrological factors.

The hydrological model used in this study is developed by Usutani *et al.* (2005). The model consists of land surface model which computes surface energy balance and snow processes, and runoff model which calculates river discharge process. In order to investigate the impact of increased temperature, temperature increment is uniformly added to input data. Temperature increment is assumed from + 1.0 K to + 4.0 K, respectively.

The causes of changes in runoff are analyzed in detail. In order to analyze causes, hydrological factors obtained from the hydrological model are examined. The result addresses rate of the components in monthly runoff changes. As mentioned in previous studies, runoff increases in winter due to increase of rainfall instead of snowfall, and decreases in spring due to decreased volume of snowmelt. In addition, it is found out that discharge from storage (soil moisture) plays a key role in runoff changes whereas snowmelt and rain are significant components. Moreover, causes of decrease in runoff in spring are quantitatively separated into reduction in snowfall and earlier snowmelt. Distributions of hydrological factors are also examined. Responses to temperature increase in lowland and mountainous area are contrasting. In particular, reduction of snowmelt in lowland occurs in April, but it occurs in May in higher altitudes area.

The results of this study help to understand the impact of global warming and contribute to water resource management.