学 位 論 文 内 容 の 要 旨

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学 位 論 文 題 名

Estimating streamflow of the Abashiri River under likely future climate and land use land cover conditions

（将来起こりうる気候と土地利用・土地被覆変化による網走川の流出推定）

Despite that studies on the assessment of future streamflow behaviors in response to climate and LULC changes have become abundant in recent years, more efforts have been dedicated to improving the robustness in future climate and LULC projections, whereas the representation of hydrological processes in the river basin is often overlooked and has been inadequate. More specifically, three key limitations, namely, the lack of consideration on finer spatiotemporal scales, the high dependency of the established method on the used observation data, and the problematic uncertainty yield from the applied hydrological model, commonly exist. Resolving any of the three limitations could improve the reliability of future streamflow estimation. Therefore, the objective in this study was to construct a method to estimate future streamflow under certain climatic or LULC conditions, while could also provide remedies to the three limitations. In addition, this study was facing a high limited data-availability, where only open-access data was possible to be used. Under such premises, a thorough and fundamental approach was proposed and realized to the model construction stage of a distributed model, Soil and Water Assessment Tool (SWAT). Even though the statistical tuning process has been a conventional and widely accepted solution, this study aimed to substantially minimized its use by adjusting the parameter values based on the limited empirical evidence. Both the logic of the adjustment and its practical significance were demonstrated in this study. Using the constructed model, future streamflow under a series of projected future climate and LULC conditions was estimated and compared with the current level in the Abashiri River Basin (ARB), Hokkaido.

The future climate change projection data was obtained from the Japan Meteorological Agency Global Warming Projection Volume 9 (JMA-GWP9), which was projected using a non-hydrostatic regional climate model under IPCC RCP2.6 and RCP8.5 emission scenarios in 2076-2095. In the case of RCP2.6 scenario, annual streamflow received limited change, while slight decrease was estimated in spring and summer. Streamflow in autumn becomes highly variable, and minor change was found

in winter. In the case of RCP8.5 scenario, streamflow changes generally were more significant and less variable than that of RCP2.6, in addition to a two-week early shift of the peak flow occurrence. Maximum daily flow was estimated to increase in both scenarios. Normal flow and low flow of a year exhibited insignificant change in the case of RCP2.6, and a possible decrease in the case of RCP8.5. Moreover, the spatial distribution of changes in streamflow and other water cycle components were produced and compared. Lower- and upper-stream area of the ARB exhibited drastically different manner of change in spring and autumn, when impacts from decreased snowmelt and increased evapotranspiration likely became dominant, respectively. The future LULC change scenarios as of 2050 were obtained from the Predicting and Assessing Natural Capital and Ecosystem Services project (PANCES). From the simulated future streamflow results, it was estimated that possible LULC changes impose insignificant changes and difference of change on future streamflow, in addition to the limited difference in streamflow under different LULC scenarios. A likely reason may be the conservative manner that was applied in the PANCES LULC dataset.

Overall, the proposed manual adjustment to the model parameters provided verified remedies to the three key limitations. The method established in this study could contribute to the improvements of physical meaningfulness in the future streamflow estimations.