Impact of climate change on the surface water balance and groundwater level in the Kurobe River basin, Japan

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The purpose of this study is to clarify the impact of climate change on the surface water balance of the Kurobe River basin using distributed water balance model. The impact of climate change on the groundwater level of the Kurobe River alluvial fan was clarified by using the infiltration estimated water balance analysis as the boundary condition of the three-dimensional groundwater model.

It has been pointed out that the late 21st century of temperature under RCP 8.5 scenario increase by 2.6-4.8 ℃ anomaly relative to 1986-2005. In the future, climate change is projected to raise the temperatures and reduce both snowfall and snowmelt, which is projected to alter snow melting and thus affect water resources and groundwater environment in the Kurobe River catchment. There are many studies on climate change impact on river flow and surface runoff. The impact of climate change on groundwater environment is predicted to change the groundwater level and the recharge area, but there is no quantitative impact assessment study just yet.

In this study, we assessed the impact of climate change on water resources and groundwater levels using the results of several future prediction models. We used two future scenarios (Representative Concentration Pathways RCP2.6 and RCP8.5). This study use the 2014 land use data from the Ministry of Land, Infrastructure, Transport and Tourism, Japan. The layer structure of the groundwater model was created using 731 columnar data. The calculation time interval is daily for water balance analysis and monthly for groundwater analysis.

As a result of comparing the present climate (1981-2000) and future climate (2081-2100) under RCP2.6 and RCP8.5, it was clarified that the daily mean precipitation and solar radiation in the Kurobe River basin are not changing. In the case of RCP2.6 scenario, the daily mean temperature did not change between the present climate and the future climate. On the other hand, the RCP8.5 scenario, estimated that the daily mean temperature in the Kurobe River basin rise by 3.6 degrees in the future. As a result of the rise in temperature, the annual snow water equivalent in the Kurobe River basin decrease by 298 cm (50%), the peak of snow water equivalent is 8 days earlier than the current climate and the time of snow melts is the 22 days shifts earlier. In Kurobe River basin, the surface runoff and infiltration the peak timing shifts earlier (25 days) because of an earlier snow melt caused by global warming. As a result of estimating the water resources in the Kurobe River basin, the water cycle in the Kurobe River basin changed significantly in the futur. The main source of groundwater recharge in the Kurobe River alluvial fan is the Kurobe River, and changes in the water cycle of the Kurobe River are projected to have a significant impact on groundwater. As a result of three-dimensional groundwater analysis, it was clarified that the groundwater level of the alluvial fan increased from February to March and decreased from May to June in future.

