

Hydrologic Responses to the changes in watersheds environments from Meiji-era to present

Takuma Watanabe^{1*}, Michiaki Sugita²

¹College of Geoscience, School of Life and Environmental Sciences, University of Tsukuba, ²Doctral Program in Graduate School of Life and Environmental Sciences, University of Tsukuba

Two sub-basins were selected from within the Kasumigaura watershed for this study. Currently one basin (Sonobe) is mostly a rural area which was covered forests in Meiji period; thus changes are mainly from forests to agricultural fields. Another basin (Onogawa) is more of a sub-urban area which used to be forest/grass lands. A hydrologic model was applied to each of the basins; the model was calibrated against discharge and flux data in this area. After the calibration, two sets of land use were applied to the model, one representing Meiji period and one current condition, while the meteorological forcing data were kept the same by assuming no change of climate.

By comparing the two sets, decrease in evapotranspiration, and net radiation, and increase in discharge, and rise in water table were found until now in comparison to the case in Meiji at Onogawa. These changes can be summarized as follows: about 30% decrease in evapotranspiration, more than twice increase in discharge, about 15% decrease in net radiation, and about 30% decrease in latent heat flux. From inspection of the distribution maps of these variables in watershed, the above changes were identified to have occurred at the areas where forest changed into urban, or agricultural areas. It was considered that the main reason of the decrease in evapotranspiration was the decrease in canopy storage, which caused increase in discharge. Also, increase in surface runoff occurred due to increase in impermeable area; increase in sensible heat flux was due to glass, and urban area that has high albedo. On the other hand, in the comparison with the Sonobegawa results, it was clearly found that there is a difference of impact on water and heat balance due to difference of increase rate of urban, agricultural area.

Especially, in the Onogawa watershed, the rate of increase of urban area was larger in upstream area. Also agricultural area increase was most common in midstream area, and paddy field area was abundant in downstream areas. These land uses were distributed as a mass in Onogawa, while in Sonobegawa changes occurred in scatter, which impacted on the water and heat balance changes.

Keywords: semi-distributed hydrological model, Land use change, Lake Kasumigaura, catchment water budget