Estimating the runoff of water, sediment, and nutrient using SWAT model in Kikuchi-river watershed, Kumamoto, and the influence of the forest

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Recently, enclosed sea area such as Ariake-sea have severe nutrient enrichment problem and is decreasing the produce of fishery industry. Such enclosed sea area is commonly affected by river water quality discharged from the land area. Therefore, estimating the load of sediment and nutrient from its land area is important. However, most of researches estimating discharge from land area is conducted by simple method using primary load factor. These method only can provide the estimates in annual scale regardless of the land use. On the other hand, the positive effect of forest to water quality in the river, so-called green dam, is paid attention recently, and supposed to play important roll on improvement to sea environment. However, the effect of forest to water quality is not explained enough, and few research has conducted in watershed scale. In this study, we aim to simulate water, sediment, and nutrient runoff in order to provide more detail information about discharge from land area, and to estimate the influence of the forest to water quality. We use Soil and Water Assessment Tool (SWAT) and chose Kikuchi-river as a model watershed, which has the third largest watershed area among the rivers drain into Ariake-sea.

We set Komoda observatory as the most downstream point of Kikuchi-river and the model watershed is the upstream side from there. More than half of this watershed is covered by forest. We collected land use data, soil data, climate data and 30m mesh digital elevation model (DEM) data of this watershed in order to establish the model. In order to calibrate and validate the model performance, observed data of daily stream flow from 2008 to 2016, and sampling data of sediment and nutrient were collected. Moreover, we measured the amount of sediment, phosphorus and nitrogen during flood situation in 2016 and 2017. The parameters in the model were modified according to the result of calibration, and the performance of the model was evaluated from three indices such as Nash-Sutcliffe index.

The model performance was evaluated as more than satisfactory for all materials: water, sediment, phosphorus and nitrogen. Therefore, this model can simulate daily runoff from 2008 to 2017. The runoff rate of sediment and most of nutrient from forest was less than 30% of the annual average in whole watershed, although water discharge was the same level to the rate of forest area, which indicates the function of forest to provide low concentrate water of sediment and nutrient to the river. In conclusion, modelling the runoff from land area using SWAT model has potential to provide detail information about land area discharge and estimate the influence of forest to river water quality.

Keywords: SWAT model, Runoff estimation

