セサン川上流域における流れと土砂シミュレーションの再現性の改善
Improving reproducibility of flow and sediment simulation in the upstream of Sesan river basin

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1. INTRODUCTION

Expanding hillslope cultivation, urbanization, and deforestation are the more significant changes in the Central Highlands of Vietnam. The Soil and Water Assessment Tool (SWAT) has been utilized for simulating the impacts of environmental changes on flow and sediment on a watershed scale. The simulation results are impacted by distributions of the input conditions, especially the land use input data. Thus, the main objectives of this study are (1) to develop two land use maps hypothetically from local statistical land use information and (2) to evaluate how much the developed land use maps can improve the flow and sediment simulation.

2. DATA AND METHODS

Study area

The Dakbla watershed (about 3,507 km^2) was selected for this study (**Figure 1**). More than half of the catchment area is covered evergreen and mixed forests. Since 2010, many projects have been conducted to convert mixed forests to rubber forests. Since 2015, again, some of the converted rubber forests area was converted to other crops such as orchard and agricultural crops because of less suitability for rubber production in several areas.

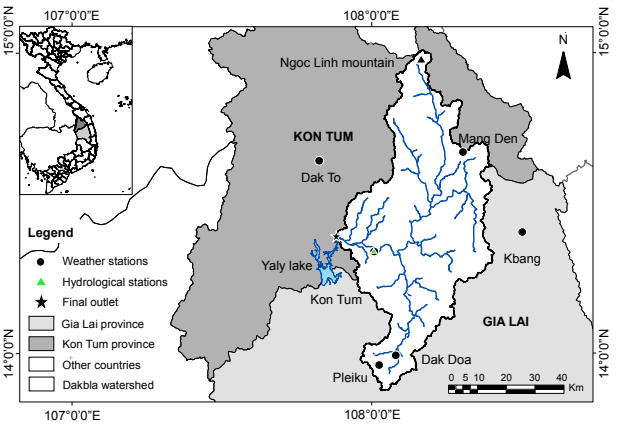

Figure 1. Location of the Dakbla watershed.

Modelling

Simulation of hydrology and erosion is based on the water balance equation and the Modified Universal Soil Loss Equation (MUSLE). The calibration of the model parameter values was conducted using the SWAT-CUP program. In simulation, calibration period was set from 2000 to 2009, and valication period was set from 2010 to 2018. In addition, R software was used to update land use conditions in the simulation.

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Development of two land-use maps in 2010 and 2015

A 2005 land-use map was used as the base land-use map for the simulation. Based on local policy decisions for land use and the statistical information, two new land-use maps were hypothetically developed for 2010 and 2015. When converting a land use type from one to another, land use percentages were mainly focused on because of no spatial location information.

3. RESULTS AND DISCUSSION

Reproducibility of flow and sediment in the calibration period

In the condition of S05 which single land use map (2005) was used in the simulation, the flow was simulated with a NSI value of 0.70. For sediment, the reproducibility of the model was evaluated with a NSI of 0.66 in this period. In addition, in the condition of S0515 which two types of land use maps were used during the calibration period, NSIs for flow and sediment were slightly improved as 0.71 and 0.67, respectively.

The influence of land use update on flow and sediment in the validation period

The NSI values for the S0515, which the land use was updated in 2015, were 0.65. The value was slightly higher than that found with S05 (NSI = 0.62). For sediment, the NSI value of the S0515 was higher than S05 with a value of 0.62 instead of 0.54 in S05.

Influence of land use update for the simulation of flow and sediment

Throughout a period from 2000 to 2018, the difference for the total cumulative sediment load between S05 and S0515 was approximately 523.6 thousand tons (**Figure 2**). Thus, especially, sediment load discharging from the watershed to a downstream lake was underestimated if only 2005 land use map was used in the simulation. It means decision makers may develop unsuitable plan for conserving local environment if they used the S05 results.

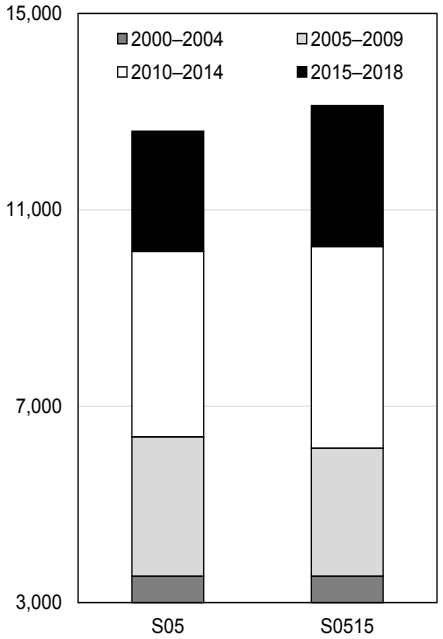

Figure 2. The cumulative sediment discharge (thousand tons)

4. CONCLUSIONS

The study was summarized as follows:

- Two land use maps were hypothetically established and evaluated its usefulness for reproducibility improvement of flow and sediment simulation.
- The reproducibility of sediment simulation was more sensitive than the flow simulation.

These findings could support decision-makers in implementing more effective land use planning policies and water resource management strategies for the watershed in the future.