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Application of Dissolved Organic Carbon Runoff Model Considering Soil Infiltration and River Runoff Processes in Multiple Forested Watersheds

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Estimation of dissolved organic carbon (DOC) runoff load in forested watershed is important for the assessment of the global carbon cycle as well as for the control of regional water environments. A few process-based models have been proposed to estimate the DOC load to water environments, which assume DOC source in topsoil and transport processes to the river, however, these models exhibited difficulties with the availability of input data and applicability to short time-scale rainfall-runoff processes in the Asian monsoon area. This study presents a new process-based model that consists of two separate systems for determining DOC load enforced by DOC Source Area (DSA) concept. For the runoff system, a semi-distributed hydrological modelling unit ('modified-TOPMODEL') was installed, by which surface and subsurface water flows, representing for DSA, were sequentially simulated. For the soil system, a wet-dry cycle was successfully simulated by an advection-diffusion and dissolution formulation as well as seasonal temperature effect. The model is first evaluated upstream (98ha) and downstream (1798ha) in the Mizugaki Watershed, Yamanashi, Japan and then applied for a Miuchi (203ha) watershed, Aichi, Japan during 2014 to 2018. The results of cumulative DOC load at baseflow and stormflow periods that the model performed well between the simulations and observations for both study sites. Considering the stormflow periods, from 25.2% to 32.0%, and 31.1% of high flows contributed to 50% of the total DOC load at Mizugaki and Miuchi watershed, respectively. Overall, the proposed model successfully simulated DOC load under different geochemical and hydrological condition by capturing the DSA variability.