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分布型水循環ー植生動態結合モデルの開発と応用
Developing Distributed Hydrologic-Vegetation Dynamics Coupling Model: A Case Study in African River Basins

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We develop an eco-hydrological model (WEB-DHM + DVM) that can simulate vegetation growth, soil moisture, river discharge, ground water dynamics and land surface fluxes at the same time in river basin scales. Modeling of vegetation dynamics in a hydrological model makes it possible to discuss the integrated management of water resources and bioresources in river basins. Moreover, dynamic vegetation modeling can contribute climate and weather prediction because we have a strong feedback of vegetation distribution to regional climate through land-atmosphere interactions especially in semi-arid regions. Considering landscape changes driven by human exploitation and climate change, we need to calculate vegetation dynamics as a diagnostic valuable in a basin-scale hydrological model. We apply the model to the Medjerda River Basin located in North Africa for a model confirmation study. The simulated river discharge has a good agreement with the in-situ observed river discharge. In addition, we show the model has adequate capacity for simulating vegetation dynamics in the semi-arid region by comparing simulated leaf area index (LAI) with the Moderate Resolution Imaging Spectroradiometer (MODIS) 8-daily LAI product. We also demonstrate the assessment of climate change impact on vegetation dynamics in the Volta River Basin located in West Africa by using WEB-DHM + DVM and multi General Circulation Models (GCMs) output. Our future projections and sensitivity analyses show that an extension of dry season duration and high land surface temperature produced by climate change may cause a dieback of vegetation in West Africa, while an increase of atmospheric humidity has a positive impact on vegetation growth. The negative impacts of certain climate forcings sometimes overwhelm the positive impacts of the other forcings, and positive and negative impacts sometimes cancel each other. Thus, there are different magnitudes of change in biomass amount in different GCMs, although we select three GCMs whose climatologies agree well with past climate. This approach demonstrates that multi-model climate change assessment is crucial, and the sensitivity analysis developed here is useful for extracting principal environmental drivers of terrestrial biomass under a changing climate. The method in this study makes it possible to address the impact of future change of terrestrial biomass on climate and water resources on a regional scale.

キーワード: 植生動態, 分布型水循環モデル, 気候変動
Keywords: vegetation dynamics, distributed hydrological model, climate change