

Simultaneous Estimation of Hydrologic and Ecologic Parameters in an Eco-Hydrological Model Assimilating Microwave Signal

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To improve the skill of reproducing land-atmosphere interactions in weather, seasonal, and climate prediction systems, it is necessary to simulate correctly and simultaneously the surface soil moisture (SSM) and terrestrial biomass in land surface models. Despite the performance of hydrological and ecosystem models depends highly on parameter calibration, a method for parameter estimation in ungauged areas has yet to be established. We develop an auto-calibration system that can simultaneously estimate both hydrological and ecological parameters by assimilating a microwave signal that is sensitive to both SSM and terrestrial biomass. This system comprises a hydrological model that has a physically based, sophisticated soil hydrology scheme, a dynamic vegetation model that can estimate vegetation growth and senescence, and a radiative transfer model that can convert land surface condition into brightness temperatures in the microwave region. By assimilating microwave signals from the Advanced Microwave Scanning Radiometer for Earth Observing System, the system simultaneously optimizes the parameters of these models. We test this approach at three in situ observation sites under different hydroclimatic conditions. Estimated SSM and leaf area index (LAI) exhibit good agreement with ground in situ observed SSM and satellite observed LAI, respectively. The root mean square error of SSM and LAI at all sites, estimated by the model with optimized parameters, is much less than that estimated by the model with default parameters. Using microwave satellite brightness temperature data sets, this system offers the potential to calibrate parameters of both hydrological and ecosystem models globally. This global-scale and automated parameter optimization system may contribute to many other research activities related to land surface, hydrological, and ecosystem modelling although the global-scale applicability of this approach should be investigated as a future work.

Keywords: Eco-hydrological model, passive microwave remote sensing, parameter optimization, data assimilation