

Satellite-based analysis of the land cover change effect on evapotranspiration over semi-arid seasonal wetlands

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Land use and land cover change (LULCC) made by human alters the land surface properties and may affect the broad-scale water cycle, including evapotranspiration (ET). Assessment of the effect on ET is essential for decision making about LULCC, especially for an agricultural land use. However, attempts of the assessment are often confronted with issues on spatiotemporal scalability. Indeed, broad-scale, frequent data collection, and an appropriate ET model which can describe heterogeneous land surface are necessary to diagnose the LULCC effect accurately. Here, we developed satellite-based fine spatiotemporal ET model, which includes satellite data fusion, Jarvis-type surface conductance model, and so-called “trapezoid” approach, in order to reveal the effect of rice introduction into semi-arid seasonal wetlands in north-central Namibia. We established Bowen ratio-energy balance (BREB) measurement systems in the experimental field at University of Namibia, and obtained the Jarvis parameters of rice paddy fields and of natural vegetated wetlands. With those parameters and with fused satellite data (AMSR series, MODIS and Landsat), we ran the developed ET model and estimated ET over three test sites (with areas of 5.3 km × 5.3 km) under the two different scenarios (i.e. rice introduction and natural vegetated wetlands). Validation result showed the estimated ET described seasonal and interannual change well. Surprisingly, ET under the rice introduction scenario was smaller than that of the original states (i.e. under the scenario of natural vegetated wetlands). This was related to the large mitigation of ET in dry season under the rice introduction scenario, in which soil plowing was carried out. The proposed model provided the useful results for this region’s policy making, as well as a novel approach to monitor broad-scale ET over heterogeneous land surfaces.

Keywords: land use and land cover change, satellite data fusion, evapotranspiration model