SEBAL evapotranspiration estimates for the improvement of distributed hydrological model runoff and soil moisture predictions

NAWA RAJ PRADHAN¹, AARON R. BYRD¹, FRED L. OGDEN² & JAN M. H. HENDRICKX³

¹US Army Corps of Engineers, Engineer Research and Development Center, Vicksburg, Mississippi 39180, USA
²Department of Civil and Architectural Engineering, University of Wyoming, Laramie, Wyoming 82071, USA
³Department of Earth & Environmental Science, New Mexico Tech, Socorro, New Mexico 87801, USA

Abstract Uncertainties in the initial distribution of soil moisture negatively impact predictability of runoff and future soil moisture state when using physics-based distributed-parameter hydrological models. In this study we tested a novel method for identifying the soil moisture distribution required to initialize the Gridded Surface/Subsurface Hydrologic Analysis (GSSHA) model. Surface Energy Balance Algorithms for Land (SEBAL)-derived actual evapotranspiration (ET) estimates are used in conjunction with an empirical relationship between the ratio of actual to potential ET and the soil moisture on a pixel-by-pixel basis. The resulting soil moisture estimates were used to initialize a GSSHA simulation of the 3000 km² Kishwaukee River watershed in Illinois. We observed that the derived initial soil moisture distribution improved GSSHA simulation of soil moisture dynamics, reducing the uncertainty in runoff estimation.

Key words soil moisture; evapotranspiration; GSSHA; SEBAL; distributed hydrologic modelling; hydrograph; runoff