Abstract

An Evapotranspiration mapping tool at Landsat resolution on the Google Earth Engine: EEFlux

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The archiving of the Landsat image collection since 1984 onto the Google Erth Engine and the full access to the Google cloud computing system has facilitated the development of an application tool for mapping evapotranspiration (ET) at the field scale. The tool, named EEFlux (Earth Engine Evapotranspiration Flux), is patterned after the operational stand-alone model METRIC (mapping evapotranspiration at high resolution with internal calibration). EEFlux is a full surface energy balance model, producing estimates of net radiation (Rn), sensible heat flux to the air (H), and conductive heat flux to the ground (G). ET is estimated from these surface energy balance components as a residual: ET = Rn – H – G. The production of ET from the surface energy balance provides estimates of actual ET that may be constrained by soil water availability. The EEFlux implementation uses the North American Land Data Assimilation System hourly gridded weather data collection on Earth Engine to estimate maximum (reference) ET using solar radiation, wind speed, specific humidity and air temperature via the American Society of Civil Engineers (2005) Penman-Monteith equation for the tall (alfalfa) reference. The system estimates residual evaporation at the time of the image via a daily soil water balance driven by the GridMET system of Abatzoglou (2011) that produces 4 km grids of evaporation from a bare soil condition for the continental US (CONUS). The Statsgo soil data base of the USDA provides soil type information. EEFlux runs rapidly on the Earth Engine, taking only seconds to produce an ET image for a complete Landsat scene. Applications can be made for the entire CONUS. Ultimately, the EEFlux application will be made freely available to the public via Earth Engine and will include a web-based operating console and means to download ET images as geoTiff files. The ET maps produced by EEFlux have 30 m resolution and are useful for water resources management, for crop production studies, estimating depletions of ground-water and surface water by irrigation, and to estimate water consumption by native vegetation. This work has been supported by Google, Inc. and is possible due to the free Landsat image access afforded by the USGS.

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