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Evaluation of Drought Impact on Evapotranspiration (ET) over a Forested Landscape in North Carolina, USA using daily Landsat-scale ET

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There are 14 million hectares of loblolly pine plantations in the southern US, constituting almost one-half of the area of the world's industrial forest plantation. Hence, improved understanding of the impact of drought on pine plantations is extremely important. Using Thermal Infrared (TIR) imagery acquired from satellites to investigate forest conditions and study impacts of stand management on water yield has recently started to become accepted in forest research community. As a key factor monitoring forest health and regional water use, ET can be estimated based on the TIR imagery using energy balance model. One challenge in using TIR remote sensing is the need for both high spatial and temporal resolution imagery. While Landsat TIR data can provide high spatial resolution, the long revisiting time limits the frequency of ET estimation. This limitation can be addressed by using the Spatial and Temporal Adaptive Reflectance Fusion Model (STARFM) to fuse ET retrieval from Landsat and MODIS. In this study, we applied an energy balance based multi-sensor data fusion method to fuse ET retrieved from Landsat and MODIS to get daily Landsat-scale ET estimation over a forested landscape (∼900km2) on the humid lower coastal plains in North Carolina, USA. The simulation period was from 2006 to 2012, with 2007 and 2008 considered years having severe drought. The simulated long-term ET datacube was evaluated at two separate AmeriFlux sites dominated by a mature and a recently clearcut plantation, showing good agreement with observed fluxes. The ET datacube was mined to investigate changes in water use patterns in response to land cover type, forest stand age, and climatic forcings. Analyses show differential response to extreme drought events, with young plantations and short vegetation showing larger impacts than mature pine plantations with significantly deeper rooting systems.