RSHS18-12
Remote Sensing and Hydrology Symposium (ICRS-IAHS)

The influence of surface roughness on remote sensing-based estimates of evapotranspiration over vineyards

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Remote sensing-based energy balance models are the most viable method of collecting high spatial and temporal resolution estimates of evapotranspiration (ET) needed to manage irrigation and ensure the effective use of limited water resources. Due to the unique canopy structure and configuration of vineyards, however, these models may not be able to accurately describe ET from vineyards. Using data collected from 2014 to 2016 as a part of the Grape Remote sensing Atmospheric Profile and Evapotranspiration eXperiment (GRAPEX), the dual objective of this study was to identify the relationship between the model required roughness parameters [zero-plane displacement height (do) and roughness length for momentum (zo)], and local environmental conditions, specifically wind direction and vegetation density and to determine the effect of using these relationships on the ability of the remote sensing-based Two-Source Energy Balance (TSEB) model to estimate the sensible (H) and latent (LE) heat fluxes. While little variation in do was observed during the growing season, a well-defined sigmoidal relationship was identified linking zo and wind direction. When the output from a version of the TSEB model incorporating these relationships (TSEB_V) was compared to output from the standard model (TSEB_S), only modest differences in either the roughness parameters or turbulent fluxes were seen. When the output from TSEB_V was compared to that of a version using a parameterization scheme representing open canopies (TSEB_O), the mean absolute difference between the estimates of do and zo were 0.44 m and 0.25 m, respectively. While these values represent differences in excess of 45%, the turbulent fluxes differed by approximately 10%, on average. The results suggest that the TSEB model is largely insensitive to changes in the roughness parameters, and that accounting for wind direction and other environmental factor influencing the roughness parameters has limited utility for enhancing the TSEB model in vineyard systems.