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Evapotranspiration assessments from drone-based thermography - a method comparison in an oil palm plantation and a look ahead

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Evapotranspiration (ET) is a key flux in hydrological cycles; it is affected by both climate and land-use change. A recent study across 42 study sites in four land-use types in lowland Sumatra (Indonesia) reported that local and regional transpiration are on the rebound due to the high water use and continuing expansion of oil palm plantations. Conventional ET assessment methods such as satellite-based thermography or the eddy covariance (EC) technique lack the high spatial resolution and spatial replicability, respectively, that are required for ET assessments in dynamic and heterogeneous, mosaic-like landscapes. For such assessments of ET, near-surface airborne thermography offers new opportunities for studies with high numbers of spatial replicates and in a fine spatial resolution. In our study, we tested drone-based thermography and the subsequent application of three energy balance models (DATTUTDUT, TSEB-PT, DTD) using the widely accepted EC technique as a reference method. The study site was a mature oil palm plantation in lowland Sumatra. For 61 flight missions, latent heat flux estimates of the DATTUTDUT model with measured net radiation agreed well with eddy covariance measurements (r^2=0.85; MAE=47; RMSE=60) across variable weather conditions and daytimes. Confidence intervals for slope and intercept of a Deming regression suggest no difference between drone-based and eddy covariance method, thus indicating interchangeability. TSEB-PT and DTD yielded agreeable results, but all three models are highly sensitive to the configuration in which net radiation is assessed. Overall, we conclude that drone-based thermography with energy-balance modeling is a reliable method complementing available methods for ET studies. It offers promising, additional opportunities for fine grain and spatially explicit studies. Further steps in the near future will include the testing and if necessary calibrating of the method across different biomes as well as ecological applications.