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Publication date:
2016

Document Version
Publisher's PDF, also known as Version of record

NORDIC UAS EVENT | 1-3 JUNE 2016 ODENSE

Hyperspatial mapping of water, energy and carbon fluxes with Unmanned Aerial Vehicles

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Having spatially distributed estimates of energy, water and carbon fluxes between the land and the atmosphere is of critical importance for improving water resource management, agricultural production, weather forecasting, and climate prediction. Traditionally, satellite based remote sensing data of vegetation or temperature has been used as inputs into land surface models (LSMs). However, the coarse resolution of satellite based remote sensing (3-90 km) data could not accurately capture spatial heterogeneity in fluxes due to changes in topography, soil types, and vegetation. With significant advances in navigation, flight control, miniaturized platforms and sensors, Unmanned Aerial Vehicles (UAVs) can provide ultra-high spatial resolution imagery (1 cm to 1 m). This presents a good opportunity to improve land surface modeling. From this perspective, our study explores the possibility to incorporate UAV-based remote sensing into LSMs. A site growing an energy crop with field sensors (eddy covariance, radiation or soil moisture) at DTU-Risø is chosen for the pilot study. A hexacopter (Tarot) equipped with a six band multispectral camera (Visible and near infrared), a thermal camera and a digital camera regularly flew over the flux site. In the near future, a smart UAV platform combining rotary and fixed wing functionality will be used as platform. The imagery acquired by UAVs will be used to retrieve the vegetation indices and land surface temperature. These data used for land surface modeling to estimate biomass, plant diseases or stress, water uptake.