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UAV-based structural and spectral data for the assessment and monitoring of oil palm biomass

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Remote sensing data provide essential capabilities regarding the monitoring of oil palm plantation carbon stocks through structural or spectral information from satellite and airborne platforms. A commonly estimated metric is the aboveground biomass (AGB) which varies with growth stage, age and status of individual palms. Unmanned aerial vehicles (UAVs)now offer new opportunities of estimating AGB related plant traits at spatially contiguous fine resolution which may prove useful in bridging the gap between in-situ measurements of oil palm traits and coarser grained satellite data, improving the capacity of large scale monitoring of oil palm plantations and their dynamics.

During a field campaign in January 2018, we will be deploying standard optical camera systems alongside a Parrot sequoia multispectral sensor on a consumer grade UAV, with a view towards characterising various age stands within an extensive oil palm plantation in Sarawak (Malaysian Borneo), with a focus on AGB estimation.

In the presentation we will demonstrate the results obtained – specifically we will demonstrate the utility of UAV based structure from motion (SfM) photogrammetry techniques to generate 3D point clouds, segment individual palms and derive height metrics to be used in the AGB estimation of oil palm plantation plots at different development stages.

We plan to calculate uncertainties in canopy height estimates and validate such measurements relative to in situ measured heights from the field. We will discuss the impact of ground sampling distance on the quality of the results obtained, as a function of flying altitude. Field data for the training and validation of an AGB model will be acquired allometrically and will also be used to compare UAV-based sub-plot and plot level estimates to more labour intensive in-situ point sampling strategies. For multiple sub-plots, corresponding UAV-acquired multispectral data will be used to generate maps of surface reflectance which are assessed by in-field validation using a point spectrometer (Ocean Optics). These maps will allow further investigation of the relationship between variations in the spectral signature and AGB in oil palm plantations, e.g. through plant area and shade fraction. The uncertainties in the products derived in this study will be discussed in regards to the potential utility of UAV acquired structural and spectral data for developing larger-scale models of AGB based on composites of medium resolution (10-30 m) multispectral satellite data.