Geophysical Research Abstracts
Vol. 18, EGU2016-4279, 2016
EGU General Assembly 2016

UAV-based Estimation of Carbon Exports from Heterogeneous Soil Landscapes – A Case Study from the CarboZALF Experimental Area

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The advantages of remote sensing using Unmanned Aerial Vehicles (UAVs) are a high spatial resolution of images, temporal flexibility and narrow-band spectral data from different wavelengths domains. This enables the detection of spatio-temporal dynamics of environmental variables, like plant-related carbon dynamics in agricultural landscapes. In this paper we quantify spatial patterns of fresh phytomass and related carbon (C) export using imagery captured by a 12-band multispectral camera mounted on the fixed wing UAV Carolo P360. The study was performed in 2014 at the experimental area CarboZALF-D in NE Germany. From radiometrically corrected and calibrated images of lucerne (Medicago sativa), the performance of four commonly used vegetation indices (VIs) was tested using band combinations of six near-infrared bands. The highest correlation (R^2 = 0.88) between ground-based measurements of fresh phytomass of lucerne and VIs was obtained for the Enhanced Vegetation Index (EVI) using near-infrared band 11 (899 nm). The resulting map was transformed into dry phytomass and finally upscaled to total C export by harvest. The observed spatial variability (75-225 g C m-2) at field- and plot-scale could be attributed to small-scale soil heterogeneity in part. Soil effects were suppressed by the nearly optimal weather conditions for plant growth in 2014.