UAV to measure canopy height and plot biomass in a lucerne variety trial

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Sensing – New Insights into Grassland Science and Practice

Book of Abstracts

From the field to the region – monitoring pre-Alpine grassland characteristics at different spatial scales

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Abstract

Grasslands in their various forms of appearance characterize the pre-Alpine landscape. Despite the economic value and significant role of plants in grassland carbon and nitrogen cycling, spatially explicit information on grassland biomass are rarely available. This study aims to develop routines to monitor grassland traits at different spatial scales. Field sampling campaigns were conducted in April 2018 and at multiple times during the growing seasons of 2019 and 2020 to collect in-situ data of aboveground dry matter biomass (DM) from differently managed grasslands. The campaigns were partially accompanied by unmanned aircraft system (UAS) flights to acquire very high resolution multispectral imagery at the field-scale. These data were complemented by time series of Sentinel-2 (S2) imagery to address the regional scale. In a first step, we tested different statistical modelling approaches and UAS input datasets to estimate DM for the single-date acquisition in 2018. Promising results were obtained by the machine learning algorithms random forest and gradient boosting machines (cross-validated R^2 of best model = 0.71). A first multi-temporal DM model for S2 imagery was developed and used to create regional maps. In the next phase we will adapt the algorithms to multi-temporal UAS data and compare the results across different scales.

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Abstract

The objective was to test the reliability of height and biomass measurements of lucerne by digital photogrammetry using an unmanned aerial vehicle (UAV). Height measurements were recorded on a variety trial involving 440 microplots of pure stand lucerne over two years from April 2019 to November 2020. For comparison, manual measurements of plant height and dry matter yield (DMY) were performed the same day as the UAV acquisitions at the end of eight growth cycles. The model Phantom 4 Advanced (DJI) with mounted RGB camera equipped with a 20-megapixel CMOS sensor was used for image acquisition. The flights occurred at an altitude of 9 m to achieve a resolution of 2 mm. When UAV heights were calculated using 100% of the pixels of the canopy height model, the correlation between heights and DMY derived from UAV acquisitions were greater than those derived from manual measurements. Regressions on the set of flights per year between UAV heights and DMY were similar with high correlation coefficients in 2019 and 2020 (0.89 and 0.96, respectively). We conclude that UAV equipped with a high-resolution RGB camera allow rapid acquisition and data treatment and predicting reliable results of canopy height and DMY for the lucerne.