Geophysical Research Abstracts
Vol. 19, EGU2017-8703-1, 2017
EGU General Assembly 2017

Hyperspectral classification of grassland species: towards a UAS application for semi-automatic field surveys

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Grasslands are one of the ecosystems that have been strongly intervened during the past decades due to anthropogenic impacts, affecting their structural and functional composition. To monitor the spatial and/or temporal changes of these environments, a reliable field survey is first needed. As quality relevés are usually expensive and time consuming, the amount of information available is usually poor or not well spatially distributed at the regional scale. In the present study, we investigate the possibility of a semi-automated method used for repeated surveys of monitoring sites. We analyze the applicability of very high spatial resolution hyperspectral data to classify grassland species at the level of individuals. The AISA+ imaging spectrometer mounted on a scaffold was applied to scan 1 m^2 grassland plots and assess the impact of four sources of variation on the predicted species cover: (1) the spatial resolution of the scans, (2) the species number and structural diversity, (3) the species cover, and (4) the species functional types (bryophytes, forbs and graminoids).

We found that the spatial resolution and the diversity level (mainly structural diversity) were the most important source of variation for the proposed approach. A spatial resolution below 1 cm produced relatively high model performances, while predictions with pixel sizes over that threshold produced non adequate results. Areas with low interspecies overlap reached classification median values of 0.8 (kappa). On the contrary, results were not satisfactory in plots with frequent interspecies overlap in multiple layers. By means of a bootstrapping procedure, we found that areas with shadows and mixed pixels introduce uncertainties into the classification. We conclude that the application of very high resolution hyperspectral remote sensing as a robust alternative or supplement to field surveys is possible for environments with low structural heterogeneity. This study presents the first try of a full classification of grassland species at the individuum level using spectral data.