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The role of UAV based multispectral data for fine scale plant community mapping and assessment in high ecosystem service value coastal meadows

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Recent developments in UAV technology allow for the rapid acquisition of highly detailed multispectral aerial imagery. As opposed to satellite-based earth observation techniques, the ability of UAVs to be operated at lower altitudes allow for repeated measurements without weather limitations such as dense cloud cover. These characteristics render UAVs an ideal tool for predictive plant community mapping. Despite the wide use of UAVs and multispectral sensors in precision agriculture, forestry and nature conservation, the use of these platforms for mapping semi-natural grassland communities has received little attention in the scientific literature.

Coastal meadows are priority habitats, according to the EU Habitats Directive. These grasslands provide a wide range of ecosystem services including: fodder for cattle, carbon storage, habitat for pollinators, erosion control, and flood regulation and support high biodiversity including plants, migratory and breeding birds, and pollinating insects. In spite of their ecological importance, coastal meadows have been subjected to habitat degradation in the form of agricultural intensification in many areas and abandonment in others. Efforts aimed at halting these trends face limitations in data availability regarding the current location and extent of the plant communities in many coastal meadows.

In order to address this lack of data, we present a workflow that integrates UAV-based multispectral imagery acquisition, vegetation indices calculation and machine learning algorithms to differentiate between five plant community types in coastal meadows in West Estonia. To automatically map the five communities under study (Reed swamp, tall grass, lower shore, upper shore and open pioneer), the ability of an agriculture-oriented camera to classify spectrally similar communities was tested.

Preliminary results show a good classification accuracy using 13 vegetation indices derived from multispectral aerial imagery and a random forest classification algorithm. Incorporating data derived from Structure from Motion shows a promising path for improving results in the near future. The maps derived from the UAV images constitute the basis for further analyses and applications such as ecosystem services mapping and assessment, habitat management strategies and assessment of the effects of climate change.