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Measuring soil erosion resistance on coastal dikes linking hyperspectral UAV-data, plant traits and soil information

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The integrity of a sea dike, especially its surface soil and biological revetment, is indispensable for coastal protection, as a dike breach would result in damages and economic losses. Estimates of the condition of a sea dike are typically established by on-site inspections and expert judgement at regular intervals. These status assessments of the protection level of the sea dike evaluate grass coverage and animal burrows, since structural inconsistencies deter the overall safety levels on coastal protection. In laboratory settings, erosion resistance of a sea dike is often determined by means of assessing critical shear stress induced by wave-run up and overtopping. Whereby the grain size distribution and soil aggregate formation on the one hand and the root penetration of the sample on the other are significant factors influencing critical shear stress and therefore erosion resistance.
Drone-/UAV-based remote sensing can be used to easily determine the degree of coverage of the dike revetment via green value detection. Thermal spectroscopy is also already used in agriculture to detect the state of health of plants at an early stage, for example due to a shortage of water. In addition, plants can be classified using hyperspectral imaging data.
We aim to derive transfer functions correlating ground truthing data, drawn from coastal real world- and a full scale laboratory dike, with plant species, its characteristic taxonomic traits and assessed top soil parameters. This approach bears the advantage of yielding an erosion-resistance estimate of the dike cover based on the plant classification using UAV-derived hyperspectral information. Furthermore, taxonomic species are sought to be paired with their respective, site specific, root architecture. Soil parameters such as nutrient availability and humidity will be observed and integrated into the approach, as they bear an impact on subterranean vegetation growth in that plants with lower nutrient availability develop a higher root network (high root length density [cm/cm³]). Finally, grazing livestock on the dike impacts the root system and soil structure as well and both aspects will be investigated comparing mowed against grazed areas as preliminary results show a dike cover void of grazing livestock exhibits a higher root shoot ratio than one with grazing. We hypothesize that classifying plants based on optical, hyperspectral UAV-

derived data and the knowledge about the composition of the subsoil, the correlation of plant-specific root architecture and root growth with nutrient availability and agricultural maintenance could provide valuable information about erosion resistance of the dike cover to support dike inspection on an objective basis.