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Structural and Functional Connectivity from Unmanned-Aerial System Data

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Over the past decade there has been an increase in both connectivity research and research involving Unmanned-Aerial systems (UASs). In some studies, UASs were successfully used for the assessment of connectivity, but not yet to their full potential. We present several ways to use data obtained from UASs to measure variables related to connectivity, and use these to assess both structural and functional connectivity. These assessments of connectivity can aid us in obtaining a better understanding of the dynamics of e.g. sediment and nutrient transport. We identify three sources of data obtained from a consumer camera mounted on a fixed-wing UAS, which can be used separately or combined: Visual and near-infrared imagery, point clouds, and digital elevation models (DEMs).

Imagery (or: orthophotos) can be used for (automatic) mapping of connectivity features like rills, gullies and soil and water conservation measures using supervised or unsupervised classification methods with e.g. Object-Based Image Analysis. Furthermore, patterns of soil moisture in the top layers can be extracted from visual and near-infrared imagery. Point clouds can be analysed for vegetation height and density, and soil surface roughness. Lastly, DEMs can be used in combination with imagery for a number of tasks, including raster-based (e.g. DEM derivatives) and object-based (e.g., feature detection) analysis: Flow routing algorithms can be used to analyse potential pathways of surface runoff and sediment transport. This allows for the assessment of structural connectivity through indices that are based, for example, on morphometric and other properties of surfaces, contributing areas, and pathways. Third, erosion and deposition can be measured by calculating elevation changes from repeat surveys. From these “intermediate” variables like roughness, vegetation density and soil moisture, structural connectivity and functional connectivity can be assessed by combining them into a dynamic index of connectivity, use them in connectivity modelling (Masselink et al., 2016b) or be combined with measured data of water and sediment fluxes (Masselink et al., 2016a).

References

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