Arbeitskreis Fernerkundung

Treffen des Arbeitskreises Fernerkundung am 06. und 07. Oktober 2022 in Halle (Saale)

Emanuel Vogel (University of Basel), Nikolaus J. Kuhn (University of Basel), Juliane Krenz (University of Basel)

Mapping Ecotonal Landscapes by Combining UAV and Satellite Imagery

Abstract

The Nama-Karoo is a semi-arid biome in South Africa whose vegetation consists of mostly perennial dwarf-shrubs that grow within a matrix of annual and perennial grasses. At its eastern extent the Nama-Karoo transitions into the wetter Grassland biome. The vegetation composition of this ecotonal boundary area is highly dynamic, and since the arrival of the European farmers in the 18th century it has been shifting back and forth between being predominantly shrubby or grassy depending mostly on variations in seasonal rainfall. Additionally, farming practices have a transforming effect on the landscape, as excessive grazing can increase the risk of land degradation which impacts the carbon cycle. In order to gain a better understanding of these complex human-environment interactions and their quantitative impact on climate, large-scale, long-term monitoring of the eastern Karoo ecotone is key. Public optical Earth Observation Satellites (EOS's) offer sufficient area coverage, as well as temporal and spectral resolution for this task, however, their spatial resolutions are not fine enough to resolve the heterogeneous vegetation mixtures typical for the region. Unmanned Aerial Vehicles (UAV's) on the other hand can be equipped with high-resolution, multispectral cameras capable to deliver both the necessary spectral and spatial resolutions, but achieving the needed area coverage as well a high temporal resolution is practically unfeasible. We therefore propose a methodology for upscaling UAV-derived vegetation cover classifications to regional scale using free Sentinel-2 and Landsat data. Our reasoning for upscaling to both Sentinel-2 as well as Landsat is not only to cover large areas with the best resolution available (Sentinel-2), but also to exploit historical time-series data (Landsat) to understand past trends in vegetation dynamics. Ultra-high spatial resolution RGB and multispectral UAV imagery (<5 cm) is used to create a classification map, distinguishing between 3 main land cover types (shrub, grass, soil). Based on this, lower resolution reference classification maps, matching the Ground Sampling Distance (GSD) of Sentinel-2 (10 m) or Landsat (30 m) respectively, will be created with each pixel representing a specific mixture of shrub, grass and bare soil. Exploiting the spectral resolution of the EOS's, a supervised classification algorithm will then be trained to match the reference classification as closely as possible. The classification can be improved further by utilizing multitemporal satellite data to take advantage of the pronounced seasonality of the eastern Karoo. Initial results of our first fieldwork conducted in the Sneeuberg Nature Reserve near Middelburg (Eastern Cape, ZA) are promising regarding the distinguishability of shrubs and grasses, as well as the recognition of degraded areas using multitemporal Sentinel-2 data. We see great potential in the proposed method to not only increase current knowledge of biome shifts and their impact on soil organic carbon concentration and climate but also to provide local farmers with a valuable tool for detection and risk assessment of land degradation. Further, we believe, that this method can eventually also be extended to work in other semi-arid ecotonal regions.