The potential use of UAV's to monitor vegetation at long-term observatories in Namibia

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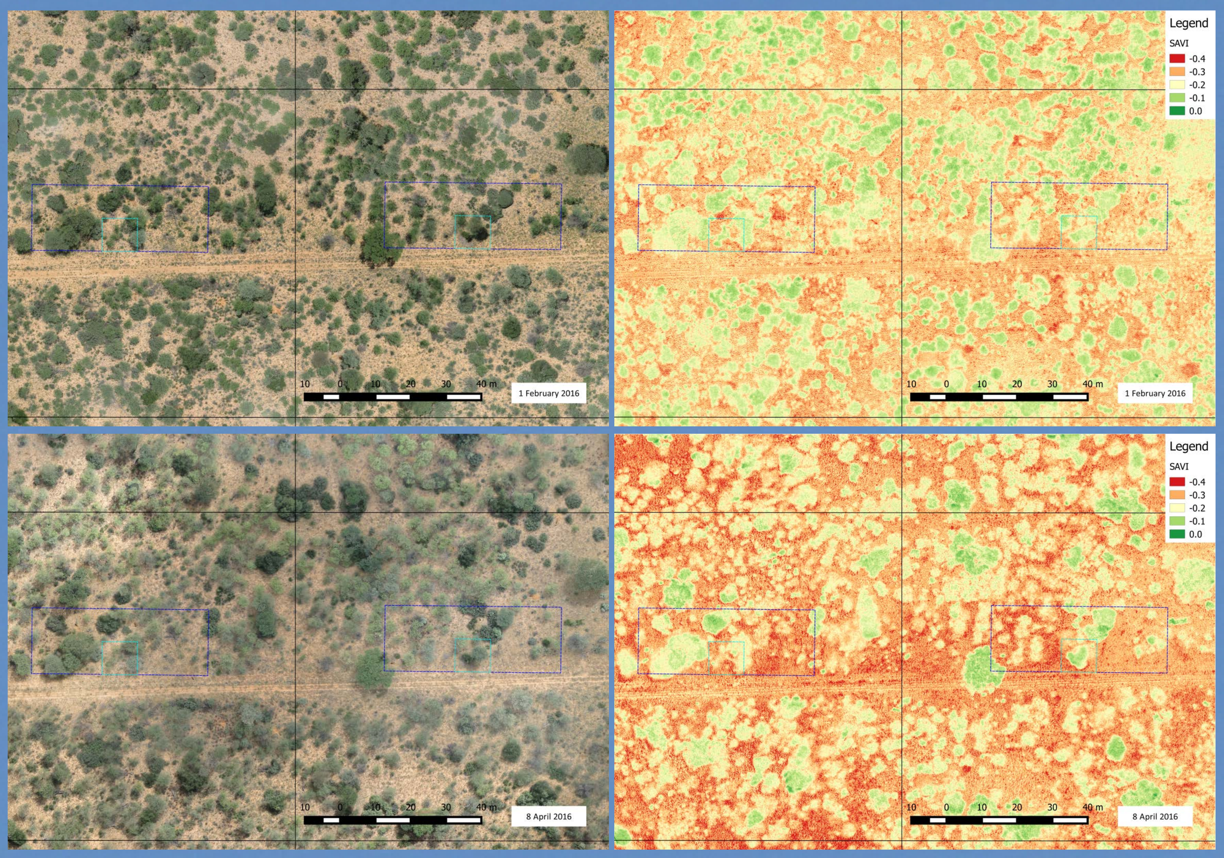
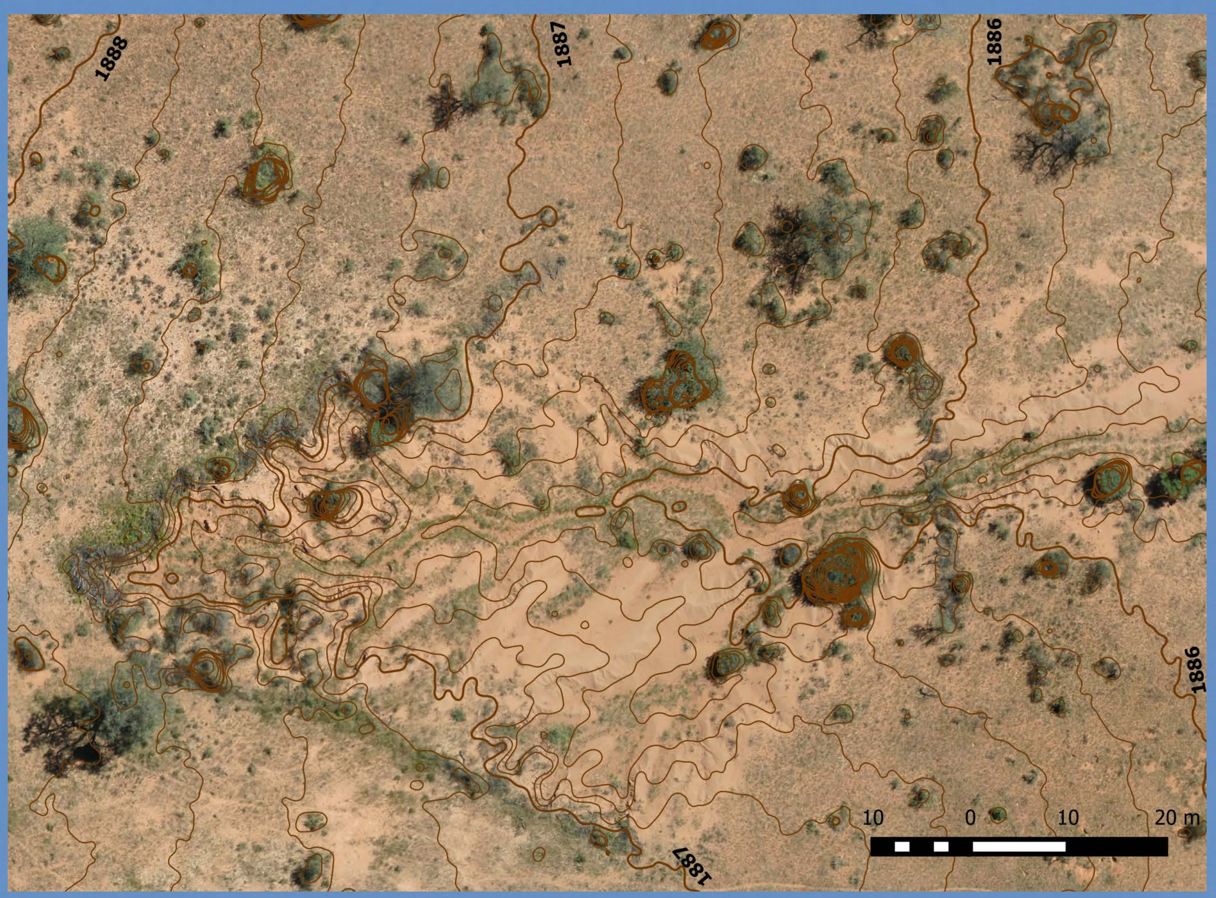
UAV's, specifically miniature surveying drones, are becoming increasingly popular for high-resolution, easily repeatable aerial photography for biodiversity monitoring purposes. Such a drone was recently obtained for exactly this purpose - to aid the monitoring of the woody vegetation at the biodiversity observatories in Namibia. The biodiversity observatories in Namibia however do not only cover woodland or savanna vegetation - in the contrary, several are situated in both dwarf shrub savanna (with the dominating woody vegetation below 1 m height) as well as desert biomes, including the Namib lichen fields.

With 21 biodiversity observatories spread over a 825,615 km^2 country, we are faced by major manpower and logistical problems to regularly do the necessary monitoring surveys each year – especially considering, that surveys are restricted to the rainy season, which often lasts less than four months. Our team generally manages up to 10 of these observatories annually, concentrating on floral diversity rather than structural diversity. Especially in the denser savanna areas of central and northern Namibia, a good understanding of the woody vegetation dynamics is essential to understand ecosystem health. For this, a detailed count of woody plants would be necessary, which is extremely time consuming.

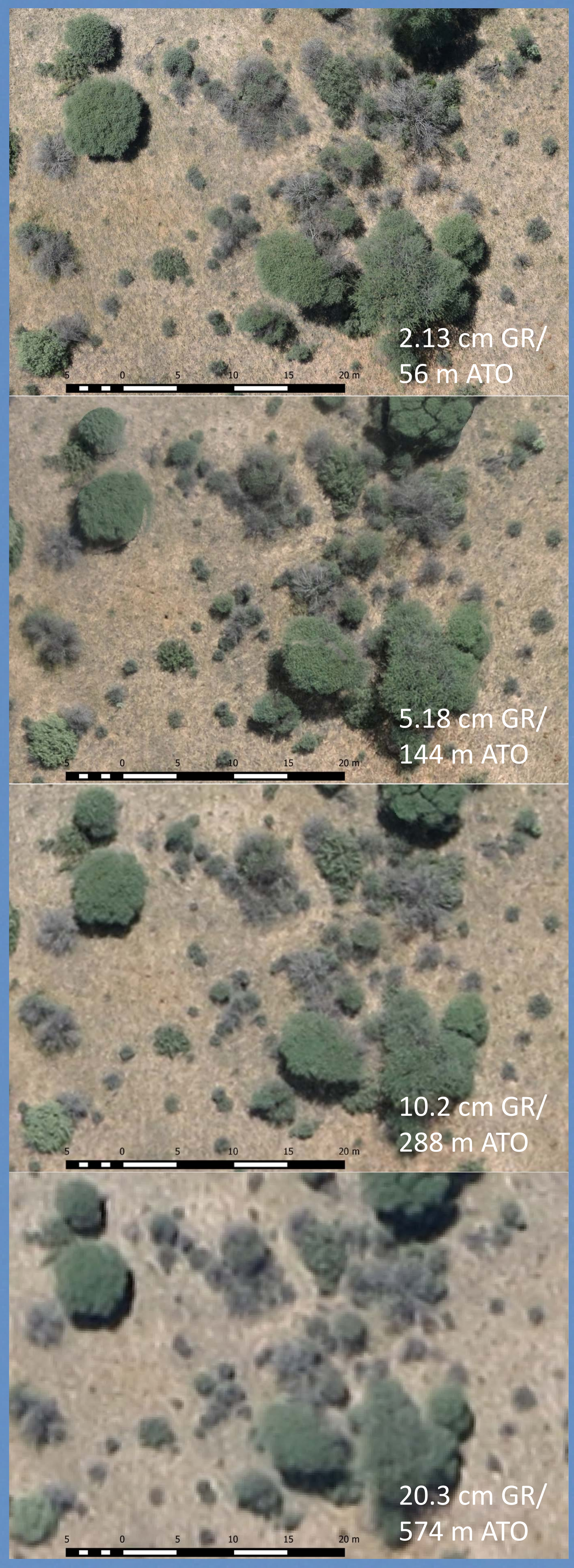
The idea came up whether annual monitoring of the woody component, as well as other indicators like grass cover and bare ground, cannot be done by cheap, repeatable high resolution aerial photography. For this an easy to use, out of the box solution was necessary – able to cover a square kilometre, able to complete a mission fully autonomous, able to prepare a final map (final product) from the photos. The eBee (from Sensefly) fitted these specifications. For the first year we aimed to get a complete coverage of all observatories, whilst getting to know the capabilities of the eBee – both flight characteristics as well as data possibilities.



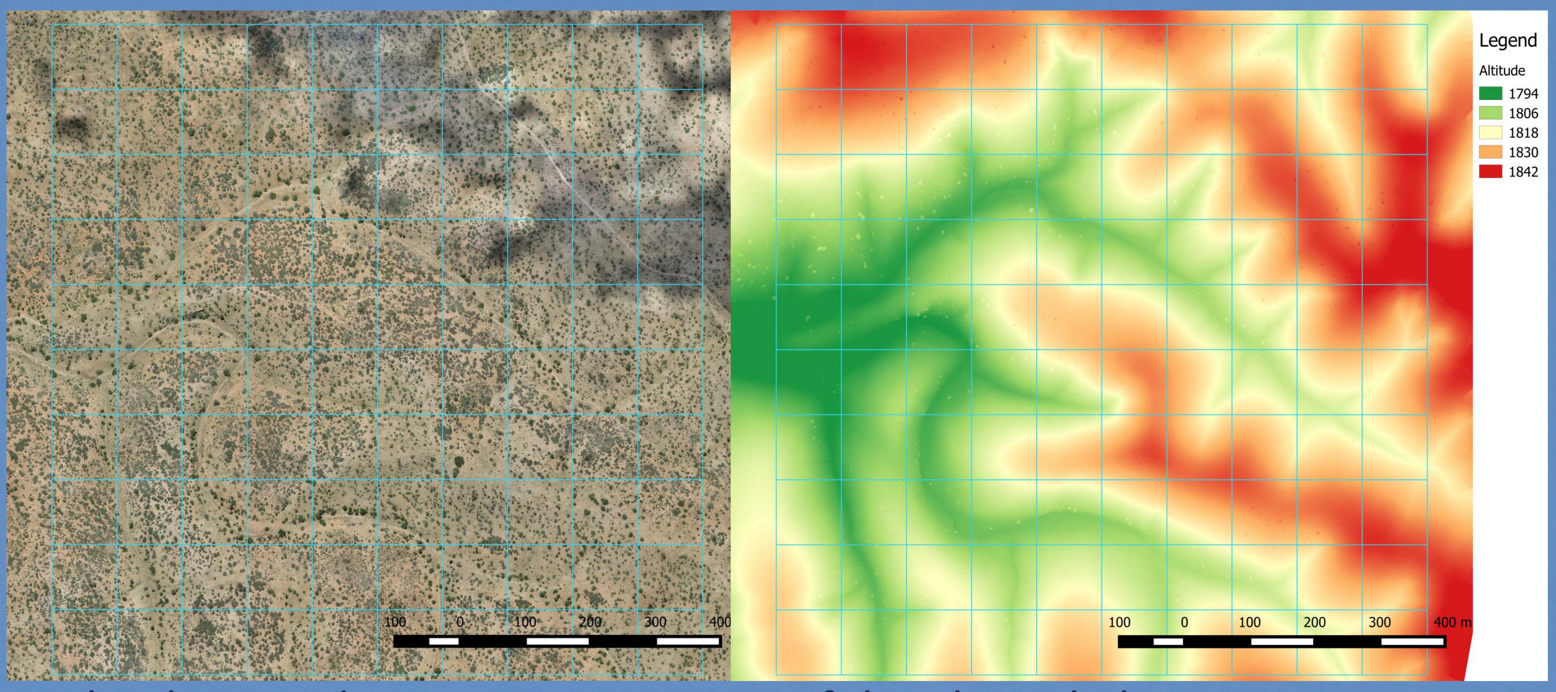
Mid-season vs late season: Comparisons like these, especially using a vegetation index, allow to study the phenological development of the vegetation during and across seasons in relation to the rainfall.



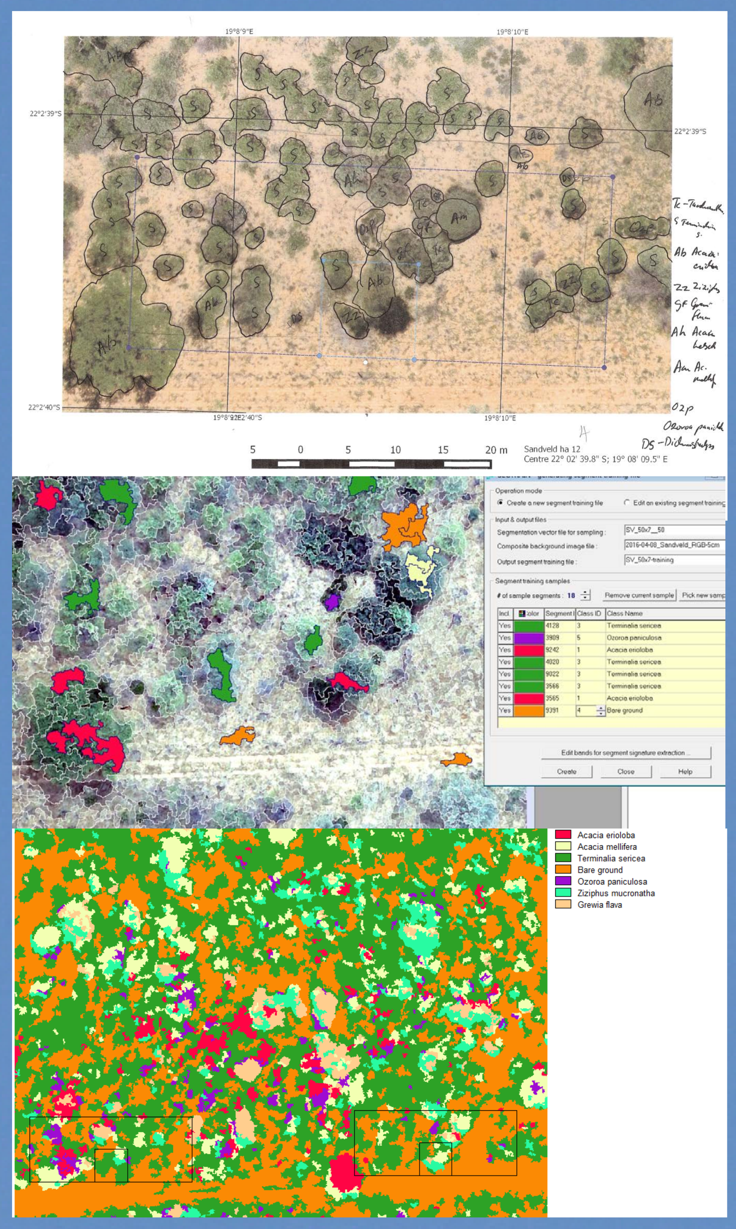
An erosion feature at the farm Krumhuk south of Windhoek. The contours have been created from a DSM generated from aerial photographs taken at 5 cm ground resolution. Contour interval: 20 cm.



A series of aerial photographs at four different ground resolutions, Sandveld observatory.

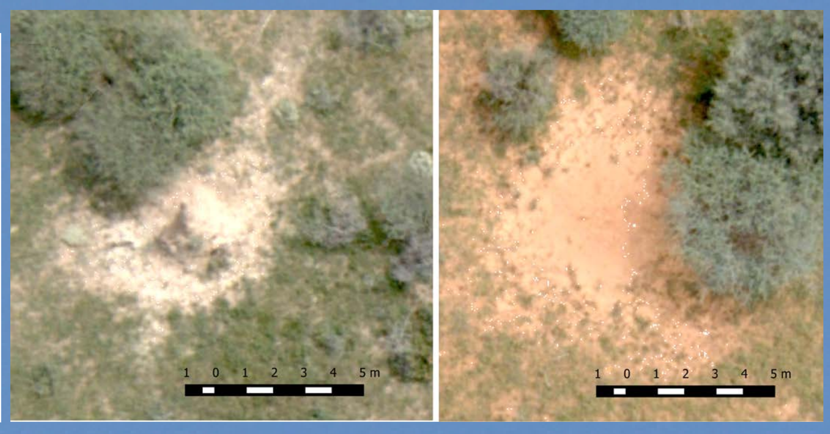


Orthophoto with accompanying DSM of the Claratal observatory.



Field ground truthing sheets (top), selection of training areas (centre) and a first classification result (bottom). Although promising, these techniques still need to be refined.

Larger animal species are readily recognisable on the imagery by shape and shadow. Wildlife population monitoring is therefore possible, especially in inaccessible areas.



Termite mounds can be identified by a steep change in relief, always on bare ground. The DSM generated by the software can be used to monitor the development and demise of these mounds.

Further tasks and ideas for future use of drones in biodiversity research

- Ground truthing of aerial photographs to map out individual species at long-term sites (formal biodiversity observatories as well as other long-term sites).
- Long-term monitoring (e.g. over 5 to 50 years) of vegetation development – individual-based, species based, structure and cover based, production based. This can include monitoring of rare and endangered endemic species, or exotic species.
- Long-term monitoring of erosion and erosion rehabilitation.
- Estimation of biomass – both tree and grass biomass.
- Relating phenology of species to the development of a rainy season – requires repeat photography throughout the year
- Testing the suitability of drone photography on monitoring lichen field dynamics (e.g. suitable resolution, spectral signatures, ideal climatic conditions, etc.)
- Measuring photosynthetic activity within a lichen field during a fog event (repeat photography during a single day). This can be expanded to include biomass production estimate as well as carbon sink estimate.
- Mapping habitats for cryptic animal species (e.g. tortoises, snakes)
- Field testing of new technology for further application, e.g. variety of spectral cameras like red edge, UV, far infrared for water content, thermal infrared.

➢A second eBee will help us greatly in achieving these tasks!

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