Communication and Marketing Department
Isebe loThungelwano neNtengiso
Kommunikasie en Bemarkingsdepartement

Private Bag X3, Rondebosch 7701, South Africa
Welgelegen House, Chapel Road Extension, Rosebank, Cape Town
Tel: +27 (0) 21 650 5427/5428/5674 Fax: +27 (0) 21 650 5628

www.uct.ac.za

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Where technology and ecology meet: using big data in fynbos studies

While the term big data may not conjure up images of plants, Associate Professor Adam West from the Department of Biological Sciences at the University of Cape Town (UCT), is using this technology to accurately map ecosystems.

Using customised drones to efficiently and easily collect data from his fynbos study plots, West has reduced a week's worth of field data capture into hours.

West said: "I want to make the connection between plant-level processes and regional- and global-scale observations, however, the satellite data natural scientists currently have access to is not at high enough resolution for study at the plant-level, especially not for a biodiversity hotspot like the Fynbos."

Through drone imagery, he has found it possible to identify species of plants on a plot and their size, and to produce an index of the vegetation's health.

As an eco-physiologist West is interested in ecosystems and the physiological processes that underpin them such as photosynthesis, and the absorption and transpiration of water. These processes happen at the level of an individual plant – or leaf – but when they are scaled up to landscapes, they have an effect on the way natural systems work.

Ten years ago it was a much more manual process. "We'd swing cameras up over the plot, we'd run cables up to them, take the photo, swing them down, pull out the memory cards, stick them in a laptop. 'Did we get the image?' 'No, we didn't.' And swing them up again. It would take us weeks to get the imagery. It was a bit of a nightmare," adds West.

The drones may have eliminated this cumbersome process but one survey of a single plot can generate more than 3500 overlapping images that need to be cross-referenced to render a navigable 3D-map of the vegetation below.

"Every pixel needs to be triangulated against others to be given a 3D position. A typical scene has about 9.5 billion pixels to be triangulated, so that is a lot of data crunching," adds West

West reached out to the team at UCT eResearch for support and together with Timothy Carr, a senior technical specialist at UCT eResearch was able to contact the developers of the Pix4D software (for processing) and install a version on UCT's high-performance computers.

After processing the thousands of images from West's drones, the high-performance computing cluster generated a 3D map of his study site to manipulate on his own computer. The map is navigable – you can pan around it and zoom into areas of interest – and shows individual plants and their structures. Viewed from the side, you can measure the height of a plant canopy. Combine that with the area from above and you can calculate the volume – or biomass – of a shrub.

Additionally, the images from West's multispectral camera can be used to generate an index of plant health that is not visible to the naked eye, and provides key insights into the effect of drought on the unique biodiversity of this region.

When one thinks of big data, ecology might not be the first field that comes to mind. But it is clear that big data is permeating all areas of research enquiry.

ENDS

Issued by: UCT Communication and Marketing Department

Aamirah Sonday
Media Liaison and Monitoring Officer
Communication and Marketing Department
University of Cape Town
Rondebosch
Tel: (021) 650 5427
Fax: (021) 650 3780
Cell: (076) 947 6071
Email: aamirah.sonday@uct.ac.za
Website: www.uct.ac.za