



Single tree detection in agro-silvo-pastoral systems from high resolution digital surface models obtained from UAV- and gyrocopter-based RGB-imaging

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Background

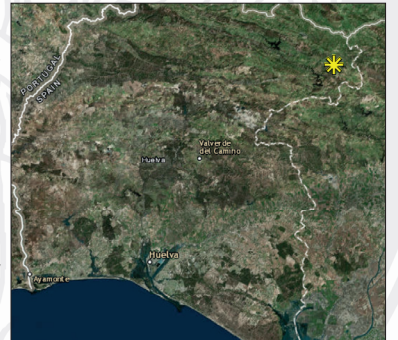
Cork oak decline in Mediterranean silvo-pastoral systems is of clear evidence (Tiberi et al. 2016). The reasons for this decline ranges from climate change, unfavorable site-related factors, pathogens, pests, and mismanagement. However, cork oaks are economically and ecologically important. Therefore, monitoring the temporal vitality of single trees is of key importance to investigate the different stresses.

Motivation & Objective

Remote sensing is a powerful monitoring tool. A spatial resolution of smaller than 0.3 m is demanded to identify pure tree crown pixels (Hirschmugl et al. 2007). Therefore, we are investigating the potential of (i) UAV-based and (ii) Gyrocopter-based imaging in very high resolutions of < 0.05 m. In a first analysis, single trees or groups of several trees are identified by using a Digital Surface Model (DSM).

Study area

The Dehesa San Francisco is located north of Sevilla and covers approx. 700 hectares with holm, cork, and Portuguese oaks (approx. 80 trees/hectare) (DSF 2016).



Methods

To obtain very high resolution remote sensing images, a UAV- and Gyrocopter campaign was carried out from March 3rd-5th 2016 at the study area. For the UAV approach, a MK Oktokopter XL with a Sony alpha 5100 was flown in 80 m altitude. The Gyrocopter was equipped with a Nikon D800E and was flown in an altitude of 300 m. Structure from Motion (SfM) technique was used to create

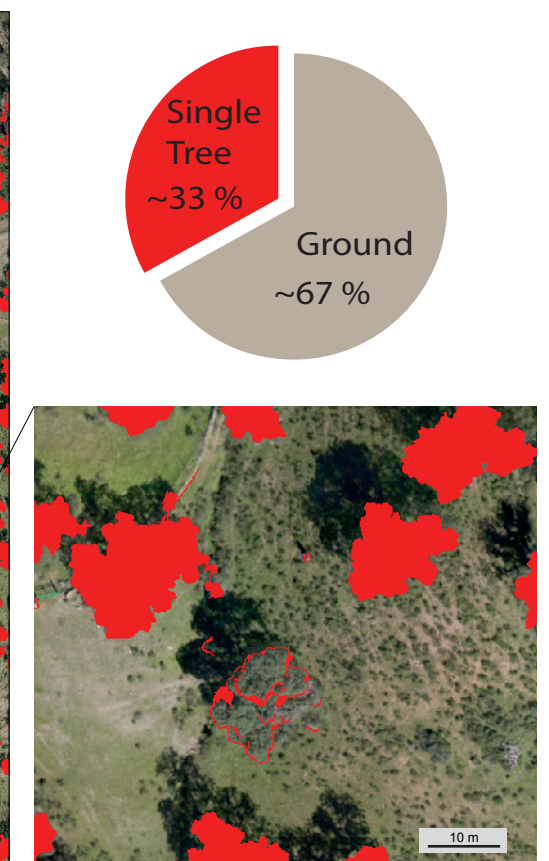
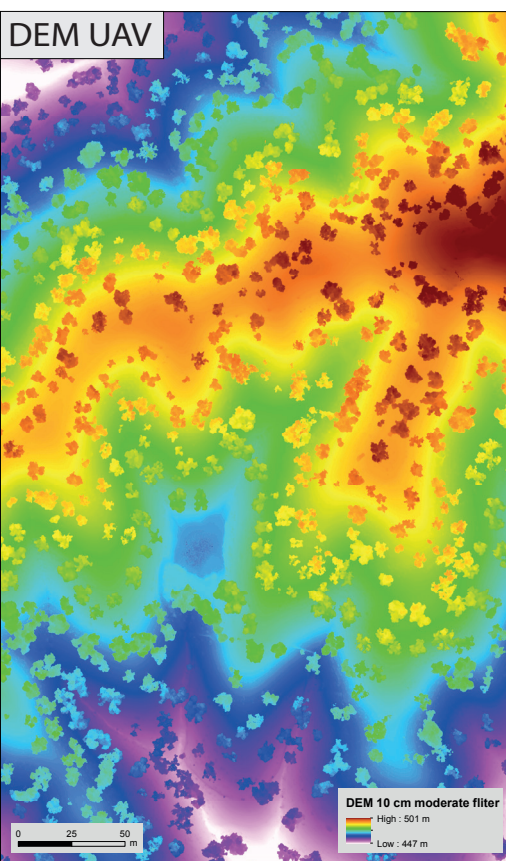


orthophotos and corresponding DSMs. For single tree analysis, slope was computed from the DSMs and via a threshold of 70° single trees were extracted.

DOP Gyro



DOP UAV



DISCUSSION and OUTLOOK

In the last years, the generation of UAV-based DEMs in cm resolution having a high accuracy was established for agro- and forest-ecosystems. A limitation of UAVs is the limited spatial coverage. In contrast, gyrocopters have a significant higher payload and the spatial coverage is comparable to airplanes or helicopters, while image resolution is much higher.

REFERENCES

- Hirschmugl, M. et al. (2007): Single tree detection in very high resolution remote sensing data. *RSE*, 110: 533-544. doi:10.1016/j.rse.2007.02.029
- Tiberi, R. (2016): Cork oak pests: a review of insect damage and mismanagement. *AFS*, 73: 219-232. doi: 10.1007/s13595-015-0534-1
- DSF - Dehesa San Francisco (2016): www.fundacionmontemediterraneo.com

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