



## Analyzing Forest Inventory Data from Geo-Located Photographs

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Forests are widely monitored using a variety of remote sensing data and techniques. Remote sensing offers benefits compared to traditional in-situ forest inventories made by experts. One of the main benefits is that the number of ground reference plots can be significantly reduced. Remote sensing of forests can provide reduced costs and time requirement compared to full forest inventories. The availability of ground reference data has been a bottleneck in remote sensing analysis over wide forested areas, as the acquisition of this data is an expensive and slow process.

In this paper we present a tool for estimating forest inventory data from geo-located photographs. The tool can be used to estimate in-situ forest inventory data including estimated biomass, tree species, tree height and diameter. The collected in-situ forest measurements can be utilized as a ground reference material for spaceborne or airborne remote sensing data analysis. The GPS based location information with measured forest data makes it possible to introduce measurements easily as in-situ reference data. The central projection geometry of digital photographs allows the use of the relascope principle [1] to measure the basal area of stems per area unit, a variable very closely associated with tree biomass. Relascope is applied all over the world for forest inventory.

Experiments with independent ground reference data have shown that in-situ data analysed from photographs can be utilised as reference data for satellite image analysis. The concept was validated by comparing mobile measurements with 54 independent ground reference plots from the Hyytiälä forest research station in Finland [2].

Citizen scientists could provide the manpower for analysing photographs from forests on a global level and support researchers working on tasks related to forests. This low-cost solution can also increase the coverage of forest management plans, particularly in regions where possibilities to invest on expensive planning work are limited.

### References

- [1] Bitterlich, W. (1984) *The Relascope Idea: Relative Measurements in Forestry*, Commonwealth Agricultural Bureaux, Farnham Royal, 1984.
- [2] Molinier, M., Häme, T., Toivanen, T., Andersson, K., Mutanen, T., *Relasphone — Mobile phone and interactive applications to collect ground reference biomass data for satellite image analysis*, Geoscience and Remote Sensing Symposium (IGARSS), 2014 IEEE International, pp. 836-839, 13-18 July 2014, doi: 10.1109/IGARSS.2014.6946554