

COST-EFFECTIVE, DRONE-BASED RECORDING OF A TEMPERATE CONIFEROUS FOREST LEAF AREA INDEX

KOSTENGÜNSTIGE ERMITTLUNG DES BLATTFLÄCHENINDEX VON NADELWÄLDERN DER GEMÄSSIGTEN KLIMAZONE MIT HILFE VON DROHNEN

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SUMMARY

The aim of this study was to evaluate a non-destructive and cost-effective method for measuring the leaf area index (LAI) using an unmanned aerial vehicle (UAV). Data were collected from a managed coniferous forest in the humid and temperate climate of southwestern Germany. Recordings during 2019–2020 were based on digital hemispherical photography and UAV imaging. Red–green–blue images of the canopy top were collected using the UAV, from which green canopy coverage was estimated. Subsequently, using the gap fraction, LAI was estimated through several binary classification methods. Hemispherical photograph estimation of LAI was assumed as the ground truth data. Hemispherical photograph data were analyzed using the Hemisfer application. The four produced LAI datasets correlated with the reference ground truth images at R^2 values of 0.73, 0.84, 0.67, and 0.64, respectively, indicating good accuracies for the analyzed UAV images. However, some UAV data overestimated LAI, presumably due to canopy heterogeneity, collection site weather conditions, or light reflectance of the forest. UAV image-derived canopy variables contributed significantly toward explaining local patterns of forest structures. Hence, this novel UAV method for measuring LAI can substantially contribute to highly accurate ecological monitoring by providing low-cost high-resolution data.

Keywords: leaf area index, unmanned aerial vehicle, digital hemispherical photography, ecological monitoring, canopy, coniferous forest

ZUSAMMENFASSUNG

Ziel dieser Untersuchung war es eine zerstörungsfreie und kostengünstige Methode zur Messung des Leaf Area Index (LAI) mittels eines unbemannten Fluggerätes (UAV) zu entwickeln. Die dazu erfassten Daten stammen aus einem bewirtschafteten Nadelwaldgebiet