

Comparing field- and Unmanned Aerial Vehicle-derived vegetation metrics



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Introduction

The future mitigation and management of cumulative environmental effects from ongoing industrial activities in Alberta, Canada, requires a long-term monitoring framework. One important monitoring component will be local-level ecological assessment - in particular, of vegetation characteristics.

Unmanned Aerial Vehicles (UAVs) have shown potential as a possible tool to enable timely, efficient, and effective capture of vegetation information, such as structure [1,2]. Their power lies in the capture of densely-overlapping aerial imagery, from which 3-D photogrammetric point clouds (similar to LiDAR point clouds) are produced.

Research Objective

To compare vegetation structural metrics estimated from 3-D photogrammetric point clouds, generated from UAV aerial imagery, to traditional on-the-ground vegetation surveys.

Methods

- Traditional vegetation survey measurements & UAV images collected at nine reclaimed wellsites in Alberta's western boreal forest (Figs. 1 & 2).
- Dense, 3D photogrammetric point clouds generated from the UAV imagery at each site (using Agisoft PhotoScan Professional; Fig. 2).

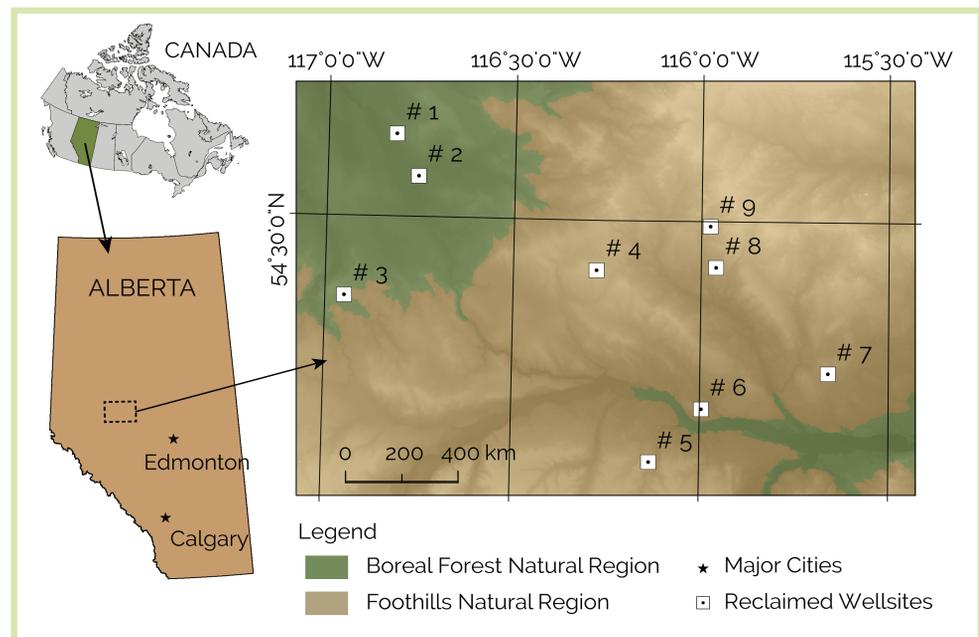


Figure 1. Study area map, showing the study sites (on reclaimed wellsites) where vegetation plots were located, in west-central Alberta, Canada.

- Pearson's r correlation coefficients used to compare ground and UAV-based point cloud measurements of vegetation height and cover.
- Forward stepwise multivariate linear regressions using point cloud metrics built to model several vegetation characteristics (e.g., tree diameter at breast height; i.e., at 1.3 m) using point cloud metrics, similar to the common use of LiDAR metrics to model forest parameters [3].

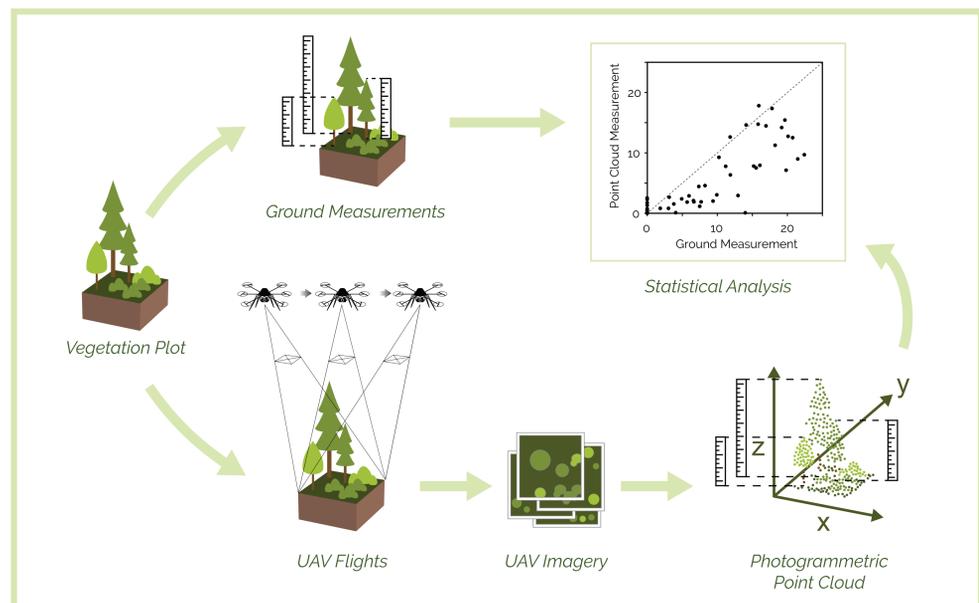


Figure 2. Diagram showing the overall methods of the study, including the two data collection approaches followed at each study site.

Results & Discussion

- Strong, positive, significant correlations between ground and UAV-based point cloud mean and maximum vegetation height estimates (Fig. 3).
- No similarly meaningful correlations for vegetation cover estimates

This shows that surface vegetation heights captured by UAV image-based point clouds and traditional field methods are comparable. Little similarity exists between the two sets of vegetation cover estimates, indicating a mismatch between these two approaches to estimating vegetation cover.

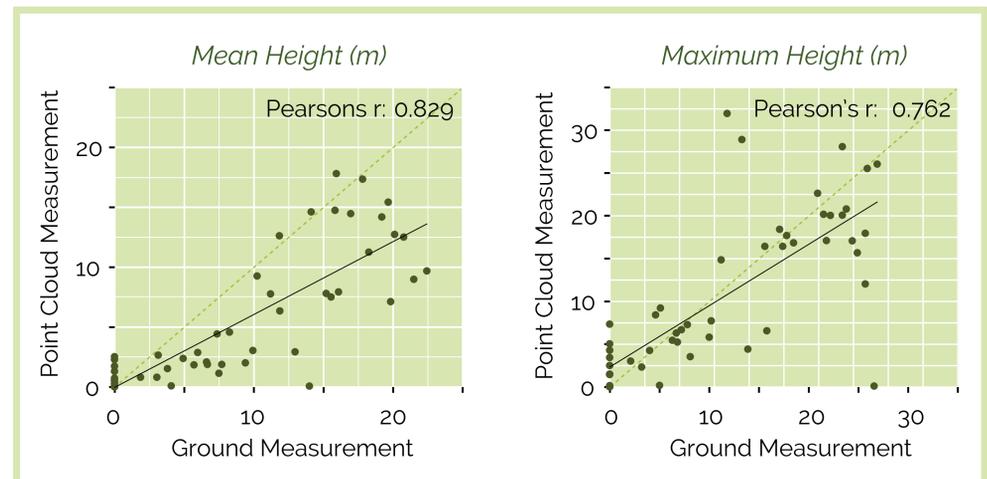


Figure 3. Scatterplots showing the comparison of ground measurements to photogrammetric point cloud-based estimates of mean (left) and maximum vegetation height (right).

- Mean, maximum, minimum and range of tree diameter at breast height modeled well by our multivariate regressions ($0.70 < \text{adjusted } R^2 < 0.80$).
- Mean, maximum, and minimum tree heights also modeled well ($0.73 < \text{adjusted } R^2 < 0.88$).
- Vegetation cover regression models produces low R^2 values (i.e., < 0.5).

Our results demonstrate the potential of UAV-derived point clouds for modeling certain vegetation characteristics (e.g., tree height and diameter). However, ground-based visual estimates of vegetation cover are too subjective and inconsistent to model well using point cloud metrics.

Conclusion

This preliminary study shows that vegetation heights estimated from UAV-derived point clouds are very comparable to heights estimated with traditional field methods. The former also show potential for the indirect modeling of other vegetation characteristics, as is common with LiDAR data sets. Traditional, visual estimates of vegetation cover, however, are very different from the mathematically-based UAV-derived estimates and do not compare well with these values.

Acknowledgements

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