Boreal Ecosystem Recovery & Assessment
An NSERC Collaborative Research & Development Program

REMOTE SENSING TEAM FALL 2018: *ESTIMATING THE HEIGHT OF CONIFER SEEDLINGS IN RECOVERING LINEAR DISTURBANCES WITH UAV*

Michelle Filiatrault
Canadian Forest Service, Natural Resources Canada
michelle.filiatrault@canada.ca

Research Team:
[1]Guillermo Castilla, [1]Michael Gartrell, [2]Man Fai Wu and [2]Greg McDermid
[1]Canadian Forest Service, Natural Resources Canada; [2] University of Calgary, Department of Geography

Project summary

Recent advances in computer science have given a renewed impetus to digital aerial photogrammetry (DAP) applications in forestry. Using a variety of airborne platforms – including piloted aircrafts to UAVs (a.k.a. drones) – it is possible to capture geolocated, above-canopy digital photographs that can then be automatically aligned using a Structure from Motion workflow to create a 3D model (a point cloud) that has orders of magnitude more points than the typical airborne LiDAR acquisition. The objective of this study is to determine the data requirements that enable DAP to accurately measure conifer seedling height. UAV DAP data was collected at 8 Kirby sites in August and October 2017 at flying altitudes (AGL) of 5m, 30m and 120m yielding a respective ground sampling distance (GSD) of 0.35cm, 0.75cm and 3cm, respectively. This research is part of the efforts by the BERA project to develop cost-effective methods to monitor seismic line vegetation recovery.

Progress to date

All UAV DAP data has been processed in Agisoft Photoscan, yielding point clouds of varying mean density (from 336 points/m^2 for the 3cm GSD imagery to 31,000 points/m^2 for the 0.35 cm GSD imagery). There are 407 inventoried conifer seedlings covered by these point clouds. Multiple methods of seedling height estimation were tested, of which the two best methods derive seedling height as: 1) the elevation of the tallest point within a 20cm radius of the reported location of the seedling minus the ground elevation determined from a LiDAR digital terrain model (DTM), or 2) the elevation of the tallest point within a 20cm radius minus the elevation of the lowest point within a 1m radius. A number of the seedlings seem to be outliers caused by a number of spurious factors; thus we identified a number of elimination criteria. After removing those seedlings from the analyses, the RMSE improved from ~40cm to ~30cm. For GSD of 0.75cm and 3cm there was minimal difference between leaf-on and leaf-off conditions. For GSD of 3cm method 1 performed slightly better, where method 2 performed best for GSD of 0.75cm. The best results were obtained with the O.35 cm GSD in leaf-off conditions, where method 1 yielded a RMSE of 0.17m with a mean absolute difference of 0.13cm and bias of 0.05m. For all GSDs and phenological conditions, there is a tendency to underestimate tall seedlings. There was no apparent species effect on RMSE. We are still analyzing the results and expect to have a publication before next BERA annual workshop.

Management implications

We aim to establish guidelines and trade-offs between flight altitude/GSD and accuracy for both survival and establishment surveys.

Geographic location

Selected BERA Kirby sites, located south of Conklin, Alberta, treated (mounding and planting) and untreated.