ABBY-NET E^3-Systems Research Project Update 2019:
#18: Comparing Laser Scanning and photogrammetry to detect openings in the boreal forest in Alberta

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Project summary

Governmental ecological protection plans such (e.g. Provincial Woodland Caribou Range Plan) requires detailed and reliable environmental monitoring. One parameter of interest is the canopy openings -- i.e. spaces between the trees -- of a given forest. Natural canopy openings support forest rejuvenation and biodiversity, but persistent anthropogenic ones can have detrimental effects. Monitoring openings via field campaigns is costly, spatially restricted, and prone to human error. We require alternative remote-sensing strategies to fulfill our monitoring needs. Light detection and ranging (LiDAR) is the de-facto standard for measuring three-dimensional forest structure, but digital aerial photogrammetry (DAP) has emerged as a viable and economical alternative. We compared the performance of LiDAR, DAP, and a LiDAR-DAP Hybrid model for characterizing canopy openings across a 1-km2 expanse of boreal forest in northern Alberta, Canada.

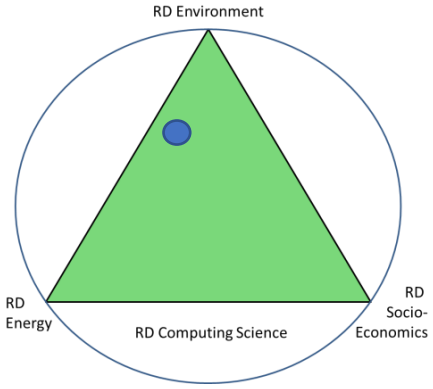
From a point-based detectability perspective, LiDAR produced the best results (87% overall accuracy), followed by the Hybrid and DAP models (47% and 46%, respectively). The Hybrid and DAP models experienced large errors of omission (9 – 53%), particularly with small openings up to 20m2, which are an important element of boreal-forest structure. By missing these, DAP and Hybrid datasets substantially under-reported the total area of openings across our site (152,470 m2 and 159,848 m2, respectively) compared to LiDAR (245,920 m2). Our results illustrate DAP's sensitivity to occlusions, mismatched tie points, and other optical challenges inherent to using structure-from-motion workflows in complex forest scenes. These under-documented constraints currently limit the technology's capacity to fully characterize canopy structure.

Progress to date

The project is complete.

Contribution to E3-system and Implications

The research represents one of a number of projects investigating the use of remote sensing and machine learning to characterize the effects of energy development on boreal forest ecosystem structure and function. This work illustrate DAP's sensitivity to occlusions, mismatched tie points, and other optical challenges inherent to using structure-from-motion workflows in complex forest scenes. These under-documented constraints currently limit the technology's capacity to fully characterize canopy structure. For now, we recommend that operational use of DAP in forests be limited to mapping large canopy openings, and area-based attributes that are well-documented in the literature.



Geographic location

My study area is a 1 x 1 km expanse located at the Kirby research site in northern Alberta, Canada.

Final Outcomes

Ms. Dietmaier completed a Masters thesis from Ludwig-Maximilian University on this topic in December 2018. A manuscript (DIetmaier et al., 2019) is in press in the journal Remote Sensing.