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Applications for Remote Sensing in Early-Stage Project Development

BACKGROUND

Remote sensing serves as a valuable tool for understanding natural resources during early-stage site assessments, especially when field-based environmental studies are impractical due to logistical or financial constraints. Light Detection and Ranging (LiDAR) utilizes pulsed laser light to measure distances (ranges) to objects or surfaces and creates precise point clouds representing the terrain or obstacles. LiDAR is used by engineers in solar array and collection design to understand topography, but also presents the opportunity to collect natural resource data with increased efficiency, accuracy, and precision compared to traditional desktop methods.

OBJECTIVE

The primary aim of this study was to assess applications of remote sensing, using LiDAR, for natural resources assessments in early-stage project siting. To meet this objective, we set-forth to answer the following questions:

- Where are LiDAR data available in the public domain?
- What tools are available for analyzing LiDAR data in a natural resources context?
- Can these data be leveraged to increase understanding of natural resources in early siting?
- What are project examples where LiDAR has been used?

METHODS

We conducted a literature review to identify tools and techniques for processing LiDAR data within the context of natural resources. Next, we engaged with internal and external stakeholders through interviews and discussions to gain insights into availability of LiDAR data at the project level and to identify potential use cases. From these engagements, we identified three specific use cases that exemplify the practical application of LiDAR data. Finally, we documented lessons learned and recommendations for implementing LiDAR surveys during the early stages of project siting.

RESULTS

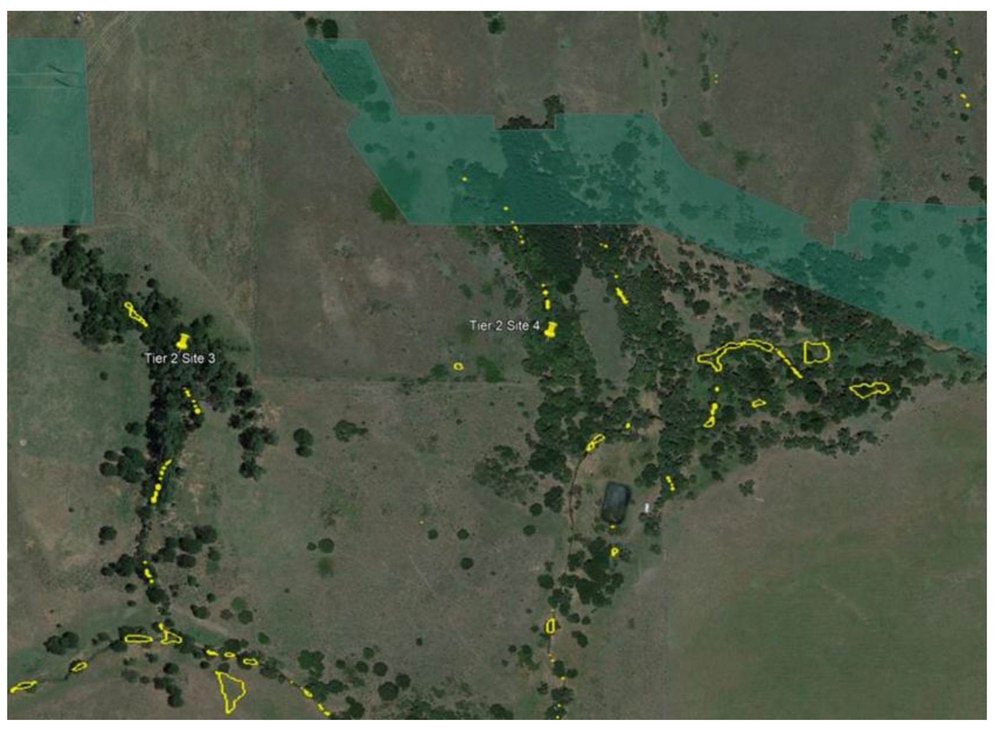
USE CASE – Bat Hibernacula

Purpose – Identify caves and sink holes that could be suitable winter habitat for bats (hibernacula).

Means of Data Collection and Processing – Airborne LiDAR converted to DEM and input into ESRI tools Flow Direction and SINK[1] analysis.

Applications –

- Identify low points where water is precluded from exiting, which potentially indicate sub-surface features
- Reduce the number of locations that need field investigation and reduce survey cost
- Identify locations of potential for winter bat habitats near a project area, early in the development process



Yellow areas were identified by the SINK analysis as containing internal drainage and yellow pins were identified by karst biologist as needing field verification.

USE CASE – Wetland & Waterways

Purpose – Identify locations and connectivity of potential wetland and water features.

Means of Data Collection and Processing – Airborne LiDAR processed as Digital Terrain Models (DTM).

Applications –

- Cross-reference with other publicly available data (e.g., National Wetland Inventory) to refine locations with high probability of wetland or waterway presence
- Review topography to understand potential connectivity between wetland and water features, which informs potential Waters of the U.S. (WOTUS) jurisdiction
- Inform design layout ahead of ability to conduct field work

LiDAR data as topographic lines (dark brown) for an Invenergy project, alongside buffers of wetland and waterways mapped by the National Wetland Inventory and National Hydrography Data (white lines).

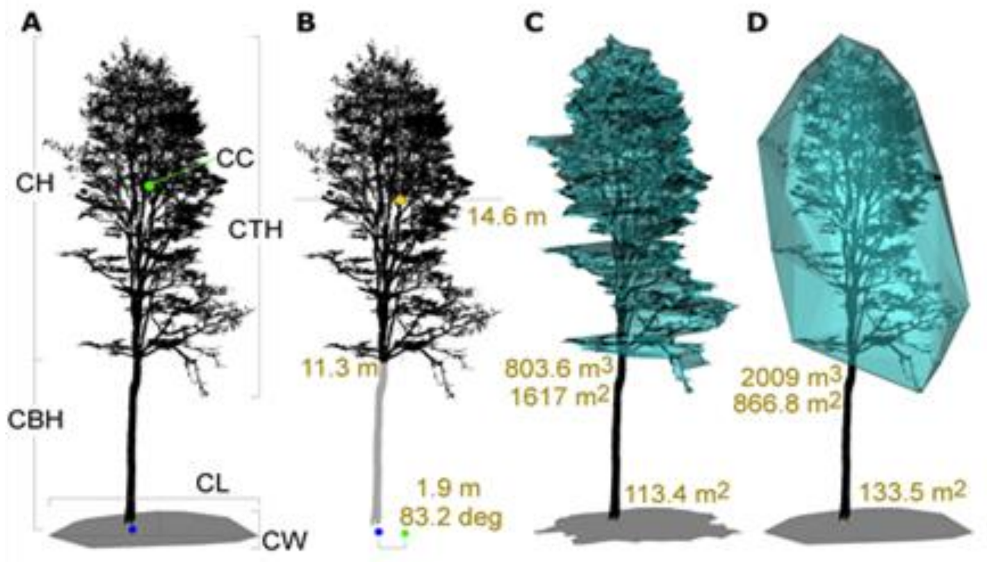
USE CASE – Tree Cover & Characteristics

Purpose – Quantify and characterize treed areas

Means of Data Collection and Processing – Ground-based LiDAR (TLS) is processed using 3D Forest v 0.52[2].

Applications –

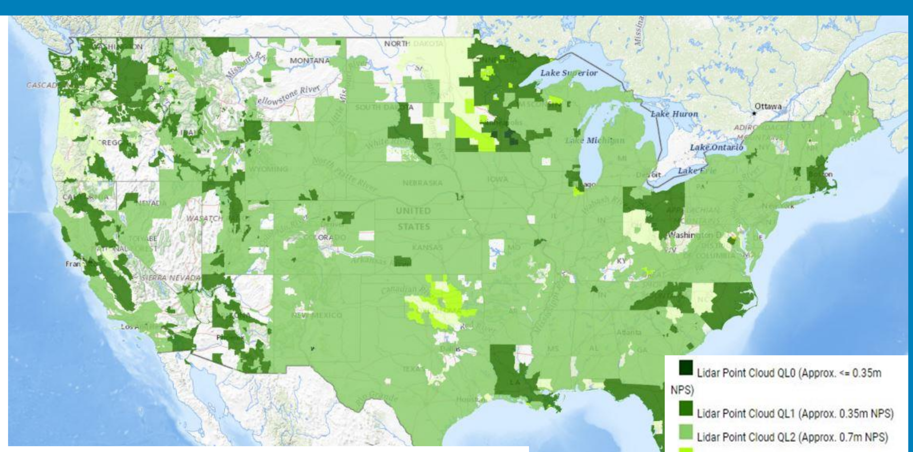
- Calculate the amount of tree cover within an Area of Interest with a high level of accuracy.
- Characterize factors such as tree height, spacing, and canopy density to identify suitable habitat for wildlife
- Gain precision in array shading potential to refine need for tree removal
- Document landcover changes over time, including invasive species and revegetation



Crown height (CH), crown base height (CBH), crown center (CC), crown total height (CTH), crown length (CL), crown width (CW). B – The example of calculated parameters and the deviation of the projection of the crown center (green) from the base of the trunk (blue). C – The concave planar projections and volume/surface of the crown as calculated according to the concave polyhedron. D – The convex planar projections and crown volume/surface calculated using a convex envelope.

CONCLUSIONS

LiDAR is a powerful technology that can be leveraged for characterizing natural resources in early siting. LiDAR is regularly collected by engineering teams for micro-siting. However, it is usually collected later in the development cycle than would be optimal for the purposes of early identification of natural resources. Publicly available LiDAR may be able to supplement these data in some areas, or project proponents could gather project-specific information earlier. LiDAR can be used to identify potential bat hibernacula and offers an effective method for conducting portal searches in early project development. LiDAR can also inform expected cost and effort anticipated for field-based wetlands and waterways delineations, and cross referencing these data may inform locations of non-mapped potential wetland features, and connectivity between them on the landscape, which has implications for WOTUS status. Point cloud LiDAR data allows analysis of the vegetation and forest structure within a project area. These use cases can allow natural resource professionals to comprehend the environment with a high degree of precision, far earlier than field studies of equal precision can be performed.



Locations of publicly available LiDAR

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REFERENCES

[1]SINK (spatial analyst). Sink (Spatial Analyst)-ArcGIS Pro | Documentation. (n.d.). https://pro.arcgis.com/en/pro-app/latest/tool-reference/spatial-analyst/sink.htm

[2]Trochta, J. (n.d.). 3D forest. 3D Forest - Terrestrial lidar data processing tool. https://www.3dforest.eu/

This research utilized an AI model developed by OpenAI.

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