LiDAR, passive spectral, and ecophysiological approaches to link Forest Tundra Ecotone structure and function

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Background

At 13,400 km in length, the Forest Tundra Ecotone (FTE) is the world's largest ecological transition zone. However, little is known about how the FTE - a critical component of the ABoVE study domain - will respond to ever-increasing environmental change. Remotely sensed information could play a key role in filling portions of this critical knowledge gap, yet relatively little remote sensing work has been conducted to link the current structural status of the FTE with dynamic changes in its ecological function.

Objective

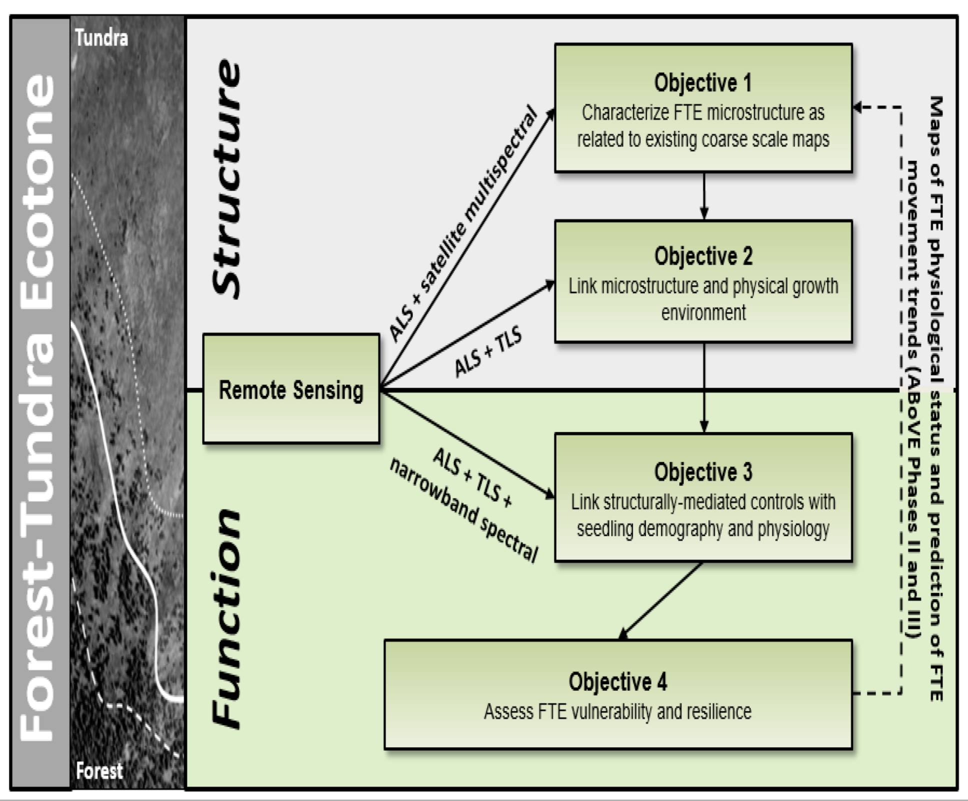

Figure 1. Main Objective: The overarching objective of the proposed study is to integrate lidar, passive spectral, and tree ecophysiological data to link biophysical structure to ecological function in the Forest Tundra Ecotone.

Methods & materials

To characterize FTE structure, we will use lidar to create standardized baseline data at multiple locations within the FTE of the ABoVE study domain, and benchmark our results relative to the existing FTE-wide map developed by Ranson et al. (2011) using MODIS and Landsat. We will establish transects at FTE sites in Alaska and Canada to study how LiDAR derived surface and canopy micro-structure affect: (1) air and soil temperature, (2) snowpack dynamics (via hyper-temporal terrestrial lidar), (3) net radiation throughout the FTE canopy and on the FTE floor (via a radiative transfer model parametrized using structural information from lidar), and (4) plant function (via the use of ground-based radiometers coupled with ecophysiological measurements.

Study sites

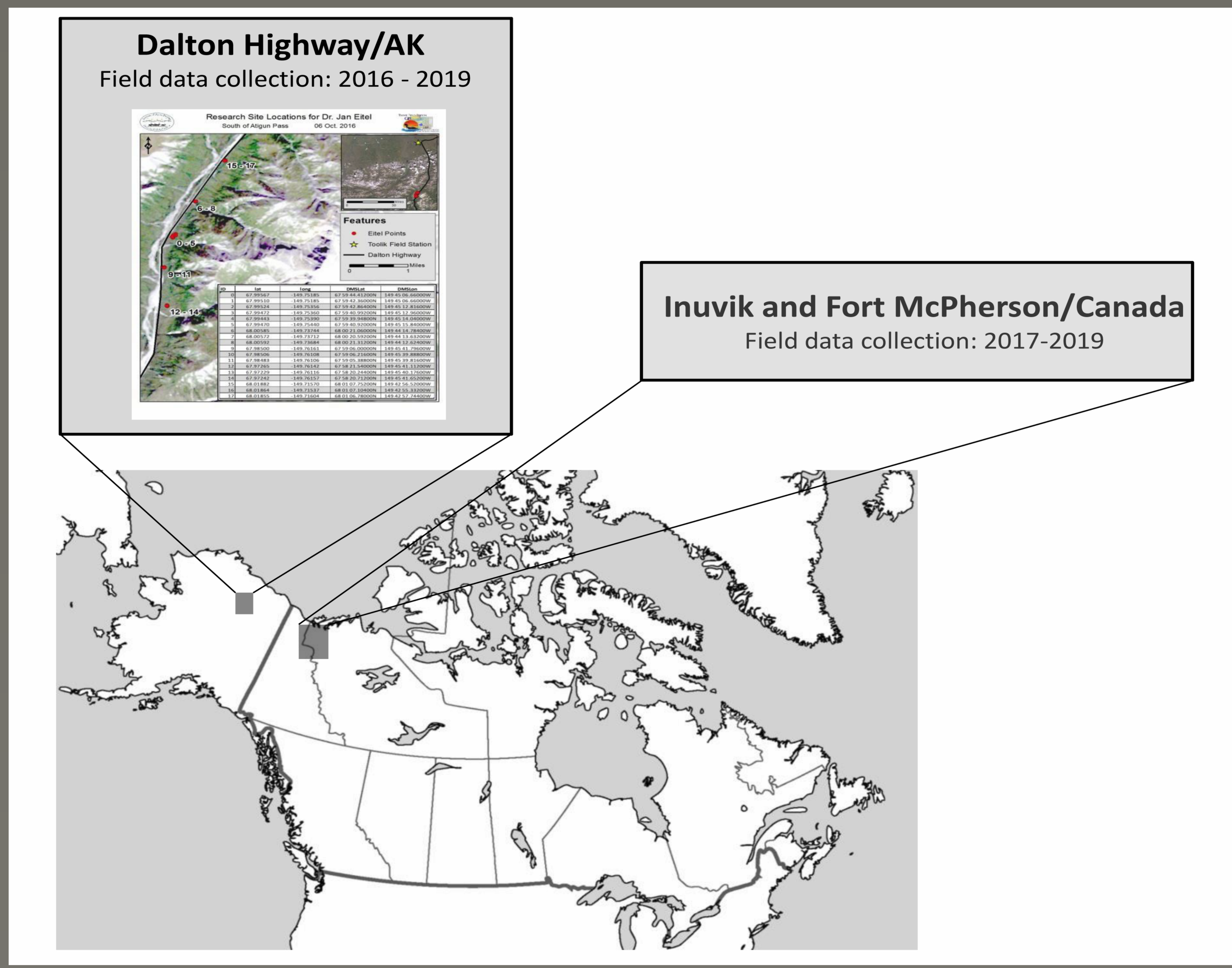

Figure 2. The overarching objective of the study is to integrate lidar, passive spectral, and tree ecophysiological data to link biophysical structure to ecological function in the Forest Tundra Ecotone.

Study transect layout

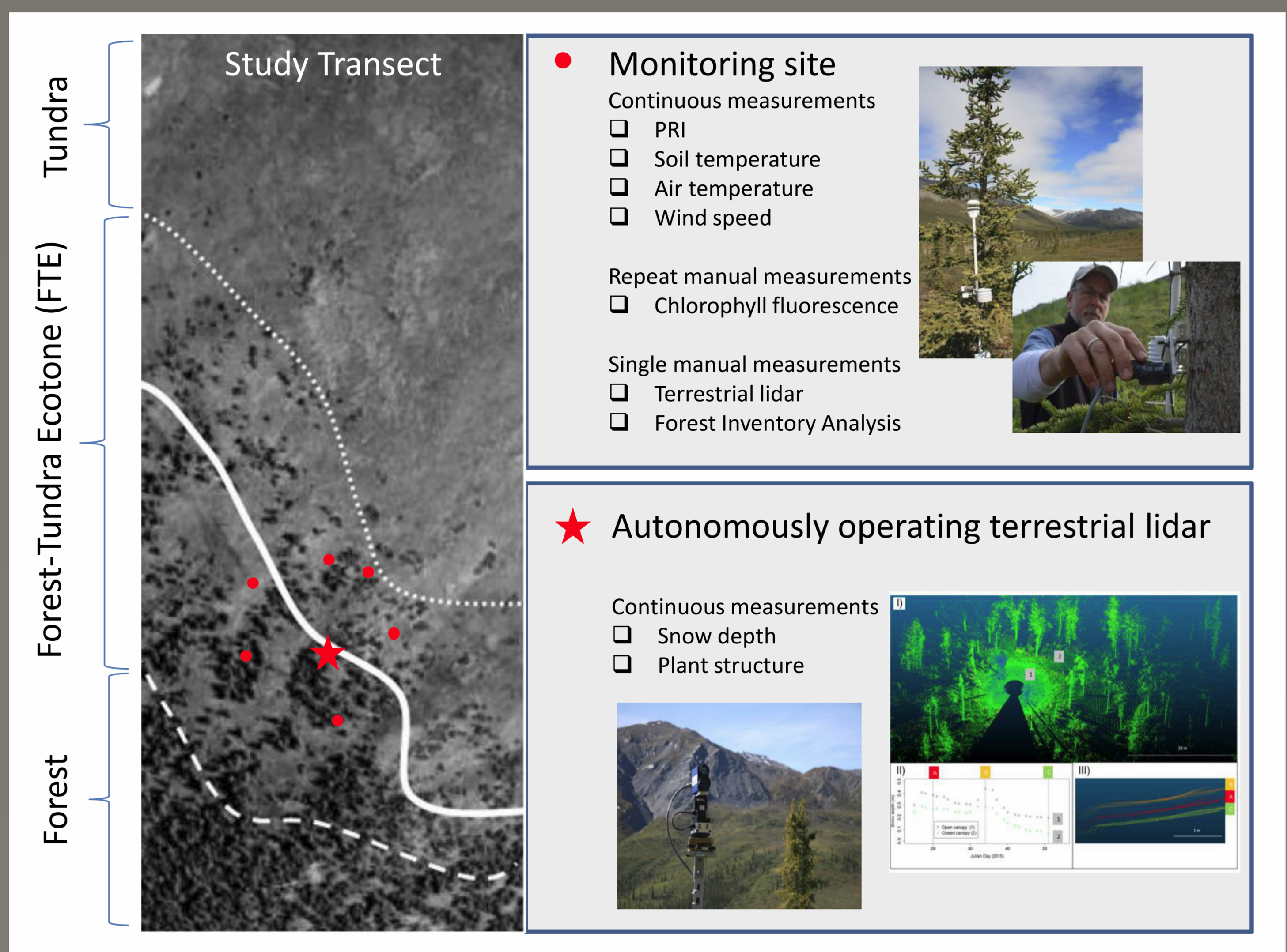

Figure 3. Study transect layout depicting tree structure-physiology monitoring sites and location of hyper-temporal autonomously operating terrestrial lidar (ATLS) (see Eitel et al., 2016).

Lidar animation

Figure 4. 3D animation of terrestrial lidar point cloud acquired at treeline along the Dalton Highway. Color shows the intensity of the laser return.

Next steps

- Establish study sites north of Inuvik and west of Fort McPherson
- Evaluate ArcticDEM for treeline mapping (see poster by Meddens et al.)
- Evaluate relationships between seedling establishment and microtopography using terrestrial lidar (see poster by Maguire et al.)
- Evaluate relationships between presence and absence of trees and microstructure using aerial lidar

Research team

Figure 5. Top from left to right: Natalie Boelman, Andrew Maguire, Jan Eitel, Lee Vierling. Bottom left to right: Jyoti Jennewein, Johanna Jensen, Kevin Griffin. Not shown: Arjan Meddens and Micah Russell.

Acknowledgements

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References

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Ranson, K.J., Montesano, P.M., Nelson, R., 2011. Object-based mapping of the circumpolar taiga-tundra ecotone with MODIS tree cover. *Remote Sensing of Environment*, 115, 3670–3680. doi:10.1016/j.rse.2011.09.006