ALASKAVIEW 2023 - 2024

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ALASKAVIEW 2023 - 2024 ACTIVITIES

Goal: To advance remote sensing research of forested ecosystems to support forest health protection and effective forest management.

Research Objectives:

1) Estimating above-ground biomass
2) Assessing tree mortality and stand-level forest loss
3) Connection between forest loss and recovery, biomass and carbon budget

In GY23, we focused on Research Objective 1; by integrating UAVSAR and LiDAR data we developed a methodology to estimate above-ground biomass (Badola et al., 2024). Co-PI Badola presented this research at the 2024 American Association of Geographers Annual Meeting in Honolulu (Apr. 16 - 20) and at the 2024 AmericaView Spring meeting in Blacksburg, Virginia.

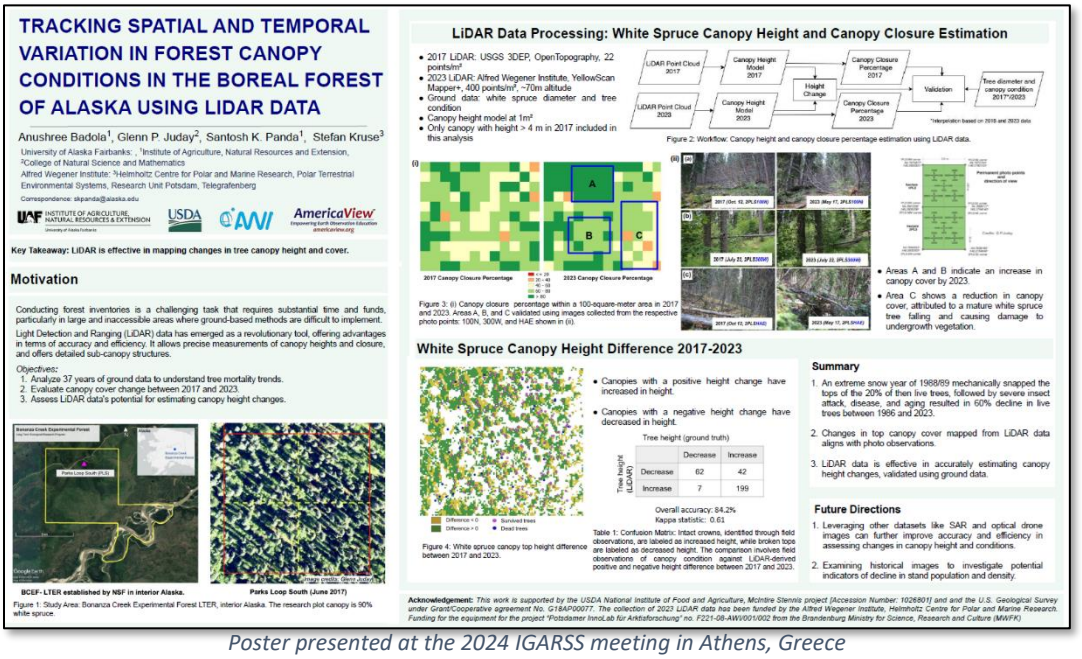
Co-PI Badola presenting at the 2024 AmericaView Spring Meeting, Blacksburg, Virginia

Also, we carried out research focused on spatial and temporal variation in forest canopy conditions using Lidar data (Badola et al., 2024). PI Panda presented this research at the 2024 IGARSS meeting in Athens, Greece (July 7 – 12).

Tree census survey

GY23 outcome:

- 3 conference abstracts (2024 AFE, AAG, AGU)
- 1 conference paper (2024 IGARSS)
- 1 journal article (in review)



TRACKING SPATIAL AND TEMPORAL VARIATION IN FOREST CANOPY CONDITIONS IN THE BOREAL FOREST OF ALASKA USING LIDAR DATA

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Key Takeaway: LiDAR is effective in mapping changes in tree canopy height and cover.

Motivation

Conducting forest inventories is a challenging task that requires substantial time and funds, particularly in large and inaccessible areas where ground-based methods are difficult to implement.

Light Detection and Ranging (LiDAR) data has emerged as a revolutionary tool, offering advantages in terms of accuracy and efficiency. It allows precise measurements of canopy heights and closure, and offers detailed sub-canopy structures.

Objectives:
1. Analyze 37 years of ground data to understand tree mortality trends.
2. Evaluate canopy cover change between 2017 and 2023.
3. Assess LiDAR data's potential for estimating canopy height changes.

BCEF- LTER established by NSF in interior Alaska.

Parks Loop South (June 2017)

Figure 1: Study Area: Bonanza Creek Experimental Forest LTER, interior Alaska. The research plot canopy is 90% white spruce.

LiDAR Data Processing: White Spruce Canopy Height and Canopy Closure Estimation

- 2017 LiDAR: USGS 3DEP, OpenTopography, 22 points/m²
- 2023 LiDAR: Alfred Wegener Institute, YellowScan Mapper+, 400 points/m², ~70m altitude
- Ground data: white spruce diameter and tree condition
- Canopy height model at 1m²
- Only canopy with height > 4 m in 2017 included in this analysis

Figure 2: Workflow: Canopy height and canopy closure percentage estimation using LiDAR data.

Figure 3: (i) Canopy closure percentage within a 100-square-meter area in 2017 and 2023. Areas A, B, and C validated using images collected from the respective photo points: 100N, 300W, and HAE shown in (ii).

- Areas A and B indicate an increase in canopy cover by 2023.
- Area C shows a reduction in canopy cover, attributed to a mature white spruce tree falling and causing damage to undergrowth vegetation.

White Spruce Canopy Height Difference 2017-2023

- Canopies with a positive height change have increased in height.
- Canopies with a negative height change have decreased in height.

Tree height (ground truth)

Tree height (LiDAR)	Decrease	Increase
Decrease	62	42
Increase	7	199

Overall accuracy: 84.2%
Kappa statistic: 0.61

Table 1: Confusion Matrix: Intact crowns, identified through field observations, are labeled as increased height, while broken tops are labeled as decreased height. The comparison involves field observations of canopy condition against LiDAR-derived positive and negative height difference between 2017 and 2023.

Figure 4: White spruce canopy top height difference between 2017 and 2023.

Summary

1. An extreme snow year of 1988/89 mechanically snapped the tops of the 20% of then live trees, followed by severe insect attack, disease, and aging resulted in 60% decline in live trees between 1986 and 2023.
2. Changes in top canopy cover mapped from LiDAR data aligns with photo observations.
3. LiDAR data is effective in accurately estimating canopy height changes, validated using ground data.

Future Directions

1. Leveraging other datasets like SAR and optical drone images can further improve accuracy and efficiency in assessing changes in canopy height and conditions.
2. Examining historical images to investigate potential indicators of decline in stand population and density.

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We continue to support 4 open access online GIS courses on edX.org:

- GIS Foundations
- 3D GIS
- GIS Image Analysis
- Remote sensing of wildfires

Poster presented at the 2024 IGARSS meeting in Athens, Greece

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BENEFITS TO ALASKA

As a result of activities and support of AmericaView the State of Alaska have benefited as follows:

Our research generated new knowledge and map products that directly contributed to mission of Alaska Forest Health Protection program and Alaska Division of Forestry.

Enrollment in edX courses: Total enrollment 45,000+ (as of Nov. 2024) from 181 countries. Among the top 10 enrollment countries 5 are developing countries (India, Nigeria, Pakistan, Bangladesh, and Ghana).

Research Support: Anushree Badola, Postdoc, received salary support. She presented at 2024 AAG, AFE, IGARSS, and AGU meetings.

We offered $1,000 fellowship to:

- Alex Baughman, a BS student, conducting research on boreal forest disturbance dynamics

PI Panda served as guest editor for a special issue, *Earth from Above: AmericaView, Remote Sensing and Geospatial Technology*, in **The Geographical Bulletin** that attracted 10 student led publications.

2024 STEM Night at a local elementary school

Public Outreach: In GY23, we participated in 2 events organized by University of Alaska Fairbanks, and 1 event organized by a local school

- 2024 CNSM Science Potpourri
- 2024 Arctic Research Open House
- 2024 Pearl-Creek Elementary Science Night

Exhibit included: a poster on forest health research, Landsat board games, NASA posters, USGS Landsat Science booklets, and Alaska As Art displays:

- to increase awareness of satellite earth observation in education, research and societal well-being
- to increase awareness of the climatic and geologic processes that continue to shape the Alaska's dynamic landforms and forest ecosystems

Consortium Development: Collaborated with UAF eCamups, UAF Institute of Agriculture, Natural Resources and Extension, edX.org, NSF Alaska EPSCoR program, U.S. Forest Service, and U.S. Fish and Wildlife Service.

ALASKAVIEW CONSORTIUM MEMBERSHIP

Federal consortium members identified above do not receive funding from AmericaView.

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