Using multi-temporal LiDAR to assess fire impacts on tree growth

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Why is monitoring forest growth important?

• Forest monitoring essential for management planning

• Timber activities vital part of Idaho/PNW economy (jobs, revenue)

• We rely on numerous wood products every single day
A little history...

Forest inventory: what – and how much – is out there?

- Sub-sampling of forest conditions using field plots
- Re-measured over time to capture growth/change
Moving from **spatially incomplete inventory** to **spatially complete inventory**

- Airborne LiDAR (aka airborne laser scanning - ALS)

Source: Eagle Mapping
LiDAR (Light Detection And Ranging)

- Produces 3D ‘point clouds’ of target landscapes
  - ‘Digital Forests’
LiDAR – Going Beyond 2D characterization

- Each point within point cloud has x and y location and z height + other information

- Stored in `.las` file format:

<table>
<thead>
<tr>
<th>x</th>
<th>y</th>
<th>z</th>
<th>Gps time</th>
<th>Intensity</th>
<th>Return #</th>
<th># of Returns</th>
<th>Class</th>
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<td>1</td>
<td>2</td>
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<tr>
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</tr>
</tbody>
</table>
Individual tree detection

Moving from samples to census:
*Identification and segmentation of individual trees*
Individual Tree Detection
Individual Tree Detection
Individual Tree Detection

Stem diameter

- 10 cm
- 40 cm

[Map showing distribution of tree stems with 10 cm and 40 cm markers]
Individual Tree Detection

Species

- Ponderosa pine
- Douglas-fir
- Grand fir
Individual tree growth

Multi-temporal LiDAR
+ individual tree identification
= individual tree growth
Fire impacts on growth

Study design
❖ 3 forest stands, half of each burned in 2014
❖ Fire intensity measured via *in situ* infrared radiometers
❖ Increment cores collected ~2 years post-fire
❖ ALS data collected in 2019, 2020, 2022
Fire impacts on growth

Results

❖ Radial growth reduction for burned vs non-burned trees

❖ This reduction varies with remotely sensed fire intensity!

Sparks et al. (2017) Int. J. Wildland Fire
Preliminary Results

❖ Long-lasting height growth reduction with increasing fire intensity
Importance and application:

❖ Better understanding of size and species dependent fire effects
❖ Guide for managers on Rx burn intensity
❖ Fire-productivity relationships could inform forest growth and earth system models
❖ ...
Thanks for your attention!

Where to find our latest research:

ResearchGate: researchgate.net/profile/Aaron-Sparks
Twitter: @double_A_R0N