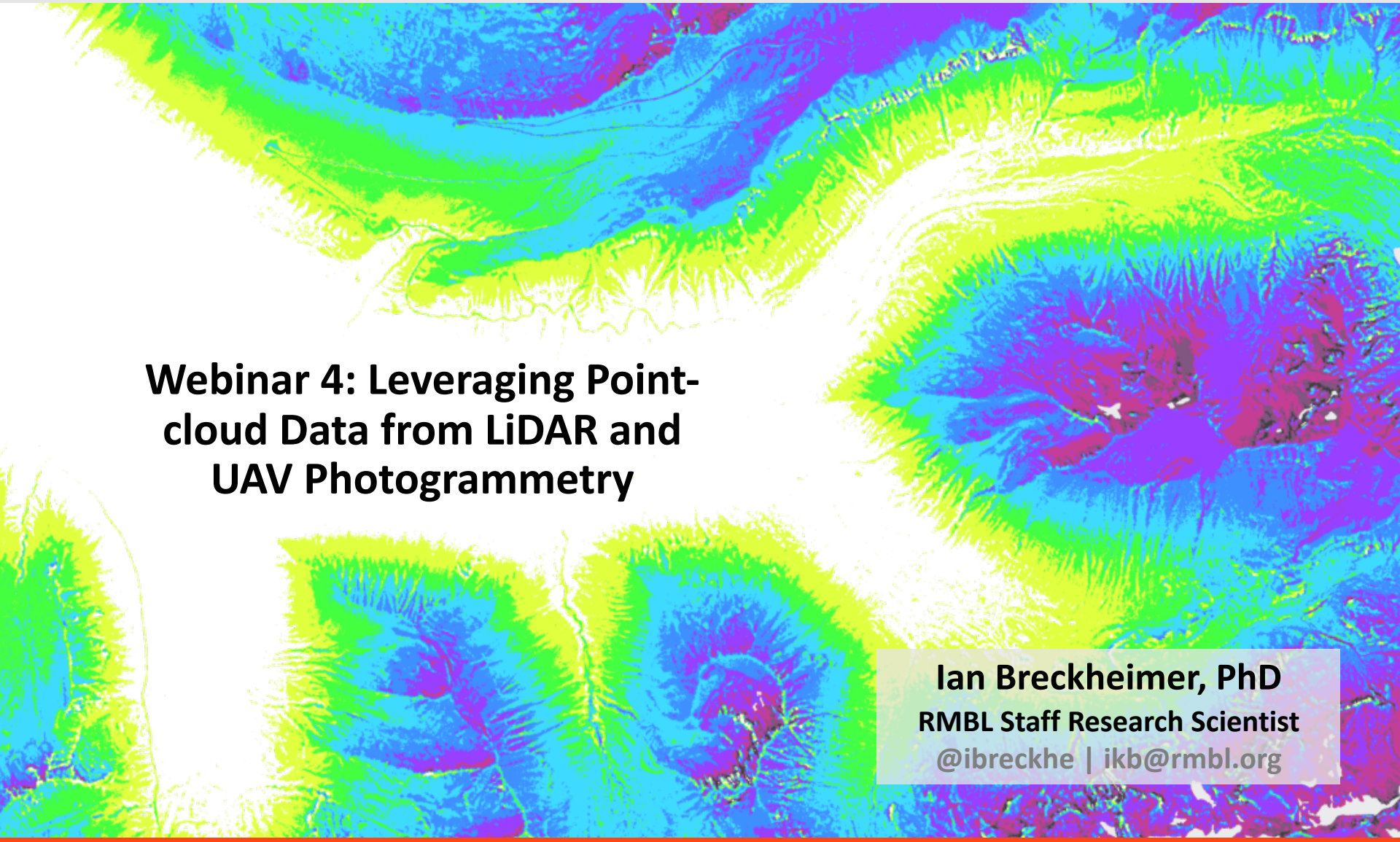

# Webinar 4: Leveraging Point-cloud Data from LiDAR and UAV Photogrammetry

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# Webinar Schedule

**Tuesday September 22nd 2020**
*Introduction to the RMBL Spatial Data Platform,*
How to access RMBL SDP data in GIS and programming environments, and where we are going with the platform.

**Tuesday October 20th 2020** *Designing Robust Field Studies using Geospatial Tools*
How to optimize site selection using GIS and the RMBL SDP.

**Tuesday January 26th, 2021** *Successful UAV Data Collection in Mountain Environments*
How to design and execute UAV flights for high-quality scientific data in challenging environments.

**Tuesday February 23rd, 2021** *Leveraging Point Cloud Data from Lidar and UAV Photogrammetry*
Mapping vegetation structure and function using 3D data from lidar and drones.

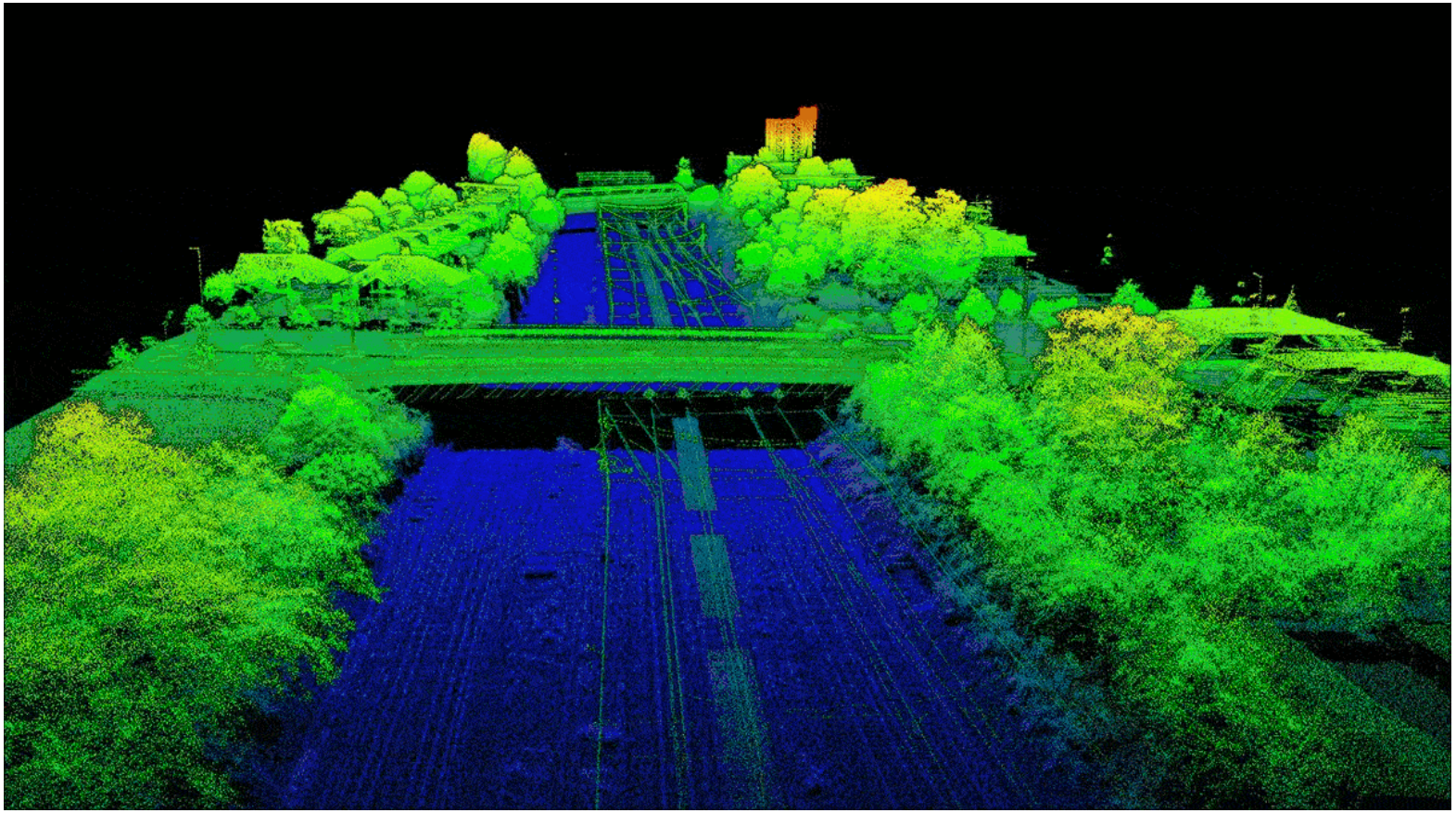
**Tuesday March 23rd, 2021** *Linking Field Data with Remote Sensing for Spatial Prediction*
How to leverage high-resolution remote sensing from imaging spectroscopy and lidar to map species, traits, and processes.

**Tuesday April 20th, 2021** *What's New in the RMBL Spatial Data Platform*
Introduction to new snow and phenology datasets that form part of the SDP Release 2 and Release 3.

# Outline

- **Why?** Why is this a good time to get comfortable with point cloud data?
- **What?**
  - What are the basic properties of point clouds, and how are they derived?
  - What are the strengths and weaknesses of SfM and LiDAR-derived point clouds
  - What are the core point cloud workflows?
  - Case Study: leveraging LiDAR point clouds to monitor forest mortality.
- **How?**
  - Demo: processing point clouds in CloudCompare and R

# What are point clouds?



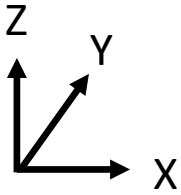



Image: Blom International

# Why Point Clouds? 3D Structure matters.

Images: James Hanula, USFS

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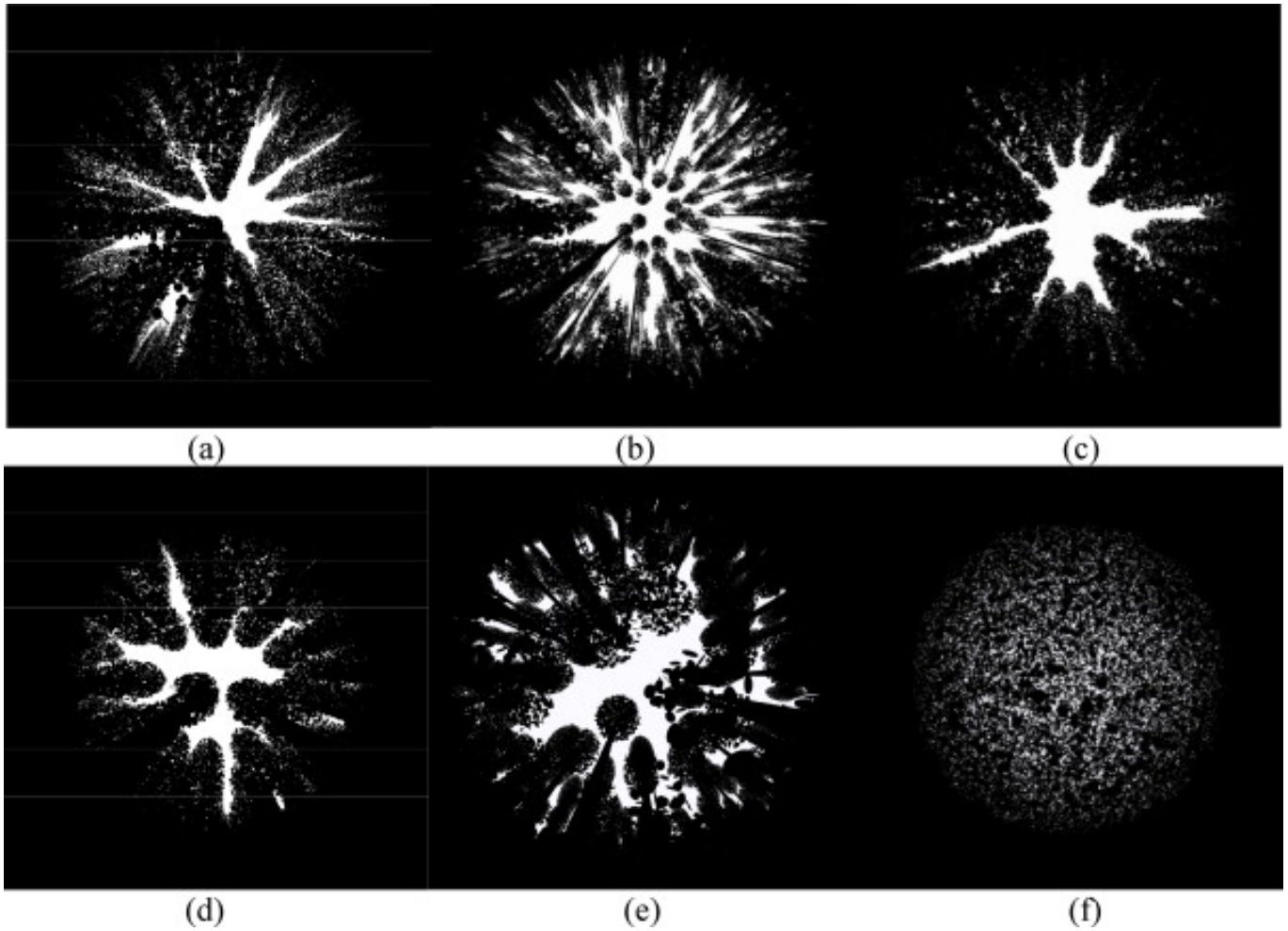
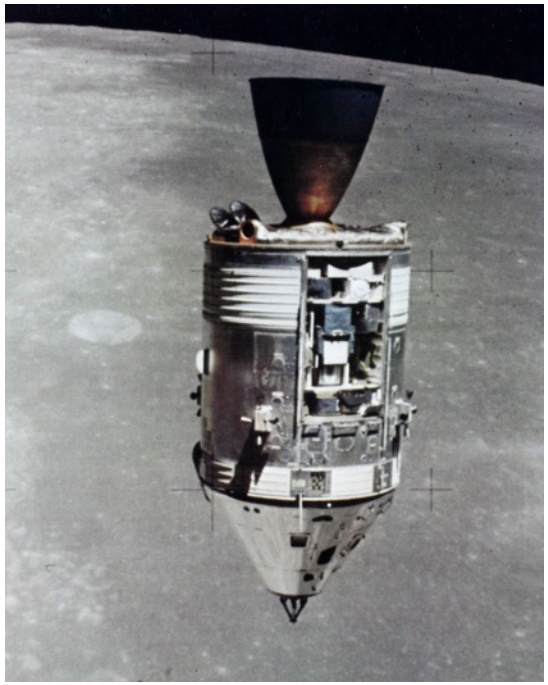
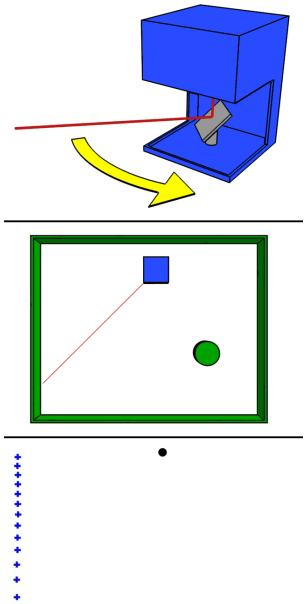



Images: Leblanc and Fournier 2014

# Why Point Clouds? New platforms and sensors.

LiDAR Then

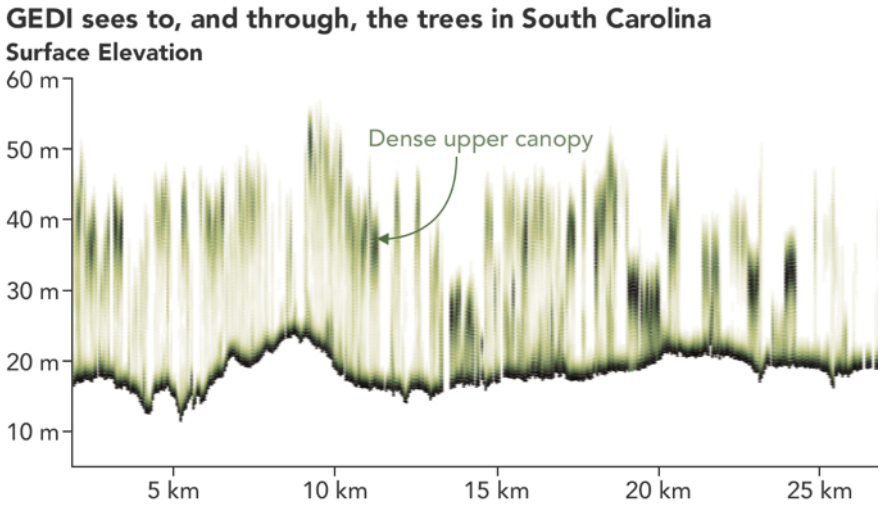


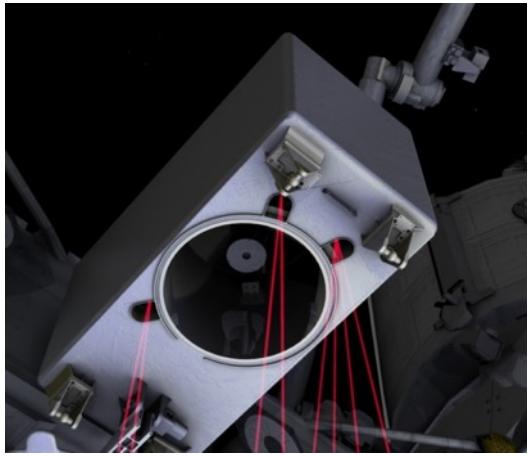


LiDAR Now

Images: NASA, mike1024, Apple

# Why Point Clouds? New platforms and sensors.

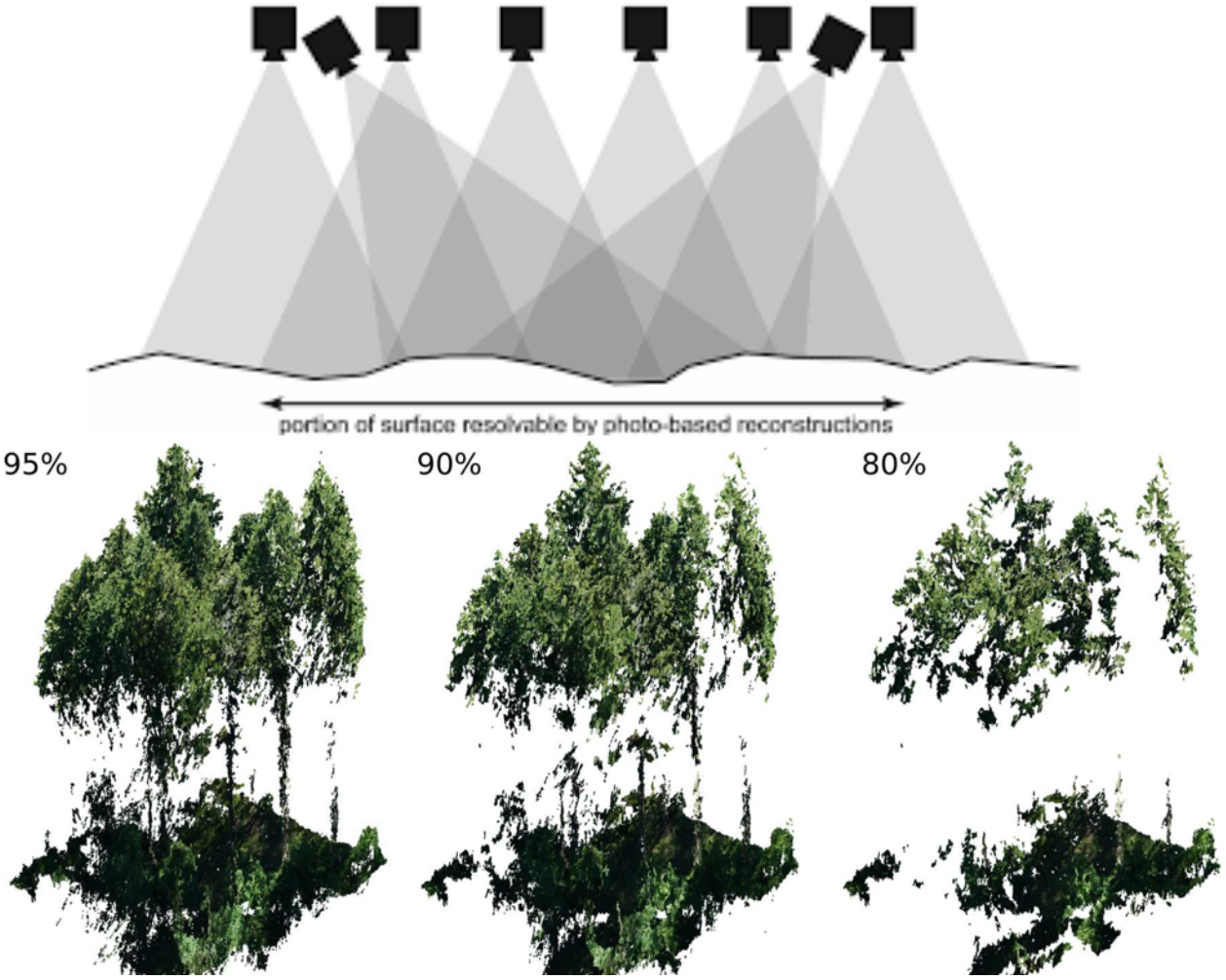



Images: NASA, University of Maryland

# Where we are going, we don't need lasers.

Structure-from-Motion




Images: SDFC

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# The structure of a point cloud dataset.

Coordinates + Attributes

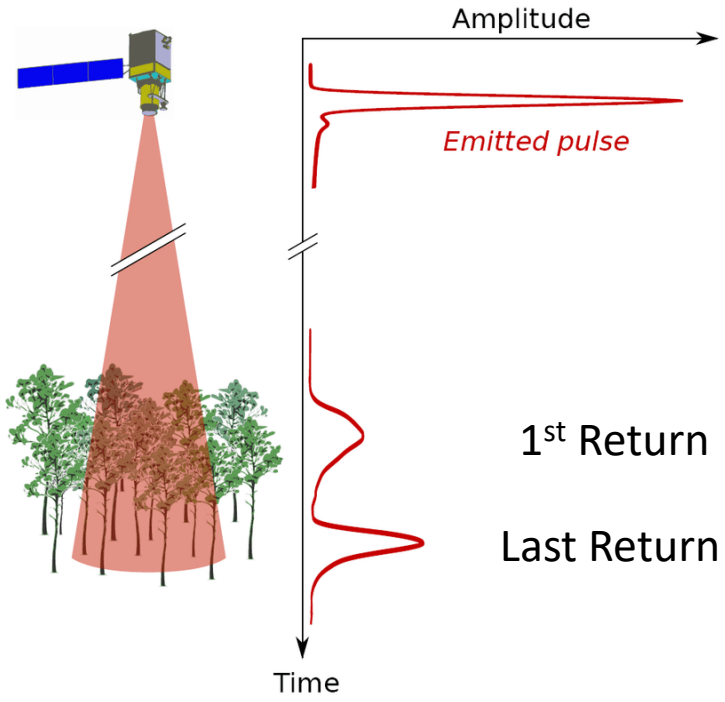
| | X | Y | Z |
|---|---|---|---|
| 1: | 327999.7 | 4313844 | 2916.05 |
| 2: | 327999.5 | 4313843 | 2916.03 |
| 3: | 328000.2 | 4313844 | 2916.07 |
| 4: | 328000.9 | 4313844 | 2916.07 |
| 5: | 328001.5 | 4313844 | 2916.15 |
| 6: | 328002.2 | 4313844 | 2916.09 |

Standard format: .las or .laz (compressed)

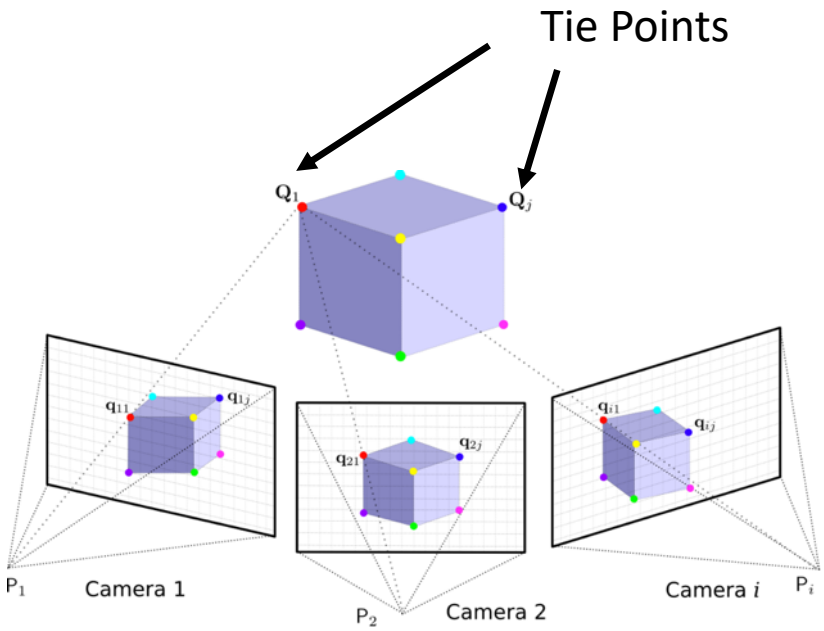
Challenges: Always BIG Sometimes messy

# How do we get there?

## LiDAR




## Photogrammetry




Images: J. Fernandez-Diaz Hypraptive

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# LiDAR versus Photogrammetry Point Clouds

## LiDAR (Airborne)

Pros:
- Relatively uniform sampling
- Constant, high spatial precision
- Can penetrate vegetation
- Rich spatial attributes (return number)

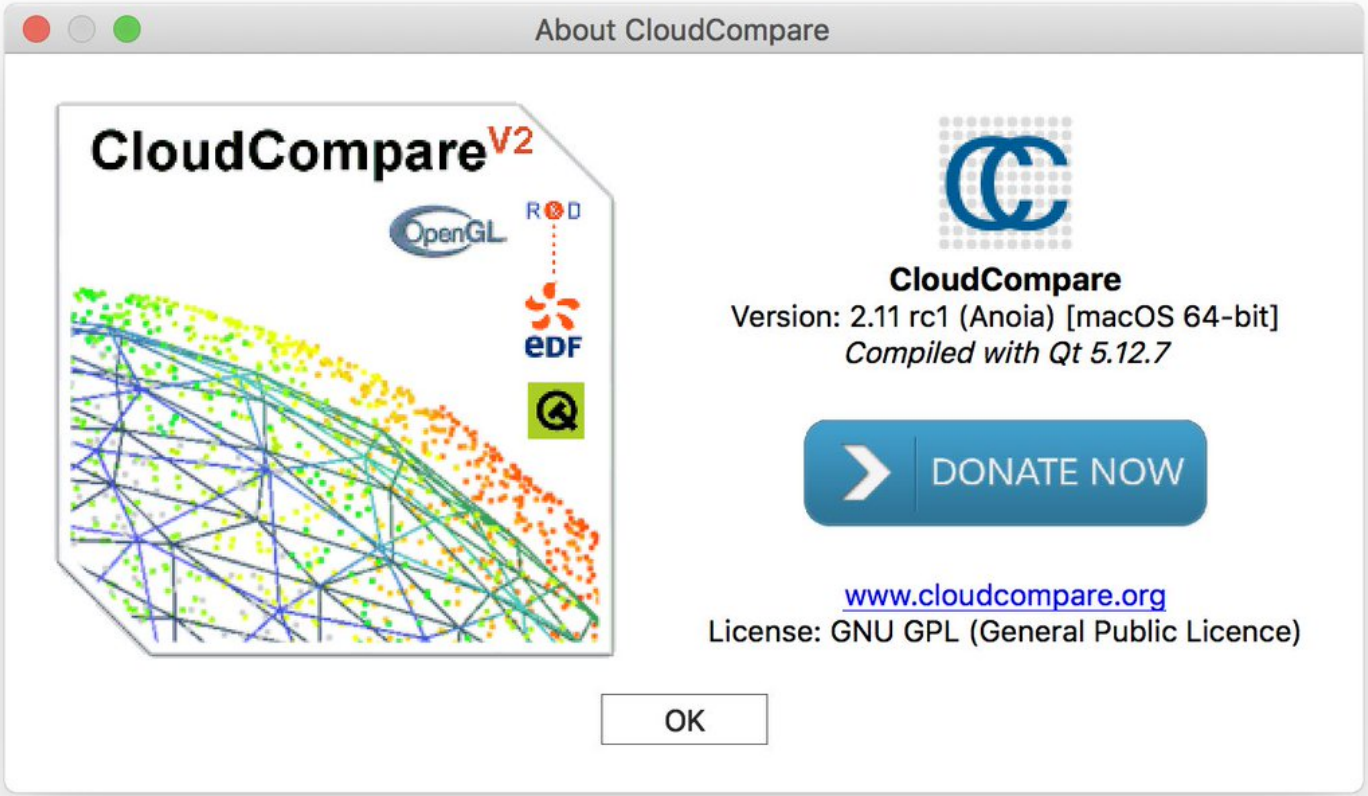
Cons:
- Equipment still expensive
- Limited spectral information
- Lower point density

## Photogrammetry

Pros:
- (Usually) higher point density
- Rich spectral information
- Inexpensive equipment
- Flexible deployment

Cons:
- Variable precision and density
- Expensive processing
- Doesn’t “penetrate” dense veg

# Demo: LiDAR versus Photogrammetry



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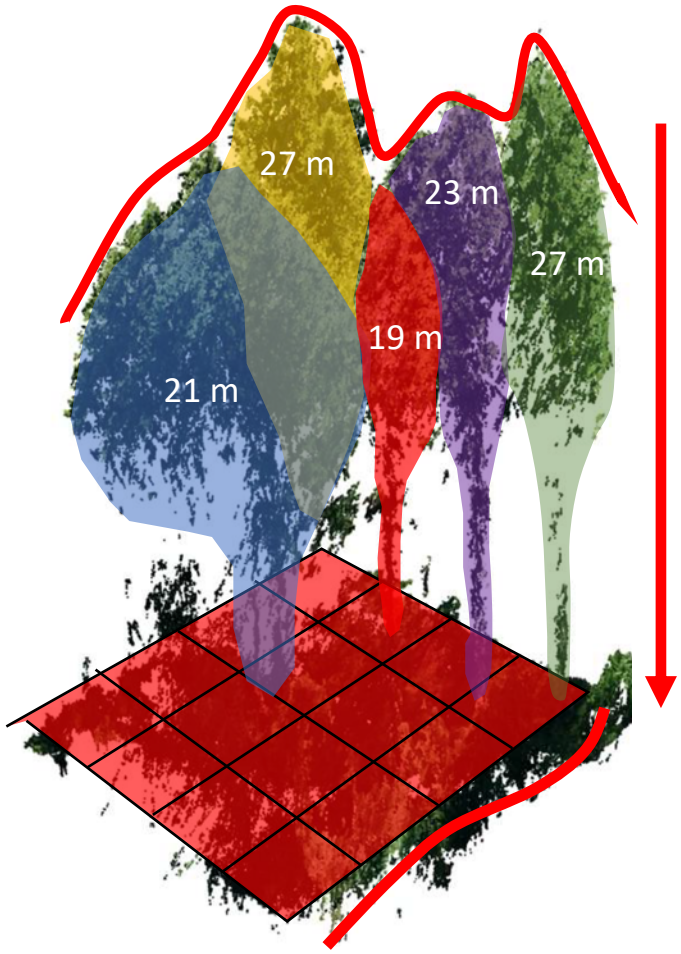
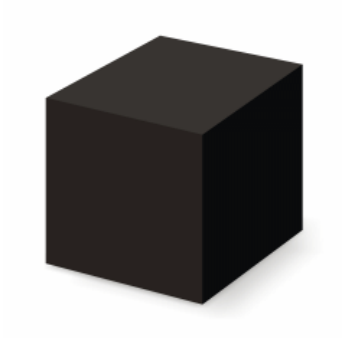
# Core Point Cloud Tasks for Environmental Research

- Terrain Classification – DEM generation
- Terrain-normalization.
- Finding and measuring the canopy surface.
- Extracting gridded measures of topography and vegetation.
- Delineating objects.
- Measuring those objects.



# Pain Points in Core Workflows

- Proprietary algorithms and software.



- Good performance requires dataset-specific tweaking.

- High data volumes.


Images: Dallas Card, Gables Engineering, PhD Comics

# A view to the future

- Fully automated pre-processing, clustering, segmentation, and feature extraction at scale.

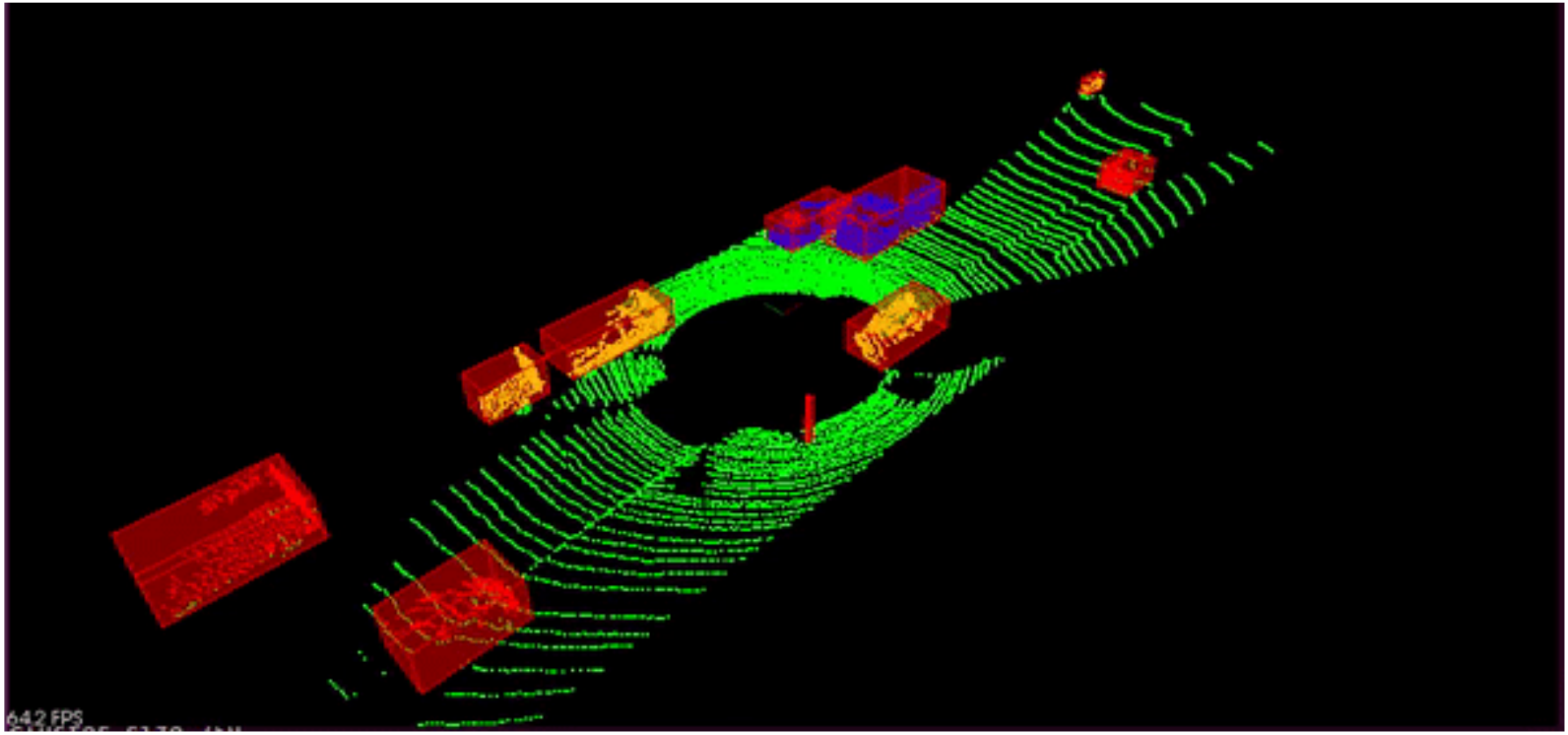
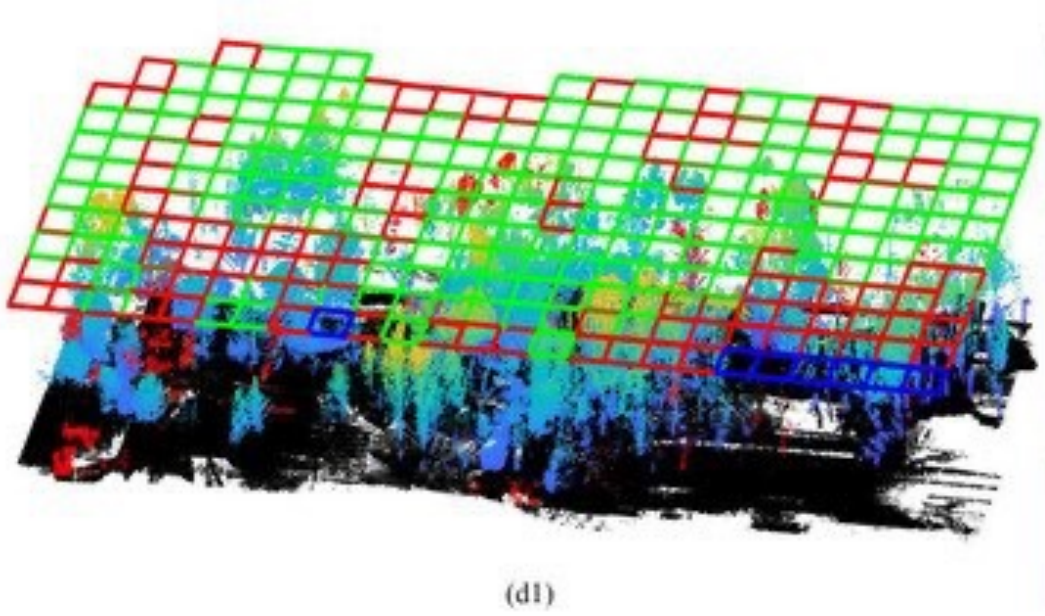



Image: engineBozkurt

# Projects to watch

*TreeSeg* – Burt et al. 2019

*PointNet* – Chen et al. 2020




Images: Burt et al. 2019, Chen et al. 2021

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# Case Study: mapping Quaking Aspen (*Populus tremuloides*) mortality dynamics using repeat LiDAR

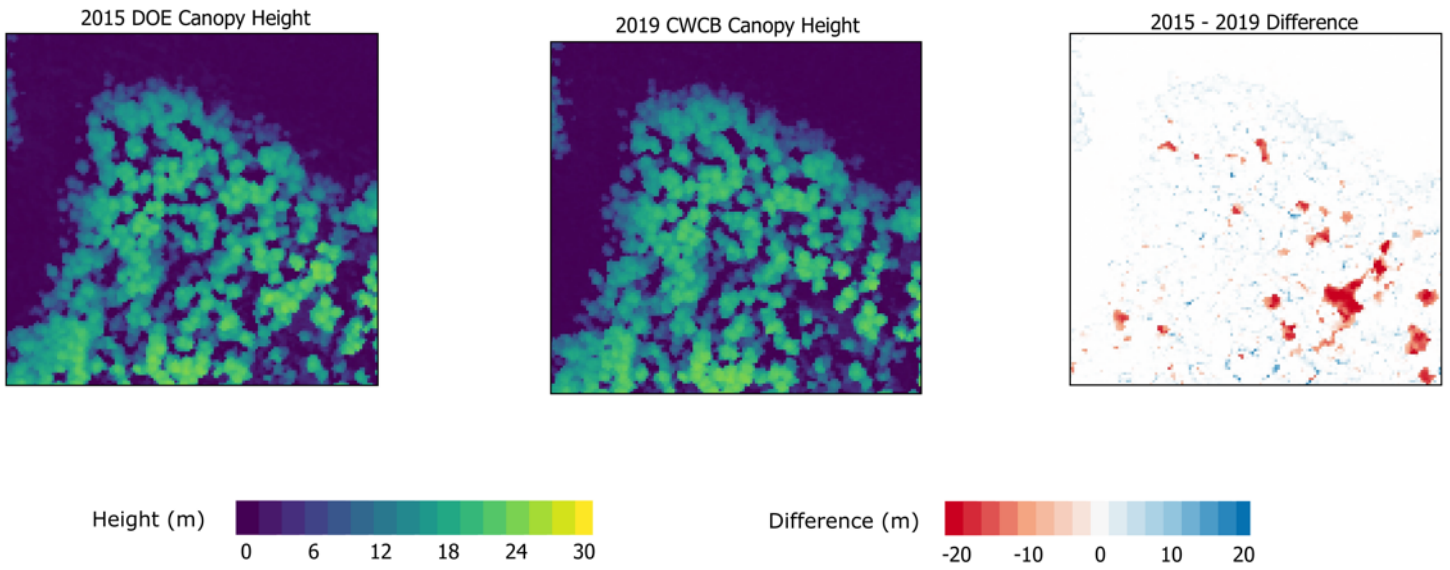


Photo: Deseret News

# Demo: Processing point clouds using R and lidR


Free lidR Book by Roussel et al:
https://jean-romain.github.io/lidRbook/

# Cloth simulation filter

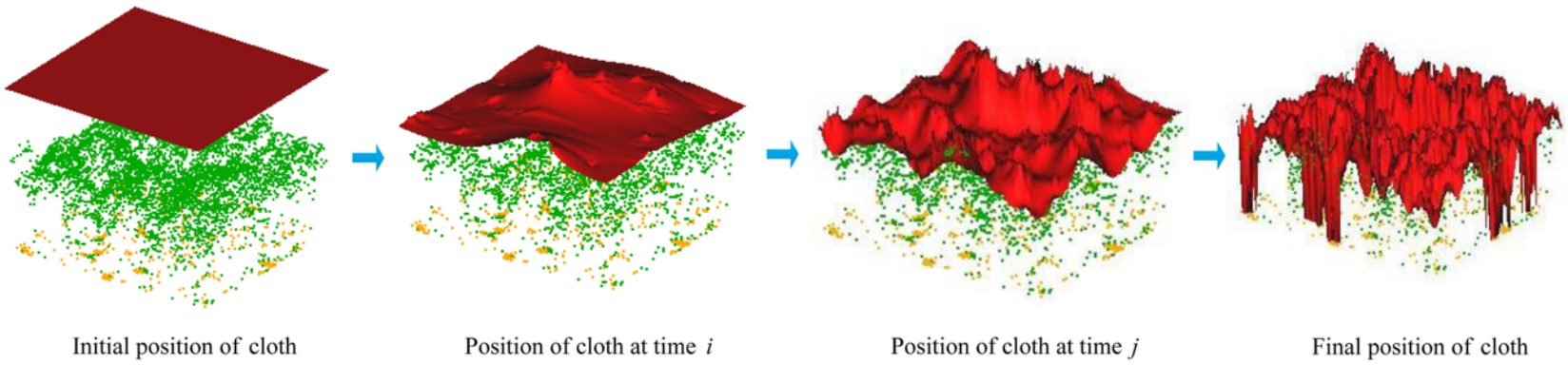


Figure: Zhang et al. 2020

# Dalponte Pitfree algorithm

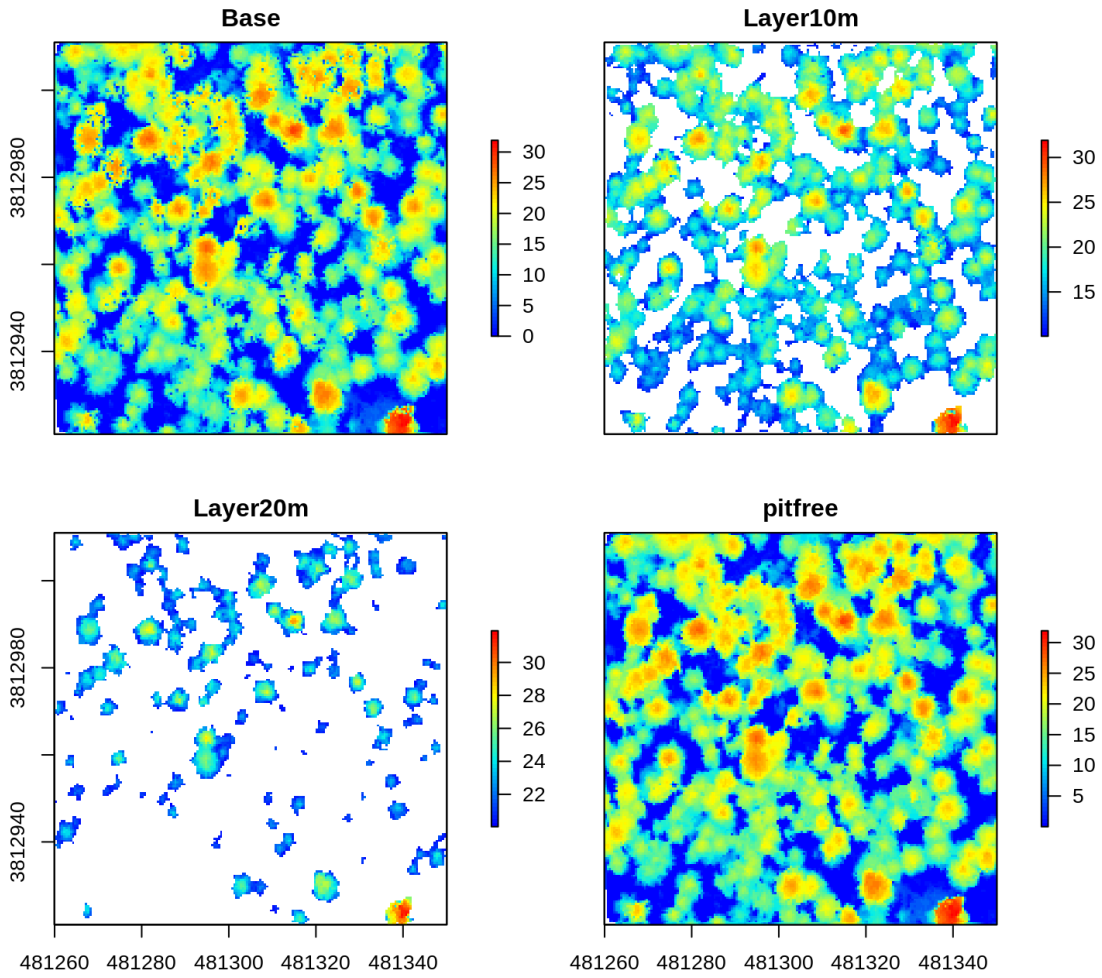


Figure: Jean-Romain Roussel

# Thanks!

## Contact Me:

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Twitter, Github: @ibreckhe

# References


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