Lidar Classification

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(with content adapted from Ralph Hagerud (USGS))

2011 SCEC LiDAR Short Course:

Imaging & Analyzing Southern California's Active Faults with High-Resolution Lidar Topography

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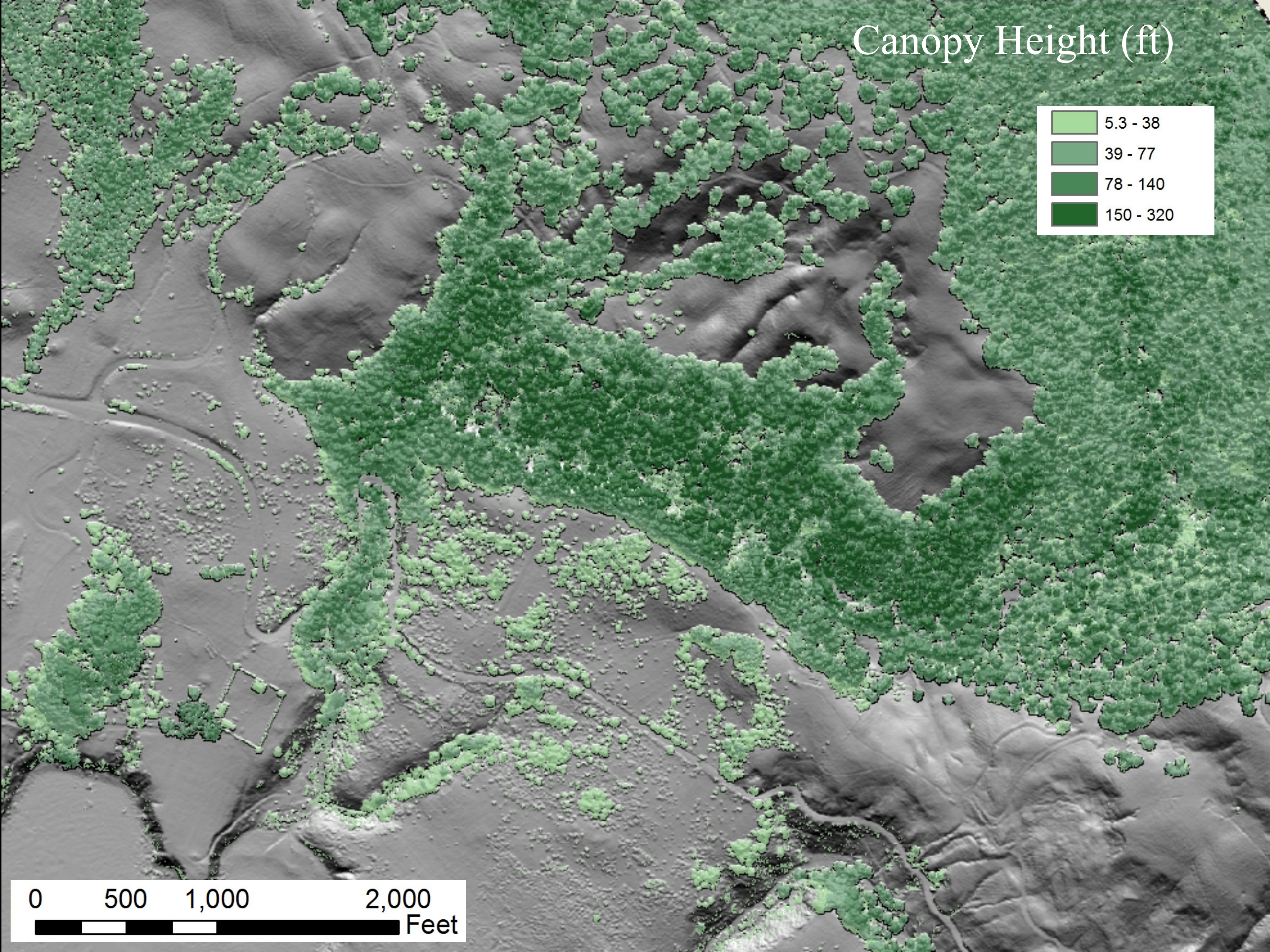
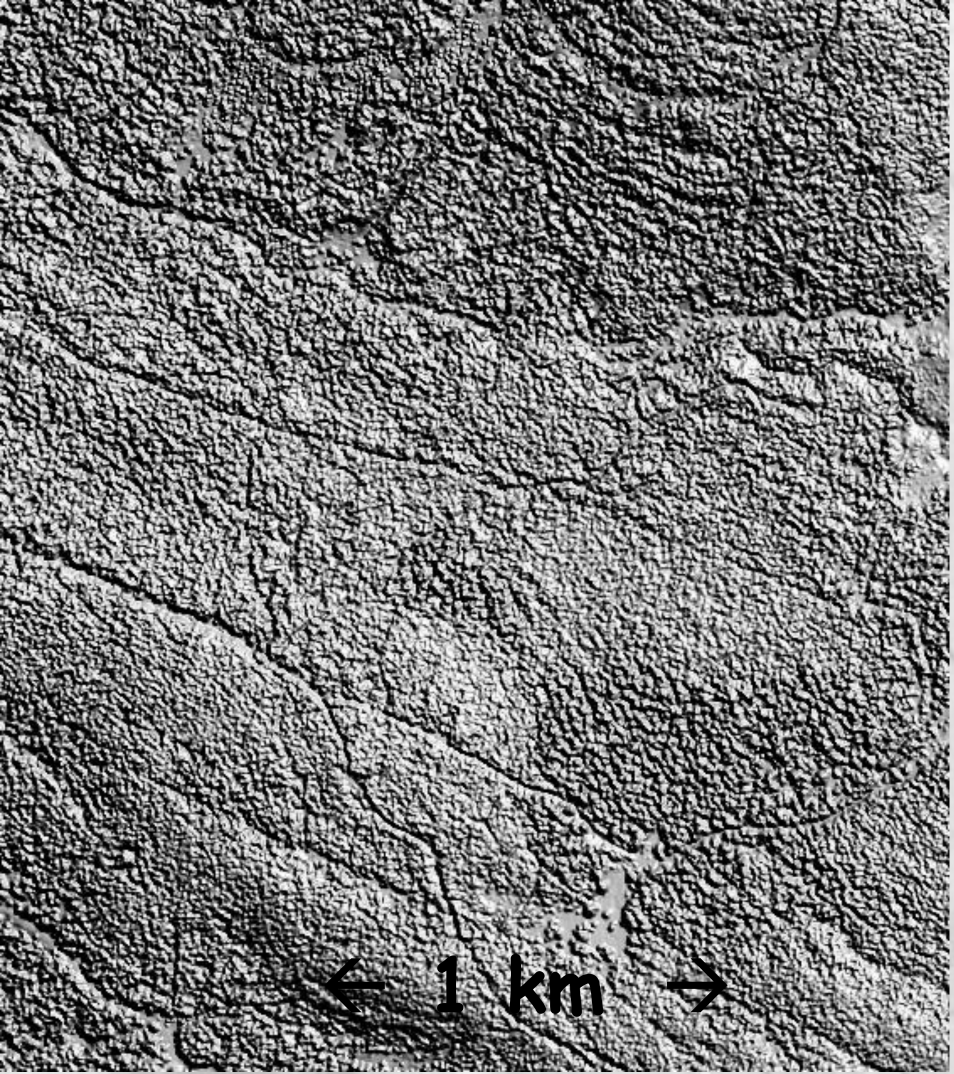
Overview

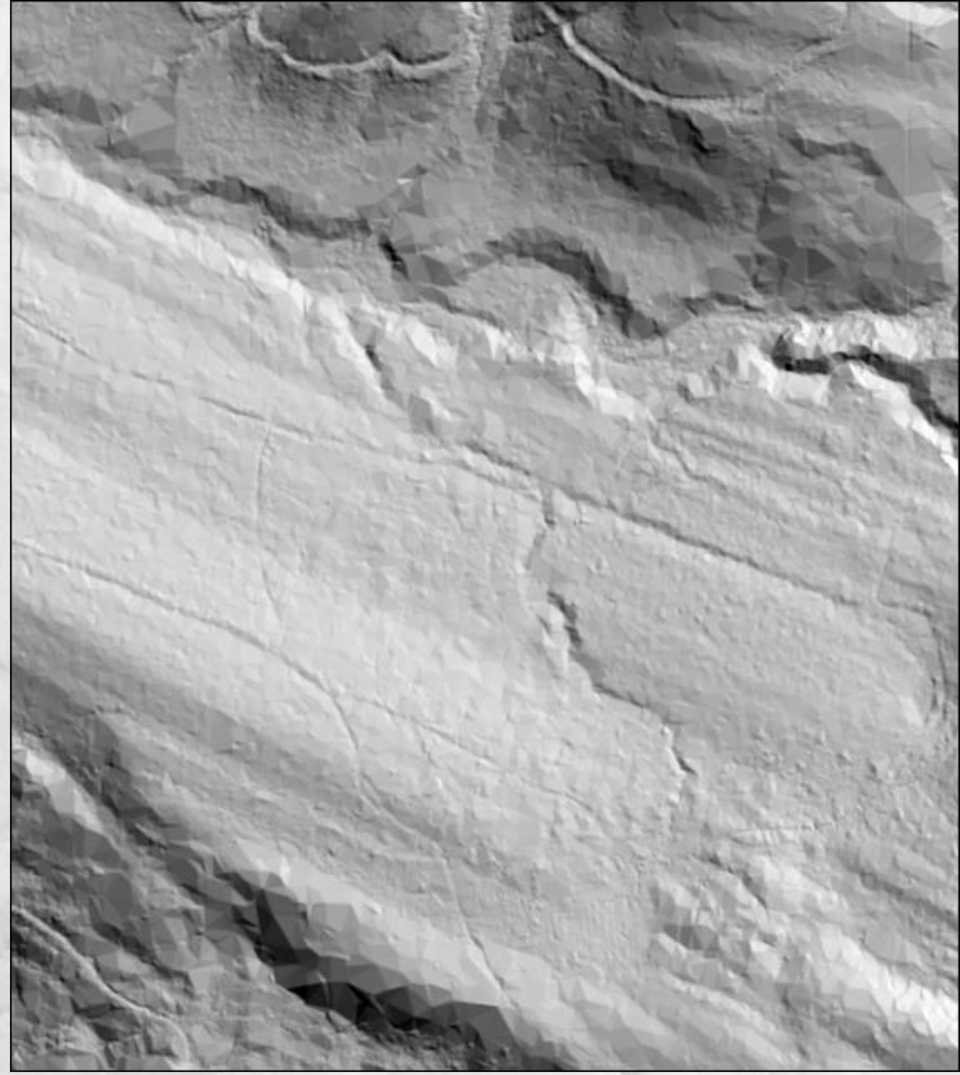
1. Lidar technology
2. Data collection workflow
3. Data products, formats, metadata
4. Lidar and vegetation
5. QA/QC, artifacts, issues to keep in mind
6. DEM generation from lidar point cloud data



Canopy Height (ft)



all surveyed points



ground points identified by
semi-automatic processing

Nookachamps Creek, east of Mount Vernon, Washington – R. Hagerud, USGS

What is ground?

Three assumptions:

Can be used to guide automated processing approaches

1. **Ground is smooth**
   - **despiking, iterative linear interpretation algorithms**

2. Ground is continuous (single-valued)
   - No-multiples algorithm

3. Ground is lowest surface in vicinity
   - Block-minimum algorithms

Modified from: R. Hagerud, USGS

Ground is smooth ⇒ despike algorithm

Approach:

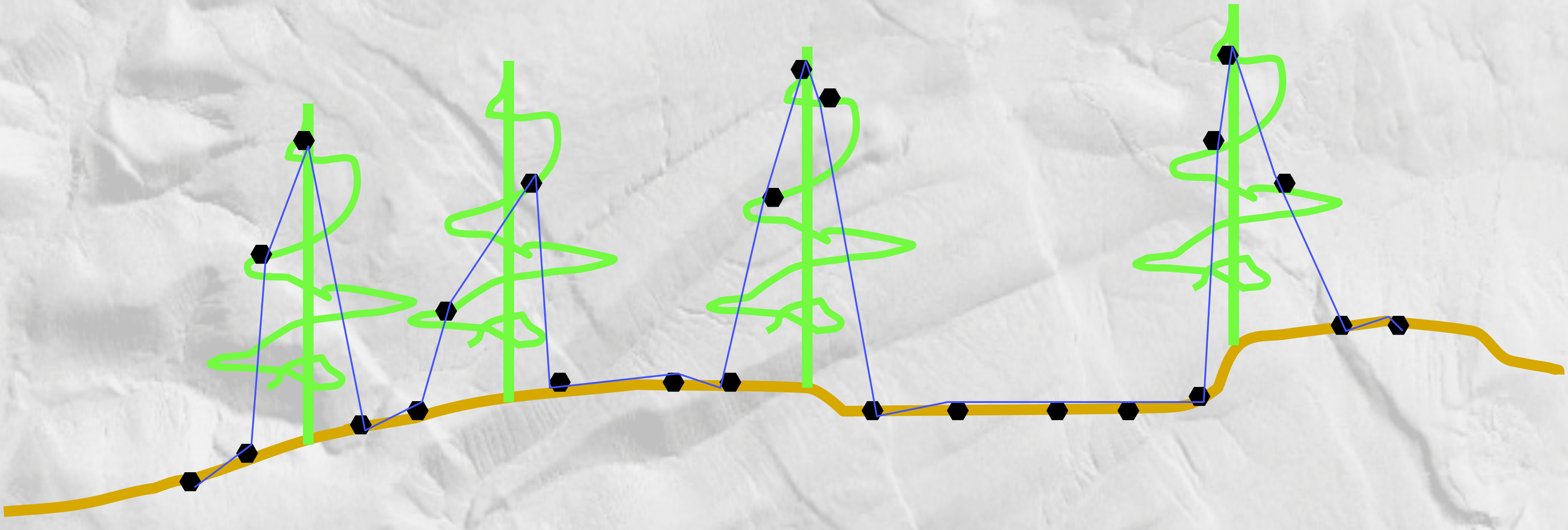
1. flag all points as ground

2. repeat:
    - build TIN (triangulated irregular network) of ground points
    - identify points that define strong positive curvatures
    - flag identified points as not-ground

3. until no or few points are flagged

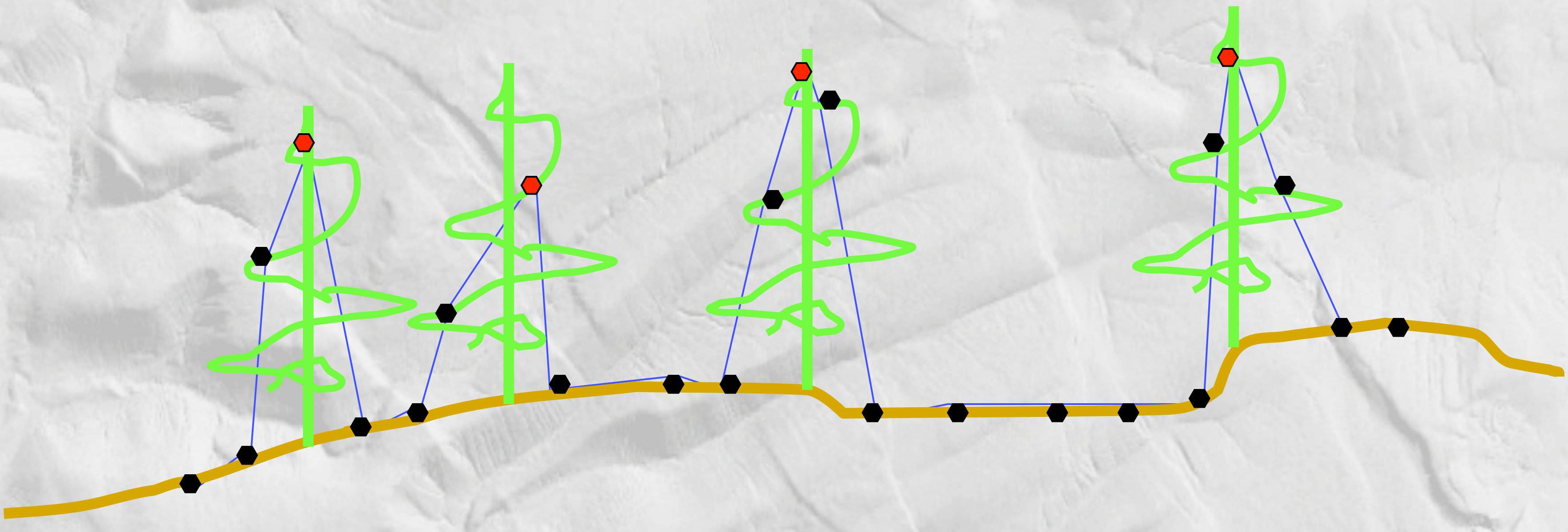
R. Hagerud, USGS

Start with mixed ground and canopy returns (e.g. last-return data), build TIN



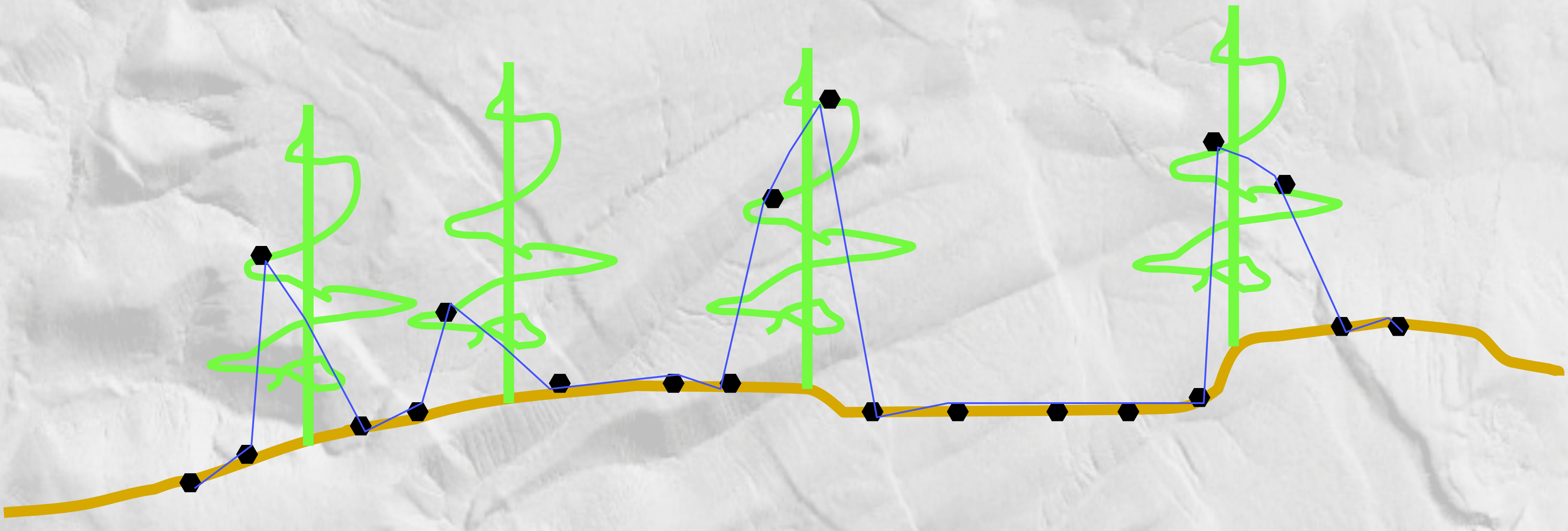
R. Hagerud, USGS

Flag points that define spikes (strong convexities)



R. Hagerud, USGS

Rebuild TIN



R. Hagerud, USGS

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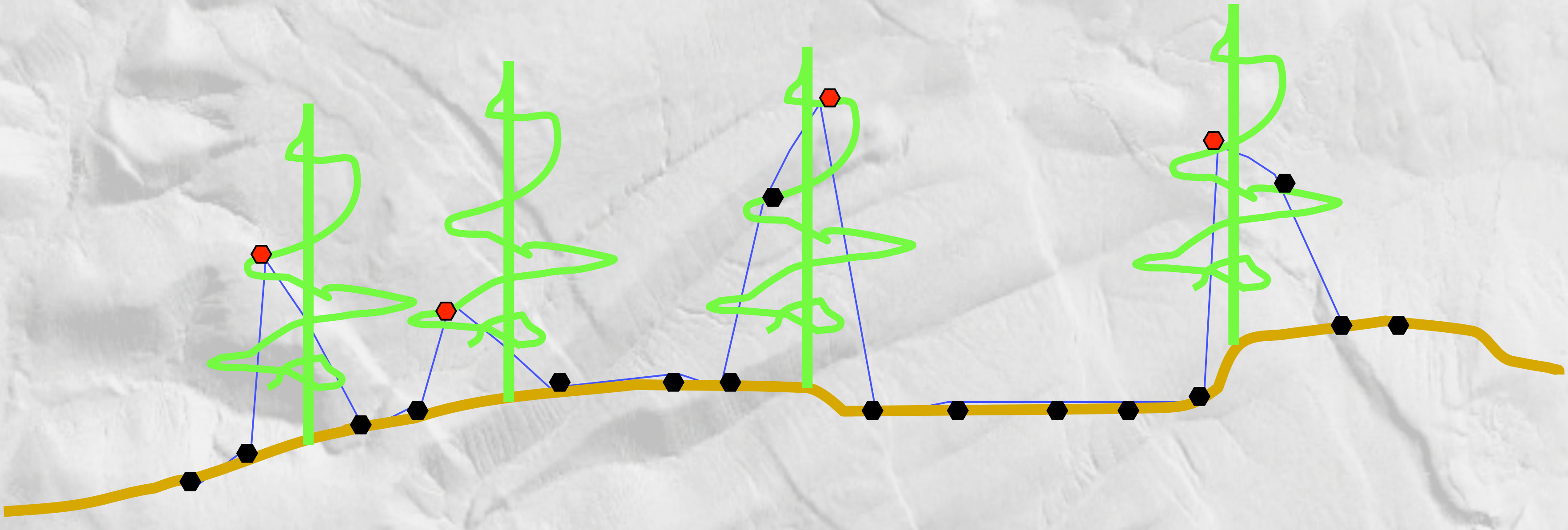
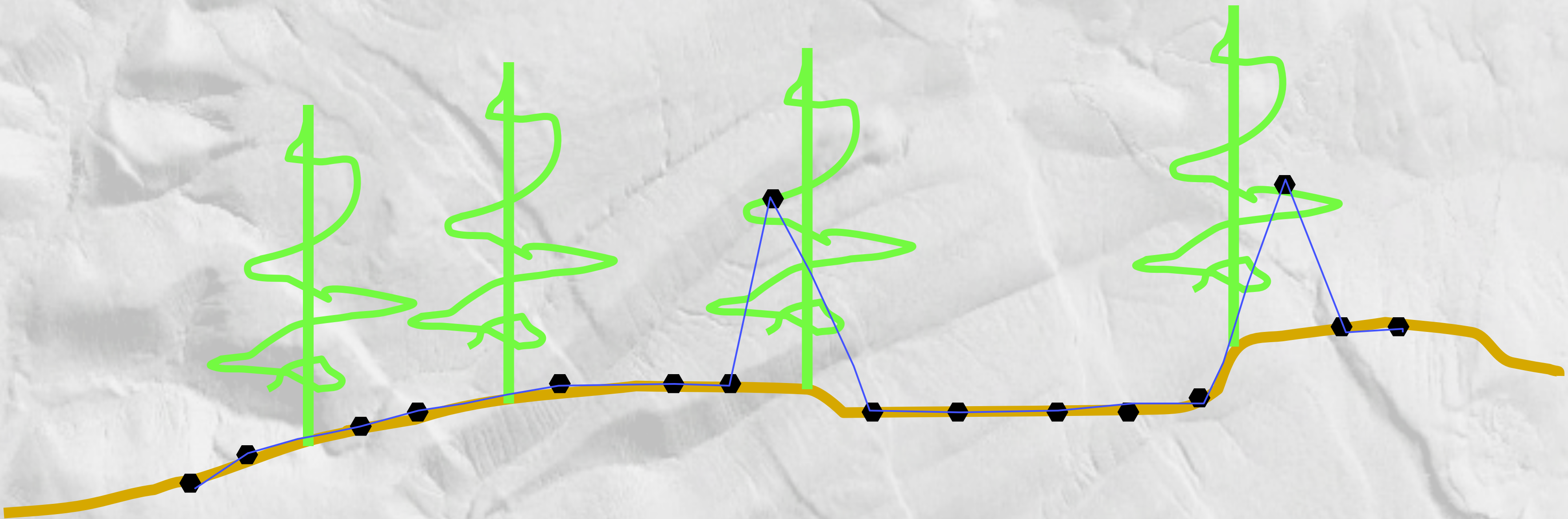


R. Hagerud, USGS

Rebuild TIN



R. Hagerud, USGS

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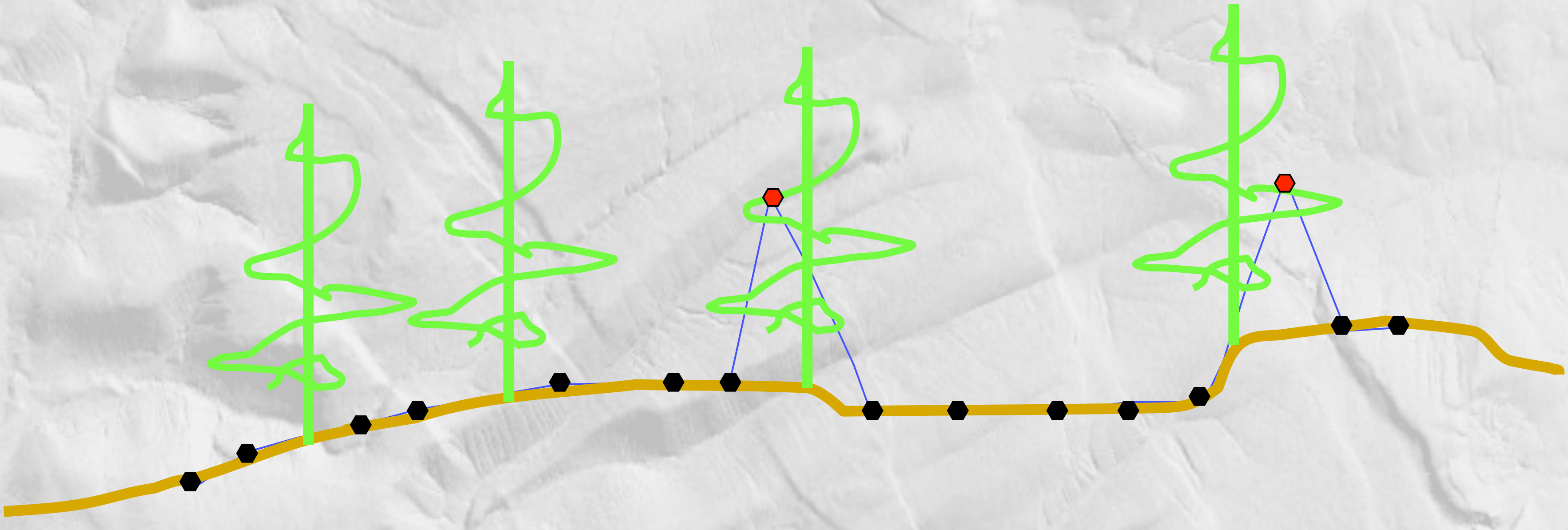
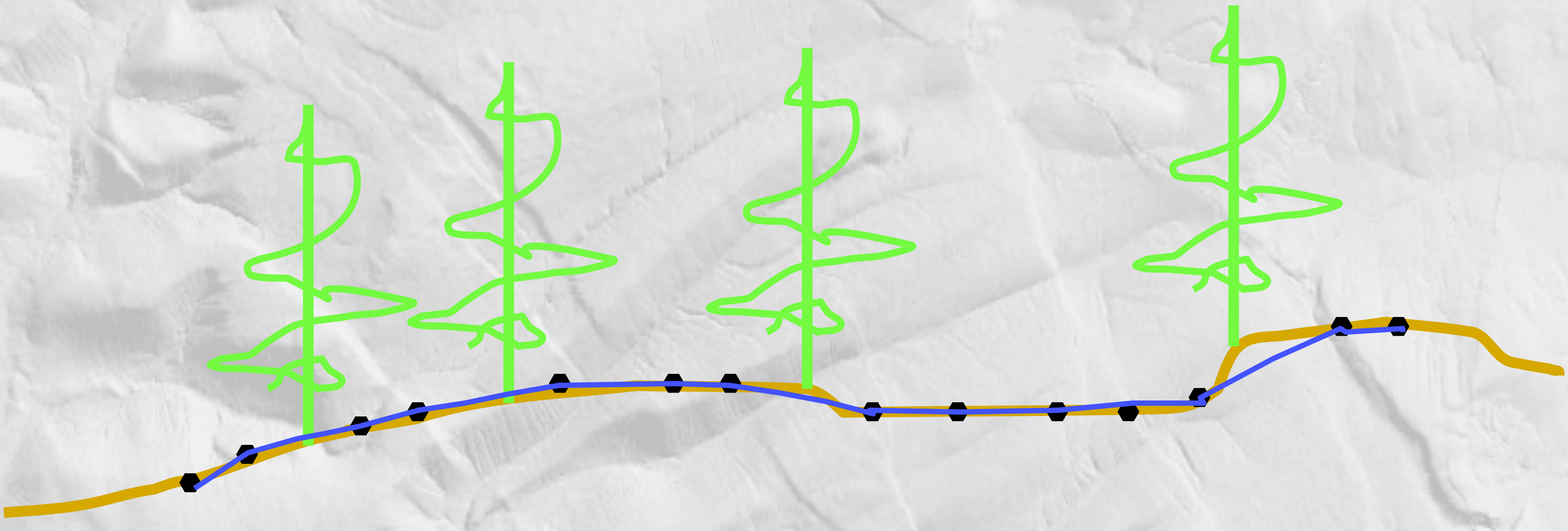


R. Hagerud, USGS

Rebuild TIN



R. Hagerud, USGS

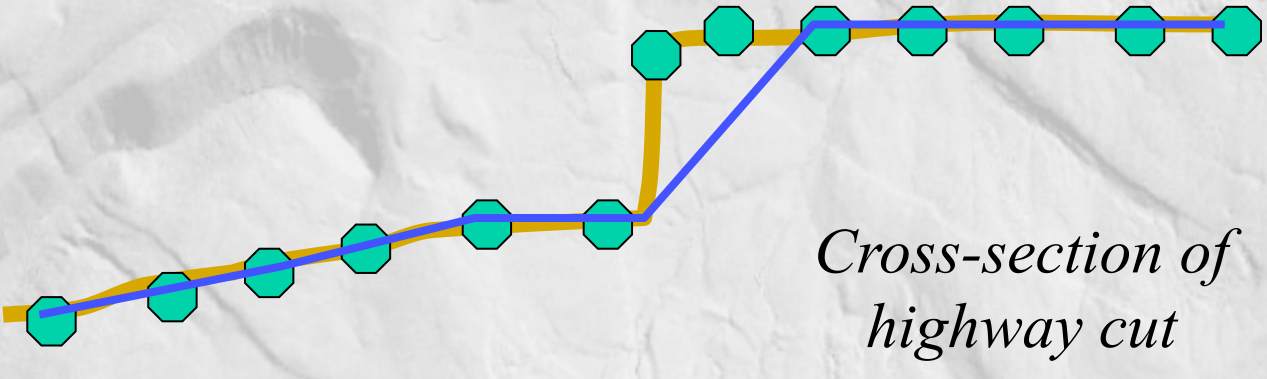
Despike algorithm

Benefits:

- It works
- It's automatic
  - Cheap(!)
  - All assumptions explicit
- It can preserve breaklines
- It appears to retain more ground points than other algorithms

R. Hagerud, USGS

Despike algorithm



Cross-section of highway cut

Problems:

- Removes some corners
- Sensitive to negative blunders
- Computationally intensive
- Makes rough surfaces
  - – Real? Measurement error? Misclassified vegetation?

R. Hagerud, USGS

In the real world…

- Almost all return classification is done with proprietary codes (Terascan the standard)

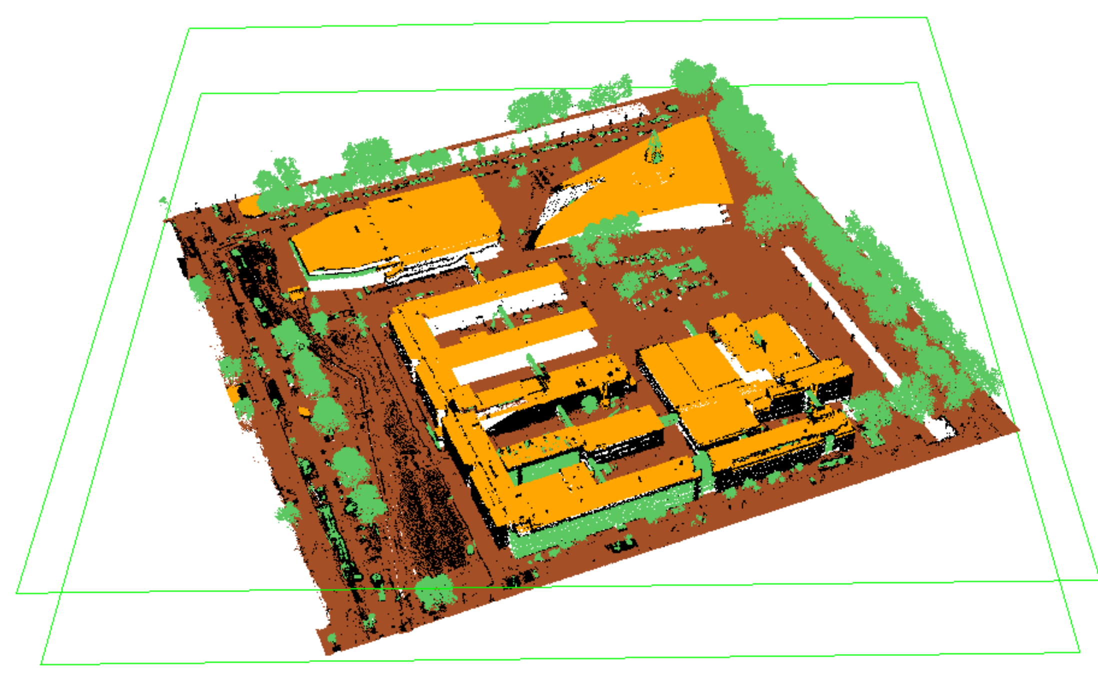
- Successful classification uses a mix of
  - Sophisticated code
  - Skilled human
    - To adjust code parameters
    - To identify and remedy problems

- Let somebody else do it! - *then carefully check their work*

- We have no useful metrics for accuracy of return classification

R. Hagerud, USGS

Do it yourself:



Open Source - Automated:

- LASTools –
  lasground.exe &
  lasclassify.exe
- MCC-lidar
  (Evans & Hudak, 2007)
  http://sourceforge.net/apps/trac/mcclidar/
- BCAL lidar tools (requires ENVI): http://bcal.geology.isu.edu/tools-2/envi-tools

More discussion: http://www.opentopography.org/index.php/blog/detail/tools_for_lidar_point_cloud_filtering_classification#comments

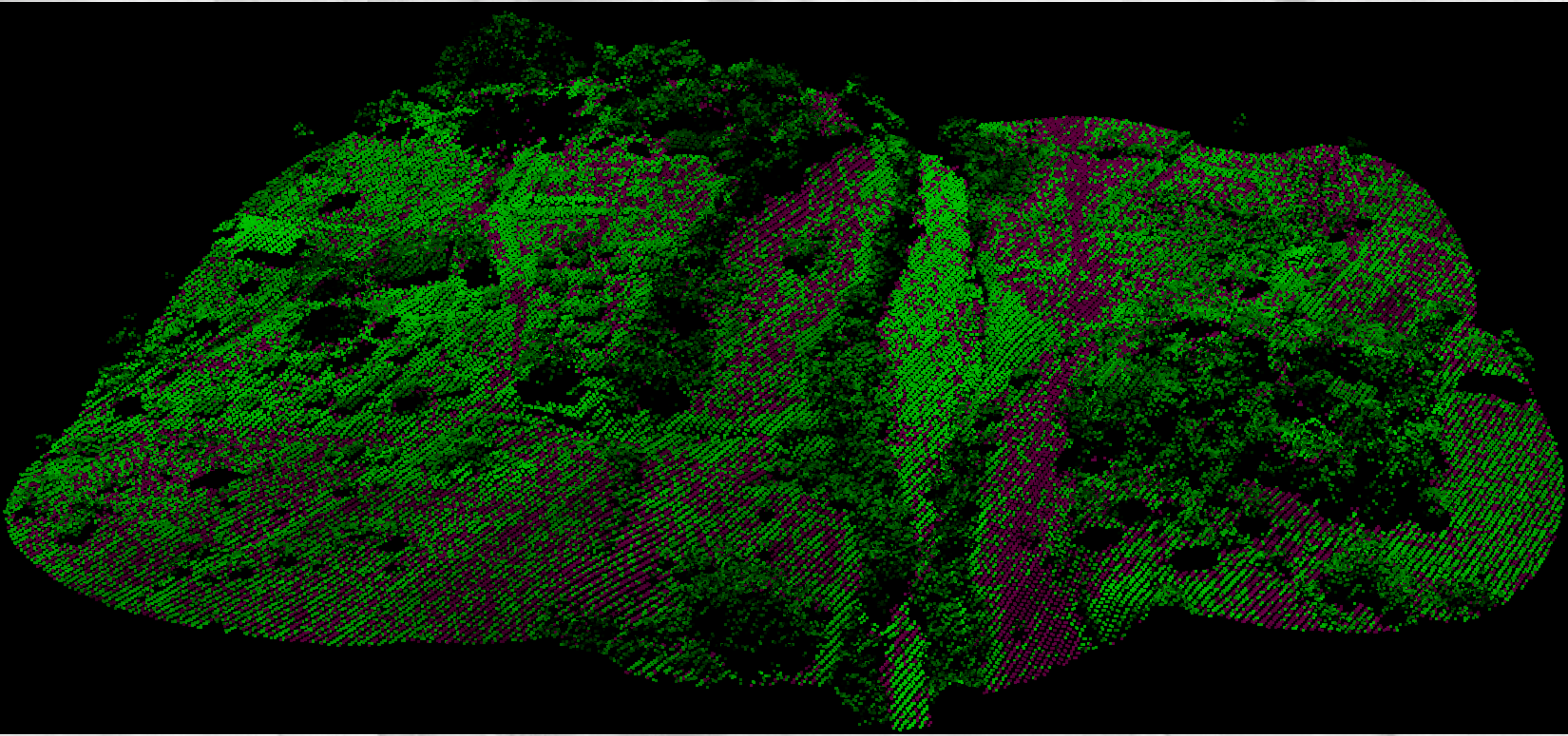
Open Source - Manual:

- LidarViewer (KeckCAVES)

R. Hagerud, USGS

When Automatic Classification Goes Wrong:

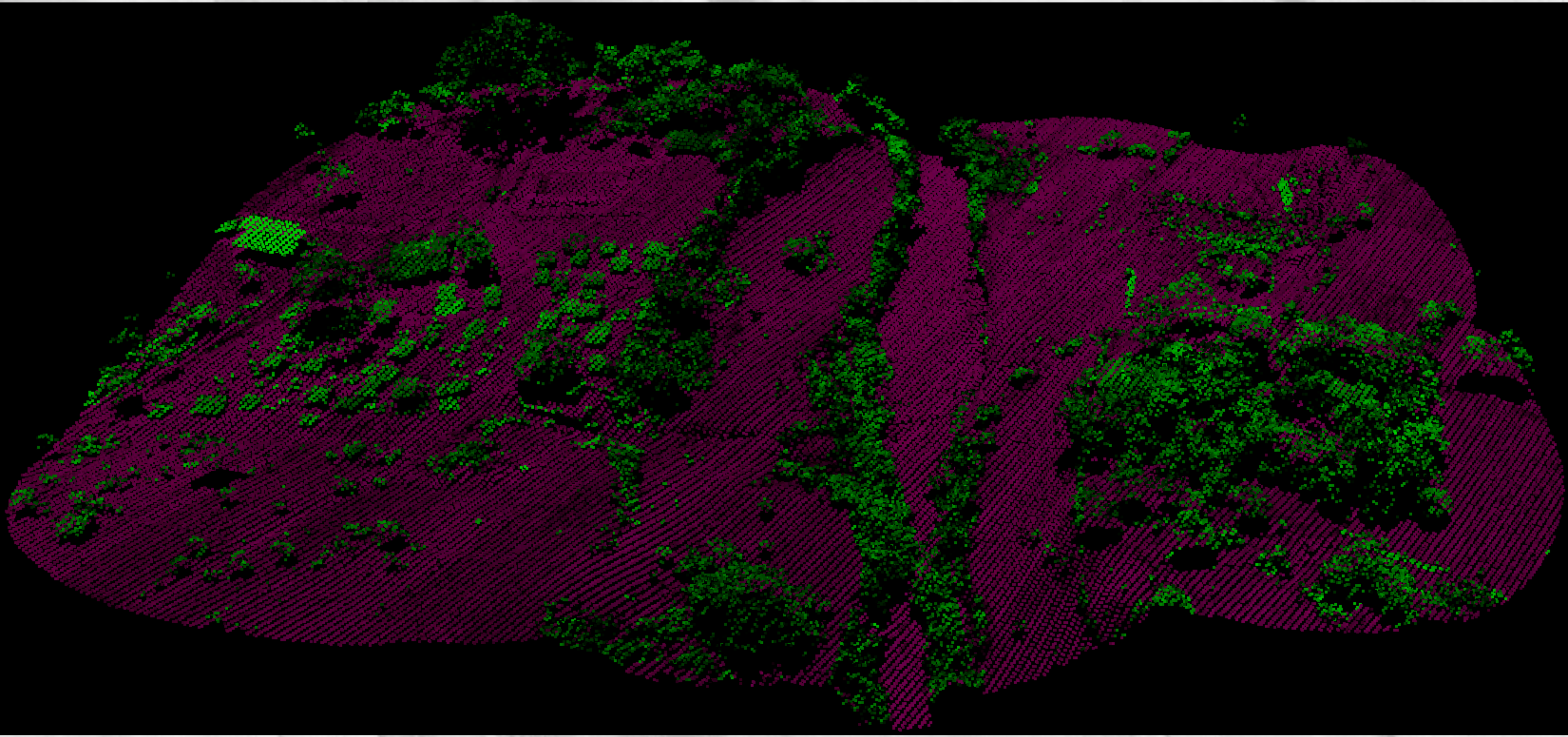
Dumay Slip-Rate Site, Enriquillo Fault, Haiti



This data set was processed quickly for assessing urban area, not faults

Manual Classification in 3D Cave

Dumay Slip-Rate Site, Enriquillo Fault, Haiti



Manual classification practical for small areas using a 3D environment