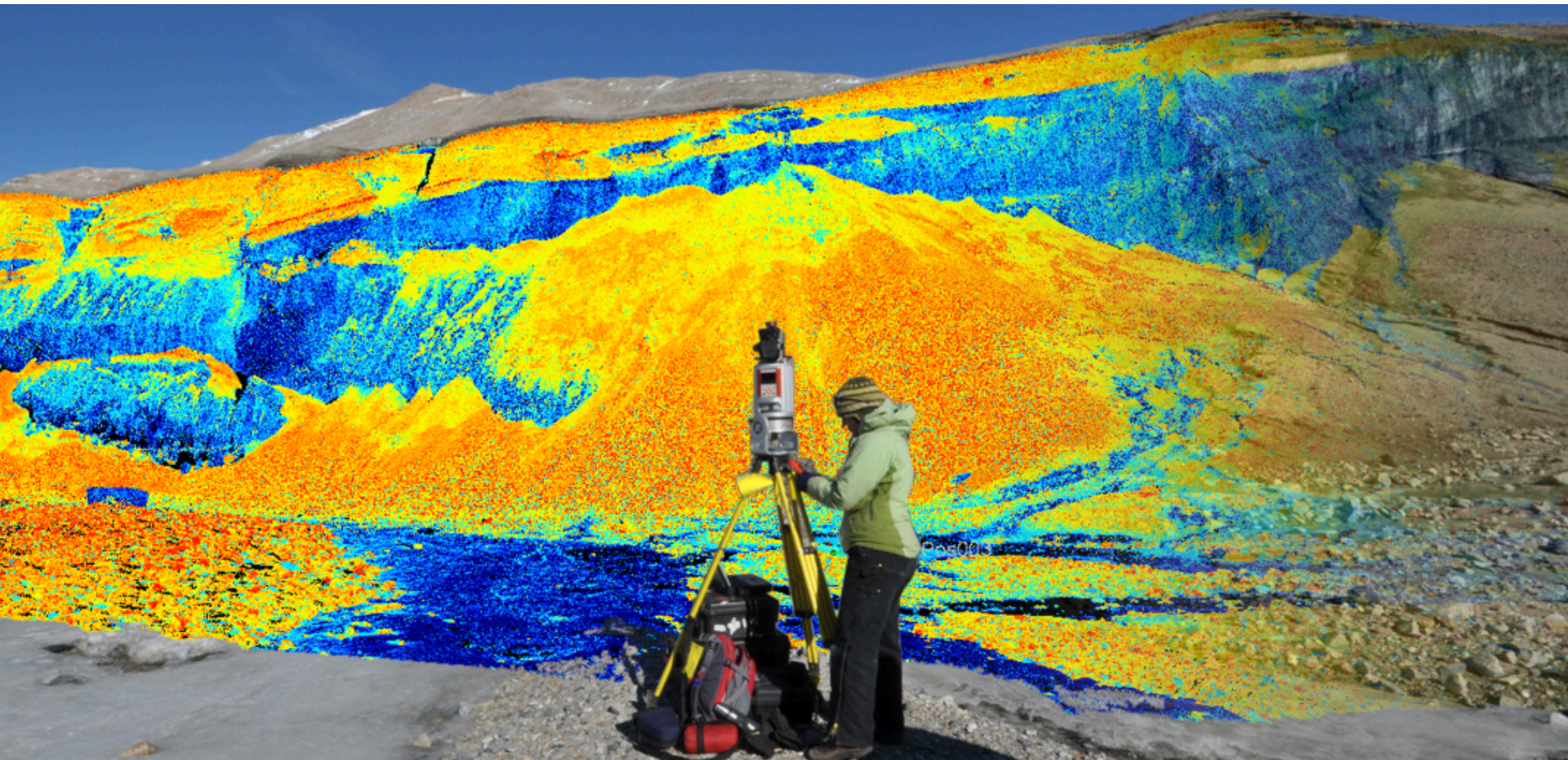


TLS Data Products & Analysis

C. Crosby, UNAVCO



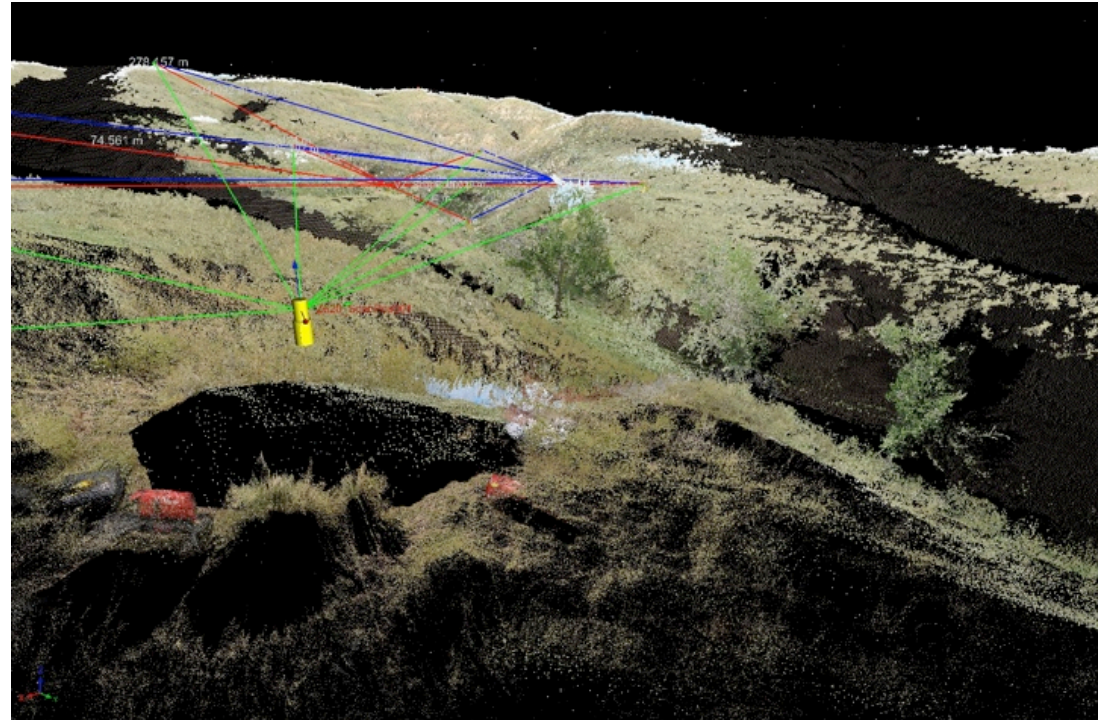
Data volume – 10s of GB of data per day of scanning

Scanner technology far outpaces most software available for data processing, management, and analysis.

Complex, multi-software workflows

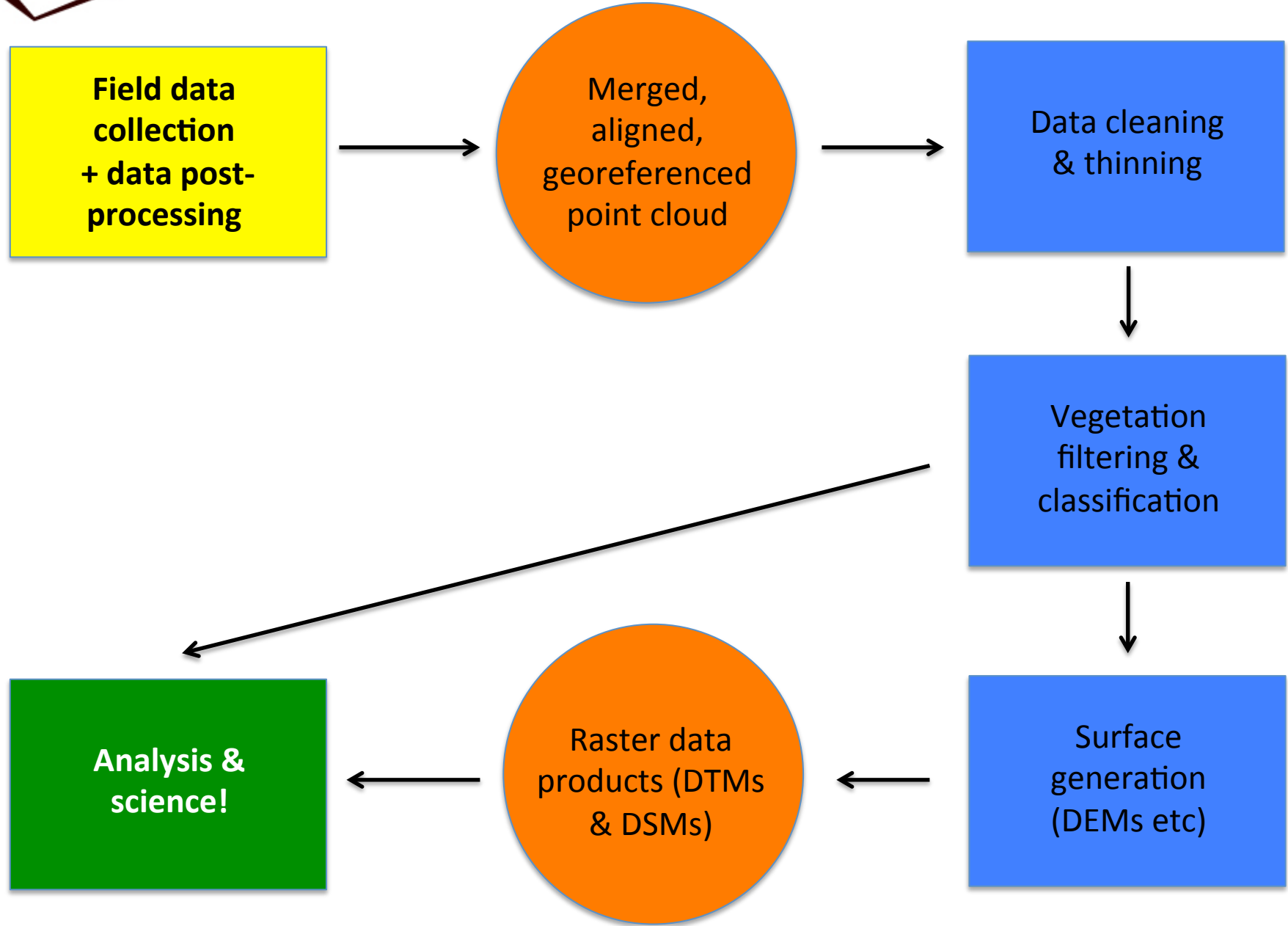
Commercial (\$\$)
software

***How do you get from
10s or 100s of millions
of X,Y,Z points to
science?***



Point Cloud

- 3D “point cloud” of discrete locations derived from range and orientation of scanner for each laser pulse.
- XYZ position in cartesian coordinates plus associated point attributes: intensity, RGB, etc.
- 3D point clouds are the basis for subsequent analysis and used to create CAD or GIS models
- Typically **ASCII XYZ** + attributes or **LAS**
- UNAVCO **standard deliverable** = merged, aligned, georeferenced point cloud in ASCII or LAS format.



- Digital representation of topography / terrain
 - “Raster” format – a grid of squares or “pixels”
 - Continuous surface where Z (elevation) is estimated on a regular X,Y grid
 - “2.5D”

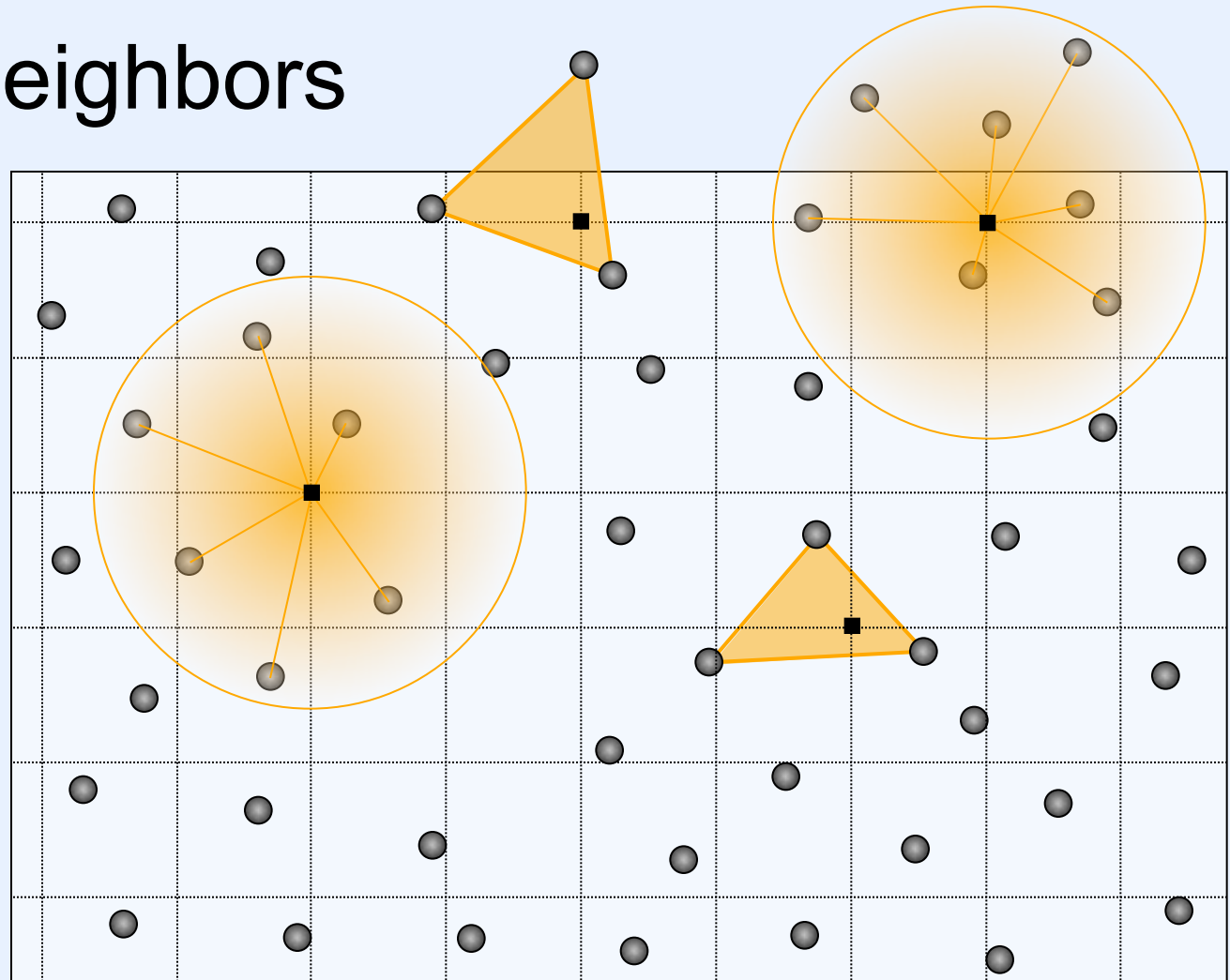
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	0
0	50	100	100	100	100	100	100	100	100	100	100	100	100	100	50	0
0	50	100	150	150	150	150	150	150	150	150	150	150	150	150	100	50
0	50	100	150	200	200	200	200	200	200	200	200	200	200	150	100	50
0	50	100	150	200	250	250	250	250	250	250	250	250	250	200	150	50
0	50	100	150	200	250	300	300	300	300	300	300	250	200	150	100	50
0	50	100	150	200	250	300	350	350	350	350	300	250	200	150	100	50
0	50	100	150	200	250	300	350	400	350	300	250	200	150	100	50	0
0	50	100	150	200	250	300	350	350	350	300	250	200	150	100	50	0
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0	50	100	150	150	150	150	150	150	150	150	150	150	150	150	100	50
0	50	100	100	100	100	100	100	100	100	100	100	100	100	100	100	50
0	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Source: <http://www.ncgia.ucsb.edu/giscc/extra/e001/e001.html>

- Grid resolution is defined by the size in the horizontal dimension of the pixel
 - 1 meter DEM has pixels 1 m x 1m assigned a single elevation value.

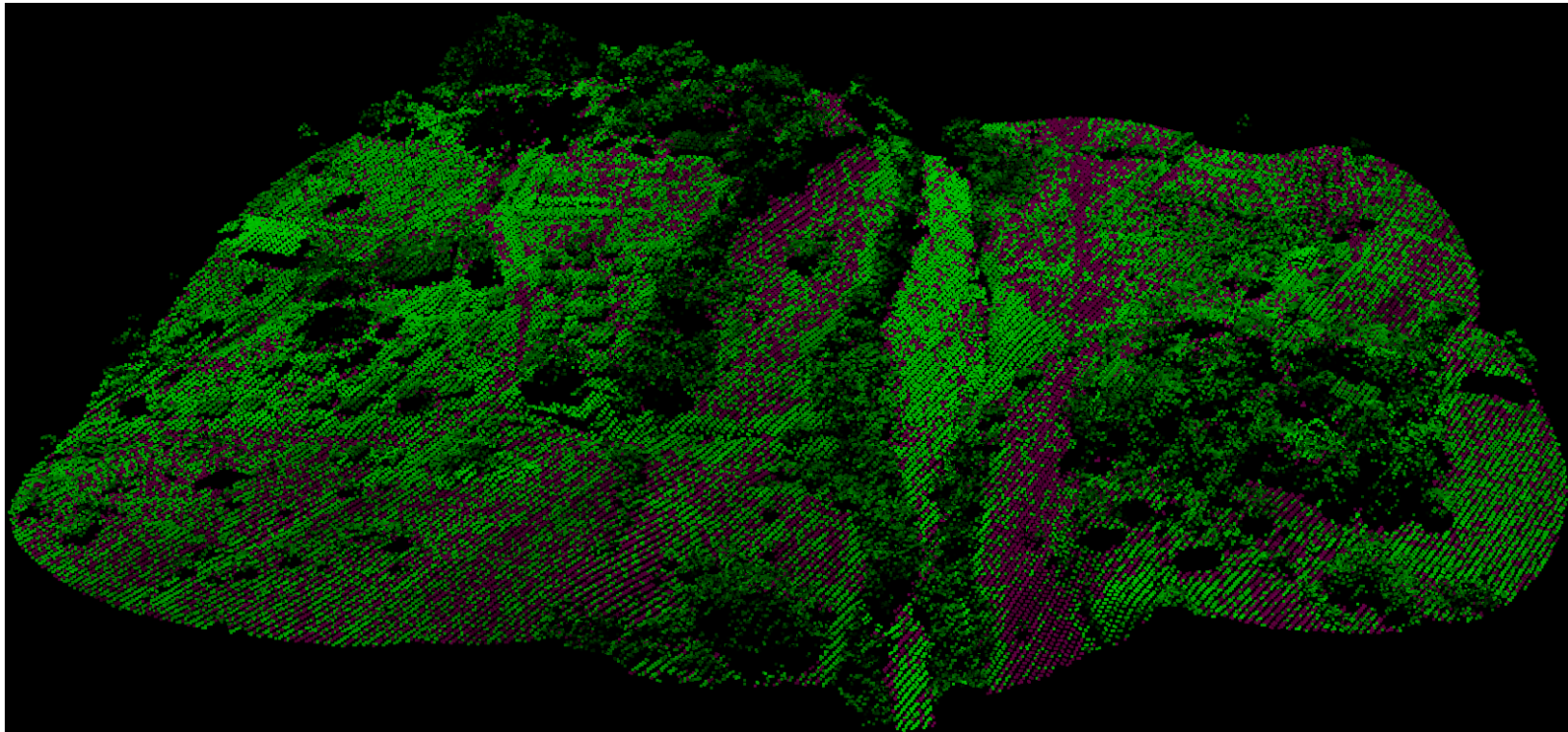
Interpolation Methods

- Inverse Distance Weighting (IDW)
- Natural Neighbors
- Kriging
- Splines
- TIN
 - linear
 - quintic
- ...



Vegetation is a headache is geoscientists

- *Our noise is someone else's signal*
- How to get good ground model? - Automated vs manual?



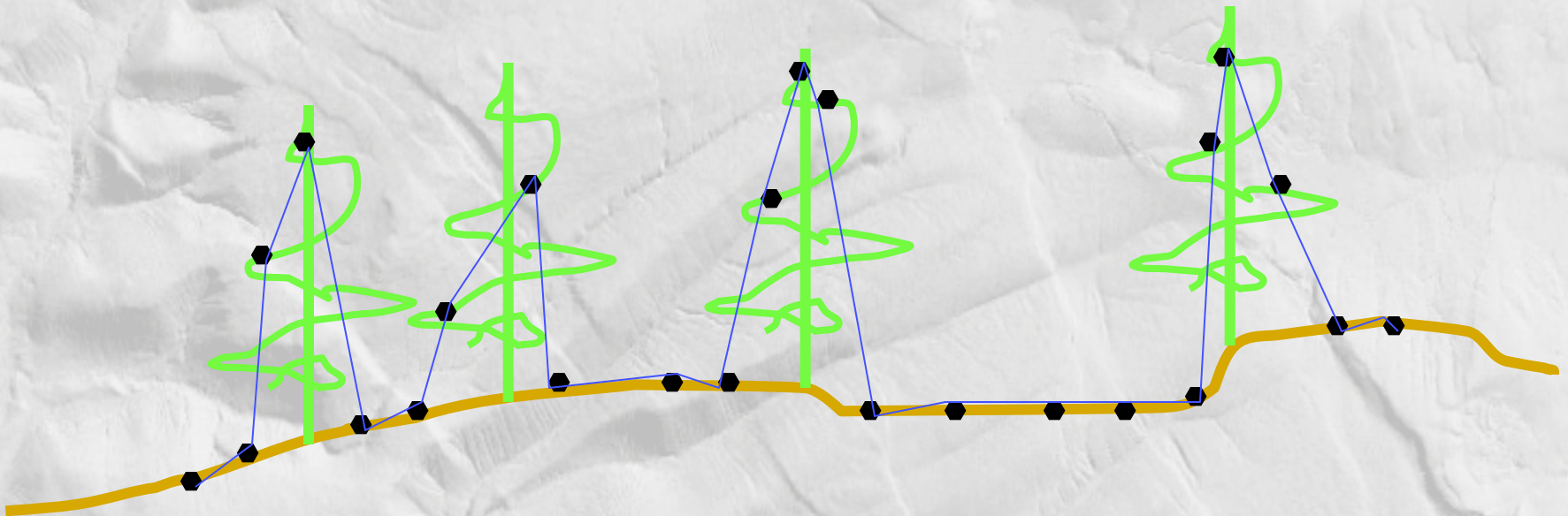
Dumay Slip-
Rate Site,
Enriquillo
Fault, Haiti

Typical approach \Rightarrow despiking algorithm

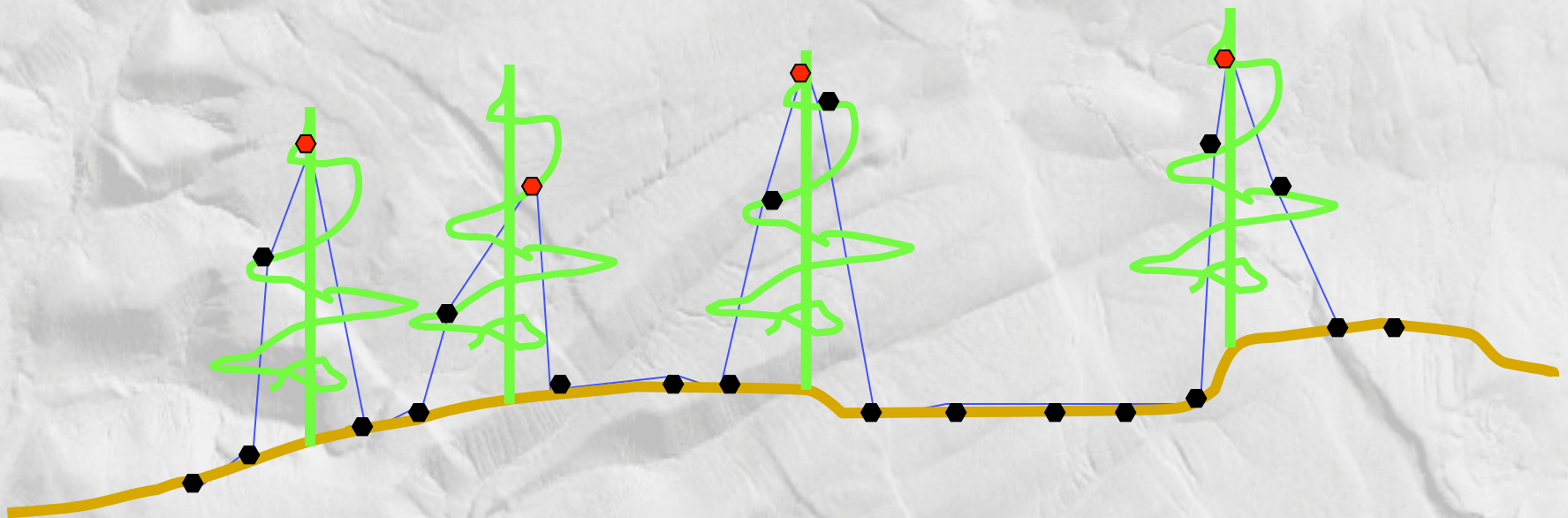
Approach:

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. Iterate until no or few points are flagged

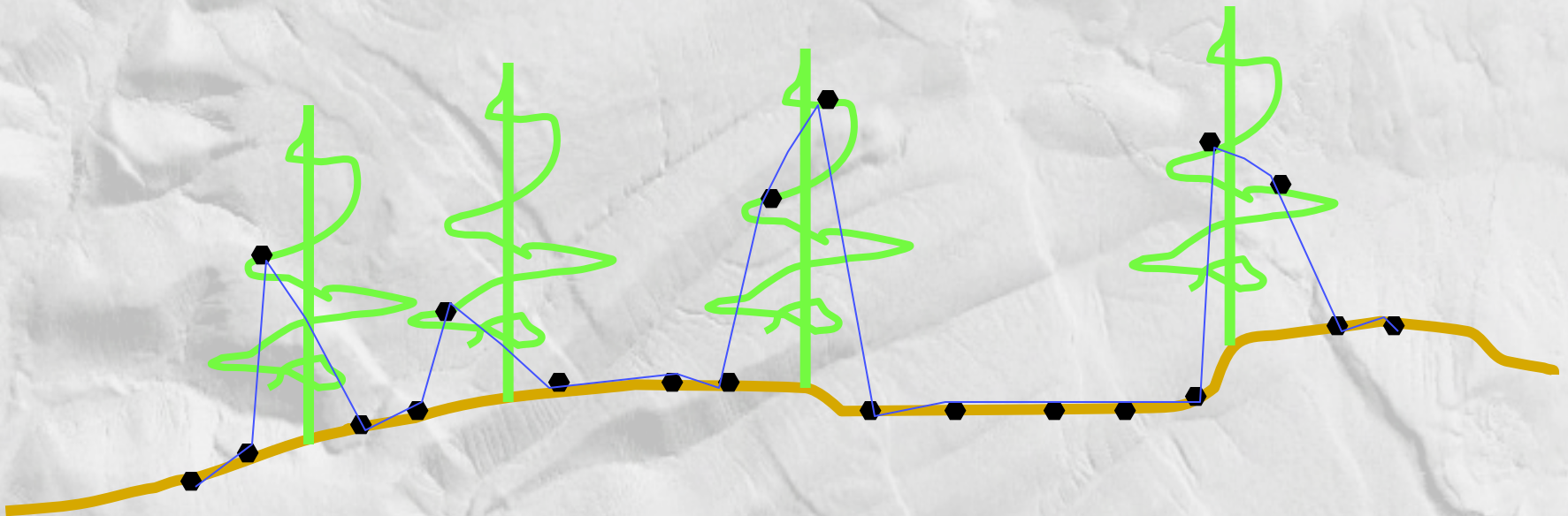
Start with mixed ground and canopy returns (e.g. last-return data), build TIN



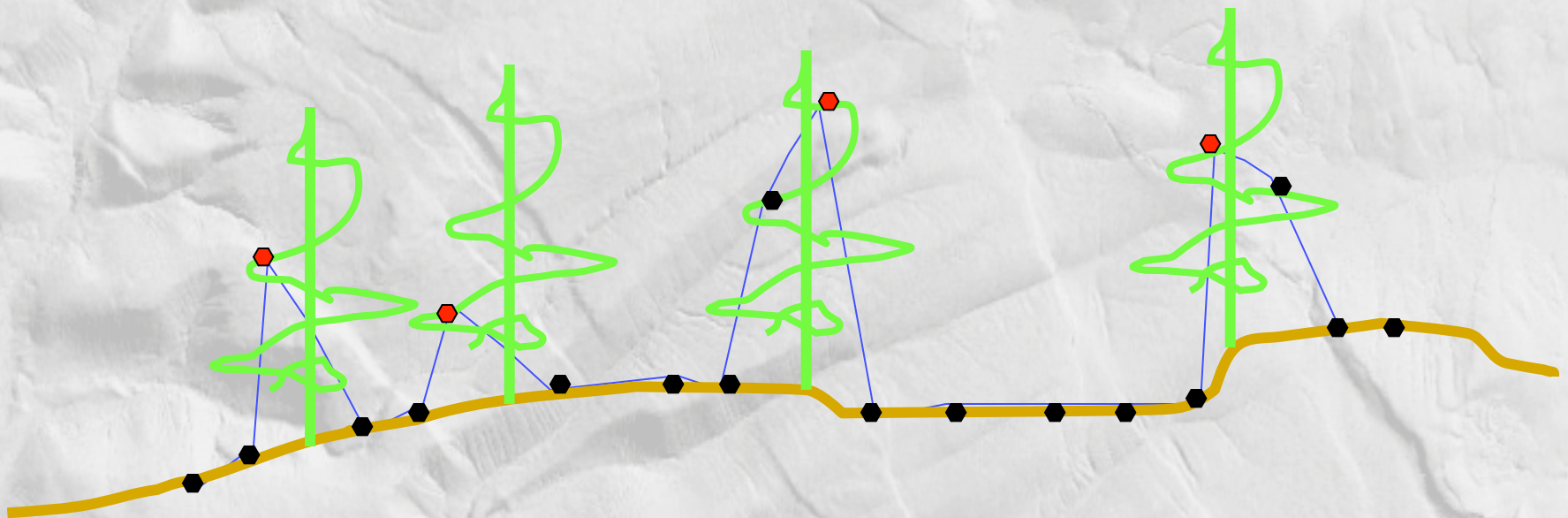
Flag points that define spikes (strong convexities)



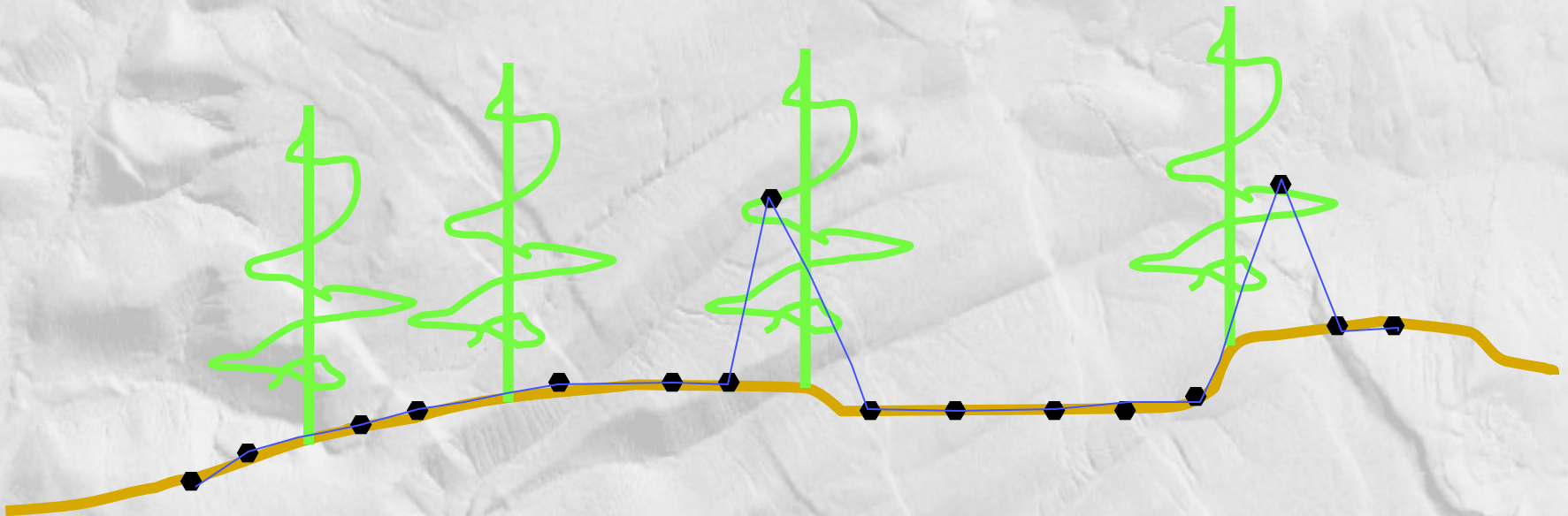
Rebuild TIN



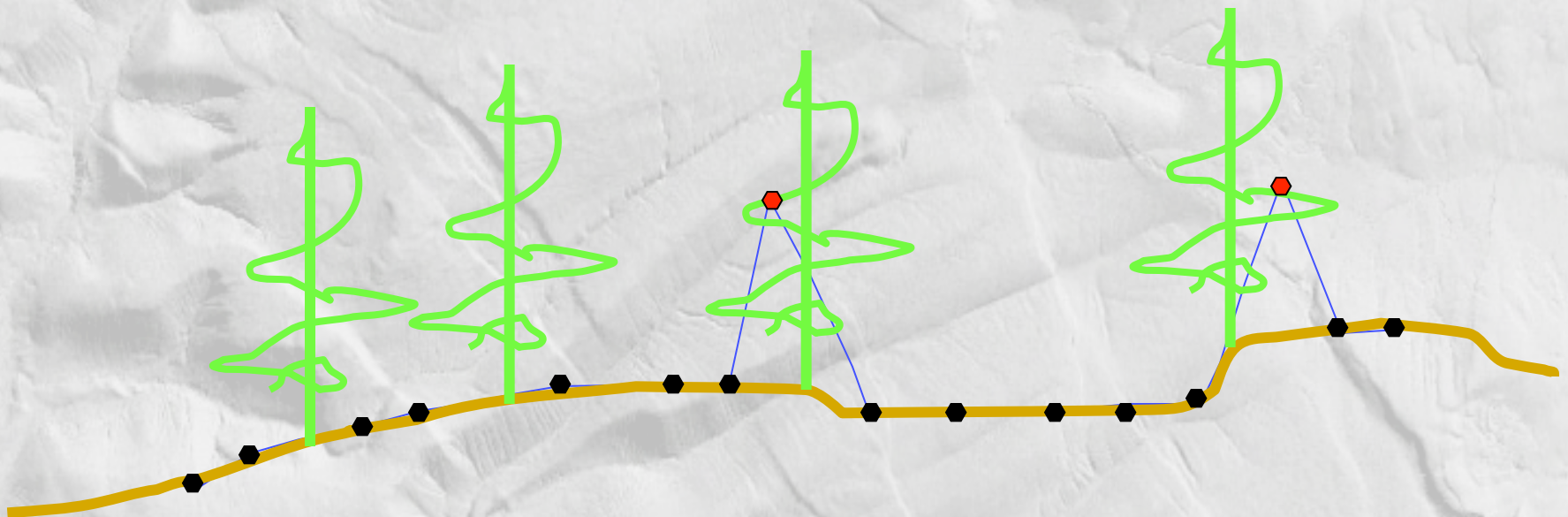
Flag points that define spikes (strong convexities)



Rebuild TIN



Flag points that define spikes
(strong convexities)



Rebuild TIN

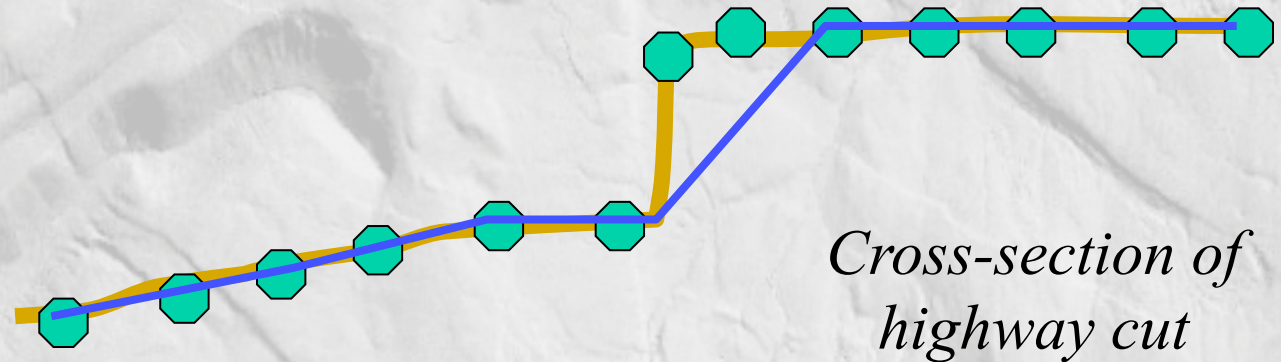


Despike algorithm

Benefits:

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

Despike algorithm



Problems:

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