





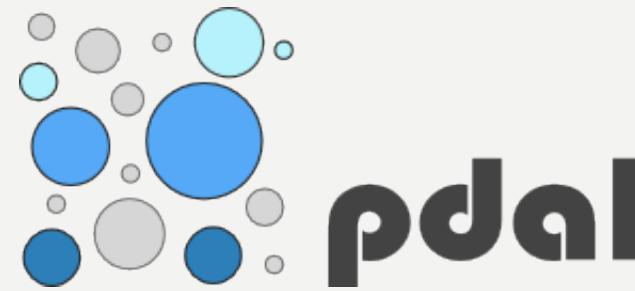
POINT CLOUDS

hcbu



libspatialindex
Rtree
Proj.4

hbku



X Y Z

X Y Z R G B I T S

WHY DO YOU WANT THEM

- 3D
- Surface characterization
- Measurement



Attribute table - doqq_dd :: Features total: 55296, filtered: 55296, selected: 0



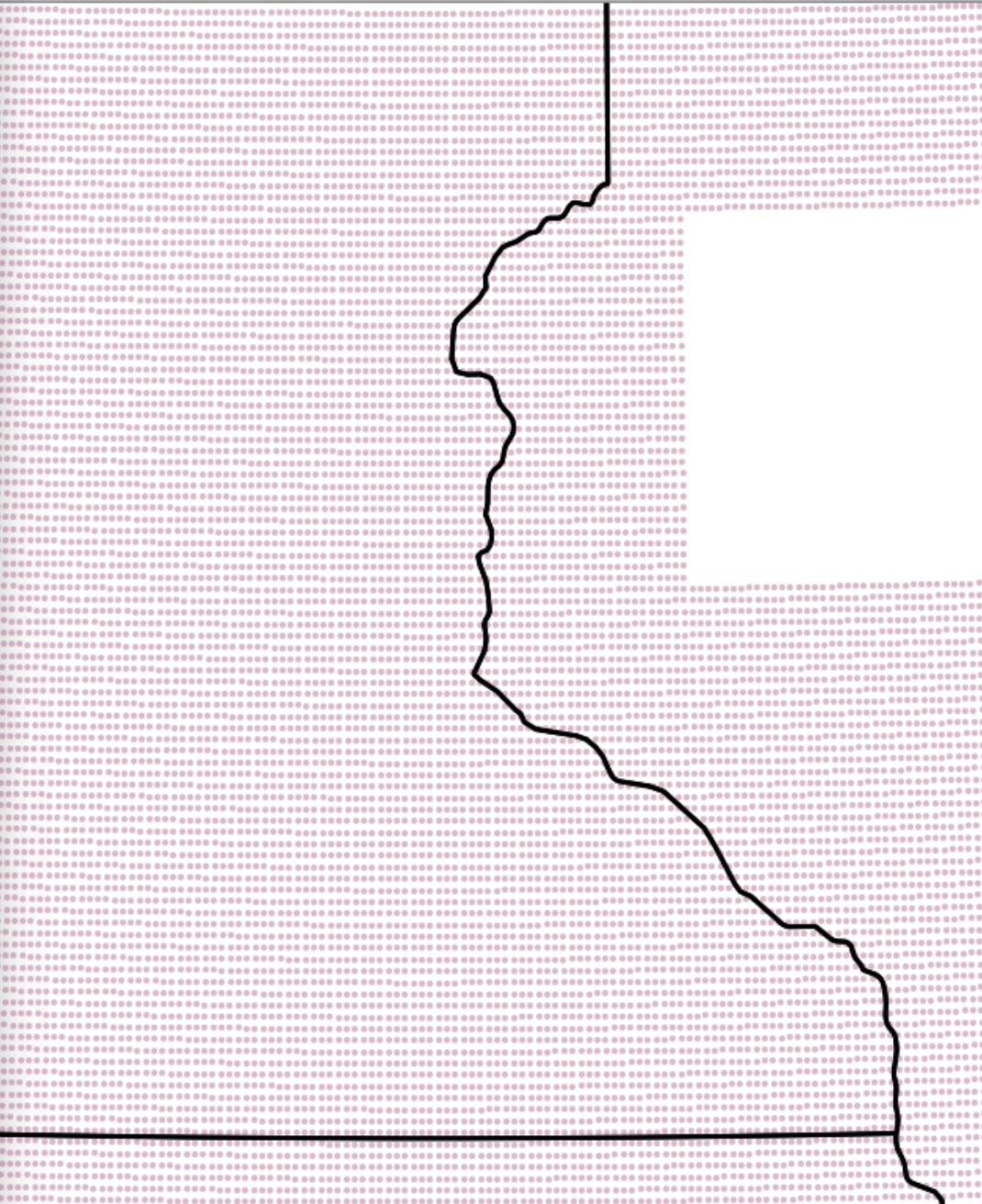
? CSW

Python

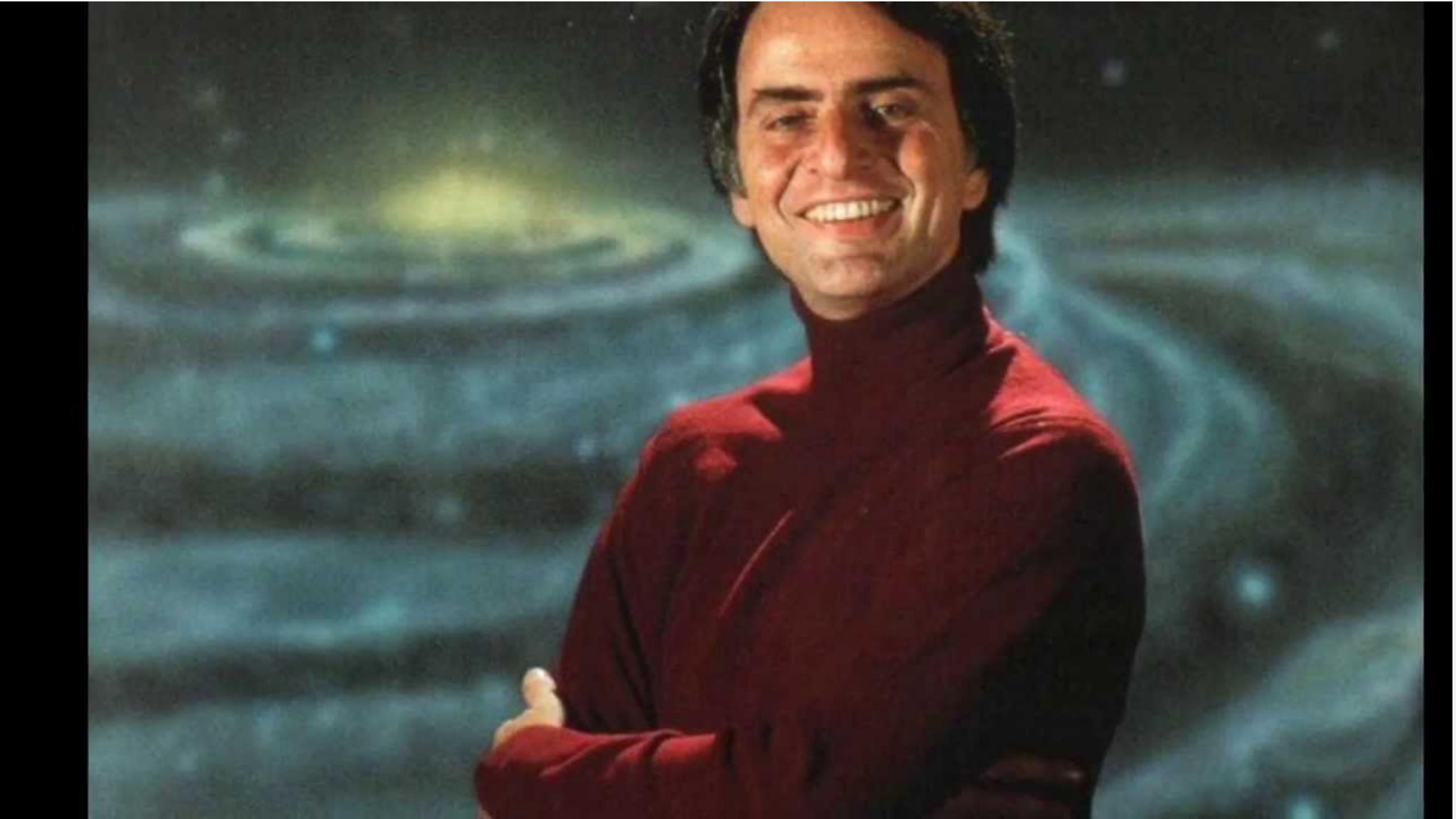
G

WKT

	NR_QQQ_ID	x	y
55272	0310-01-41	232293.1551...	5543579.190...
55273	0310-01-42	234532.7097...	5543467.698...
55274	0310-01-43	236772.2779...	5543357.145...
55275	0310-01-44	239011.8599...	5543247.531...
55276	0310-01-45	241251.4553...	5543138.855...
55277	0310-01-46	243491.0642...	5543031.118...
55278	0310-01-47	245730.6863...	5542924.319...
55279	0310-01-48	247970.3216...	5542818.459...
55280	0310-01-49	250209.9755...	5542713.539...
55281	0310-01-50	252449.6487...	5542609.560...
55282	0310-01-51	254689.3348...	5542506.519...
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55285	0310-01-54	261408.4685...	5542203.025...
55286	0310-01-55	263648.2046...	5542103.737...
55287	0310-01-56	265887.9529...	5542005.388...
55288	0310-01-57	268127.7163...	5541907.977...
55289	0310-01-58	270367.4955...	5541811.506...
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55291	0310-01-60	274847.0893...	5541621.378...
55292	0310-01-61	277086.9036...	5541527.721...
55293	0310-01-62	279326.7295...	5541435.002...
55294	0310-01-63	281566.5668...	5541343.221...
55295	0310-01-64	283806.4153...	5541252.378...



BILLIONS...



OVERWHELMING

- 1000s of measurements per second
- Typical strategies unsatisfactory (raster)
- Each point isn't worth much

PROPERTIES

- Irregular XYZ
- Other attributes (RGB, Intensity, Time)
- Unstructured, but full of information

HOW TO CREATE THEM

- Laser Scanners
- Structured Light Instruments
- Correlated Photography



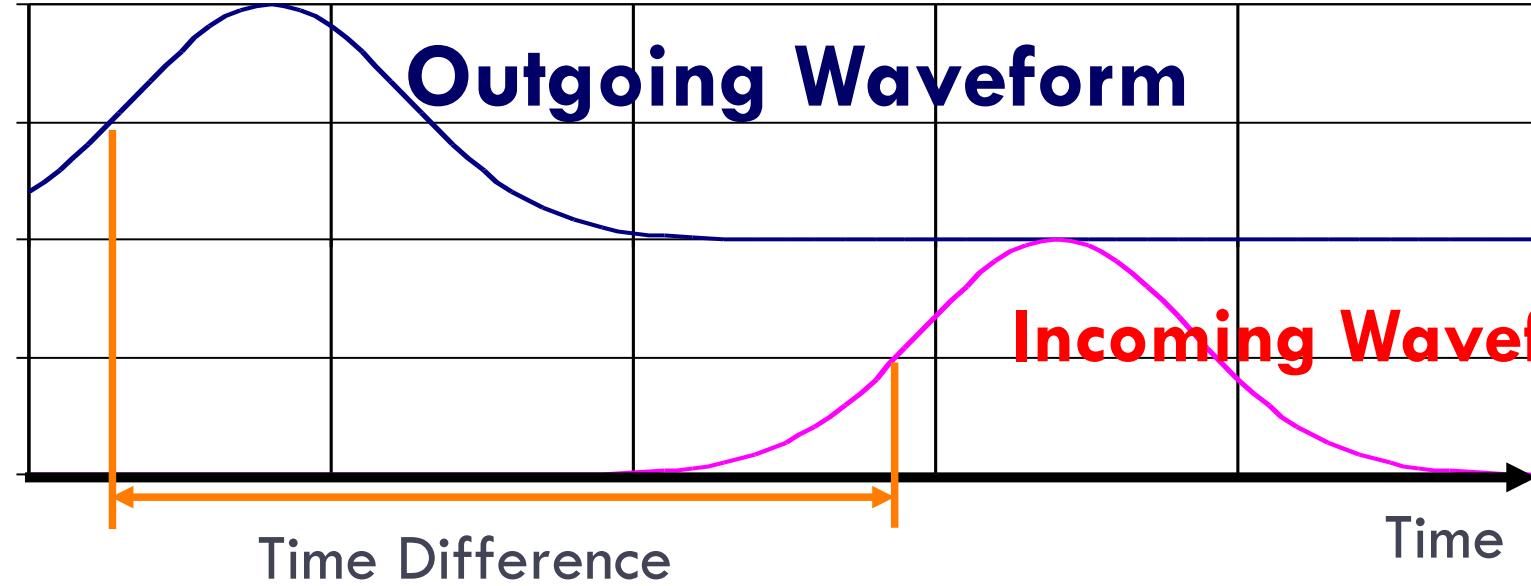
Big Scary Laser
Do not look Into beam
with remaining eye



LIDAR-LITE



- \$120
- 40m range
- 100 ma
- 1-500 Hz



Single, flat return

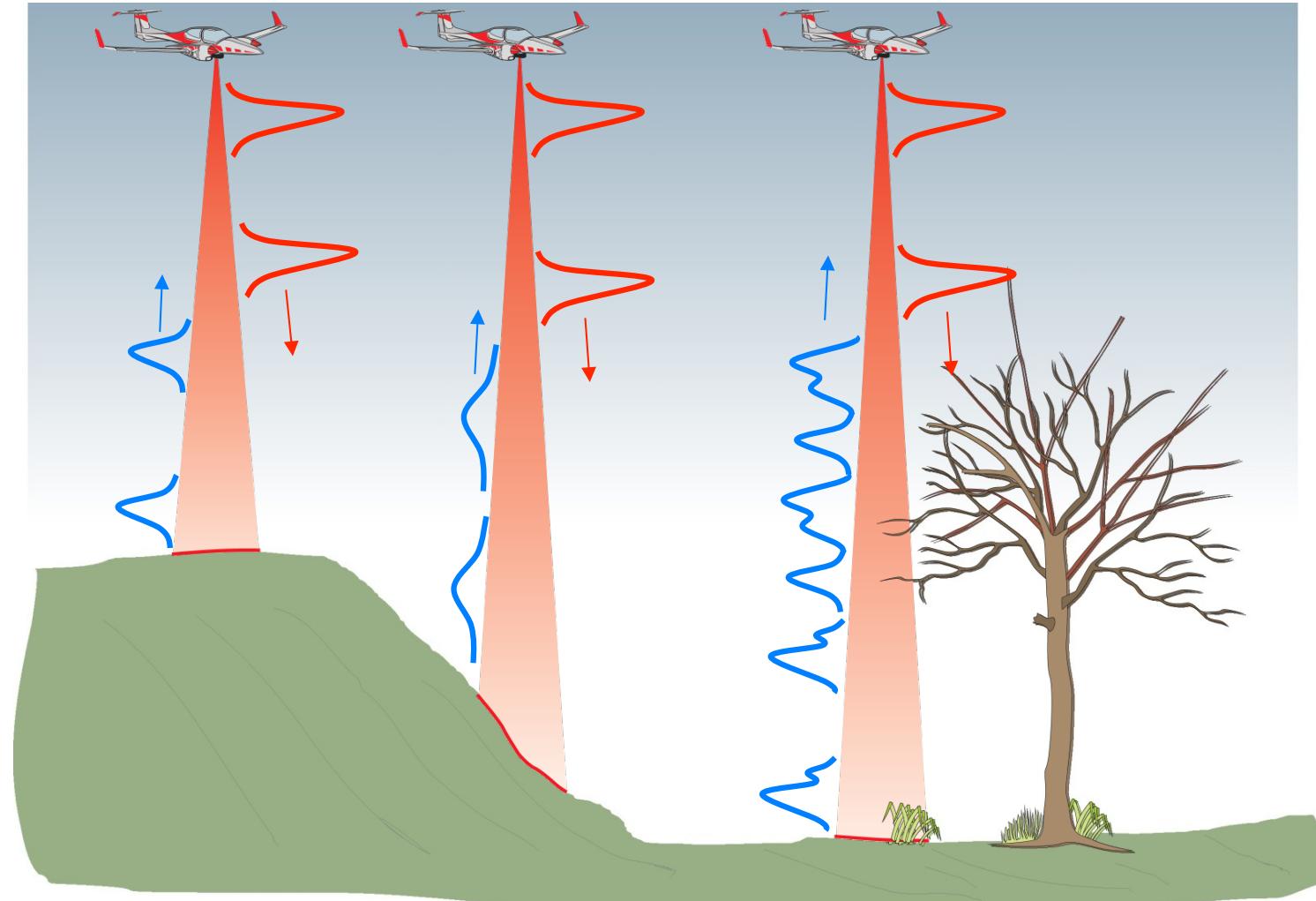
Higher magnitude
Shorter period

Single, sloped return

Lower magnitude
Longer period

Multi-return

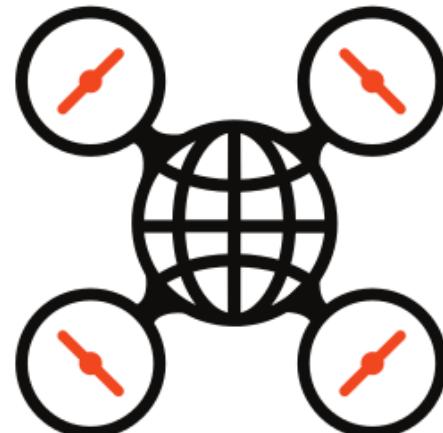
Varying pulse shapes



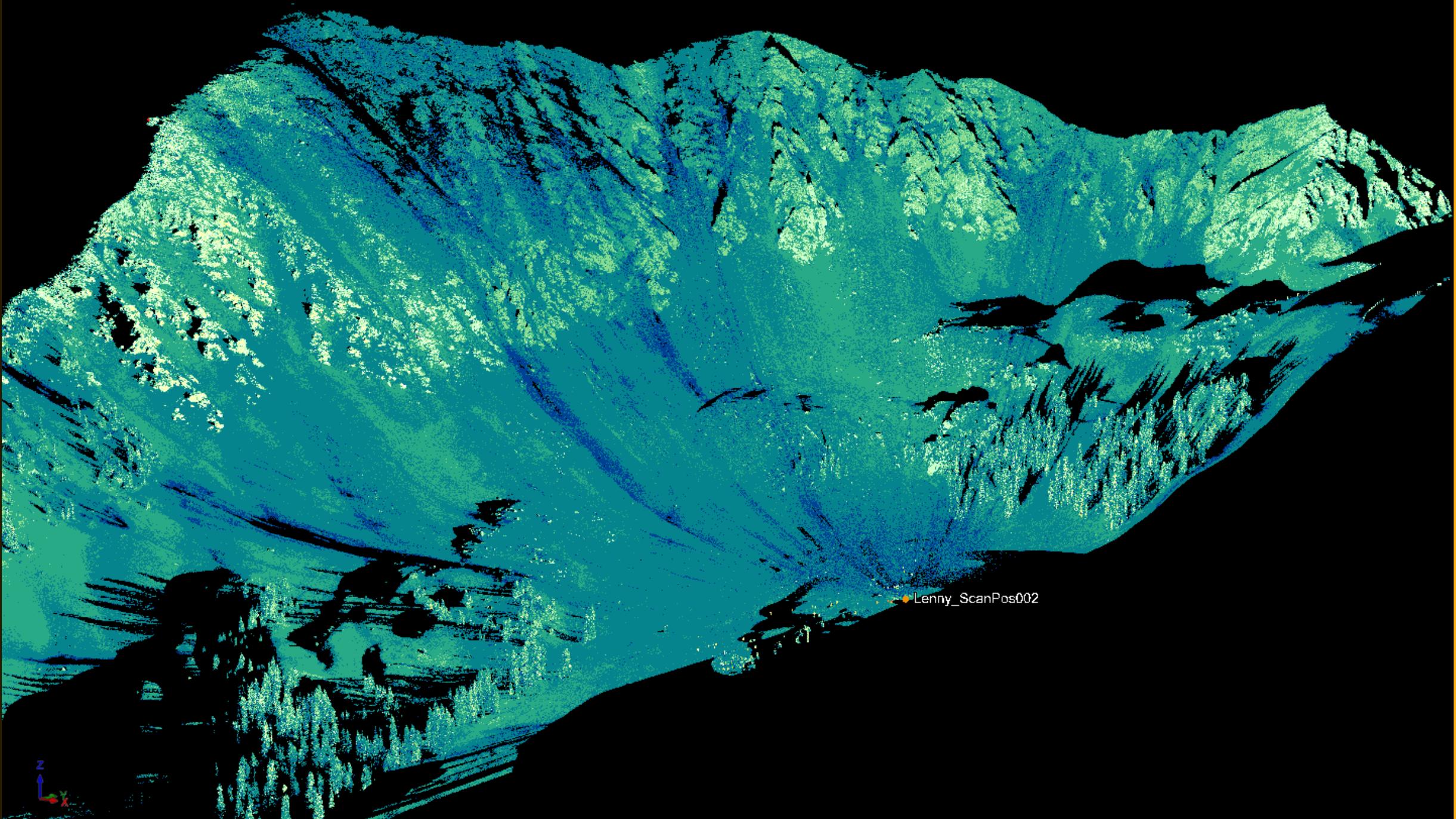


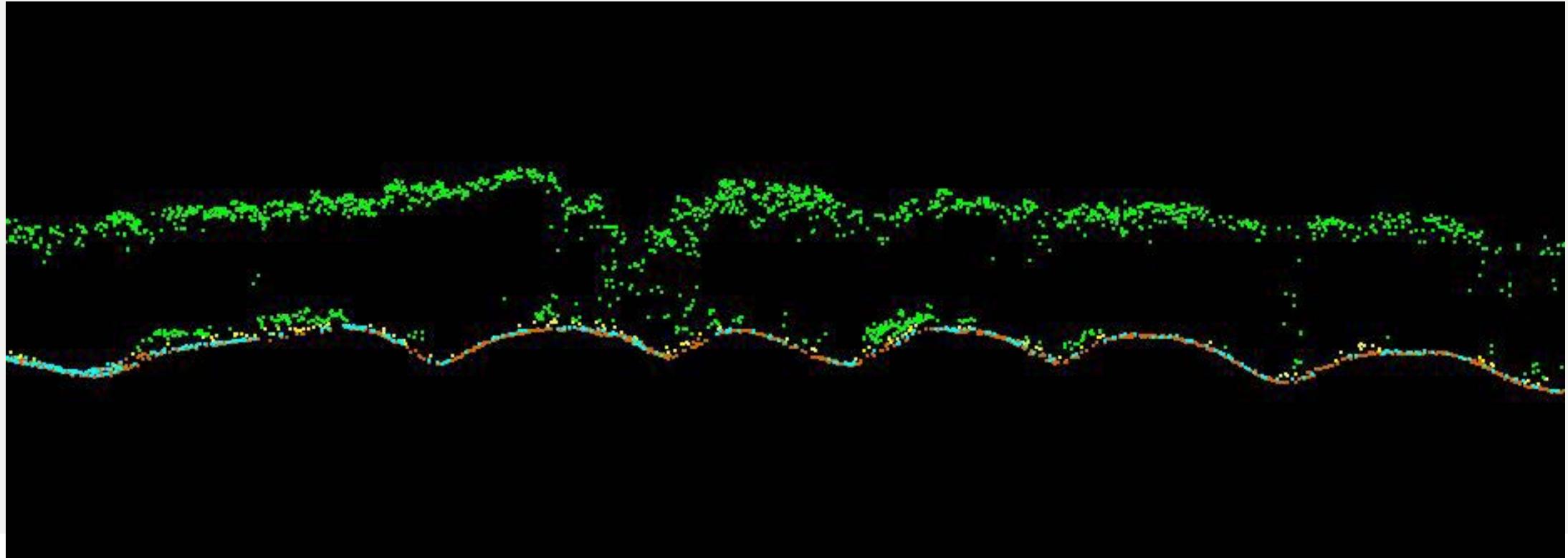
SLAM

- Simultaneous Localisation and Mapping

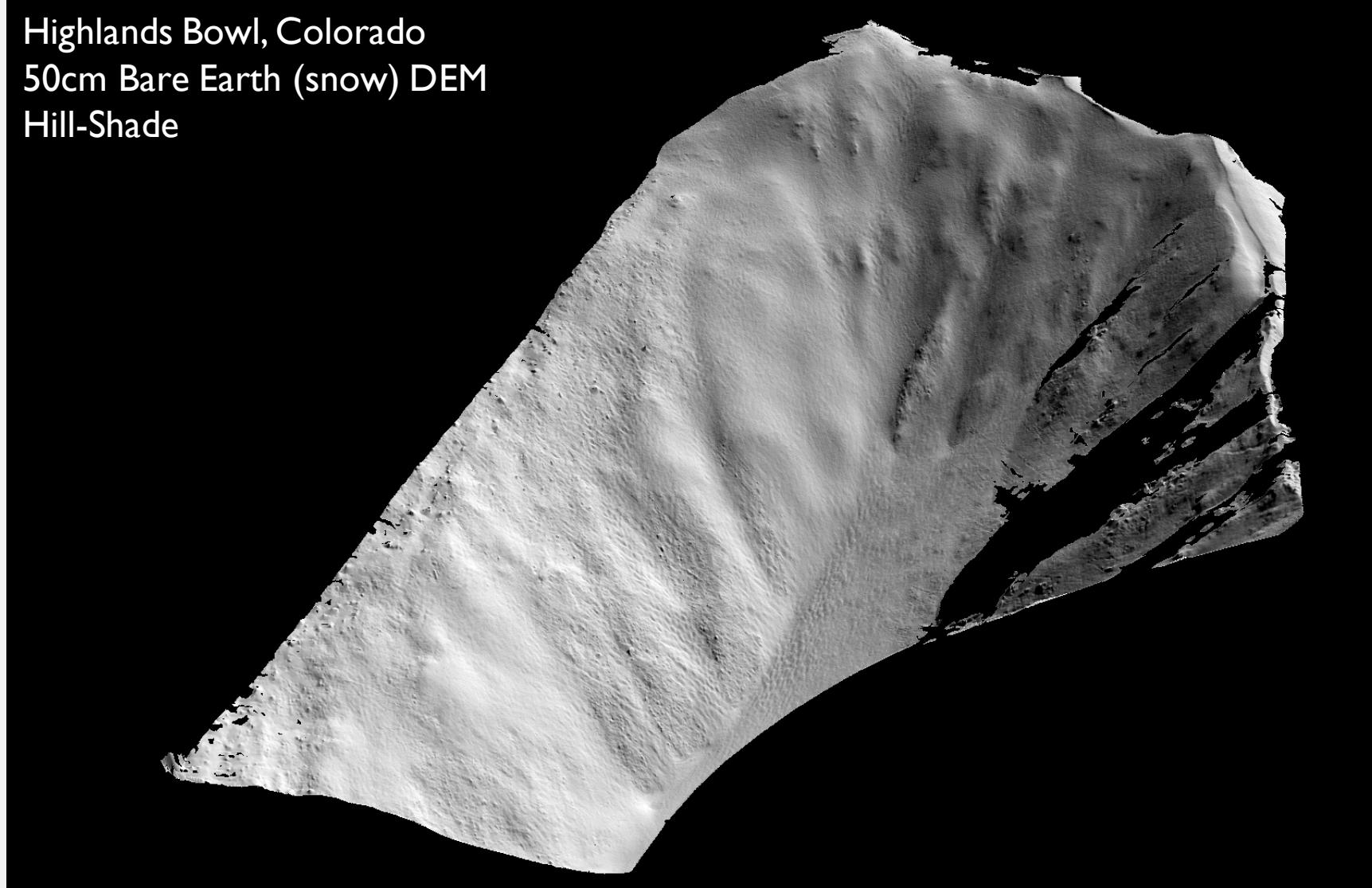


OpenDroneMap

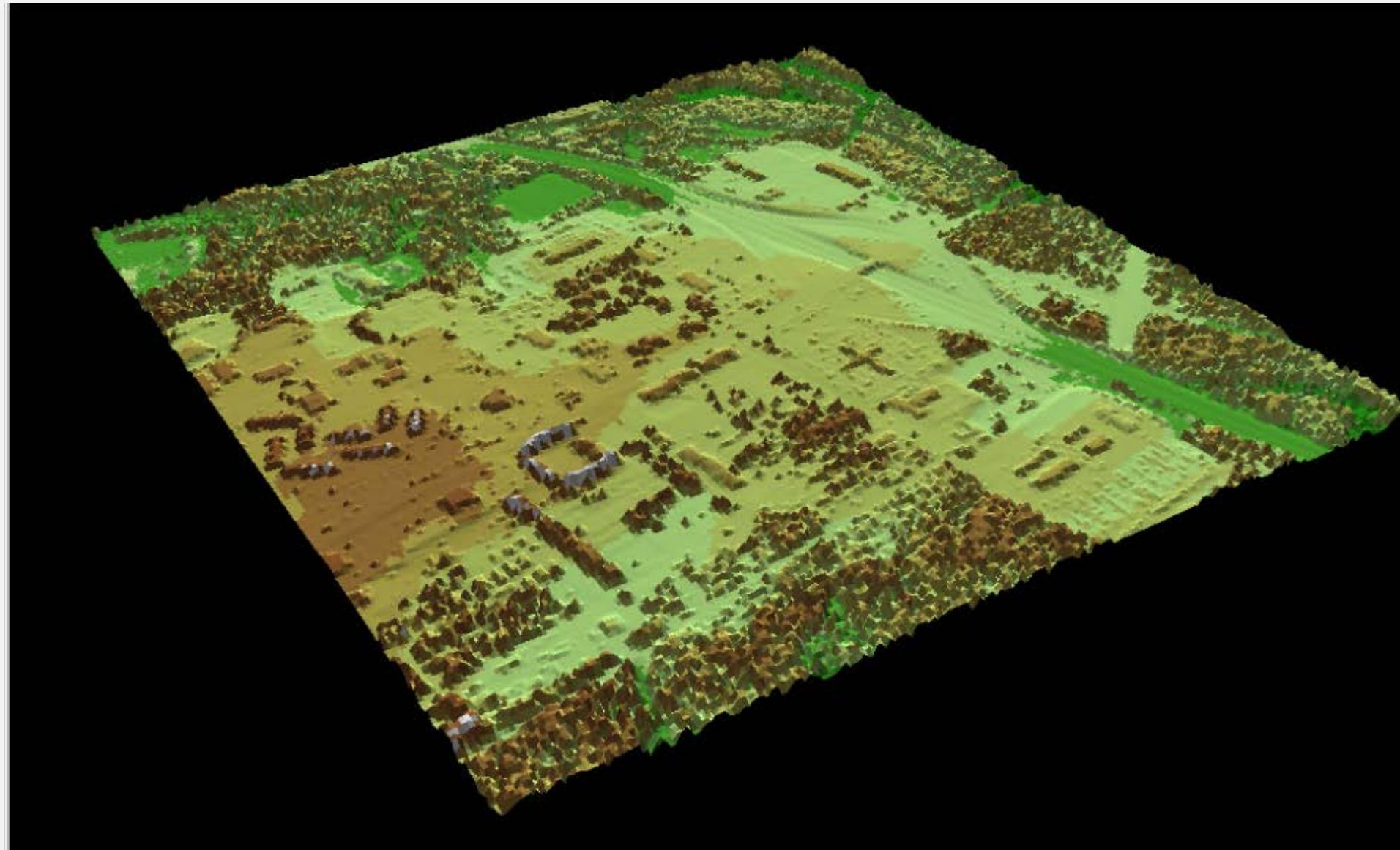




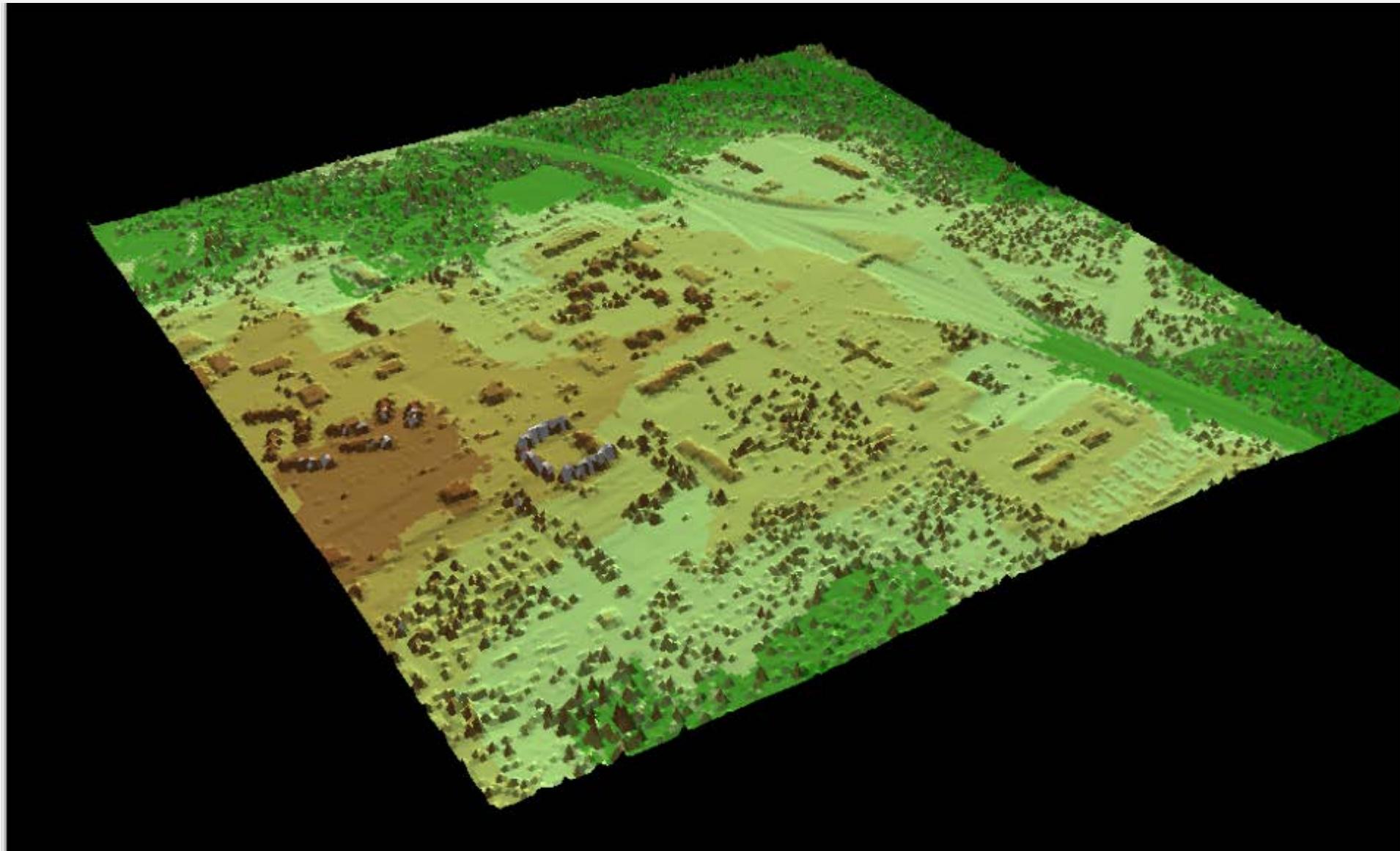
Highlands Bowl, Colorado
50cm Bare Earth (snow) DEM
Hill-Shade



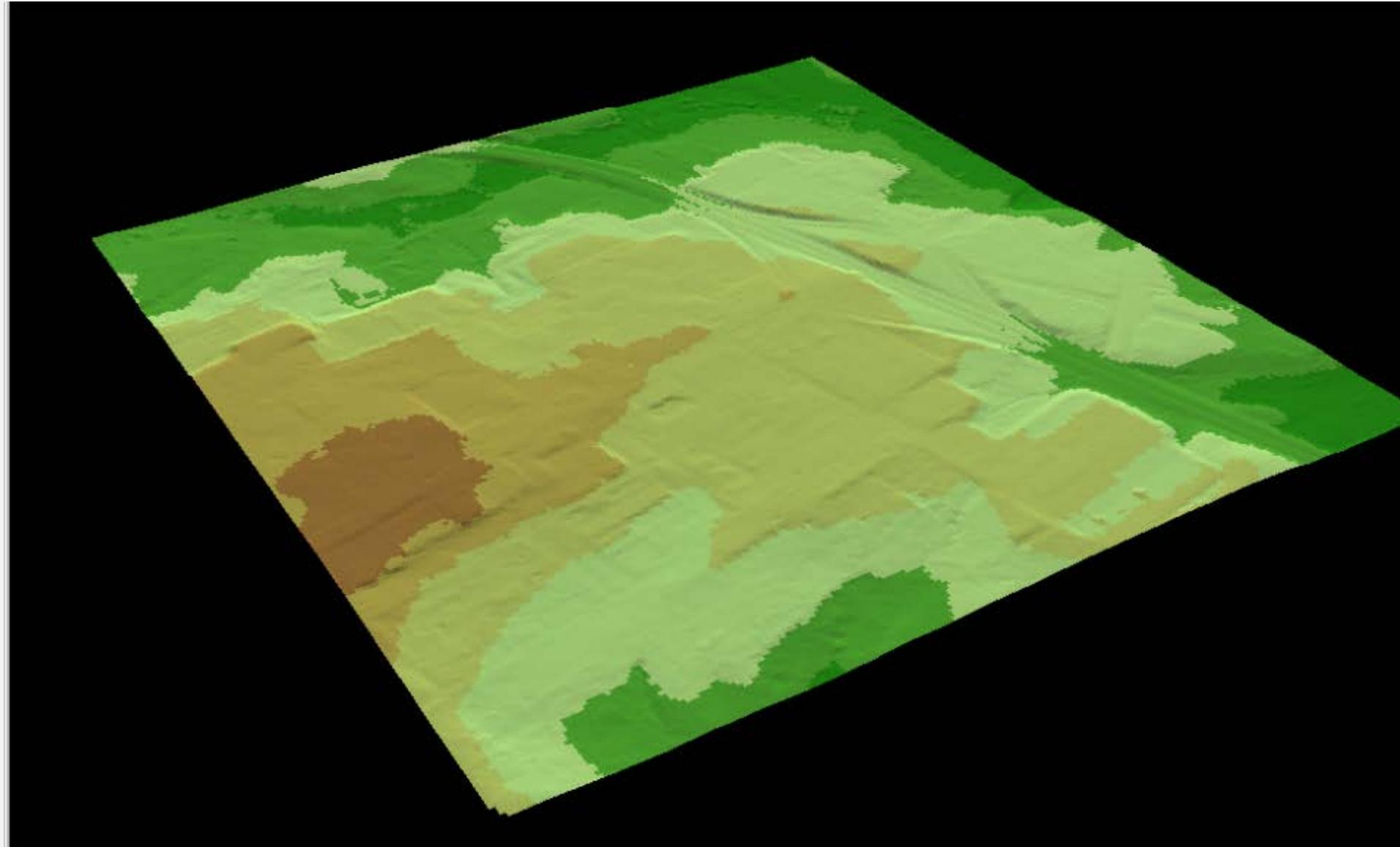
EXAMPLE: RAW FIRST RETURN LIDAR DATA DEM



EXAMPLE: RAW LAST RETURN LIDAR DATA DEM



EXAMPLE: FINAL DTM (DIGITAL TERRAIN MODEL)



WHERE DO YOU GET FREE DATA

- [OpenTopography](#)
- [MN Geo](#)
- [speck.ly](#)

OPEN SOURCE TOOLS

- [PDAL](#)
- [PCL](#)
- [laspy](#)
- [LAStools](#)
- [libLAS](#)
- [CloudCompare](#)
- [plas.io](#)
- [potree.org](#)

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- <http://plas.io>