APPLICATIONS OF AIRBORNE LIDAR IN THE ARCTIC

14TH INTERNATIONAL CIRCUMPOLAR REMOTE SENSING SYMPOSIUM

ISAIAH DITMER – KODIAK MAPPING INC.

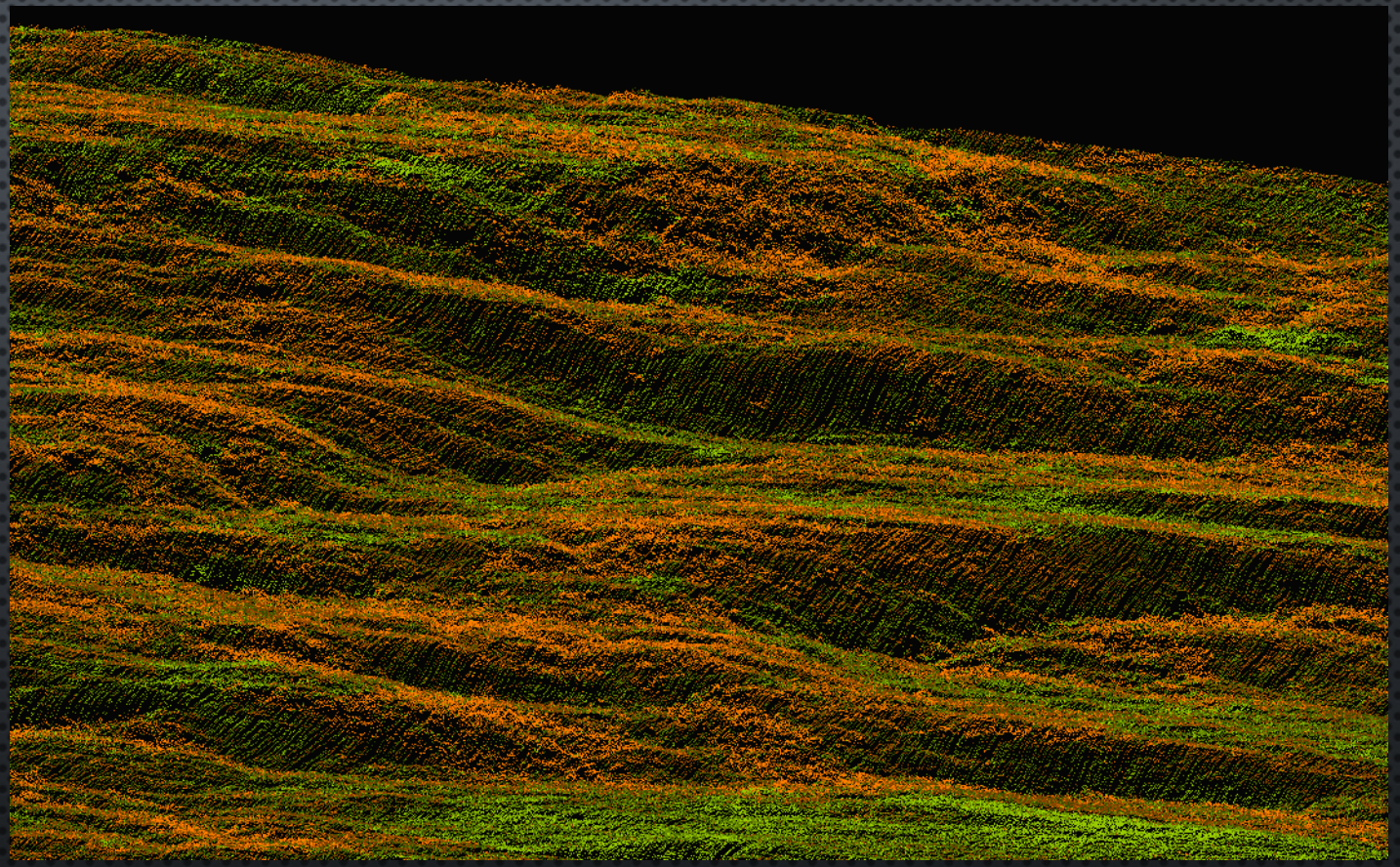
Three Main Topics

- What types of information are stored within a LiDAR data set
- What types of questions can be answered utilizing those data
- What considerations should end users make when working with LiDAR

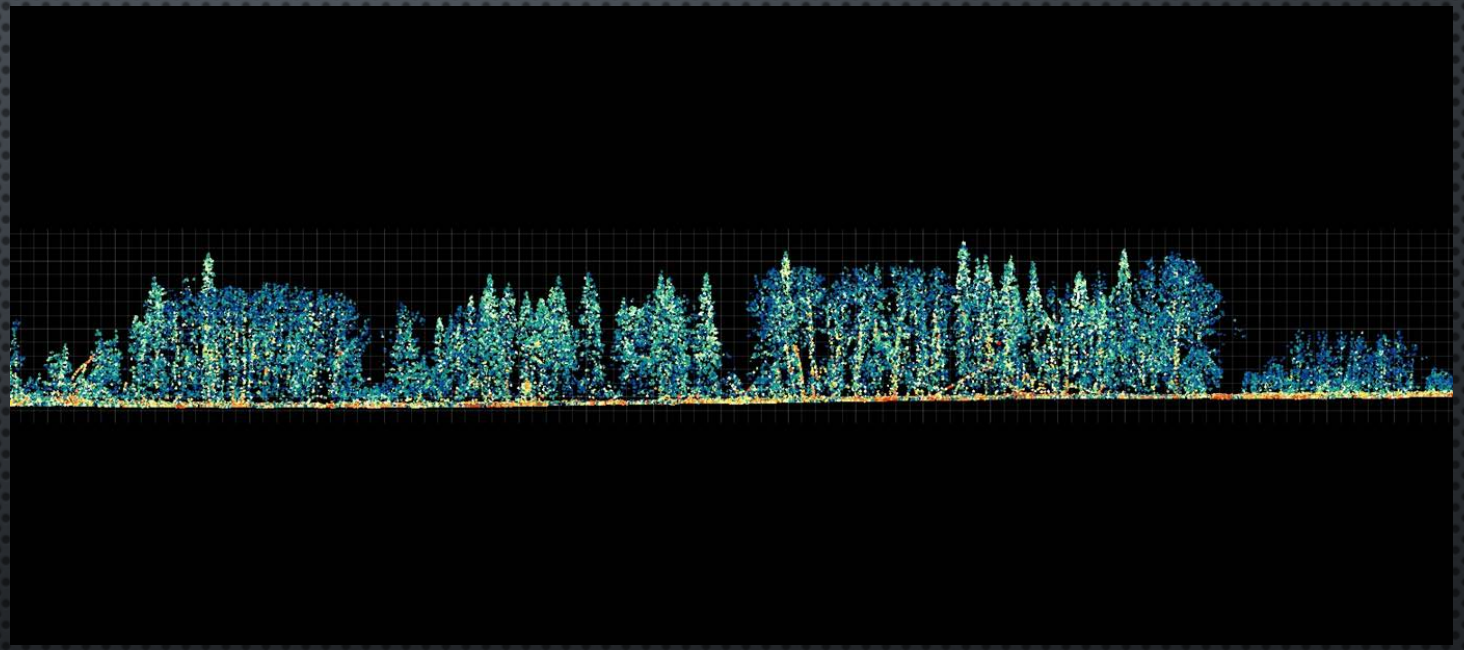
Elements of a LiDAR Data Set

- Persistent Data
  - Geometric Data
    - 3D Point Cloud – Usually Classified
    - Derivatives – DEM/DTM/DSM
  - Precise Time Data
  - Return Properties
  - Laser Intensity Data
- Additional / Optional Data
  - Spectral Information From Imagery
  - Bathymetric Data
  - Full Waveform Data

3D POINT CLOUDS

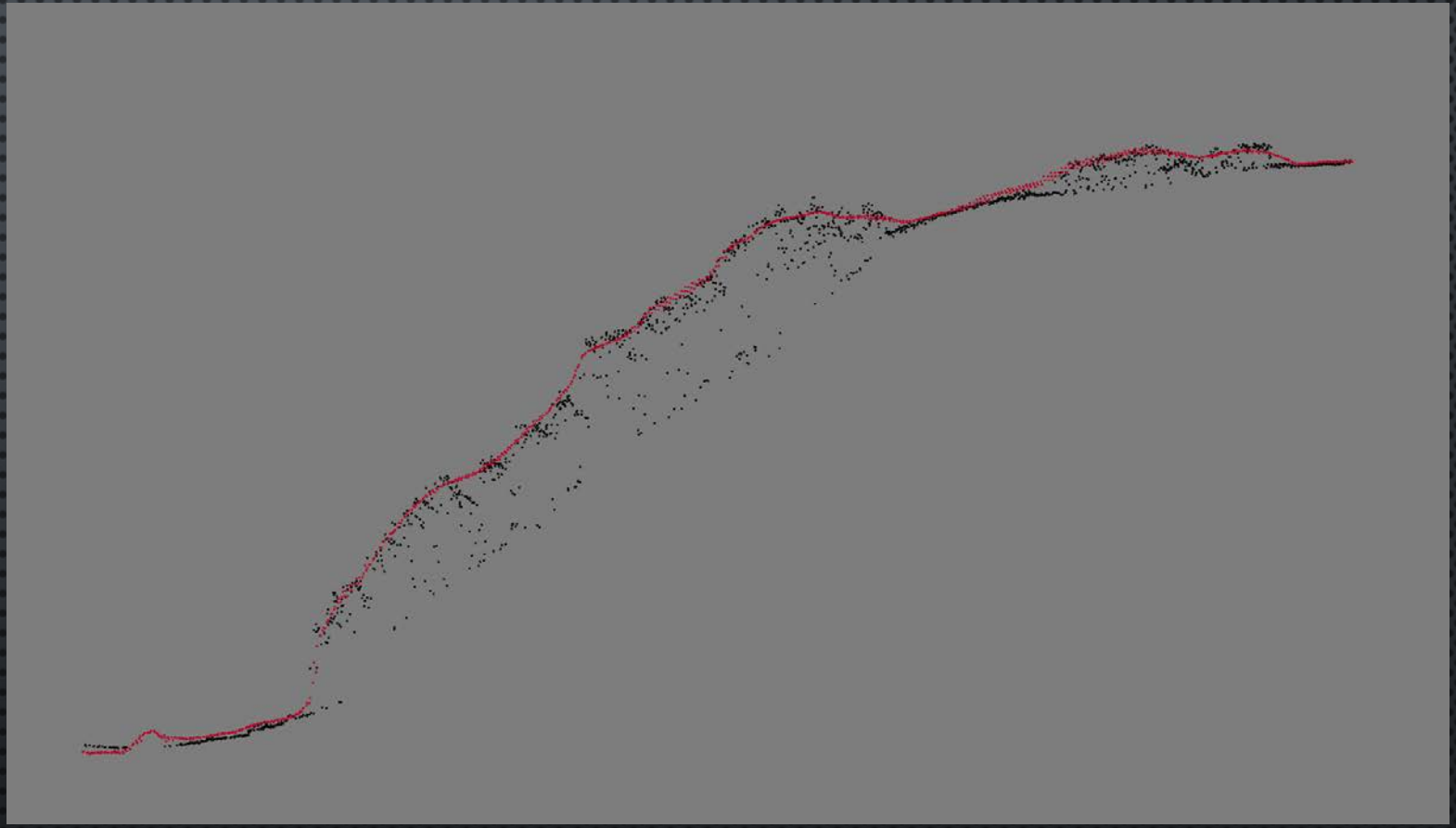


3D POINT CLOUDS



3D POINT CLOUDS

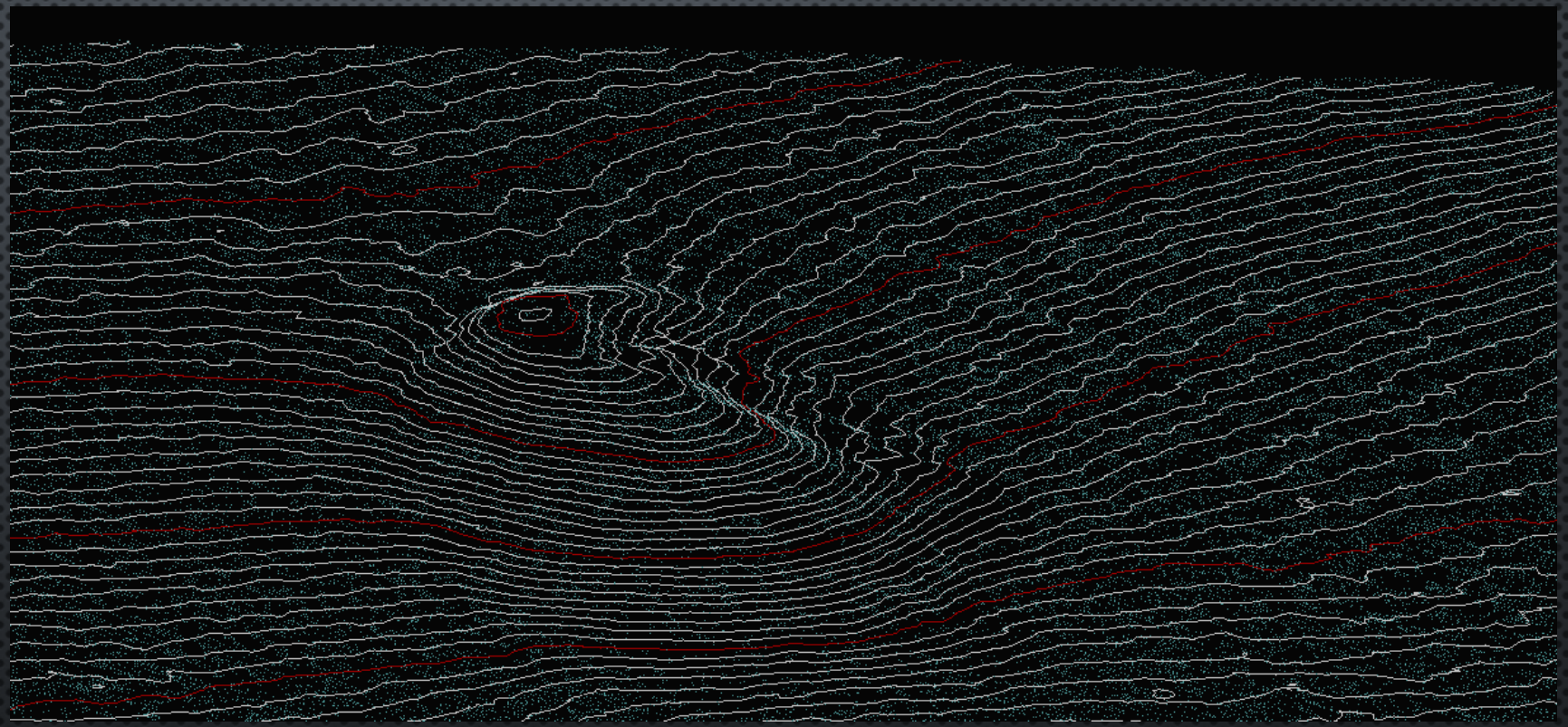
As Compared to Points Generated from Dense Imagery



GEOMETRIC DERIVATIVES

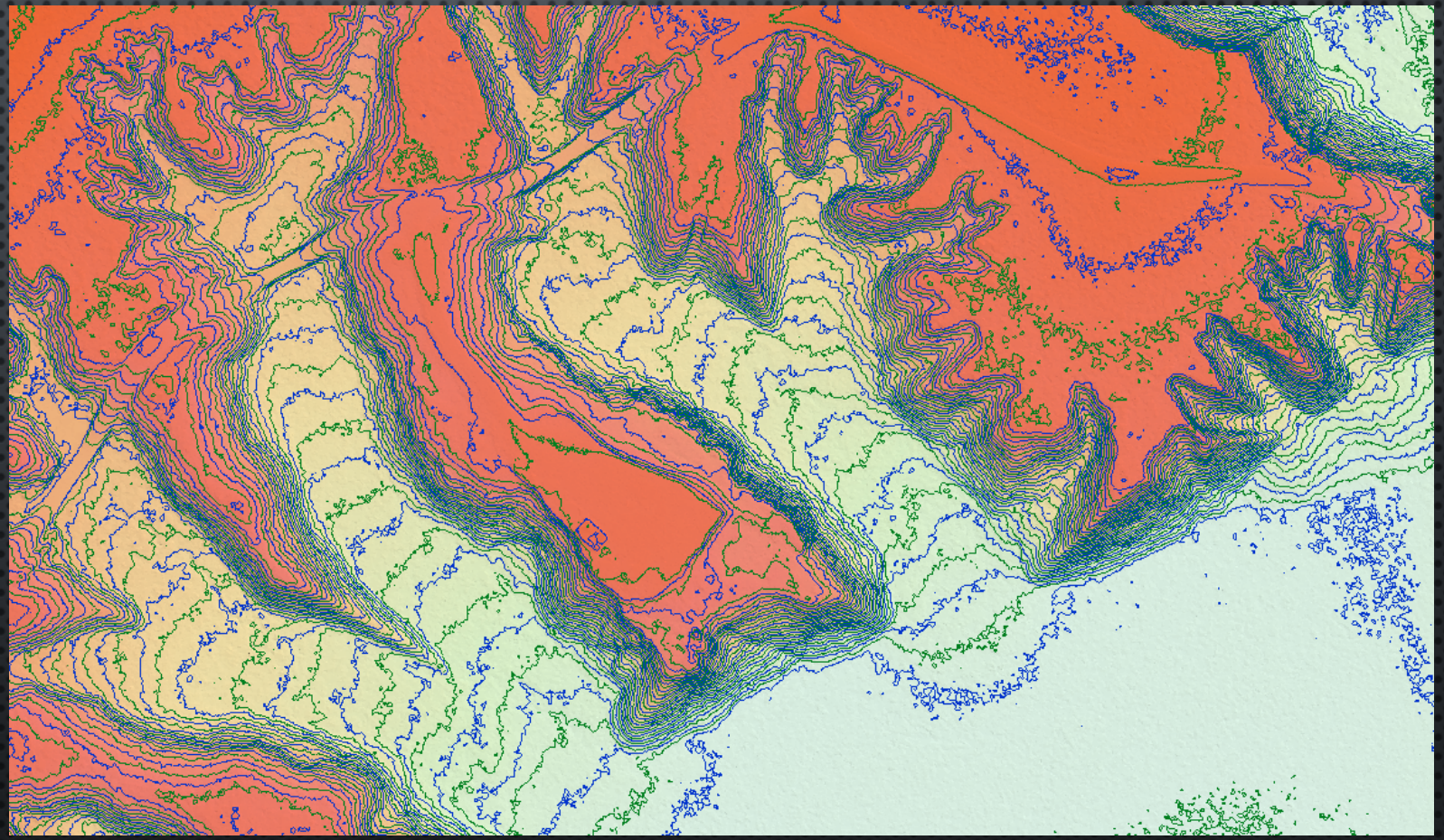
CLASSIFIED POINTS +

BARE EARTH DTM



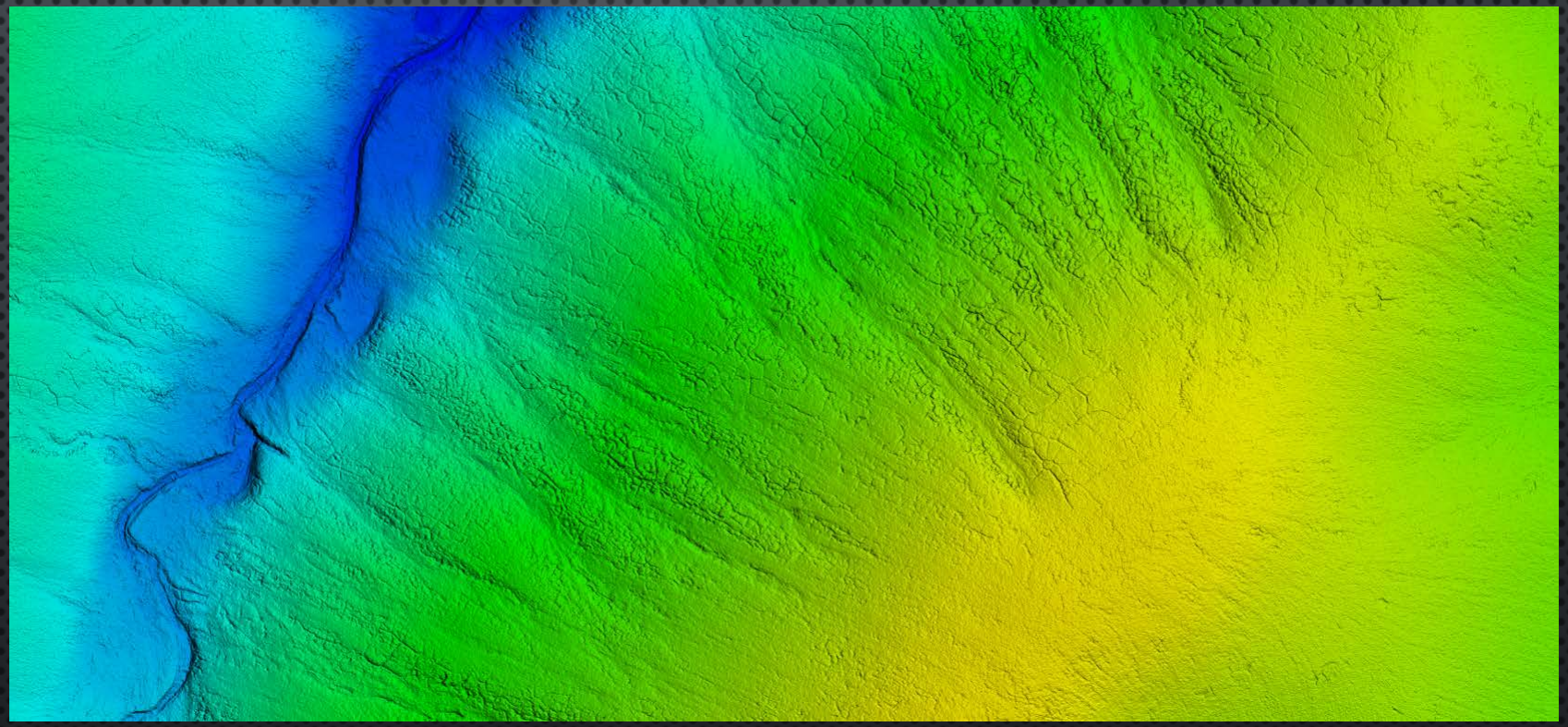
GEOMETRIC DERIVATIVES

BARE EARTH DTM



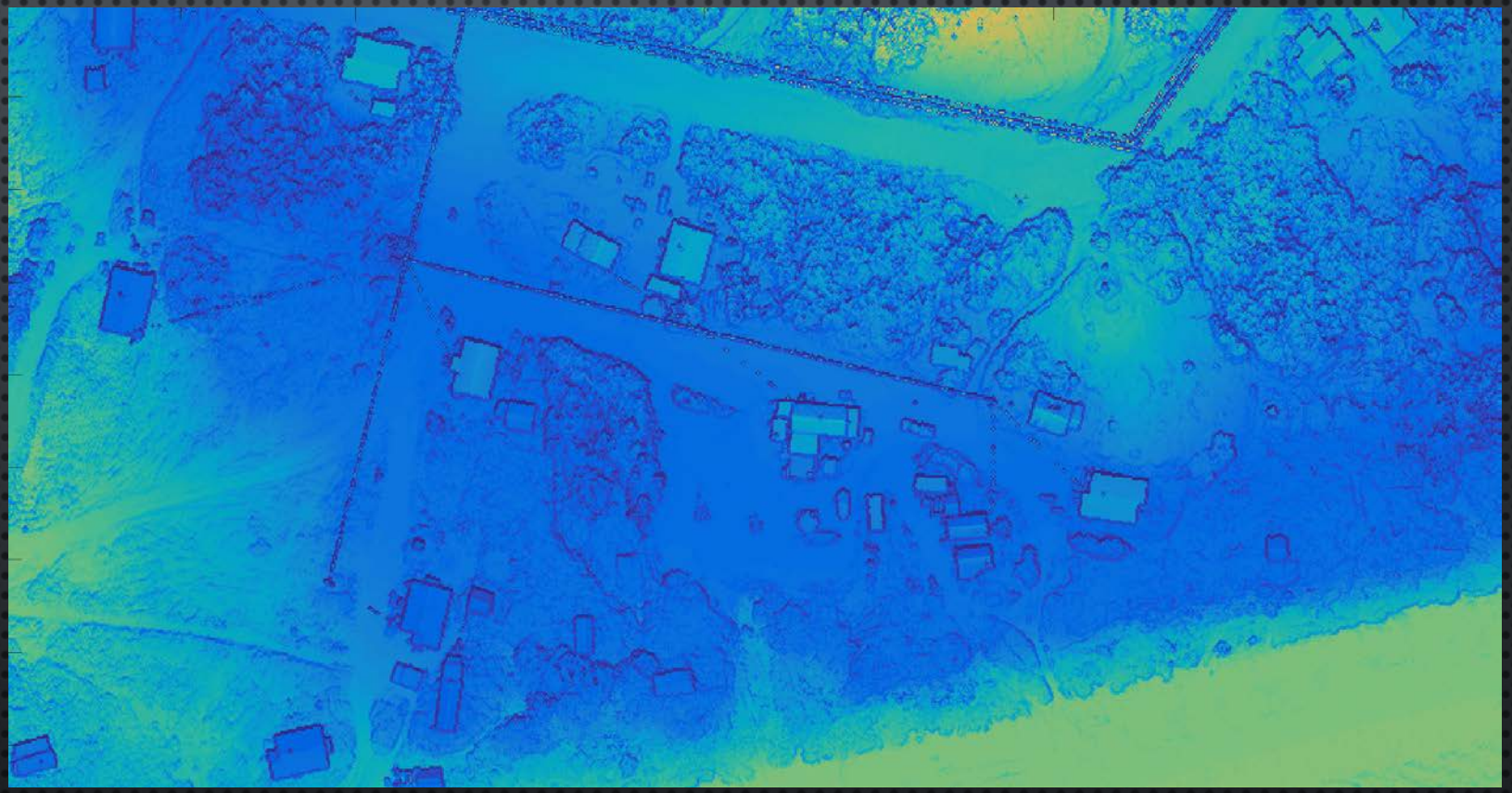
GEOMETRIC DERIVATIVES

BARE EARTH DEM



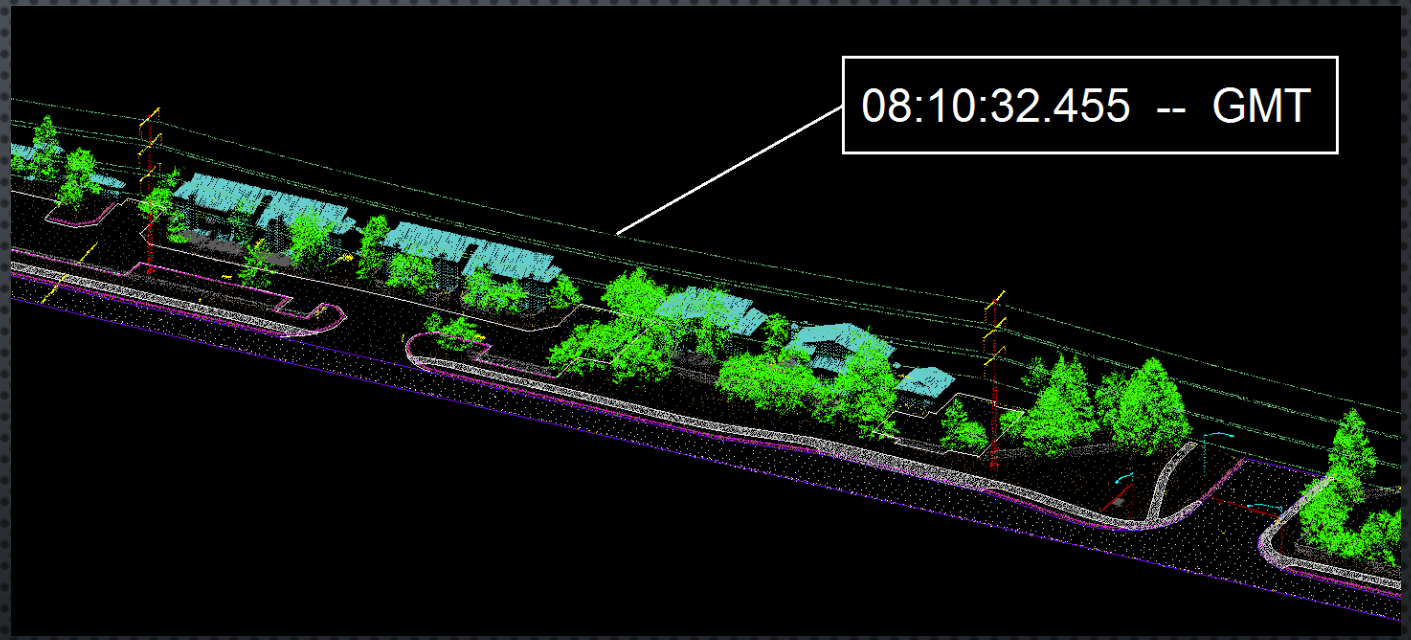
GEOMETRIC DERIVATIVES

HIGHEST HIT DSM



PRECISE TIMESTAMPS

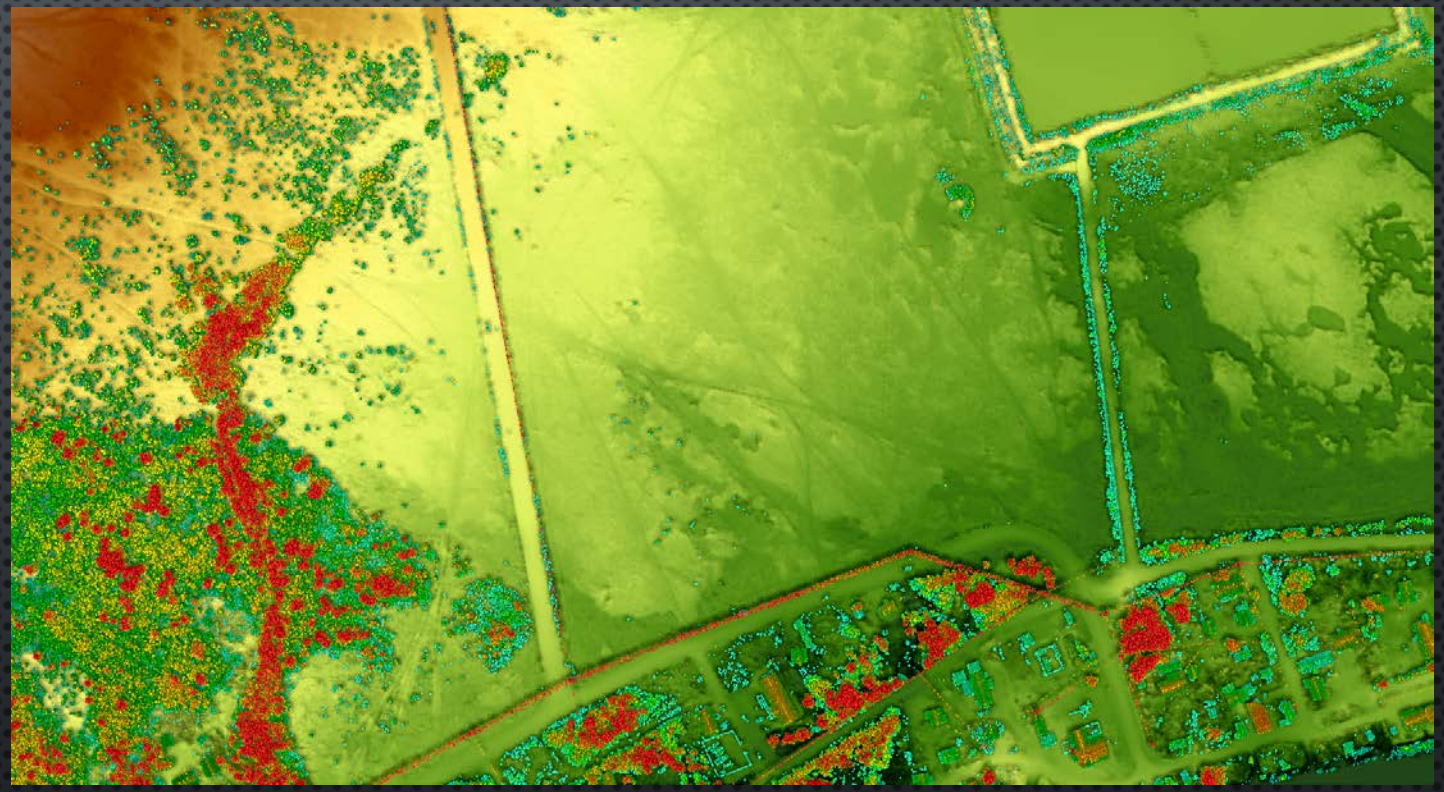
'Adjusted GPS Time' provides Absolute Time to sub-second level for each point



Discrete Return Data

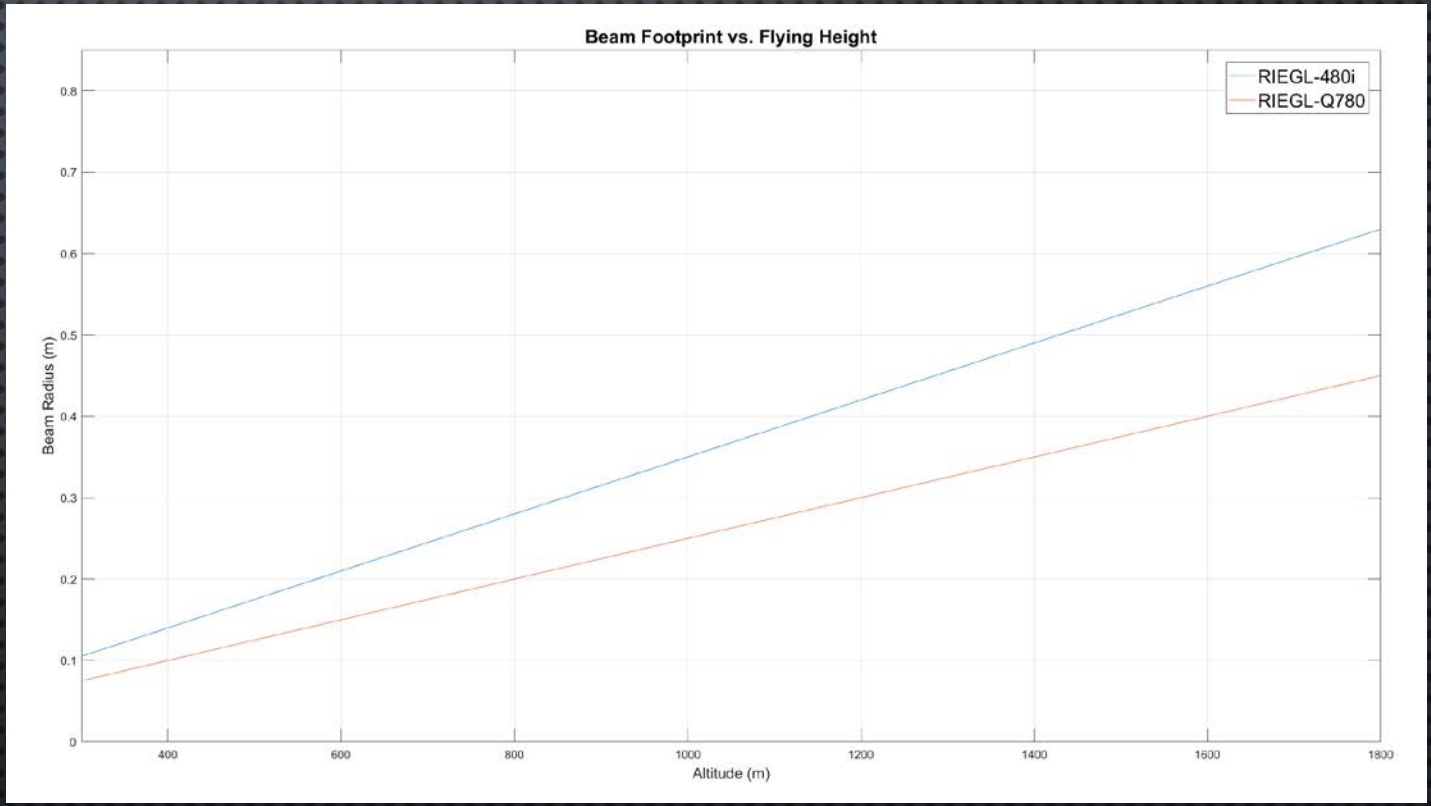
Often used in Height Difference Analysis –

Use Caution :
First Returns Aren't Always on Top
Last Returns Aren't Always Ground



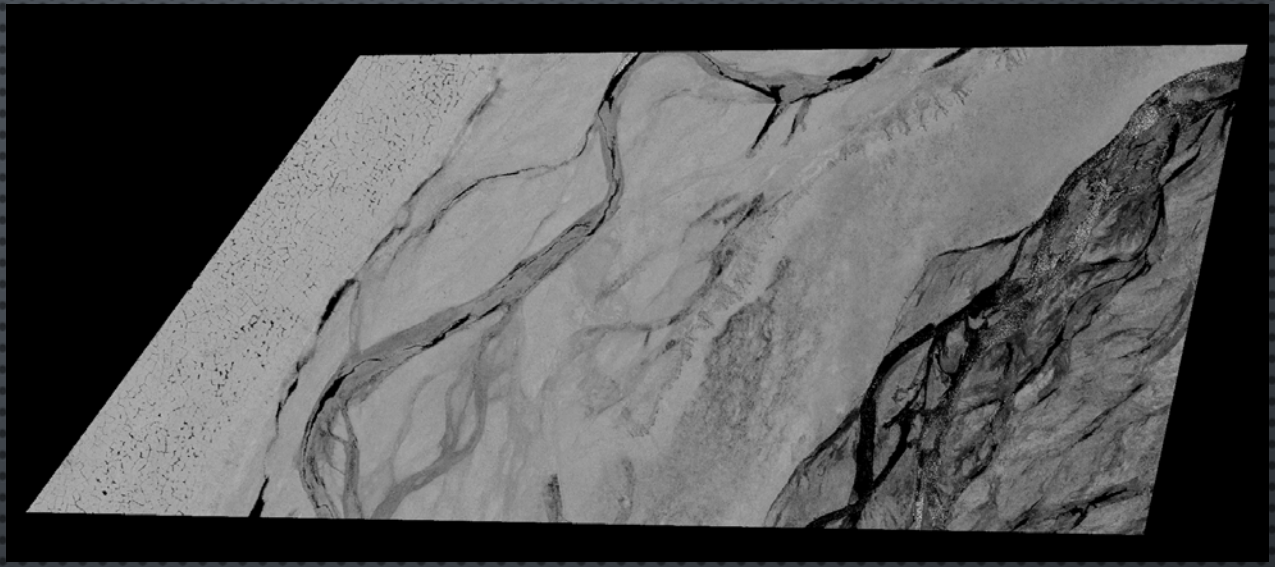
SLIGHT ASIDE…

FIRST RETURNS MAY NOT BE FROM HIGHEST LOCAL OBJECT BECAUSE DATA COLLECTED AT LOWER ALTITUDES OFTEN PENETRATES CANOPY AS THE BEAM SIZE IS RELATIVELY SMALL STILL



INTENSITY DATA

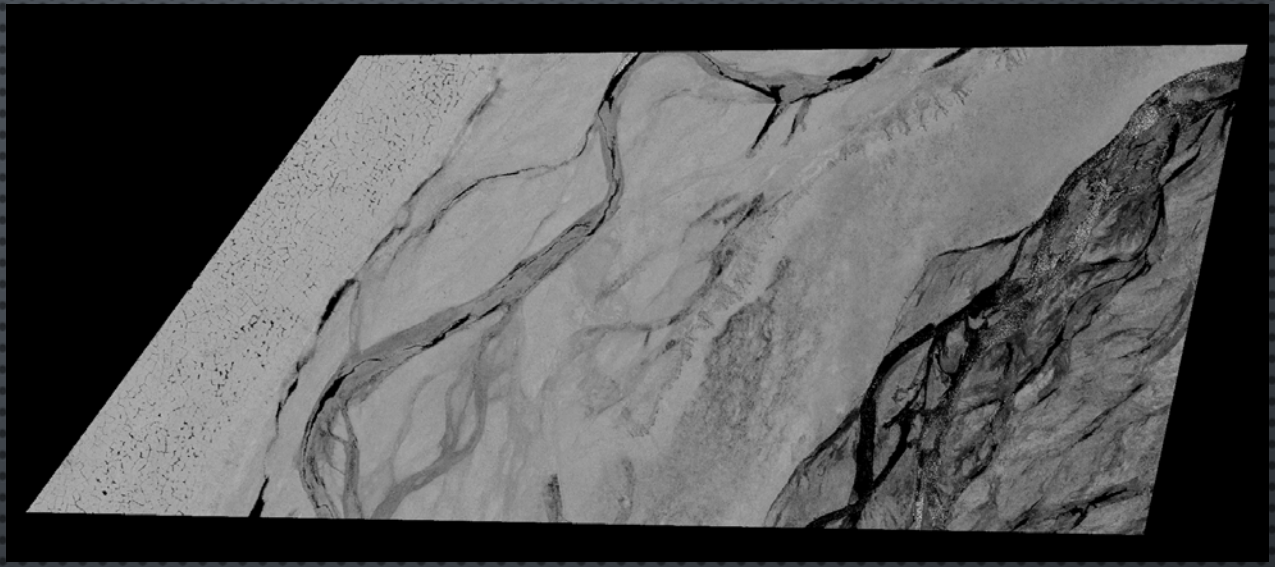
A measure of laser reflectance which is often rasterized as a visual, but…



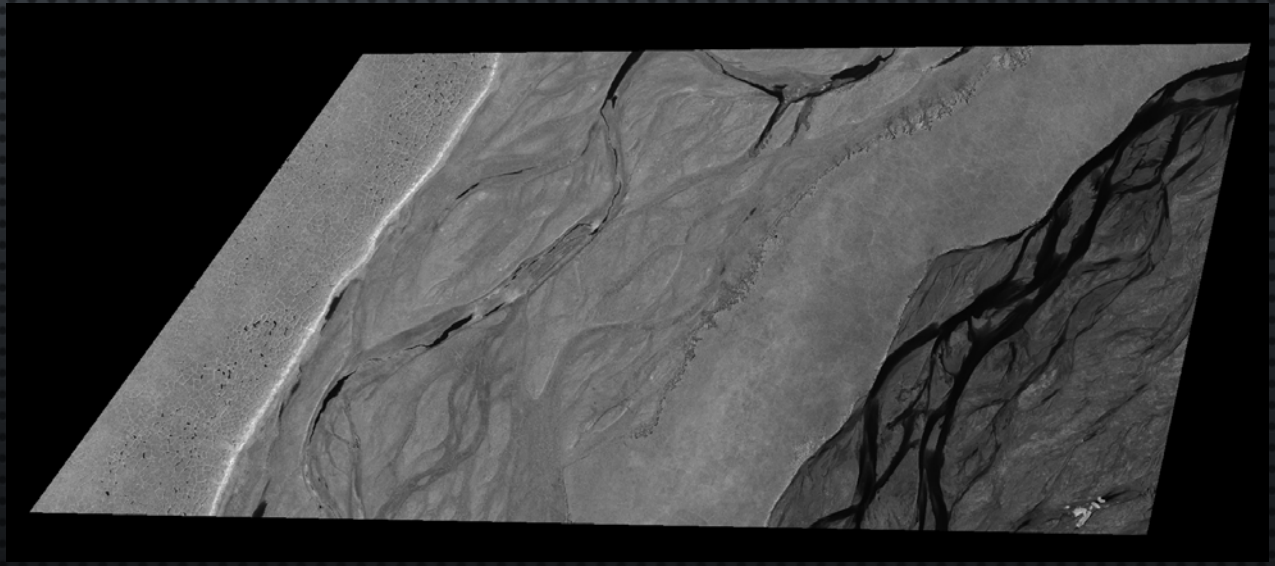
Lidar Intensity

INTENSITY DATA

…AIRBORNE LIDAR SENSORS TYPICALLY OPERATE IN THE NIR PORTION OF THE SPECTRUM. HOW DOES THIS COMPARE TO THE NIR BAND IN IMAGERY?

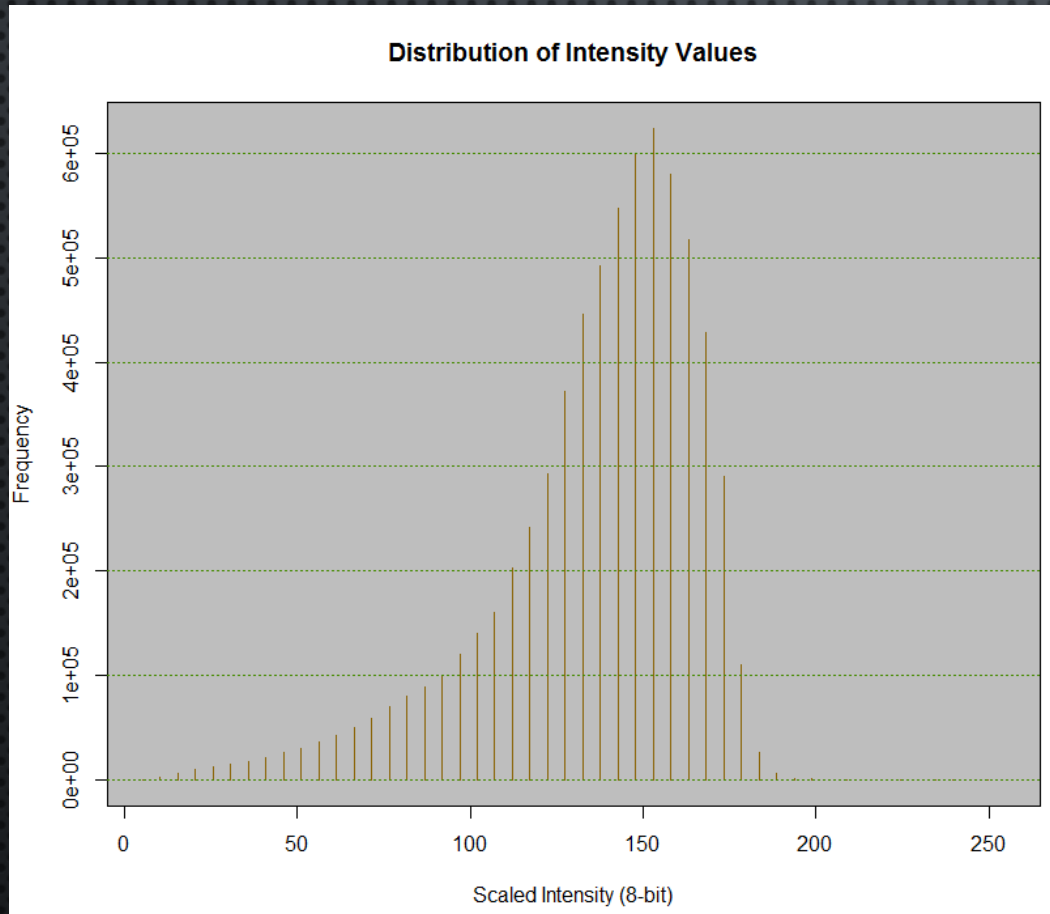


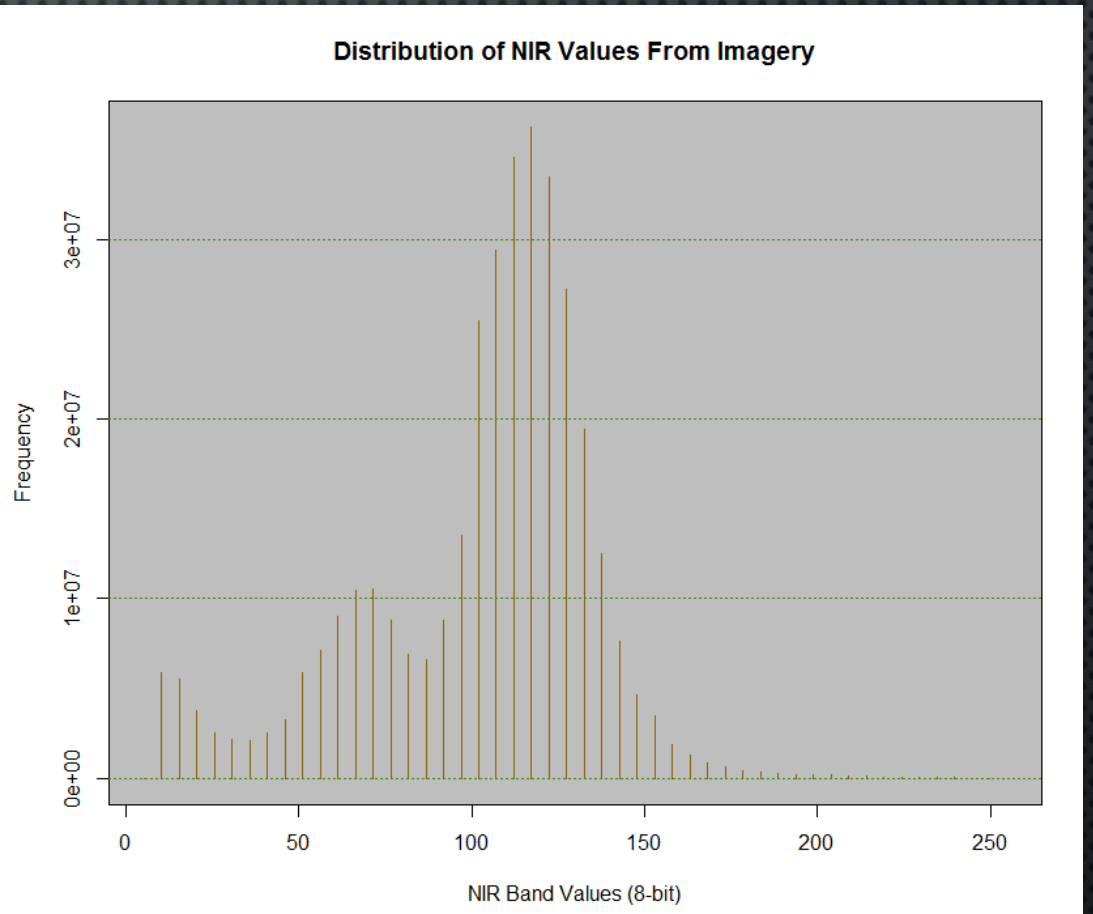
Lidar Intensity



NIR Imagery

QUANTITATIVE COMPARISON

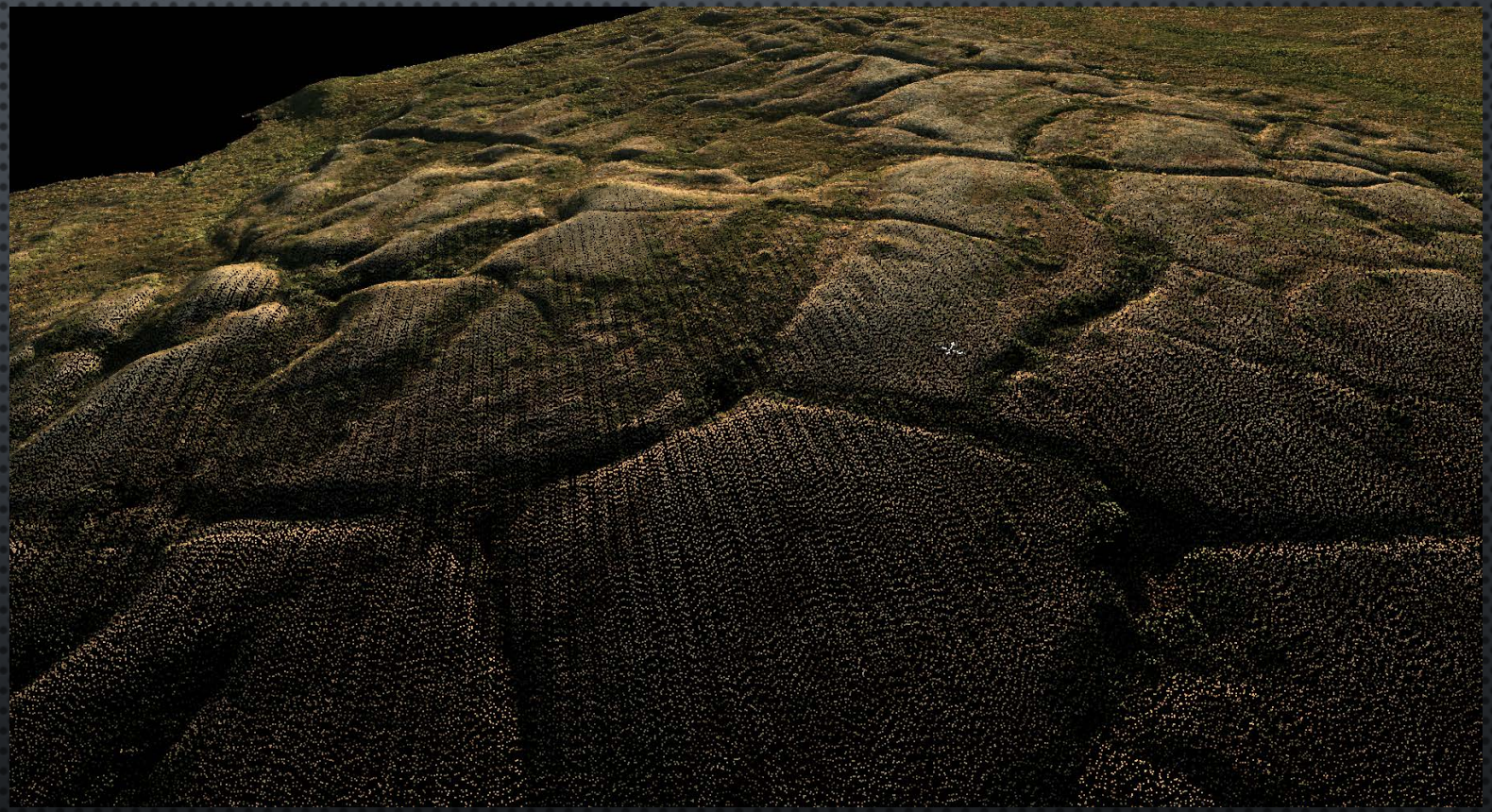




SPECTRAL DATA

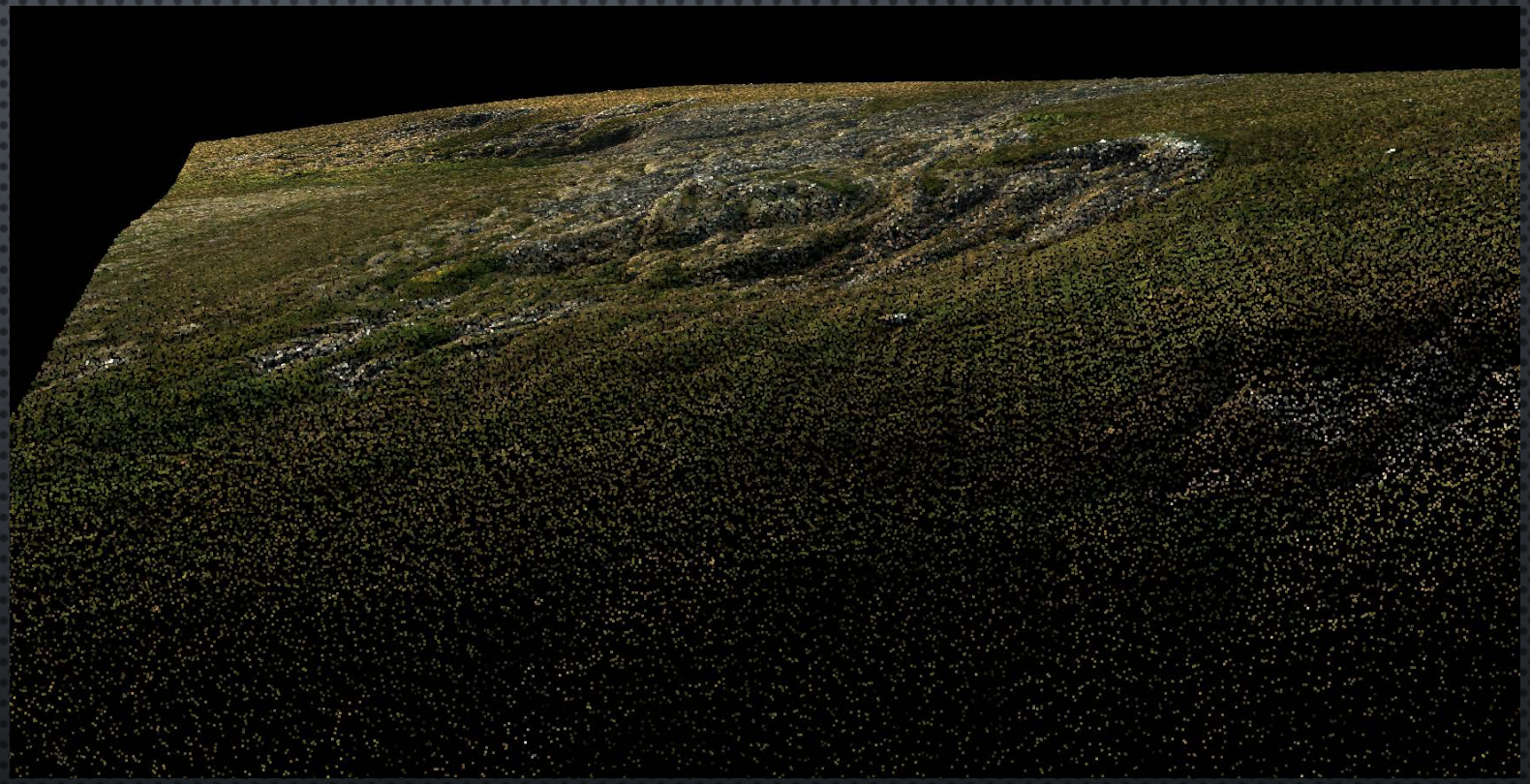
Color Values from Imagery

Stored Directly In LAS Data



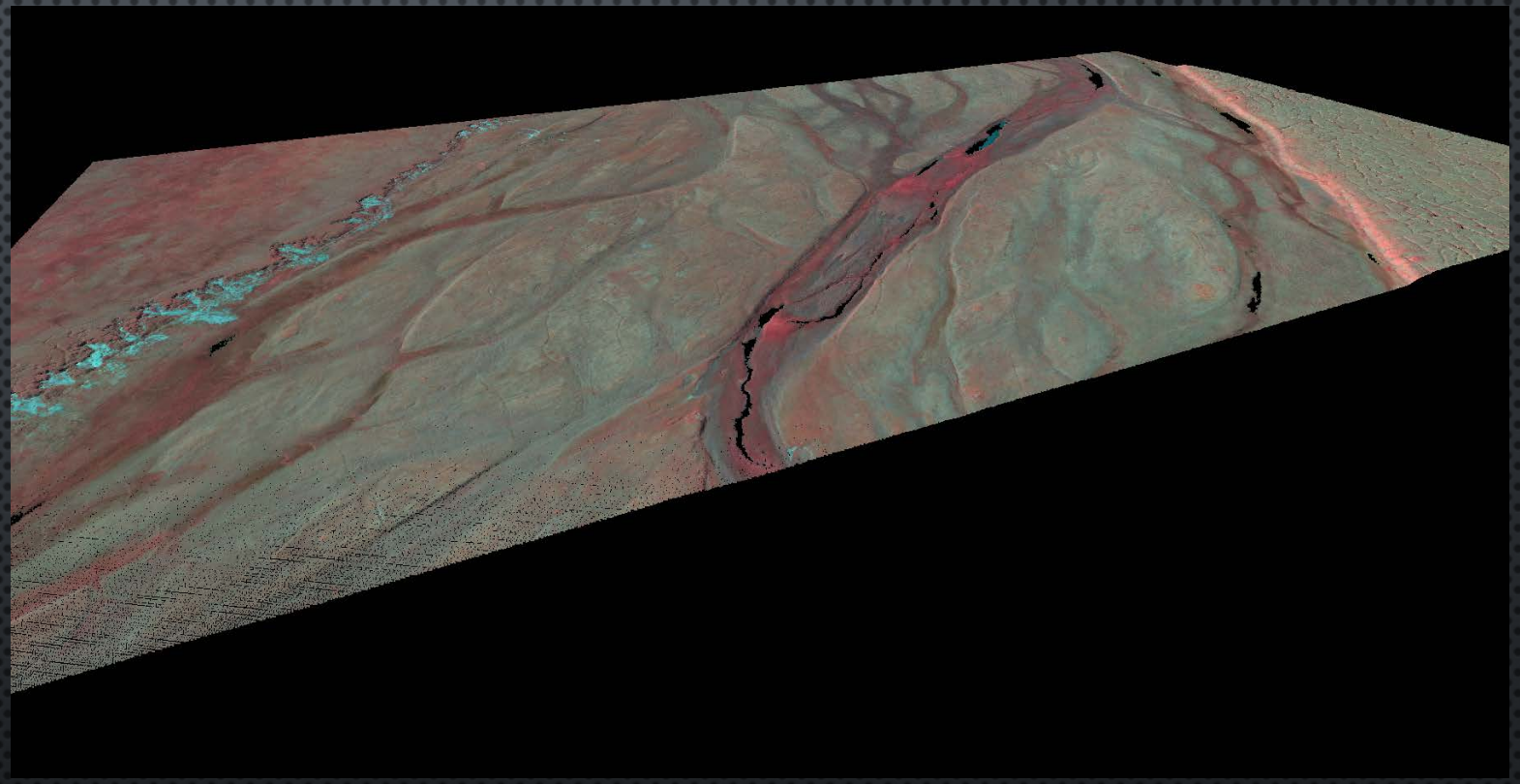
SPECTRAL DATA

Resolution Agreement a Necessity for Meaningful Combination of Data



SPECTRAL DATA

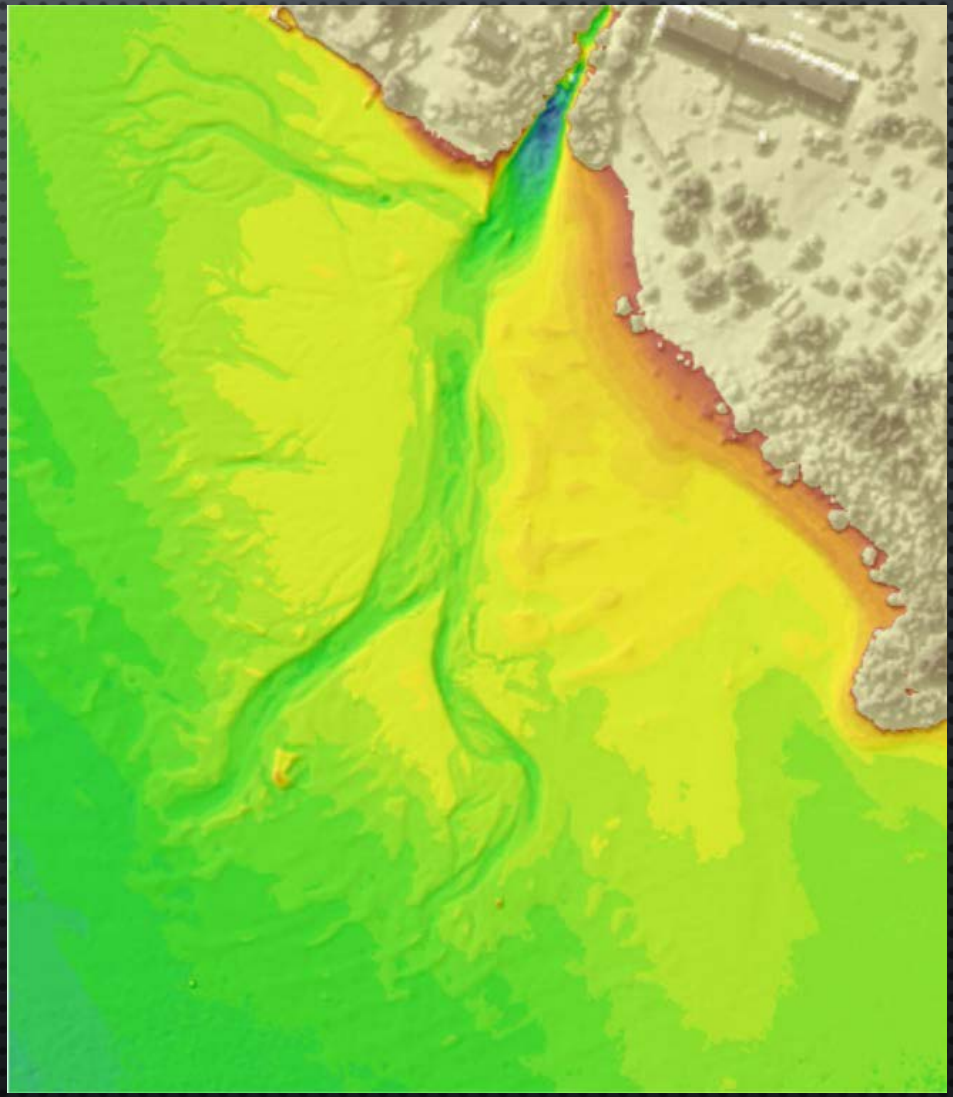
Up to 4 Bands (16-bits each) can be Stored in LAS Data



BATHYMETRIC DATA

Specialized Dual Laser Sensors

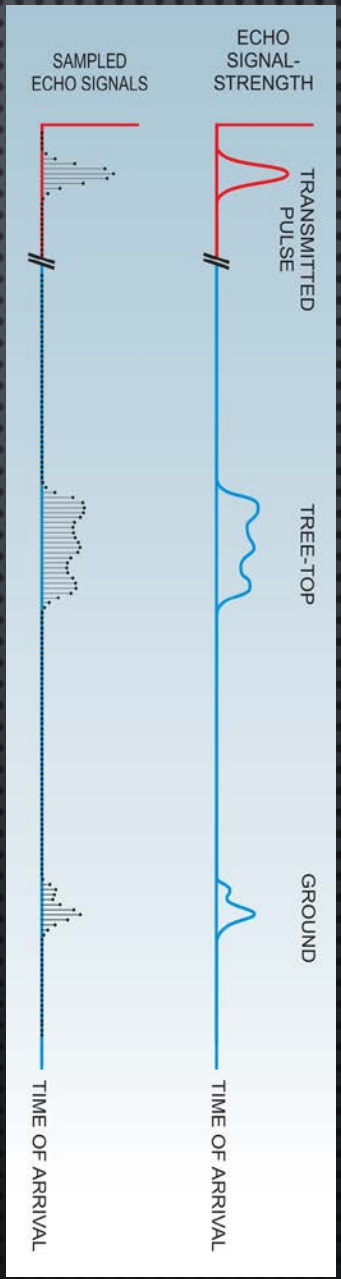
Increasing Interest in Testing in Alaskan Water Bodies



Wessels et al., 2015

FULL WAVEFORM DATA

Stores ‘Shape’ of Returning Pulses in Many Bins as Opposed to Only Storing Signal Peaks



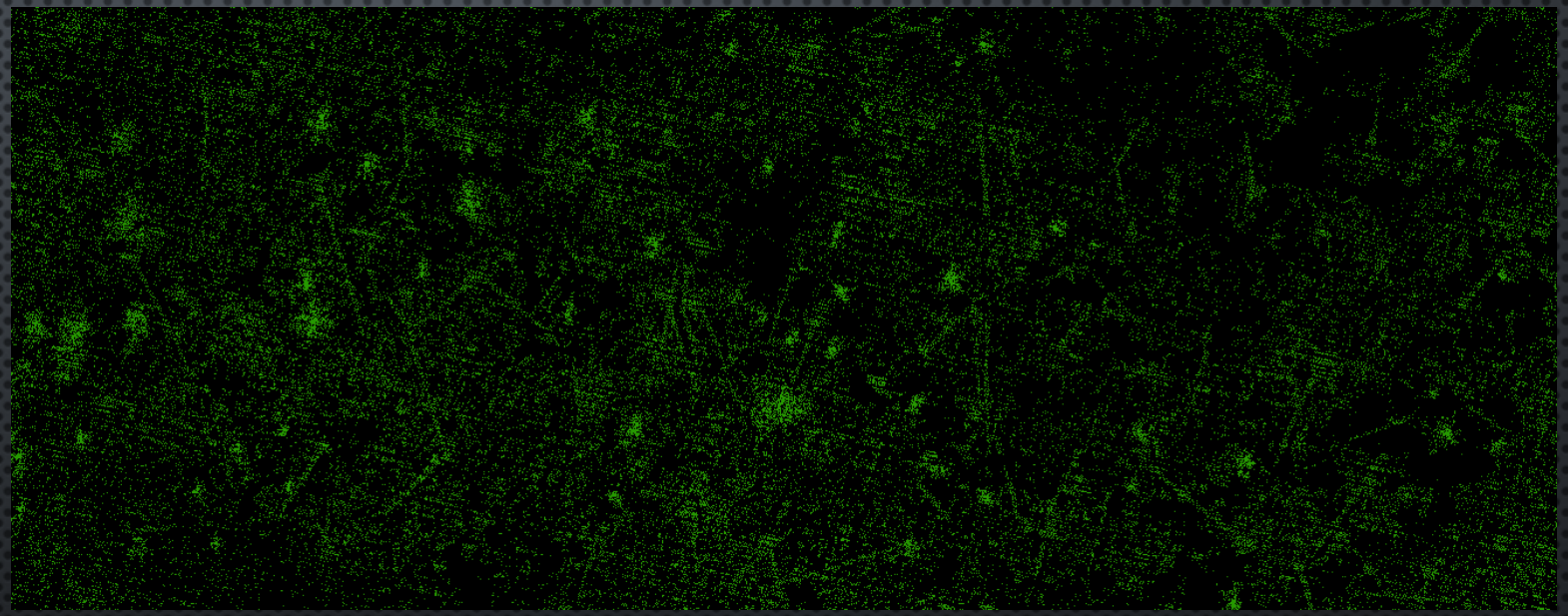
RIEGL Laser Measurement Systems GmbH, 2016

Questions These Data Can Help Answer

- How much distance _____ a reference feature/surface is another feature/surface?
  - Above
  - Below
  - Away From
- How Is _____ Changing Over Time?
  - Topography
  - Vegetation
  - The Coast

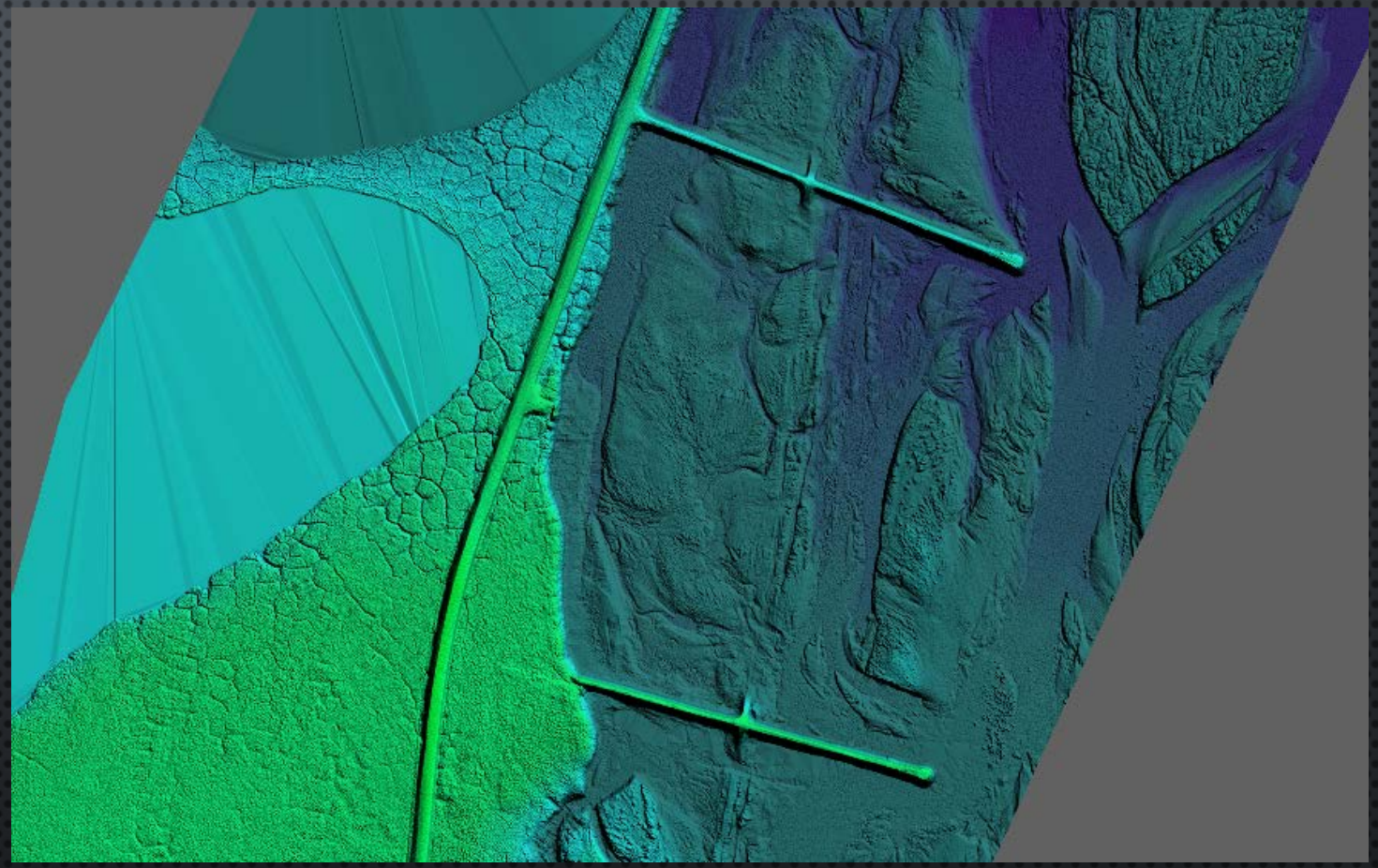
ABOVE SURFACE VEGETATION

Lidar points right above ground surface reveal Fallen Vegetation Structures



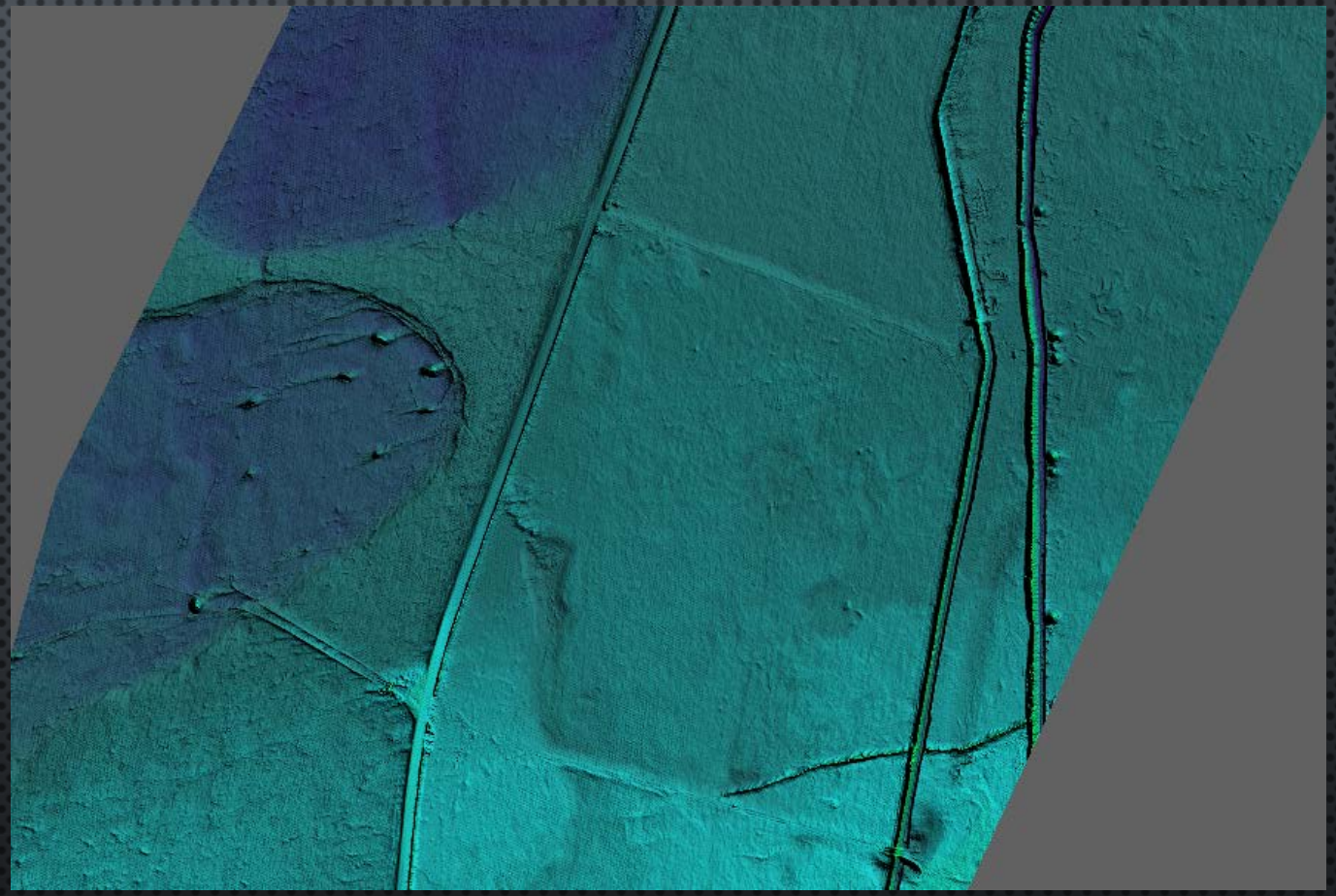
DEPTH OF COVER

LIDAR SURFACE FROM 2011…



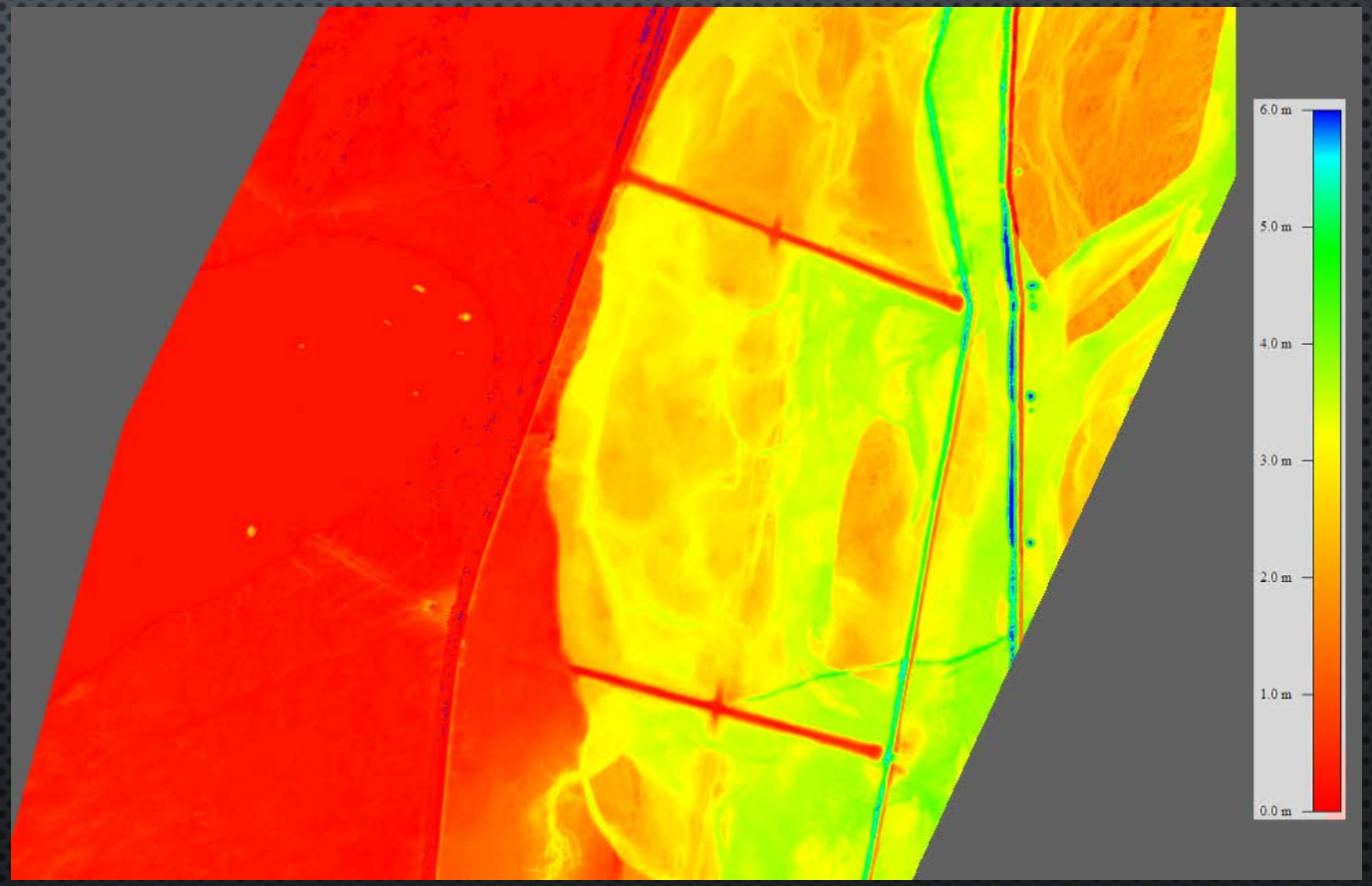
DEPTH OF COVER

…LIDAR SURFACE OF SNOW & ICE, 2015…

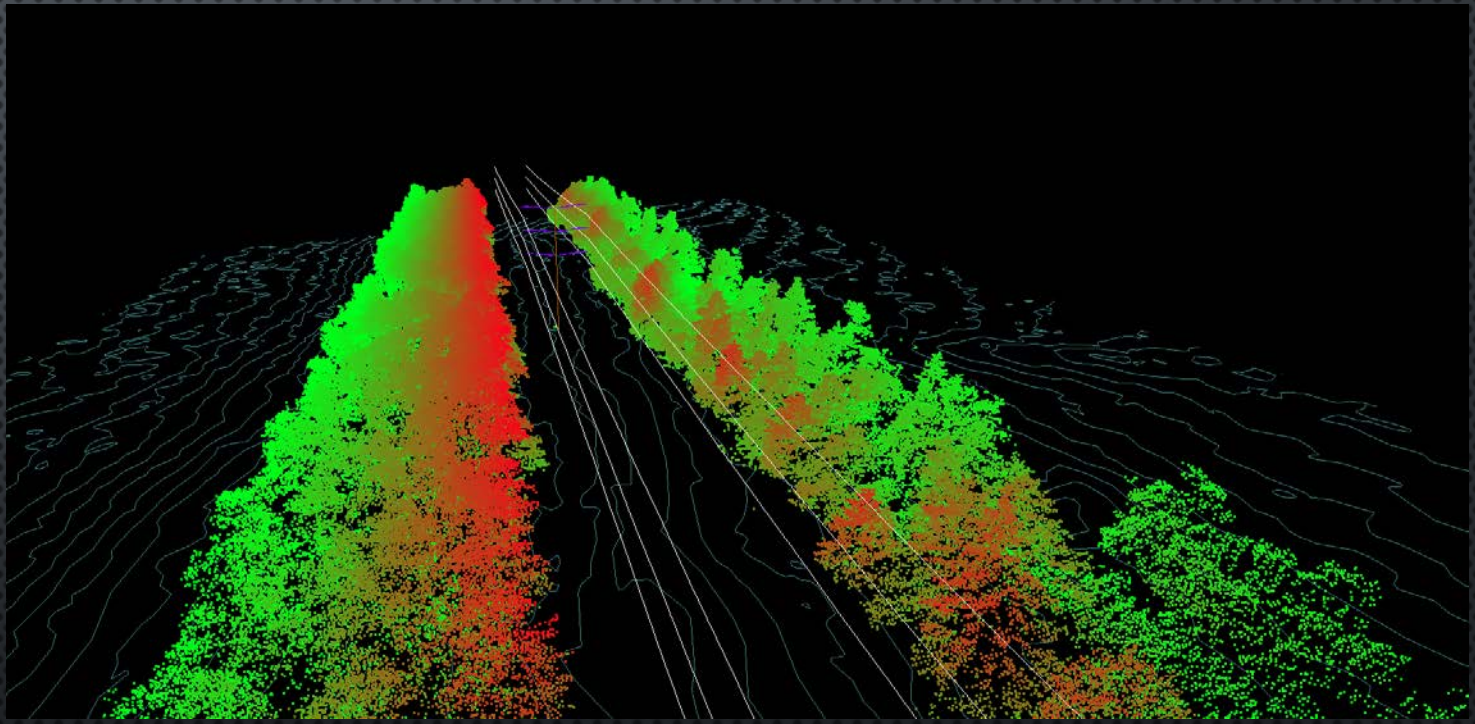


DEPTH OF COVER

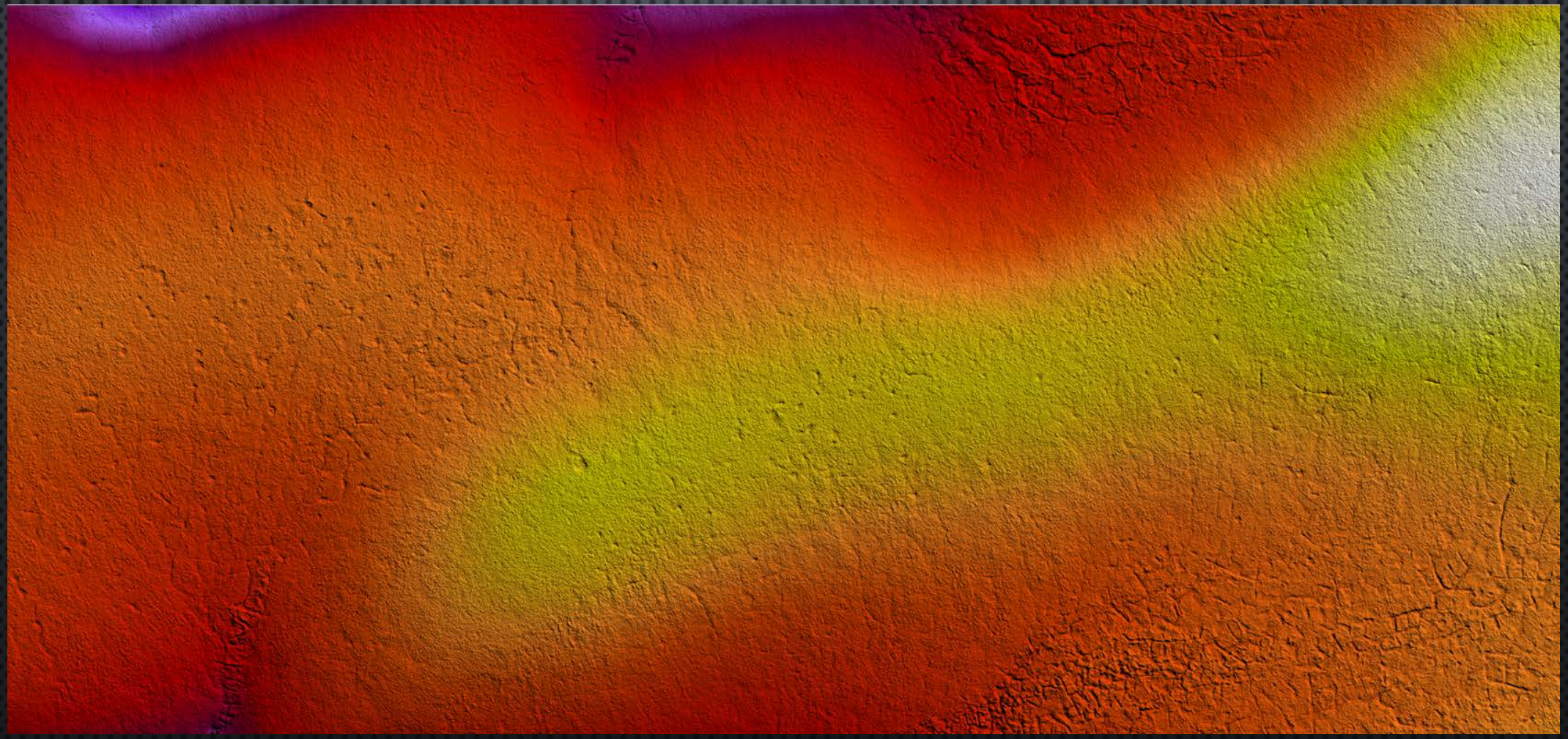
…Depth of Terrain Beneath Snow & Ice buildup.



DISTANCE BETWEEN 3D FEATURES

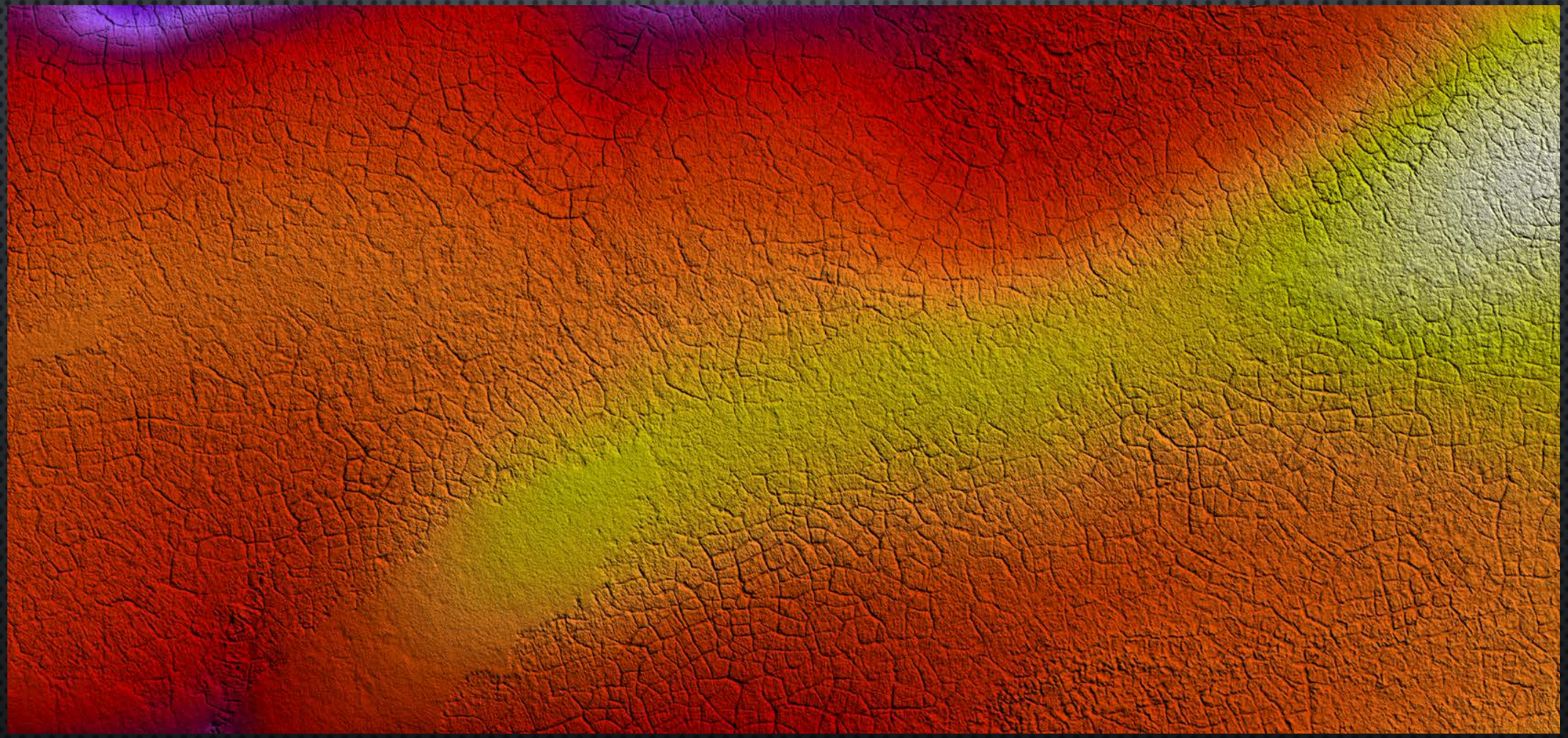


TOPOGRAPHIC CHANGE OVER TIME



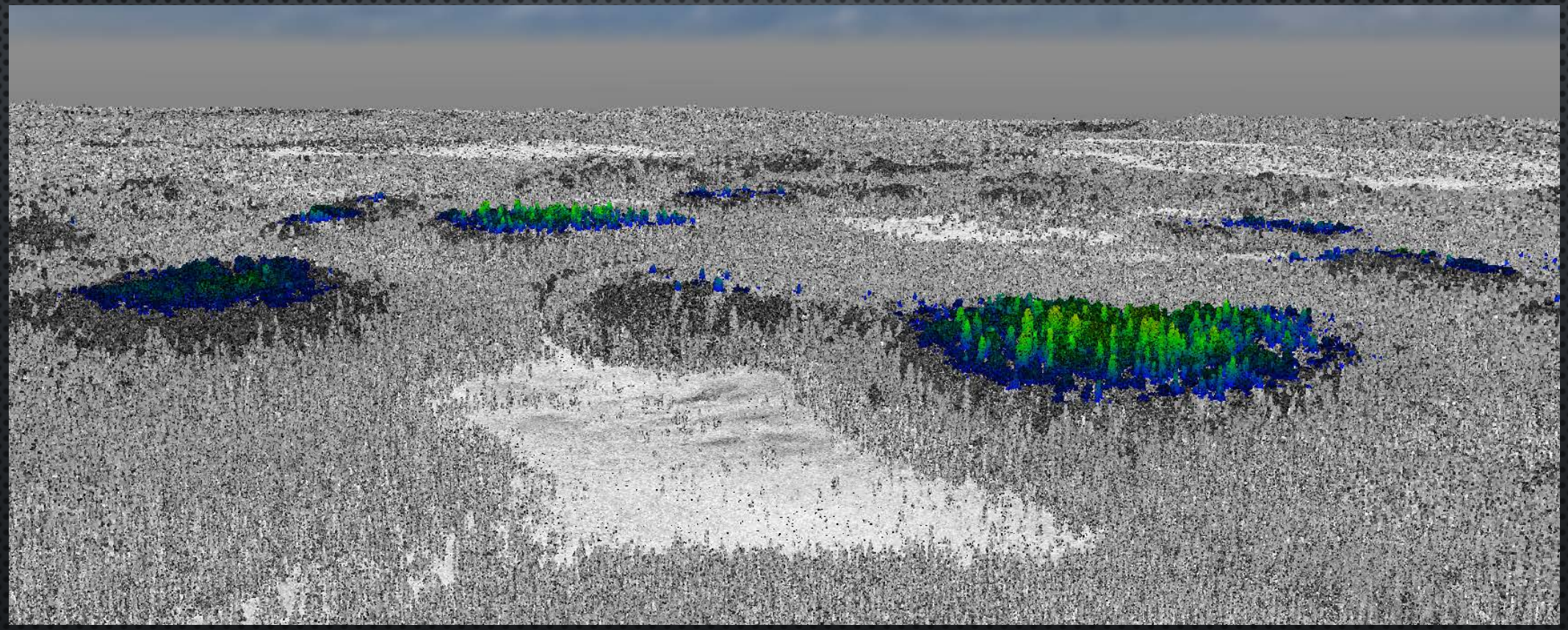
2009 Lidar DEM – Anaktuvuk Fire Area

TOPOGRAPHIC CHANGE OVER TIME



2014 Lidar DEM – Anaktuvuk Fire Area

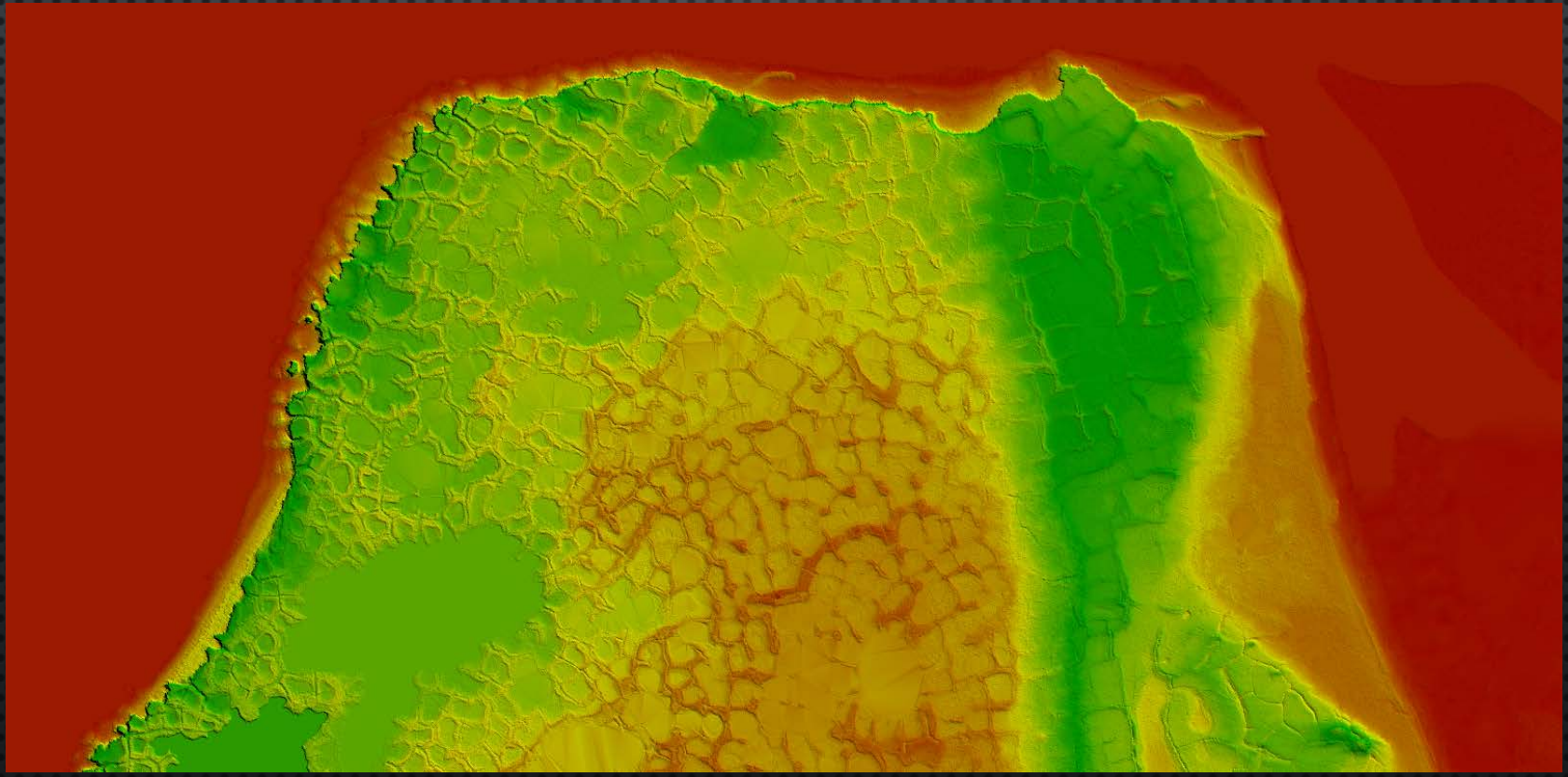
VEGETATIVE CHANGE OVER TIME



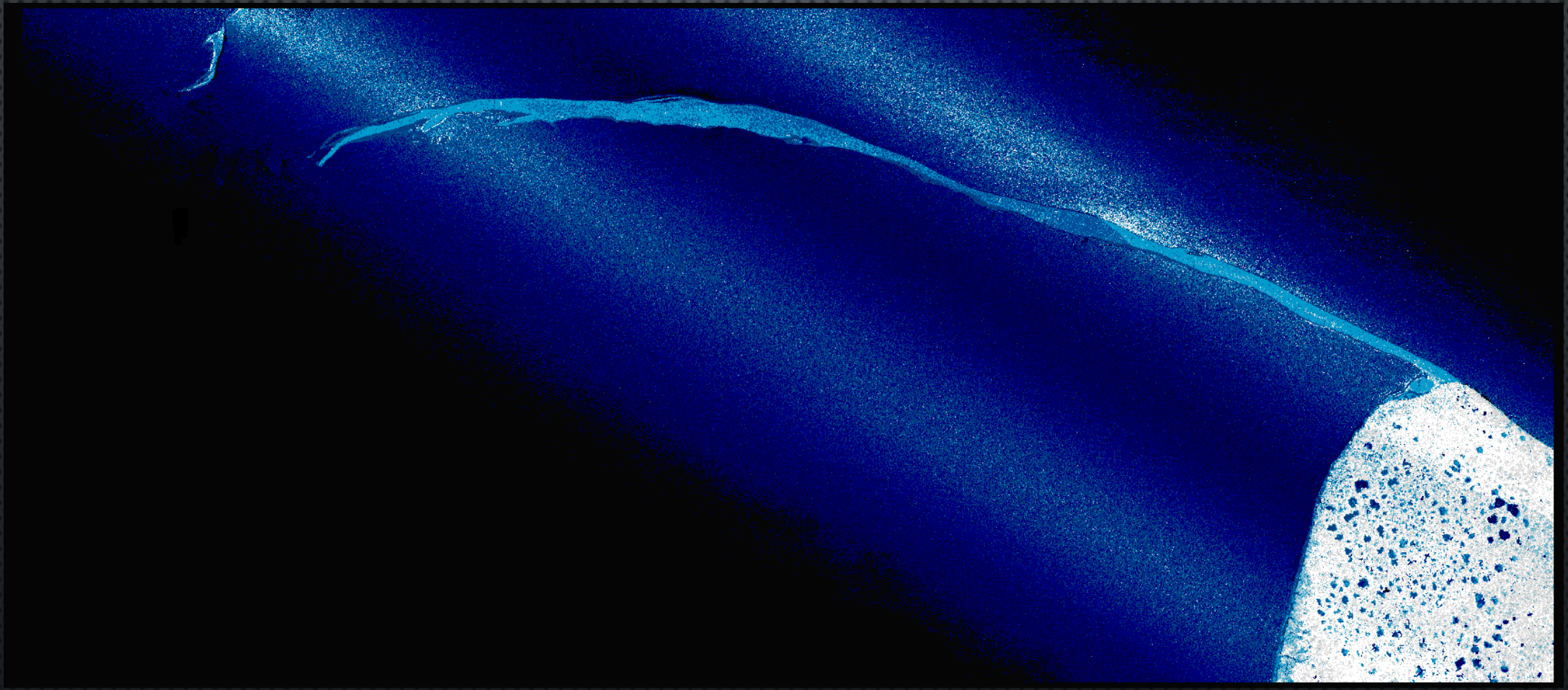
VEGETATIVE CHANGE OVER TIME

High Resolution Mapping of Aboveground Shrub Biomass, Greaves et al., 2015

COASTAL CHANGE OVER TIME

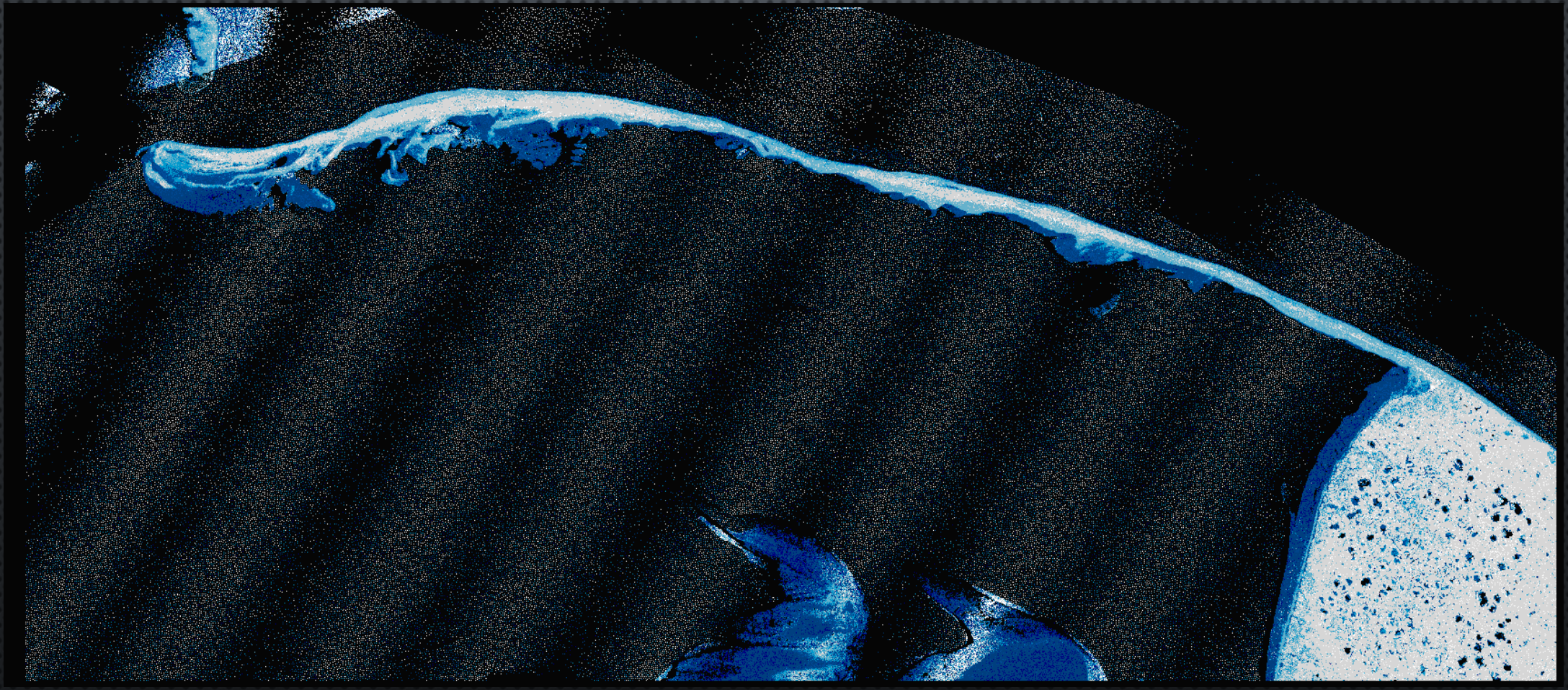


COASTAL CHANGE OVER TIME



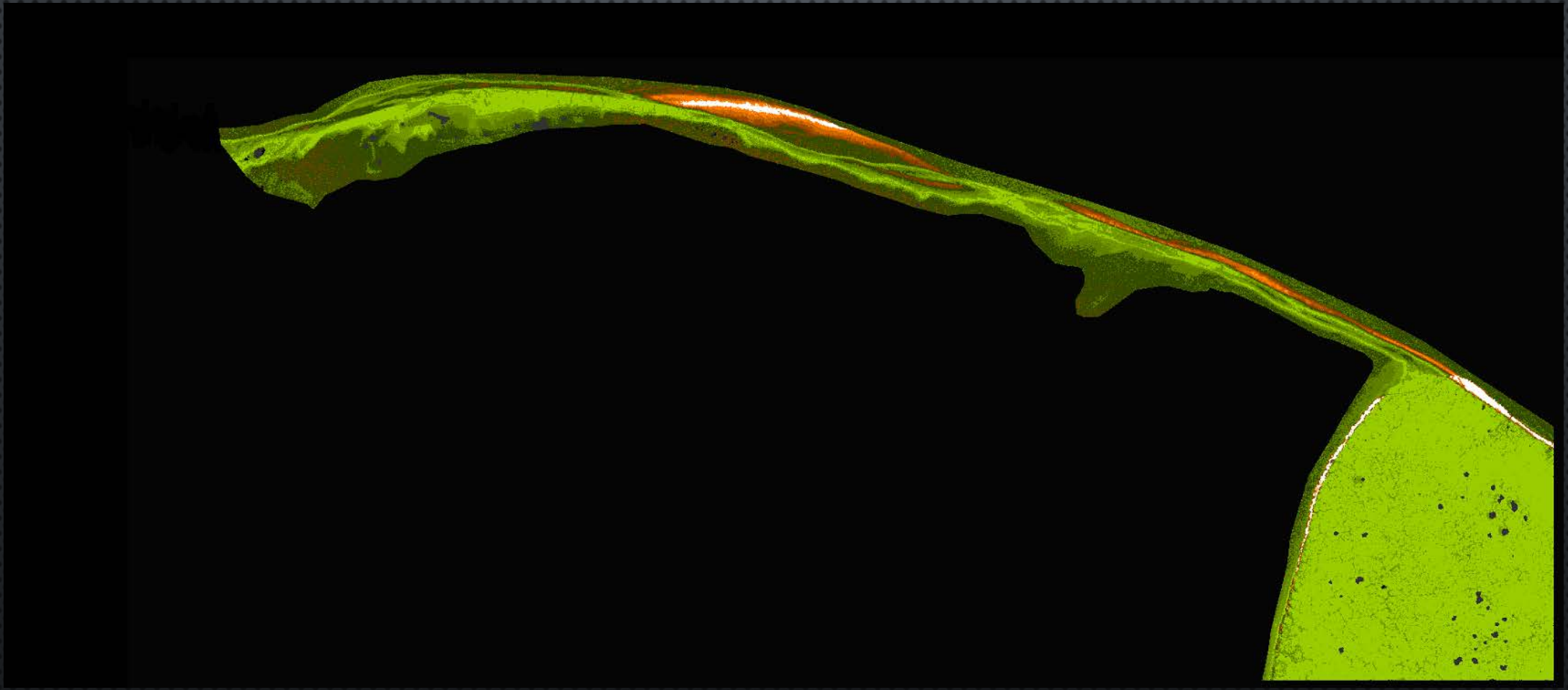
2010 Coastal Lidar Data

COASTAL CHANGE OVER TIME



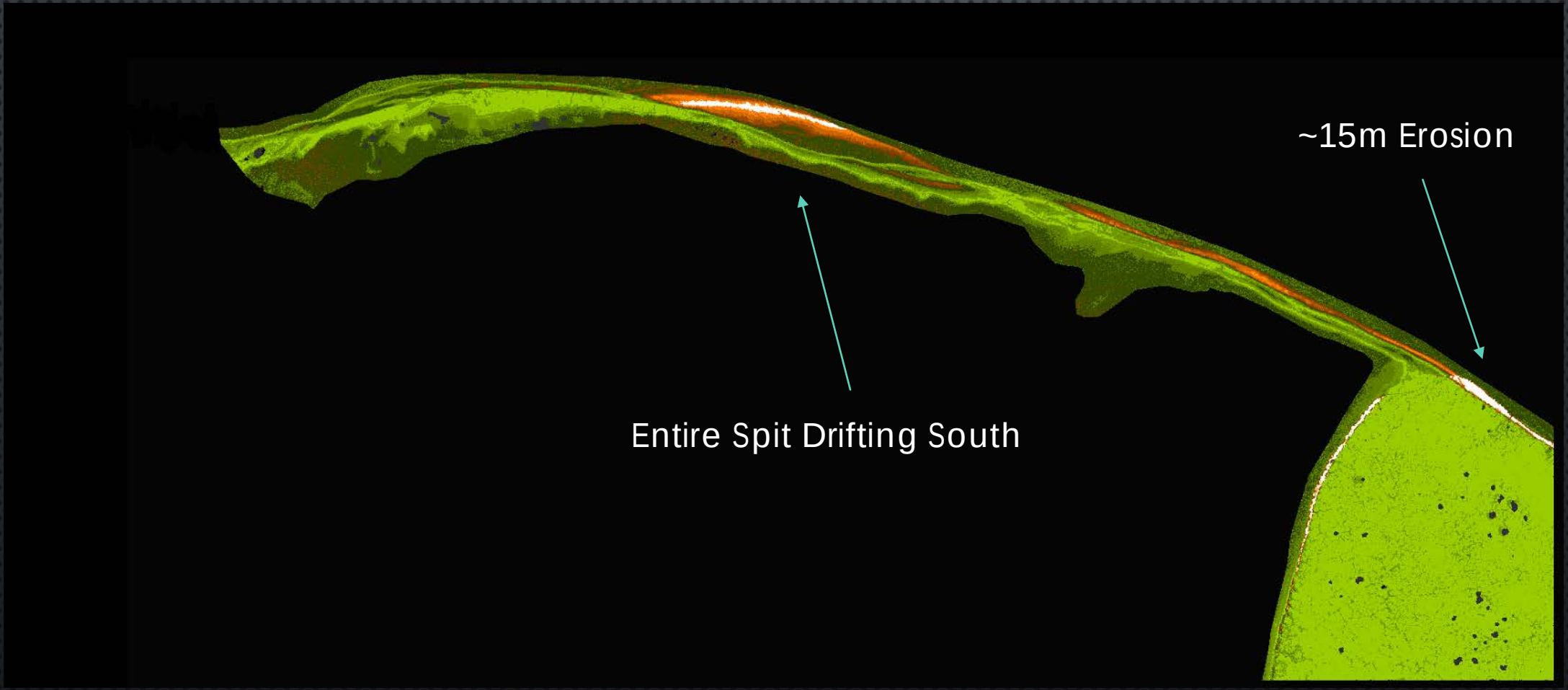
2016 Coastal Lidar Data

COASTAL CHANGE OVER TIME



Visualizing Erosion / Accretion

COASTAL CHANGE OVER TIME



Visualizing Erosion / Accretion

Things to Consider

- Optimal Acquisition Window
  - Seasonal Vegetation / Runoff
  - Tidal Coordination
- Data Accuracy Requirements
  - Relative / Absolute
  - Point Density
  - Standards and/or Project Needs
- Tying Into Existing / Planned Data
  - Spatial Reference
  - Resolution / Density

-- THANK YOU --
-- QUESTIONS? --
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MAPPING