California Forest Lidar Analytics Collaborative Biomass

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California's Forest Climate Policy Landscape

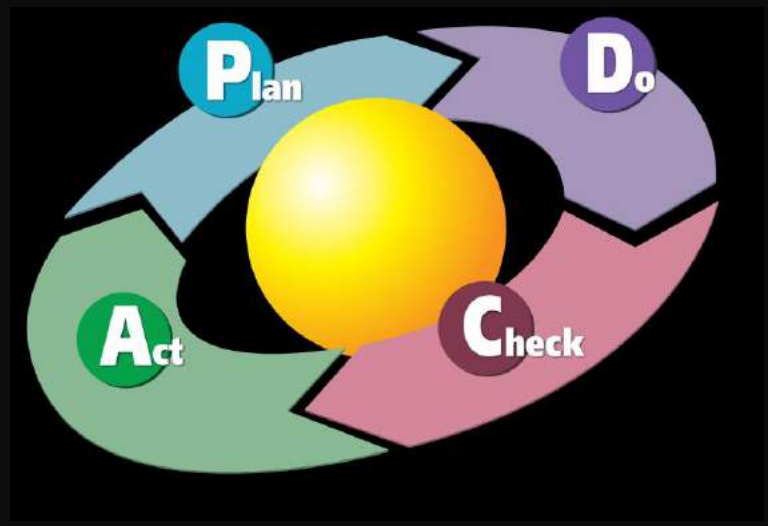
- Over the last decade California has experienced climate stress, including extreme wildfire behavior and increased tree mortality
- Forests are a key element in the States climate adaptation and mitigation goals
- State and Federal governments have committed to dramatically accelerate the pace and scale of forest climate adaptation activities over the next decade
- This initiative utilizes a large number nongovernmental organizations and local jurisdictions to plan and implement
- The California Climate Investments Forest Health program requires organizations to produce robust project carbon budgets
- Many of the partner organizations are not well equipped to use

Why Lidar

- Lidar Provides the best available geospatial data on canopy structure
- Many of our Forest Climate Resilience Strategies are based on managing stand structure

Total Quality Management

- ISO 9001
  - Section 1: Scope
  - Section 2: Normative references
  - Section 3: Terms and definitions
  - Section 4: Context of the organization
  - Section 5: Leadership
  - Section 6: Planning
  - Section 7: Support
  - Section 8: Operation
  - Section 9: Performance evaluation
  - Section 10: Continual Improvement
- ISO 14001
  - **Plan: Establish objectives and processes required**
  - **Do: Implement the processes**
  - **Check: Measure and monitor the processes and report results**
  - **Act: Take action to improve performance of EMS based on results**



Developing and evaluating variable density treatments

- CITATION: Knapp, Eric E.; Carlson, Robert L.; North, Malcolm P.; Lydersen, Jamie L.; Collins, Brandon M. 2020. Restoring forest heterogeneity with thinning and prescribed fire: Initial results from the central Sierra Nevada, California. In: Pile, Lauren S.; Deal, Robert L.; Dey, Daniel C.; Gwaze, David; Kabrick, John M.; Palik, Brian J.; Schuler, Thomas M., comps. The 2019 National Silviculture Workshop: a focus onforest management-research partnerships. Gen. Tech. Rep. NRS-P-193. Madison, WI: U.S. Department of Agriculture, Forest Service, Northern Research Station: 216-226. https://doi.org/10.2737/NRS-GTR-P-193-paper28.

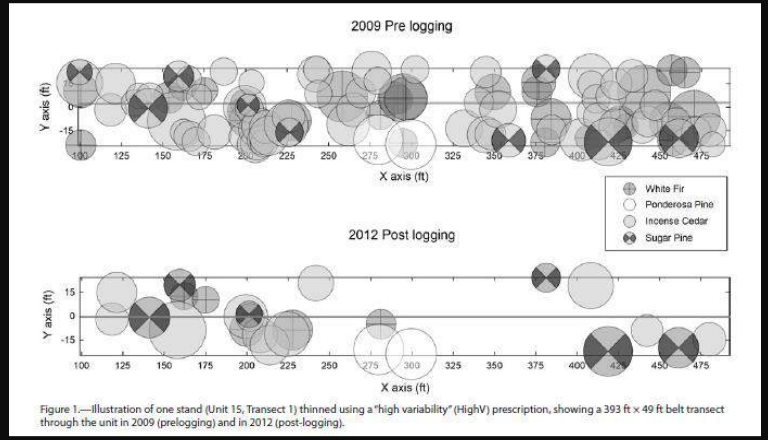
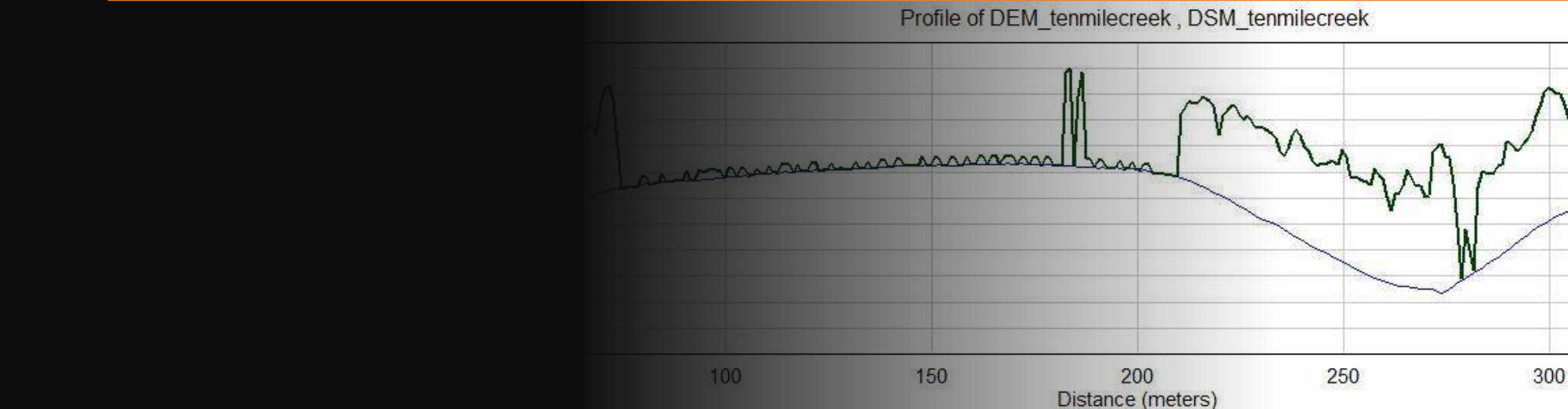


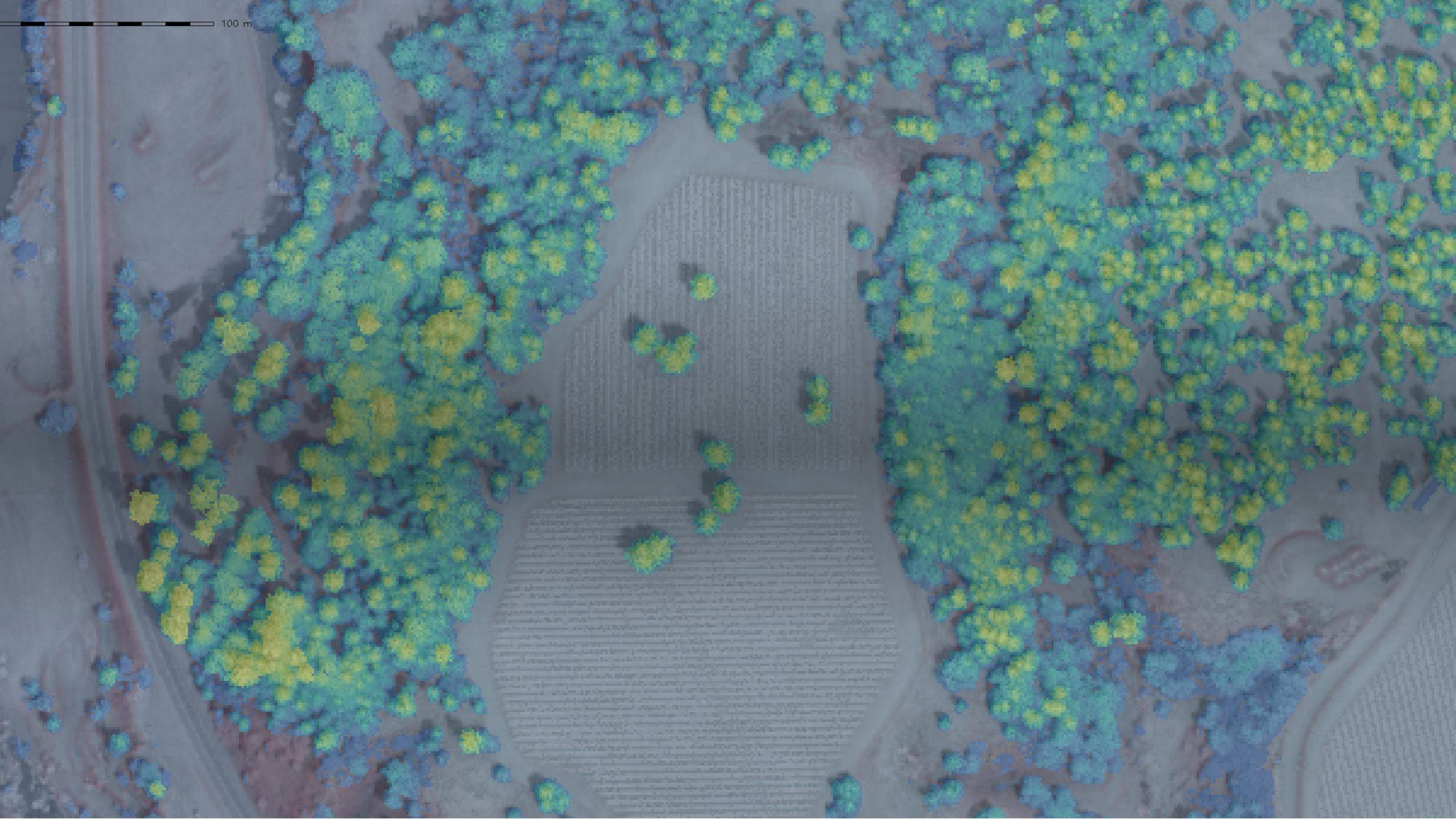
Figure 1.—Illustration of one stand (Unit 15, Transect 1) thinned using a "high variability" (HighV) prescription, showing a 393 ft × 49 ft belt transect through the unit in 2009 (prelogging) and in 2012 (post-logging).

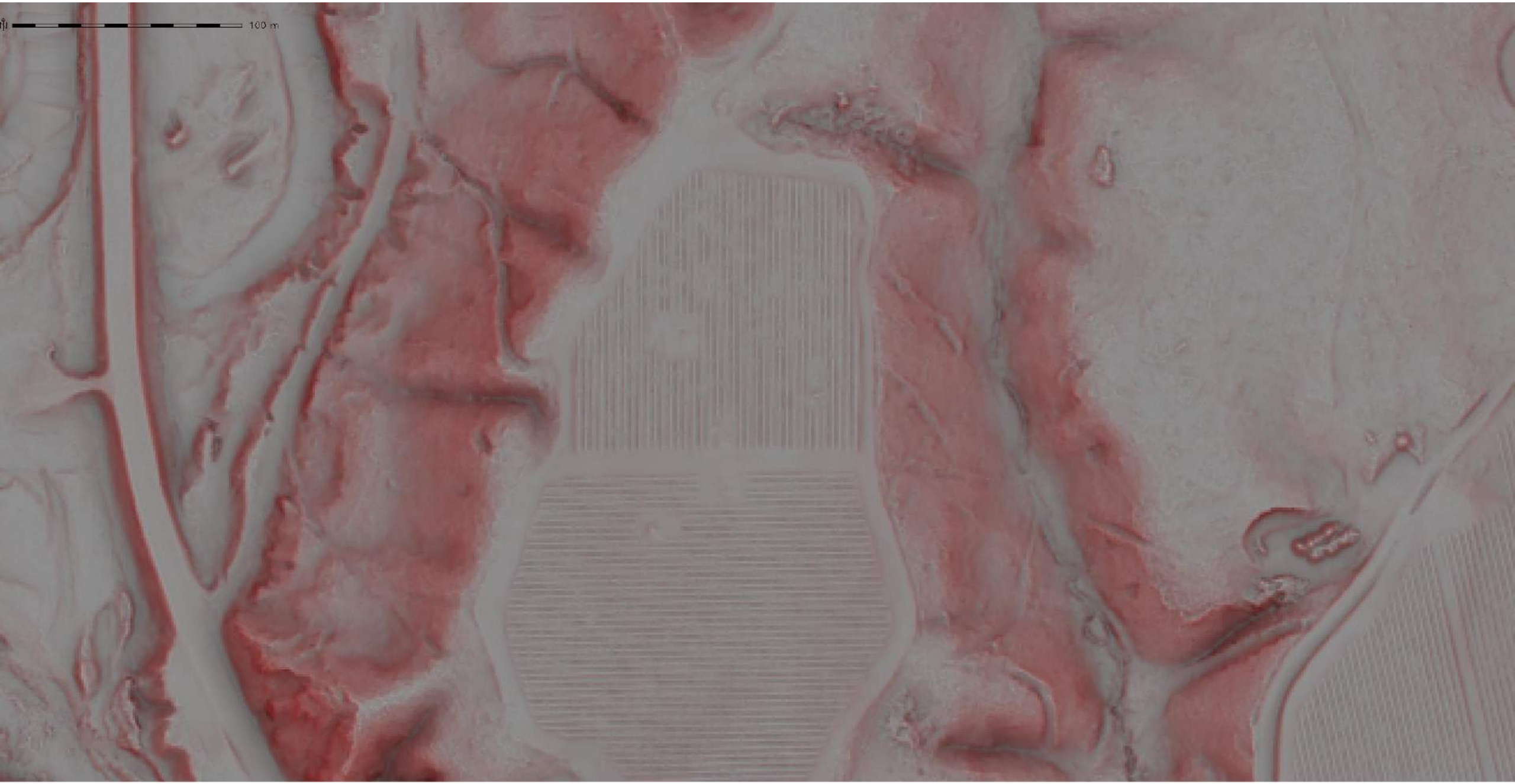
Lidar point cloud analytics are an important geospatial tool for forest planning

- Forest Health Program Needs
  - Systematic review of treatment effectiveness is needed to refine climate adaptation strategies
  - Public Trust requirements for open data
  - Forestry requires intergenerational planning horizons
  - Long term discoverability and reuse of planning data sets
  - Findable, Accessible, Interoperable, and Reusable are appropriate goals for environmental compliance documents
- Barriers to Adoption
  - Big data issues, point cloud analytics result in rapidly growing computational and storage demands
  - Lack of long-term data repository
  - NGO's funding cycles are tied to program implementation
  - NGO's have limited research, development, and capacity building funding
  - Commercial software ecosystem excludes diverse user groups

Vegetation Structure




100 m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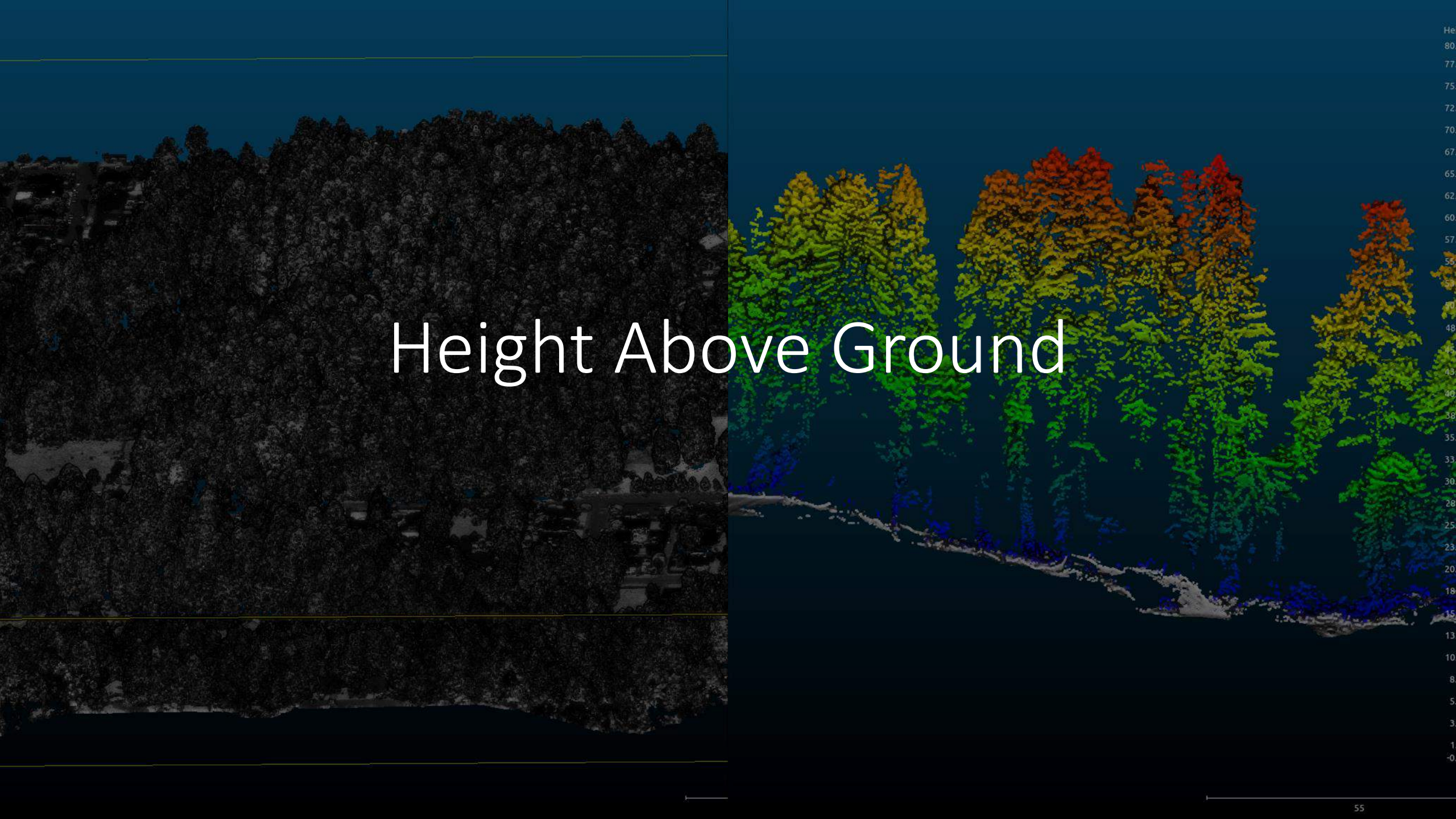
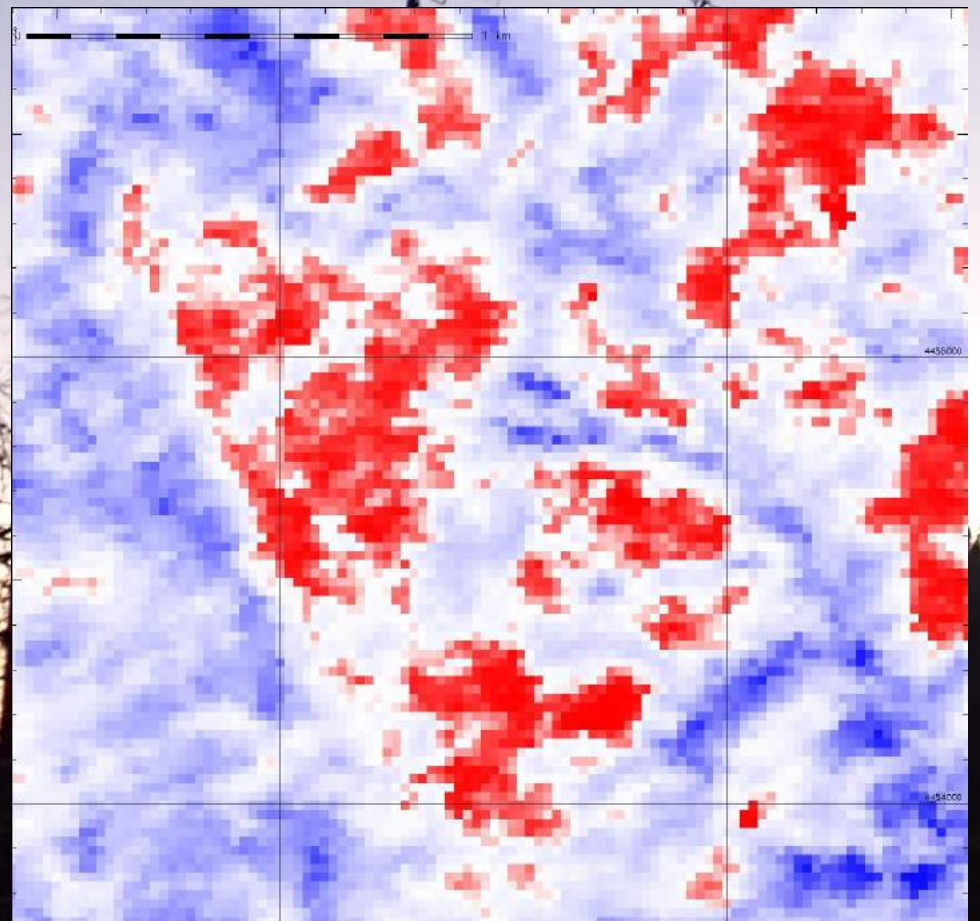

Height Above Ground

Point Cloud Classification

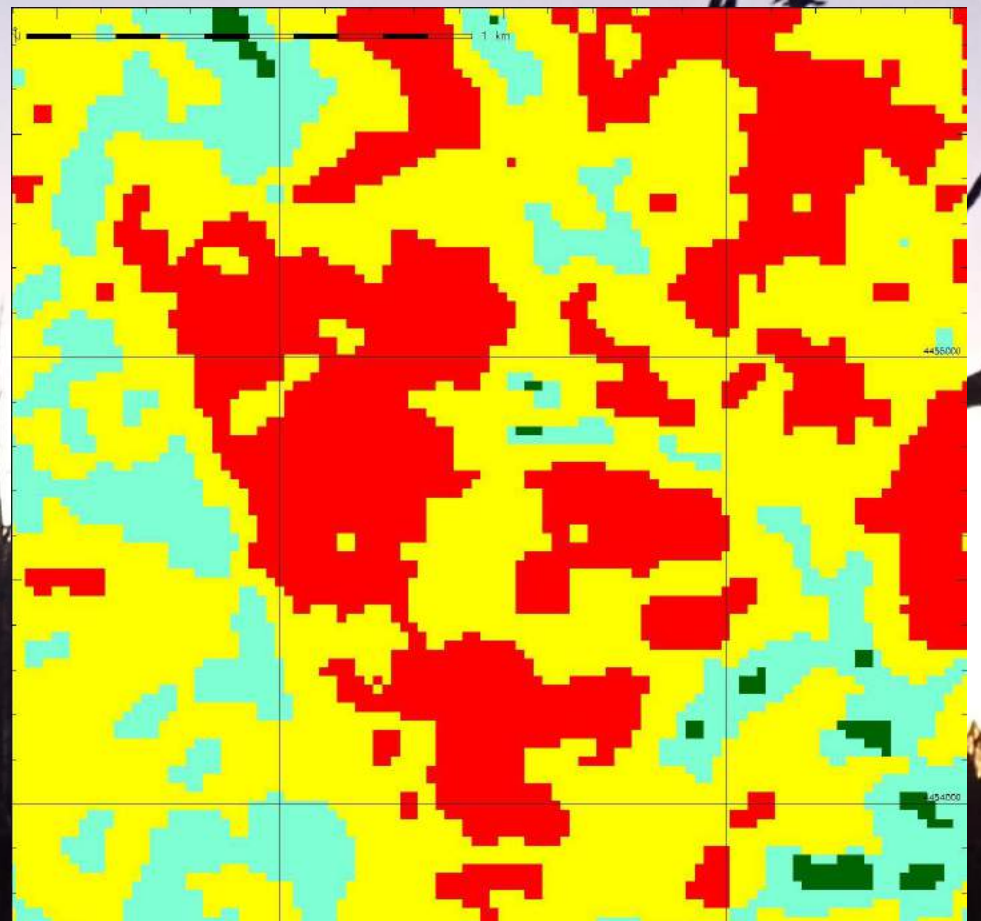
UAV photogrammetry

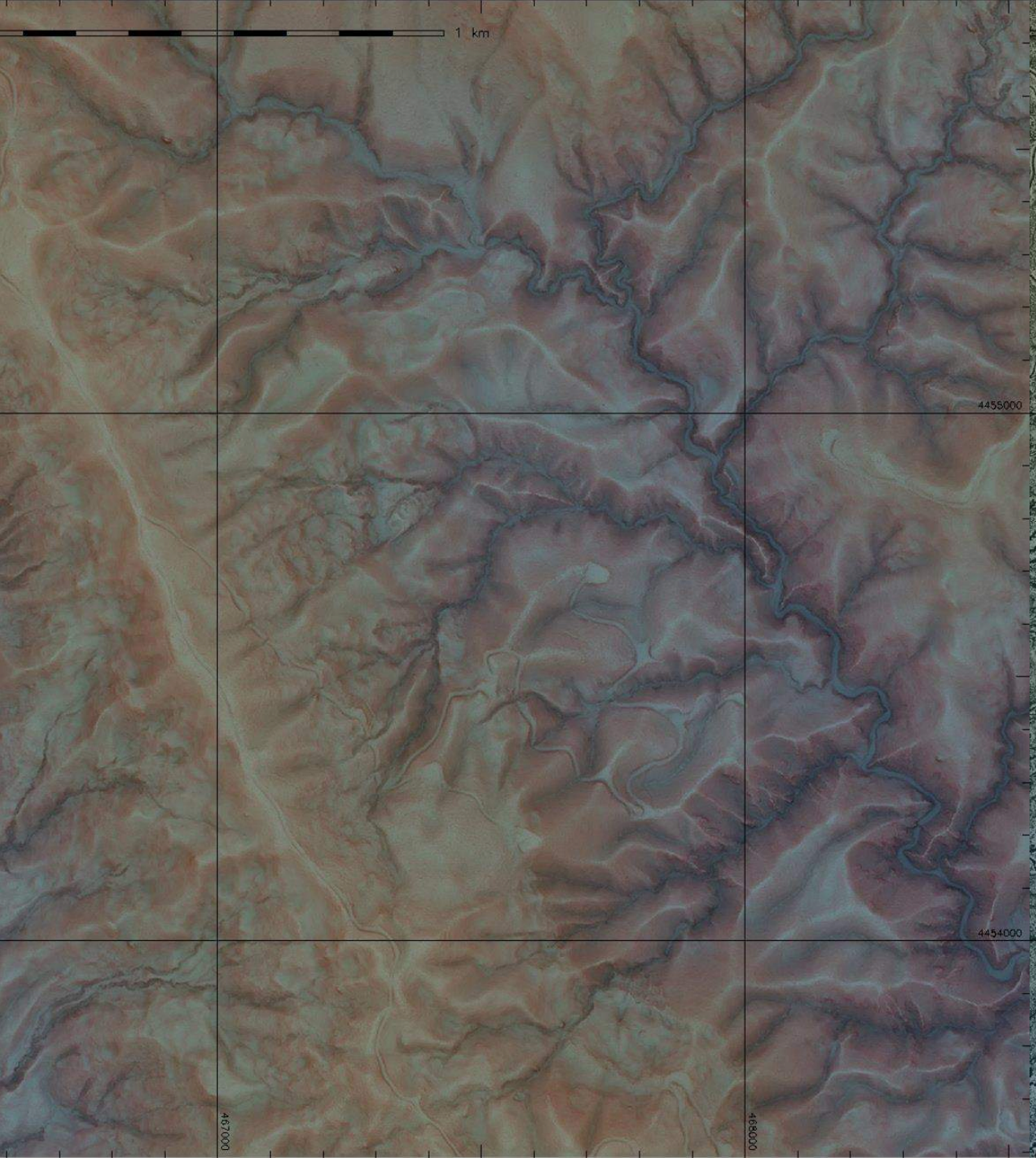
Postfire erosion hazards

DNBR



Soil Burn Severity




1 km
4455000
4454000
467000
468000

1 km
4455000
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467000
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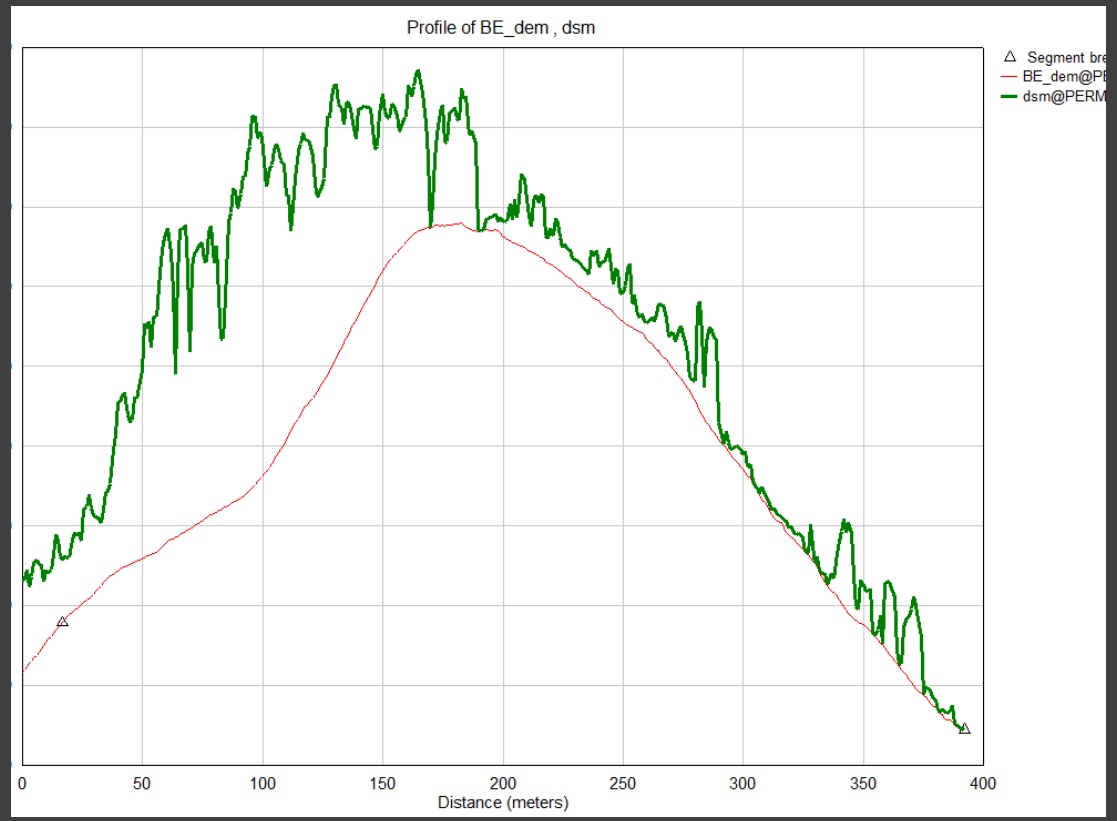
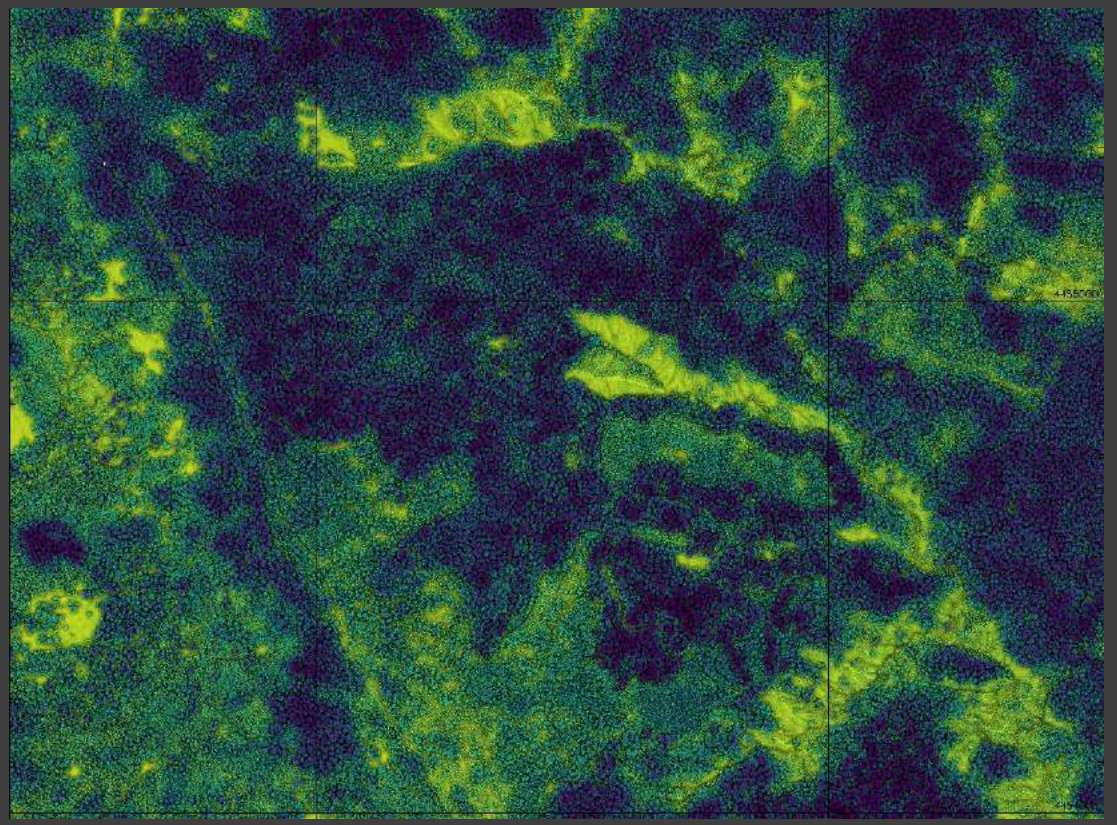
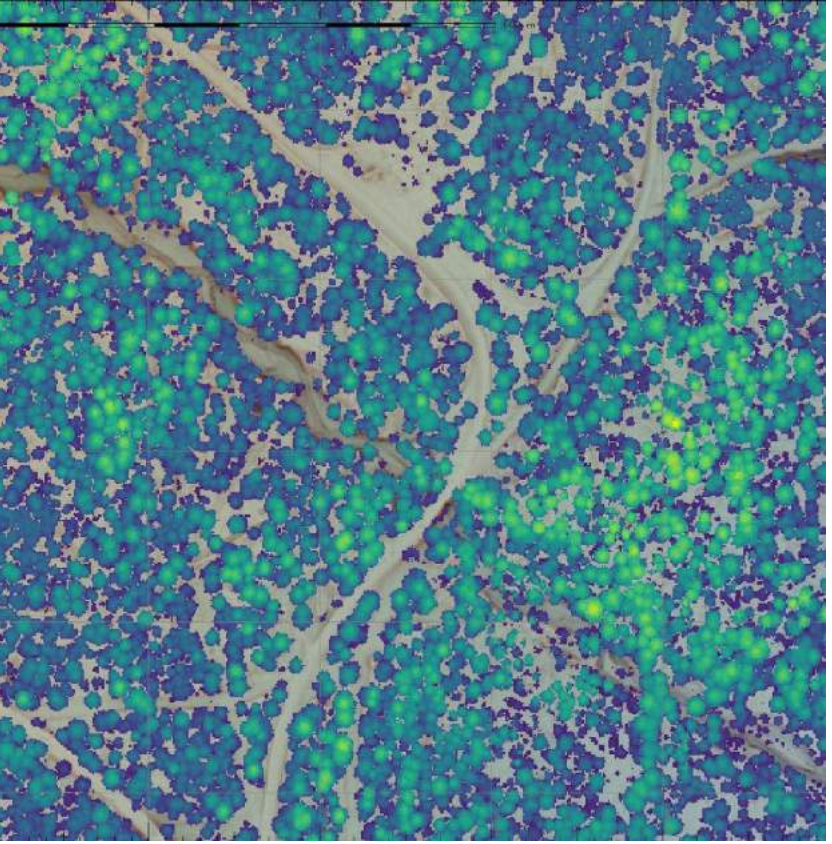
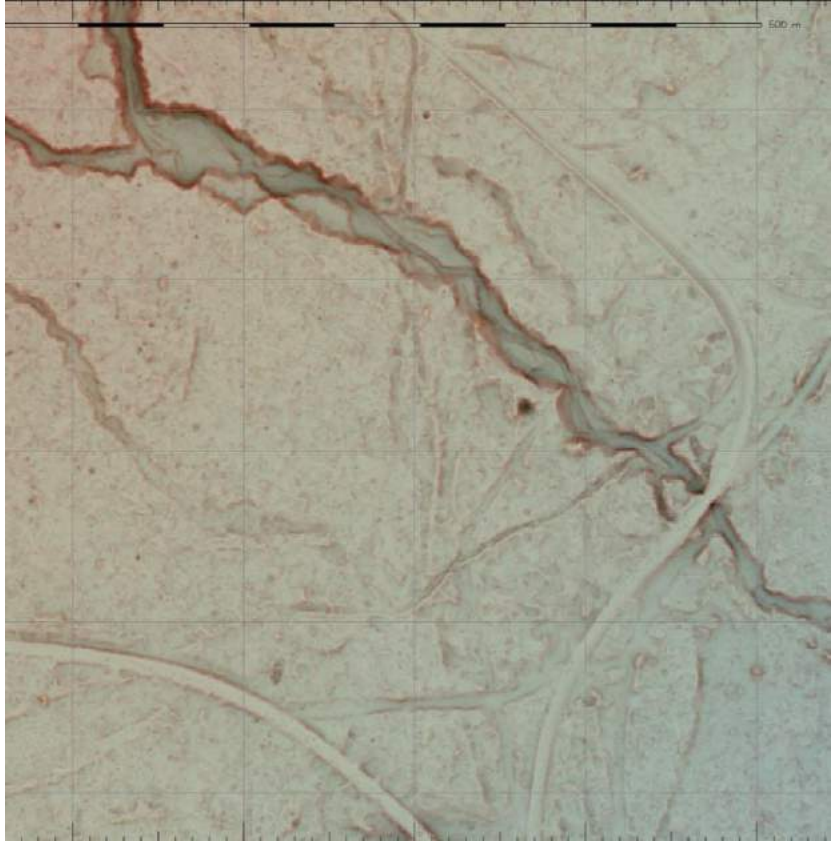
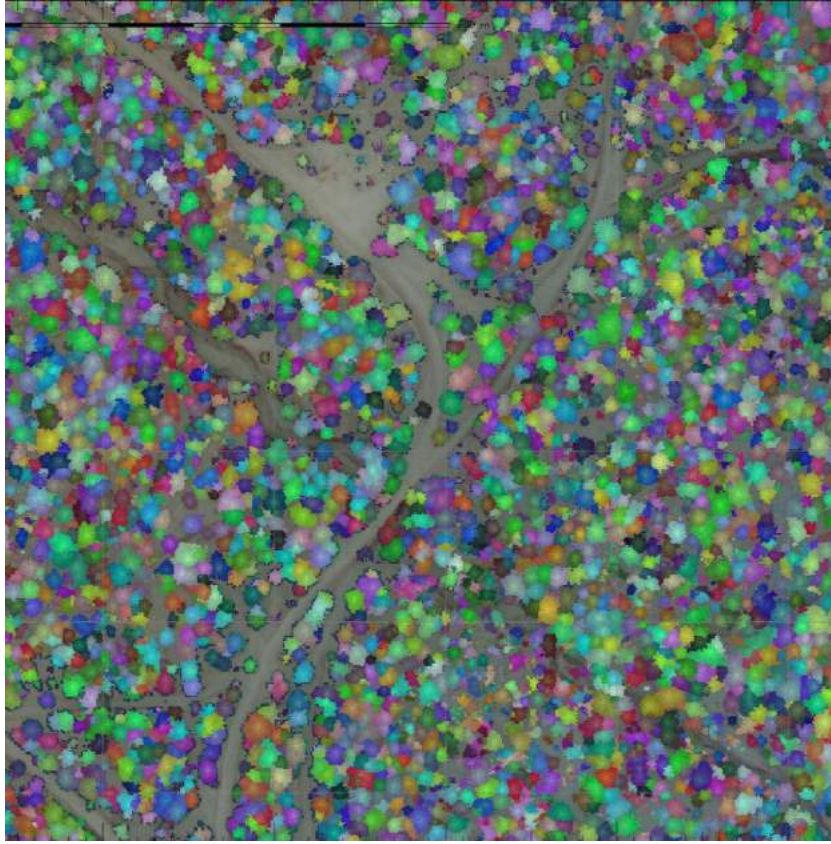
prefire canopy conditions





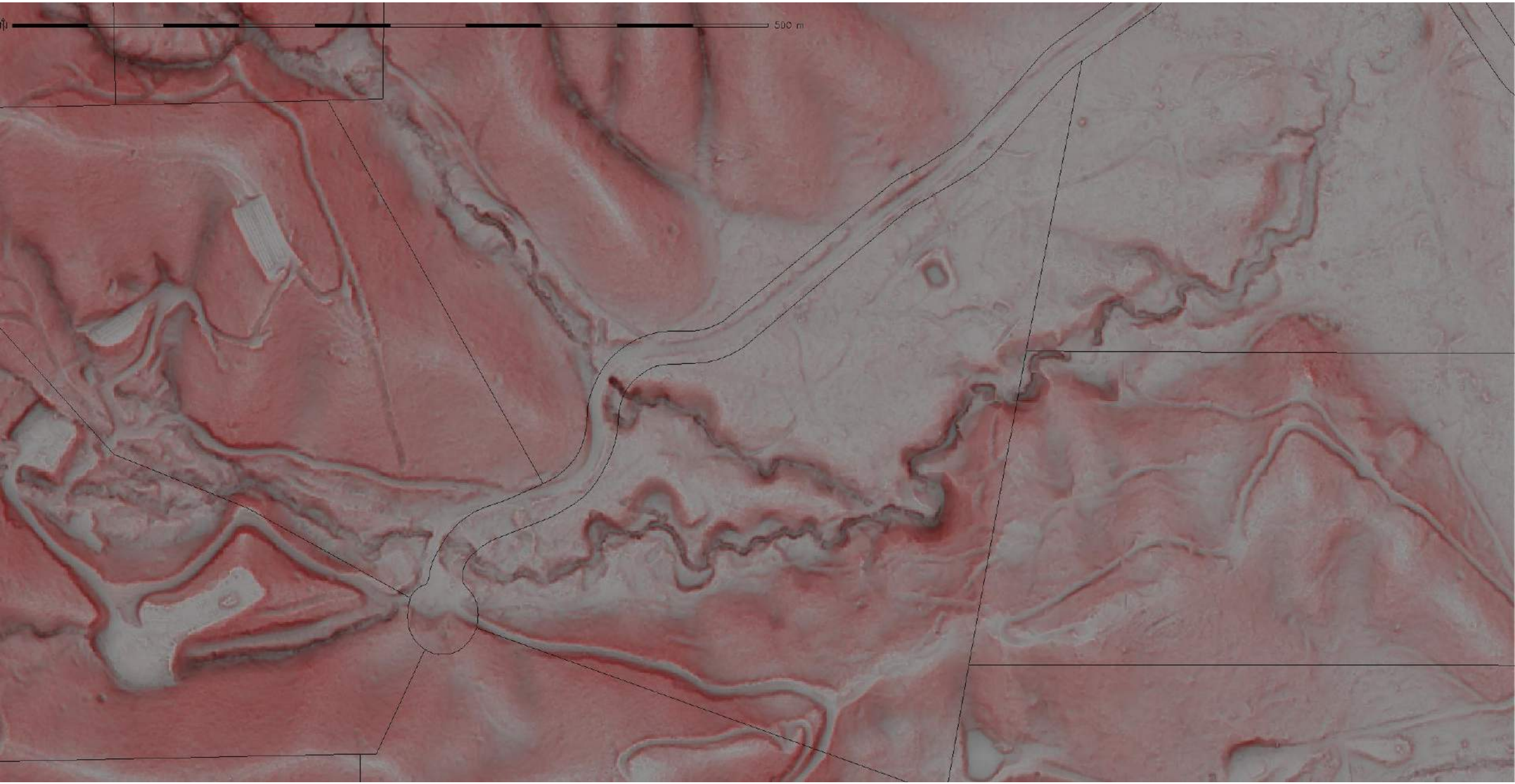


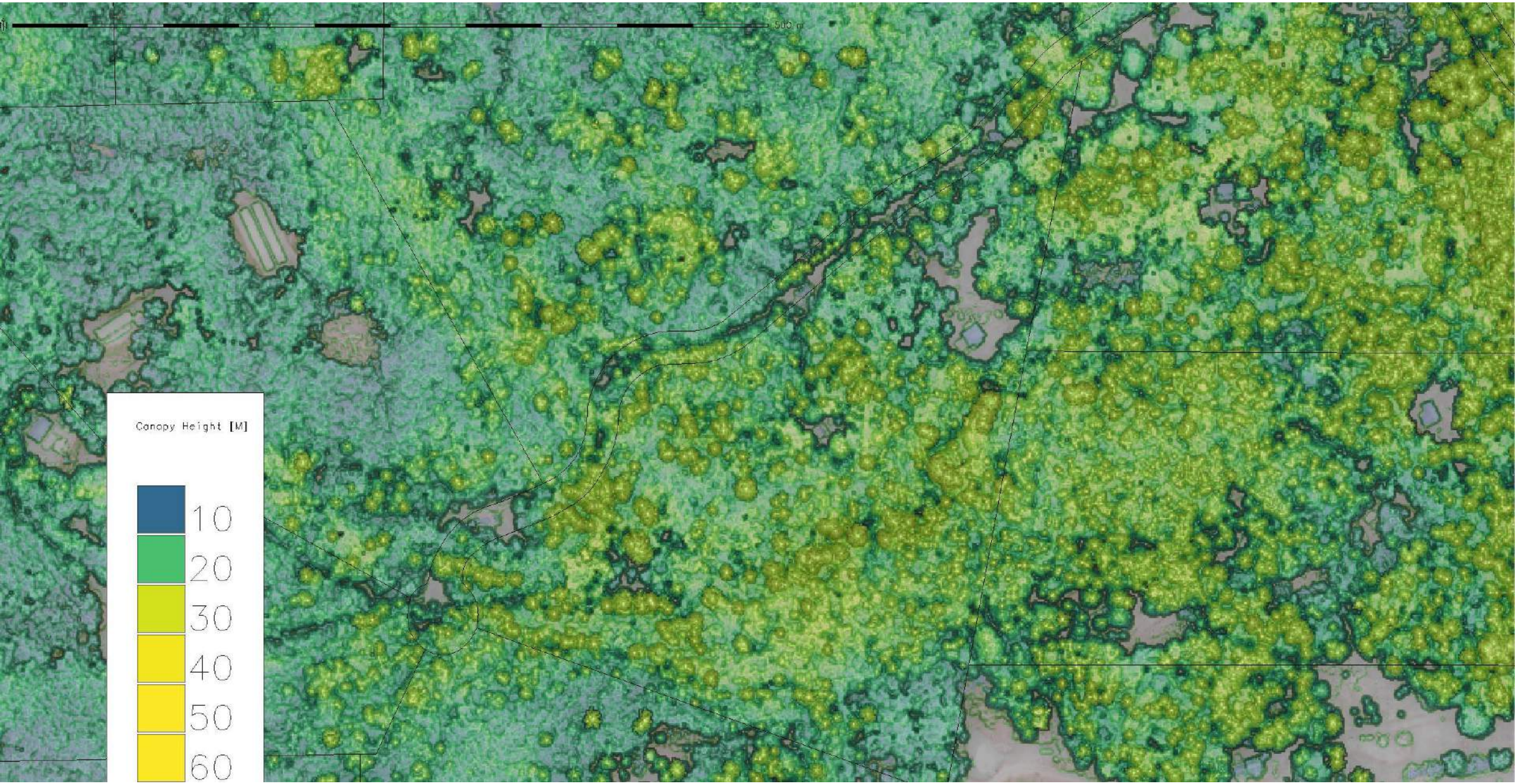




Standard raster routines

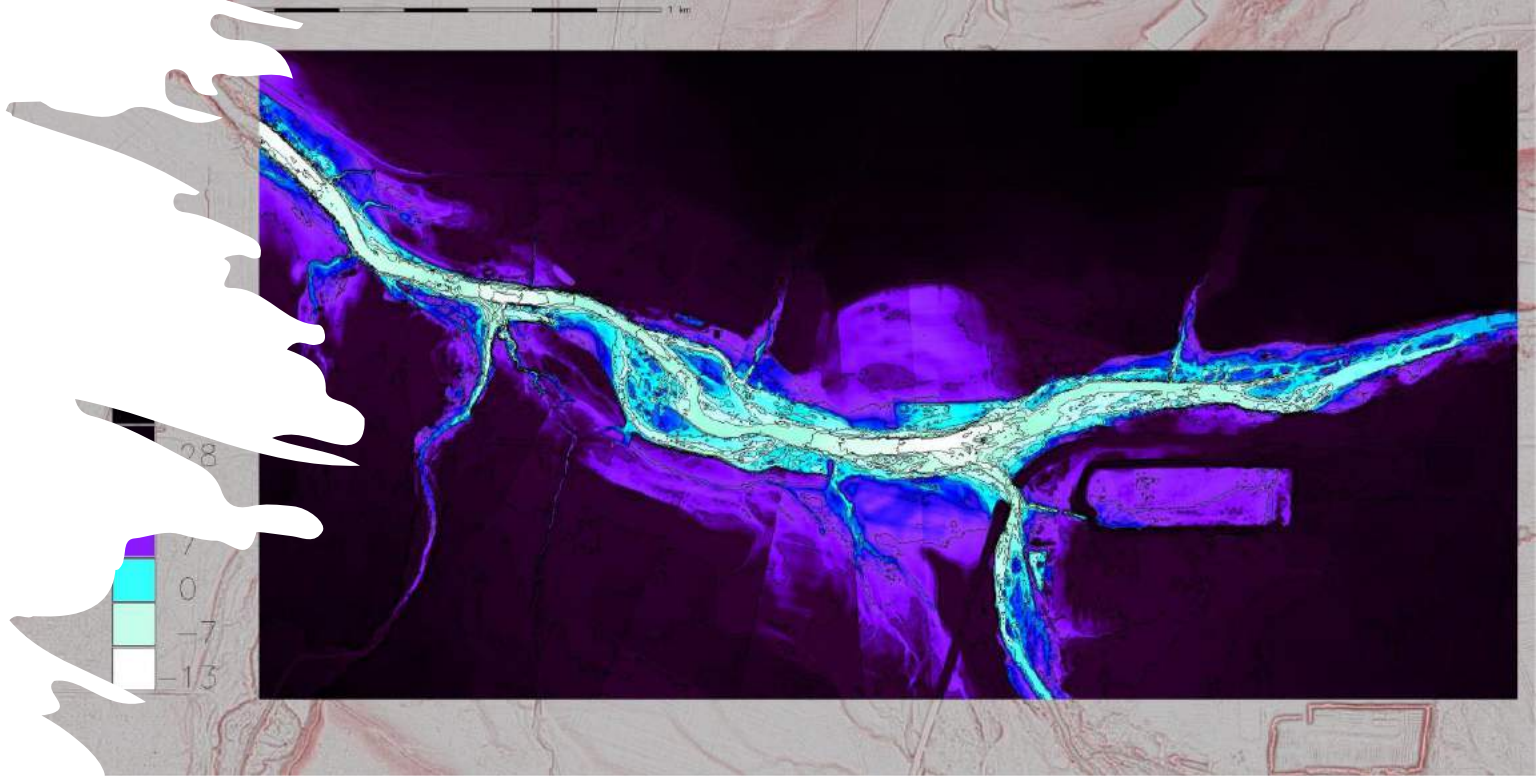
- Red Relief image map
- Canopy Height Model
- Tree segmentation

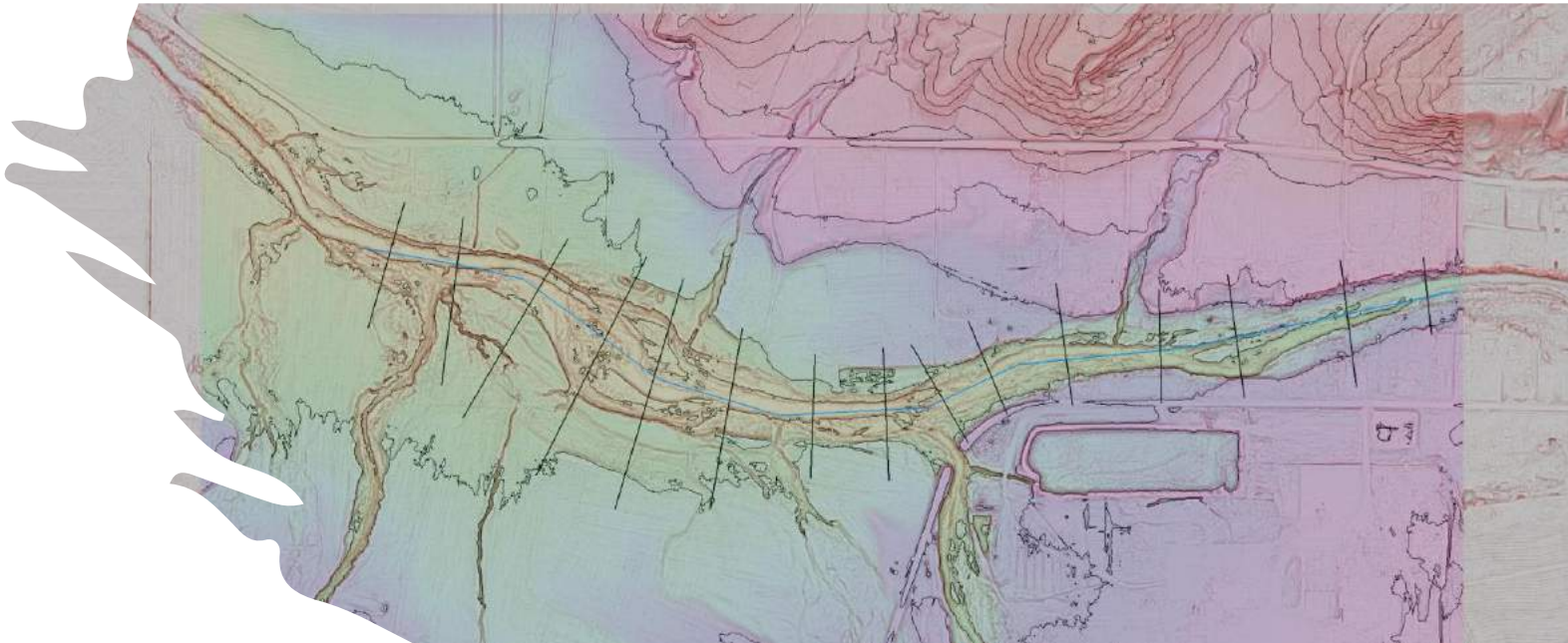

500 m


500 m
Canopy Height [M]
10
20
30
40
50
60

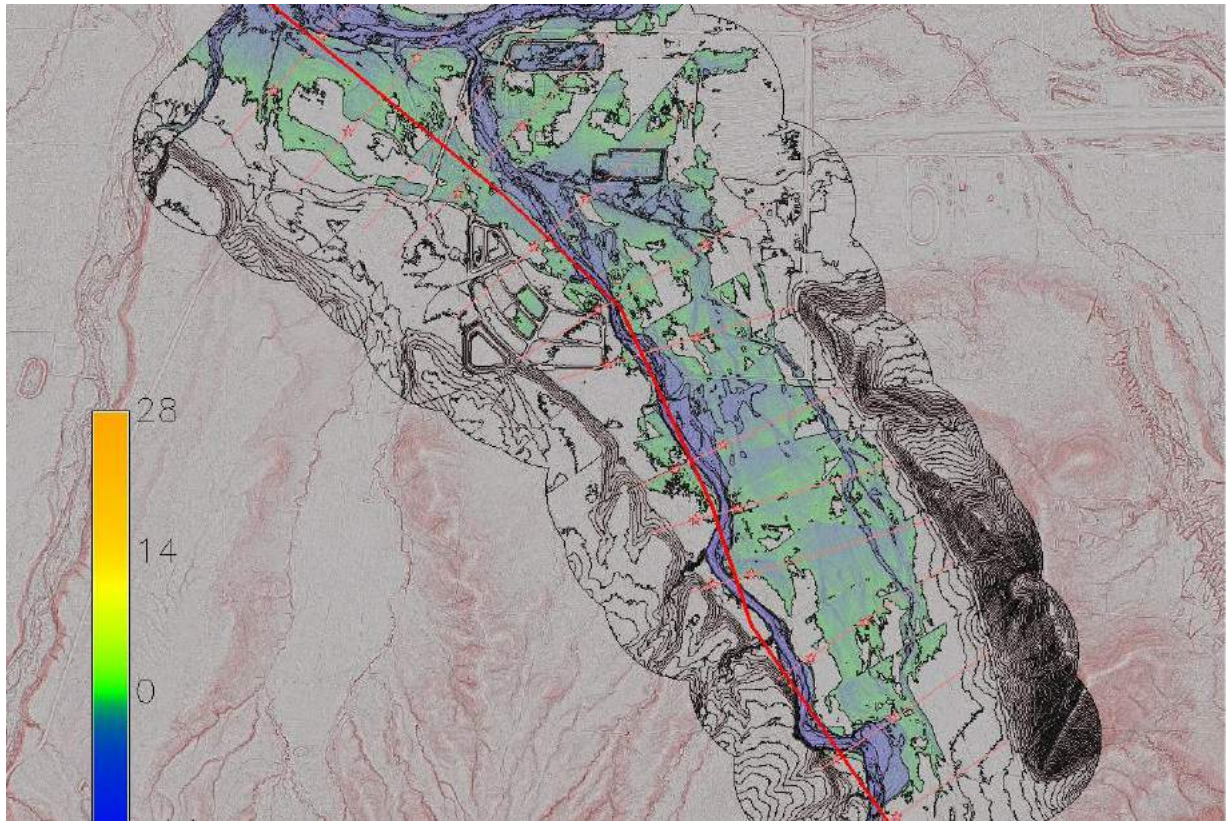
Geomorphic Gradeline Assessment

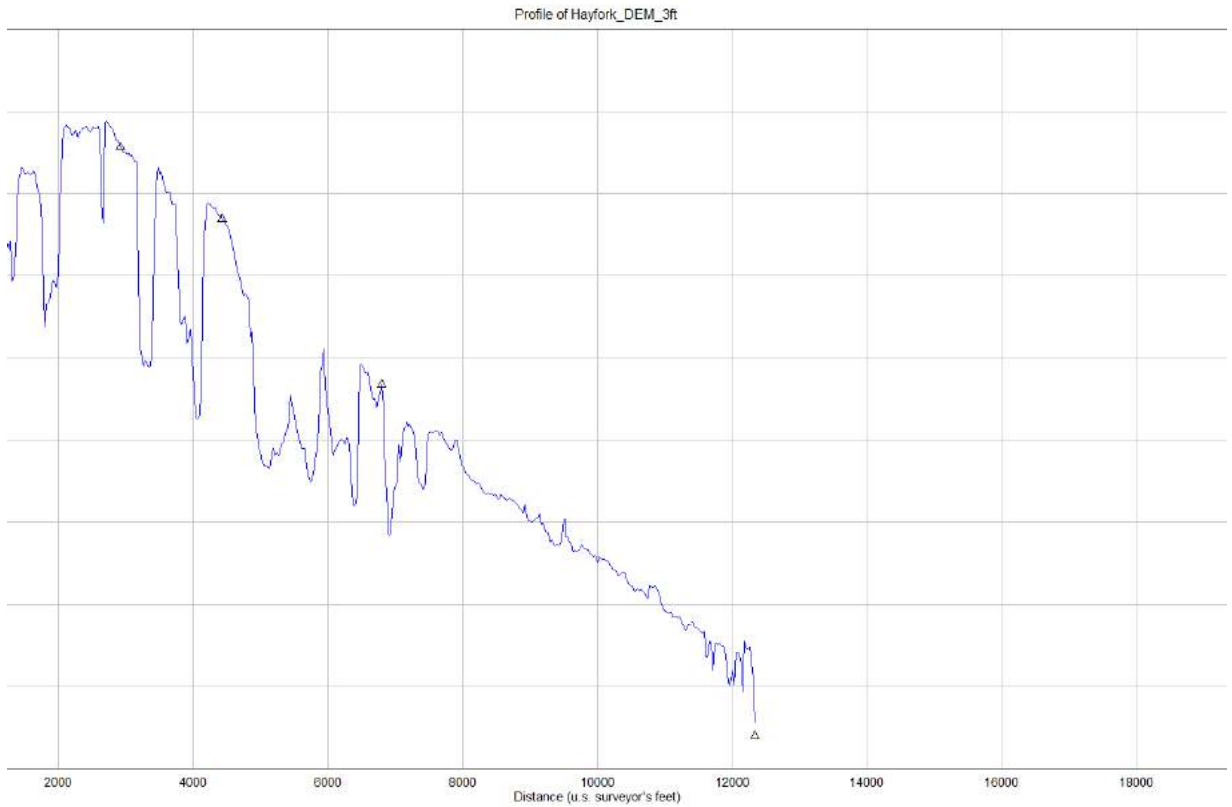
- Identifies channel restoration opportunities based on a detrended floodplain elevation surface.
- Generated by sampling hydraulic cross sections, producing a trend line and



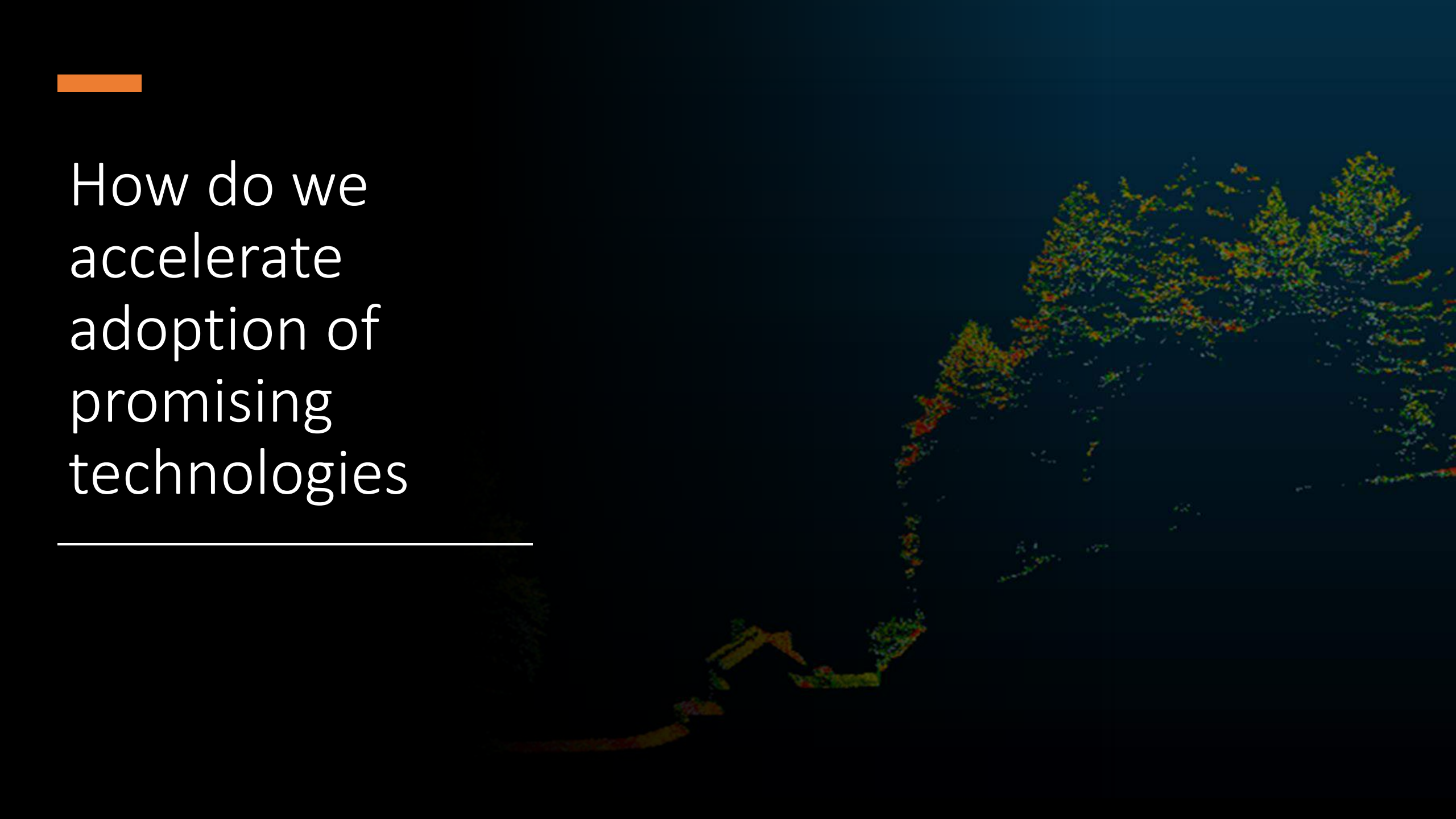


Geomorphic Gradeline Assessments





How do we accelerate adoption of promising technologies



By reducing friction

HOSTED COMPUTATIONAL RESOURCES

SHARE ANALYTICS TOOLS

SUPPORT DATA BEST PRACTICES

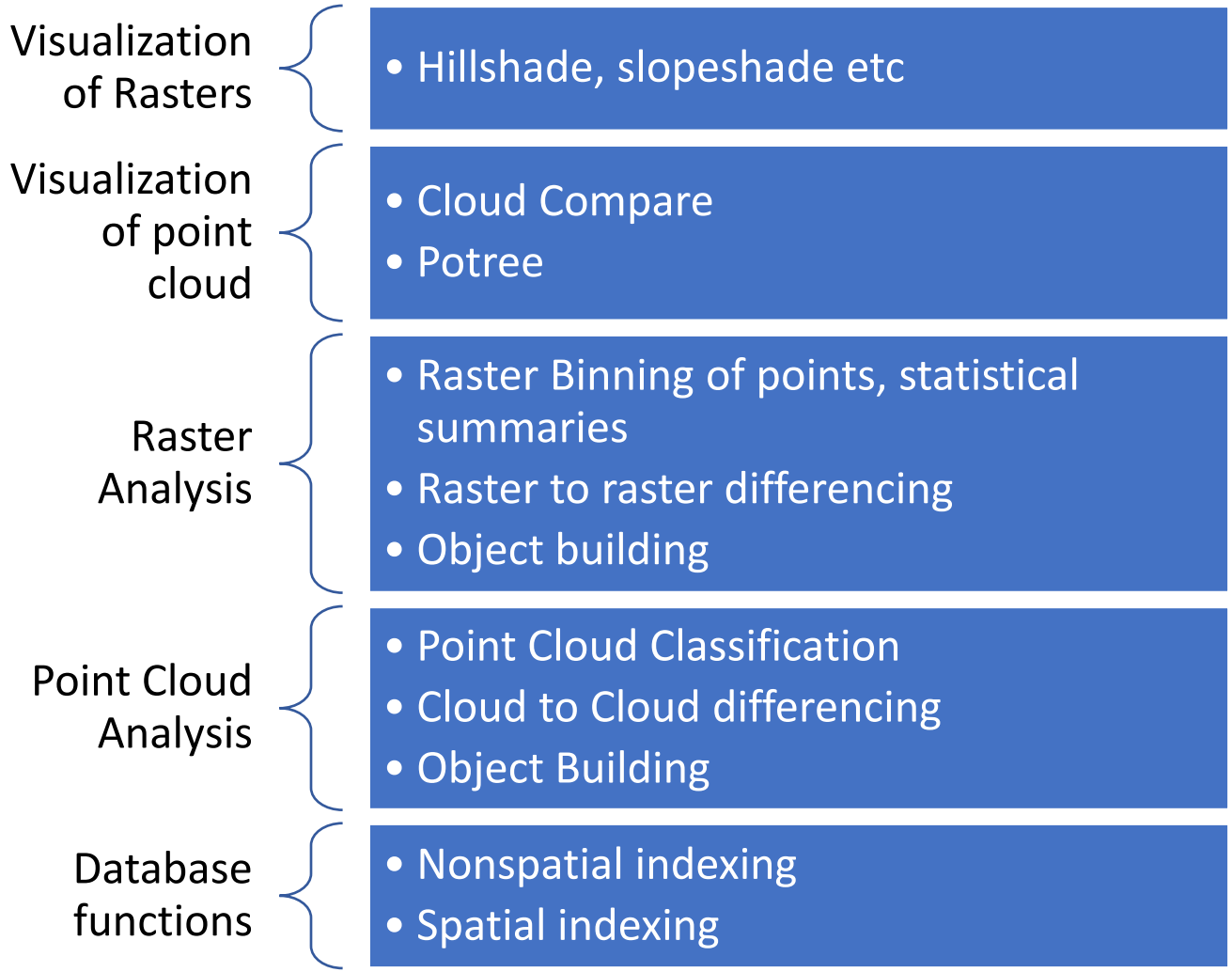
DIRECT TECHNICAL SUPPORT

USE AUTOMATION AND REPRODUCIBLE WORKFLOWS

COMMUNITY PEER SUPPORT

FACILITATED ACCESS TO LARGE DATASETS

Hierarchy of Point Cloud Analytical Capacity



Who is this for?

- Californian’s
- People implementing Forest Climate Adaptation Solutions
- People who are working on natural resources problems
- Program Partners of Cal Fire, Department of Conservation, USFS, DOI
- Local Jurisdictions developing their own climate planning

CAFLC program

- Direct Technical Support for upcoming FH and FL CCI applicants
- Development and scaling of Analytics tools
  - Access to cloud resources
  - Supported development of analytical procedures
  - Support with hosted computational resources
- Support for formal Data Life Cycle Management
  - Findability and Archive Services for ongoing

This is not intended to be a class exactly

- We are here to deliver business value to our organizations by building analytical processes
- Our participation is based on this effort being useful within a specific timeframe
- Participation has real costs
  - The Bay Area Council's California Resilience Challenge is providing resources
  - Your host organization is expected to deploy the tools shared in this program in the near future

Two Options

- Introductory Session
  - Does not assume prior knowledge or skills
  - Requires curiosity
  - Requires a nexus of action

- Joining the Scrum
  - Are you already developing point cloud derived products
  - Admission will be based on a portfolio that demonstrates existing capacity and understanding of some technical issues.

Expectations for program participants

- Active participation
  - Programs will include synchronous and asynchronous components
  - Users will bring use cases that are appropriate to share publicly
  - Work product from this program will be licensed in an appropriate open source manner
  - Participants will be prepared to mentor others within their organizations
  - Participants will report on programs that benefit from this investment
  - Users will continue engage with the community to support future educational participants

Project Planning

Plan

Find and develop source data

Develop analytical pipeline

Test resulting pipeline against well understood conditions

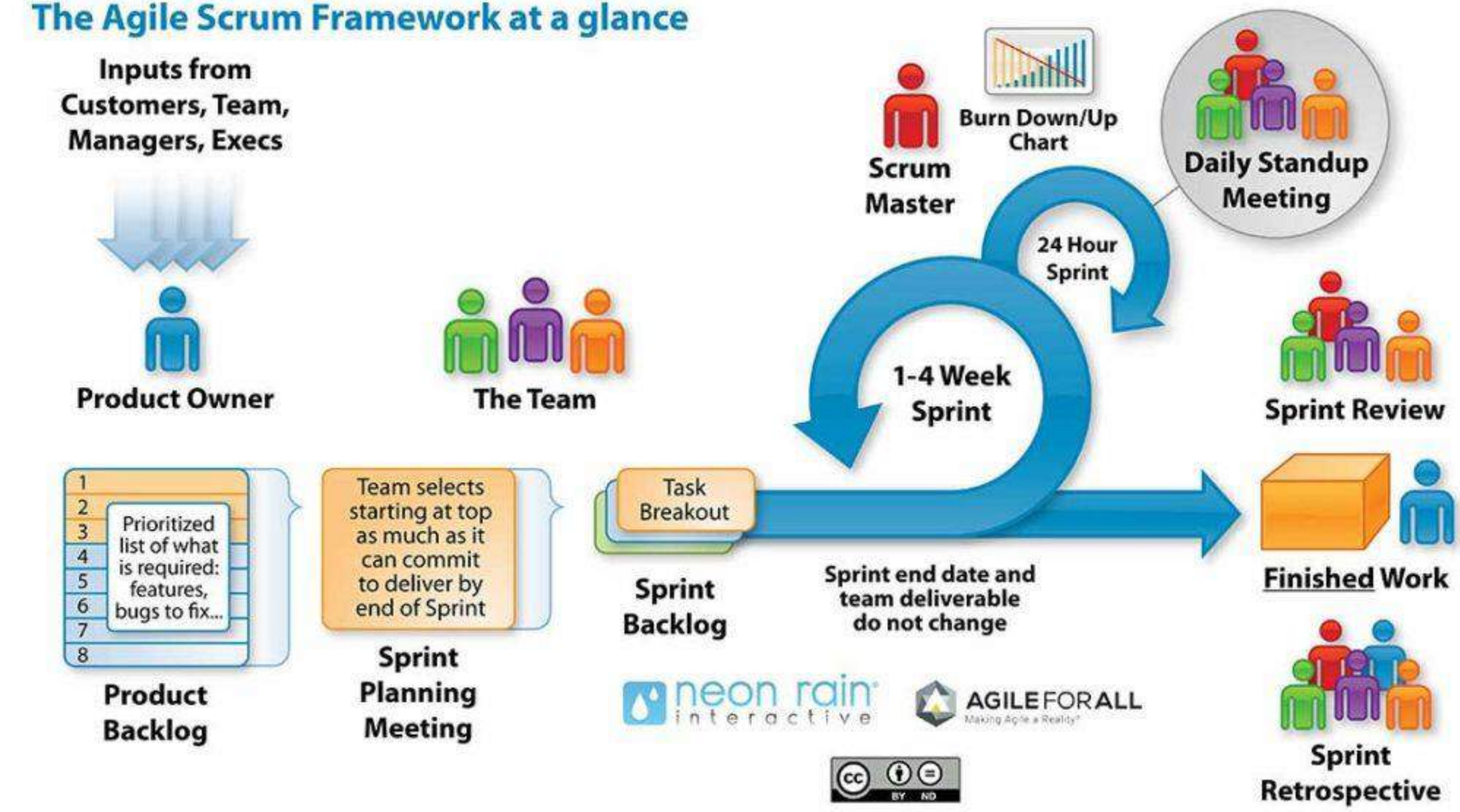
Document test results

Analyze wider population of dataset

Distribute Publish data outputs to user community

Increment of DONE!

The Agile Scrum Framework at a glance



User Stories

The user story template is a tool to identify priorities in the Agile Methodology

Who

Identify the role

Get specific

What

What is the action that is being identified

Why

Is the action justified.

What are the benefits

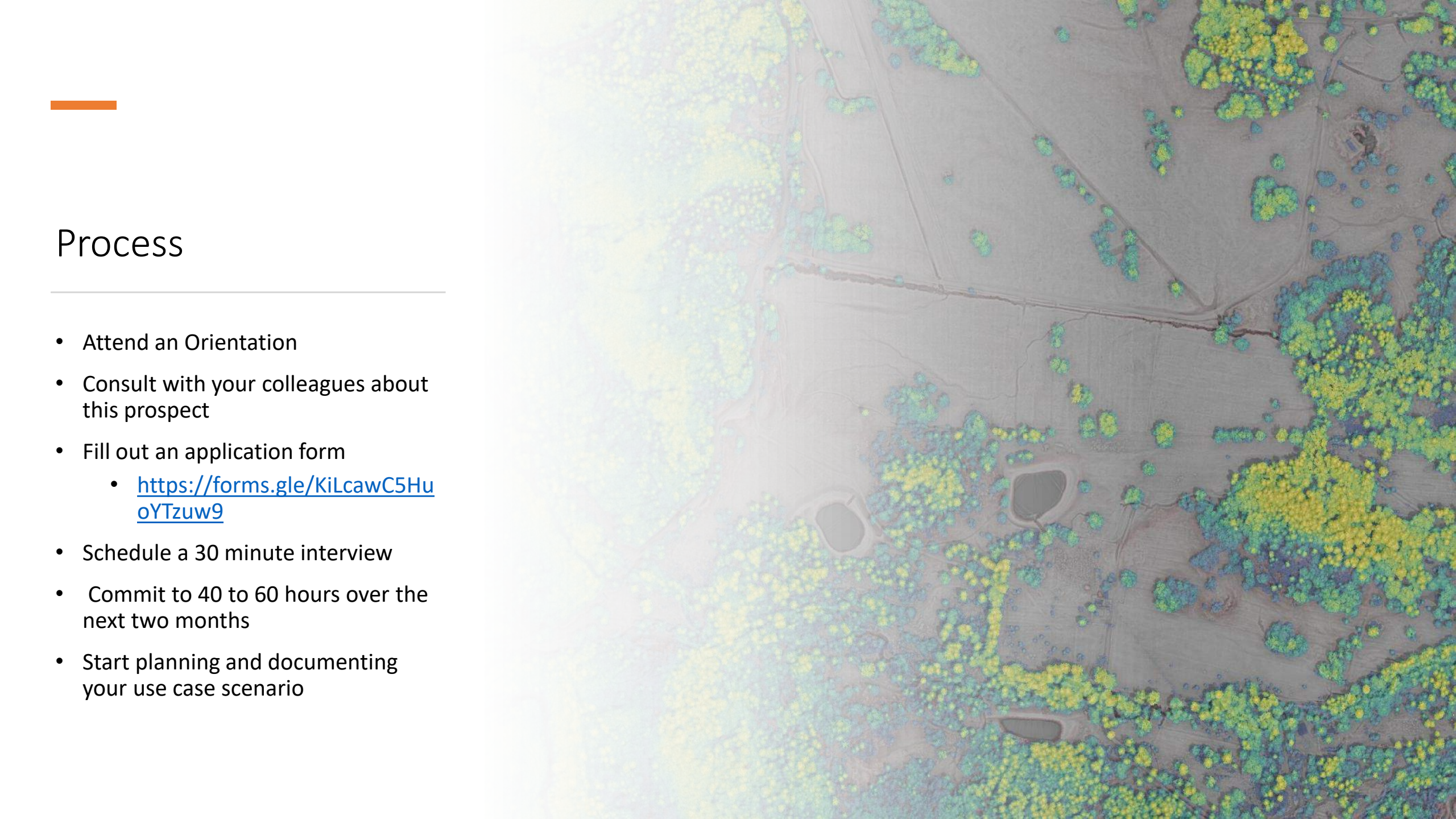
How does this provide business value to the organization

Who

- The Team
- The Product Owner
- The Constituents
- The Scrum Master

Process

- Attend an Orientation
- Consult with your colleagues about this prospect
- Fill out an application form
  - https://forms.gle/KiLcawC5HuoYTzuw9
- Schedule a 30 minute interview
- Commit to 40 to 60 hours over the next two months
- Start planning and documenting your use case scenario



Summary

- FAIR data best practices are well suited for applied climate mitigation
- Project based data sets need to be developed for long term reuse
- State and Federal entities need to continue to invest in geospatial infrastructure that can be opportunistically utilized by the public interest sector
- Technical challenges can be overcome through a networked community of practice
- Lack of investment in human resources for implementing FAIR data practices is a critical barrier

Thank You

Contact information

tim@thewatershedcenter.com

- Participant application

https://forms.gle/KiLcawC5HuoYTzuw9

Website

- https://sites.google.com/thewatershedcenter.com/caflclanding

Product	A product can be an item (hardware or software), service, idea, method, or information that satisfies a need or a want. It has a combination of tangible and intangible attributes (benefits, features, functions, uses) that a seller offers a buyer for purchase.
Goal	Goals are measurable, time-bound objectives that have clearly defined success metrics associated with them. They are included in a product roadmap to show the critical accomplishments required to make the product vision a reality.
Initiative	Strategic initiatives represent high-level efforts or big themes of work that need to be completed to achieve the goals. You can overlay initiatives on a roadmap to show how specific releases and features relate to the strategy.
Release	A release is typically the launch of new functionality for a product that provides value to customers. Releases often contain epics or multiple features that get delivered at the same time.
Epic	An epic is a large user story that cannot get delivered as defined within a single release. It is often broken down into small features or user stories that can get delivered incrementally.
Feature	A feature represents new or improved functionality that delivers value to users. Features provide more detailed information about new functionality.
User story	A user story defines a new software feature from an end-user perspective — including what the user wants and why. You can use the words “feature” and “user story” interchangeably.
Time	Product roadmaps typically include dates to show when new products and updates to existing ones will be completed and released. The time scale used depends on the level of detail required and can range from days and weeks to months, quarters, and sometimes even years.
Status	Product roadmaps are even more useful when they clearly explain how the team is progressing against planned work. Status indicators for goals, initiatives, releases, epics, and features are a great way to highlight the current state of a plan.

From aha.io

As a ...	I want to ...	So that ...
Watershed Program Intern	use LiDAR to identify slopes in the headwaters of the Kings River and San Joaquin that pose the greatest threat of eroding soil or toxic ash from burned houses	we can use our limited resources to reduce erosion and protect downstream drinking water sources and fisheries.
Riparian Landowner	Assess my property for Beaver Dam Analogs or wood loading	I can know if my site is suitable and locations for implementation
Project manager	Generate forest cover /fuel density analysis for communities are risk	I can know where to focus future funding for fuels reduction projects
meadow restorationist	Use Lidar to assess hydrology of meadows	We can plan low tech restoration to increase hydrological function of degraded meadows
Project manager	Assess conifer encroachment in aspen and oak stands	We can plan for funding for removal
watershed management intern	identify areas burned in the Creek Fire that are highly susceptible to erosion	we can prioritize them for recovery and restoration efforts.
Watershed Information Systems Technician for the Watershed Council	create a watershed wide LiDAR vegetation density assessment	we may identify high fire severity areas as they relate to homes and important vegetation as well as having data to combine with other spectral information for further analysis, such as identifying tank oak stands.
non-profit watershed organization and federal partner	estimate metrics such as fuel loading, ladder fuel density, canopy cover, basal area, vegetation type, and fire risk	we can prioritize treatments on the landscape.
project manager for a Resource Conservation District	assess forest structure	I can design effective restoration treatments and monitor the change
watershed collaborative group	estimate departure from historical range of variation	we can prioritize areas for restoration treatment.
WIS Technician for the Watershed Council	catalogue vegetation density and land features within the Mattole Watershed	we may establish Potential Operational Delineation zones, which are polygons whose boundaries are relevant control points such as roads, ridgelines, changes in fuel composition, waterbodies, etc., to better prioritize the protection of culturally and biologically valuable regions across the entire greater Mattole watershed.
regional firesafe council that is developing a PODs program	identify developed manmade features such as roads, buildings, and powerlines	these features may be used to establish boundaries and control locations for Potential Wildland Fire Operational Delineations to better contain and control wildfires.
regional firesafe council that is developing a PODs program	identify landscape features such as ridgelines dramatic changes in slope	I can incorporate this information into the development of POD boundaries.

Program Inspiration

- Opentopography
- NEON
- Cyverse
- The Carpentries
- Jupyter
- OSGeo

Getting to Reproducibility

Findable
Accessible
Interoperable
Reproducible

Use Code

Go Open Source

Track your versions

Document your analysis

Archive your data

Replicate your environment

Automate

Get Help

Perkel Nature vol 560 2018

Analysis Ready Data?

For Earth Sciences applications

- Most users want bare earth raster datasets
  - Can develop their own algorithms and filters as needed
  - Reprojection and scale issues
  - Assessment of data quality
  - Adequacy for proposed use

  Change detection benefits from Cloud to Cloud comparison

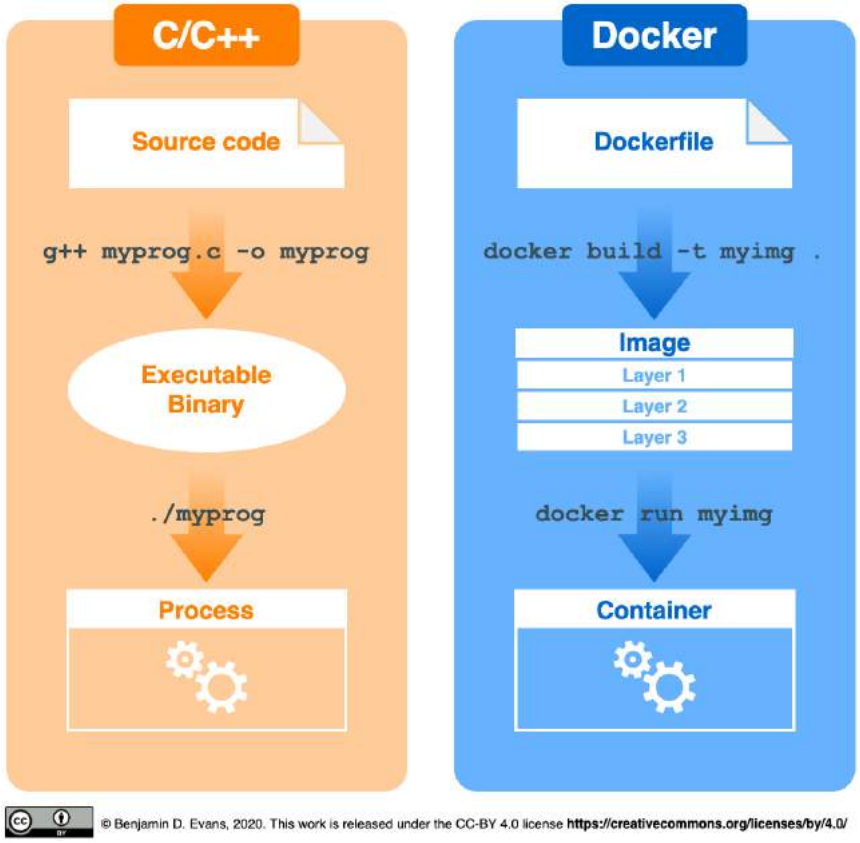
For Forestry and vegetation management

- Extract specific traits from binned rasters
  - 95 percentile height
  - Return number
  - Voxel density
- Point Clouds with additional information to be passed to Database like querries
  - Classification
  - Segmentation
  - Relative Height
  - 3D buffering

Complementary Emerging Technologies

- Photogrammetry
- Field based scanning
- Vehicular Scanning
- Phenocams
- High Cadence multispectral imaging
  - Landsat/Sentinel
  - Planet
- GEDI
- Satellite Radar
  - NISAR
  - Copernicus Biomass
- UAV
  - Photogrammetry
  - Lidar
  - Multispectral imaging

Container best practices



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Advanced topics

TRAINING ON USE OF REMOTE VIRTUAL MACHINES

SUPPORT FINDING OUTSIDE RESOURCES

DOCUMENTATION OF WORKFLOWS

SUPPORT FOR IMPLEMENTING DATA MANAGEMENT LIFECYCLE

BENCHMARKING RESOURCE DEMANDS