

Education Toolkits for the 21st Century Ecological Research

NEON's University Education / Outreach Program



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Solely Sponsored by the NSF



National Ecological Observatory Network

NEON

Boulder, CO

National Ecological Observatory Network

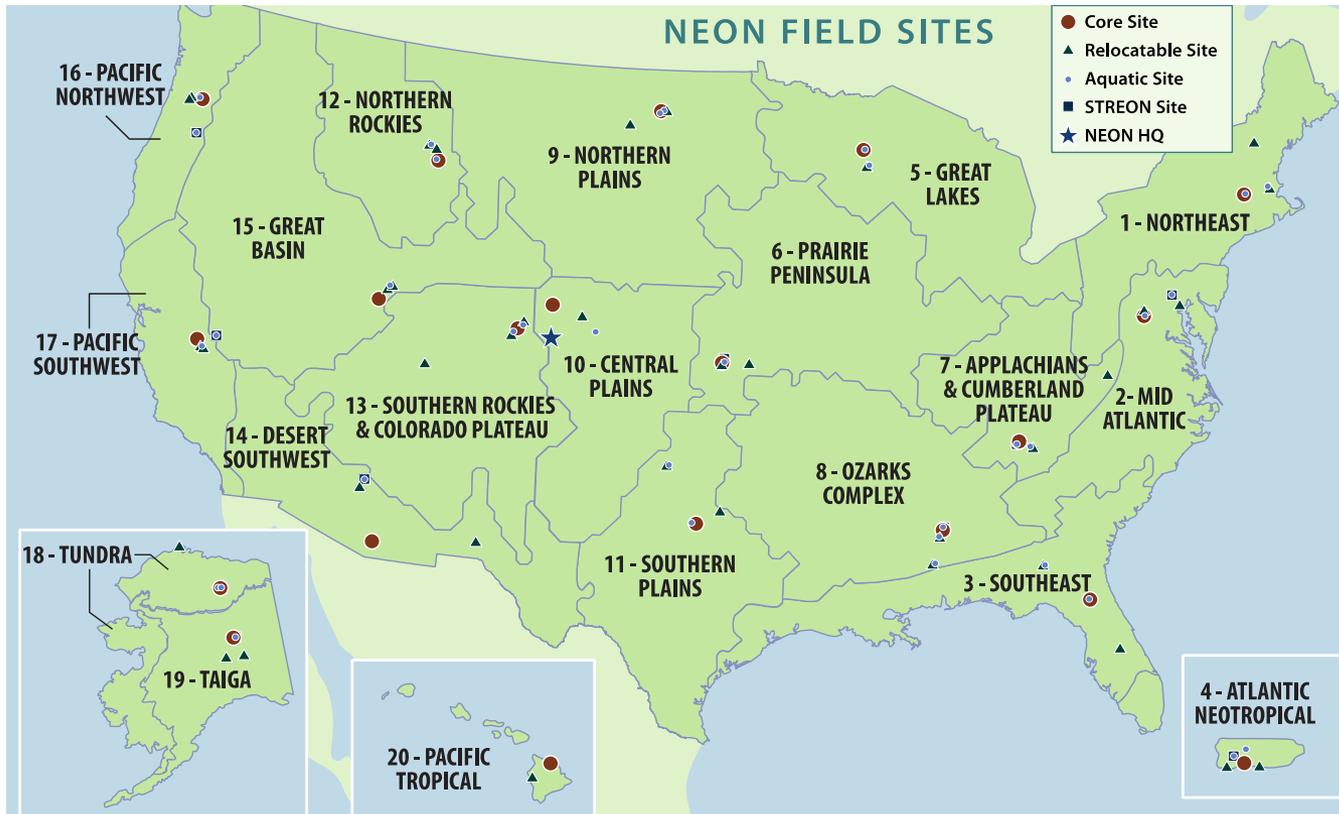
Continental-Scale Ecological Observatory

- Fully funded by the National Science Foundation
- Collects and provide data on the drivers/responses of ecological change (30 years)
- Serves as an infrastructure/backbone for other research
- Develops and provides educational resources to engage communities in working with scientific data

Project Timeline

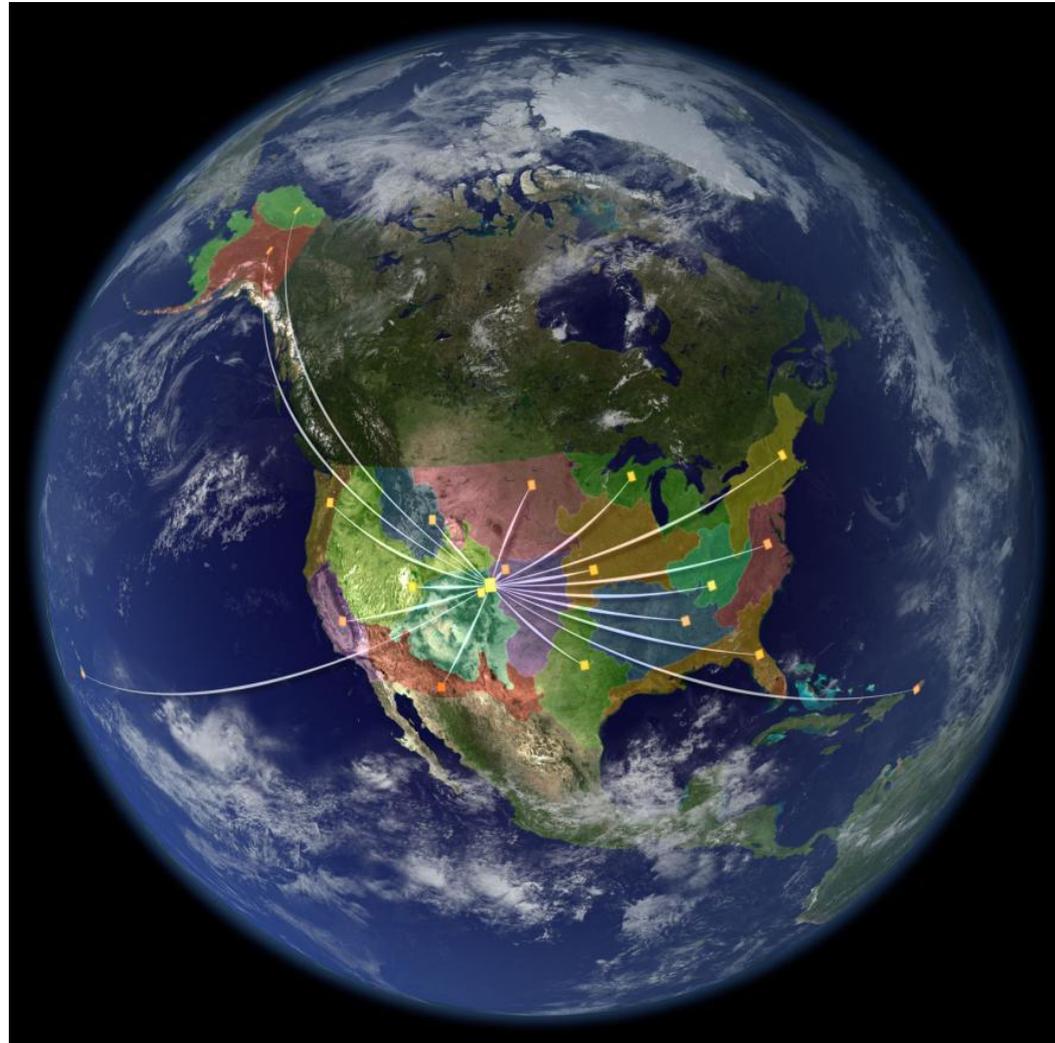


A Continental-Scale Design



- 1. Core sites:**
Located in unmanaged wildland conditions
- 2. Relocatable sites:**
Important ecological and/or human disturbance gradients.
- 3. Aquatic sites:**
Changes in aquatic systems

How NEON Collects Data



A NEON site



Image courtesy of People Productions

Starting with individual organisms...



NEON biological sampling



NEON tower in Sterling, CO



Airborne Remote Sensing

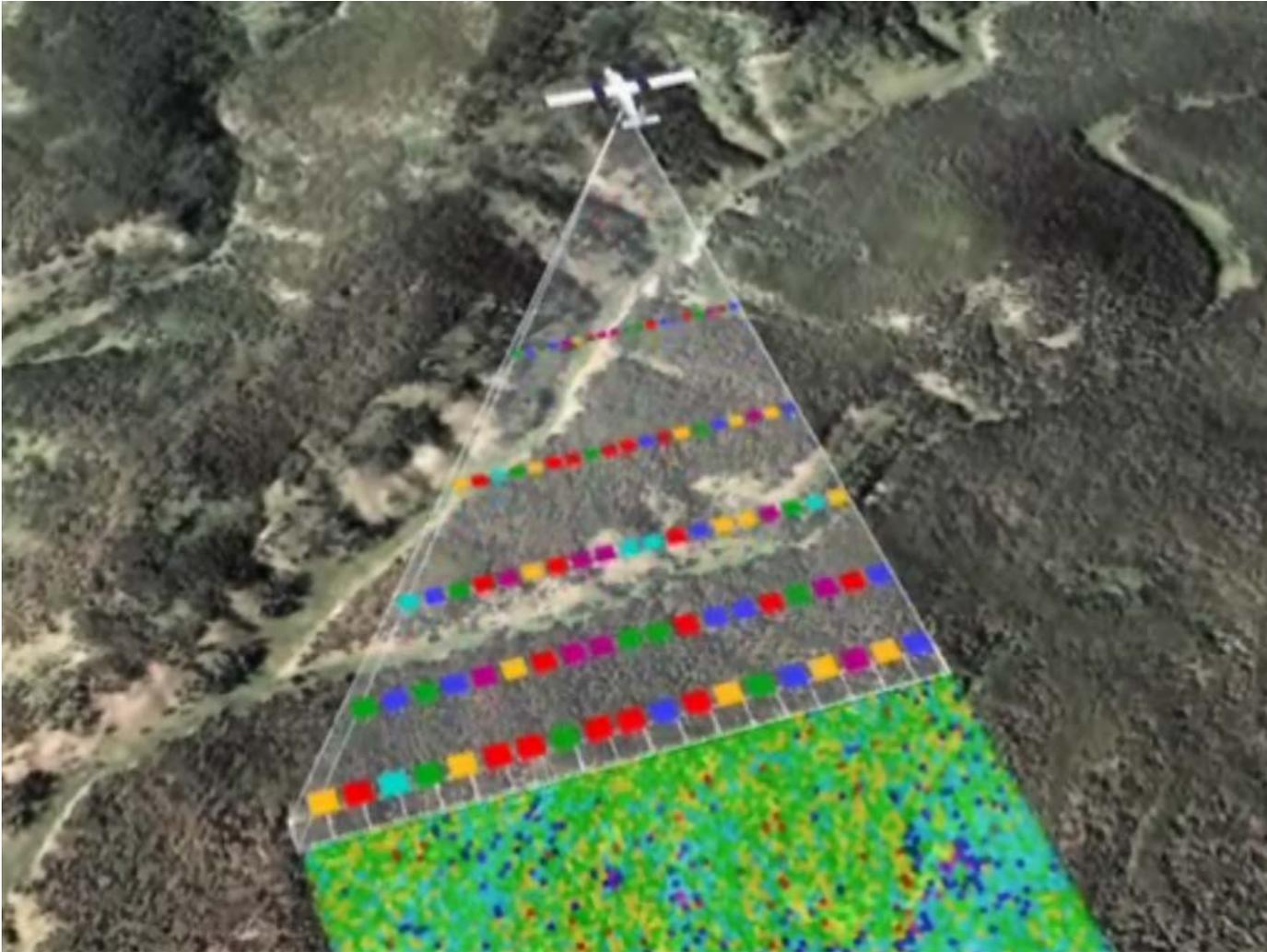
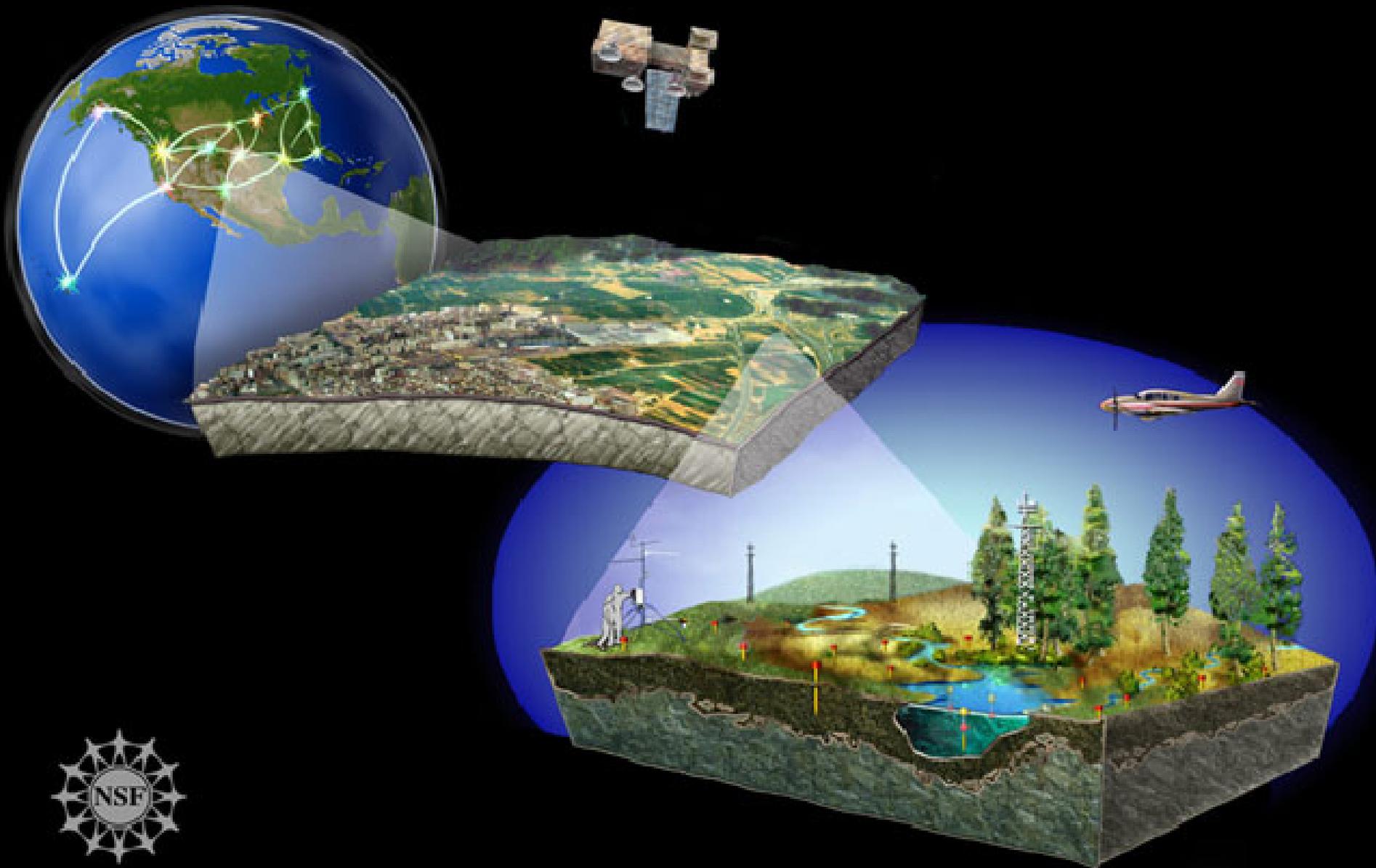


Image courtesy of People Productions



Modified from the image of Nicolle Rager Fuller, National Science Foundation, 2007

NEON Integrated Sampling Strategy



Terrestrial



Aquatic



Atmospheric

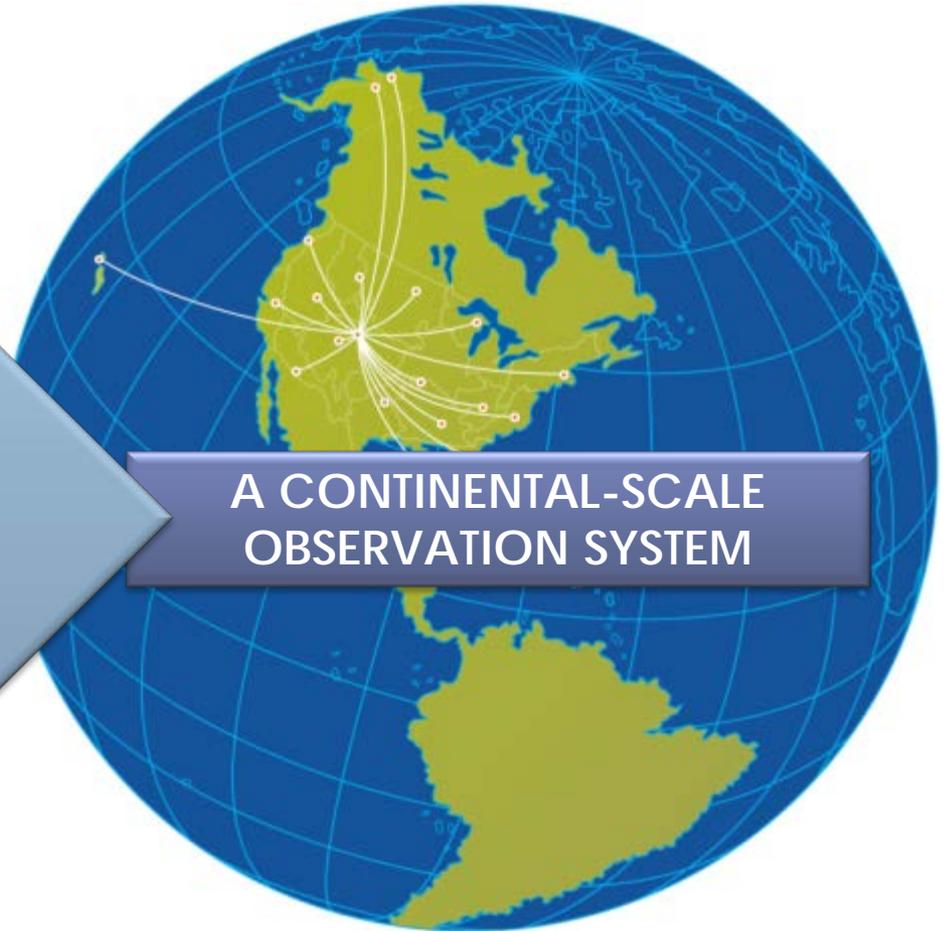
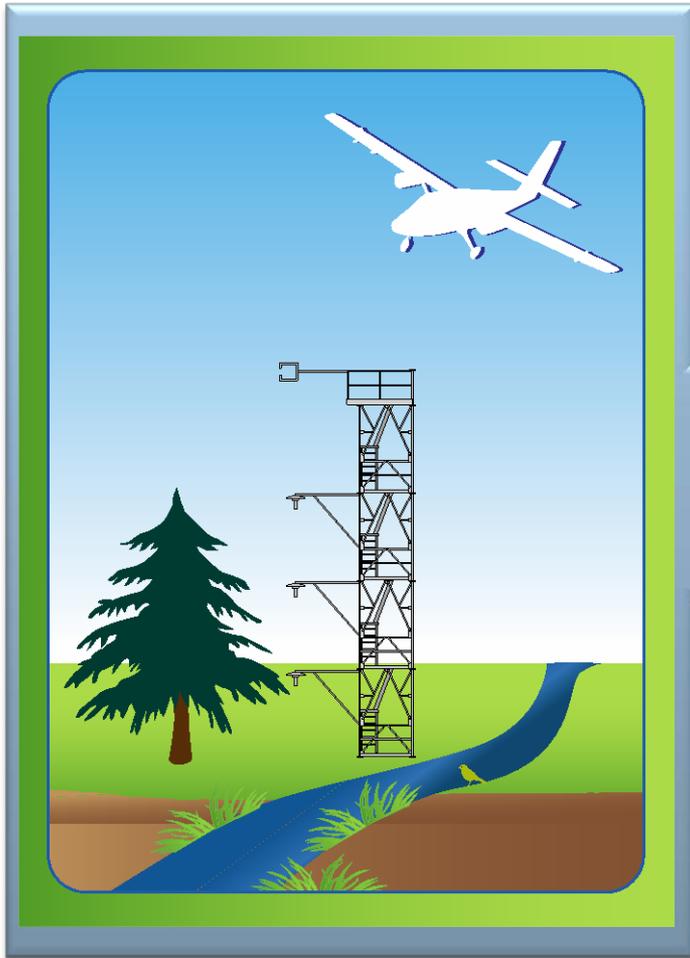


Airborne Observations



National Data Sets

A Continental Observation System



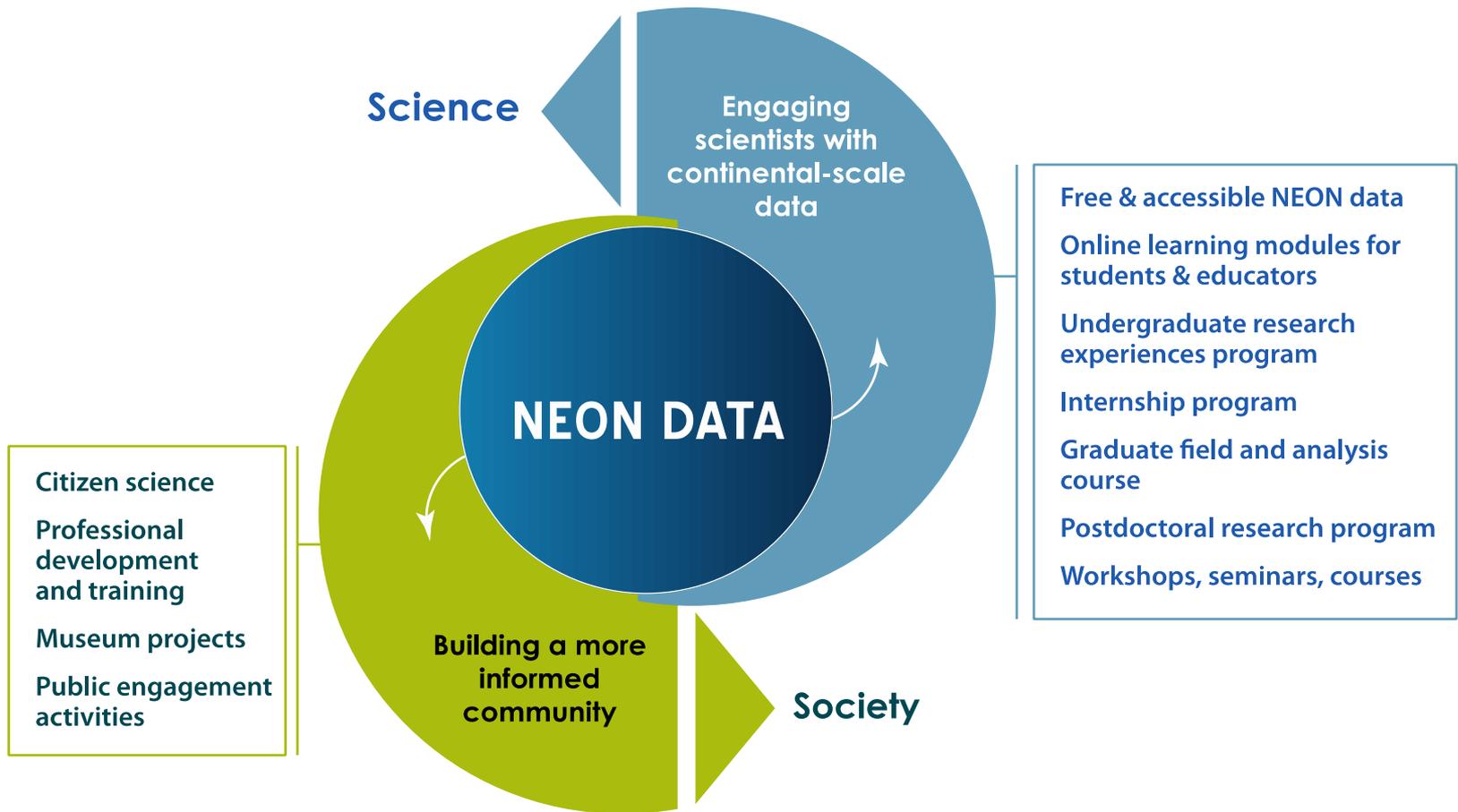
**A CONTINENTAL-SCALE
OBSERVATION SYSTEM**

NEON Resources

NEON Offers:

- Free Data
- Assignable Assets: Scientists can propose to fly our airborne system over sites of interest.
- Scientists can propose to add additional sensors, or conduct experiments within NEON infrastructure
- Educators can utilize prepackaged NEON datasets and associated activities in classroom settings
- Students can apply for internships and REUs (future)

NEON Education Focus



National Ecological Observatory Network

UNIVERSITY PROGRAMS

University Program

Engaging
scientists with
continental-scale
data

NEON DATA

a more
med
nunity

Society

Free & accessible NEON data

Online learning modules for
students & educators

Undergraduate research
experiences program

Internship program

Graduate field and analysis
course

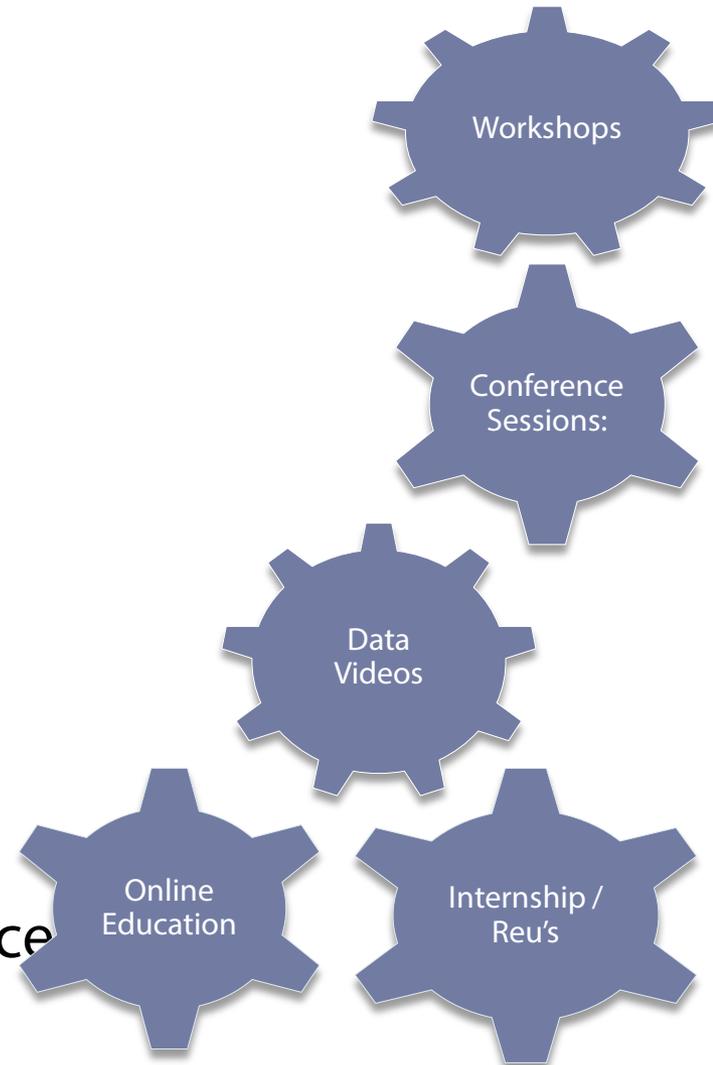
Postdoctoral research program

Workshops, seminars, courses

NEON University Program

GOALS:

1. Facilitate NEON data classroom use (Videos, Online Modules, Workshops)
2. Train next generation scientists: data analysis skills (Workshops, Graduate Course, Internship, REU)
3. Provide real world experiences for students (Internship, REU)
4. Call attention to NEON relevant science (Conference Sessions)



University Program Overview

Online Education

- Education Modules: Online materials to facilitate the use of NEON data in the classroom
- Short videos: YouTube style, watch at home – on relevant data topics

Data Focused Workshops / Webinars

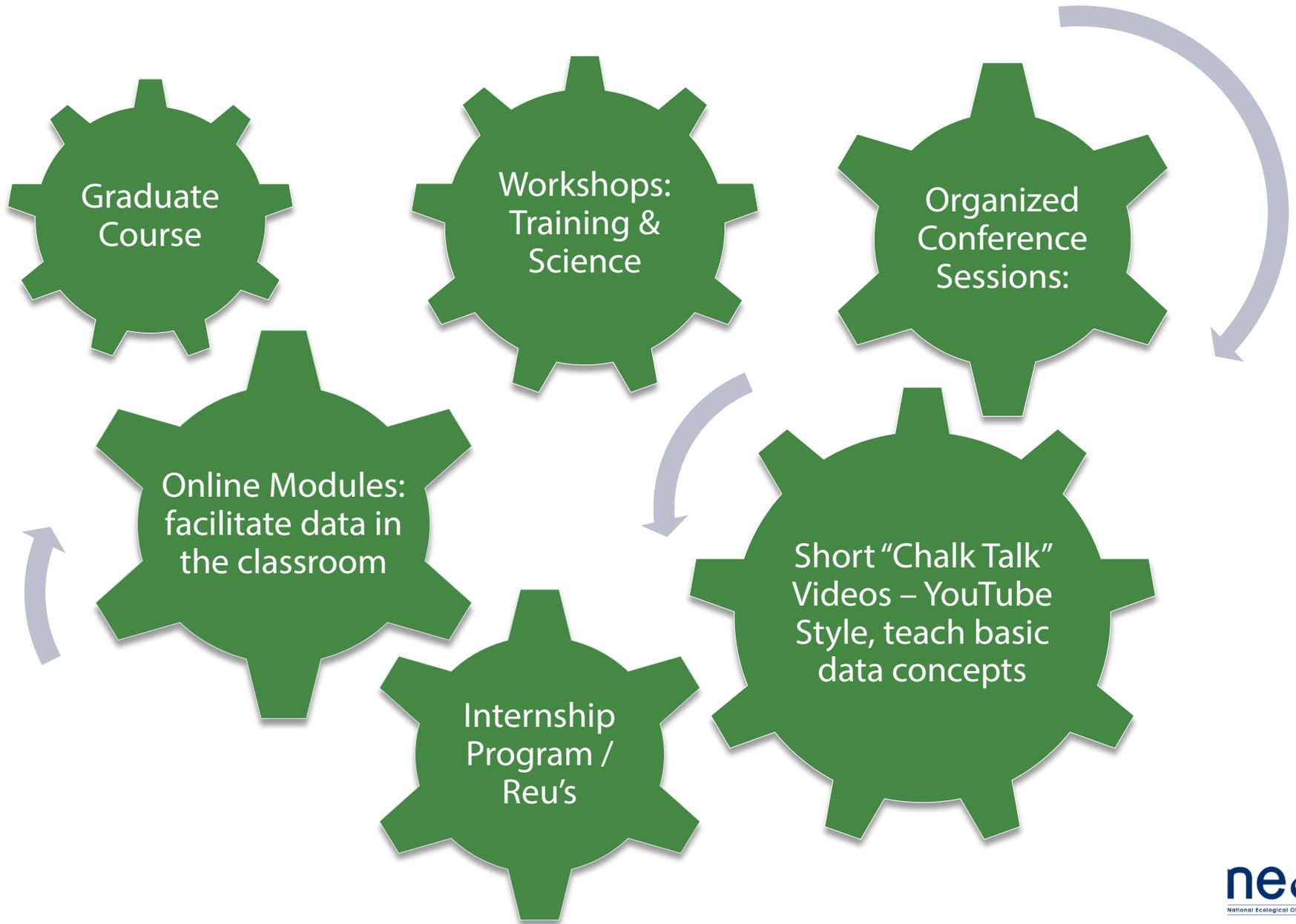
Applied Student Experiences

- Internship Program
- REU (*Future*)
- Graduate Course (*Future*)

Scientific Awareness

- Conference Sessions: NEON relevant topics (e.g. scaling, uncertainty)

NEON's University Program

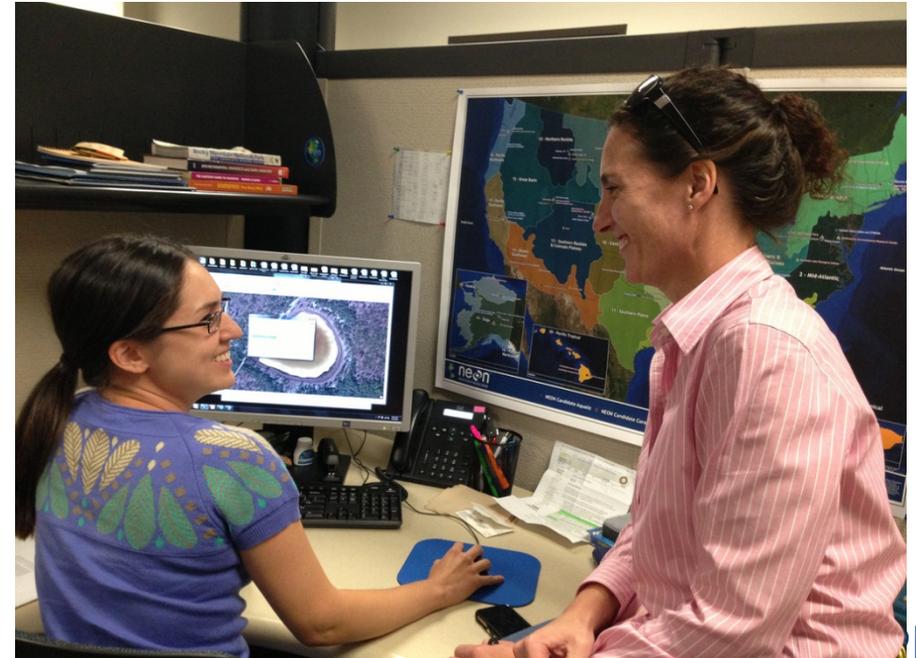


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INTERNSHIP PROGRAM

Internship Program Goals

- Prepare future STEM professionals
- Broaden participation in STEM careers by traditionally under-represented groups in science and engineering



Internship Program Design Components

- Real-world projects
- Mentorship by NEON staff
 - Project, Writing and Community mentors
- Career exploration and support
 - Leadership Training, Weekly Career Series, Informational interviews and Career Counseling
- Resume-building deliverables
 - Department specific documents (e.g., Data Processing Algorithms, Engineering drawings, research paper)
 - Published Abstracts
 - Formal Poster Sessions with other local REU and Internship Programs
 - Outreach: blog entries, elevator speeches
- Program evaluation
 - CU-Boulder W. Penuel and graduate student E. Dutilly

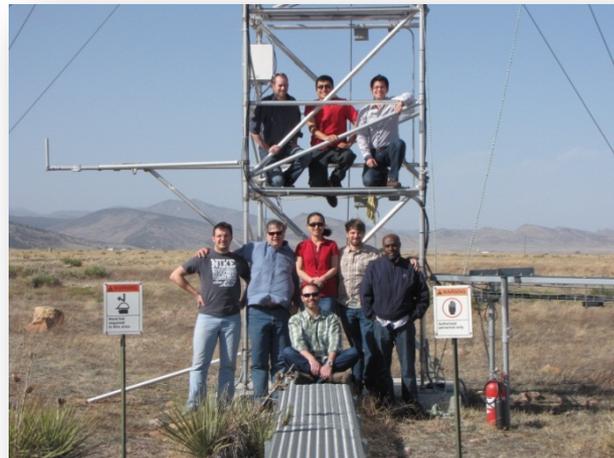
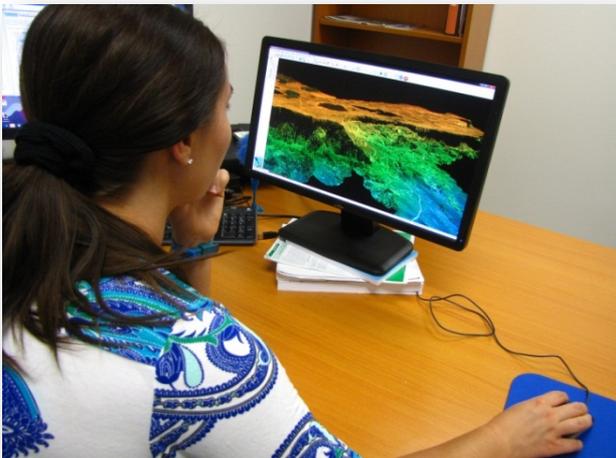
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ONLINE LEARNING

NEON Online Learning

Skills Needed to Explore Ecological Questions

- 21st Century Ecologist Toolbox
 - Build Data Analysis / Comprehension / Awareness Skills
 - Facilitate Use of “Big” Data in Research & Classroom
 - Engage: working with NEON data



organisms, populations, communities

atmosphere

biogeochemistry

Lots of Data!

landcover / landuse

ecohydrology

Unprecedented Opportunity in Ecology

Big data generally refer to **massive volumes of data** not readily **handled by the usual data tools** and practices and present unprecedented opportunities for advancing science and informing resource management through data-intensive approaches.

*Hampton et al, 2013
Frontiers in Ecology*

It Ain't Easy Being Big....

- Development of Custom Data Analysis Techniques
- Required Computing Resources
- Huge Data Volume
- Software: Cost, complexity

Student Frustration
in the
Classroom!!!



Free / Open Source Tools

Programming



GNU Octave



Data Management



Spatial Analysis (GIS)



GRASS GIS



Quantum GIS

Remote Sensing



Opticks



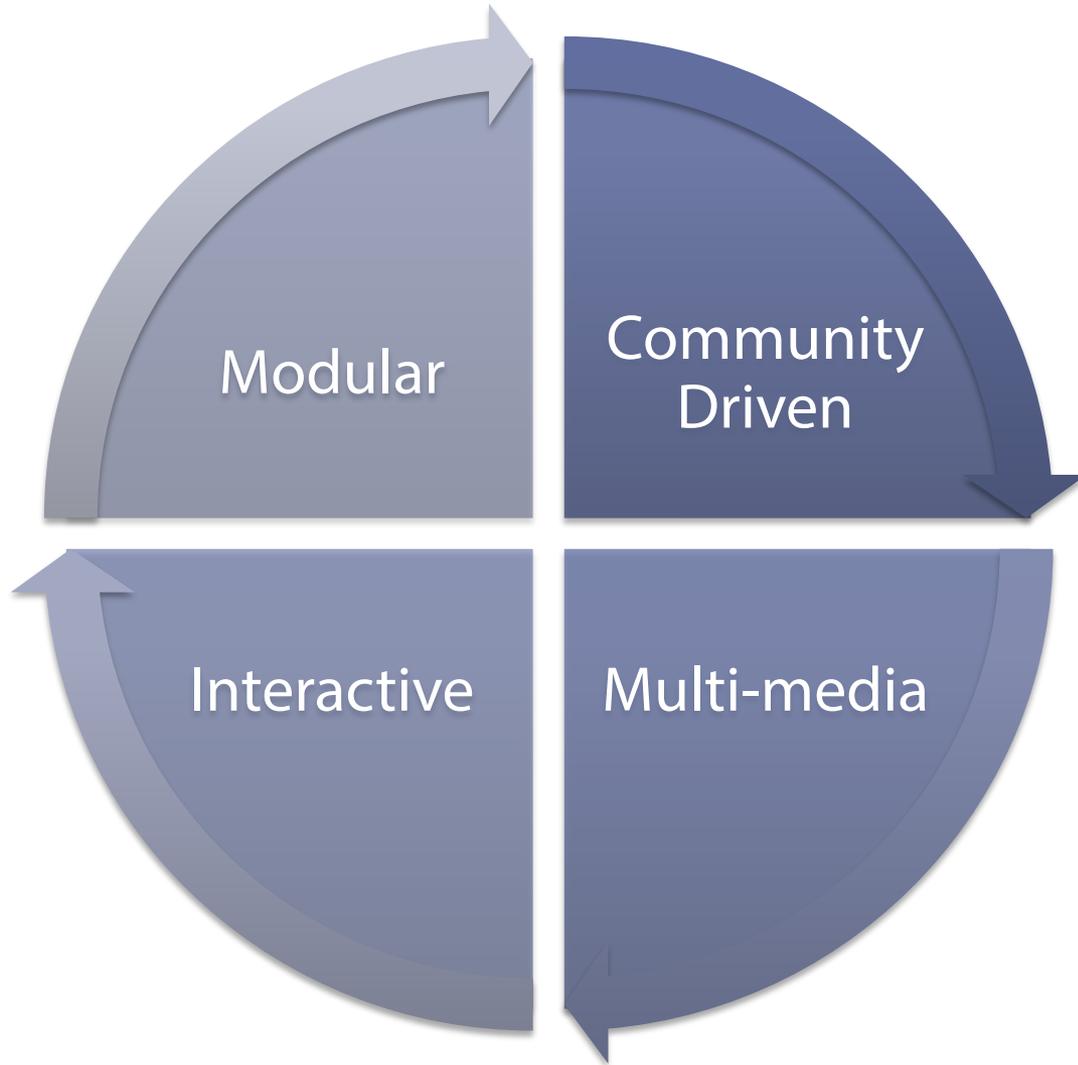
Today's Challenges

How to integrate into the classroom?

- Data Formats
- Data / Metadata
- Data management
- Processing
- Storage



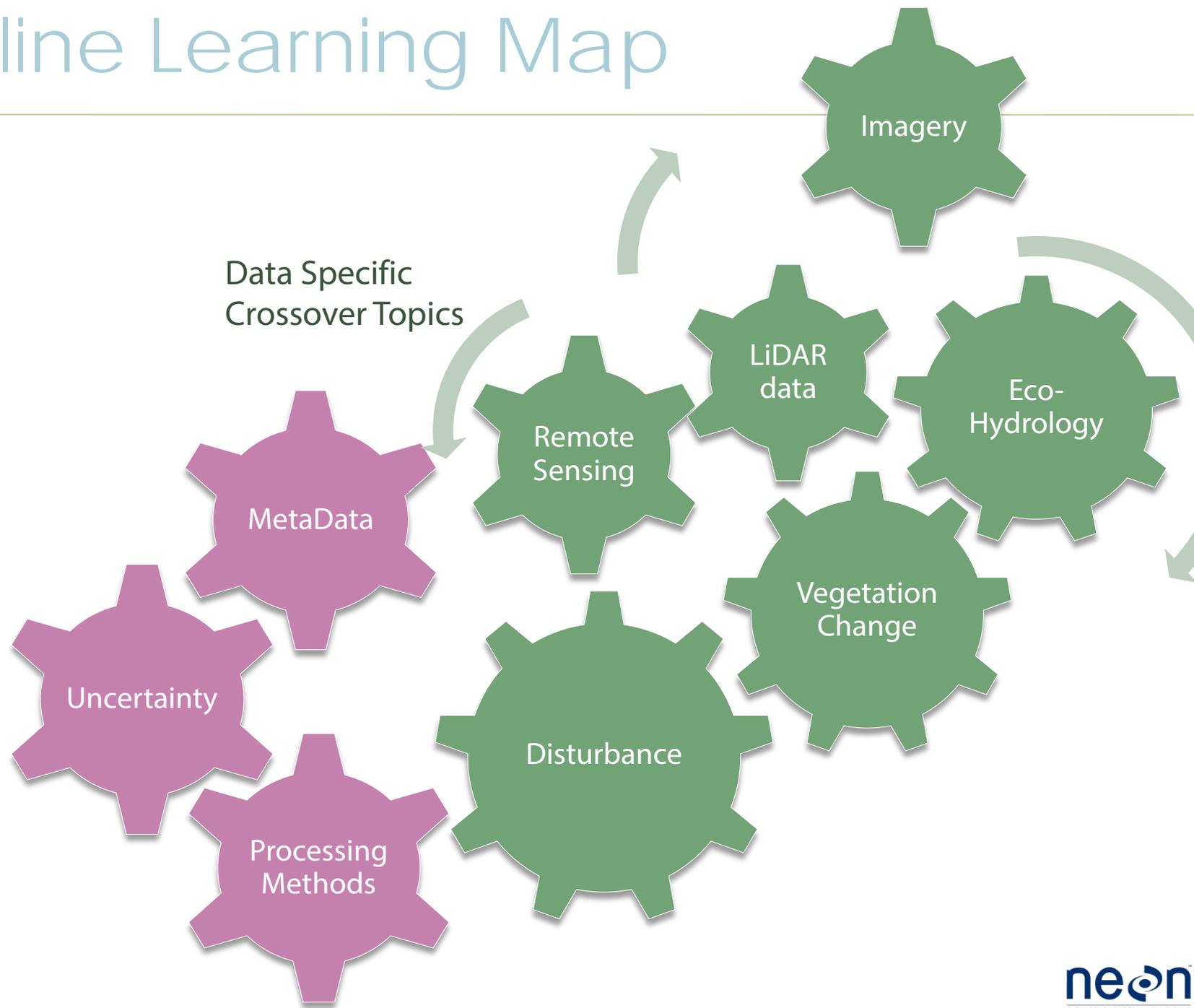
NEON's Approach to Online Learning



Open Source data
Analysis Tools

Packaged with
Relevant Peer
Reviewed
Literature

Online Learning Map



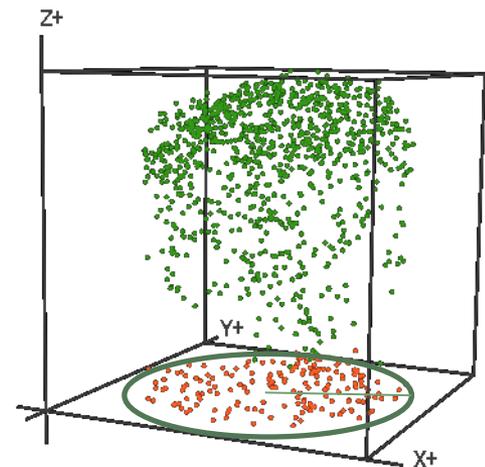
THEME: Landcover / Landuse

Sub-Theme:
Regional
Vegetation Change

Topic / Question:
Structural
Attributes of Forest
Trees & Understory

Methods:
Remote Sensing

LiDAR Data



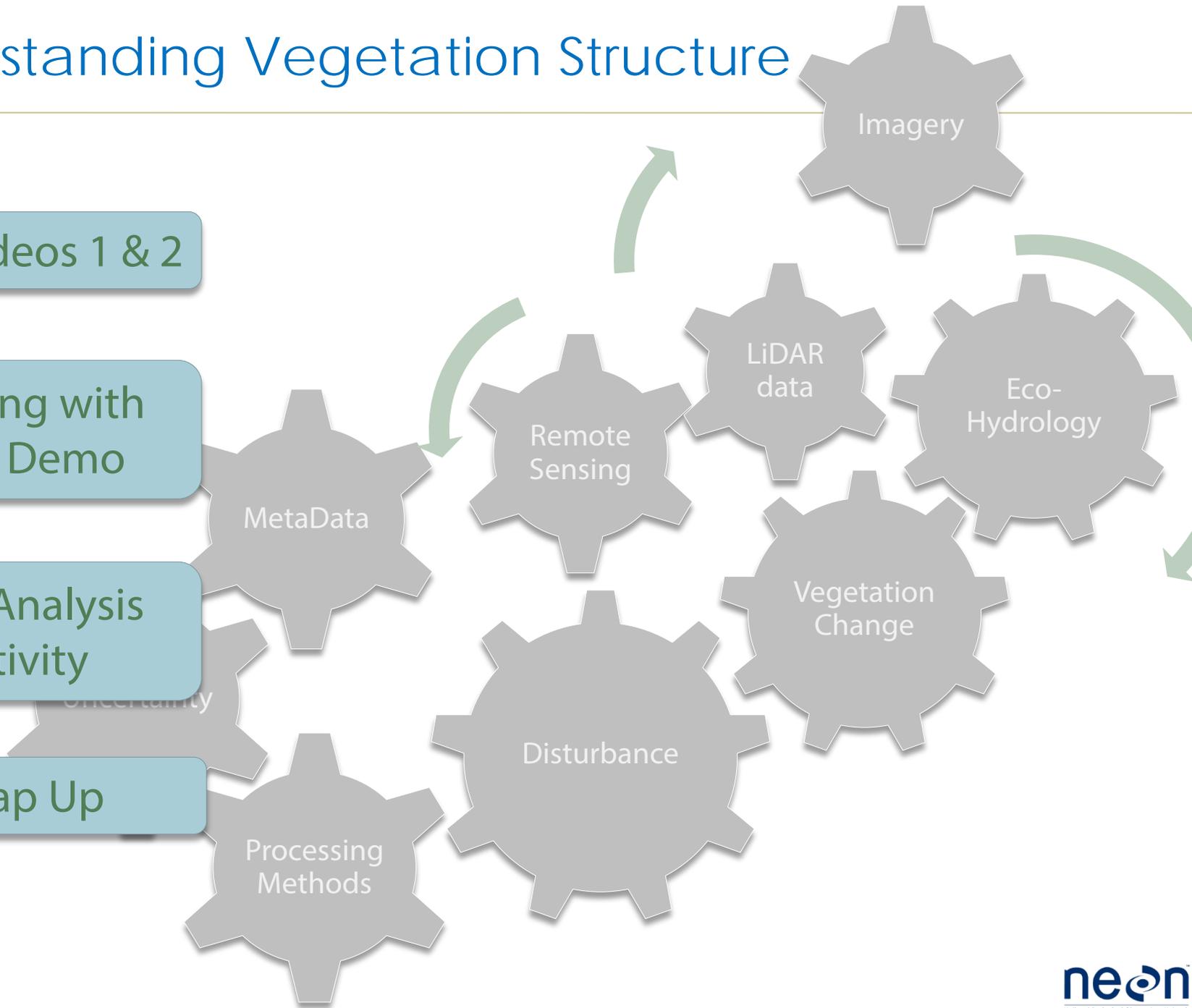
Understanding Vegetation Structure

Intro Videos 1 & 2

Working with Data Demo

Data Analysis Activity

Wrap Up



Why A Modular Approach?

Things Change.

Vegetation Change

What is LiDAR Data?



Light Detection And Ranging

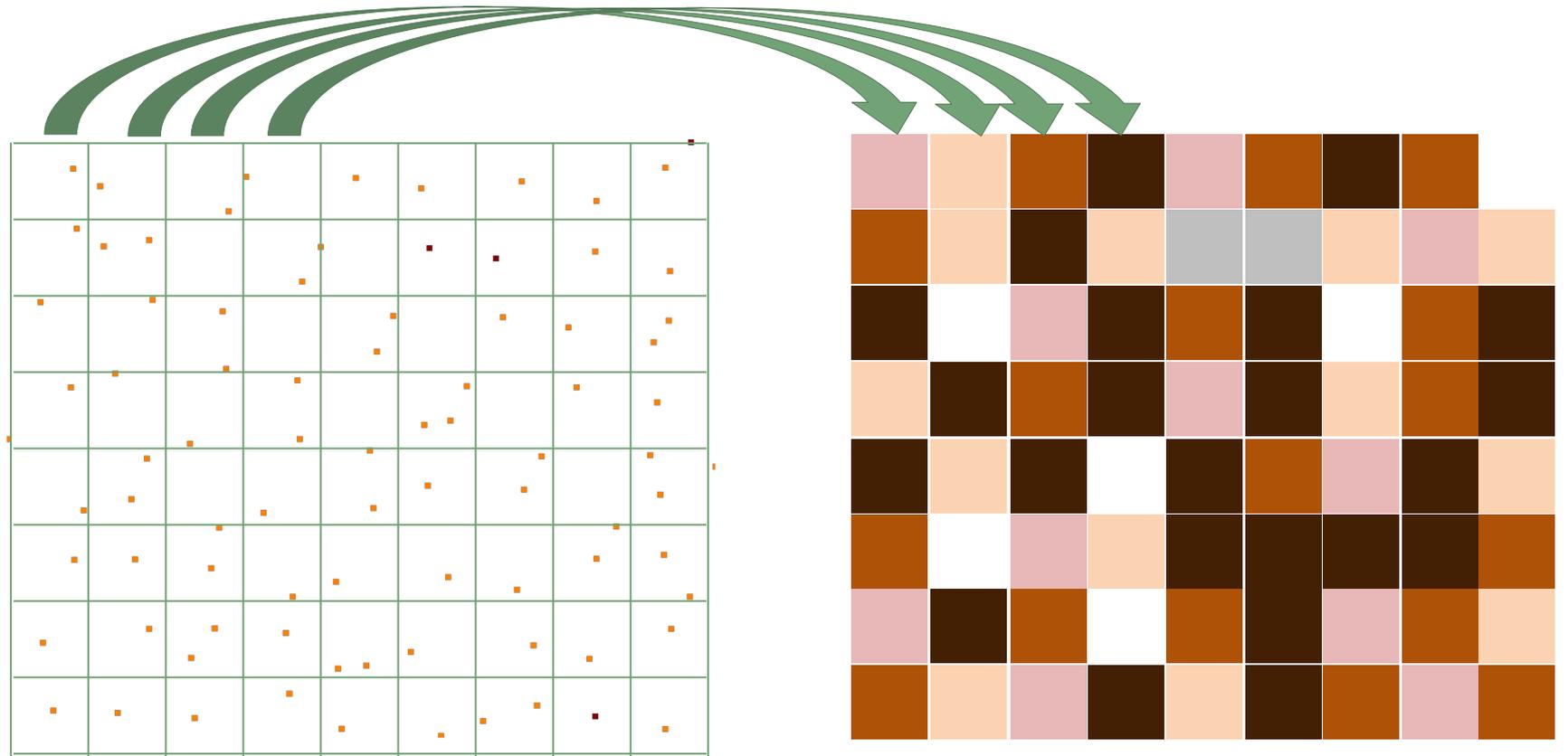
Scanned trees



Resultant LiDAR Data



LiDAR Data Products



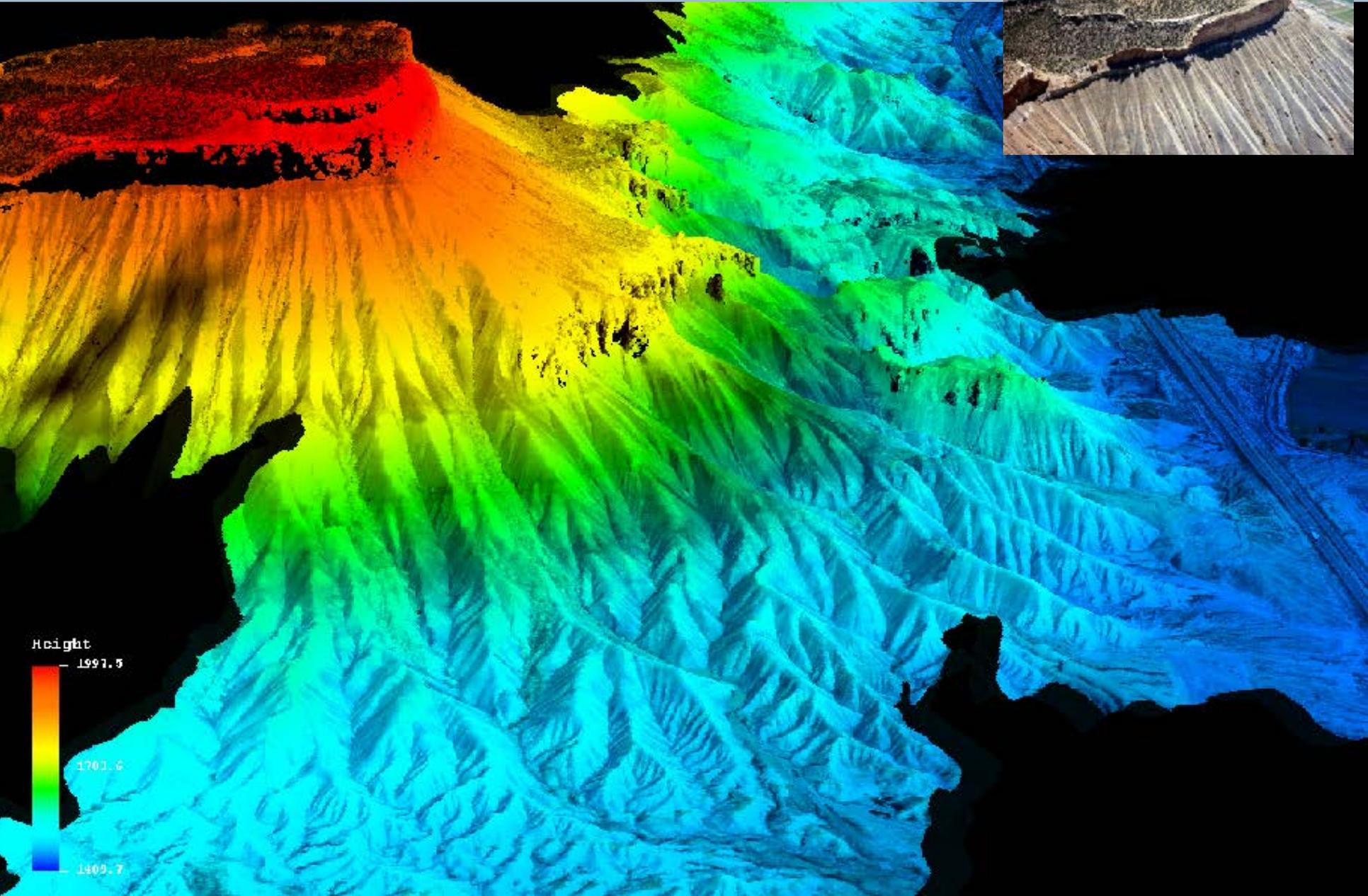
Legend



Shorter Trees

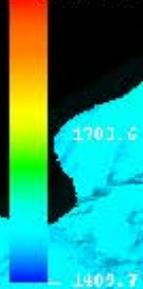
Taller Trees

Understand LiDAR Data



Height

1997.5

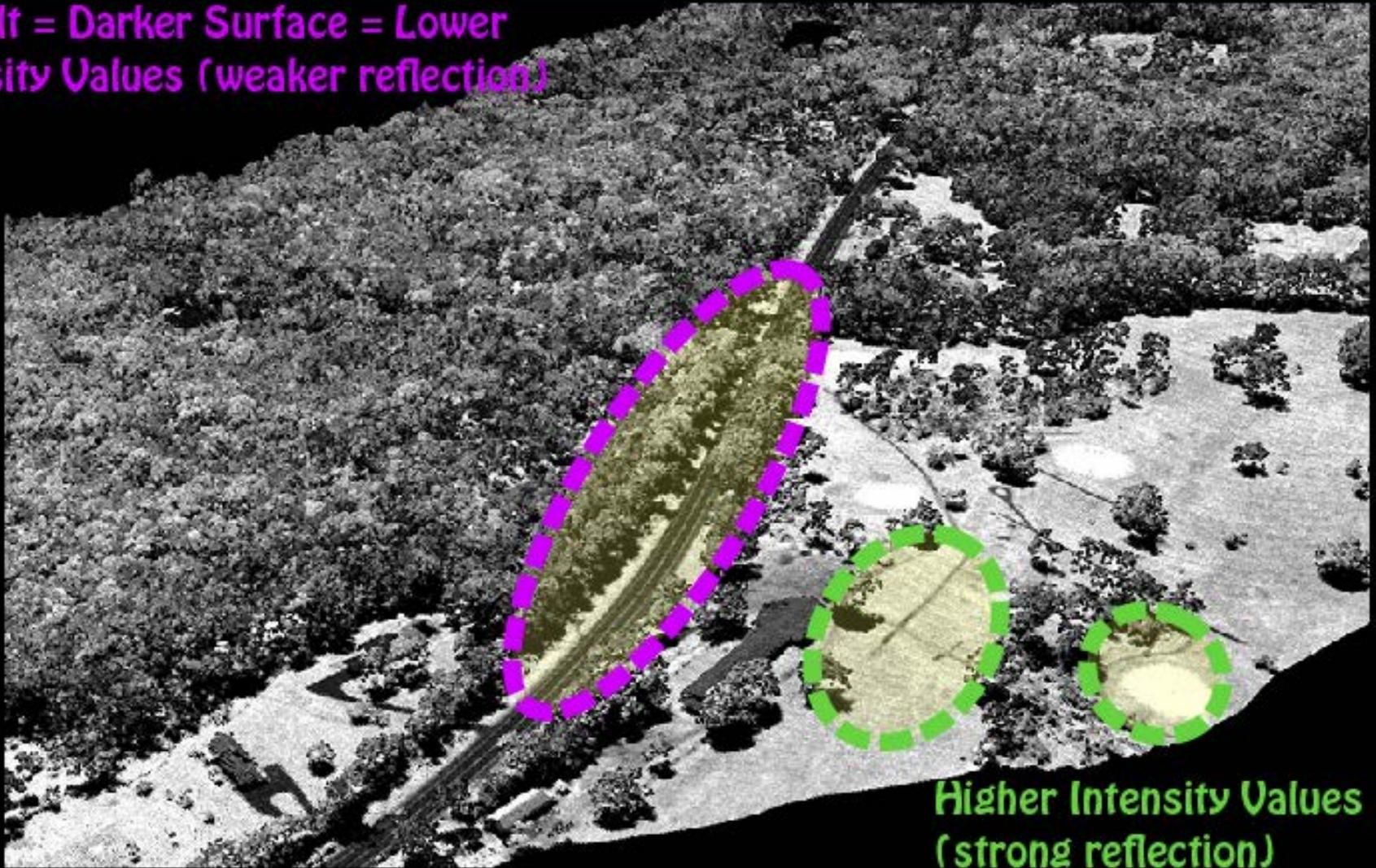


1703.6

1999.7

Learn About LiDAR Data Products

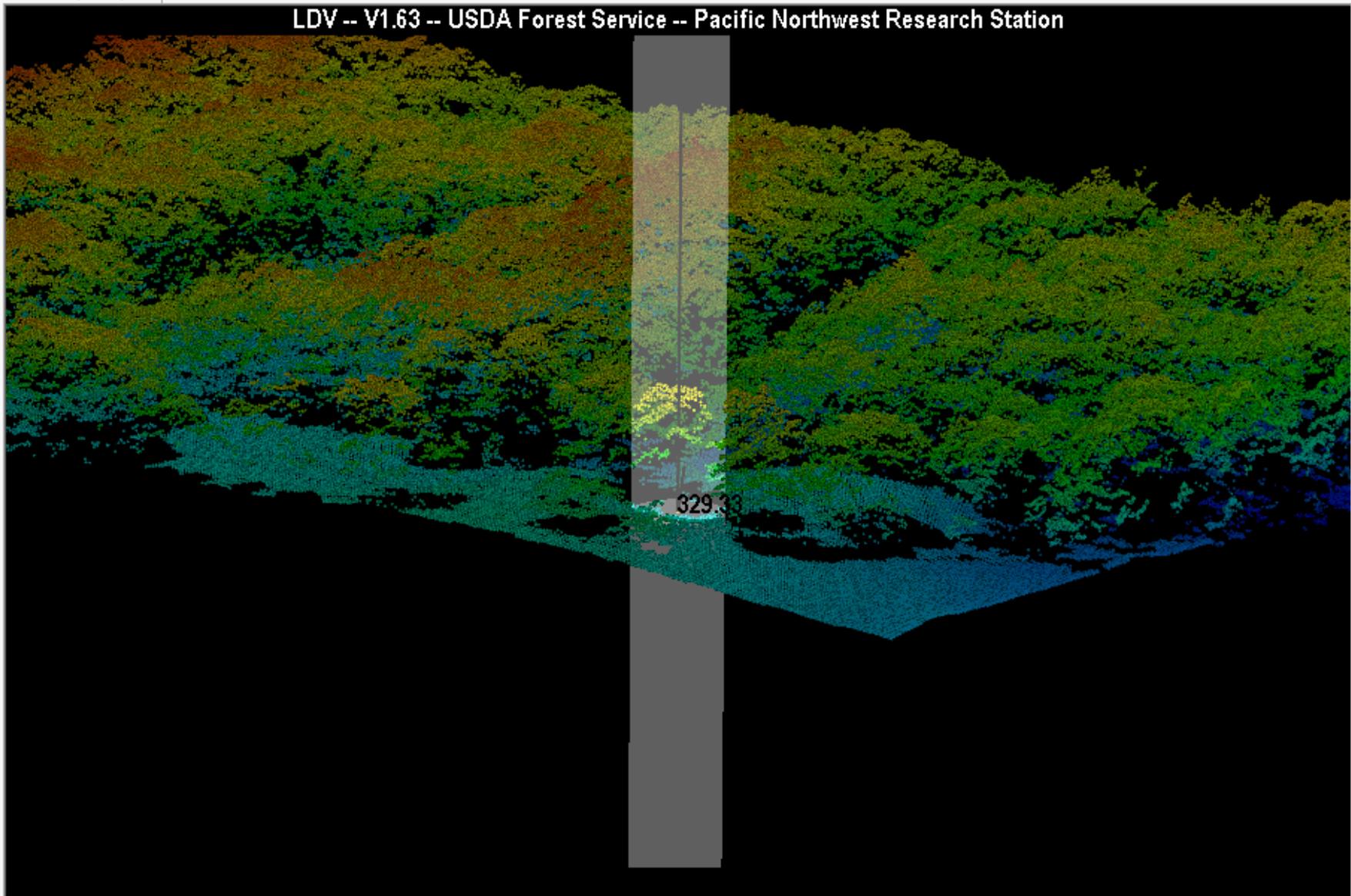
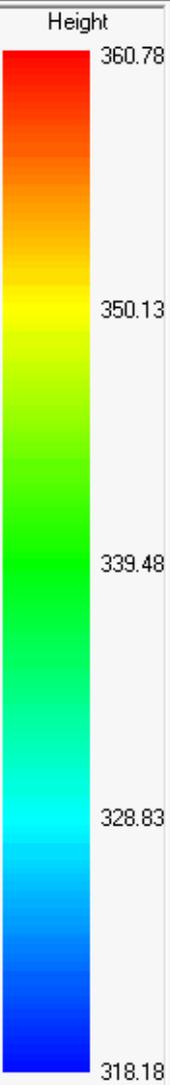
asphalt = Darker Surface = Lower Intensity Values (weaker reflection)



Higher Intensity Values
(strong reflection)



LDV -- V1.63 -- USDA Forest Service -- Pacific Northwest Research Station



Histogram

ADDITIONAL LDV
and
Keystroke

X: 730838.98 Y: 4714731.67 Elevation: 336.33
X: 730838.98 Y: 4714731.67 Elevation: 336.33

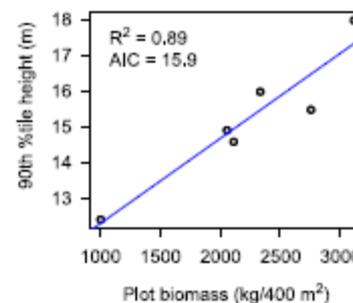
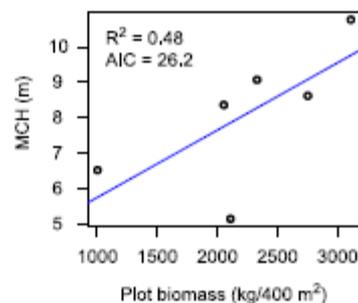
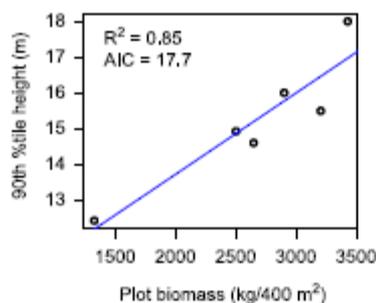
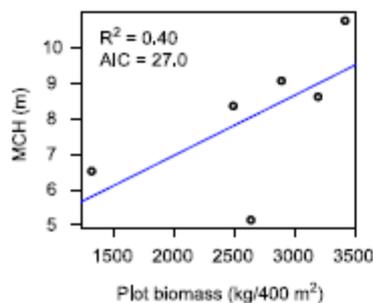
Example Data Activity

Assess relationships between in situ measured canopy height and lidar data derived height

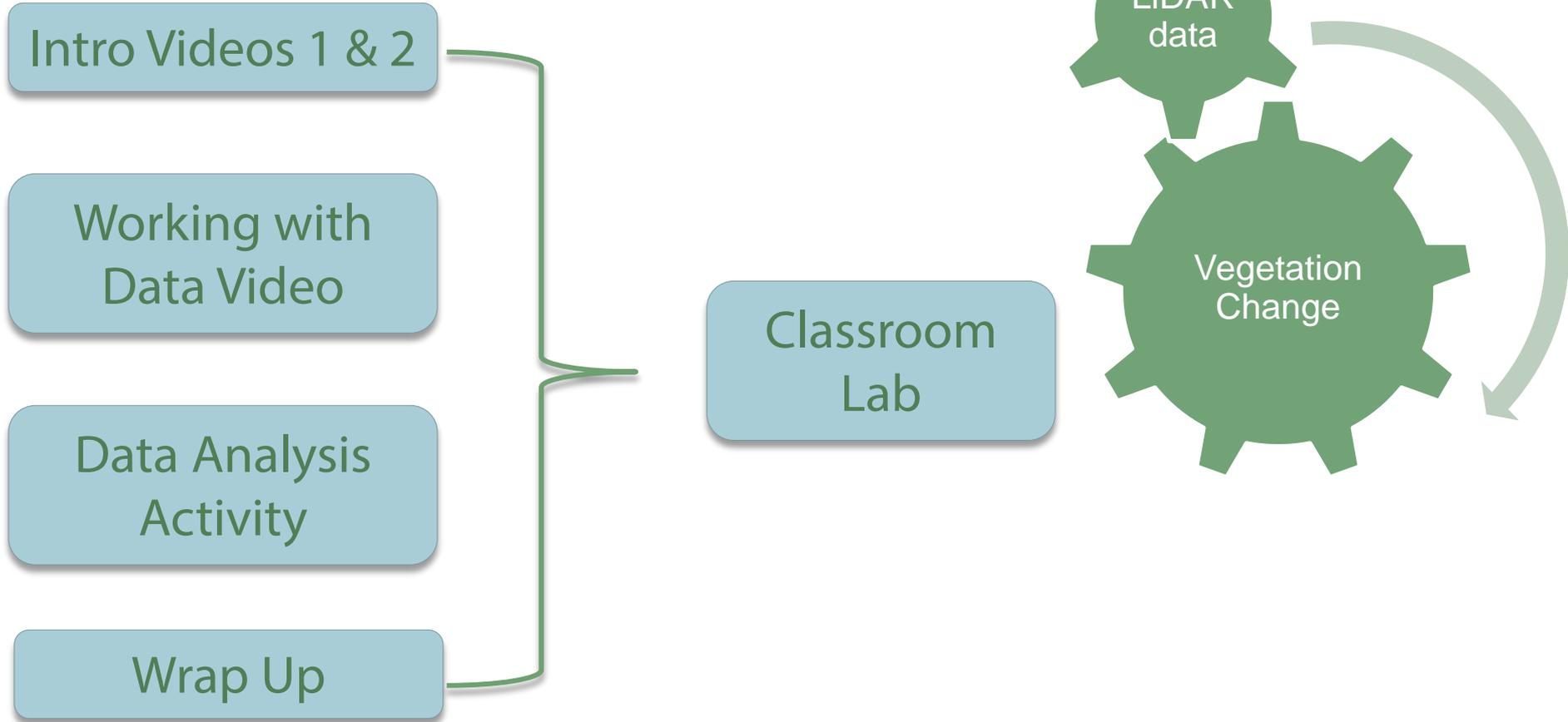
Regressions of CHM height parameters against plot-level biomass

Plot biomass = f(DBH, Height, ρ)
[Chave et al. 2005]

Plot biomass = f(DBH)
[Popescu et al. 2004]



Online Learning Map



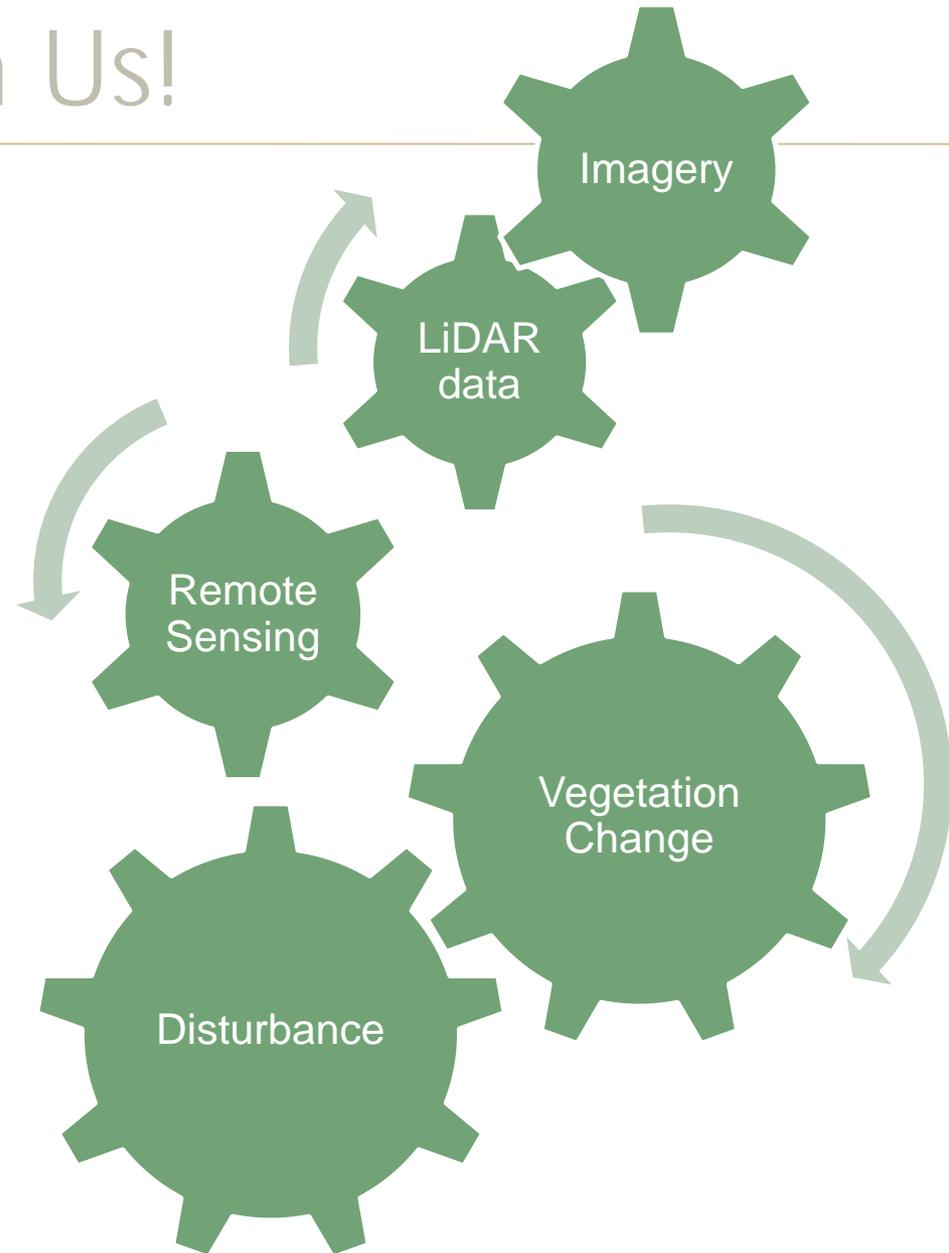
To Be

Freely Available on the
NEONinc.org Education
Portal

Collaborate with Us!

Community Input

- Review existing materials
- Contribute lesson content
- Share topic ideas
- Contribute graphics, videos



A community Approach

Partner with experts in respective fields (LiDAR)

- Jan Van Aardt (Rochester Institute of Technology)
- Stuart Phinn / Alex Held: Australia TERN/ CSIRO
- Crystal Schaaf (Boston University)
- Laura Chasmer (Wilfrid Laurier University)
- ... many others!

External Review

Moving Forward

Identify Important Topics (data & Ecology) that are supported using NEON data

– Characterizing Vegetation Structure over Broad Areas (ESA 2014 Workshop)

- Data Topic: LiDAR data products (under development)
- Sampling Design Topic: NEON In Situ Veg Sampling
- Activity: Scaling In Situ to Remote (Lidar) using R

Questions??



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