



Spectral Data Discovery: Access and Analysis through the EcoSIS Toolkit

Phil Townsend, Clayton Kingdon and Justin Merz

AIST-16-0118

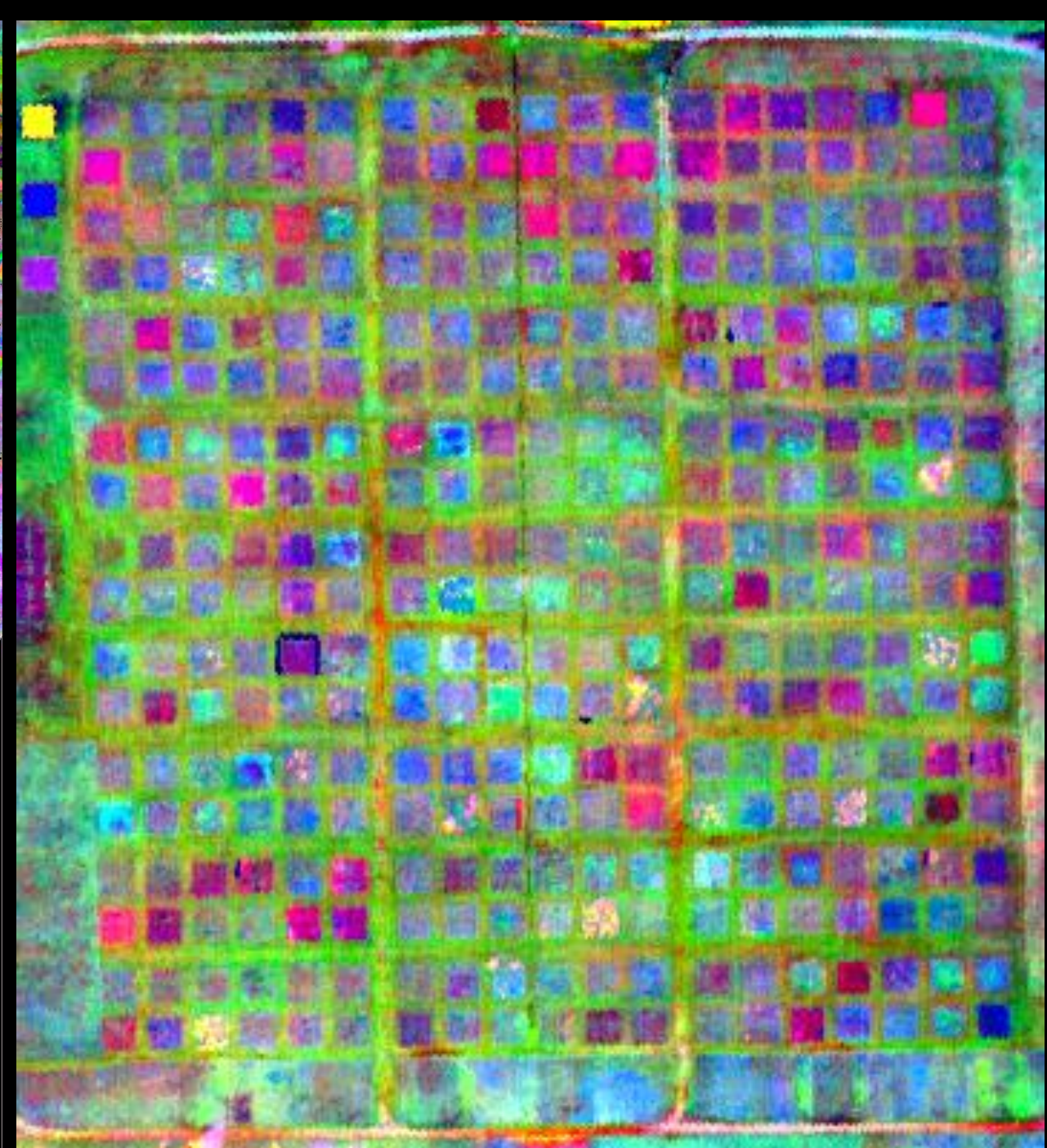
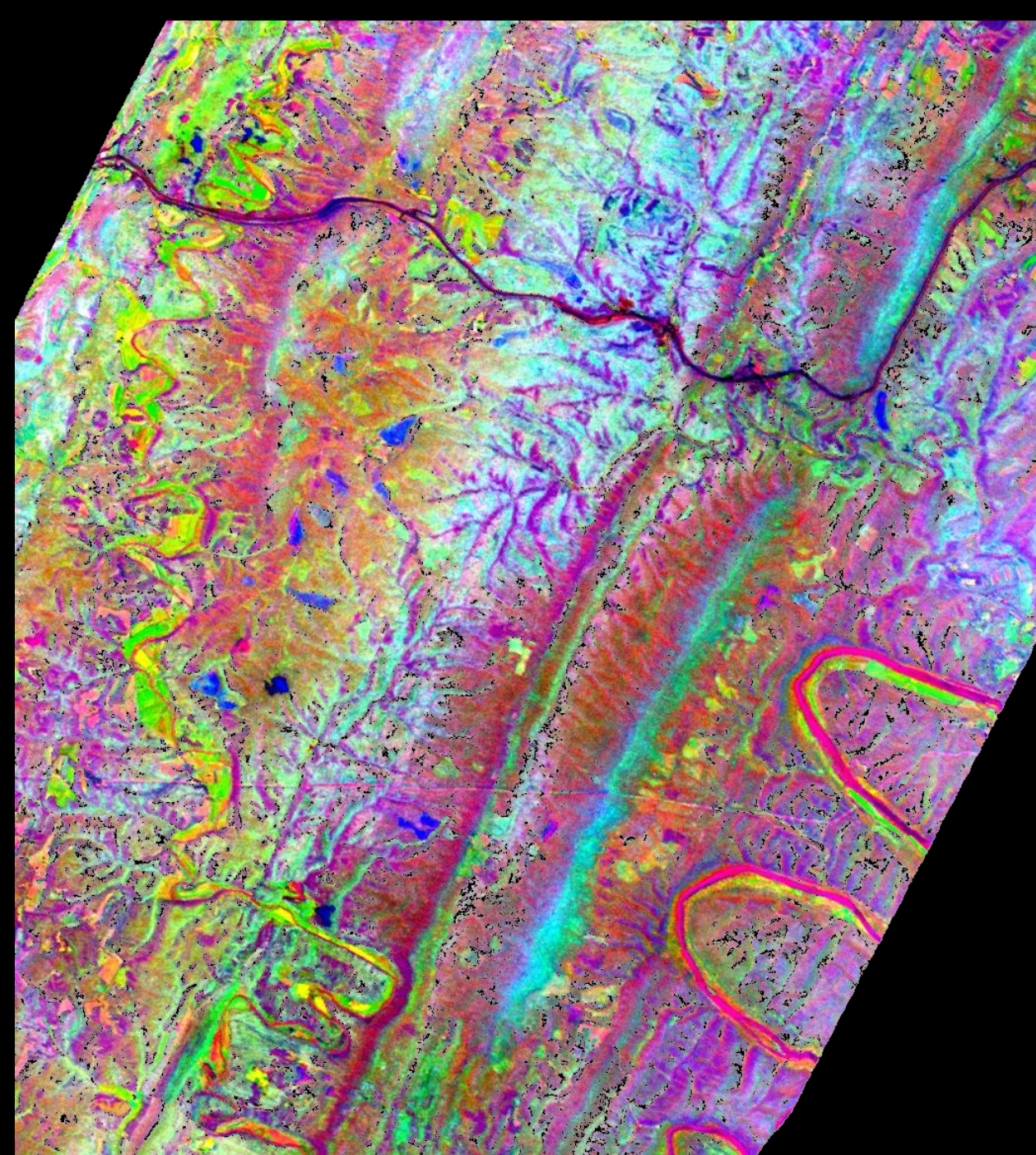
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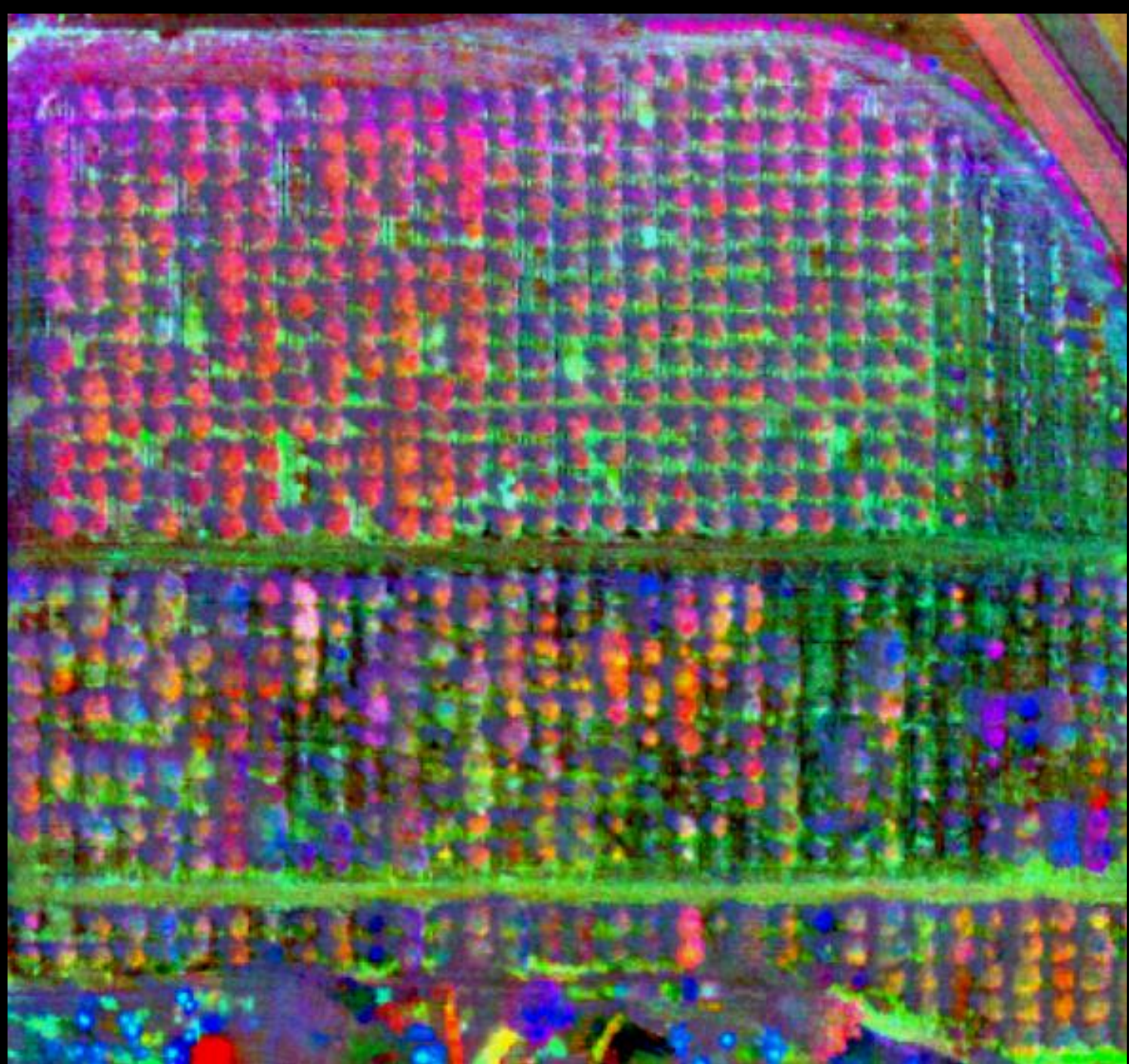
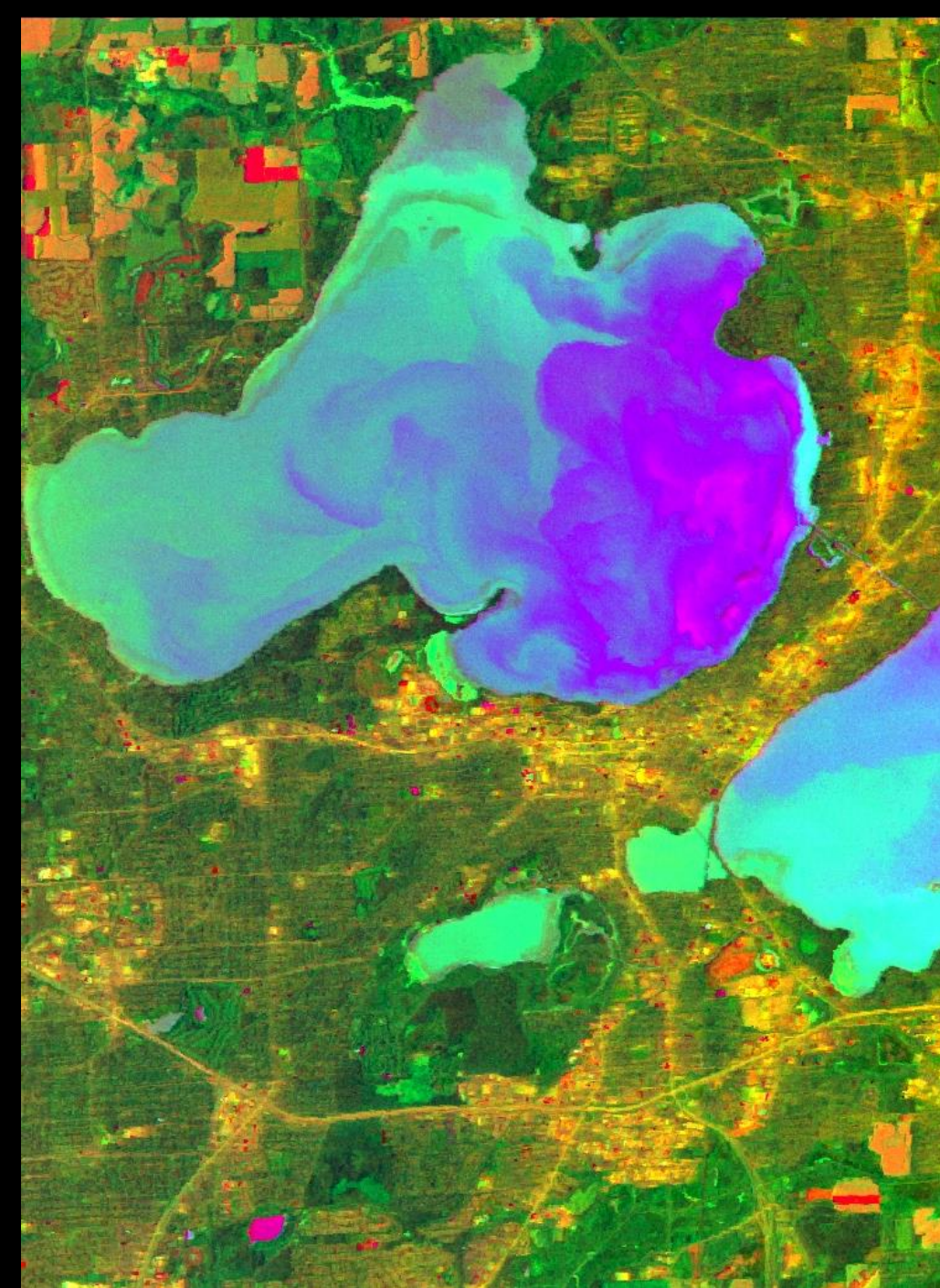
Previous Award: Terrestrial Ecology Program

NNX13AK85A

14 June 2018

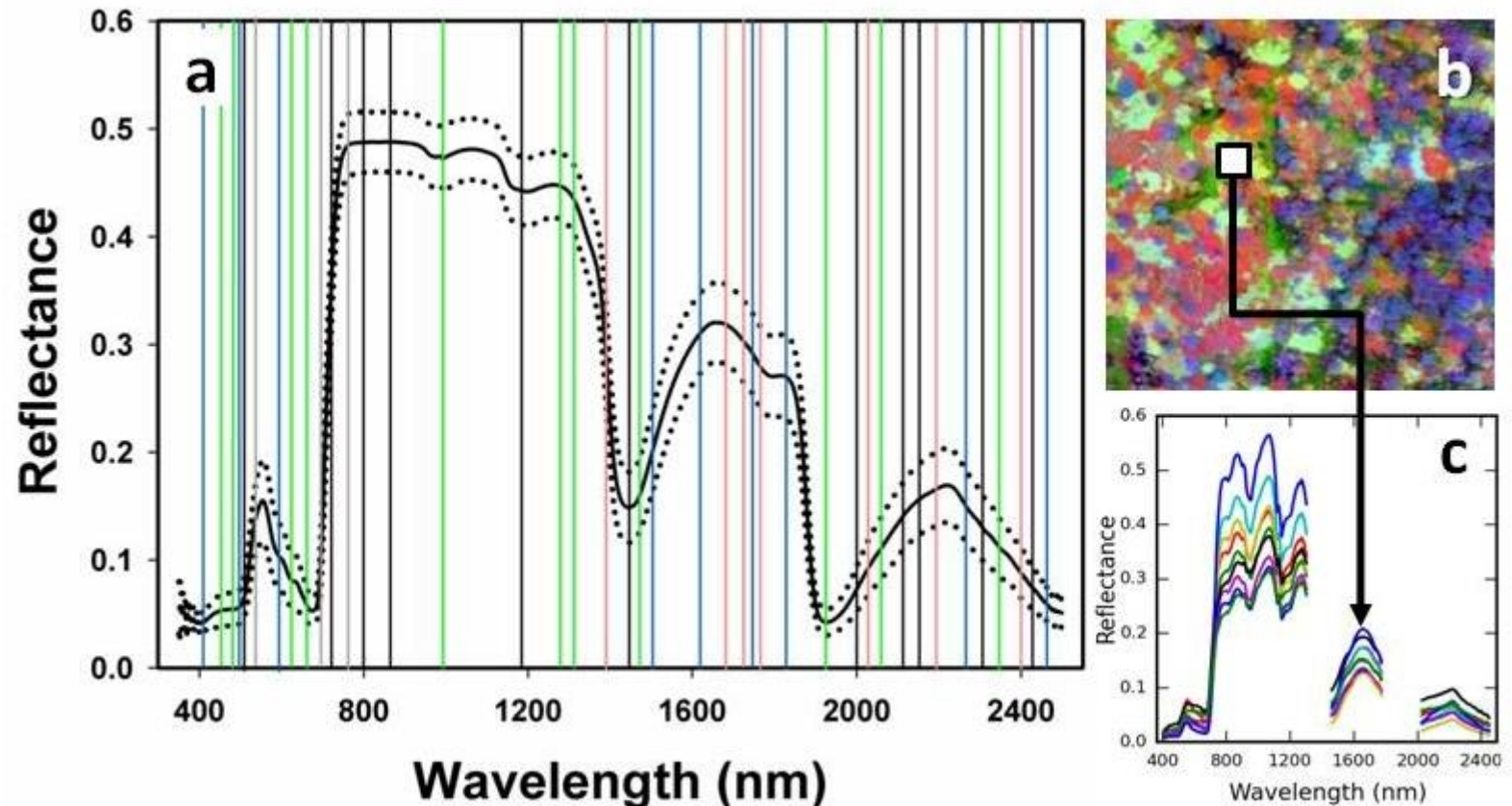




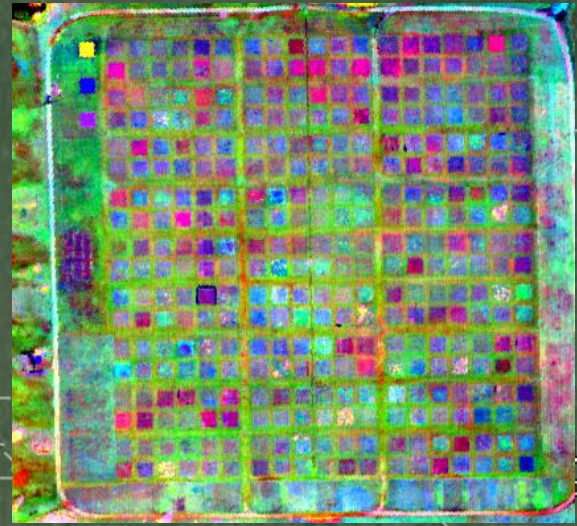
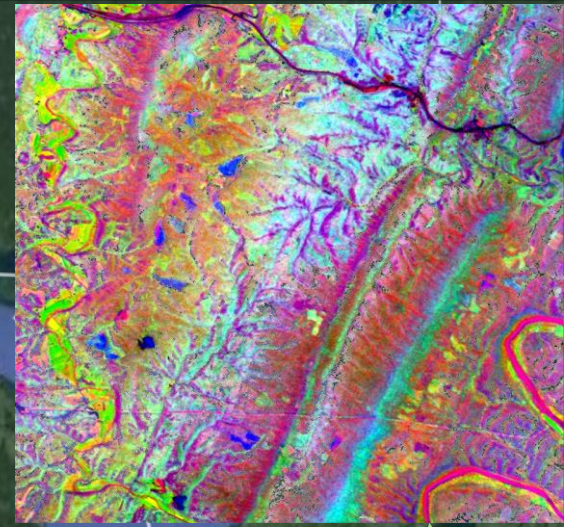
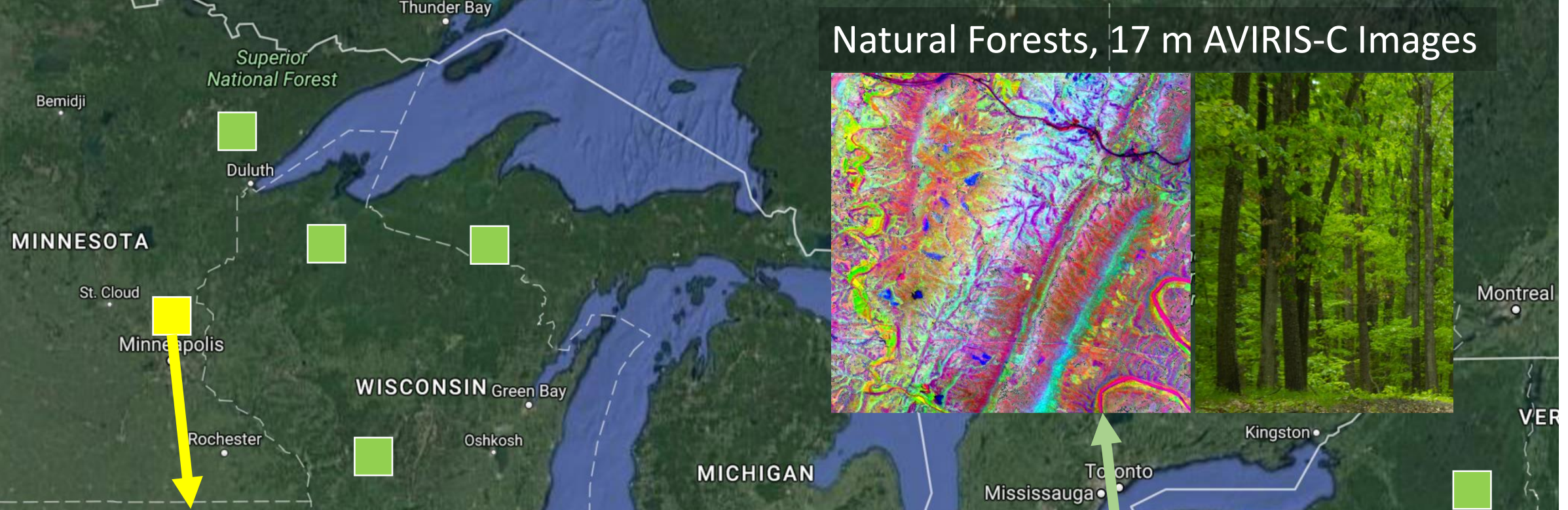


Absorption Features are Related to Functional Traits

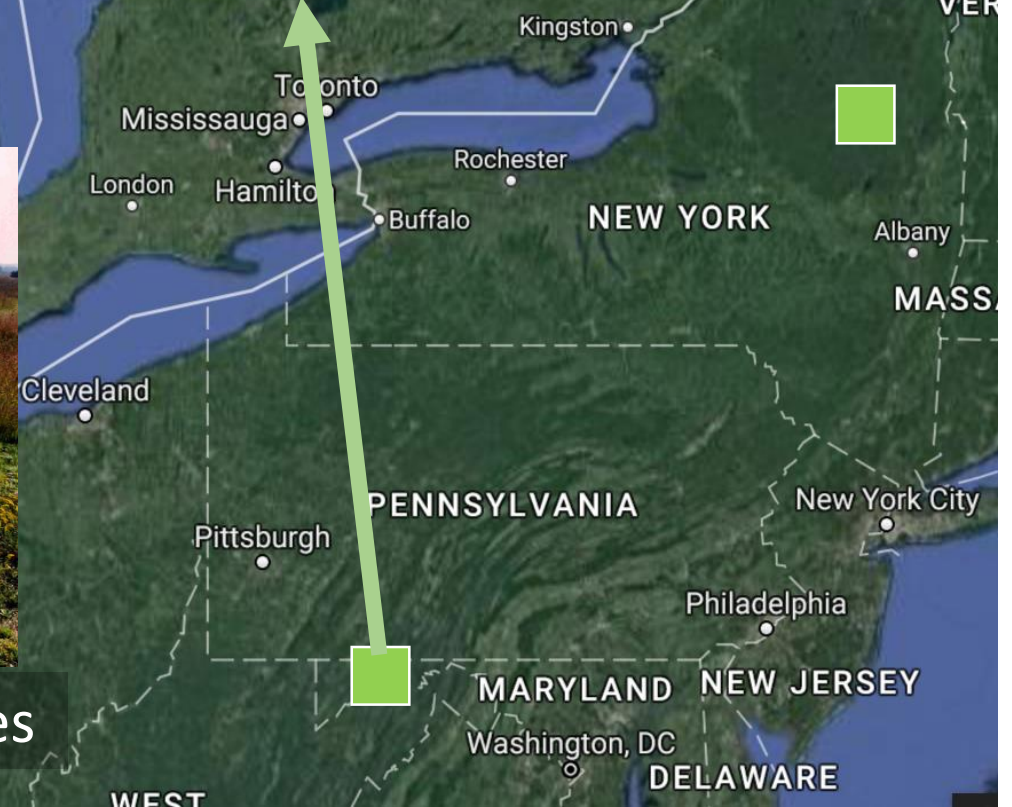
- Ecological properties of plants that describe their role in an ecosystem
- Response to environmental conditions
- Leaf trade-offs between fast growth and longevity
- Biochemistry
 - Nitrogen, Lignin, Pigments
 - Phenolics, Isotopic N
- Physiology
- Leaf Mass per Area (LMA)



Natural Forests, 17 m AVIRIS-C Images



Grasslands, Cedar Creek LTER, 1 m AVIRIS-NG Images



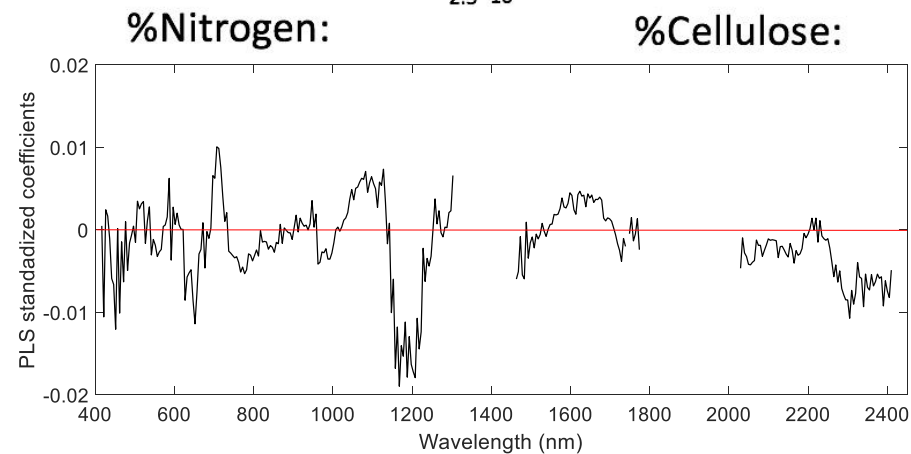
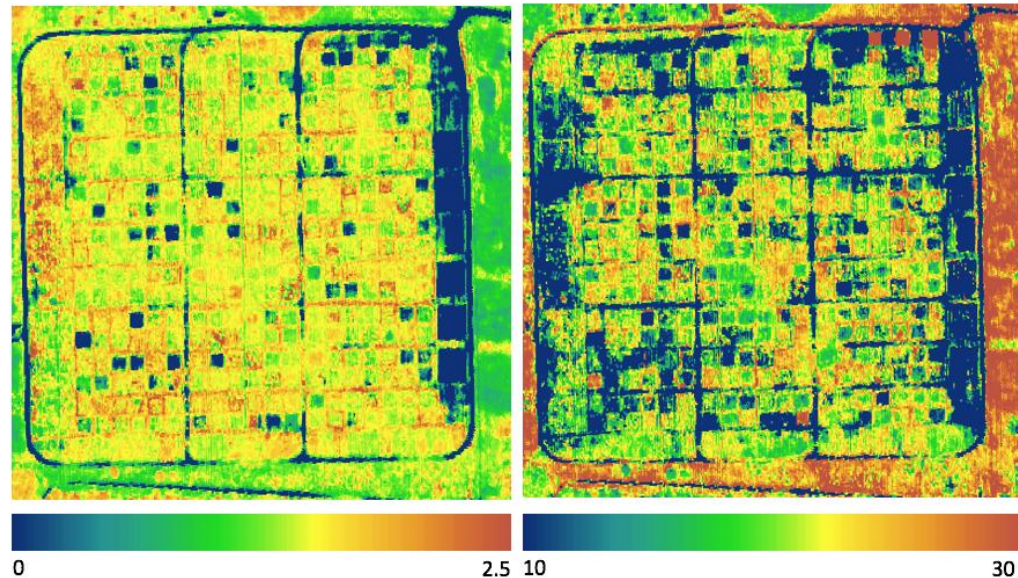
Cedar Creek LTER (NSF-NASA DoB)

158 Plots, Dozens of Species

1-16 Species Diversity Treatments

Data from 2015 shown (2014-2016)

16 Traits from Field Data and Imagery

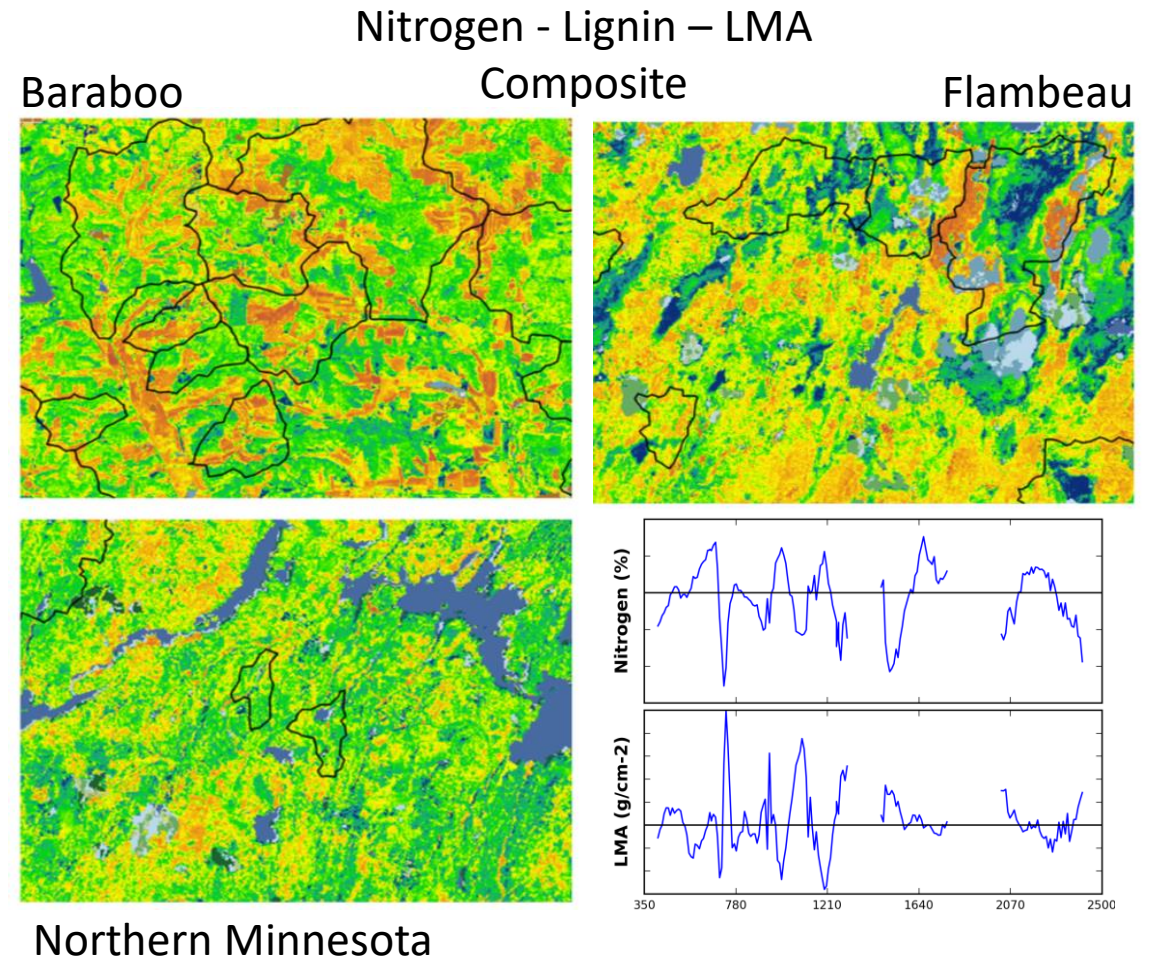


US Northern Forests (NASA TE)

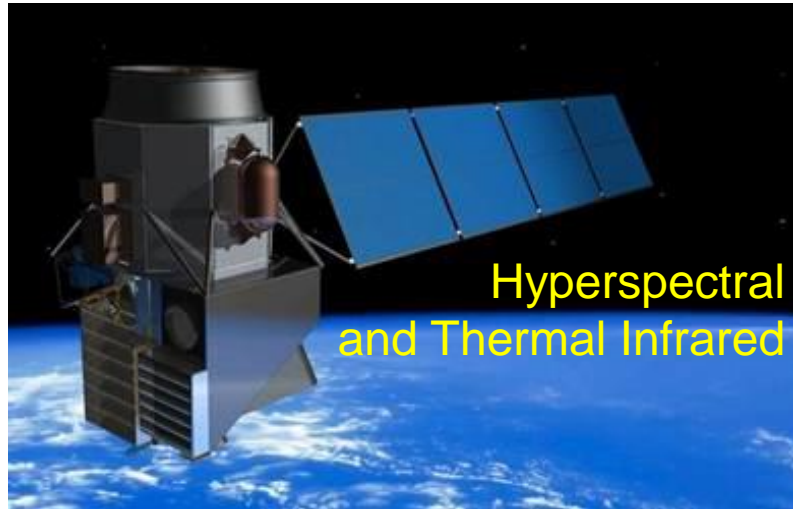
237 Plots, 36 Woody Species

Data from 2008-2011 shown

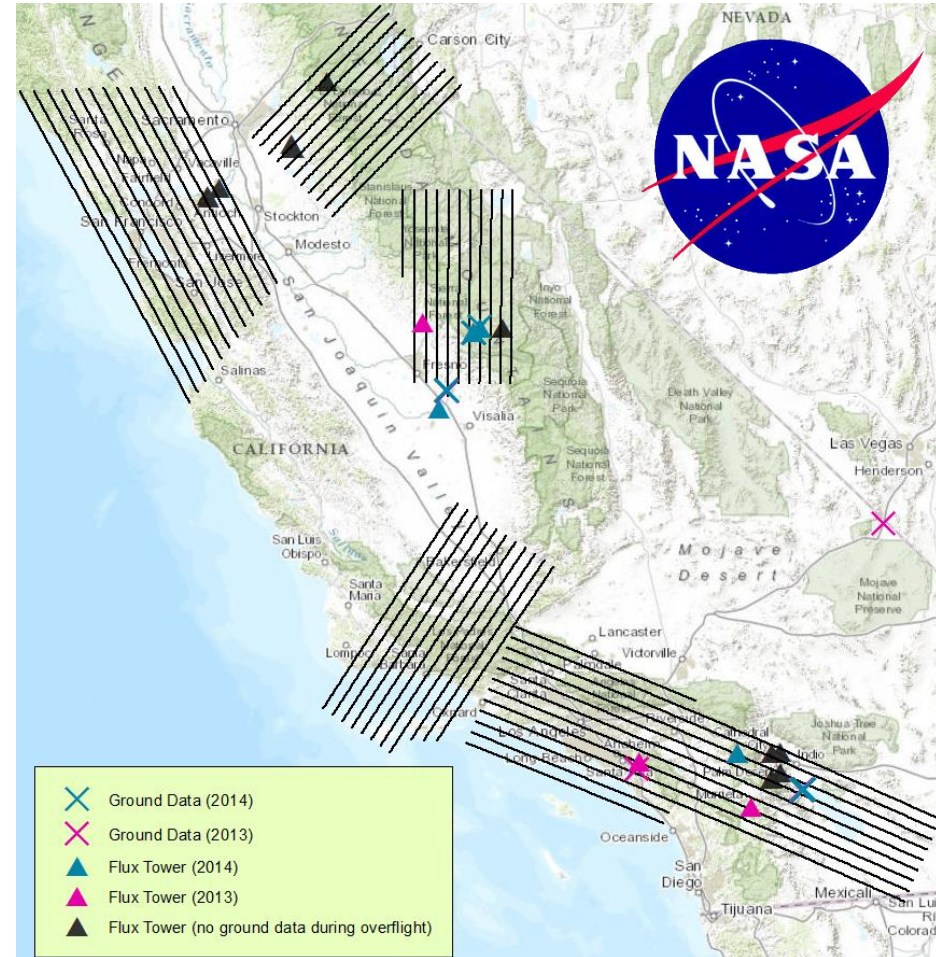
15 Traits from Field Data and Imagery

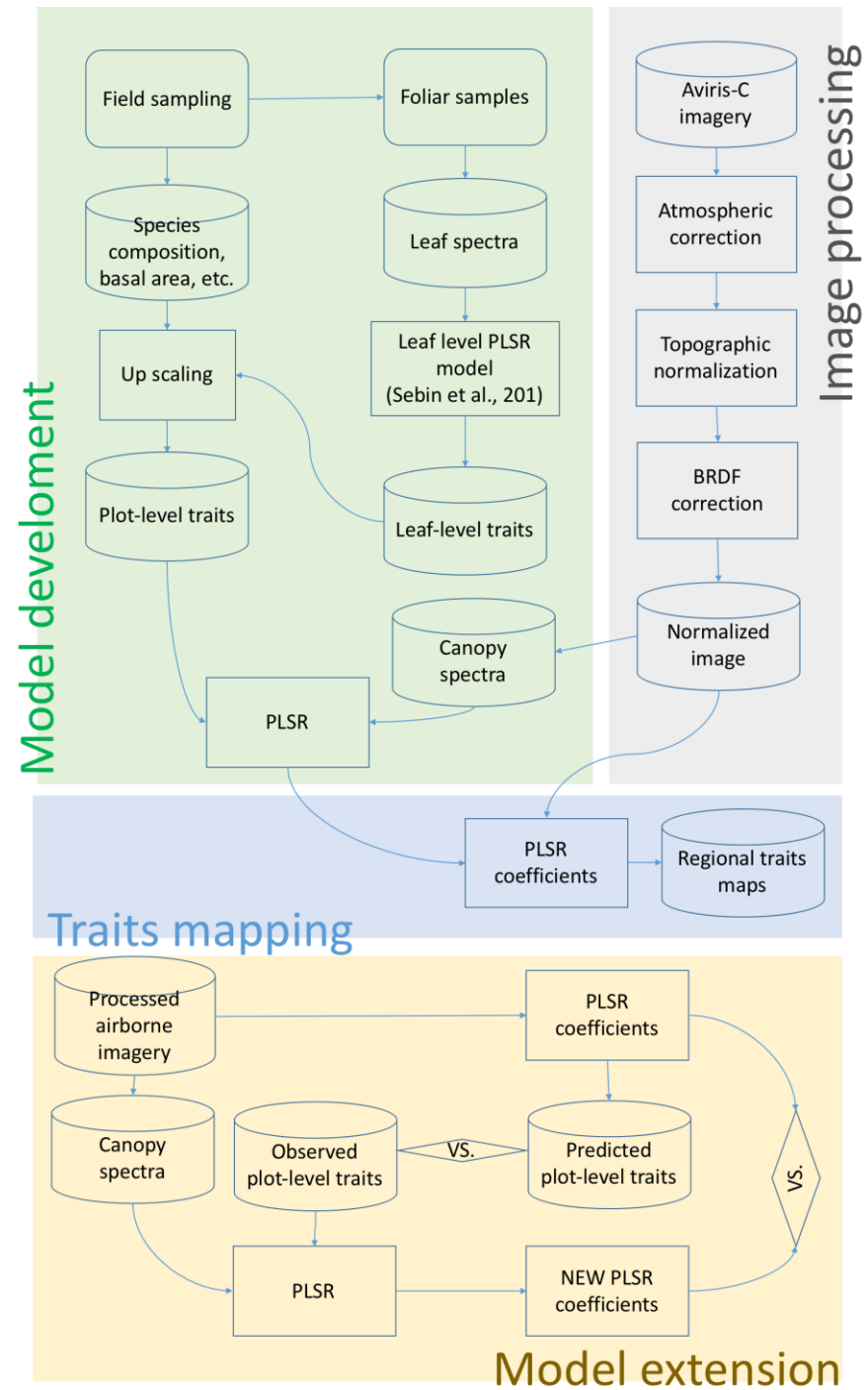


NASA's California HypsIRI Campaign

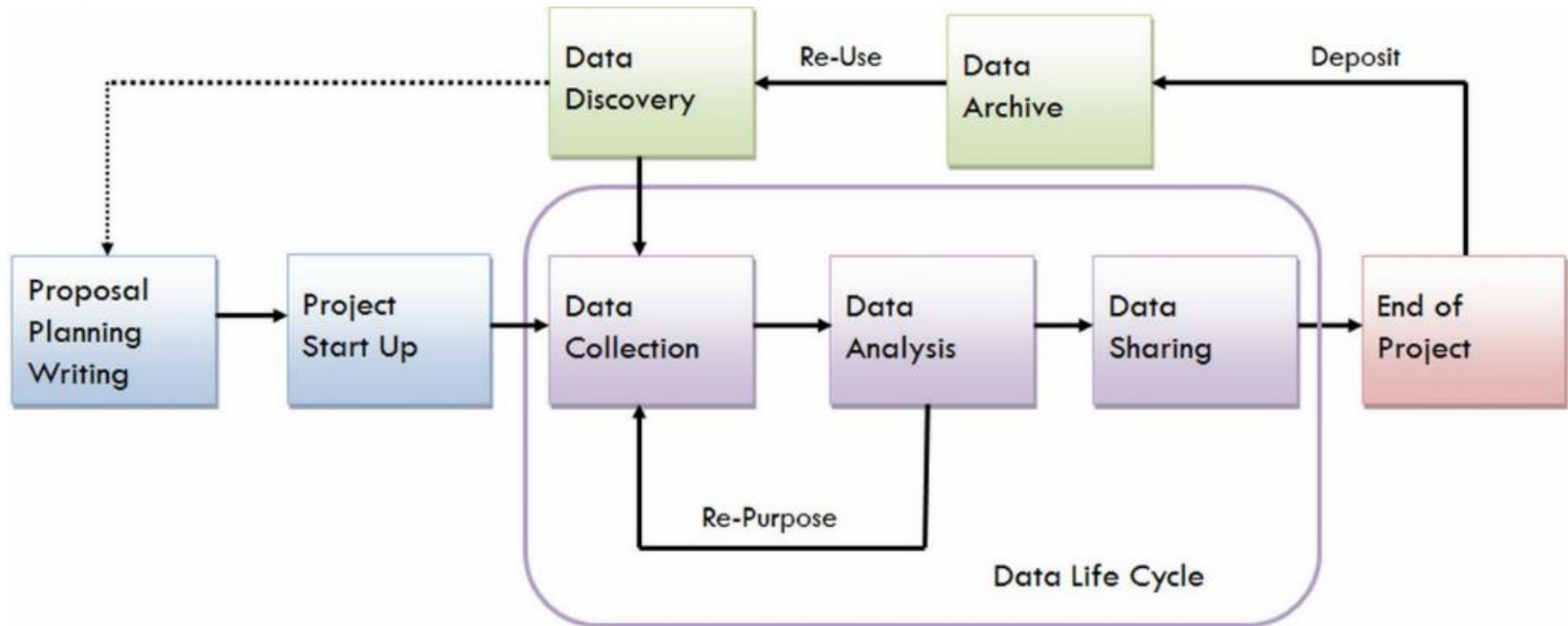


- 20 Flux Towers
- 9 Campaigns (2013-2015)
- 104 combinations of tower & imagery; 73 field sites
- Simulate HypsIRI satellite data using high altitude aerial imagery

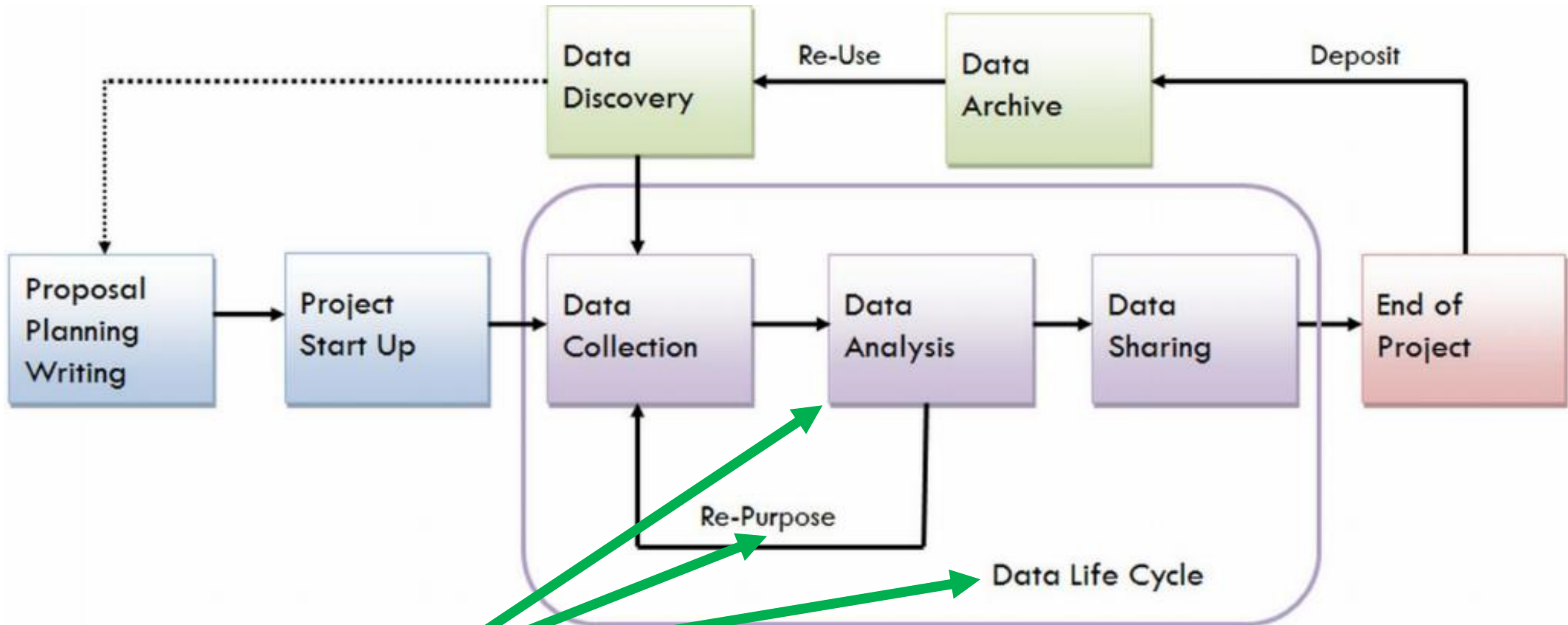




Data Life Cycle



Data Life Cycle



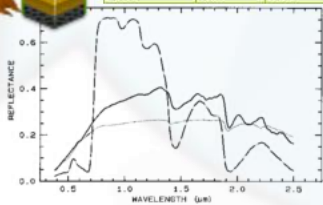
Models, Code

Data
Discovery

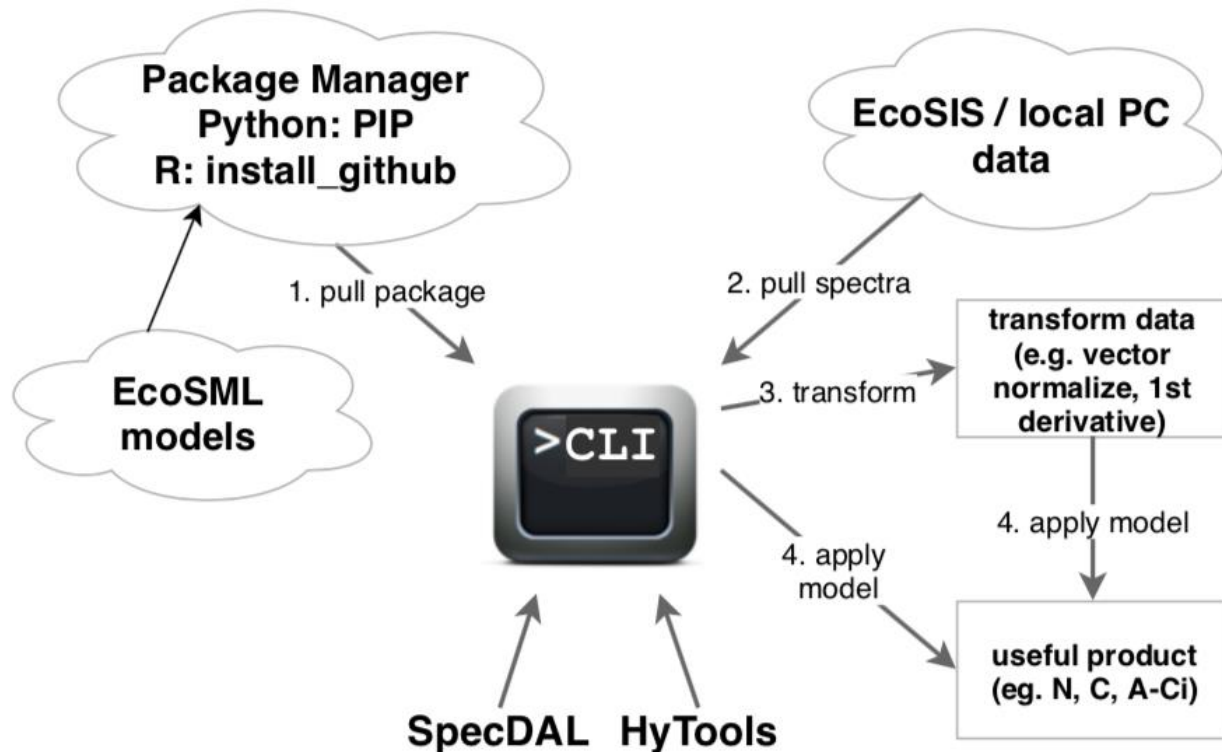
Data Import
& Management



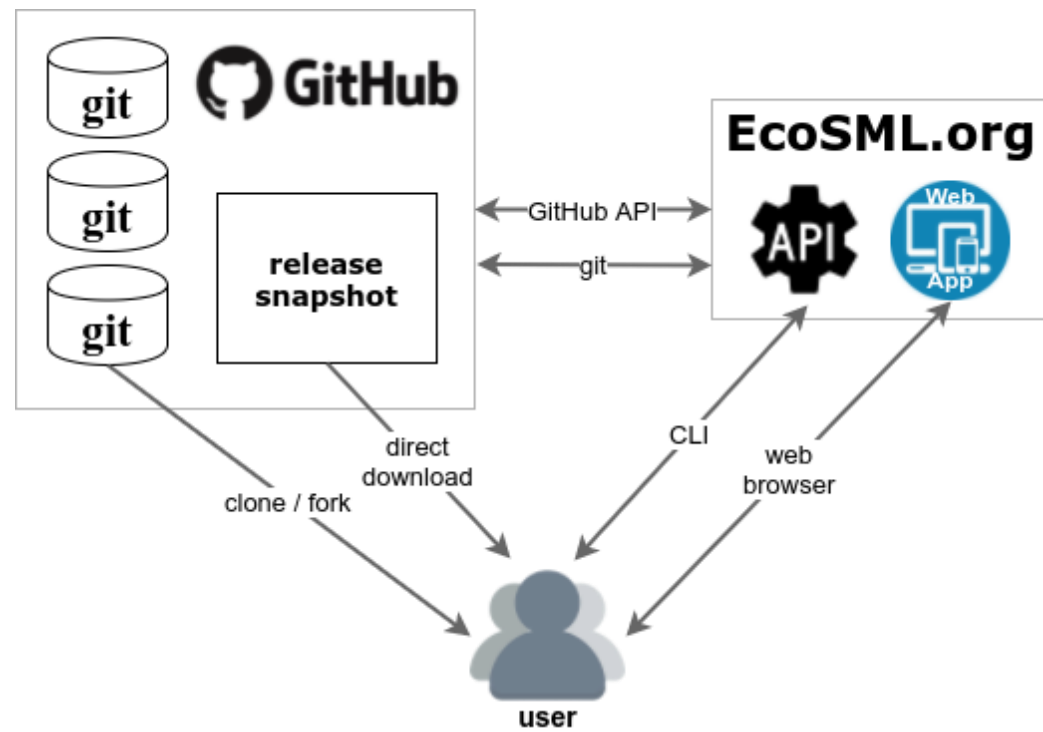
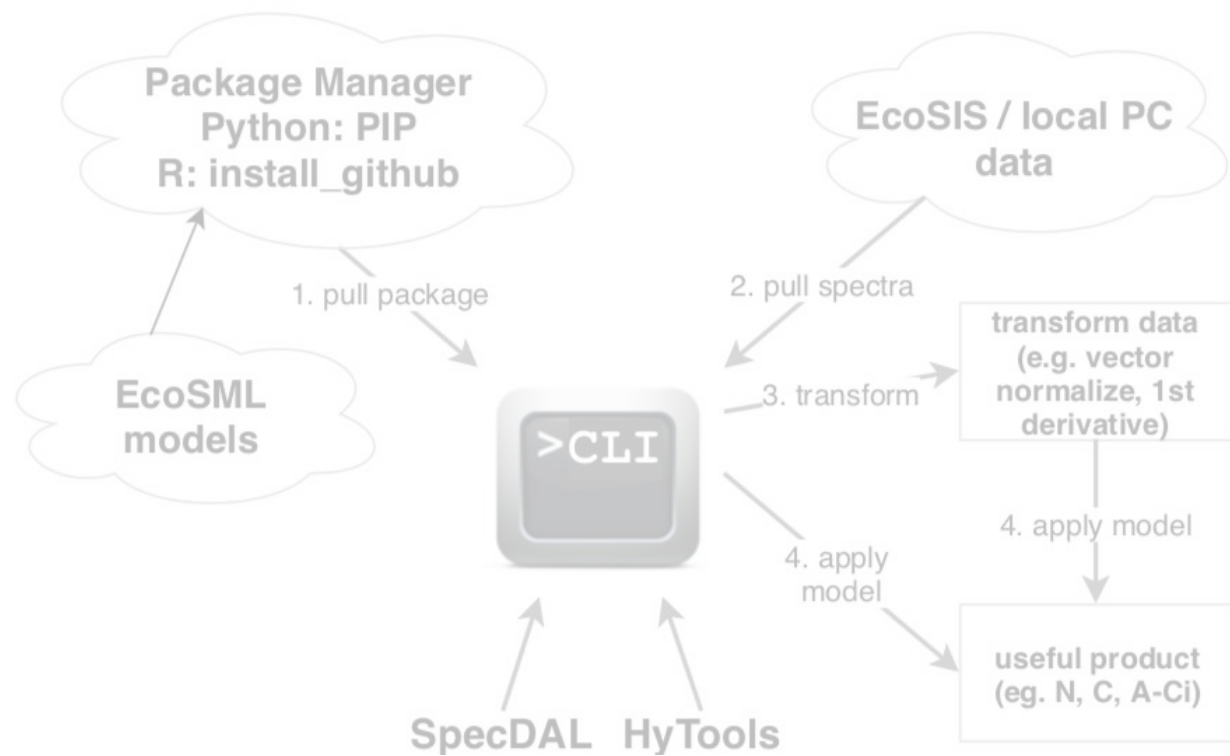
Site-ID	ADL	LMA
site01	2.25	40.22
site02	1.98	42.17
site03	3.21	44.98
site04	2.77	43.22

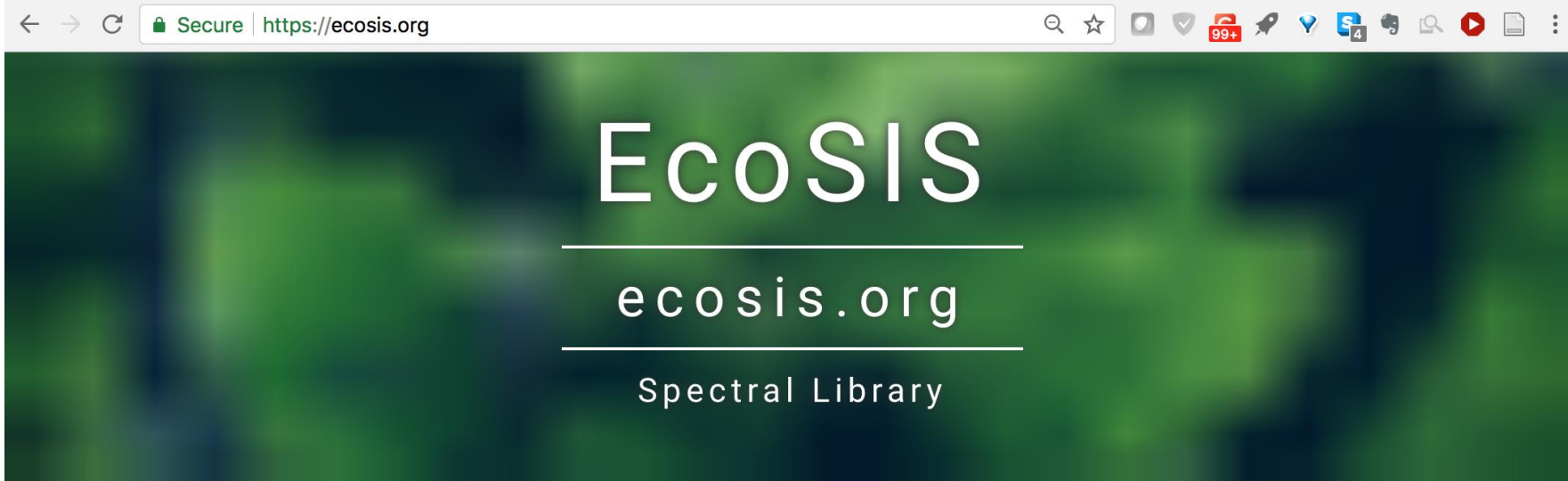






Command Line Interface





Welcome to the EcoSIS Spectral Library, a useful tool for finding spectral data.

69,470 spectra and counting.

[Q FIND SPECTRA](#)

Data maintainers, add or edit spectra [here](#).

Top Organizations

Systems Ecology Lab	31
UW EnSpec	14
Brookhaven National Laboratory	7
University of Utah	6
Foundational Datasets	3

Top Keywords

arctic	33
ndvi	32
productivity	31
tundra	31
phenology	30

Top Themes

ecology	54
phenology	36
biochemistry	15
agriculture	12
forest	12

Recently Added

Coming Soon.



About

[EcoSIS Toolkit abstract](#)

EcoSML.org is part of the EcoSIS Toolkit. Currently under development, EcoSML is planned to be a database of models for retrieving ecologically-relevant information from field spectroscopy data and hyperspectral imagery.

Researchers will provide details and resources to create model packages that include coefficients, error parameters, demonstration data, and code. Users will be able to browse models, explore example code, and test outputs. Model packages will be installable via common package managers like Python's PyPI/pip, as well as R's CRAN.

Initially, EcoSML will accommodate model forms including Partial Least Squares Regression and Gaussian Process Models, and will be expanded to accept other model formats in the future.

EcoSML has two major objectives:

- Serve as a widely-accessible online repository where researchers can offer spectroscopy-derived models to the science community

Current Status:

Building the architecture of EcoSML.org

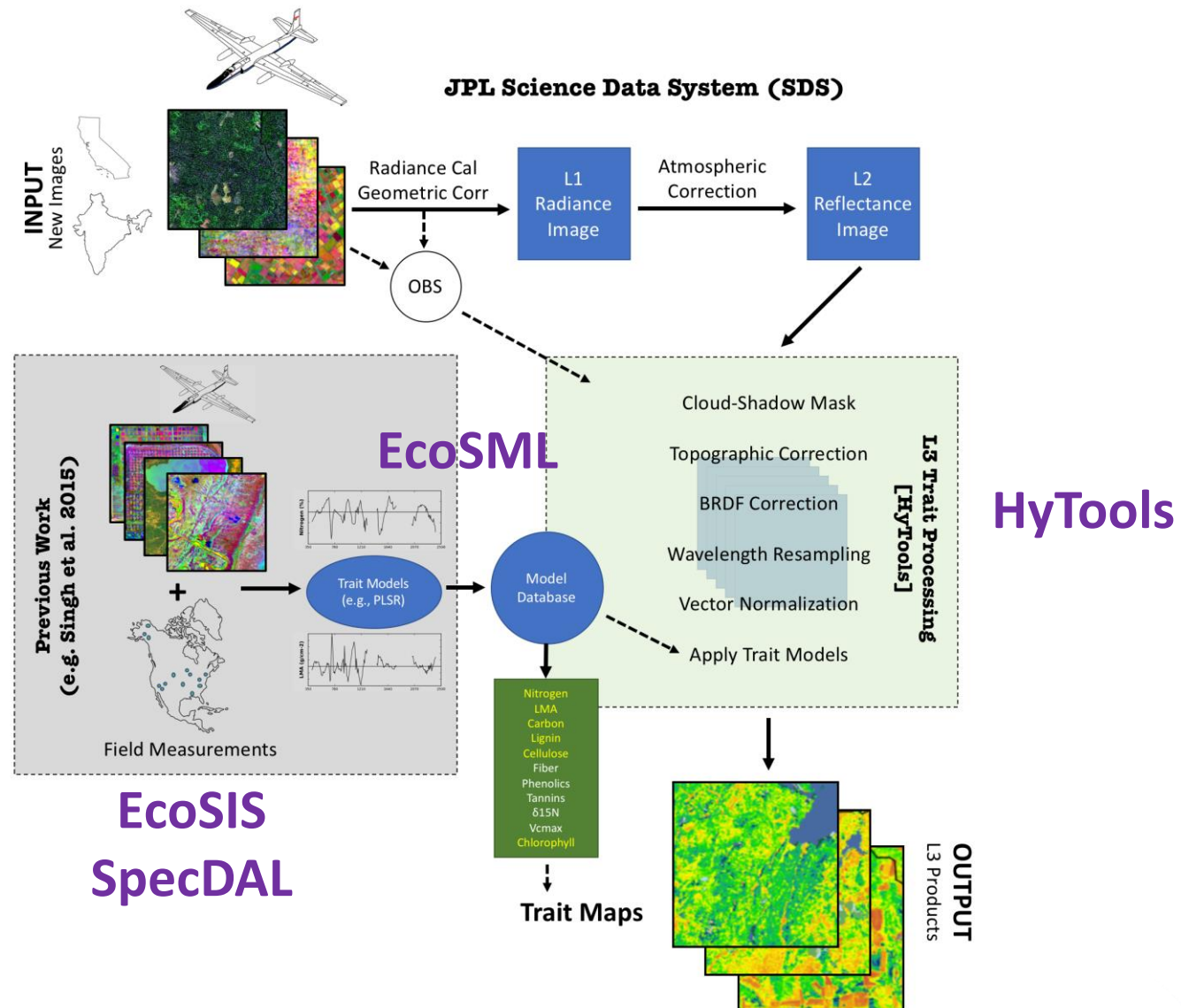
Assimilating models and model structures to populate EcoSML.org

SpecDAL exists, on GitHub

HyTools being tested at JPL



Current State: HyTools/SpecDAL





Spectral Data Discovery: Access & Analysis through the EcoSIS Toolkit

PI: Philip Townsend, University of Wisconsin - Madison

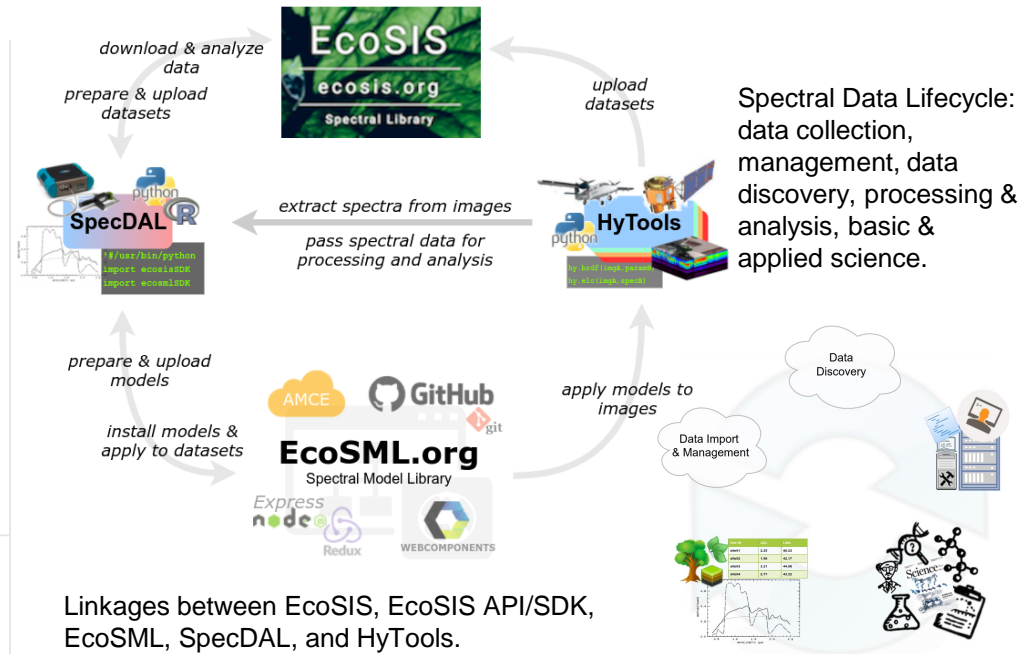
Objectives

- expand participation in EcoSIS.org by building the EcoSIS Toolkit; remove barriers to entry by:
- enabling better integration of environmental spectroscopy data from multiple sources, including alignment of data and spectra-derived models from different researchers, studies, and instruments
- facilitating processing and preparation of datasets for analysis and subsequent distribution via EcoSIS.org
- providing support, context, and resources for assessing and applying existing spectroscopy models
- allowing programmatic access to datasets and models via Software Development Kits in commonly-used open-source programming languages

Approach

- create the EcoSIS Toolkit: a suite of complementary open-source tools that make processing and preparation of spectral data straightforward
- establish EcoSML.org model repository; provide access to models and related resources as installable packages in Python, R, etc.
- create EcoSIS SDK libraries to allow direct and efficient programmatic access to via open-source languages
- continue and expand SpecDAL to ease and standardize handling and processing of environmental spectroscopy data
- further develop HyTools to make processing and analysis of hyperspectral imagery easier, cheaper, and more accessible

Key Collaborator: Justin Merz, Erin Wagner



Spectral Data Lifecycle: data collection, management, data discovery, processing & analysis, basic & applied science.

Key Milestones

- EcoSML: establish Github package structure Dec/17
- SpecDAL: installer package, drivers Mar/18
- EcoSIS SDK: functioning Python library Mar/18
- HyTools: refine existing functionality Jun/18
- EcoSML: functioning API for use with SpecDAL Dec/18
- EcoSIS SDK: functioning R library Mar/19
- SpecDAL: GUI and workflow scripts Mar/19
- HyTools: complete proposed additional functions Jun/19

TRL_{in} = 3 TRL_{out} = 5

Thank you!

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