

Soundscapes to Landscapes (S2L)

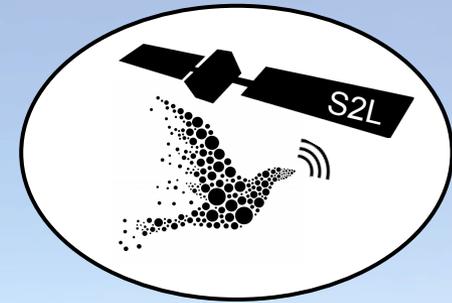
Monitoring Animal Diversity from Space Using Citizen Scientists

Matt Clark (PI, Sonoma State Univ.)

Leo Salas (Point Blue Conservation Science)

Scott Goetz (Northern Arizona Univ.)

Lisa Micheli (Pepperwood Preserve)



Funding: NASA's Citizen Science for Earth Systems Program (16-CSESP16 0055)



GEO BON, 2017

EBV classes

Candidates

Genetic composition

Co-ancestry
Allelic diversity
Population genetic differentiation
Breed and variety diversity

Species populations

Species distribution
Population abundance
Population structure

Species traits

Phenology
Body mass
Natal dispersion distance
Migratory behavior
Demographic traits
Physiological traits

Community composition

Species richness
Species interactions

Ecosystem function

Net primary productivity
Secondary productivity
Nutrient retention
Disturbance regime

Ecosystem structure

Habitat structure
Ecosystem extent and fragmentation
Ecosystem composition by functional type

Essential Biodiversity Variables

Satellite-based

TRACKING BIODIVERSITY

Ten variables

Proposed variables for satellite monitoring of progress towards the Aichi Biodiversity Targets.

Species populations
• Species occurrence **Animals?**

Species traits

• Plant traits (such as specific leaf area and leaf nitrogen content)

Ecosystem structure

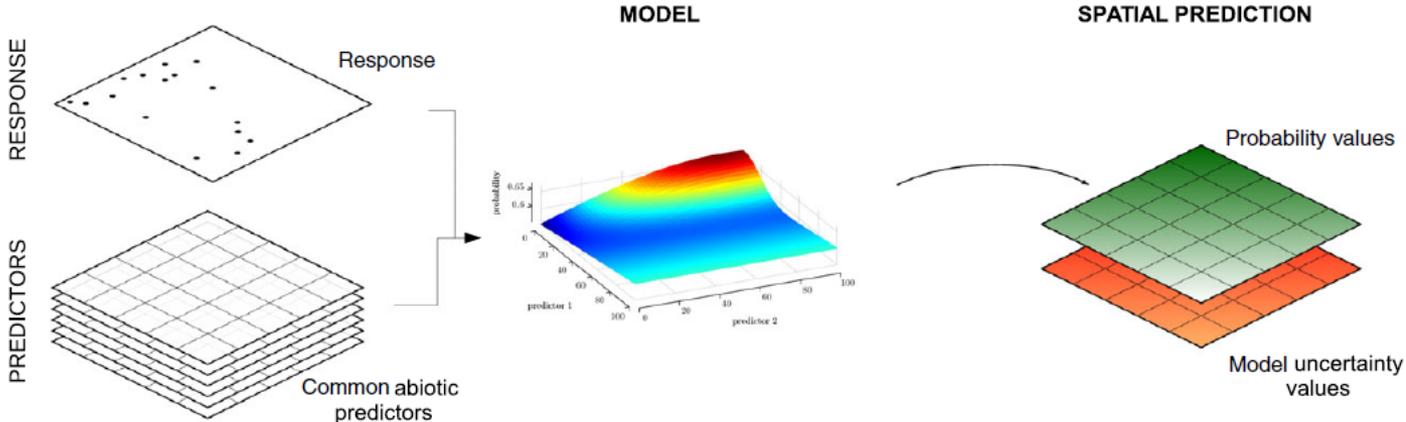
• Ecosystem distribution
• Fragmentation and heterogeneity
• Land cover
• Vegetation height

Ecosystem function

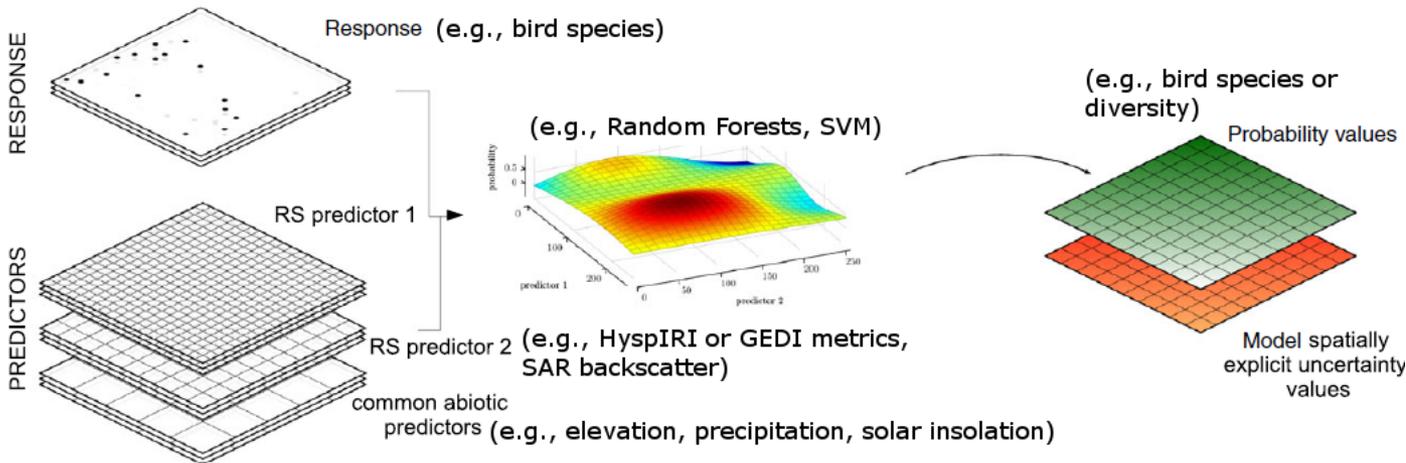
• Fire occurrence
• Vegetation phenology (variability)
• Primary productivity and leaf area index
• Inundation

Skidmore et al., Nature, 2015

Next Generation Species Distribution Modeling

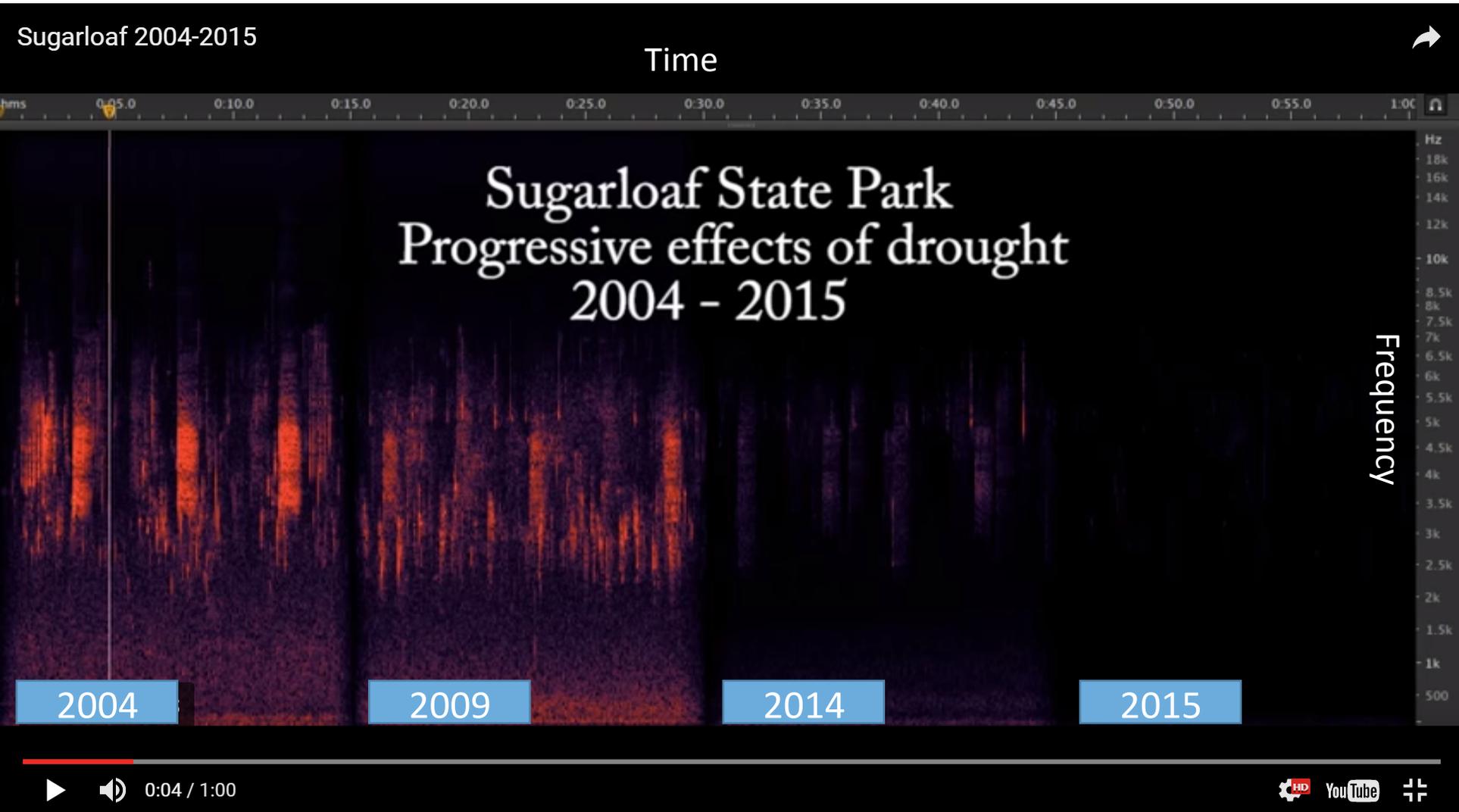


Modeling framework of current Species Distribution Models (SDMs), which include coarse abiotic predictors and model outputs



“Next Generation” SDMs that include finer-scale remote sensing predictors and model output (species probability of occupancy, richness).

Soundscape Spectrogram



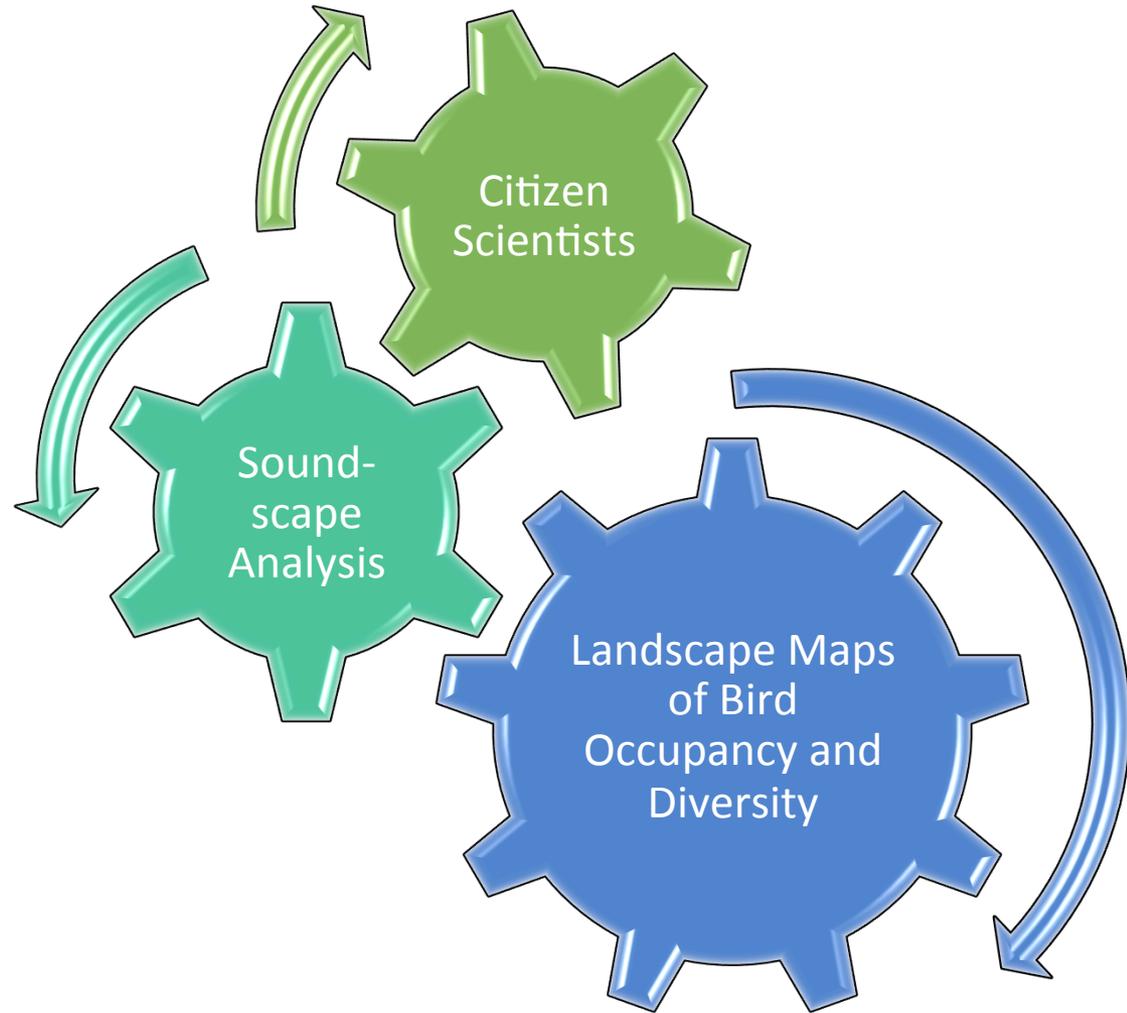
Bernie Krause, 2015

<https://youtu.be/N2z54euleGU>

Soundscapes to Landscapes

A science-based project that seeks to advance animal biodiversity monitoring from the next generation of Earth-observing satellites.

Initial focus is on birds.



Citizen scientists

- Types

- Birders
(Audubon, others)
- Undergraduate students
- Landowners

- Main tasks

- Bird observations
- Place/retrieve sound recorders
- Bird call identification in web-based system





1-minute recording every 10 minutes
3-4 days in the field

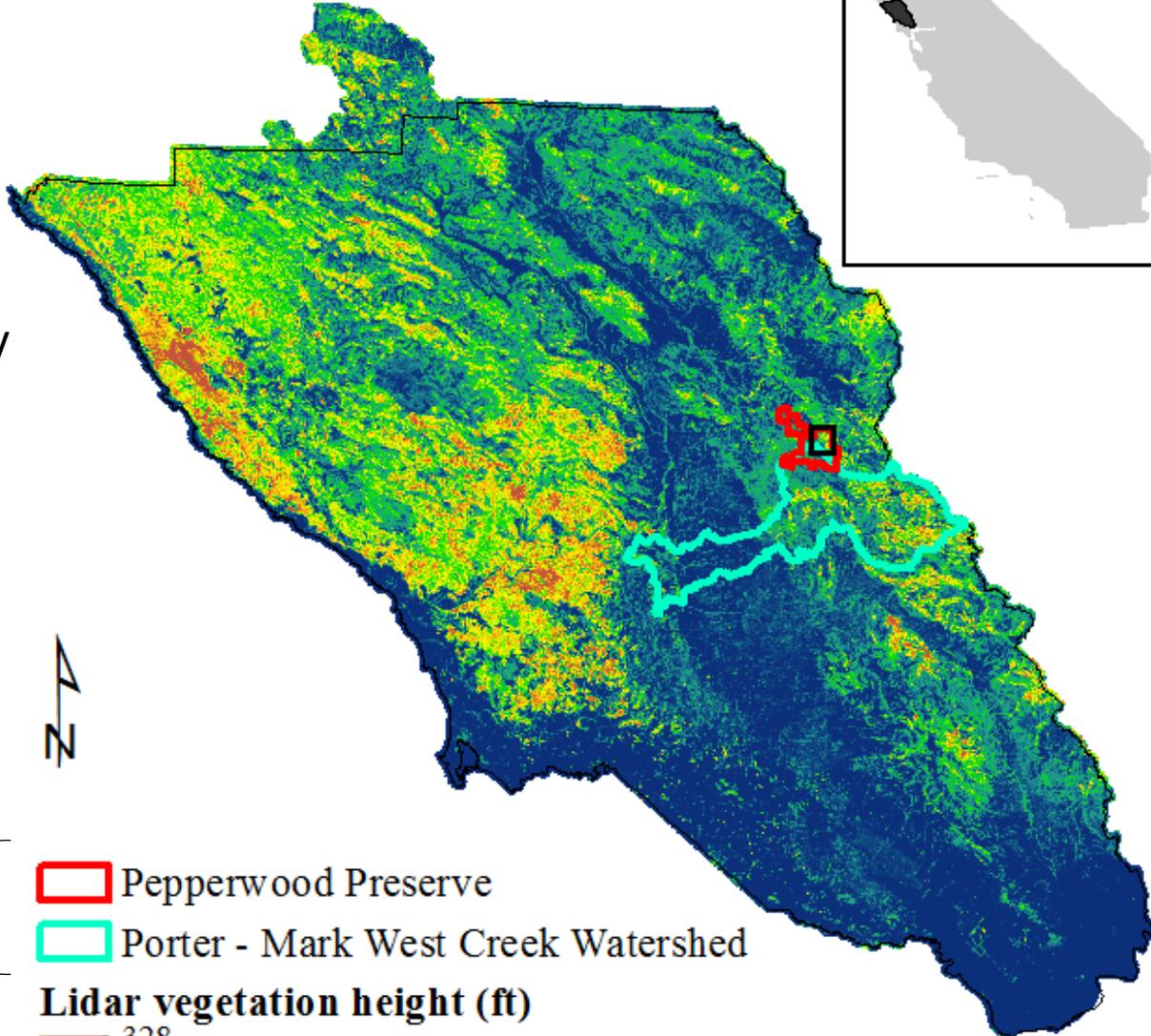


0 12.5 25 50 Km



Sonoma County

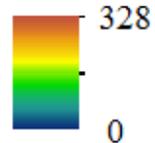
60 mi north of
San Francisco



Prototype
Phase

- Pepperwood Preserve
- Porter - Mark West Creek Watershed

Lidar vegetation height (ft)

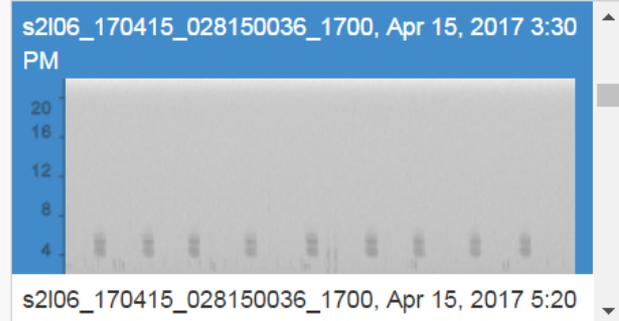


Sonoma County Vegetation Mapping and
LiDAR Consortium, NASA, University of
Maryland, Watershed Sciences, Inc.,
Tukman Geospatial LLC



junco 213

1 2 3



0.00 s
0.00 s, 8.2 kHz

s2106_170415_028150036_1700-2017-04-15_15-30.flac

No tags associated to this recording.

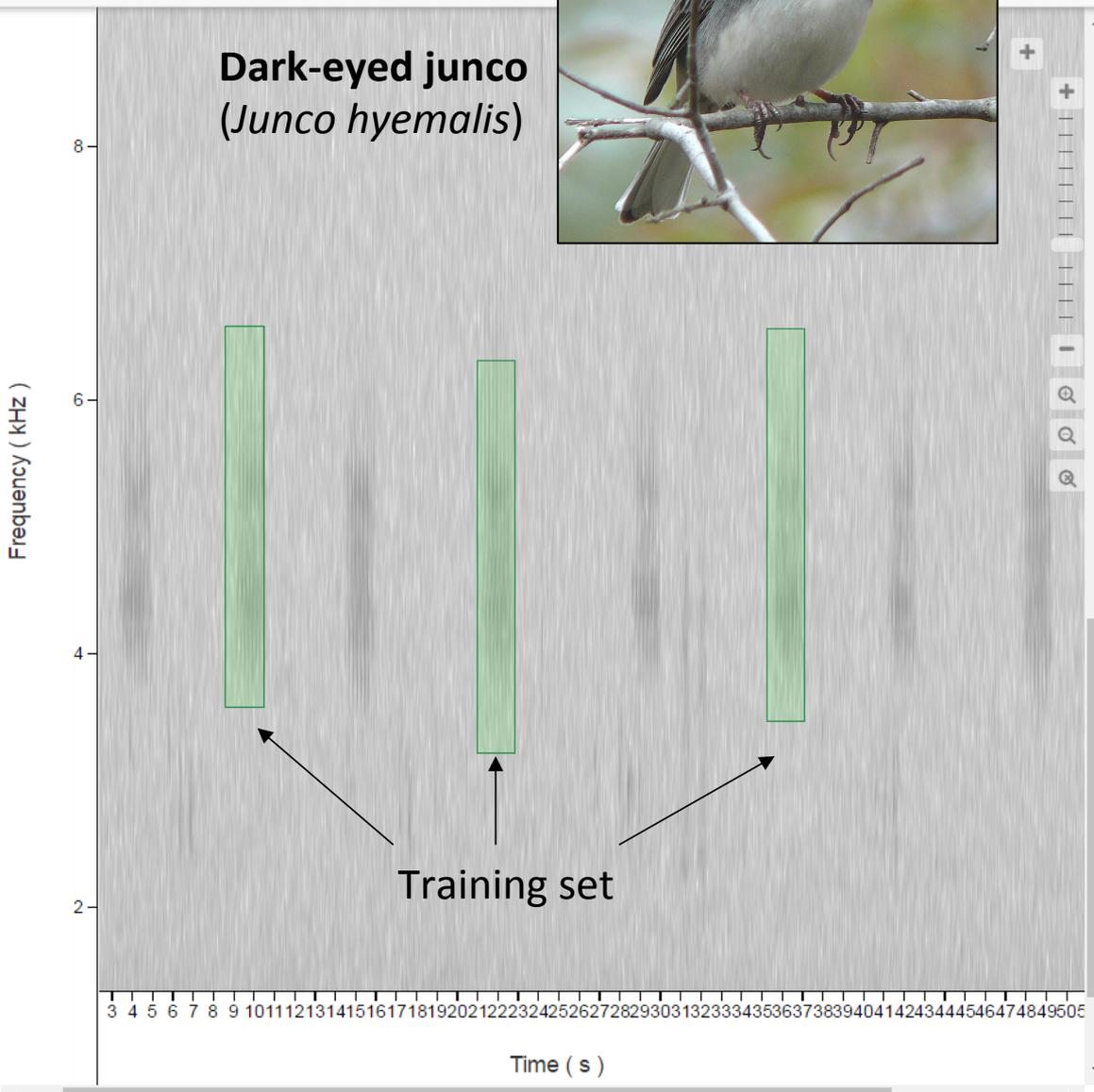
Species Presence Validation 0 / 0

Birds

Species	Sound	Annotation
Junco hyemalis	Mechanical Song	Present
Picoides villosus	Simple Call	---



Dark-eyed junco
(Junco hyemalis)



Dark-eyed junco (*Junco hyemalis*)



Arbimon II - Soundscape x

Secure | <https://arbimon.sieve-analytics.com/project/soundscapes2landscapes/analysis/m>

Arbimon

- Models
- Classifications
- Soundscapes
- Audio Event Detection

[← back](#)

Model details

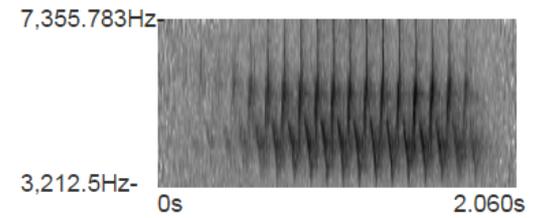
Name:	Junco hyemalis
Type:	Pattern Matching
Creation date:	May 16, 2017 6:25 PM
Last updated:	May 16, 2017 6:25 PM
Creator:	Matthew Clark
Species:	Junco hyemalis
Sound:	Mechanical Song

Training set

Name:	Junco hyemalis
Creation date:	May 16, 2017 5:00 PM
Pattern ROI Count:	7
Pattern Bandwidth:	4,143.283Hz

Training set pattern:

Zoom:



Model validation details

Total validations used: 7

Present:	3	Absent:	4
In fitting:	2	In fitting:	2
In verification:	1	In verification:	2

Statistics

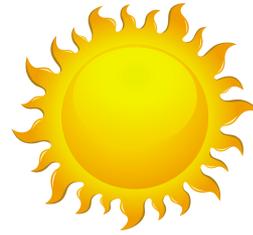
Accuracy:	0.666666666667
Precision:	0.5

Actual	Predicted	
	P	A
P	1	0
A	1	1

P = Present, A = Absent

Imaging spectroscopy
(HyspIRI, simulated)

Chemistry



Lidar (GEDI, simulated)
SAR (Sentinel-1, PALSAR)

3D Structure







NASA HypsIRI Preparatory Science Campaign



AVIRIS
Airborne Visible / Infrared Imaging Spectrometer

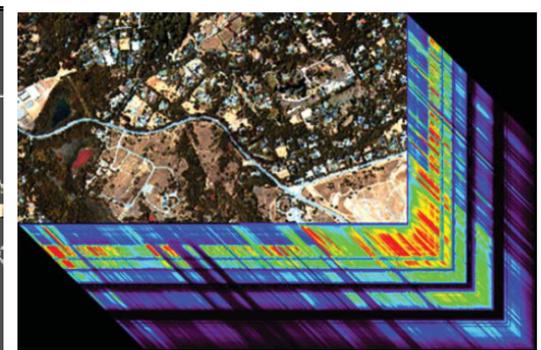
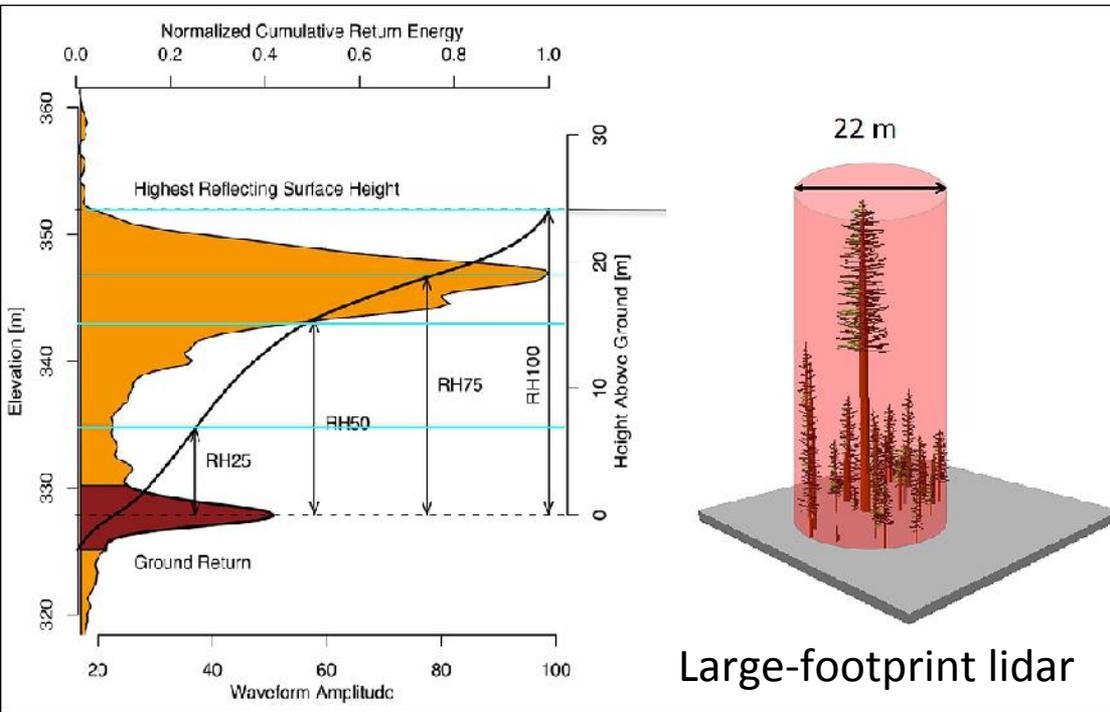


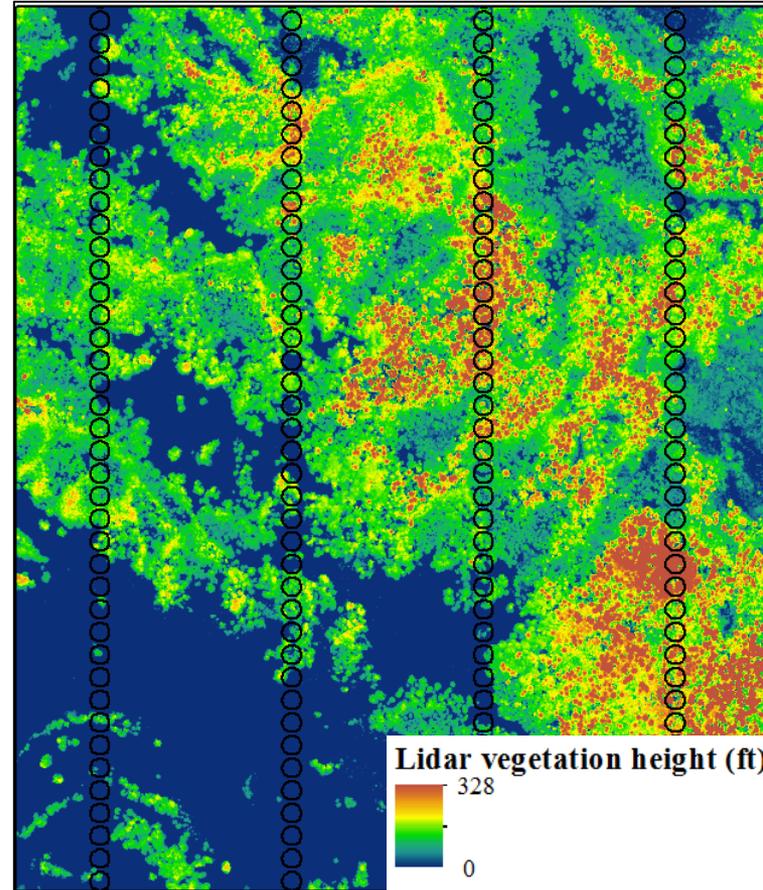
Figure 1: Hyperspectral image of the Jasper Ridge Biological Reserve near Stanford, made from an AVIRIS image with 224 bands, acquired from the AVIRIS sensor.

AVIRIS data availability
2013, 2014, 2015
spring, summer, fall
2016
summer

Global Ecosystem Dynamics Investigation (GEDI)



Large-footprint lidar



Global spatial sampling, repeat coverage, track change

Simulated GEDI

Acoustic space vs. species richness

