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Tools for Integrating Remote Sensing and Organismal Occurrence Data Streams

NASA BEF Breakout Round 4: Trainings and Tutorials
22 May 2019
3.50-4.30pm & 4.45-5.25pm

While you are waiting:

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Tools for Integrating Remote Sensing and Organismal Occurrence Data Streams

AIST-16-0092

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Tools for Integrating Remote Sensing and Organismal Occurrence Data Streams








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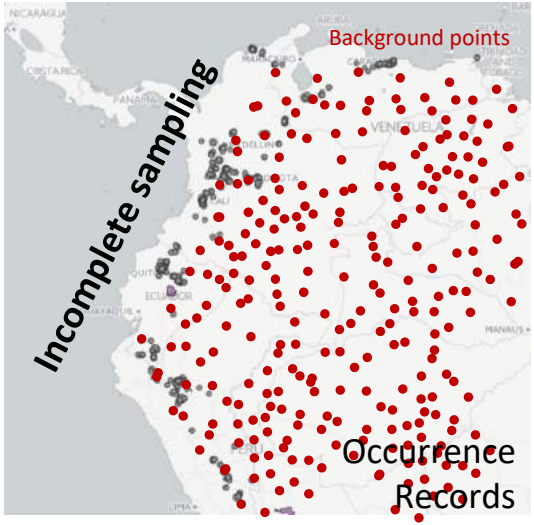
AIST Program Objectives

- Reduce the risk, cost, size, and development time for Earth science space-based and ground-based information systems,
- Increase the accessibility and utility of science data, and
- Enable new observation measurements and information products.

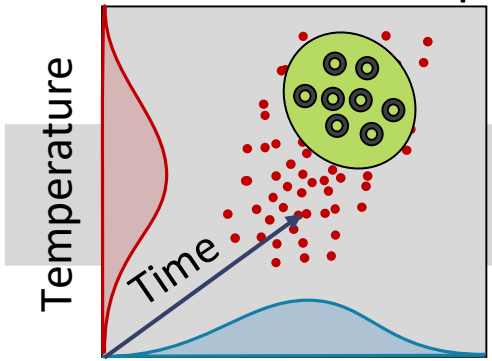
Break the 80/20 rule

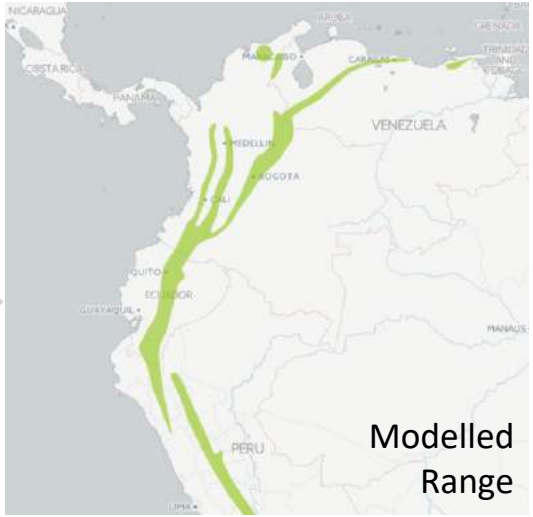
80% of a data scientist's time is spent finding, cleansing, and organizing data, leaving only 20% to actually perform analysis (IBM 2019)

Environmental Niche Modeling



Niche model in
"Environmental Space"





"Species Distribution Modeling". Google Scholar: 3.5m results (74k since 2018)!

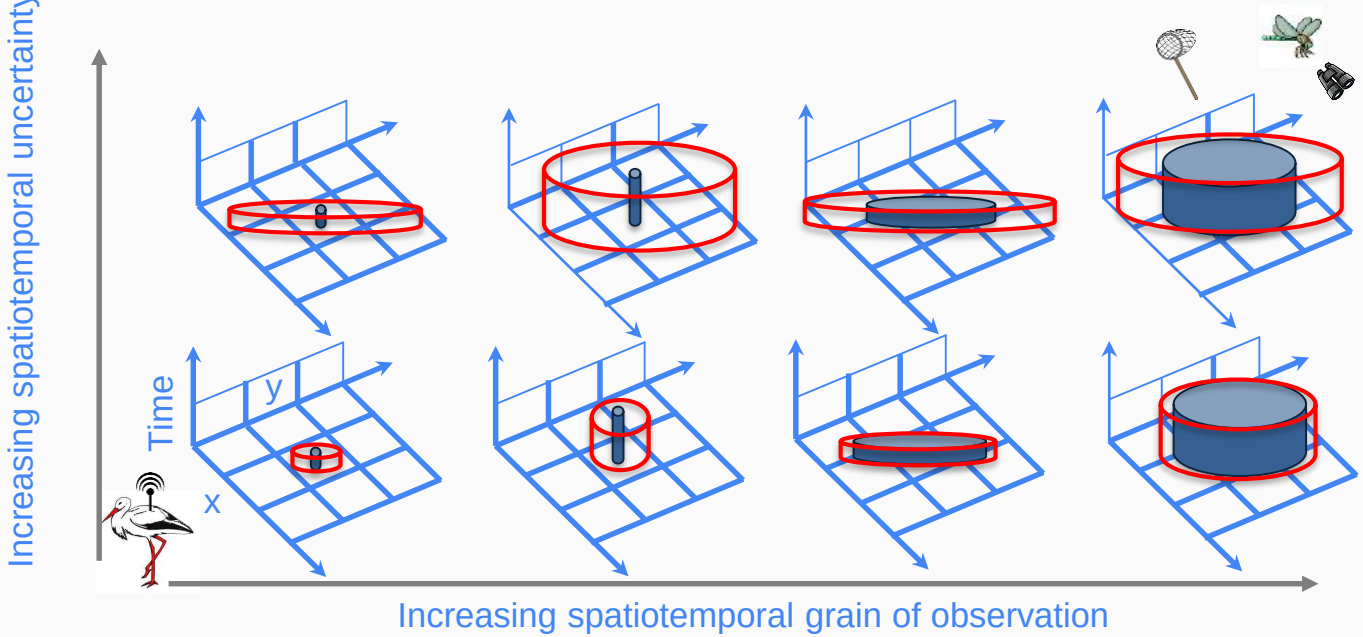
Many ways to use these data (maxent and friends)

Integrating species occurrence and environmental data is not trivial.

Observation Grain
Locational Uncertainty

Spatio-temporal grain and uncertainties

- Occurrence record
- Environmental data



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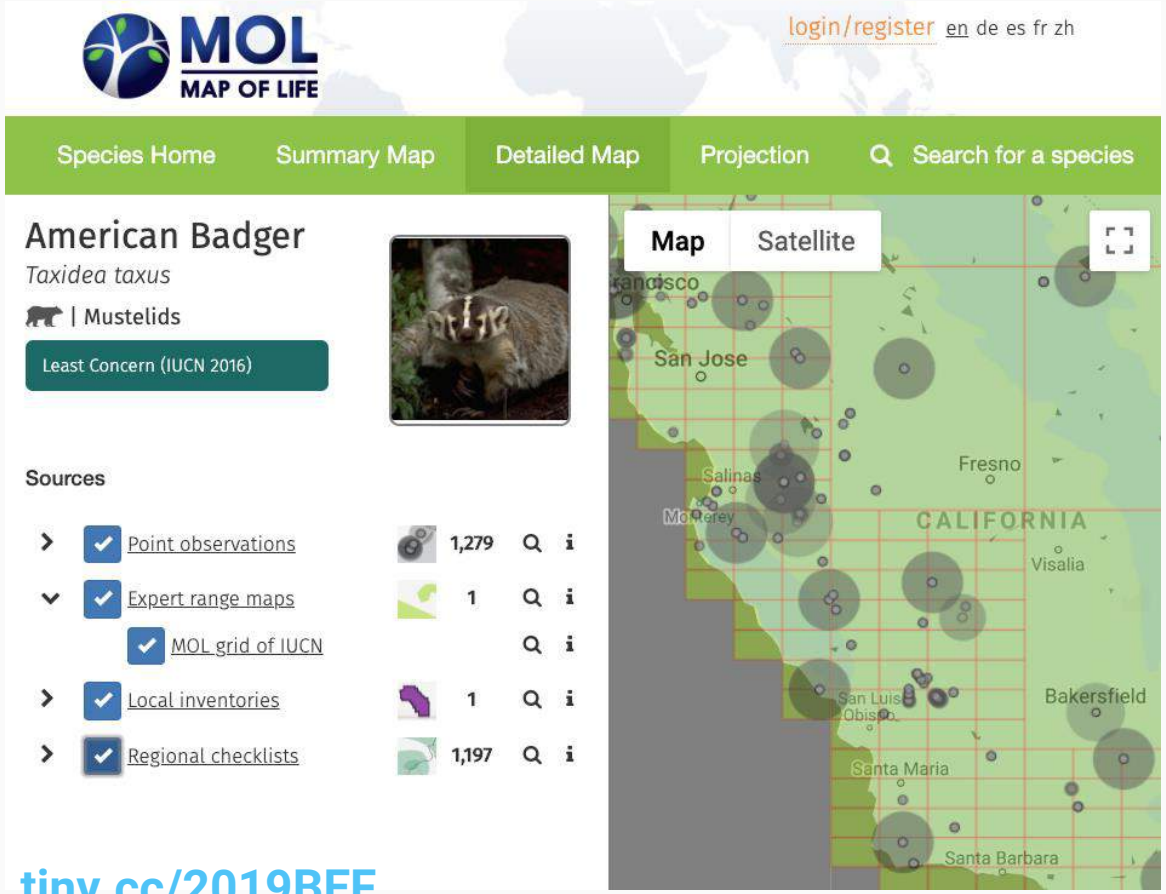
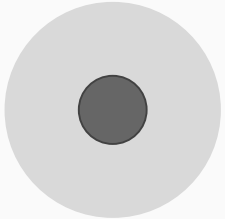
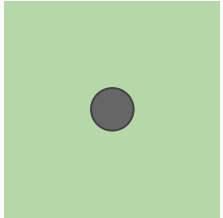
Integrating species occurrence and environmental data is not trivial

American Badger
Taxidea taxus





Spatiotemporal Uncertainties (location error)



Grain of Observation

Example eBird transect

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Motivations for cloud-based environmental annotation

1. Massive data of varying type
   a. Digitized specimen records
   b. Camera traps data
   c. GPS tags (ICARUS)
   d. Citizen science records

1. Observation-level uncertainties and grains (space and time)

   Need to be accounted for in annotation

1. Need for dynamic annotation
   a. Temperature on the day of observation?
   b. Long-term mean conditions?
   c. Environmental Anomalies?

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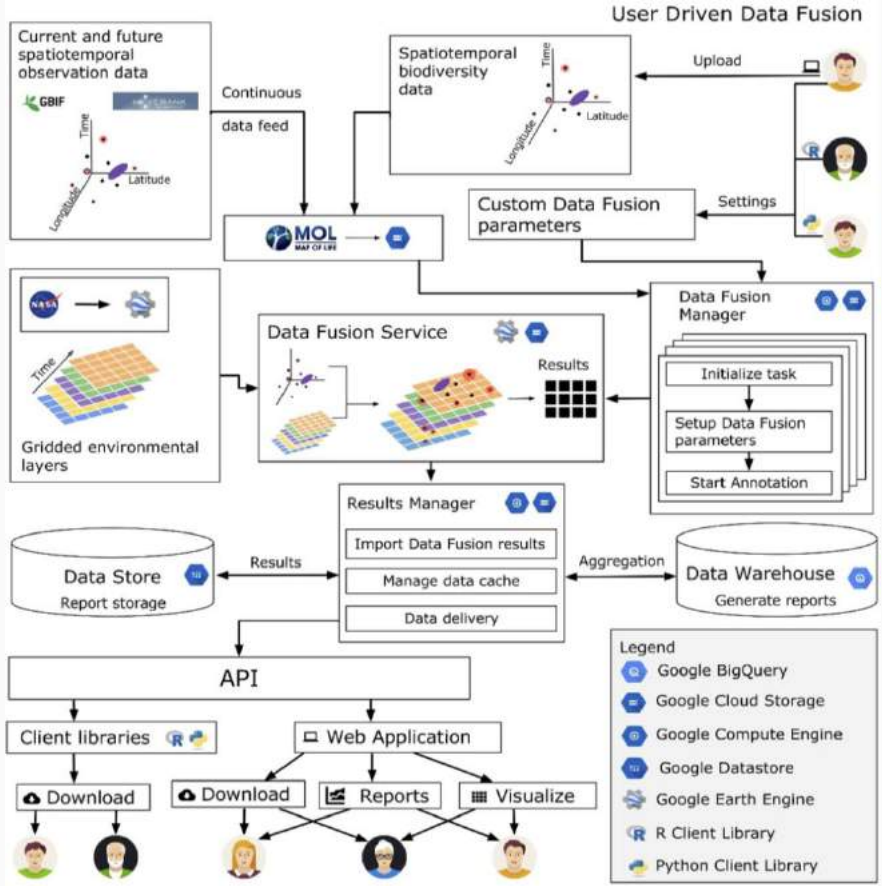
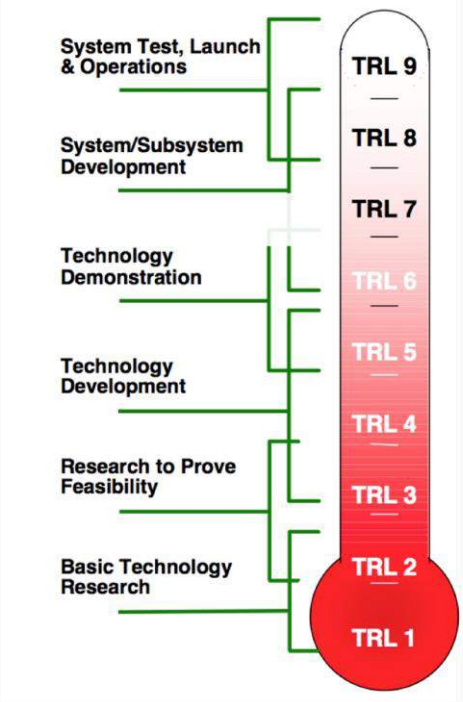
AIST Project Overview

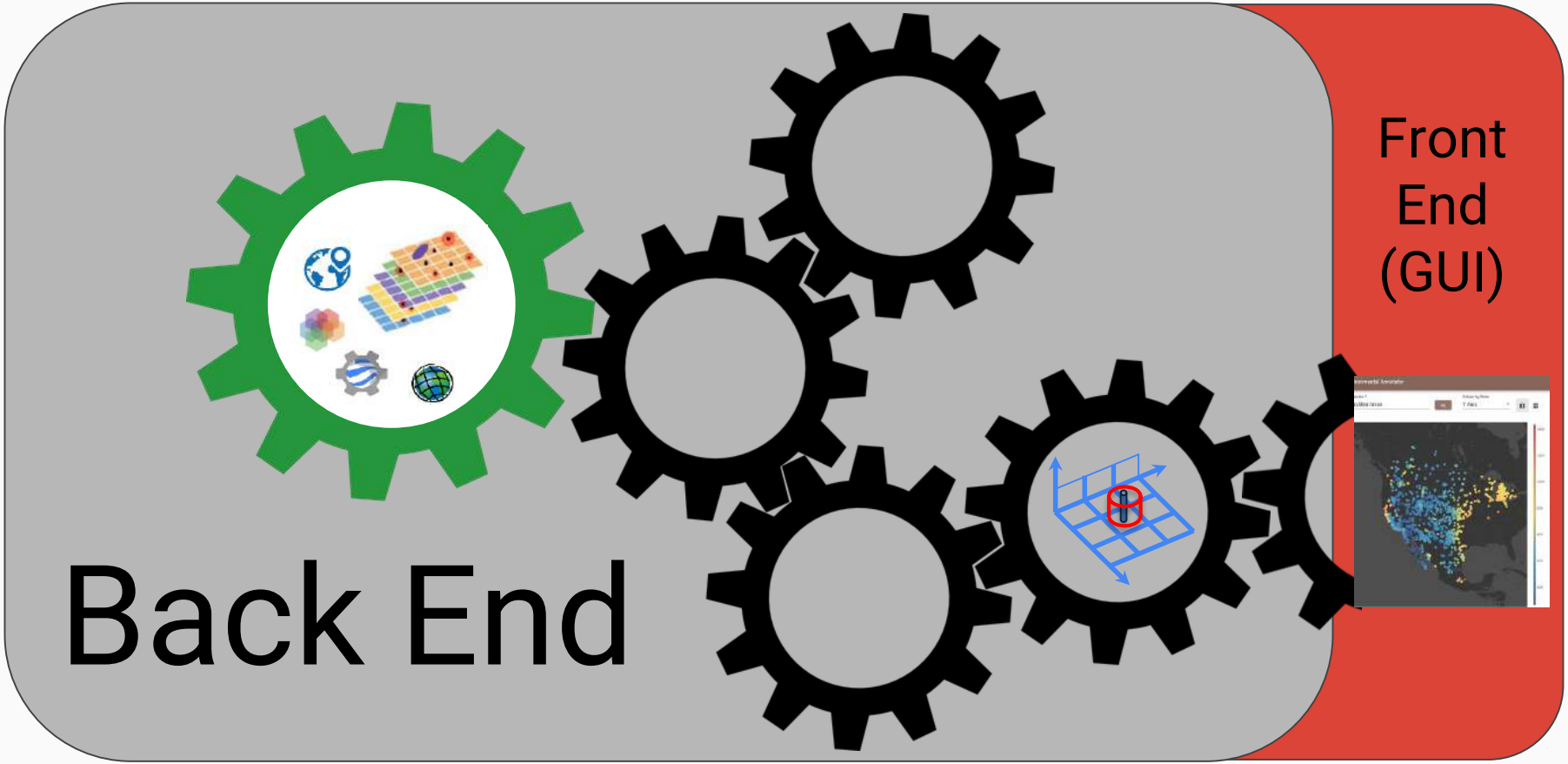


NASA Technology Readiness Level (TRL)



This Project

Computational Infrastructure



Today's Tutorial

Data Upload	Annotation	Data Download	Survey
Upload a sample species occurrence dataset	Annotate it with various environmental data	Download the annotated data for further processing	Complete a survey about the design and utility of this application

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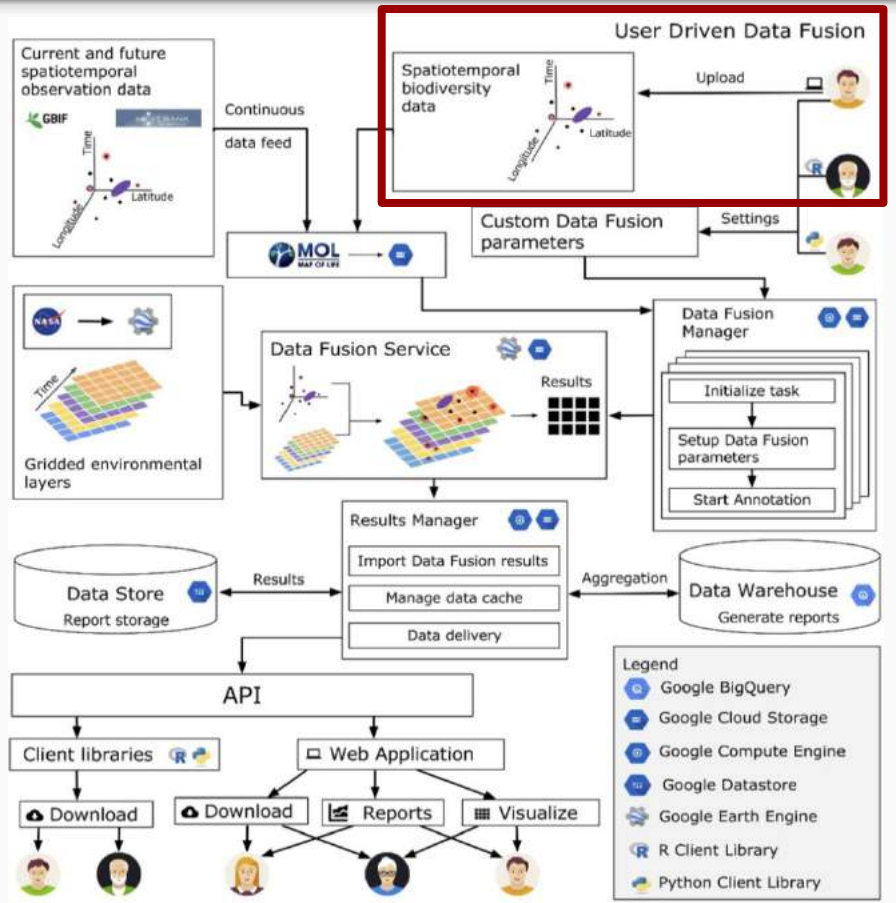
Open the workshop website and scroll down to "Explore the Prototype"

Project Overview: Data Input



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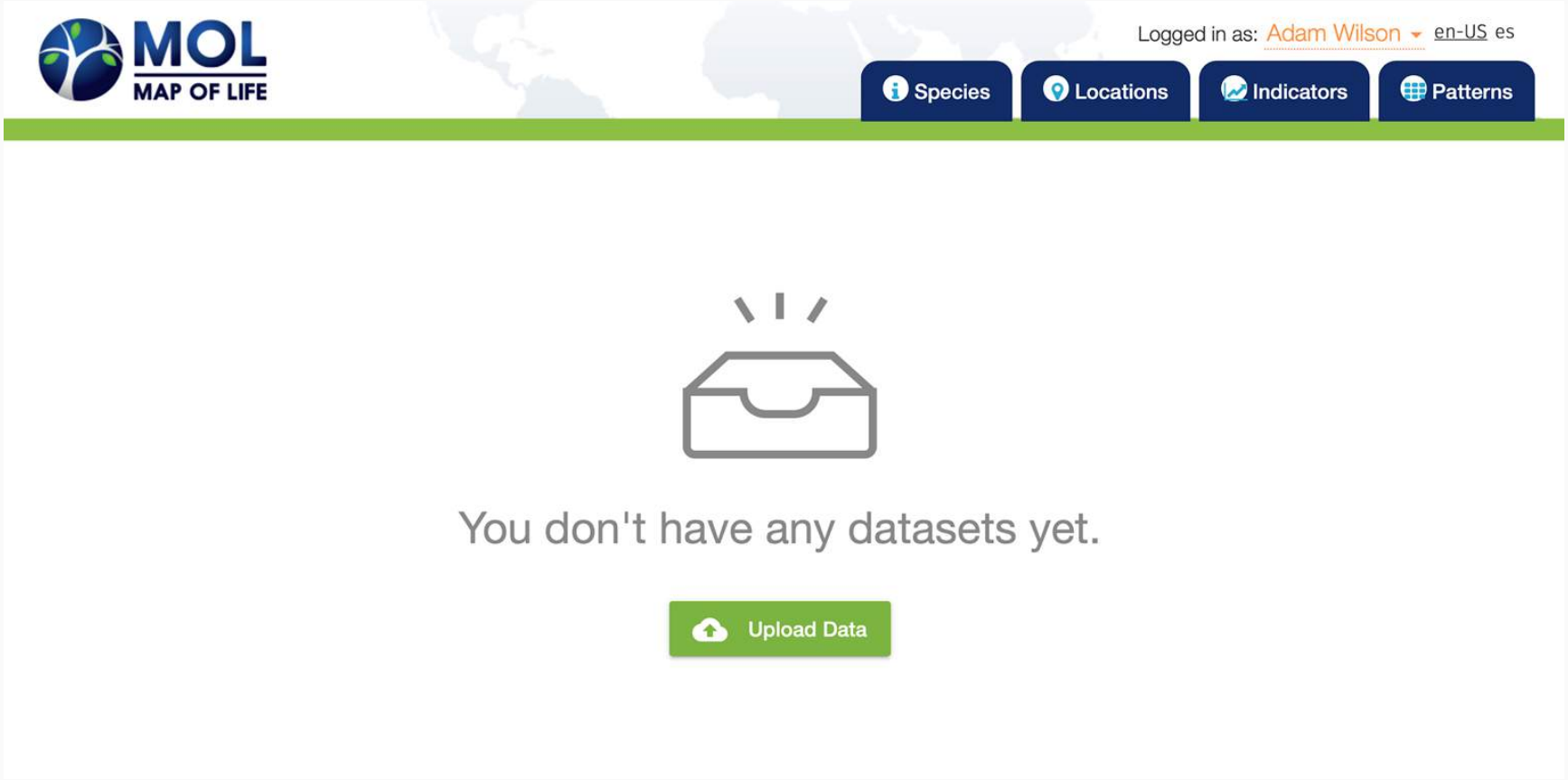
A simple, step by step upload system

https://mol.org/upload-dev



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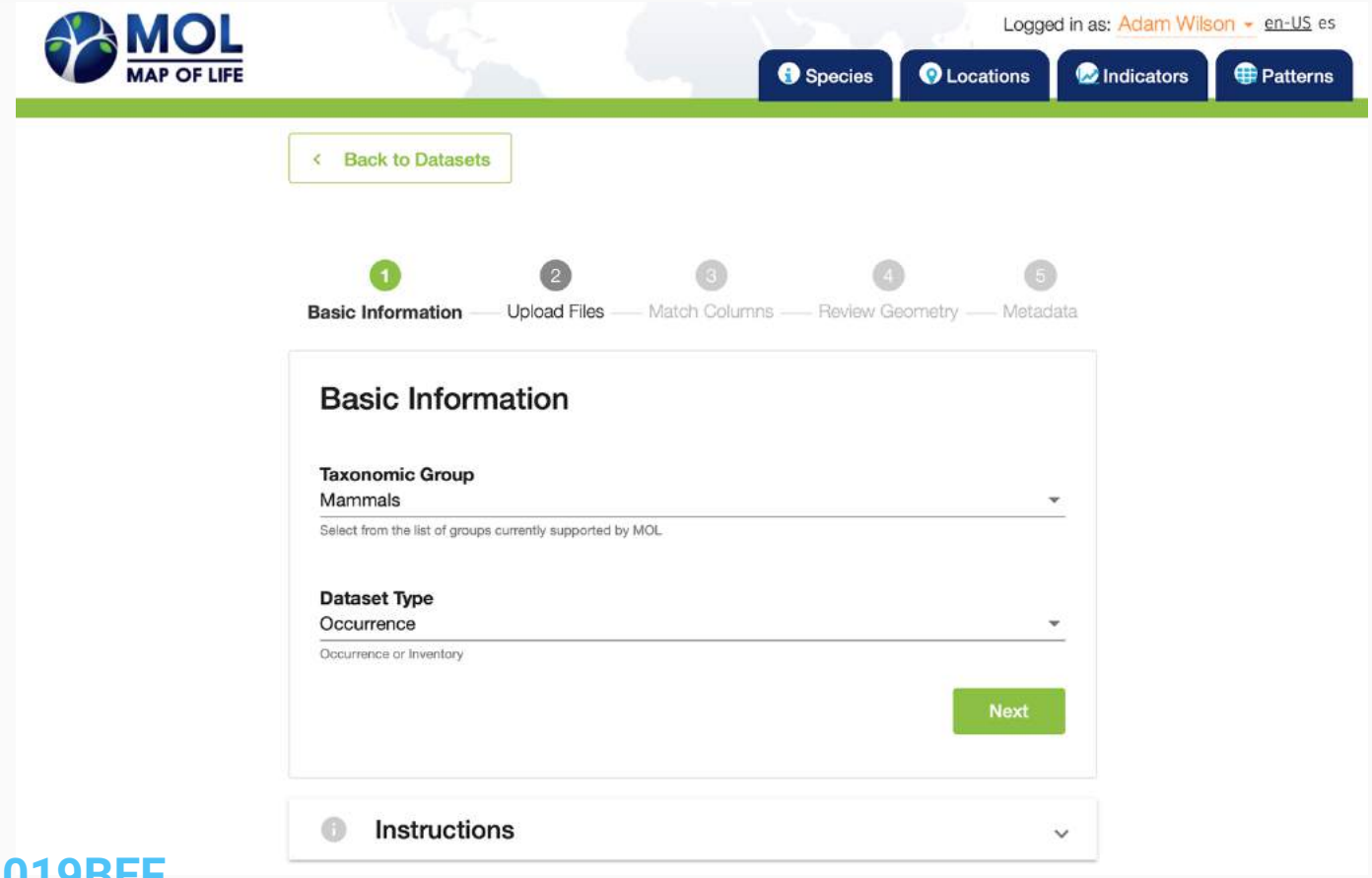
Upload - Locate local file



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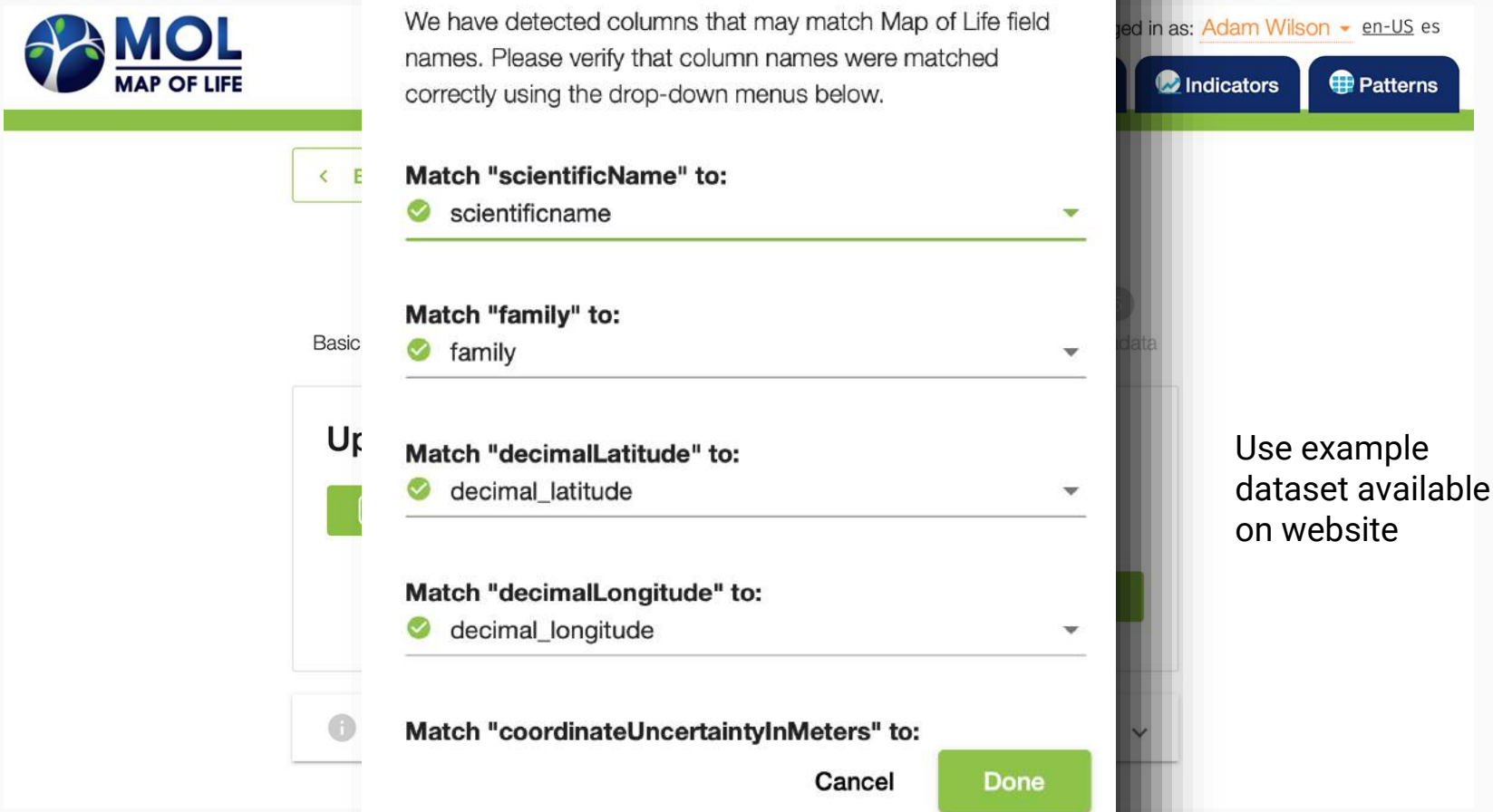
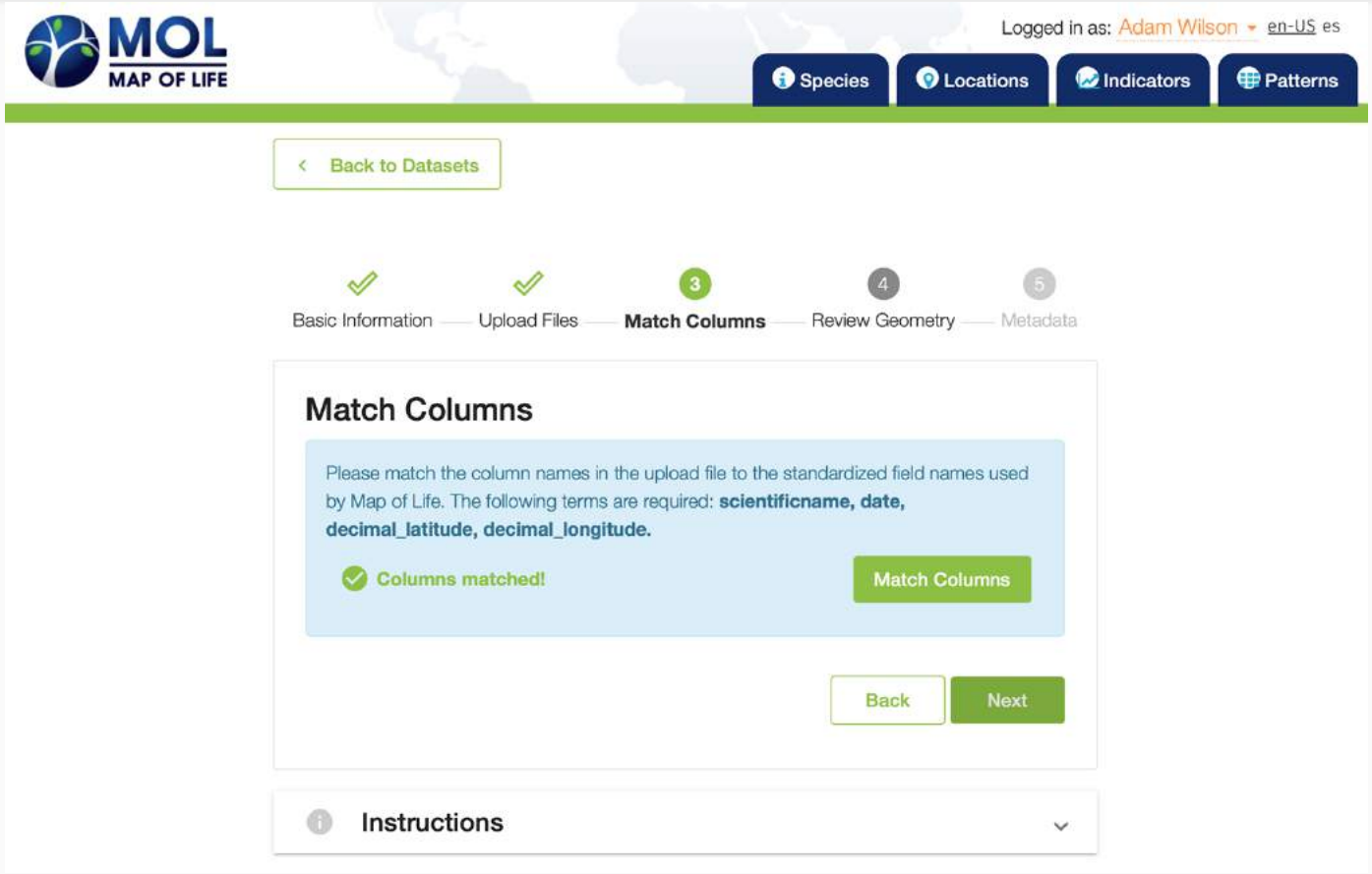
Uploader - Match colum

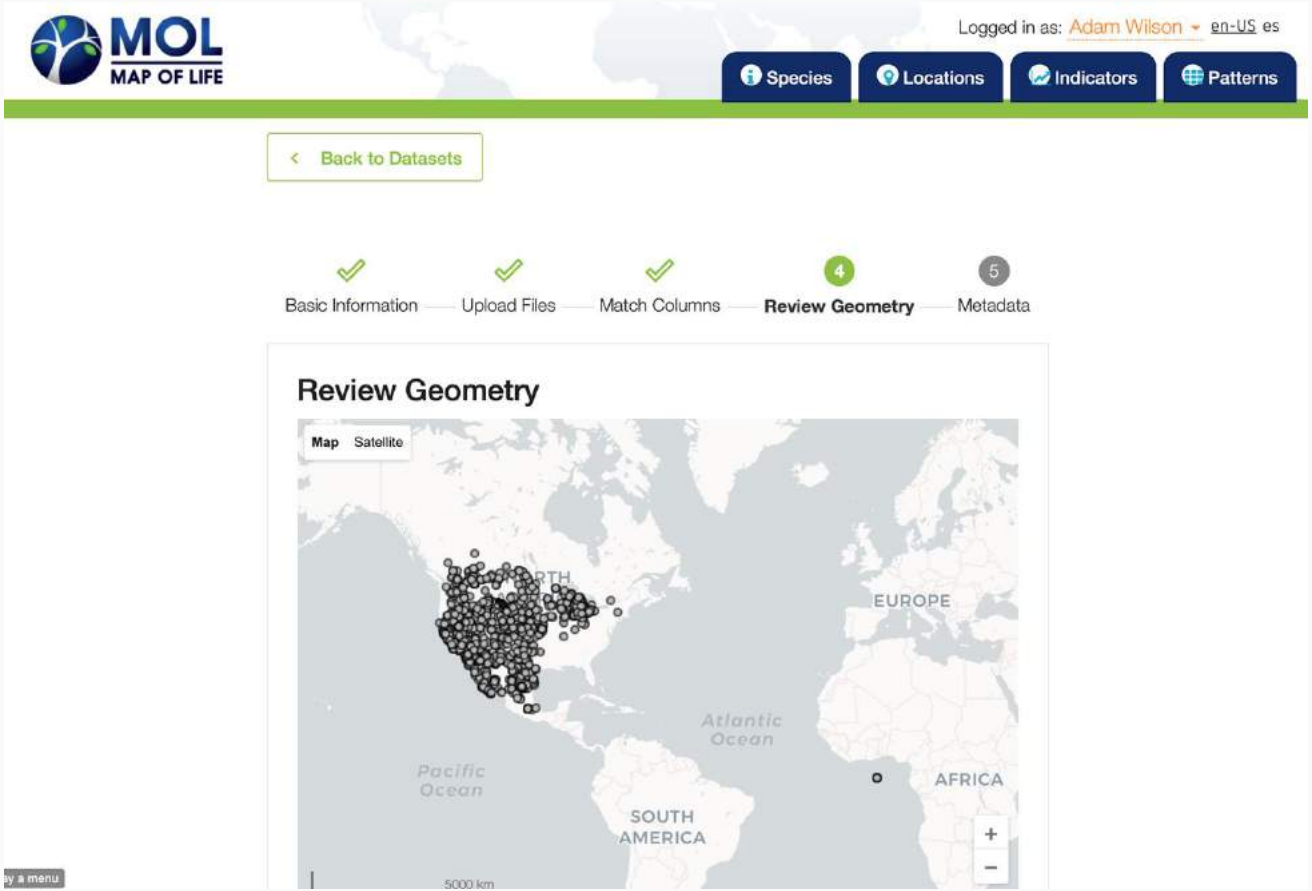


Use example dataset available on website

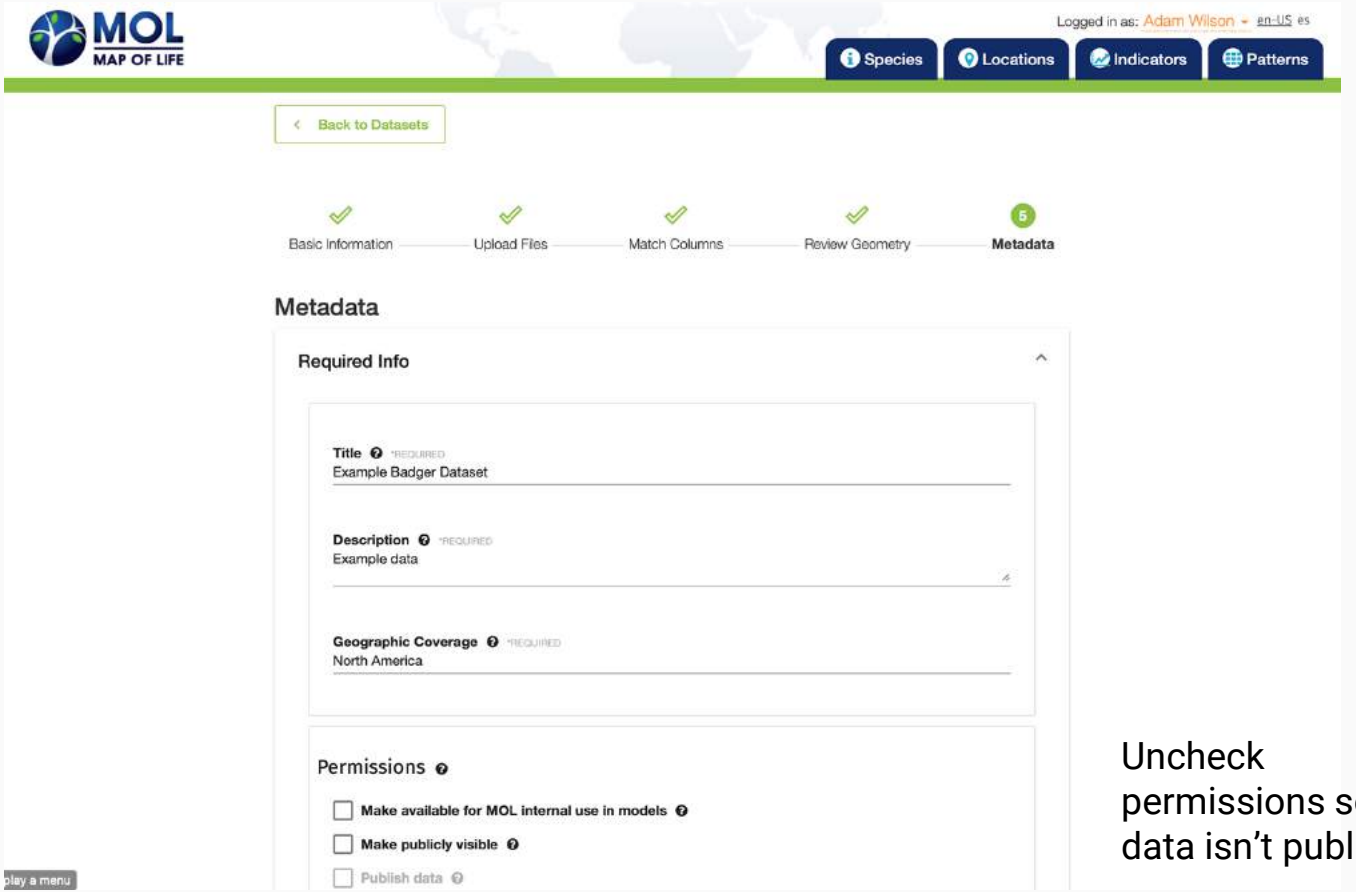
Upload - Matching Successful, move to finalization



Uploader - Review Geometry

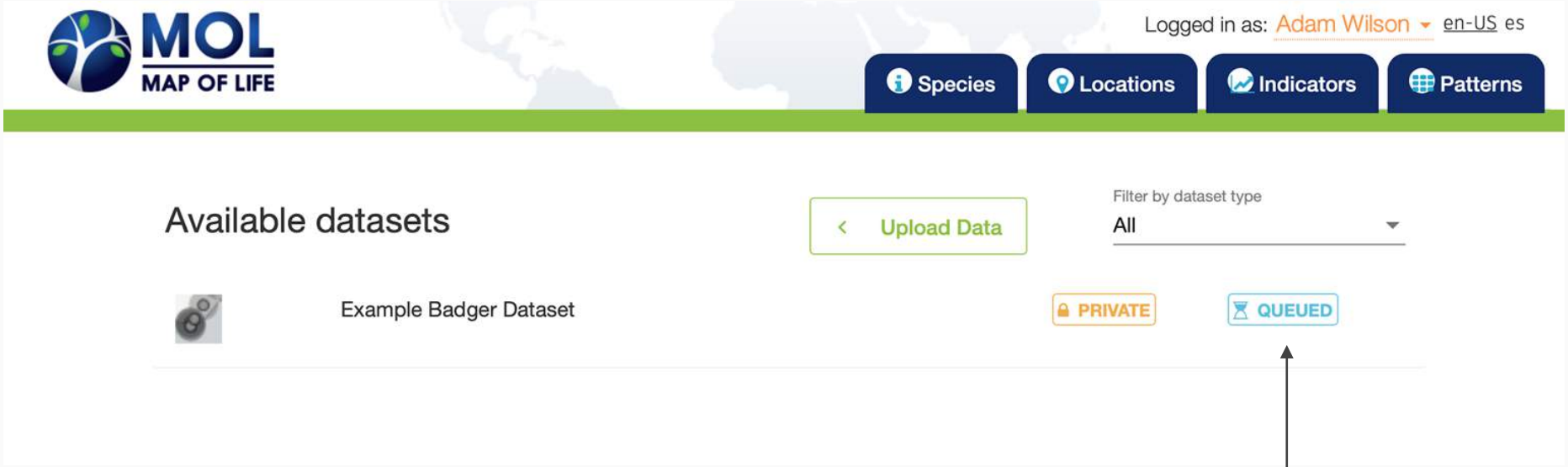


Upload - Dataset Metadata



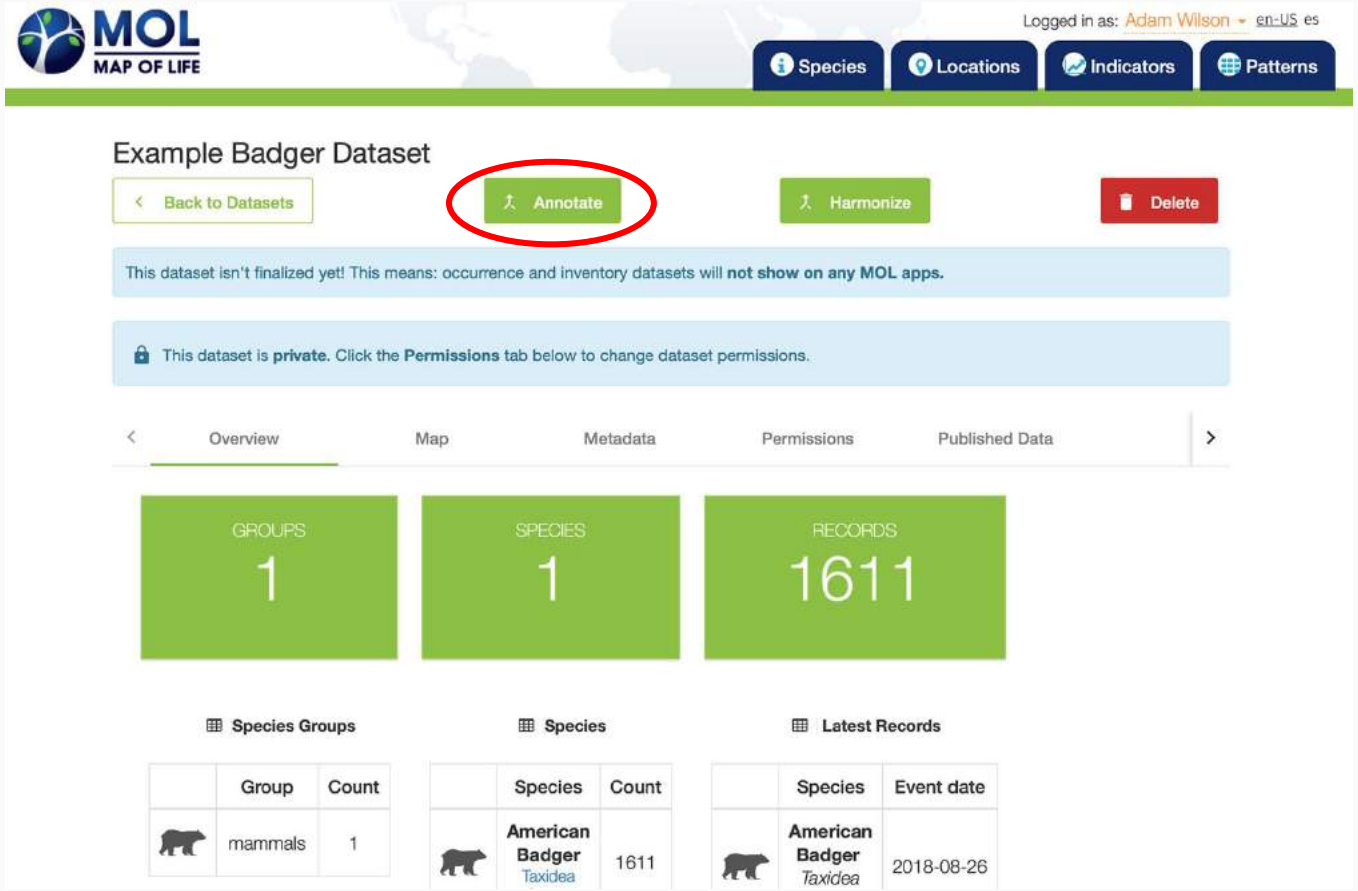
Uncheck permissions so the data isn't published

Upload - Available Datasets



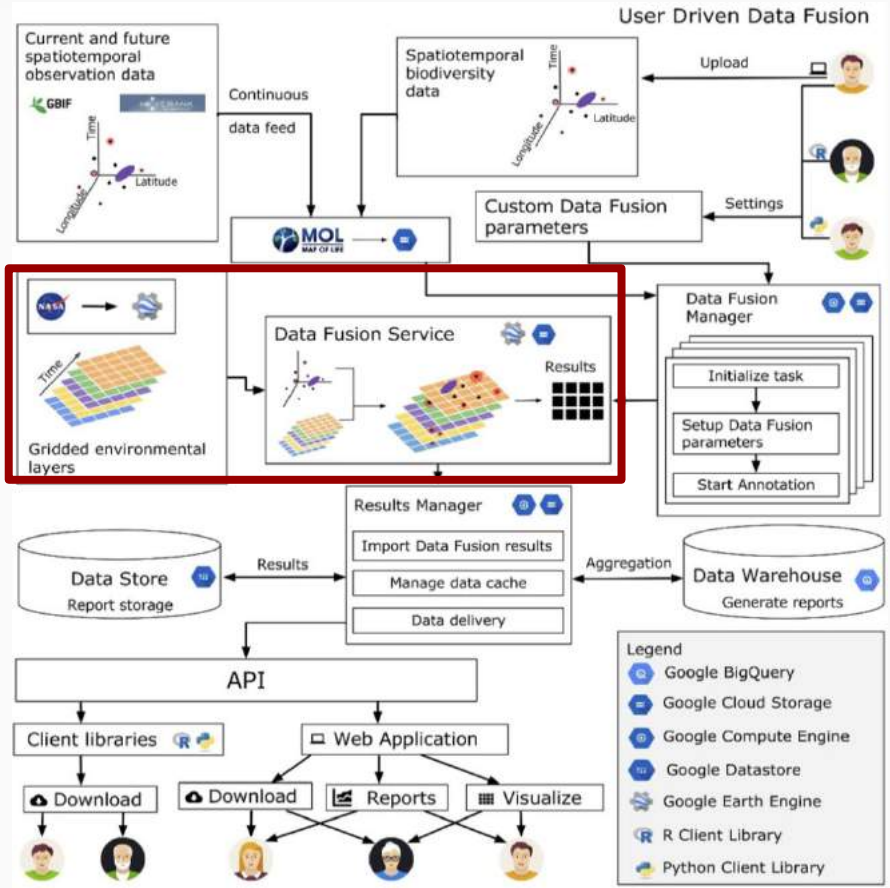
Wait until the data are processed

Upload - Overview



If you don't see the "Annotate" button, confirm you are at **`mol.org/upload-dev`**

Project Overview: Biodiversity-relevant remote-sensing - derived layers



Environmental data availability increasing rapidly

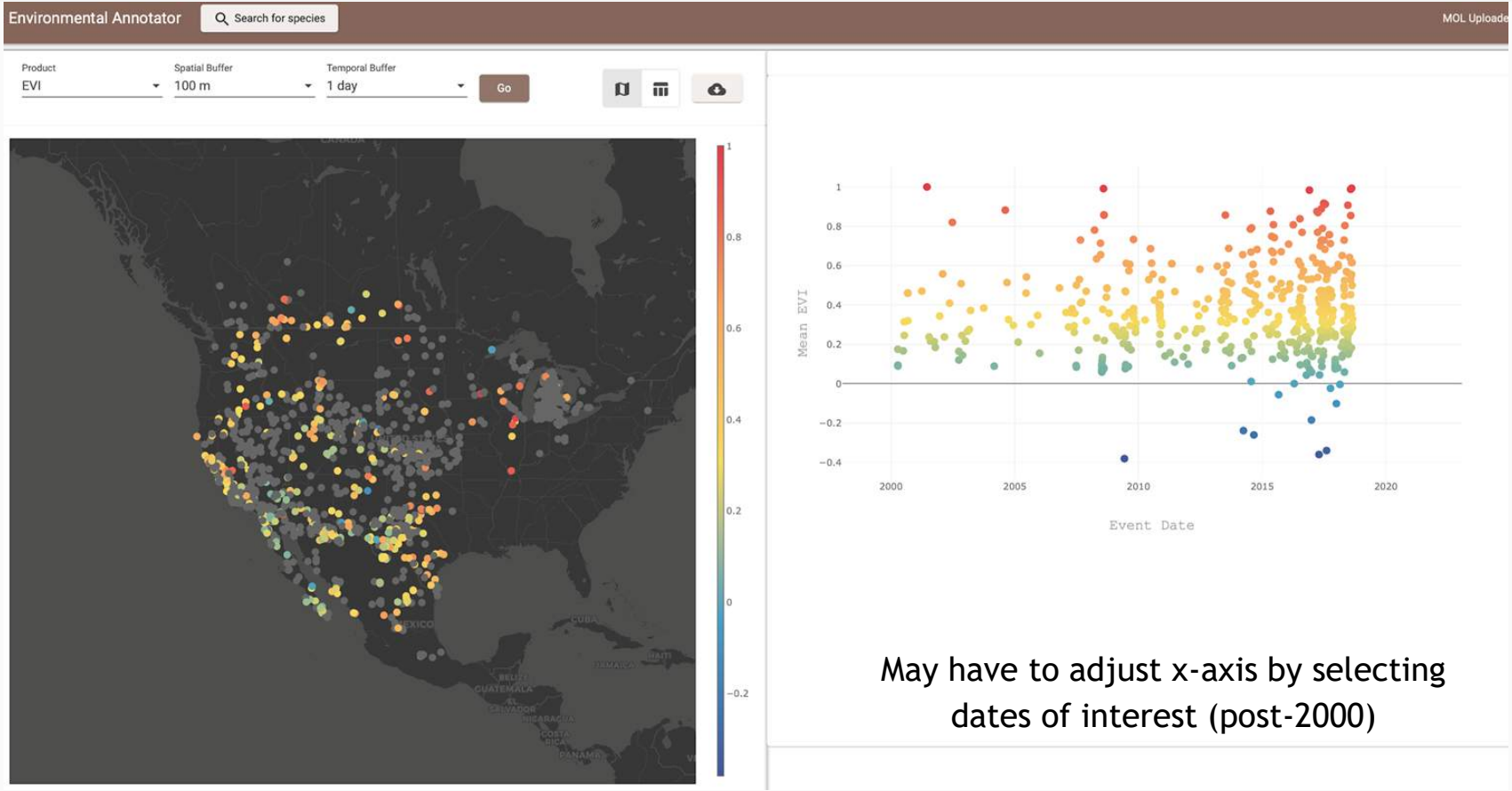
Current:

- MODIS EVI
- CHELSA

Planned:

- Radar-derived forest cover
- Evapotranspiration
- Global 30m DEM
- Surface Water

Environmental Annotator



May have to adjust x-axis by selecting dates of interest (post-2000)

Environmental Annotator - EVI

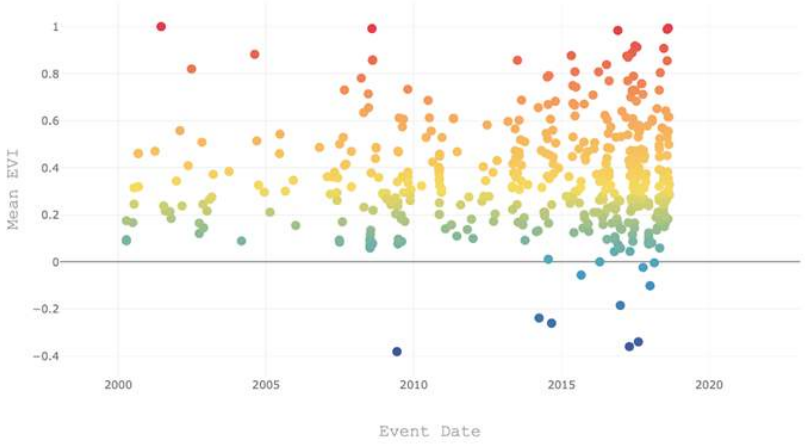
Environmental Annotator | Search for species | MOL Uploader

Product: LST Day | Spatial Buffer: 100 m | Temporal Buffer: 1 day | Go

Filter

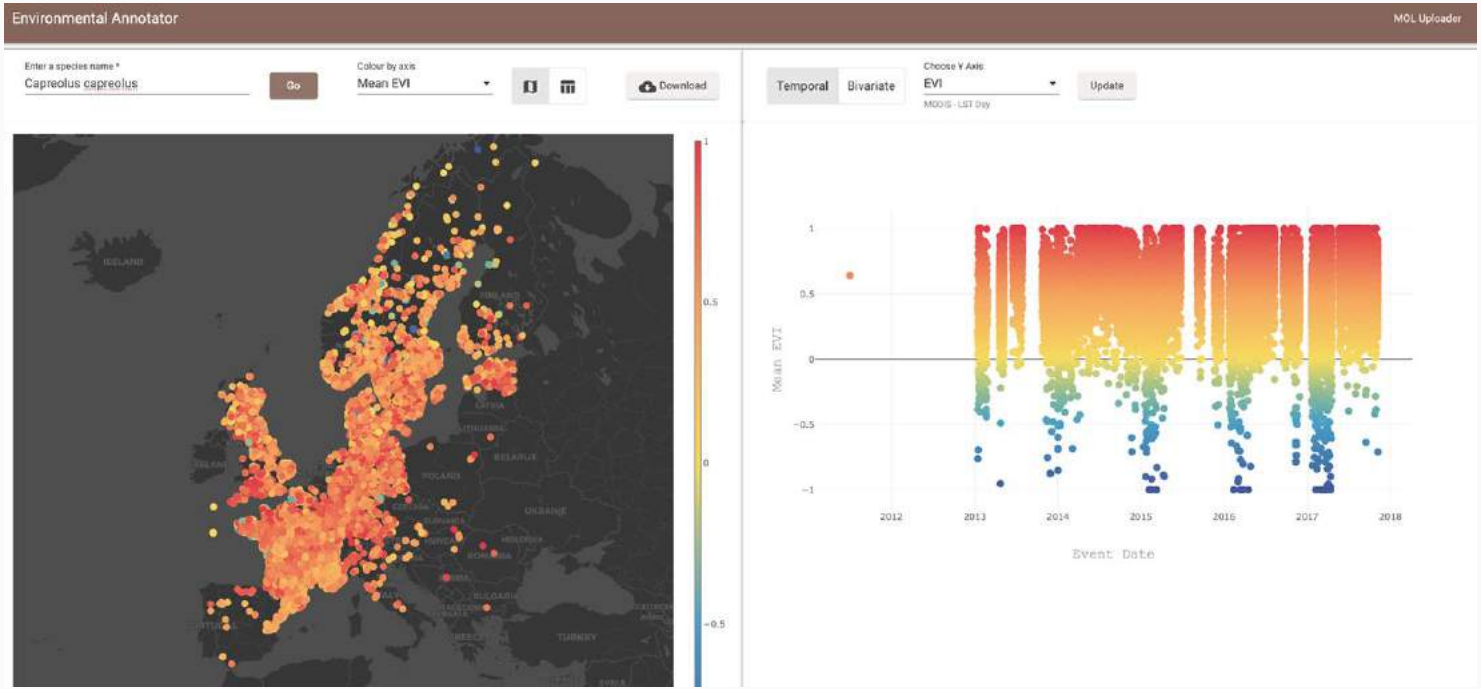
Scientific Name	Latitude	Longitude	X Axis	Y Axis
Taxidea taxus	35.4	-120.8333	1957-02-06T00:00:00Z	
Taxidea taxus	49.7167	-99.6	1923-12-09T00:00:00Z	
Taxidea taxus	42.6884	-81.7127	1948-08-01T00:00:00Z	
Taxidea taxus	51.09	-114.54	2008-08-08T00:00:00Z	0.8585
Taxidea taxus	43.03	-81.35	1990-04-08T00:00:00Z	
Taxidea taxus	32.89	-100.233	1966-03-26T00:00:00Z	
Taxidea taxus	30.5428	-98.7037	1997-01-04T00:00:00Z	
Taxidea taxus	34.179	-100.306	1968-07-27T00:00:00Z	
Taxidea taxus	33.811	-102.18	1985-09-30T00:00:00Z	
Taxidea taxus	34.723	-102.904	1985-12-20T00:00:00Z	

Items per page: 10 | 1 - 10 of 1611



Environmental Annotator
https://mol.org/nichemunk

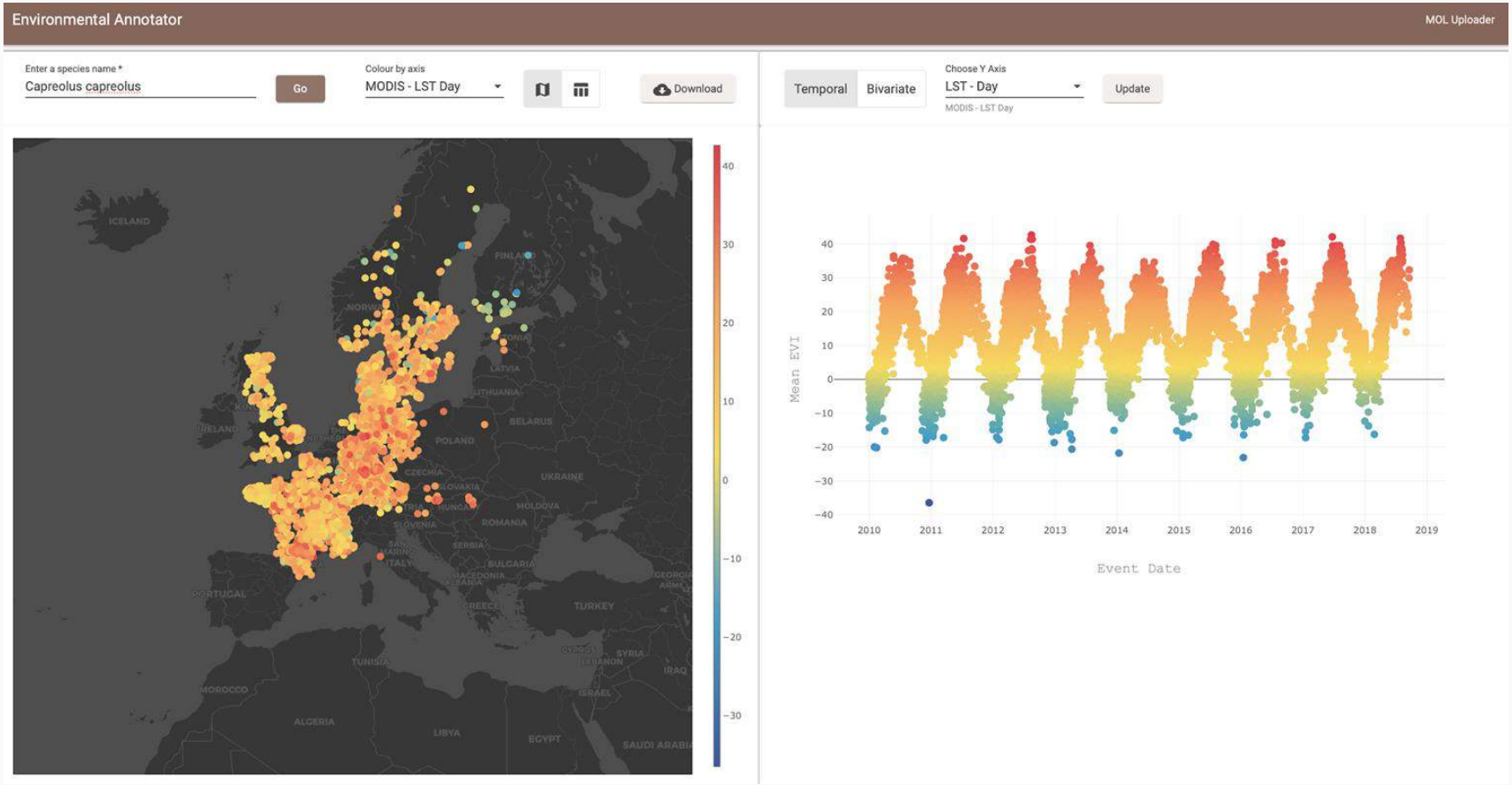
Roe Deer
Capreolus capreolus



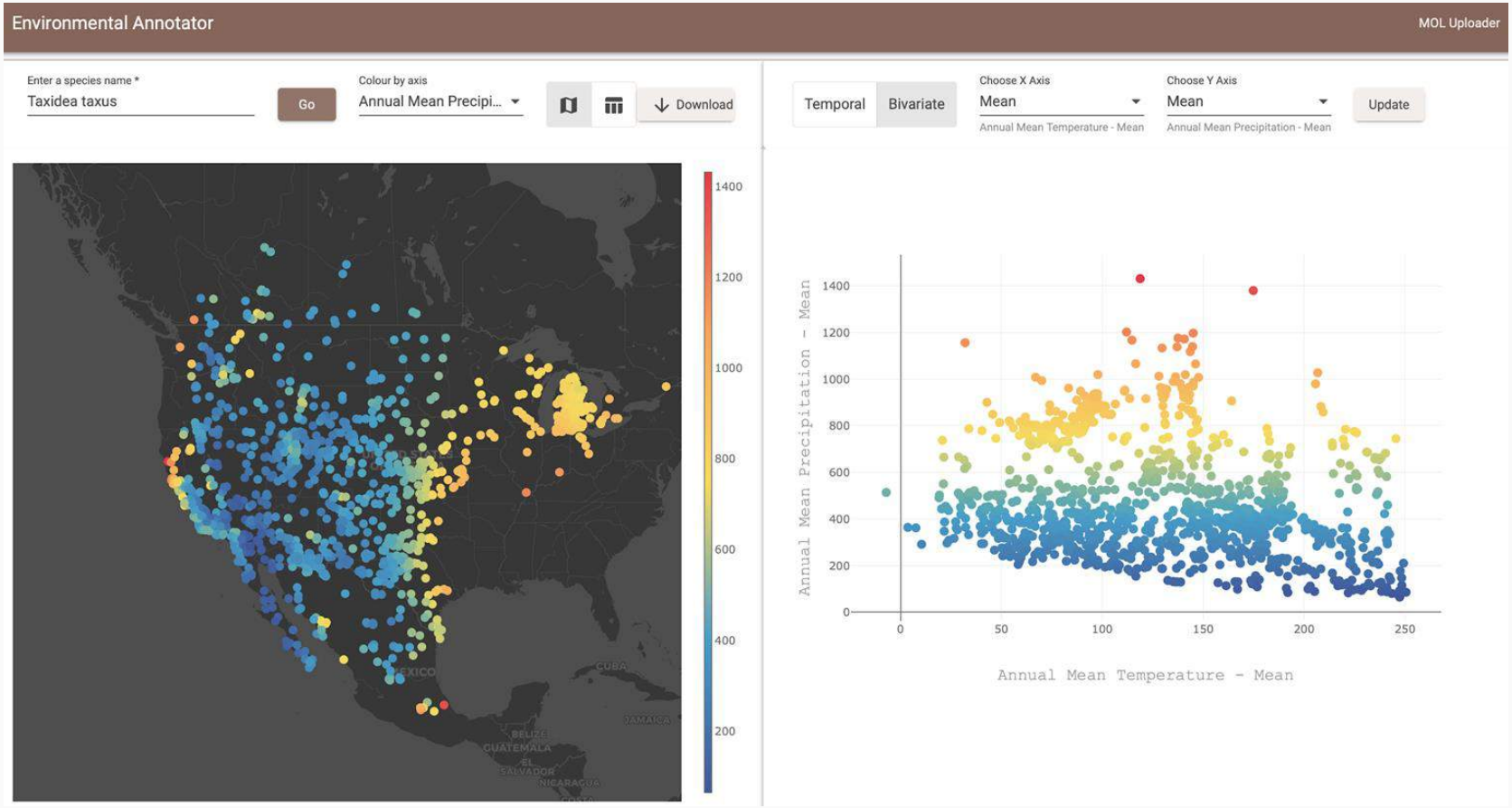
Or select any desired mammal species.

Environmental Annotator - LST (Day)

Roe Deer



Environmental Annotator



Phase II

Characterize the available habitat

Background points

Environmental data availability

Increased options for environmental data products

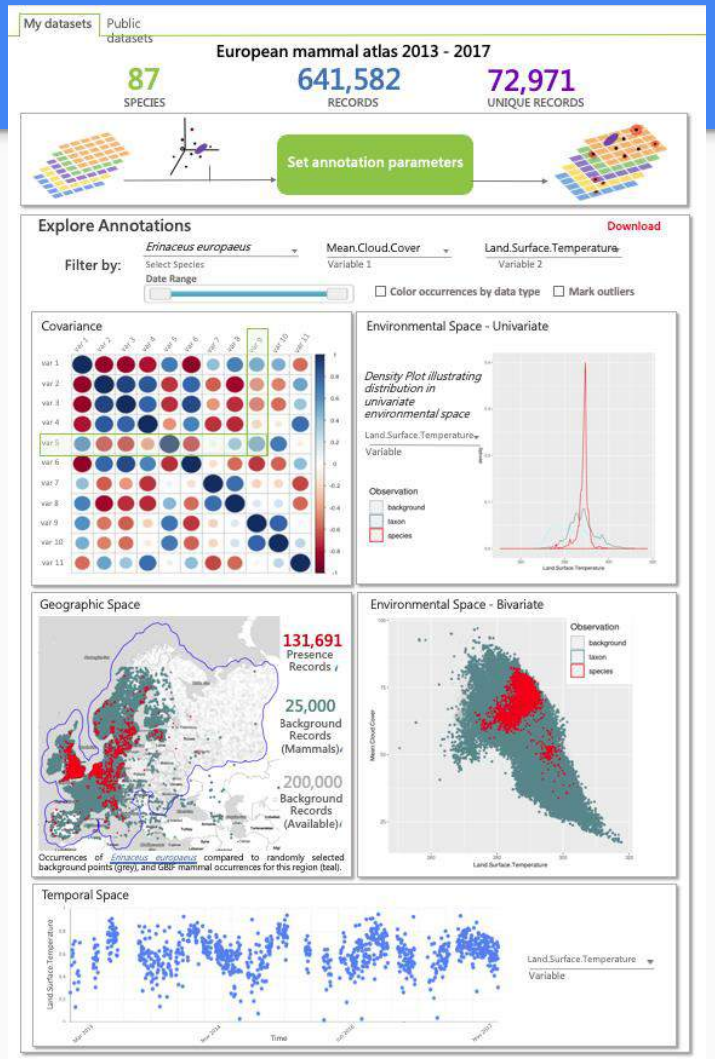
+

Spatial and temporal aggregation

Increase the options for spatial and temporal aggregation

Exploratory Data Analysis and Variable Selection

Preliminary comparisons of environmental datasets to guide user through variable selection



Products to be included in Phase II

Type	Product	Platform / Sensor / Product	Archive[1]	Resolution[2]		Domain
				Temporal	Spatial	Temporal
Terrestrial	Surface Reflectance	Landsat 4-8	D|E|G	16 days	30m	1982
		MODIS (MCD43A2)	D|G	Daily	250m	2000
		ASTER	D|G	16-day	15-30m	2000
		Sentinel 2	D|G	10-day	10-60m	2014
		Airbus SPOT (OneAtlas)	D	Once	1.5m	2015
		Airbus Pléiades (OneAtlas)	D	Once	0.5m	2015
	Vegetation Indices (NDVI/EVI)	MODIS (MOD13)	G	8-day	250m	2000
		Descartes MODIS 16-day VI	D	16-day	250	2000
	Land Cover	MODIS (MCD12Q1)	D|G	Annual	1km	2001
	Land Cover Dynamics	MODIS (MCD12Q2)	D|G	Annual	1km	2001
	3D Structure	Sentinel-1 SAR	D|G	12 days	10-25m	2014
	Elevation	Airbus	E	Once	~24m	2017
Freshwater	Surface Water	JRC Global Surface Water	G	Monthly	30m	1984
		MOD44W Surface Water	G	Annual	250m	2000
Marine	World Ocean Atlas	Temperature, Salinity, Oxygen; others	E	Decadal	25km	1955
	NOAA OI SST	Sea Surface Temperatures	E	Daily	25km	1981
	Sea Surface Temperatures, Topography, Colour	Sentinel-3	D|G	1-2 days	300m - 1km	2014
		MODIS Aqua	G	Daily	1km	2001
	Chlorophyll	MODIS Aqua	G	Daily	1km	2001
	Various	HYCOM + NCODA	E		~10km	2008
Climate	Various Climate Variables	TerraClimate	G	Monthly	1km	1958
	Temperature	[3]CHELSA / EarthEnv	G	Daily	1km	1979
	Precipitation	[3]CHELSA/ EarthEnv	G	Daily	1km	1979
	Growing Degree Days	CHELSA Derived	G	Monthly	1km	1979
	Land Surface Temperature	MODIS (M*D11A1/A2)	D|G	8-day	1km	2000
	Thermal IR	ASTER	D|G	16-day	90m	2000
	Cloud Cover	EarthEnv	G	Monthly	1km	2000

We want your feedback! Please fill out the survey!

Workshop Feedback

Software Workflows and Tools for Integrating Remote Sensing and Organismal Occurrence Data Streams to Assess and Monitor Biodiversity Change

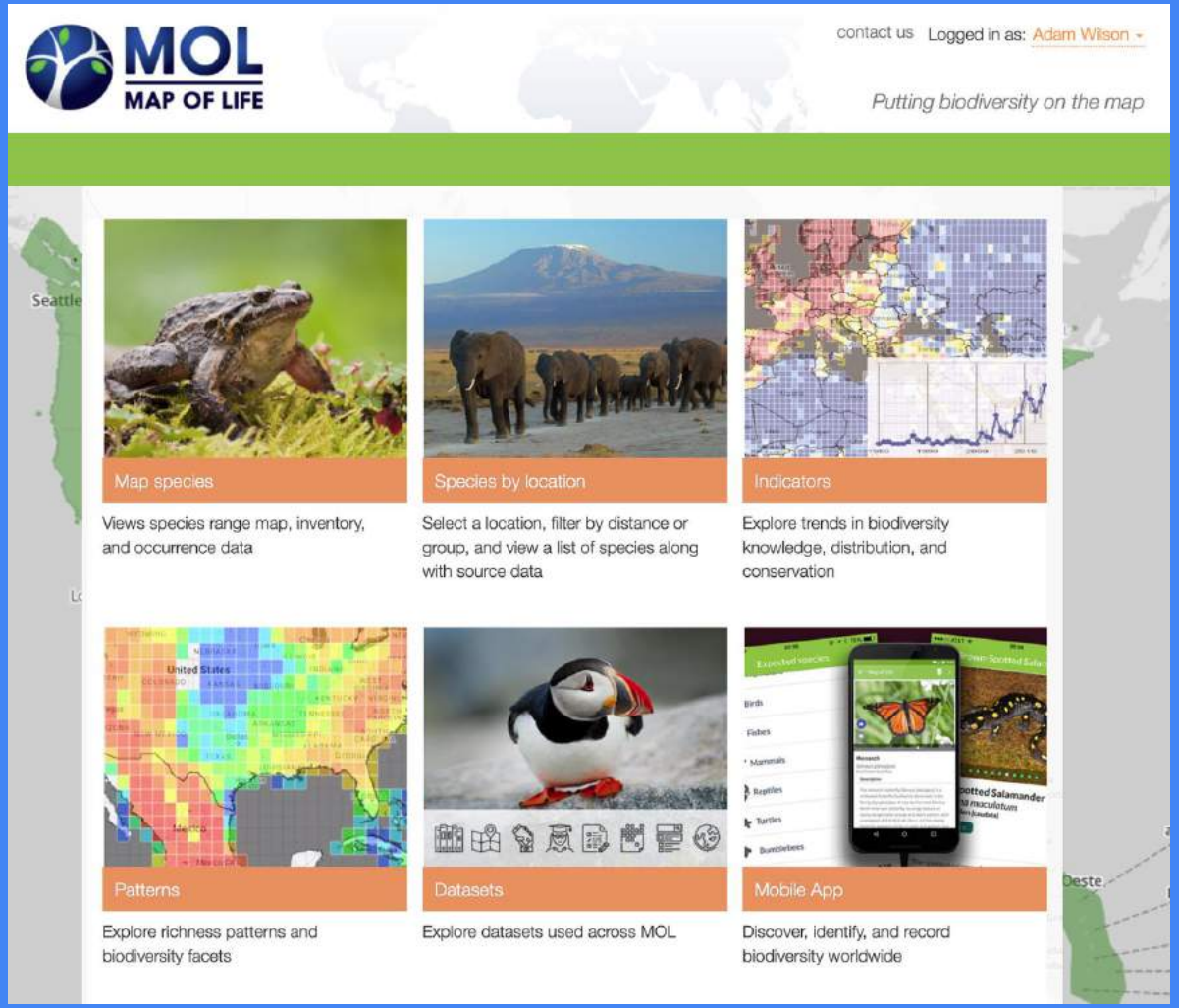
Select variables and spatial resolutions that are important for your work.

	15m	30m	250m	1km
Vegetation Indices / NPP / GPP	☐	☐	☐	☐
Land Cover Classification (e.g. forest, urban)	☐	☐	☐	☐
Continuous Vegetation Fields (e.g. % forest)	☐	☐	☐	☐
Land Surface Temperature	☐	☐	☐	☐

Please provide feedback on the current prototype and offer suggestions about what else this tool *should* do.

Direct survey link here

https://forms.gle/pxu69giSBmUvwYDMA

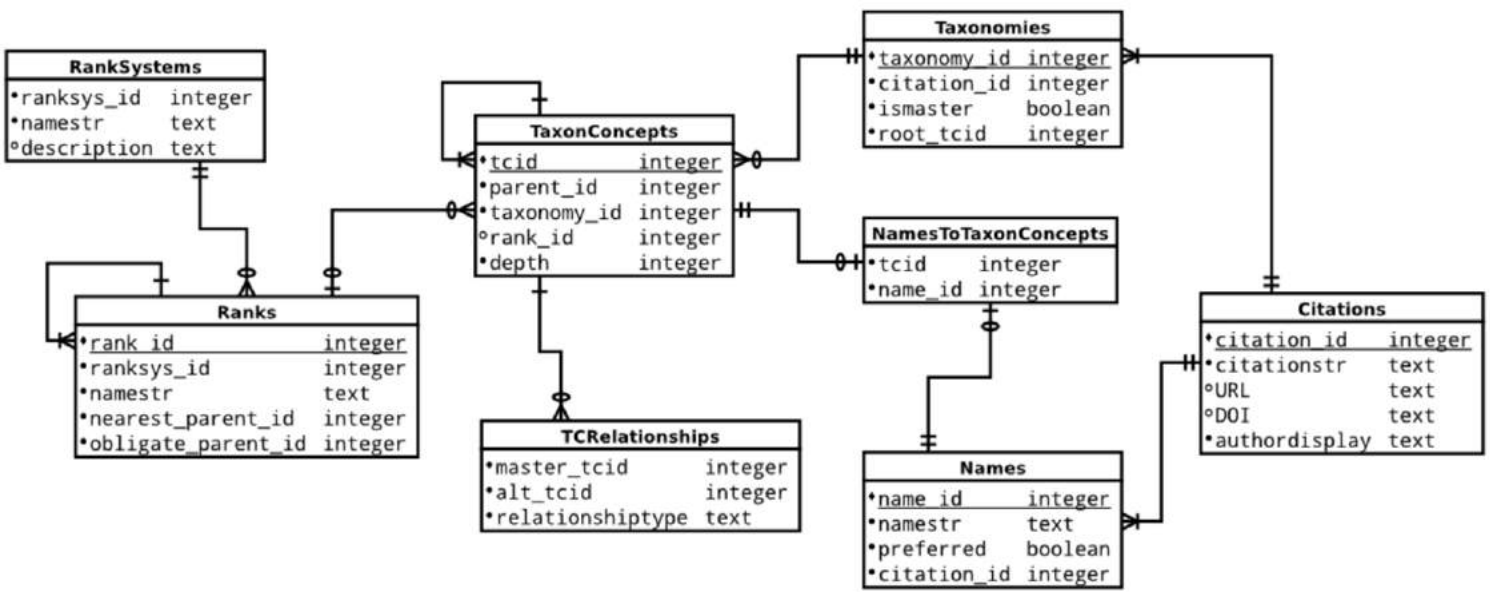

MOL
MAP OF LIFE
contact us
Logged in as: Adam Wilson
Putting biodiversity on the map
Map species
Views species range map, inventory, and occurrence data
Species by location
Select a location, filter by distance or group, and view a list of species along with source data
Indicators
Explore trends in biodiversity knowledge, distribution, and conservation
Patterns
Explore richness patterns and biodiversity facets
Datasets
Explore datasets used across MOL
Mobile App
Discover, identify, and record biodiversity worldwide

mol.org

Thank you for your attention!

Management On The Back-End

- MOL has a well developed access control system
- One of the biggest challenges is managing taxonomy/species names
- Taxonomy management - nearly a million names and synonymies
- Prototype tools to help harmonize names



Environmental Data Products

Satellite and model-derived 1km environmental data at varying temporal resolutions

	Source	Daily	Monthly	Annual	Climatology
Enhanced Vegetation Index	MODIS				
Land Surface Temperature	MODIS				
Air Temperature (Daily Min, Max, Mean)	CHELSA				
Precipitation (Daily Min, Max, Mean)	CHELSA				

Available in the current prototype