

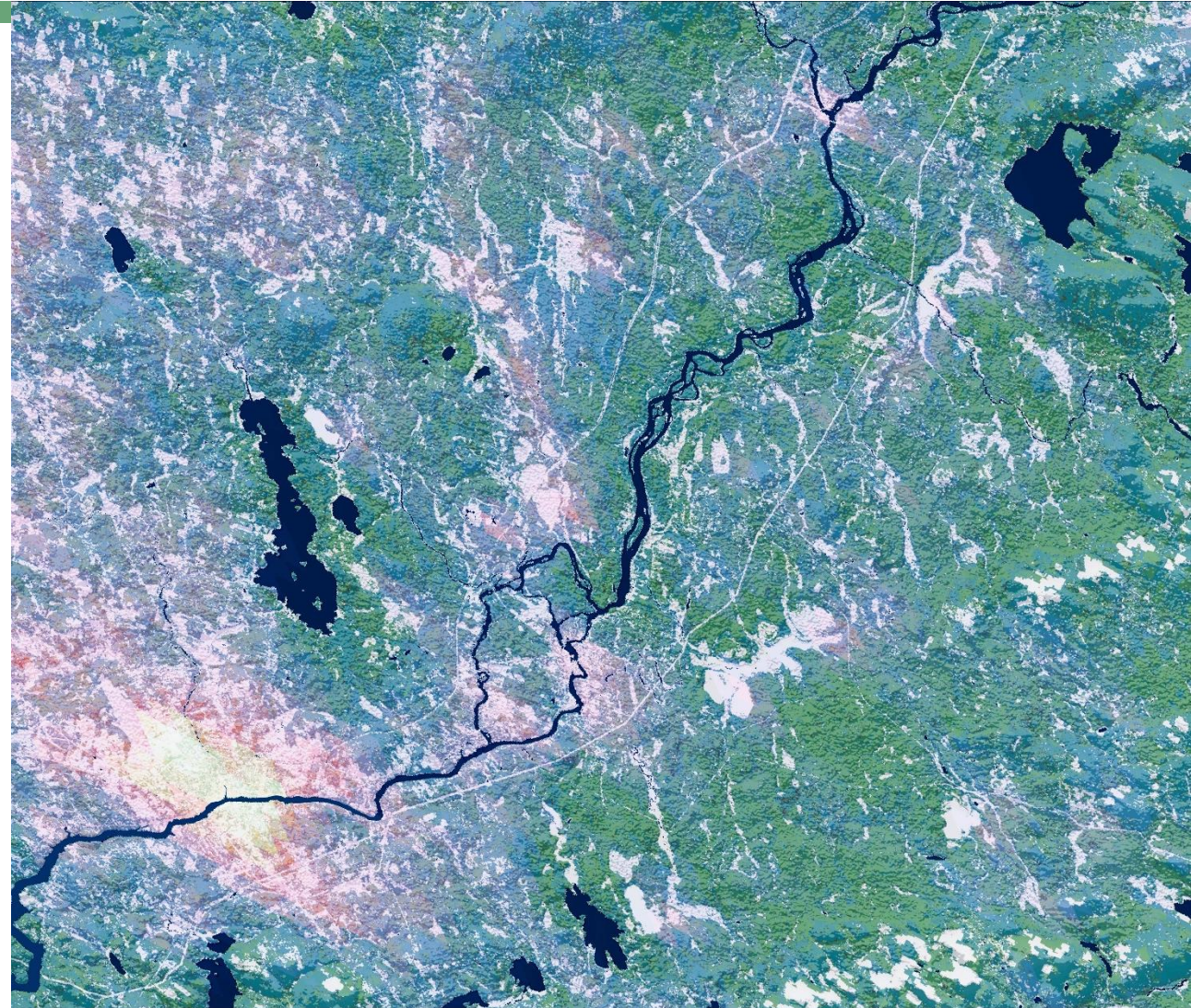


Maine

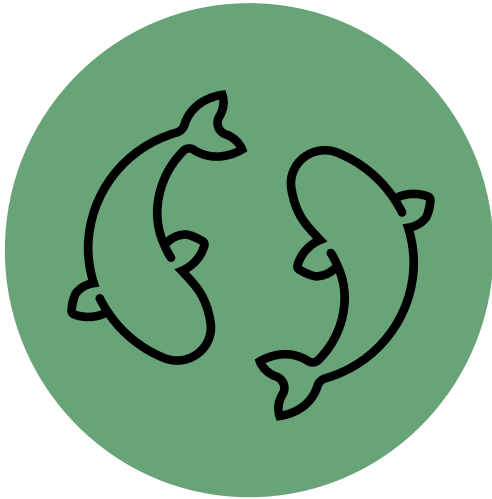
Ecological Forecasting III

Utilizing Earth Observations to Monitor Federally
Endangered Atlantic Salmon (*Salmo salar*) Habitat in
Maine: An Interactive Workshop

Jonathan Falciani
Colin Hogan
Linda Mitchell
Makario Sarsozo



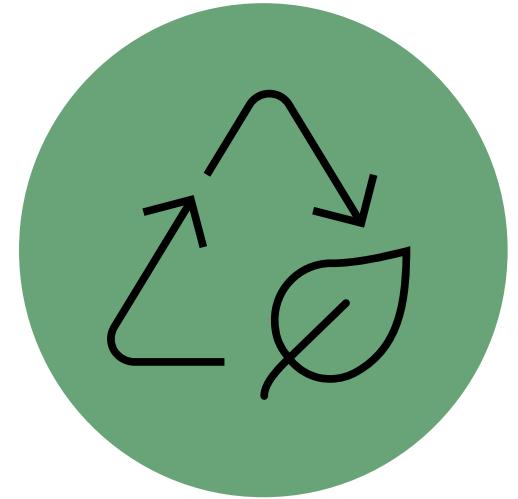
Objectives



Project Background



**Merging Past Work into
Present**



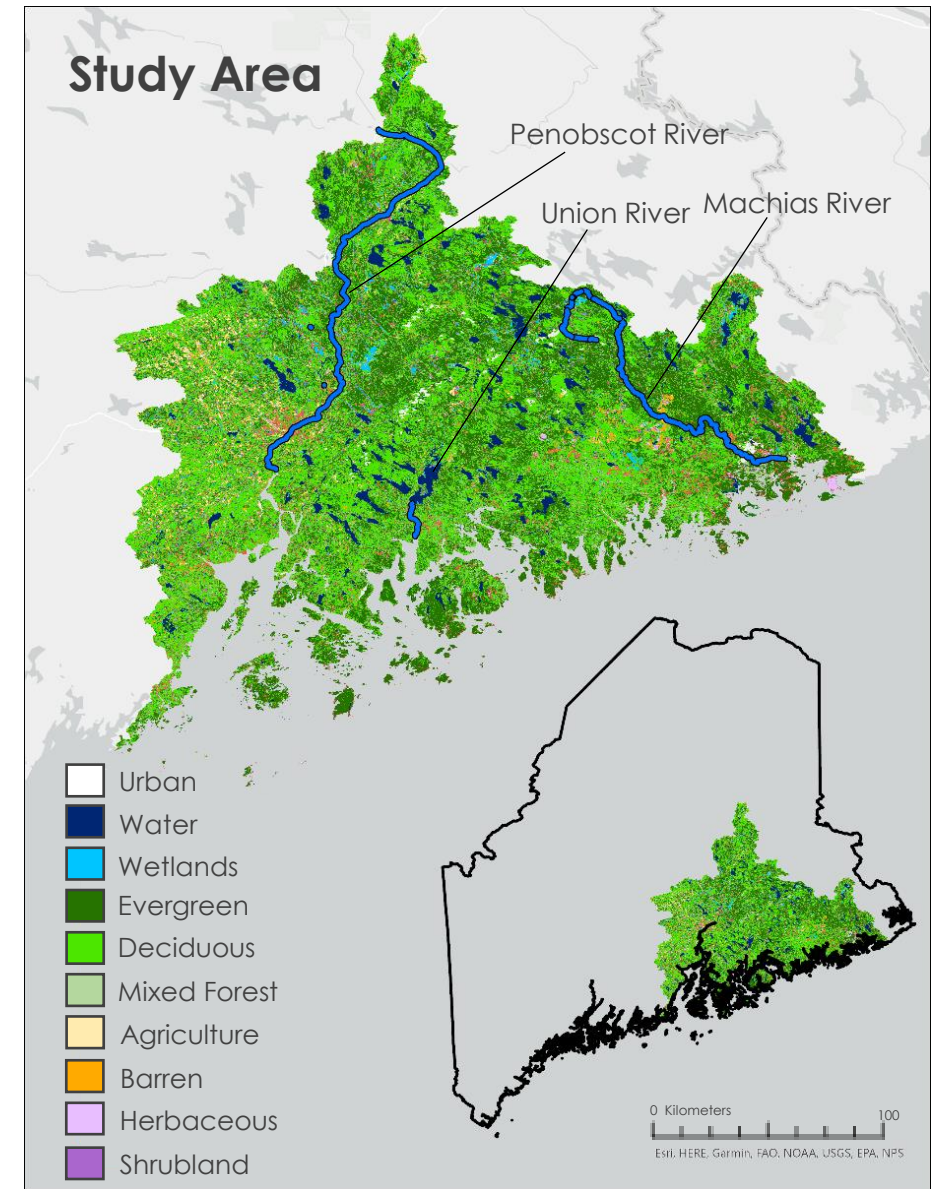
Future



Downeast Salmon Habitat



- ▶ The rivers in Downeast Maine are the habitat of the last remaining wild Atlantic salmon (*Salmo salar*) population in the United States
- ▶ 5 remaining runs in the United States; historically present throughout New England and New York
- ▶ Rapid decline led to Federally Endangered status in 2000
- ▶ Home to communities in Maine that regard salmon as vital to their culture and way of life including indigenous populations



Partner Organizations



Maine Department of Marine Resources



Downeast Salmon Federation



Community Concerns



Climate



- Increasing land temperature
- Prevents salmon populations from recovering

Land Use Change



- Increased urbanization and cultivation
- Changing forest succession patterns

Water Quality



- Dam installation
- Pollutants

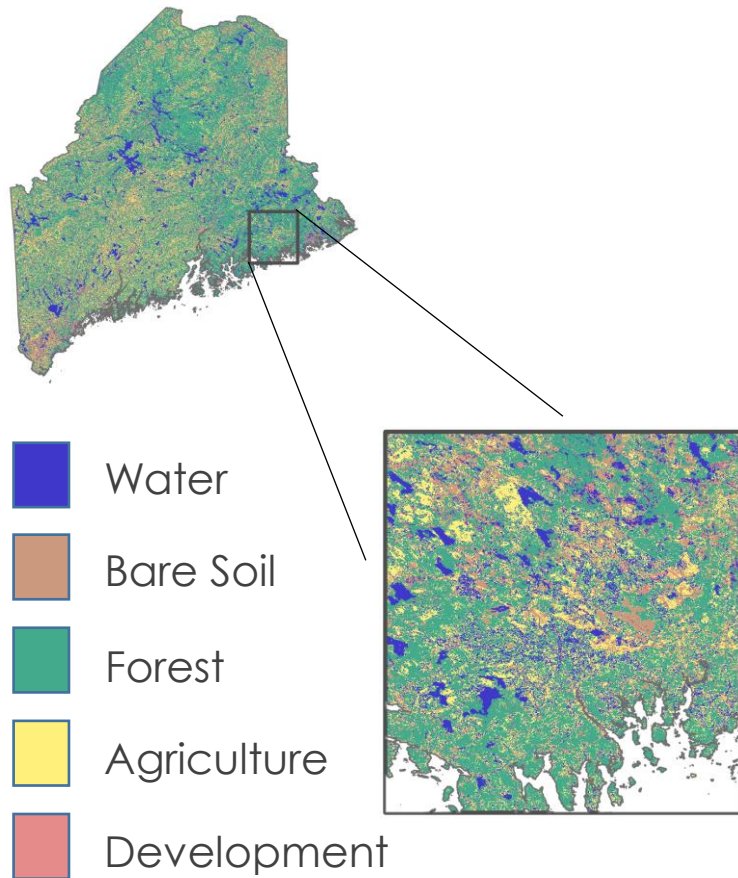


Term 1 Project Goals

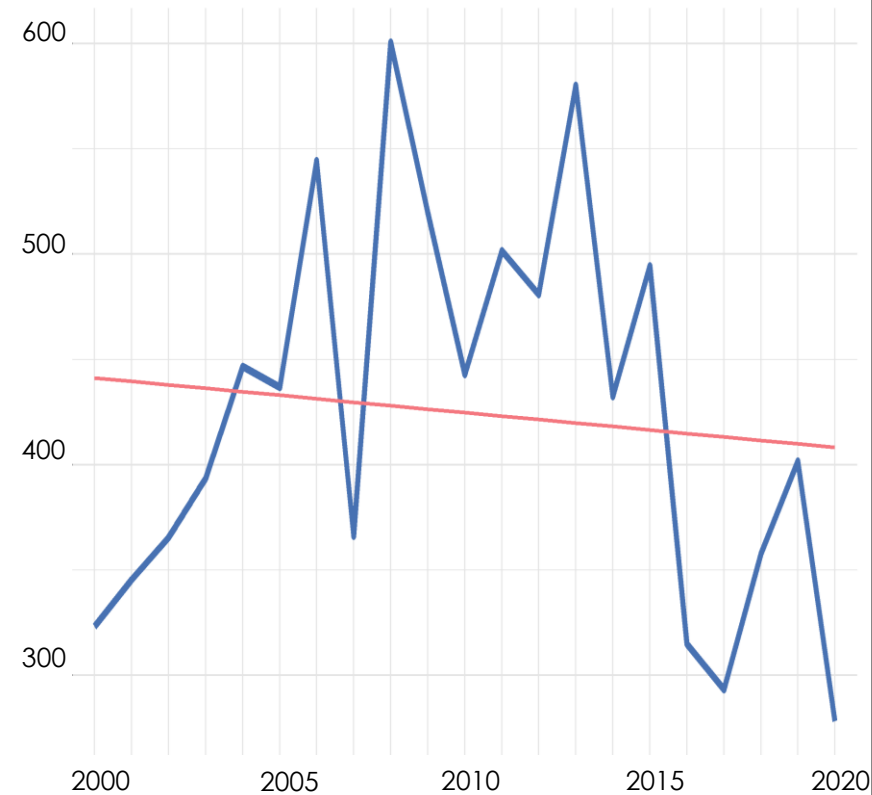
Assess how various factors have influenced decline of Atlantic salmon using Earth observations from 1985-2021



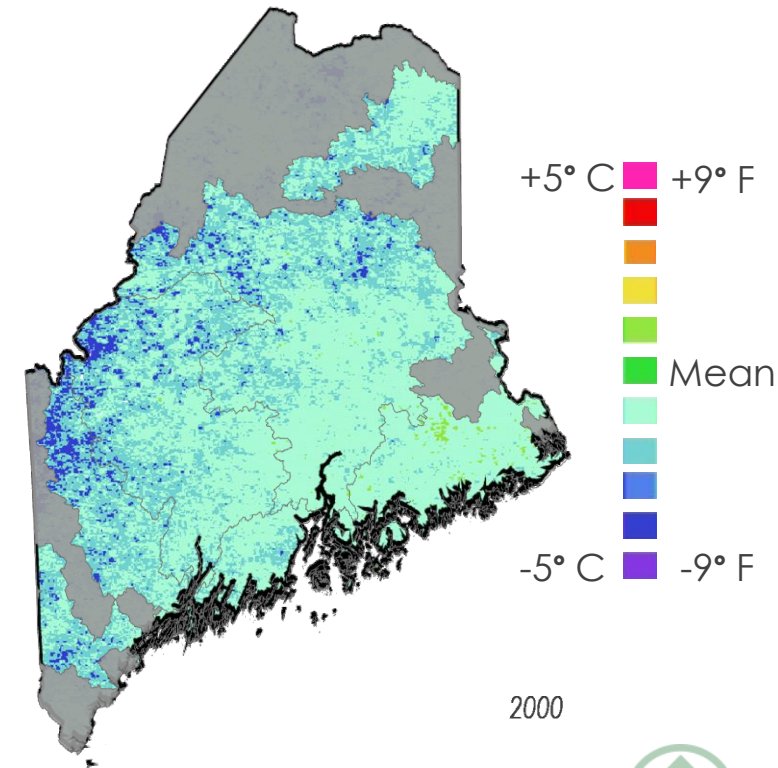
Land-Use Land Cover



Precipitation



Land Surface Temperature



Term 2 Project Goals

Refine maps created in term I and analyze trends over time



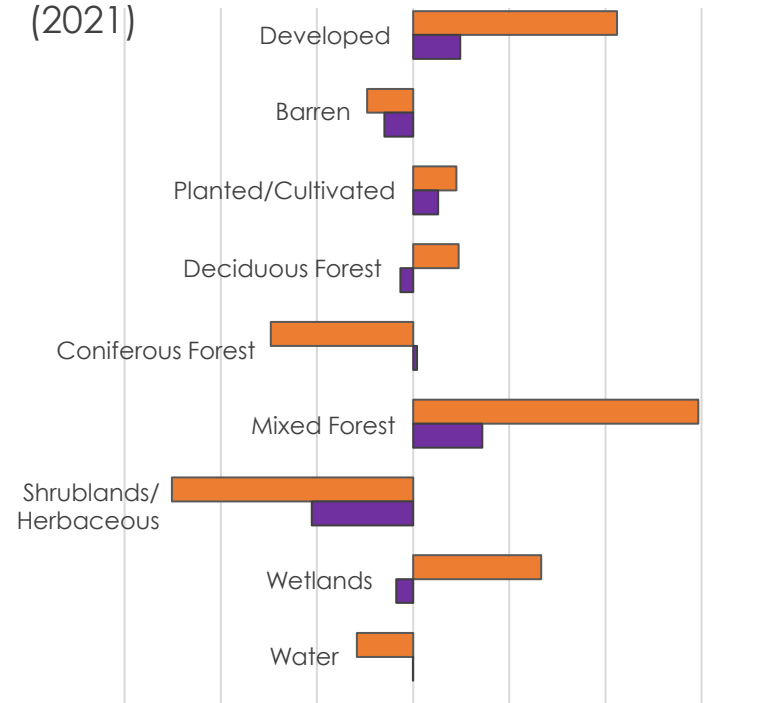
Refine LULC Maps



The LULC maps from previous terms were refined to produce more accurate results

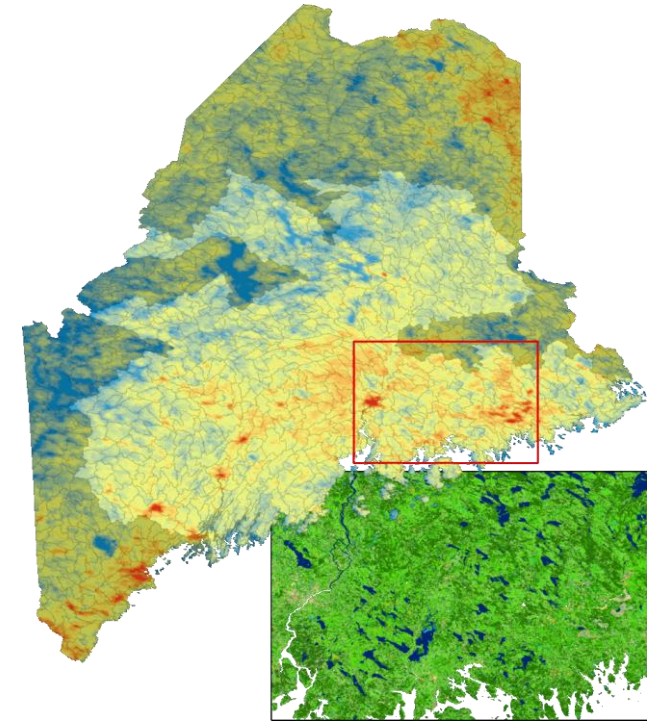
Analyze trends from terms I+II

Temperature (°F) Change per 10,000 Acres (2021)



Trends over time from 1985-2021 were assessed to better understand temperature and precipitation shifts

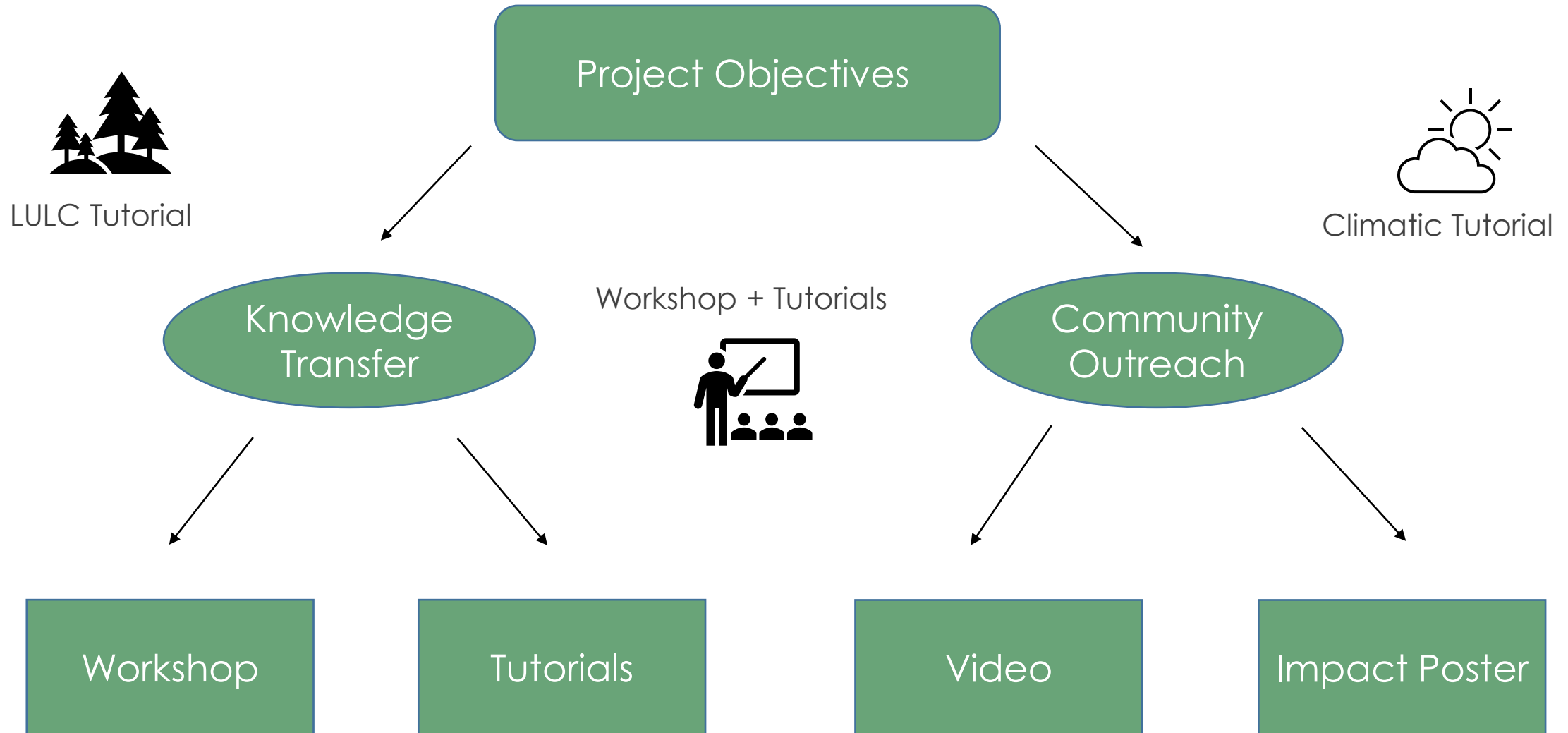
Forest Type + LST Anomalies



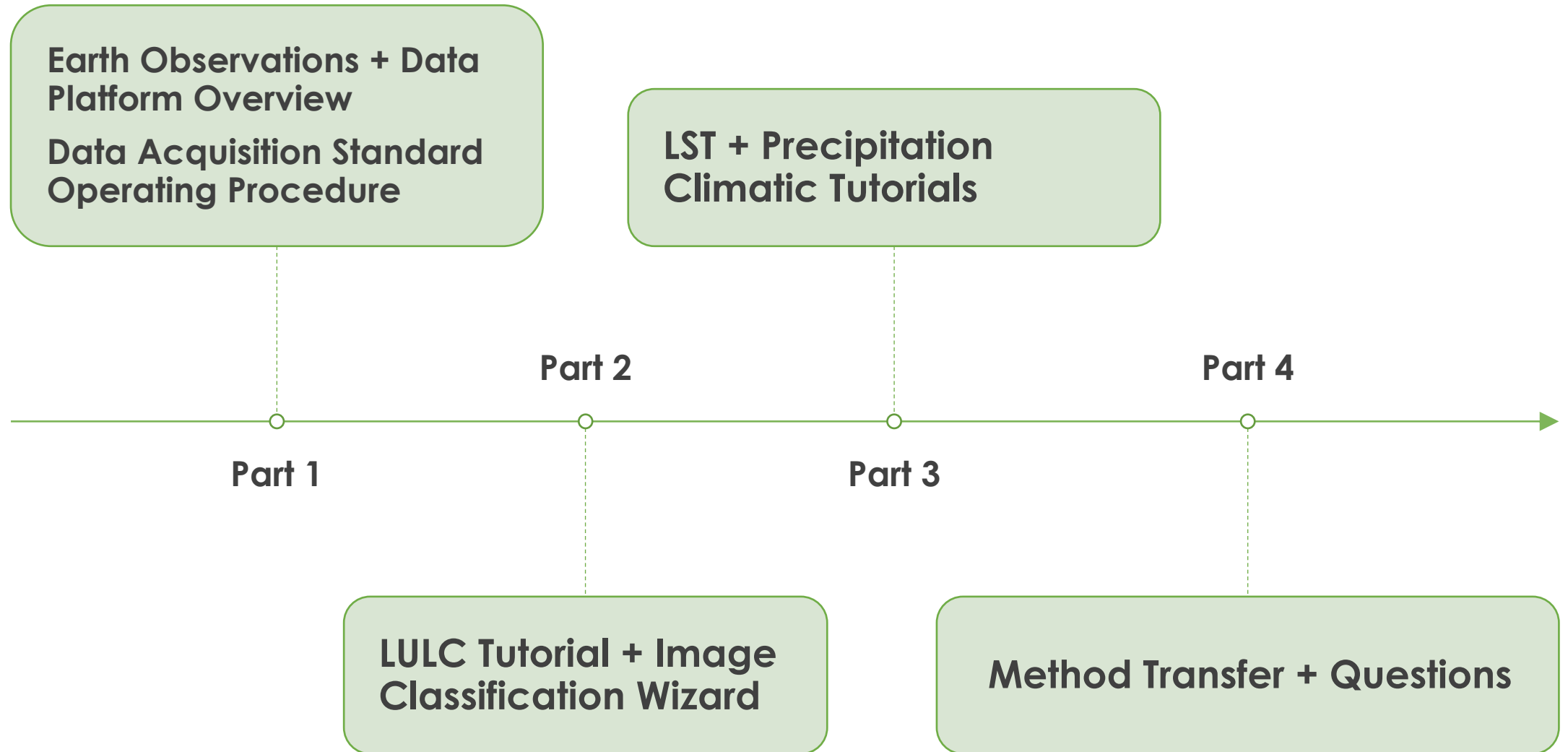
Forest cover type was delineated and analyzed with LST to show how forest type impacts temperature



Workshop Planning



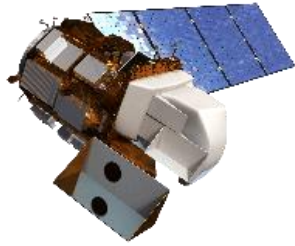
Workshop Overview



Earth Observation Overview



Landsat 5 TM



Landsat 8 OLI



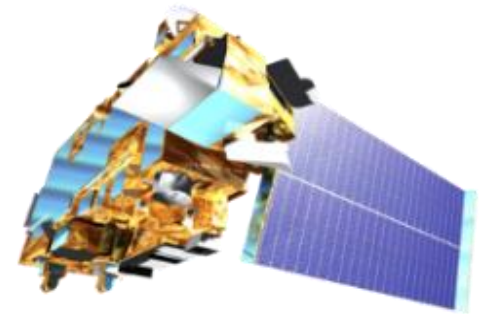
Landsat 9 OLI-2



GPM IMERG



Sentinel-1 C-SAR



Terra MODIS



Tutorial Objectives

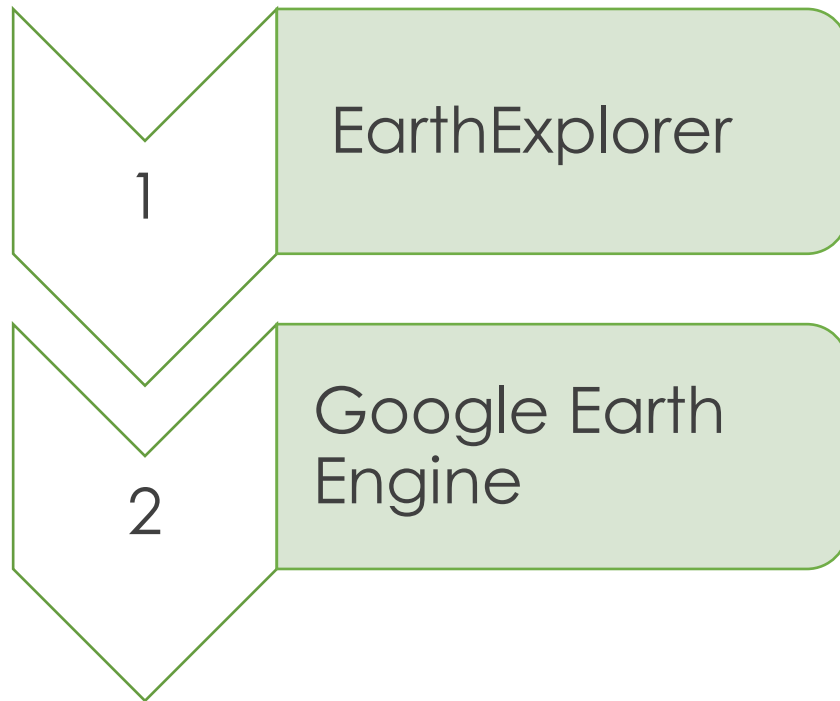
- ▶ EarthExplorer
- ▶ Google Earth Engine
- ▶ Land Use/Land Cover
- ▶ Climate



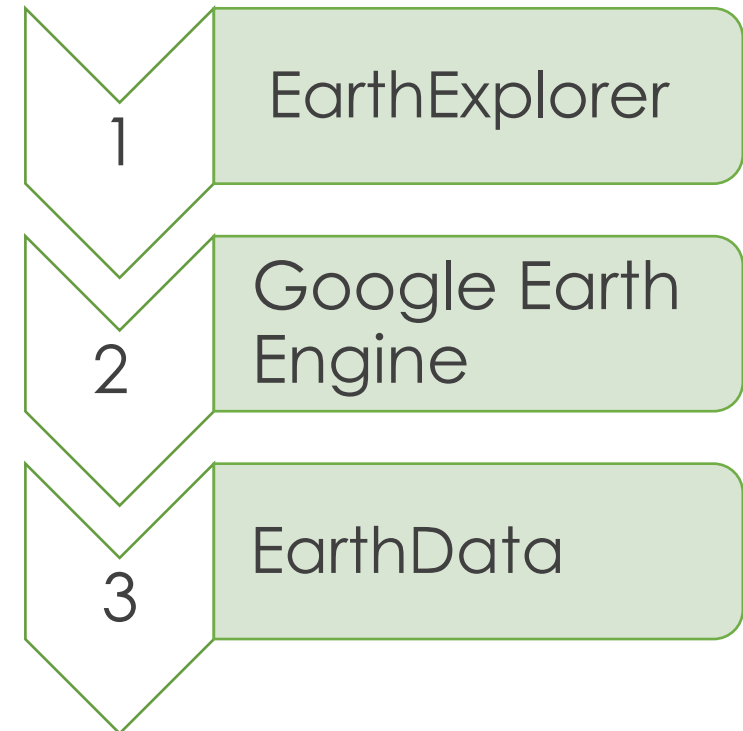
Data Acquisition



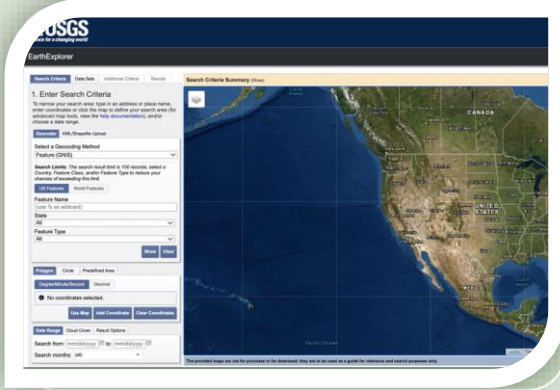
Live Tutorial with Written Documentation



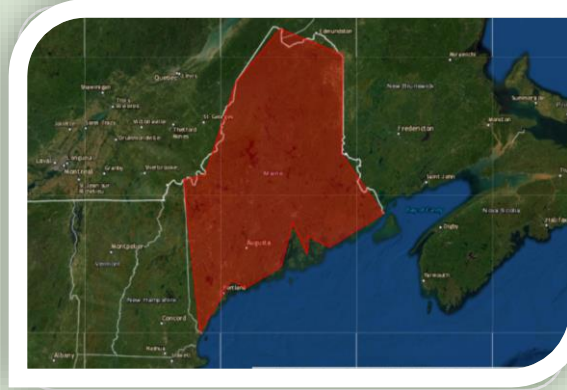
Written Documentation Provided



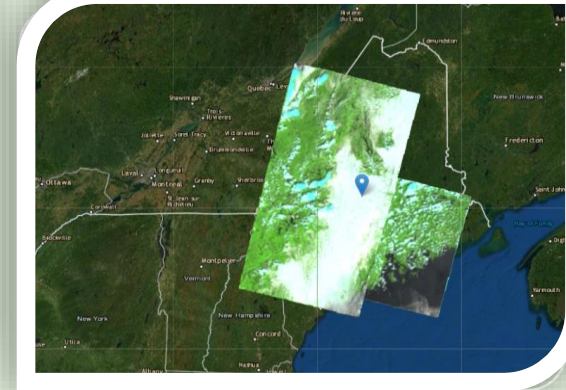
EarthExplorer Tutorial



Learn how
to use the
interface



Select
datasets
and set up
search
criteria



Perform a
search, view
selected
datasets, and
download files



EarthExplorer

Why

Access earth science data

- ▶ Landsat collections
- ▶ Images of the Earth
- ▶ Orthoimagery
- ▶ Topographic
- ▶ National Land Cover Databases
- ▶ And More!

What

Use EarthExplorer to

- ▶ Conduct research through the largest collection of images of the Earth's surface

Discover

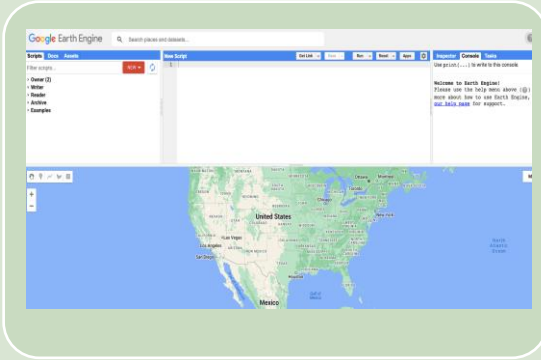
- ▶ Satellite images
- ▶ Data
- ▶ Aerial photography
- ▶ Elevation & land cover datasets
- ▶ Digitized maps
- ▶ Image gallery collections

Who

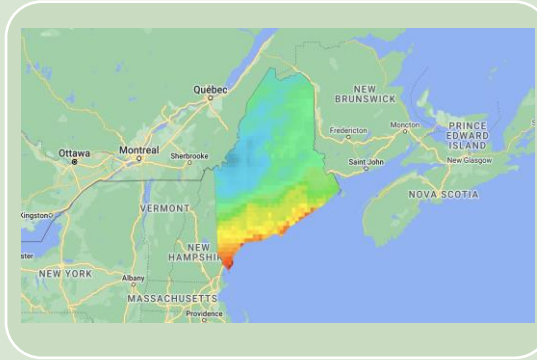
- ▶ **Scientists**
- ▶ **Disaster managers**
- ▶ **Engineers**
- ▶ **Educators**
- ▶ **The General Public**



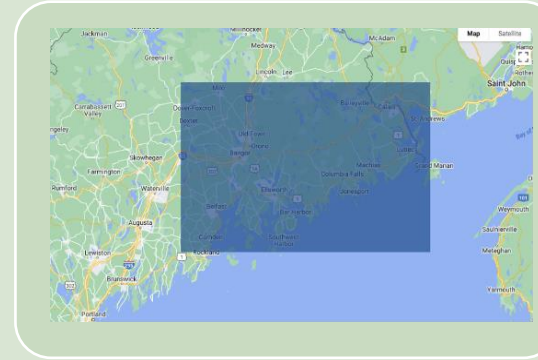
Google Earth Engine Tutorial



Introduction
to Google
Earth Engine



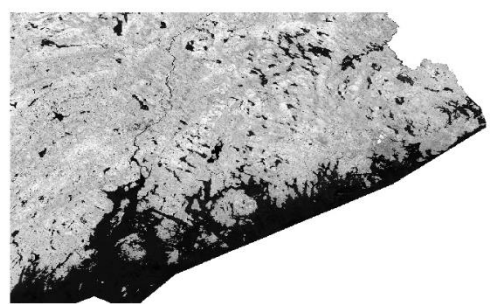
Accessing
Earth
observation
data



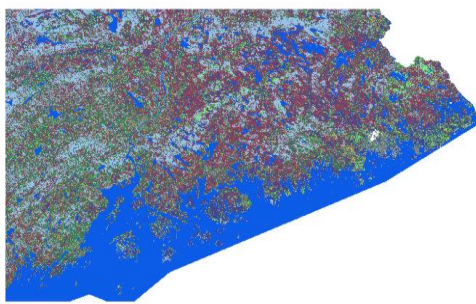
Selecting an
Area of
Interest



LULC Tutorial



Learn how to
create
indices



Use the
Image
Classification
Wizard



Accurately
classify &
produce an
LULC map



Land-Use Land Cover (LULC) Tutorial

Overview

Setup



Process



End-
Result

Goals

Gather TIFs +
Creating
Indices +
Composite
Bands

Image
Classification
Wizard +
Accuracy
Assessment

Cluster Busting
+
Reclassification

Specifics

Summer/Winter
Medians +
NDVI/MBI +
Composite
Raster

Classification +
Random
Sampling
Points

Accurate LULC
Map





Spectral Indices – Using Landsat bands, it is possible to create indices based on band equations that produce a range of values from -1 to 1 that give an idea of how much of something is present.

Normalized Difference Vegetation Index (NDVI) – Used to estimate how much vegetation is present in a given area

Normalized Difference Built-Up Index (NDBI) – Used to estimate urbanization present in a given area

Modified Bare Index (MBI) – Estimates the amount of agricultural land present in an area



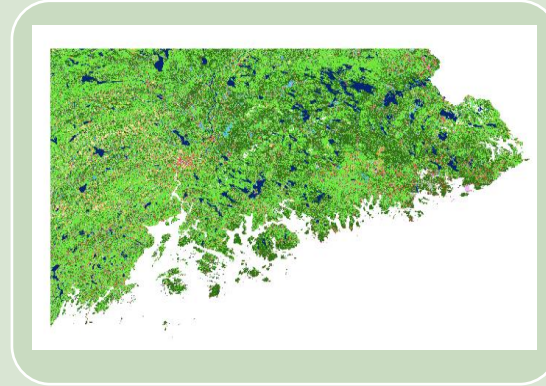
Image Classification Wizard – In ArcGIS Pro, the Image Classification Wizard takes Landsat imagery provided and groups the imagery by land use. In doing so, it is possible to create an accurate land use map for a given area which can prove beneficial for conservation efforts.



Cluster Busting – The Image Classification Wizard doesn't always get things right, and so it is possible to isolate specific classes and run those classes through again. Given that there is less data to process, it will be more accurate that time around and the old and new classifications can be merged together into one.



Climate Tutorial



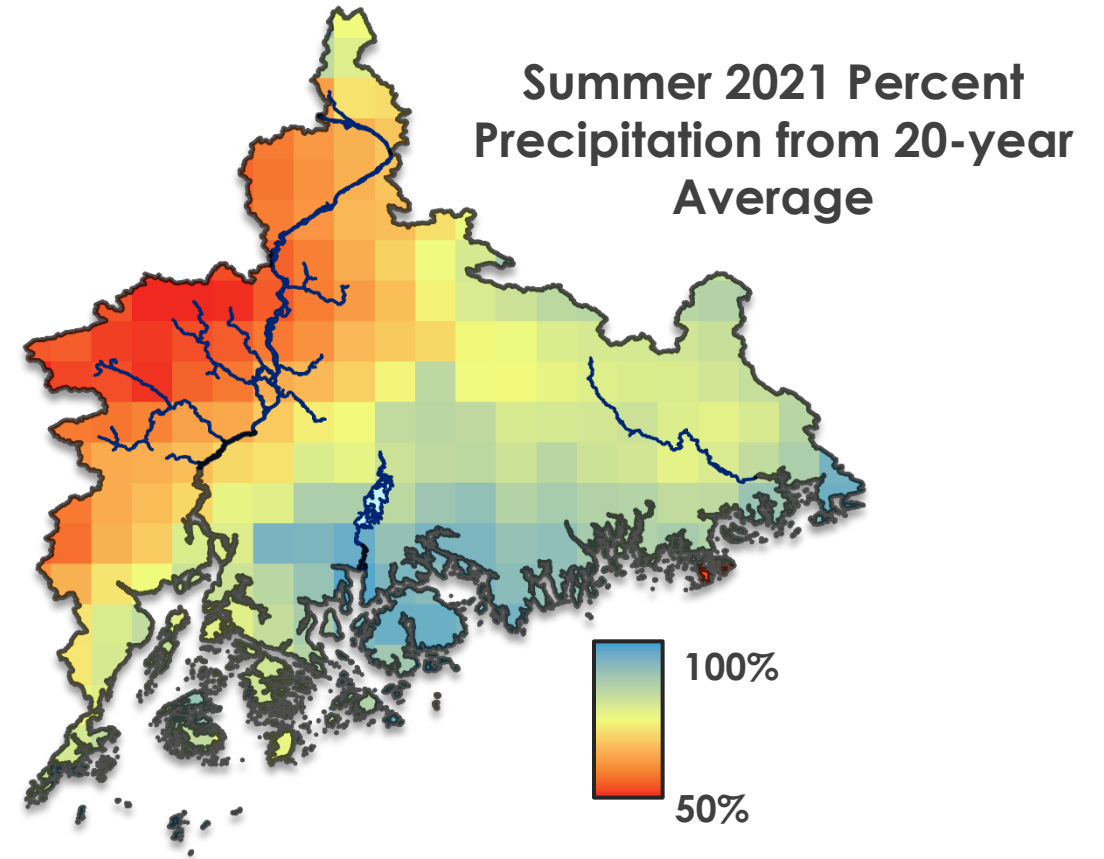
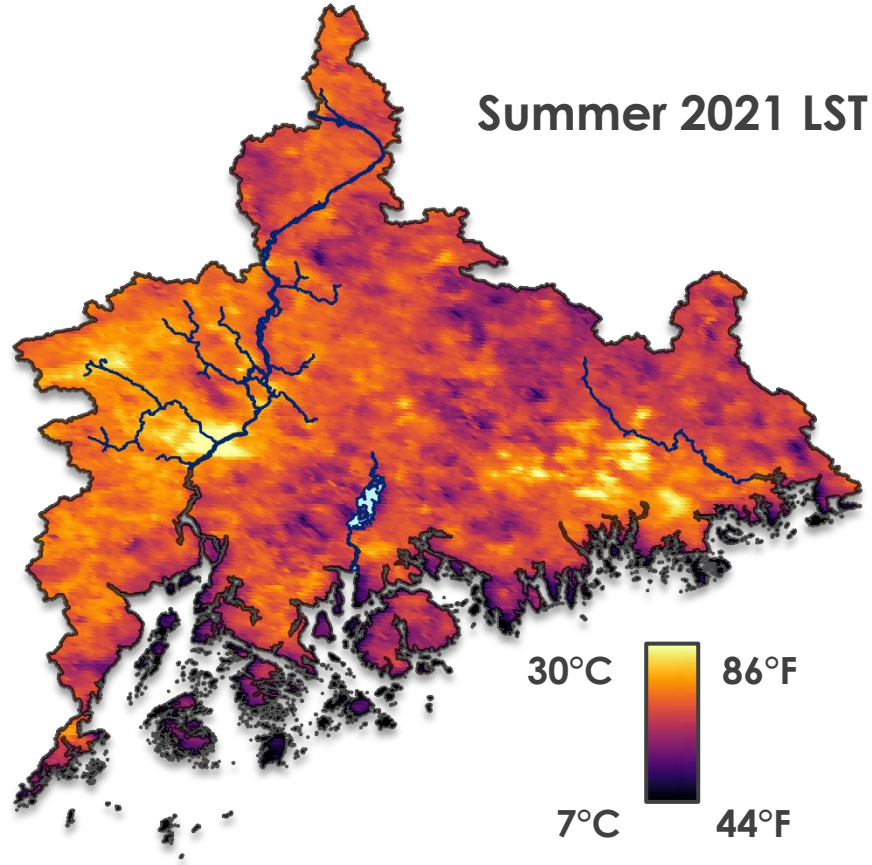
Compare
remote
sensing data
to *in-situ*
data

Analyze
trends in LST
and
precipitation
data

Relate LST to
LULC
classification
scheme



Climate Tutorial



Demonstrate EcoSHEDS

Introduce strengths & weaknesses of *in-situ* measurements for stream temperature

Process Climate Data

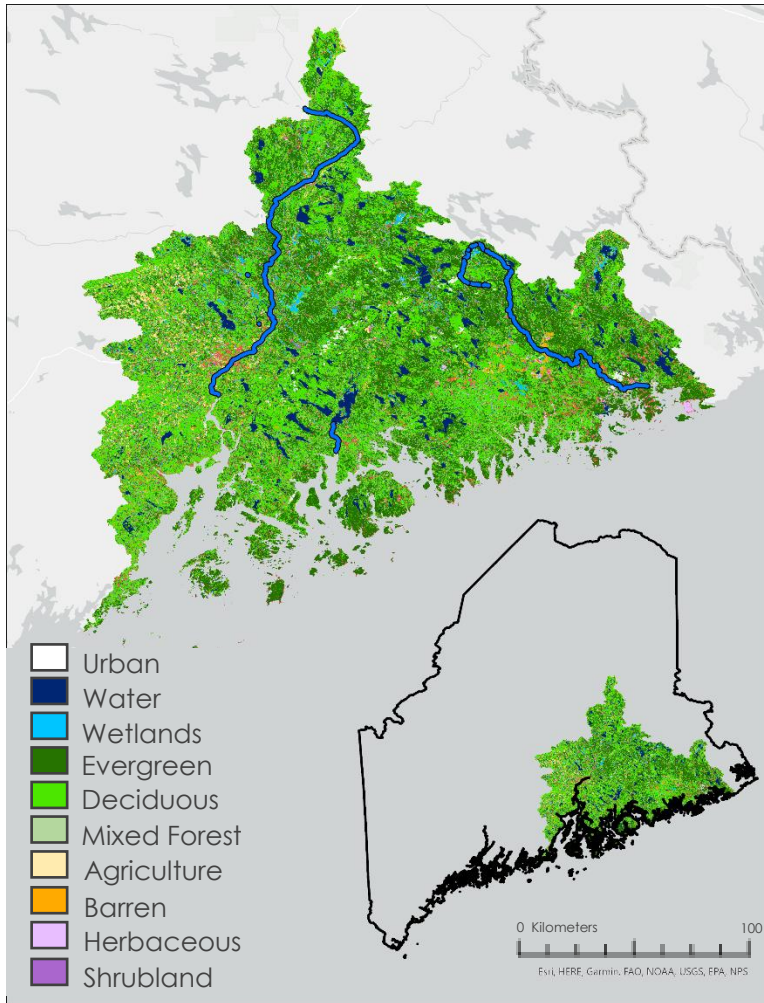
Access LST & precipitation data before processing using historical averages

Relate Climate Data

Identify areas exceeding salmon's thermal maximum & undergoing drought. Establish trends between LST and LULC

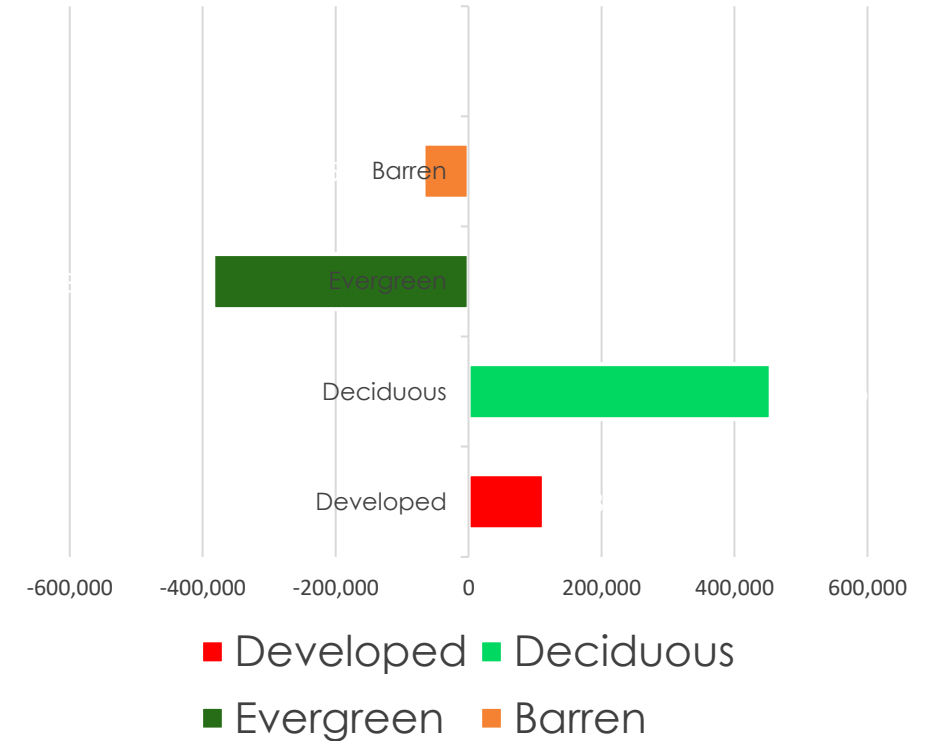


Conclusions



- ▶ Deciduous forest increased
- ▶ Evergreen Forest decreased
- ▶ Developed area increased
- ▶ Barren area decreased

**Land-Use Changes in Acres
1983-2021**



ACKNOWLEDGEMENTS

Partners

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- ▶ Joseph Spruce (Science Systems & Applications, Inc.)

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- ▶ Tony Bowman
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- ▶ Kelsey Preslar

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