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# Transforming Global Challenges with Geospatial Analytics

## *Clark Center for Geospatial Analytics*



**Hamed Alemohammad**

Director, Clark CGA

Associate Professor, Graduate School of Geography

*Geospatial World Forum*

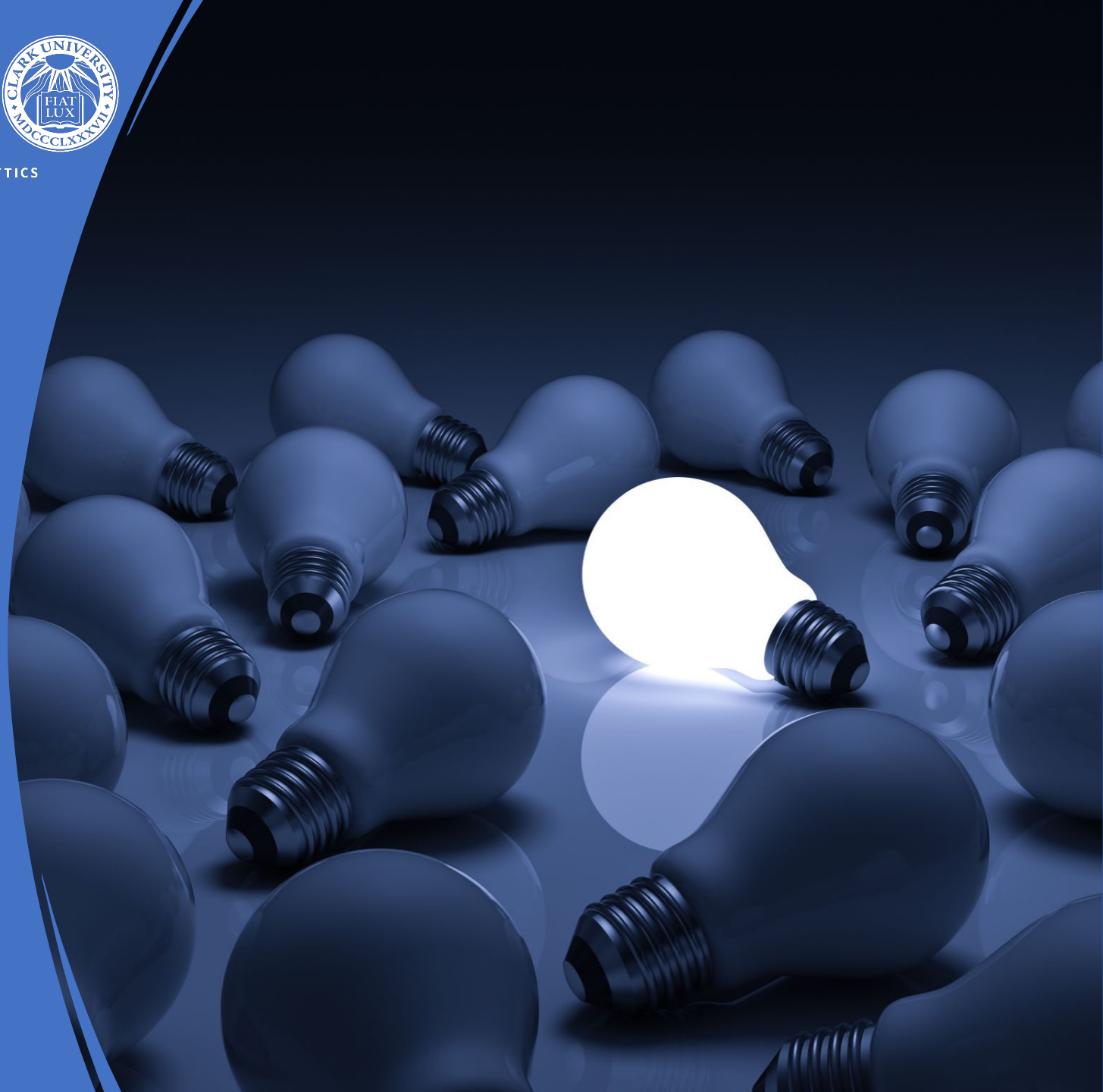
*US Summit: The National Geospatial Ecosystem of the United States*

*May 15<sup>th</sup>, 2024*

# Mission

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Conducting *transformative research* using geospatial analytics to address *global environmental challenges*, emphasizing *climate change adaptation and mitigation*, *ecological conservation*, and *agriculture*.



# Clark CGA Strategic Functions

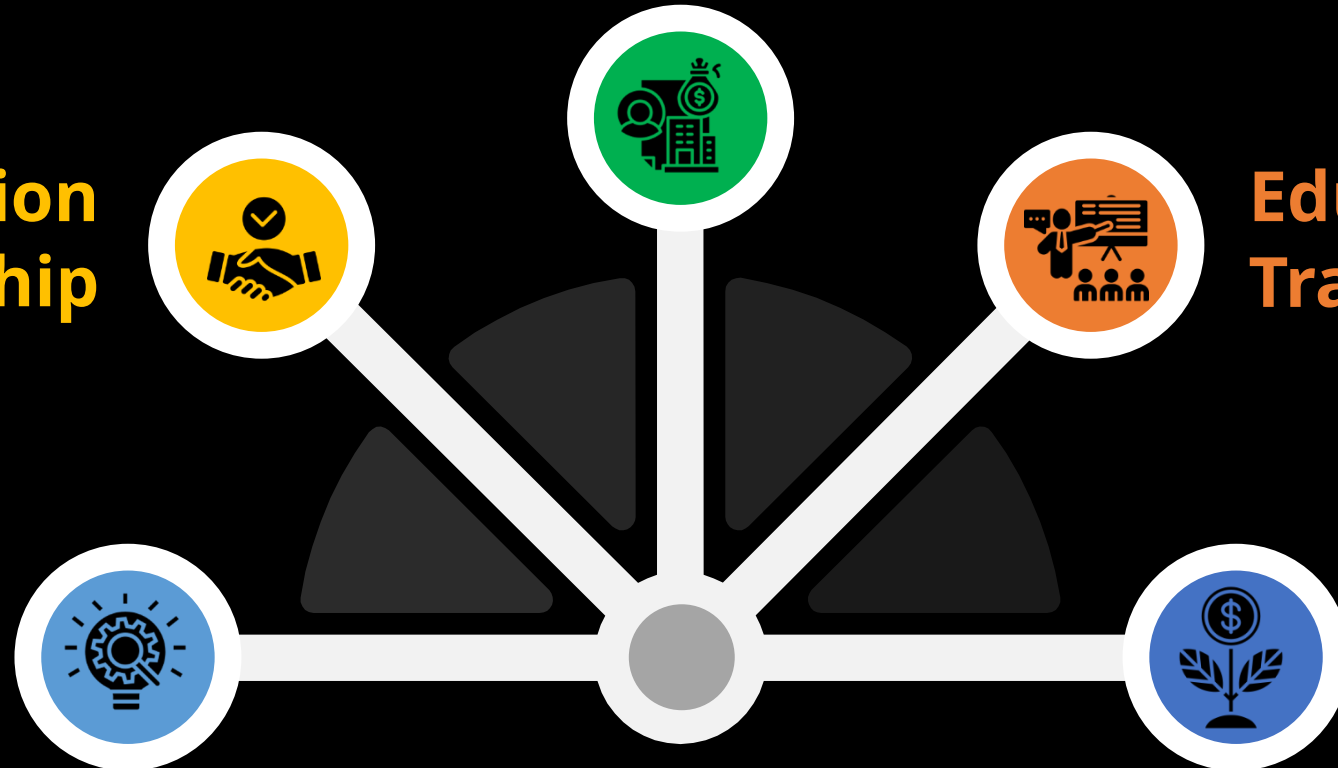
**Infrastructure  
and Resources**

**Collaboration  
and Partnership**

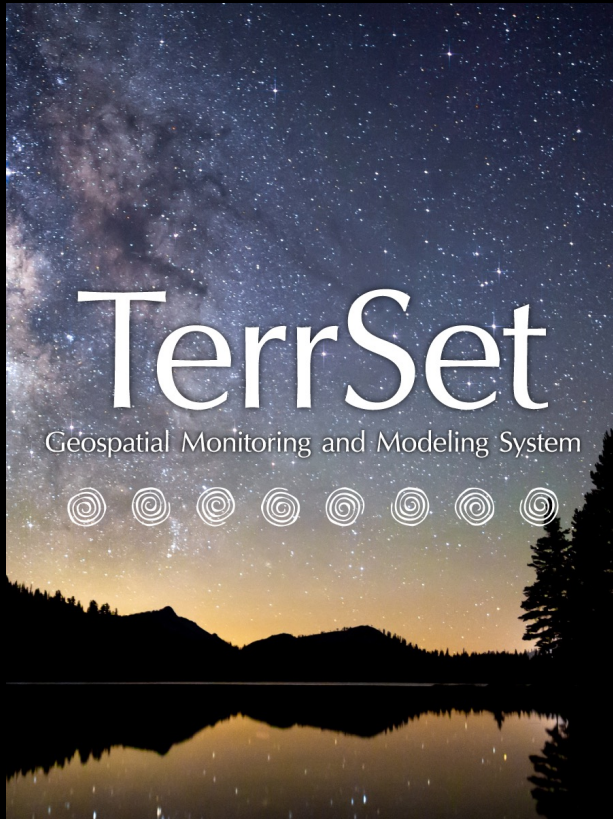
**Education and  
Training**

**Research and  
Innovation**

**Funding and  
Sustainability**



# Software and Datasets



YaoTingYao Merge pull request #17 from ClarkCGA/yayao

- data Update ui label
- doc doc&ui: Update
- font Initial commit
- LICENSE Initial commit
- README.md 1. Updated REA
- UDef-ARP.py Deleted get\_in
- UDef-ARP\_conda\_env.yml Remove prefix
- allocation\_tool.py Added calculat
- model\_evaluation.py Enhanced (mo
- vulnerability\_map.py Revised replac

README GPL-3.0 license

## Unplanned Deforestation Allocated Risk Modeling and Mapping Procedure (UDef-ARP)

SOURCE COOPERATIVE Search BROWSE SIGN IN / REGISTER

Read Me

### Multi-Temporal Crop Classification with HLS Imagery across CONUS Featured

This dataset contains temporal Harmonized Landsat-Sentinel (HLS) imagery of diverse crop type and land cover classes across the Contiguous United States (CONUS) for the year 2022. The target labels are derived from USDA's Crop Data Layer (CDL). It's primary purpose is for training segmentation geospatial machine learning models. It includes 3,854 chips of 224 x 224 pixel area at 30m spatial resolution.

Provided By @clarkcga • Published on August 10, 2023

crop type land cover segmentation hls agriculture

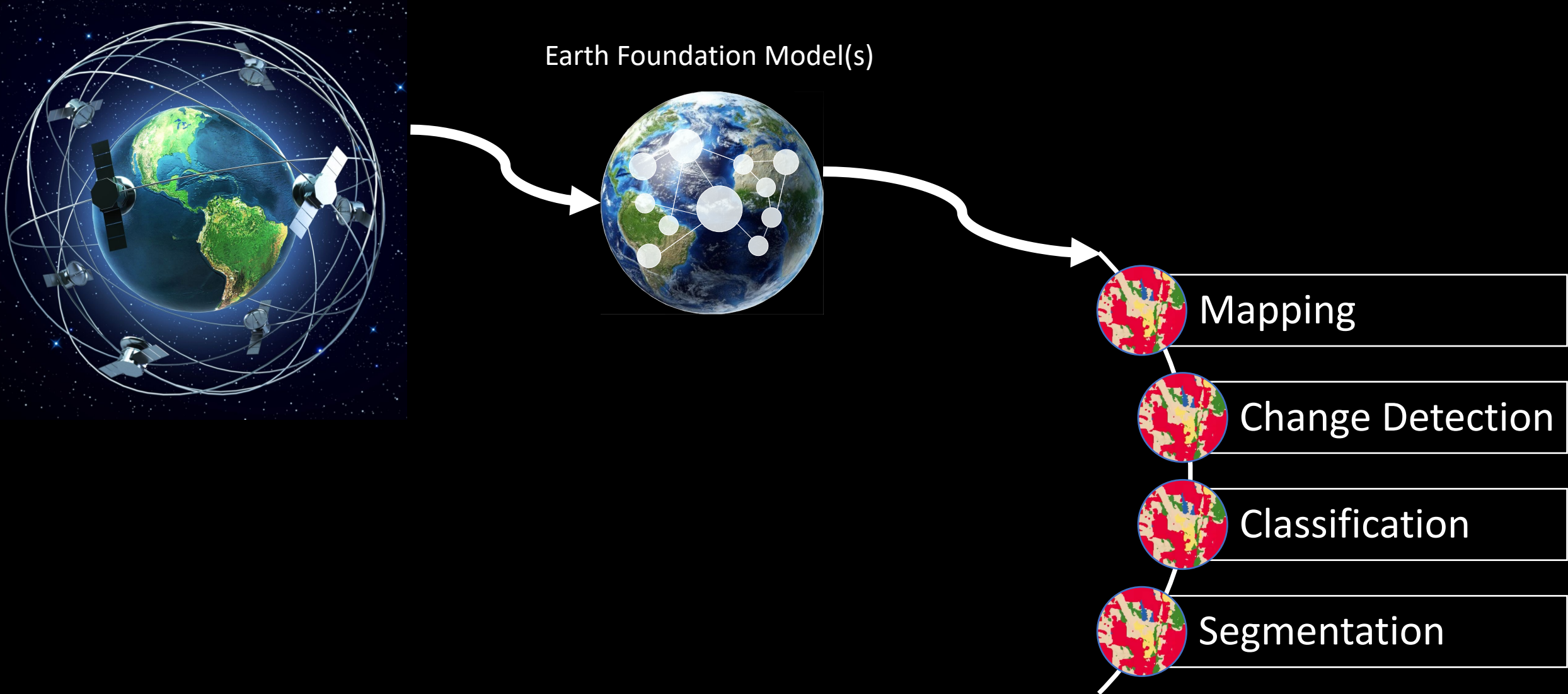
### Multi-Temporal Crop Classification with HLS Imagery across CONUS

#### Dataset Description

#### Dataset Summary

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# Foundation Models for Geospatial Analytics



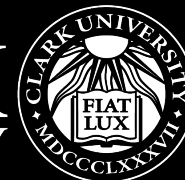
# Prithvi Foundation Model

- Transformer-based geospatial foundational model
- Using 1TB of Harmonized Landsat-Sentinel 2 (HLS)
- 6 bands as input (RGB + NIR + 2 SWIR)
- Downstream applications: *Crop, Flood and Mangrove Mapping, Cloud Gap Filling, ...*

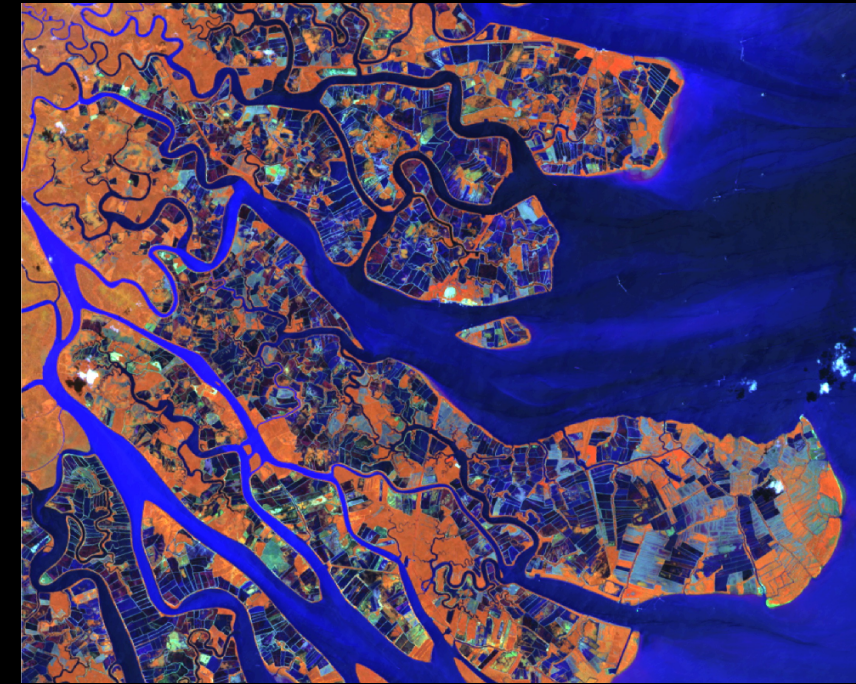
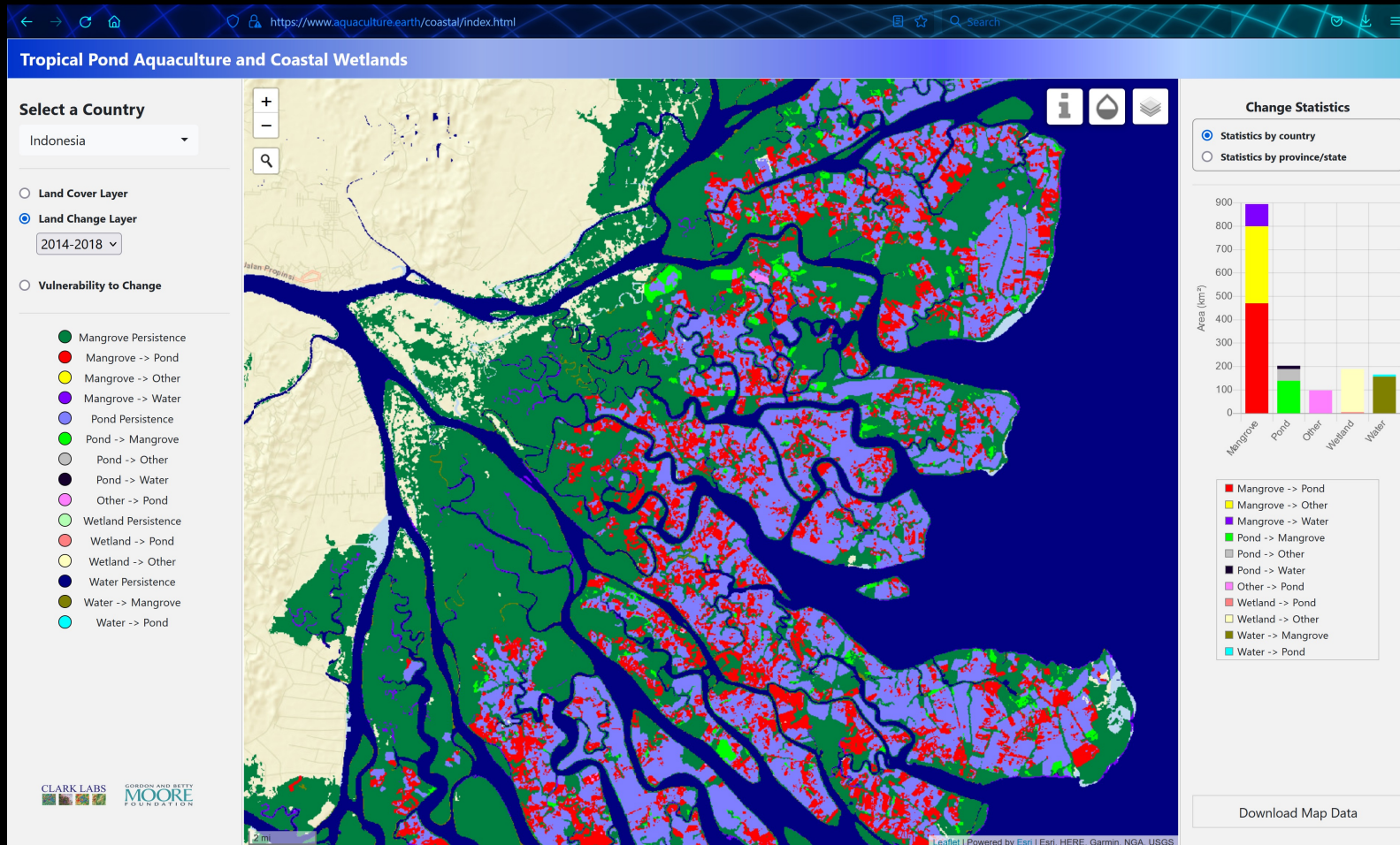


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# Global Monitoring of Aquaculture and Coastal Habitats

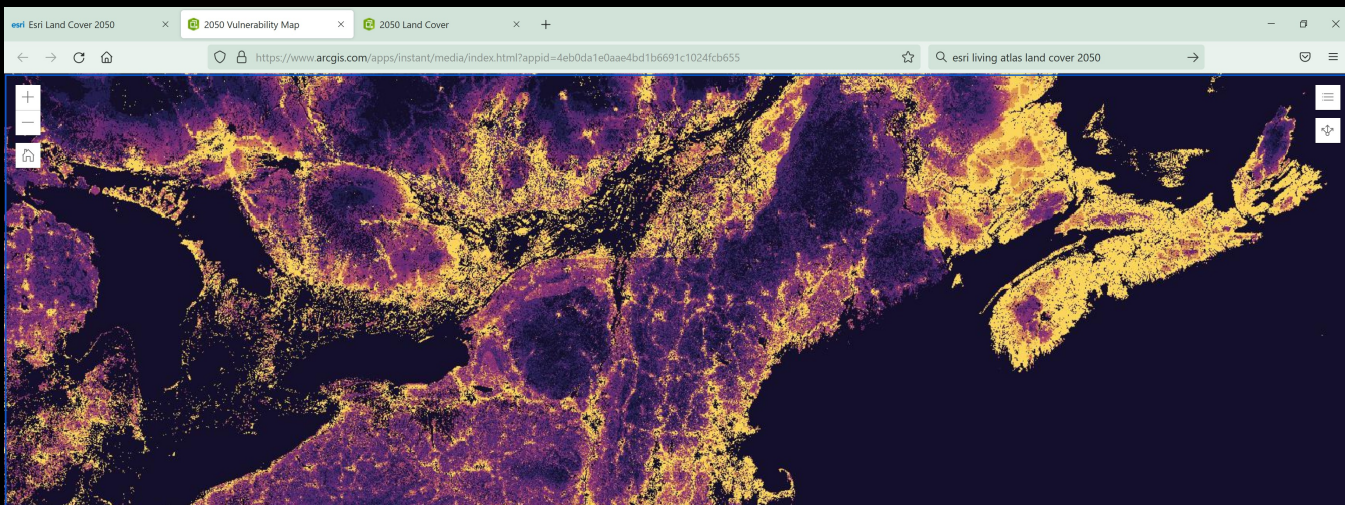


Landsat 8/9 Imagery

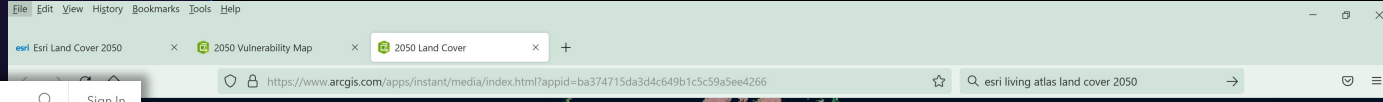
[www.aquaculture.earth](http://www.aquaculture.earth)

GORDON AND BETTY  
**MOORE**  
 FOUNDATION





# Land Cover 2050



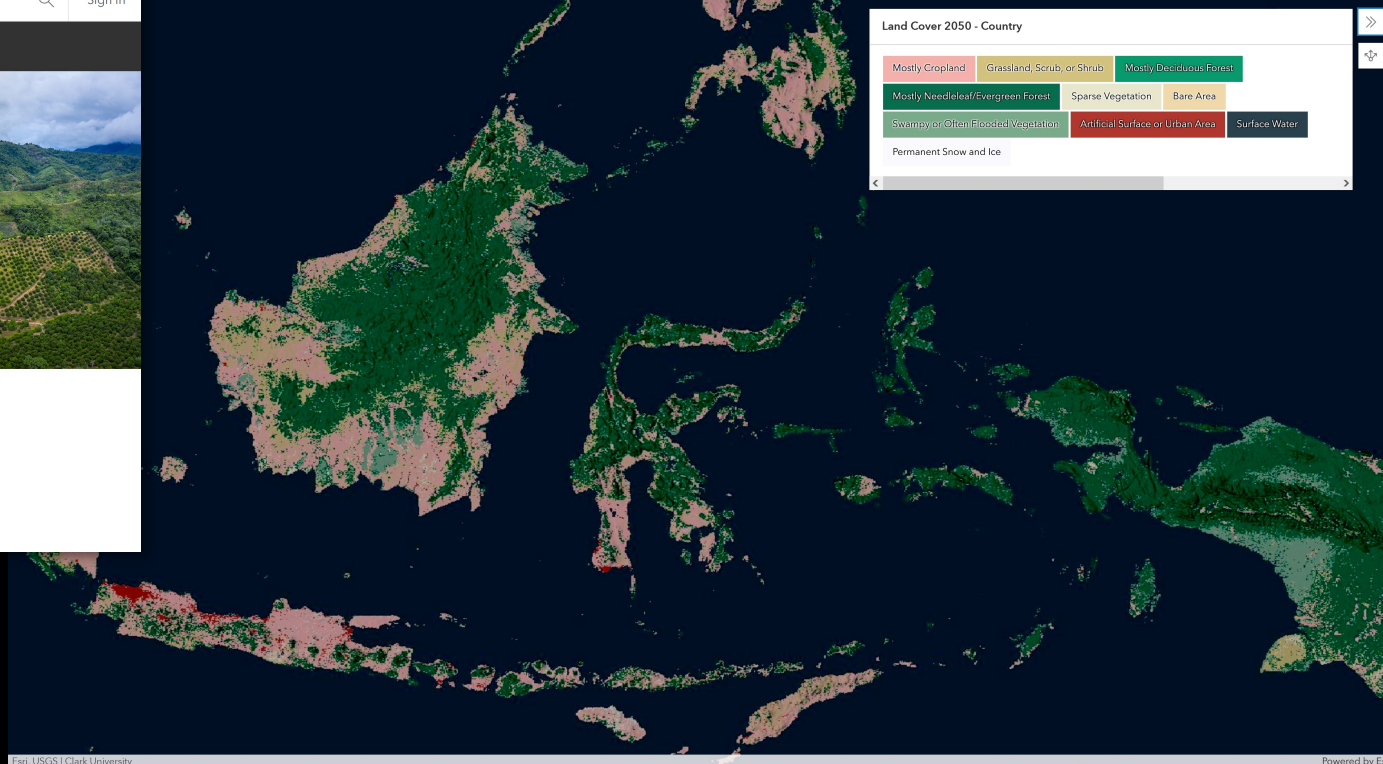
Esri Land Cover 2050

## Esri Land Cover 2050

How will land cover change by 2050? Here's a glimpse.

Plan for the future...now.

Understanding how our world has changed can provide insight into building a more sustainable and prosperous future. By analyzing historic global land cover data and observing change over time, we can make fundamental predictions and forecast growth patterns for the future.

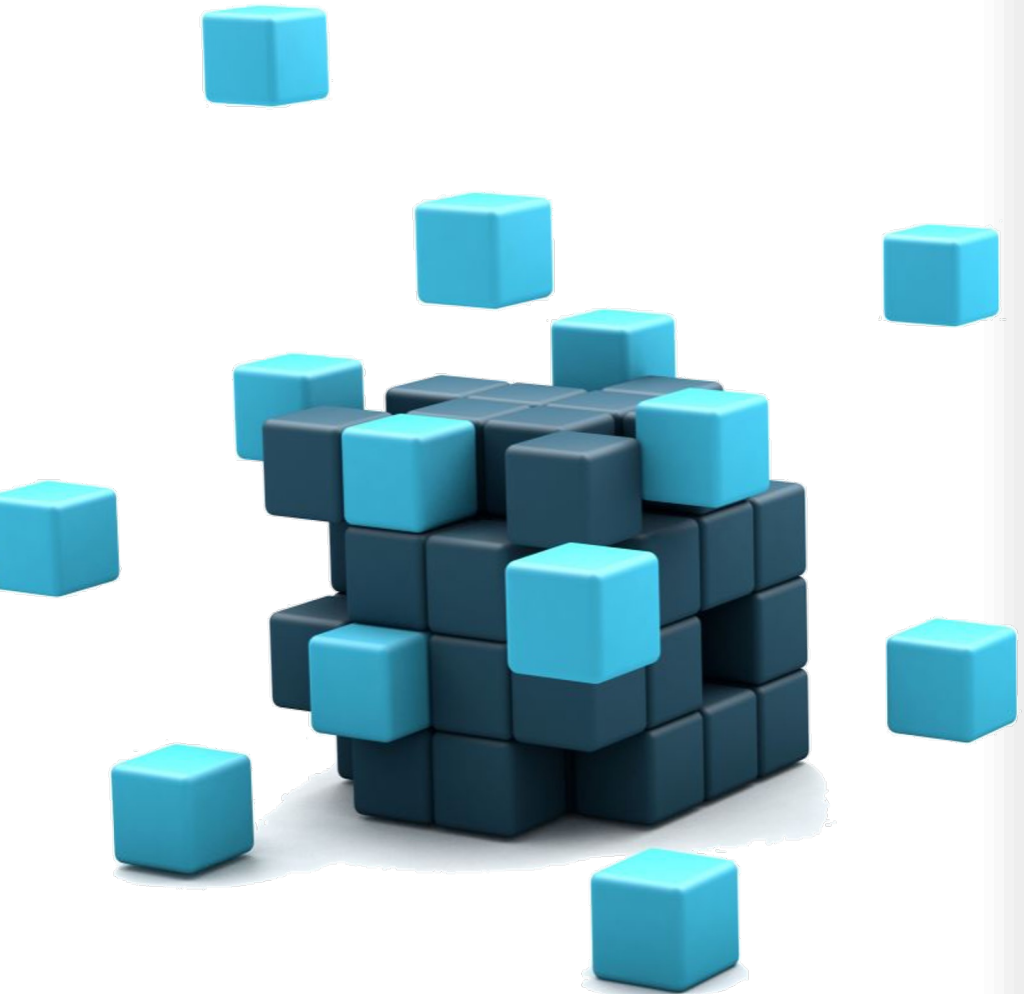


# Existing Industry and Non-Profit Partnerships



# Clark CGA Convenings





# Educational Blocks

- Domain Knowledge
- Data Literacy
- Reproducibility and Documentation
- Data Visualization
- AI
- Understanding Uncertainty
- Foundational Programming
- Computing and Cloud
- Software Agnostic

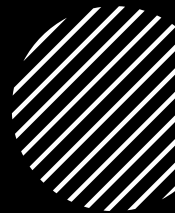
A photograph of two students in a computer lab. One student, a man with a beard wearing a denim jacket, is pointing at a computer monitor. The other student, a man with a shaved head wearing a blue and white striped polo shirt, is looking at the monitor. The monitor displays a GIS map with various colored regions. There are papers and a keyboard on the desk. The background shows other computer workstations in a dimly lit room.

# MSGIS Degree at Clark University

- Mastering the core concepts in GIS and remote sensing
- Developing high-tech expertise that leads directly to a career
- Applying GIS tools to real-life problems
- Coding and developing software applications for GIS
- Integrating and synthesizing diverse information sources



# Mechanisms



Open Source



Multi-disciplinary Groups (peer-learning)



Internships



Partnerships




Increasing Diversity



Online Courses and Lectures

# Course: Advanced Geospatial Analytics with Python



**GEOG 213/313: Advanced Geospatial Analytics with Python**

**Introduction**

- Syllabus
- Team
- Schedule
- Assessment
- Resources
- Policies

**Lectures**

- Intro to Unix
- Intro to Version Control and Git
- Python Environments
- Intro to JupyterLab
- Intro to Docker
- Geospatial Landscape

## GEOG 213/313: Advanced Geospatial Analytics with Python


**Overview**

Geospatial analytics is being revolutionized by the increasing availability of multi-modal observations from various sensors, new analytical methods including machine learning techniques, and the shift to using cloud infrastructures. Along the last decade. While open-source software in this landscape. Python including web development, large developer community and usability of Python.

This course is a follow-up to the Introduction to Information Science, a programming course. This course will introduce reproducible workflow with an emphasis on cloud data and data visualization.

The intended audience is students in Geography, GIS, ESS, and related fields.

Week	Date	Topic
1	8/29 & 9/1	Workflows for Open Reproducible Science (including Git) and Introduction to Unix *
2	9/5 & 9/8	Basics of Python Environments and JupyterLab
3	9/12 & 9/15	Introduction to Containers and Docker *
4	9/19 & 9/22	Introduction to Geospatial Python Landscape and STAC
5	9/26 & 9/29	Geospatial Data on the Cloud and Introduction to Dask
6	10/3 & 10/6	Introduction to Dask DataFrame and CRS *
7	10/13	Working with Vector Data in Python
8	10/17 & 10/20	Scaling Vector Data Analytics and Working with Raster Data in Python *
9	10/24 & 10/27	Scaling Raster Data Analytics
10	10/31 & 11/3	Working with Multi-Dimensional Arrays in Python *
11	11/7 & 11/10	Geospatial Data Visualization and Mapping
12	11/14 & 11/17	Microsoft Planetary Computer Demo *



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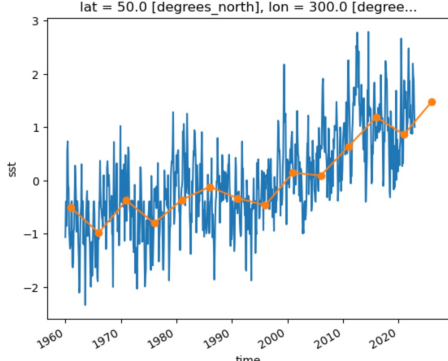
**Lectures**

- Intro to Unix
- Intro to Version Control and Git

```
ds_anom_resample.sst.sel(lon=300, lat=50).plot(marker='o')
```

[<matplotlib.lines.Line2D at 0x78264bc2f550>]

lat = 50.0 [degrees\_north], lon = 300.0 [degree...]



```
(ds_anom_resample.sel(time='2015-01-01', method='nearest') - ds_anom_resample.sel(time='1965-01-01', method='nearest')).sst.plot()
```

21.1. Interpolation  
21.2. Groupby  
21.3. Groupby-Related: Resample, Rolling, Coarsen  
21.3.1. Resample  
21.3.2. Rolling  
21.4. Coarsen  
21.5. An Advanced Example

[hamedalemo.github.io/advanced-geo-python](https://hamedalemo.github.io/advanced-geo-python)

# Thank You!

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 [clarku.edu/cga](http://clarku.edu/cga)