

# Virtual Consulting Office I-GUIDE Platform 101

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I-GUIDE Core Cyberinfrastructure Capabilities and Services Team



# Table of Content

- Introduction
- I-GUIDE Platform
  - JupyterHub
  - Data Catalog
  - Technical Support
- Demo
- Future
- Q&A

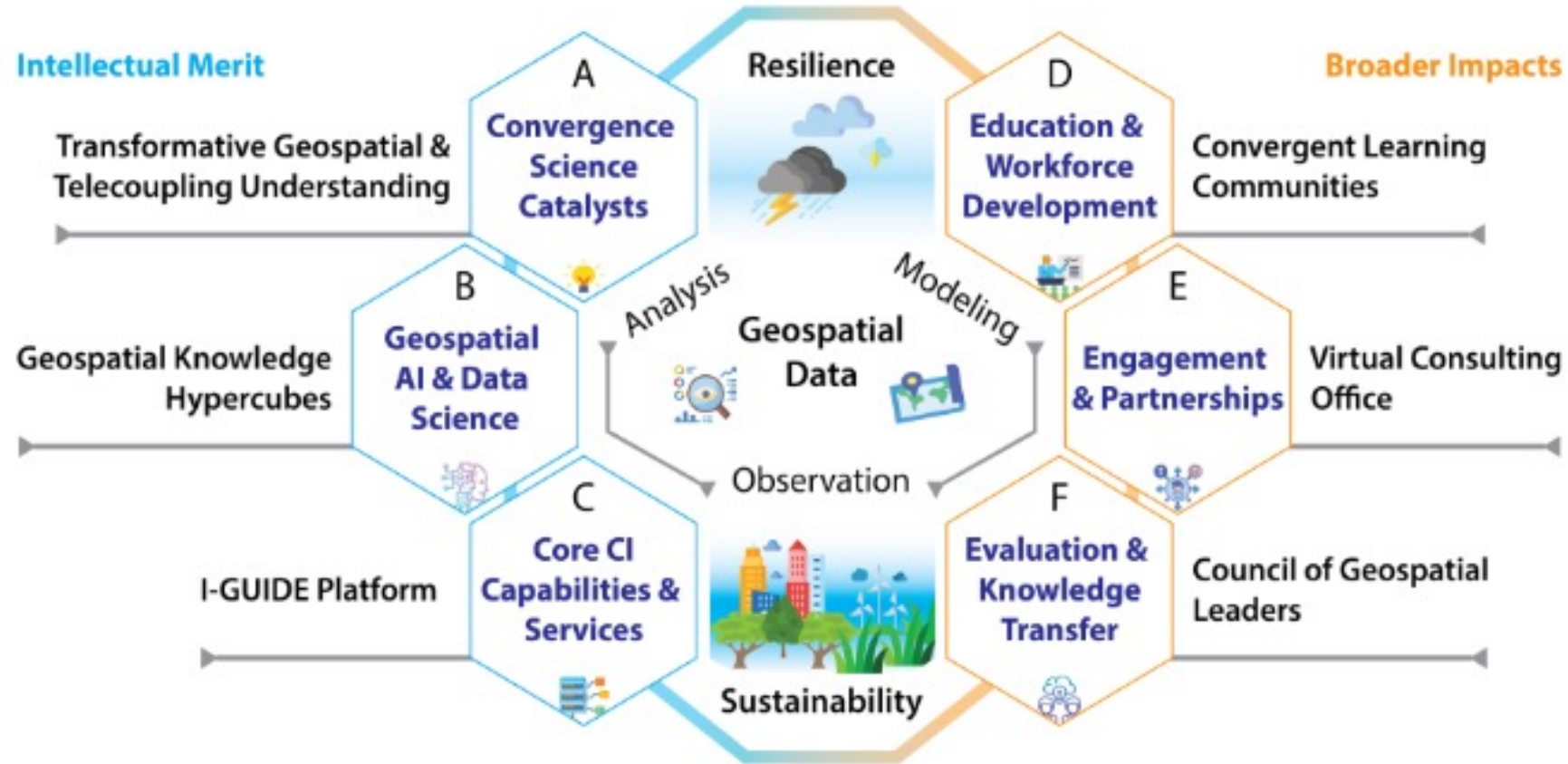
# Introduction

# I-GUIDE

- I-GUIDE: NSF Institute for Geospatial Understanding through an Integrative Discovery Environment
- Proudly funded by NSF
- Collaboration with other universities and scientific organizations
  - Illinois, Purdue, USU, MSU, UMTC, etc.
  - CUAHSI, UCGIS, etc.



# I-GUIDE Focus Areas



# When you start a new geospatial project

- Big spatial dataset
- Heavy computation
- Potential problems
  - Data storage
  - Memory
  - Infrastructure maintenance
  - Scalability

```
>>>
Traceback (most recent call last):
  File "D:\Research\Code\Python_Code\MakeXYEventLayer\ClipAndTrans2Ascii_20151224.py", line 19, in <module>
    data_clip()
  File "D:\Research\Code\Python_Code\MakeXYEventLayer\ClipAndTrans2Ascii_20151224.py", line 16, in data_clip
    arcpy.Clip_analysis(in_features, clip_features, out_feature_class, xy_tolerance)
  File "C:\Program Files\ArcGIS\bin\python.exe", line 56, in Clip
    raise e
ExecuteError: ERROR
Failed to execute
```

```
In [4]: import numpy as np
        from keras.layers import Input, Dense, Dropout
        from keras.models import Model
        from obspy import read

        seg1=[]
        seg2=[]
        from pathlib import Path
        for filename in Path('/home/nriag/Data/2018centuar').glob('**/HH.NABDT..HHZ_*'):

            st = read(str(filename), debug_headers=True)

            tr = st[0]
            a = tr.data

            seg1.append(a)
        seg1 = np.concatenate(seg1)
        sh = np.shape(seg1)
        seg2 = np.reshape(seg1,(int(sh[0]/200),200))
```

```
-----
MemoryError                                Traceback (most recent call last)
<ipython-input-4-c9c650f2b97a> in <module>
    26
    27     seg1.append(a)
--> 28 seg1 = np.concatenate(seg1)
    29 sh = np.shape(seg1)
    30 seg2 = np.reshape(seg1,(int(sh[0]/200),200))

<_array_function__ internals> in concatenate(*args, **kwargs)

MemoryError: Unable to allocate array with shape (4517769183,) and data type int32
```

# What could you do?

- Upgrade your infrastructure?
  - Expensive
  - Time consuming
  - Waste of resource
- Just wait due to slow performance?
  - Time wasted on waiting
  - Slow debugging
- Explore I-GUIDE Platform

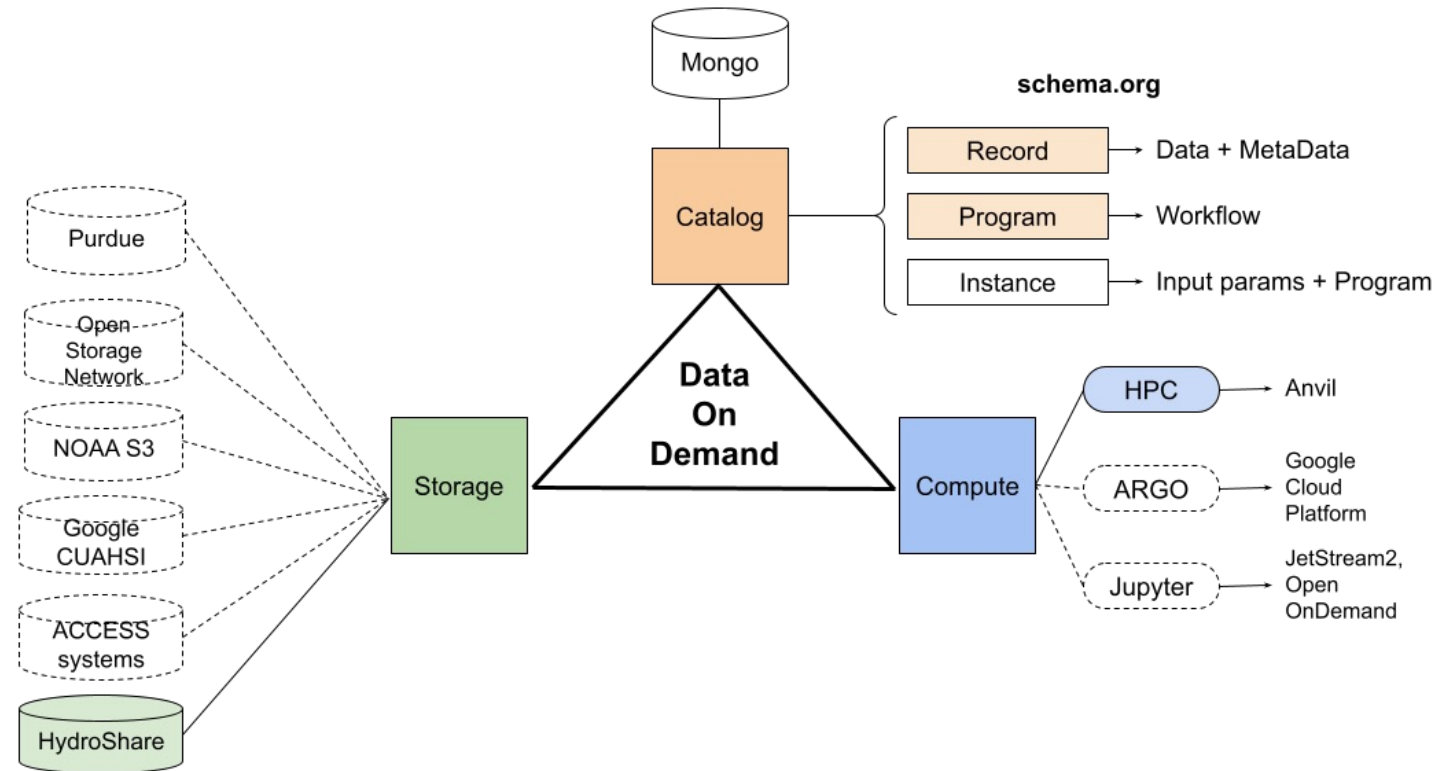


# I-GUIDE Platform

- Browser-based
  - Easy to use
  - Portable
- Remote infrastructure
  - Data are stored safely on our server
  - No infrastructure maintenance
- Provides geospatial researchers and developers:
  - A powerful cloud infrastructure - JupyterHub
  - A knowledgebase – Data Catalog



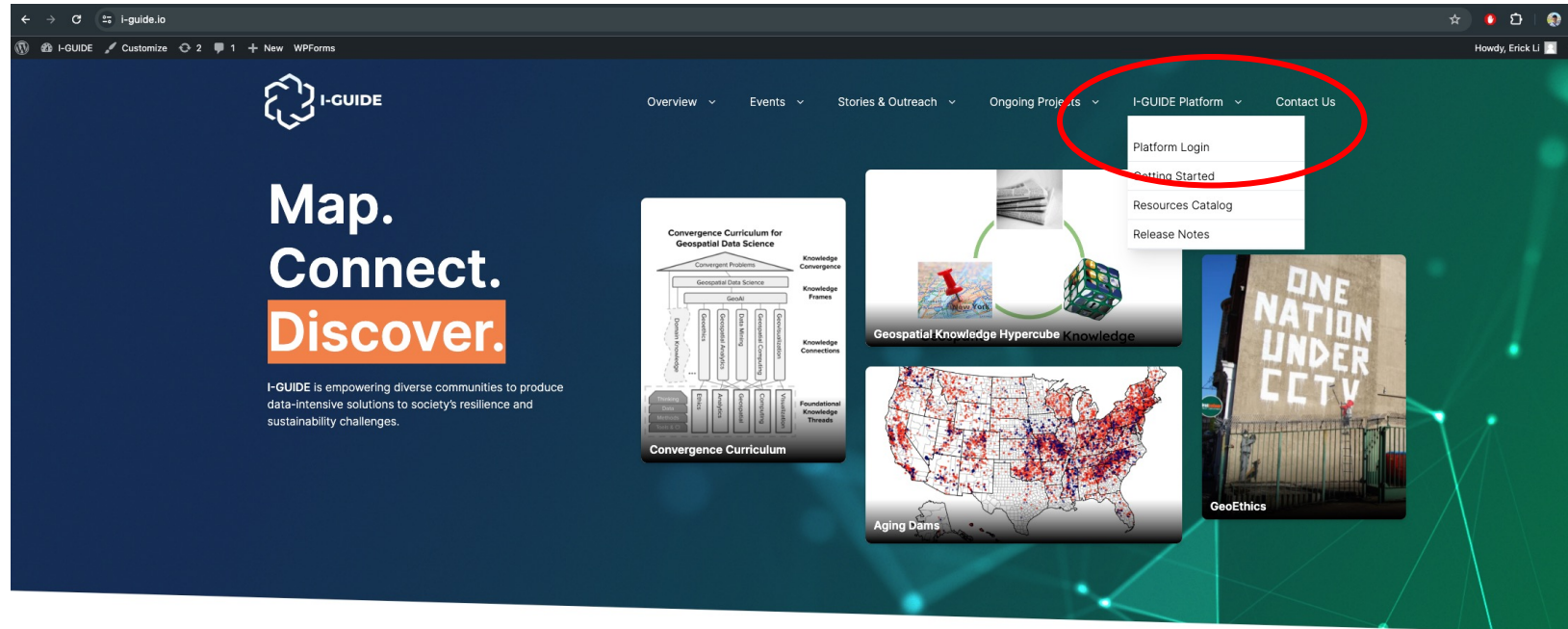
# I-GUIDE Platform Diagram



# I-GUIDE Platform JupyterHub

# Access portal

Go to I-GUIDE website at i-guide.io



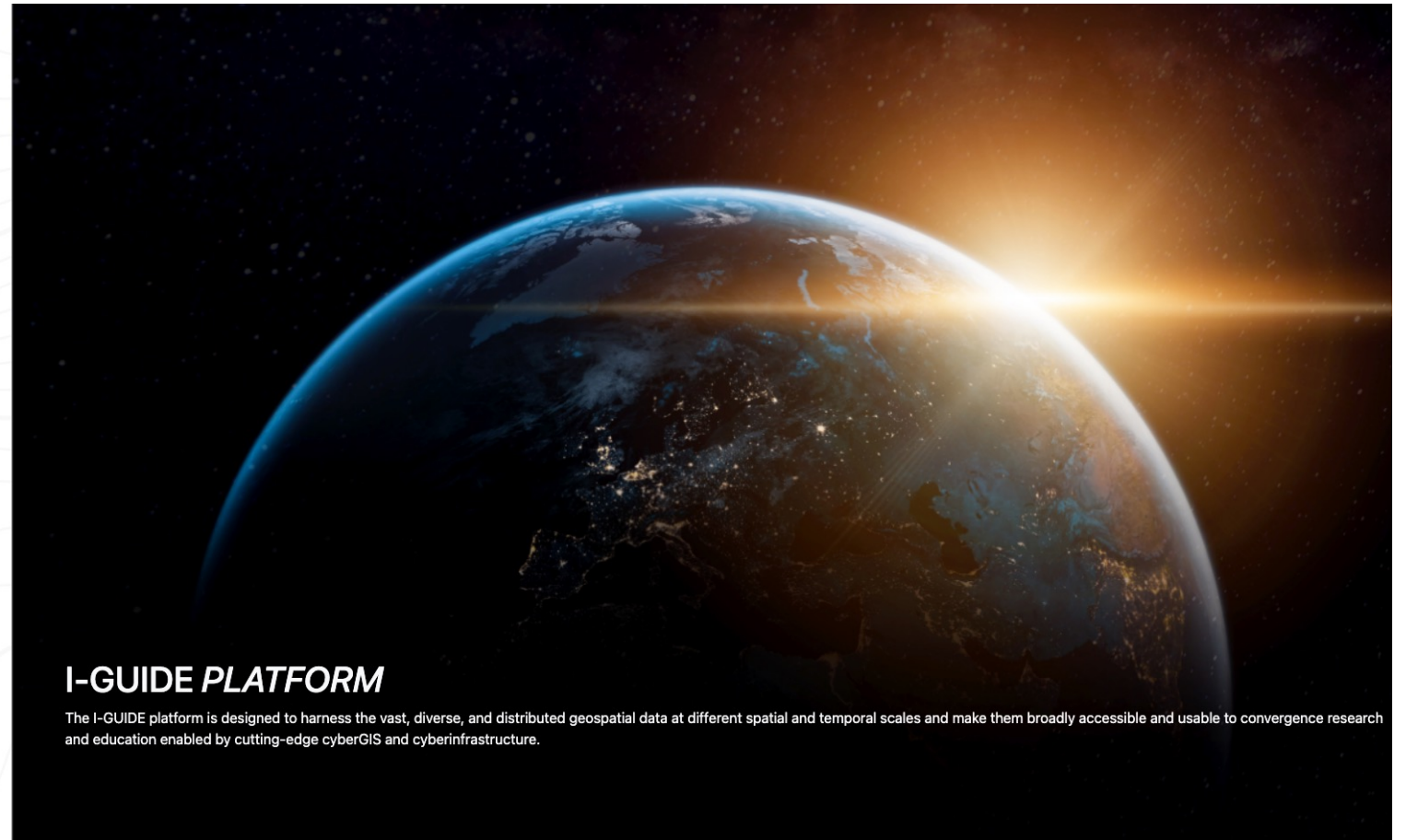
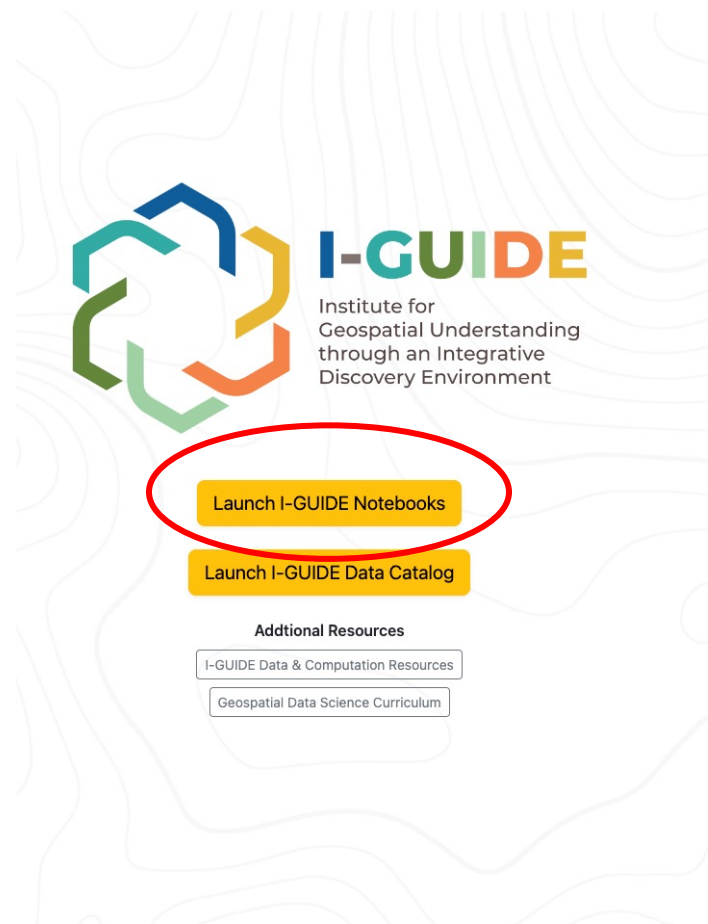
## I-GUIDE

**Vision:** Digital discovery and innovation through harnessing the geospatial data revolution

**Mission:** Transform convergence and geospatial sciences for holistic sustainability solutions



# Landing Page



# I-GUIDE Platform JupyterHub

[Back to I-GUIDE website](#) [Get started](#) [Log in](#)

## Integrative Discovery Starts Here!

### Modeling the relationship between urban tree canopy, land cover, and land surface temperature

This exercise shows how to apply Machine Learning Models to explore the relationship between urban tree canopy, land cover, and land surface temperature. It lays out an initial modeling approach that combines exploratory data analysis with KNN regression and decision tree models to better understand the patterns of the data and for prediction purposes in the R environment.

[Open Notebook](#)

### Mapping Transit-induced Gentrification

This exercise shows how to use Census API to get data from the Census Bureau website and explore demographic changes over time near transit stops to identify areas which might be experiencing transit-induced gentrification.

[Open Notebook](#)

### Summer School 23 - Image segmentation by foundation model finetuning

The main focus of this work is to gain practical experience in applying deep learning techniques to real-world spatial problems, at the cutting edge of GeoAI.

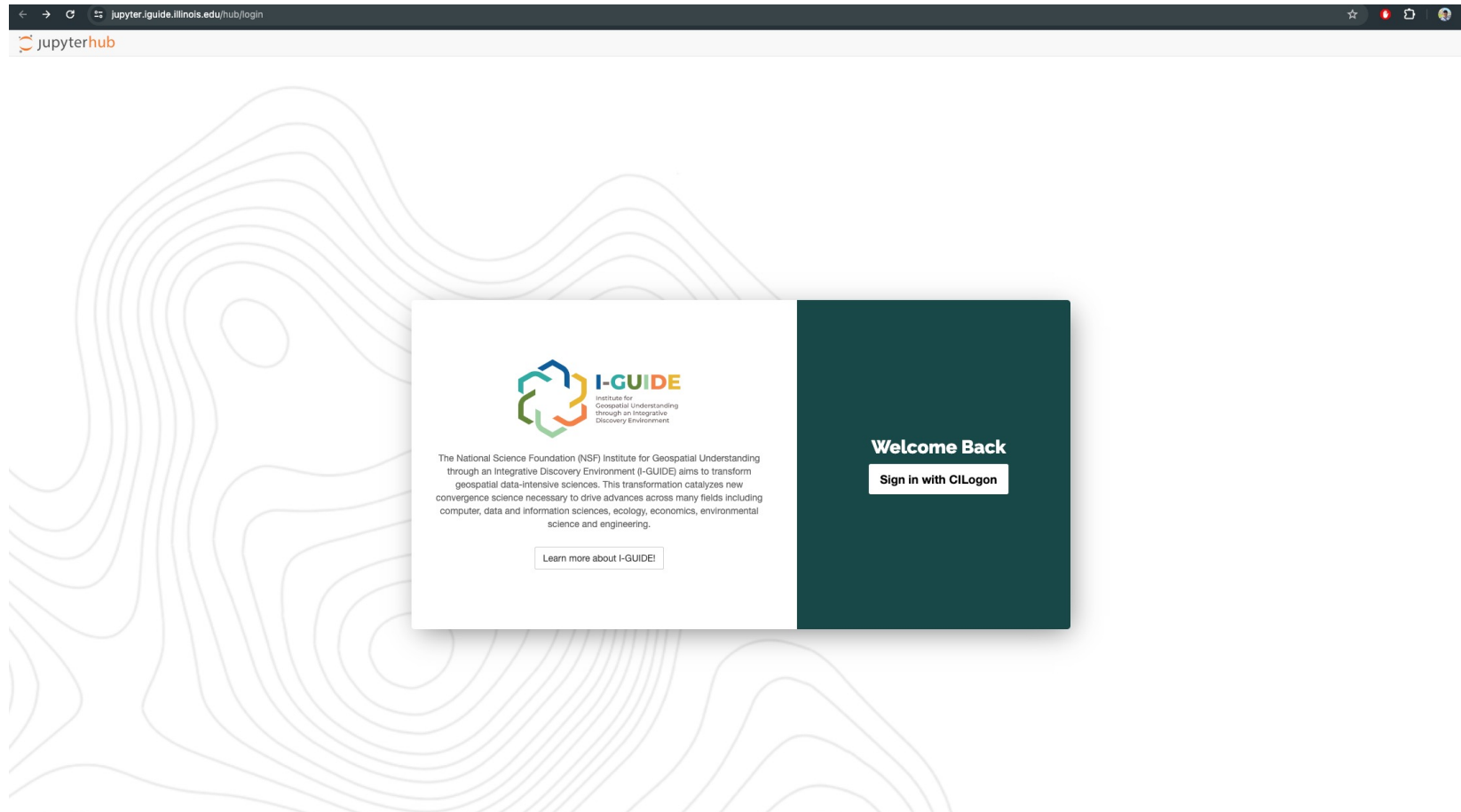
[Open Notebook](#)

### Summer School 23 - Investigating Hydrological Responses and Shrinkage

### Summer School 23 - Spatio-temporal dynamics of a metacoupled world

### Summer School 23 - Characterizing the spatiotemporal changes of wildland urban

# Single Sign-on - CILogon



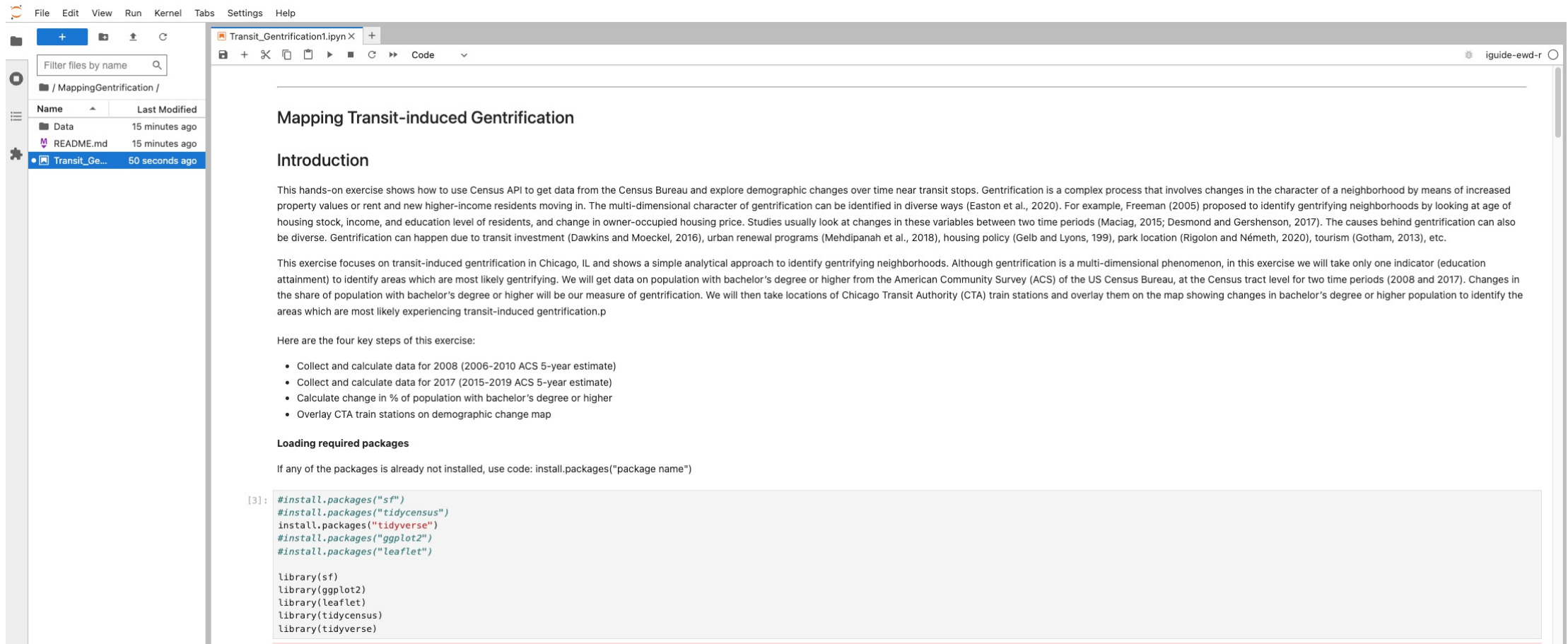
# Server Options

The screenshot shows a web browser window with the URL `jupyter.iguide.illinois.edu/hub/spawn`. The page title is "Server Options". There are two radio button options:

- I-GUIDE Platform**  
Default Environment for the I-GUIDE Platform (most users should choose this)
- I-GUIDE Esri Summer School 2023**  
I-GUIDE Esri Summer School 2023

At the bottom of the options section is a large orange button labeled "Start".

# Sample Jupyter Notebooks



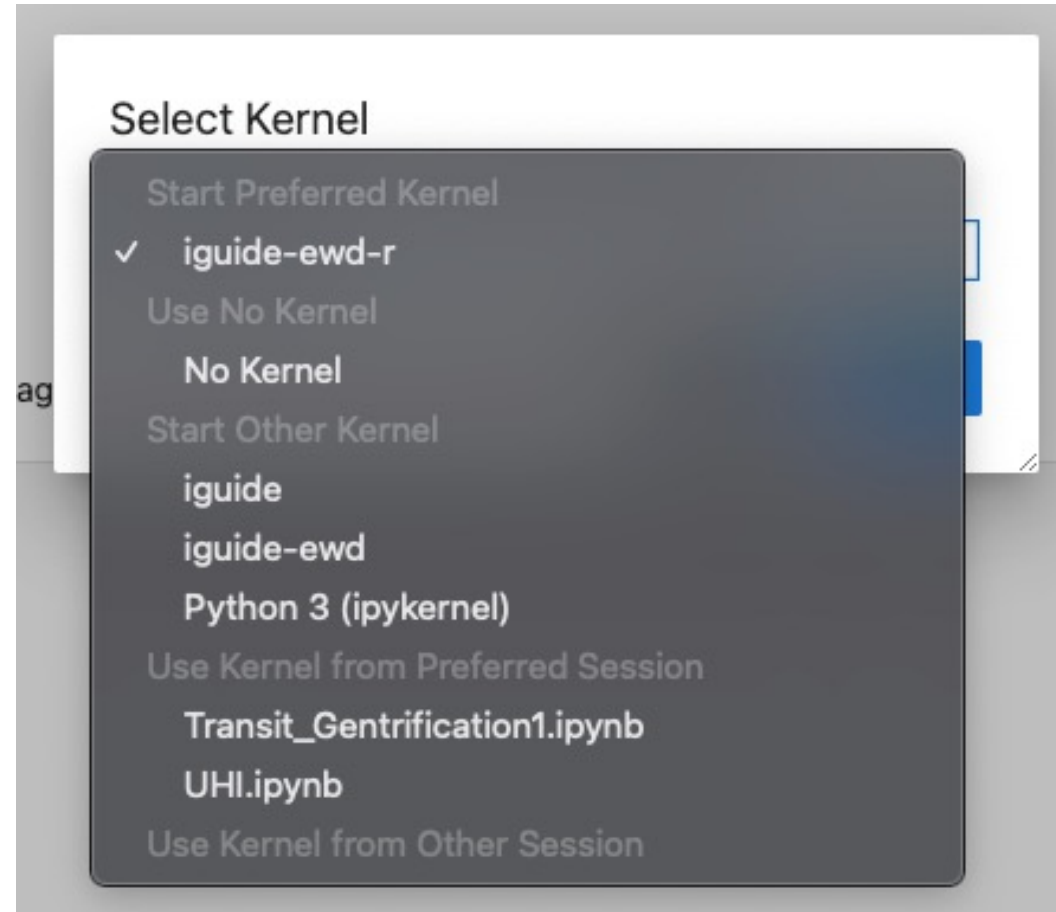
The screenshot displays a Jupyter Notebook environment. On the left, a file browser shows a directory named 'MappingGentrification' containing files 'Data', 'README.md', and 'Transit\_Ge...'. The main notebook area is titled 'Mapping Transit-induced Gentrification' and contains an 'Introduction' section. The text describes a hands-on exercise using the Census API to explore demographic changes near transit stops. It mentions gentrification as a complex process involving increased property values and higher-income residents. The exercise focuses on Chicago, IL, using education attainment as an indicator to identify gentrifying neighborhoods. It references the American Community Survey (ACS) and Chicago Transit Authority (CTA) train stations. A list of four key steps is provided: collecting data for 2008 and 2017, calculating the percentage change in the population with a bachelor's degree or higher, and overlaying CTA train stations on a demographic change map. Below the text, a code cell is shown with the following content:

```
[3]: #install.packages("sf")
#install.packages("tidycensus")
install.packages("tidyverse")
#install.packages("ggplot2")
#install.packages("leaflet")

library(sf)
library(ggplot2)
library(leaflet)
library(tidycensus)
library(tidyverse)
```



# Kernel Selection



# Easy to install and use libraries/modules

## Loading required packages

If any of the packages is already not installed, use code: `install.packages("package name")`

```
[3]: #install.packages("sf")
#install.packages("tidycensus")
install.packages("tidyverse")
#install.packages("ggplot2")
#install.packages("leaflet")

library(sf)
library(ggplot2)
library(leaflet)
library(tidycensus)
library(tidyverse)

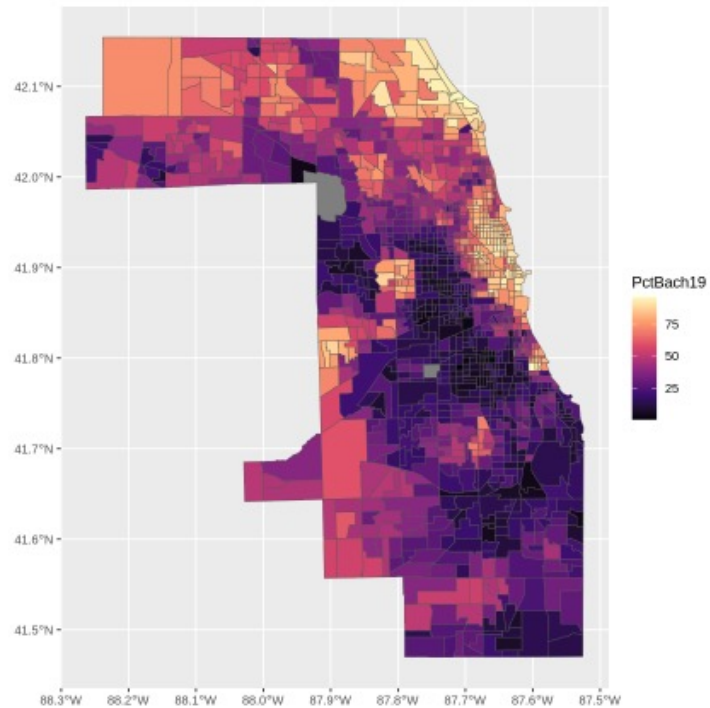
Installing package into '/home/jovyan/R/x86_64-conda-linux-gnu-library/4.3'
(as 'lib' is unspecified)

also installing the dependencies 'rematch', 'backports', 'blob', 'tidyselect', 'gargle', 'cellranger', 'ids', 'broom', 'conflicted', 'dbplyr', 'dtplyr', 'forcats', 'googledrive', 'googlesheets4', 'haven', 'modelr', 'readxl', 'rex', 'rprojroot', 'rstudioapi', 'scales', 'stringr', 'tibble', 'tidyr', 'xml2', 'zip'

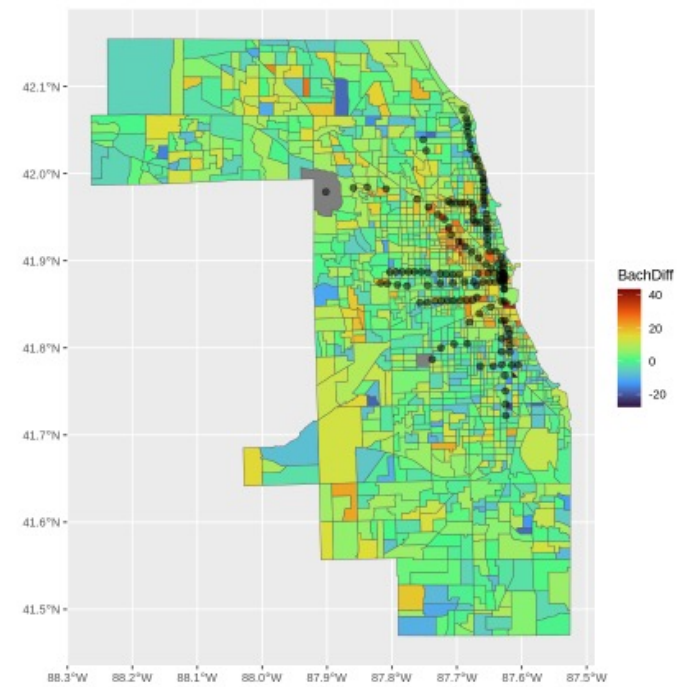
— Attaching core tidyverse packages — tidyverse 2.0.0 —
✔ dplyr 1.1.3      ✔ readr 2.1.5
✔ forcats 1.0.0   ✔ stringr 1.5.0
✔ lubridate 1.9.3 ✔ tibble 3.2.1
✔ purrr 1.0.2    ✔ tidyr 1.3.0
— Conflicts — tidyverse_conflicts() —
✖ dplyr::filter() masks stats::filter()
✖ dplyr::lag() masks stats::lag()
i Use the conflicted package (<http://conflicted.r-lib.org/>) to force all conflicts to become errors
```

# Data Visualization

```
[19]: Dat19sf %>%  
  ggplot(aes(fill = PctBach19)) +  
  geom_sf() +  
  scale_fill_viridis_c(option = "magma")
```



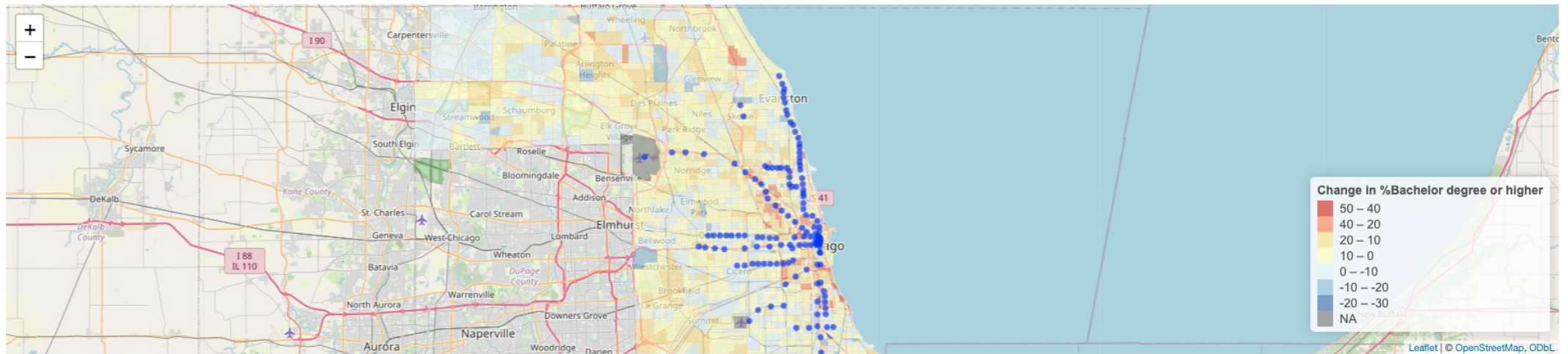
```
[25]: ggplot() +  
  geom_sf(data=DatAll.sf, aes(fill = BachDiff)) +  
  scale_fill_viridis_c(option = "turbo")+  
  geom_sf(data=CTA_stops, size = 2, alpha = 0.5)
```



# Interactive Maps powered by Leaflet

```
[27]: bins <- c(50, 40, 20, 10, 0, -10, -20, -30)
      pal <- colorBin("RdYlBu", domain = DatAll.sf2$BachDiff, bins = bins, reverse=TRUE)

      m <- leaflet() %>%
        addTiles() %>% # Add default OpenStreetMap map tiles
        addPolygons(data=DatAll.sf2, fillColor = ~pal(BachDiff), fillOpacity = 0.6, stroke=FALSE) %>%
        addCircles(lng=CTA_stops$long, lat=CTA_stops$lat, popup=CTA_stops$LINEs, radius=2, opacity =0.7, fill = TRUE) %>%
        addLegend(position = "bottomright", pal = pal, values = DatAll.sf2$BachDiff, title="Change in %Bachelor degree or higher", opacity = 0.7, )
      m
```



The interactive map shows that some areas along Blue line stations (going to O'Hare airport) experienced more concentration of highly educated populations (bachelor's degree or higher) between 2008 and 2017 compared to other areas. However, stations along most other lines do not show any significant change in their neighboring areas.

# Create your own Notebooks

The screenshot shows the I-GUIDE Platform website. At the top, the browser address bar displays "i-guide.io/platform/discovery/". The website header includes the "I-GUIDE Platform" logo and navigation buttons: "Back to I-GUIDE website", "Get started", and "Log in". A red circle highlights these buttons. Below the header is a banner with the text "Integrative Discovery Starts Here!". The main content area features a grid of six notebook cards, each with a thumbnail image, a title, a brief description, and an "Open Notebook" button.

**Modeling the relationship between urban tree canopy, land cover, and land surface temperature**  
This exercise shows how to apply Machine Learning Models to explore the relationship between urban tree canopy, land cover, and land surface temperature. It lays out an initial modeling approach that combines exploratory data analysis with KNN regression and decision tree models to better understand the patterns of the data and for prediction purposes in the R environment.

**Mapping Transit-induced Gentrification**  
This exercise shows how to use Census API to get data from the Census Bureau website and explore demographic changes over time near transit stops to identify areas which might be experiencing transit-induced gentrification.

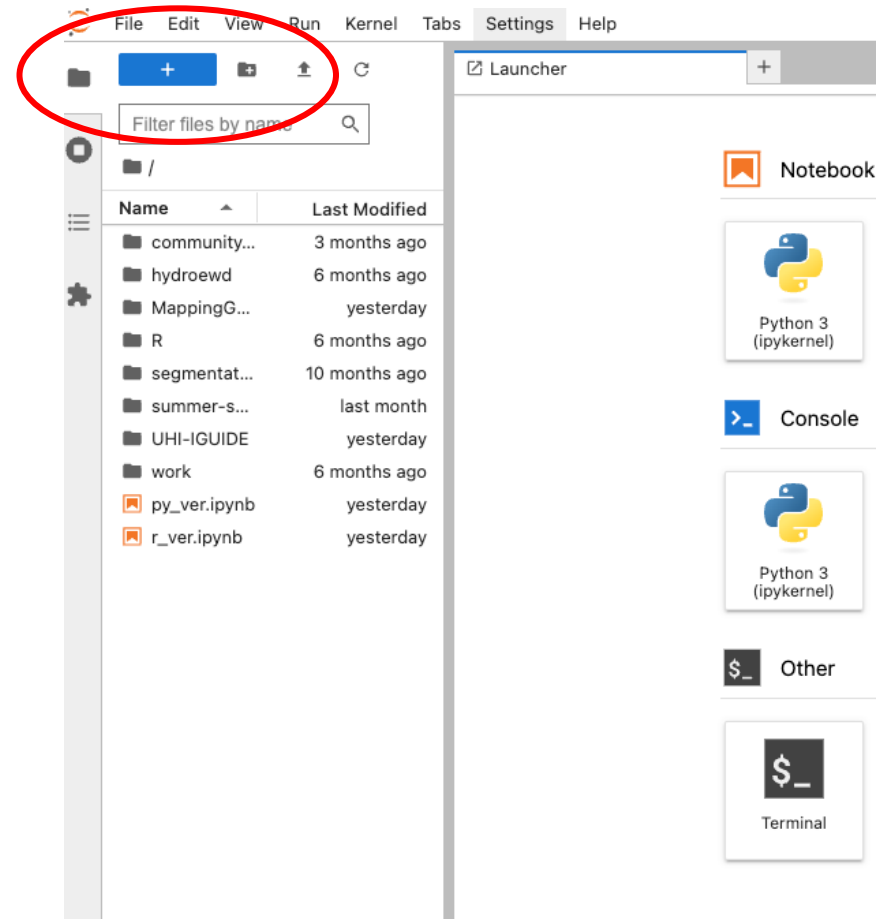
**Summer School 23 – Image segmentation by foundation model finetuning**  
The main focus of this work is to gain practical experience in applying deep learning techniques to real-world spatial problems, at the cutting edge of GeoAI.

**Summer School 23 – Investigating Hydrological Responses and Shrinkage**

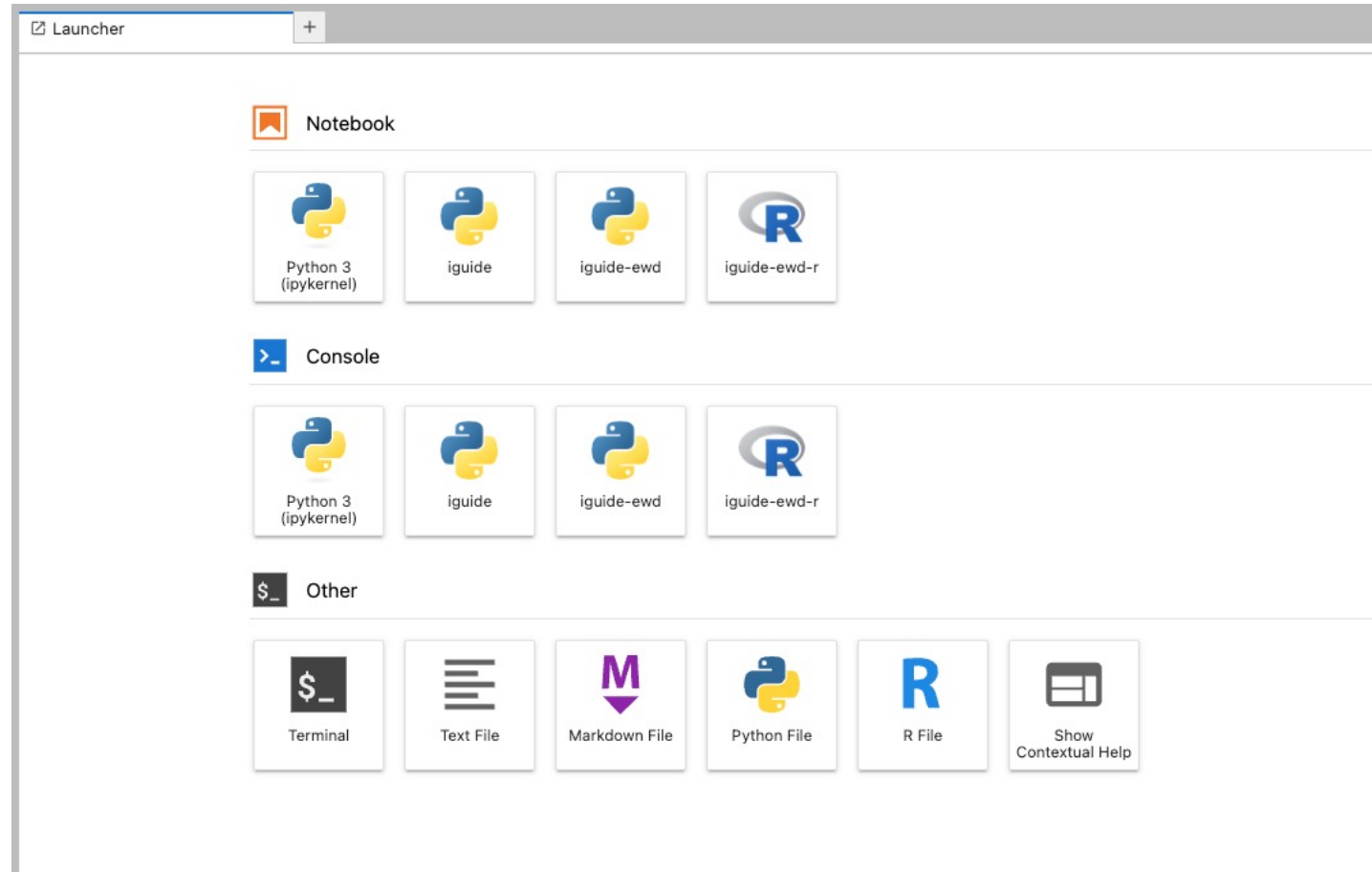
**Summer School 23 – Spatio-temporal dynamics of a metacoupled world**

**Summer School 23 – Characterizing the spatiotemporal changes of wildland urban**

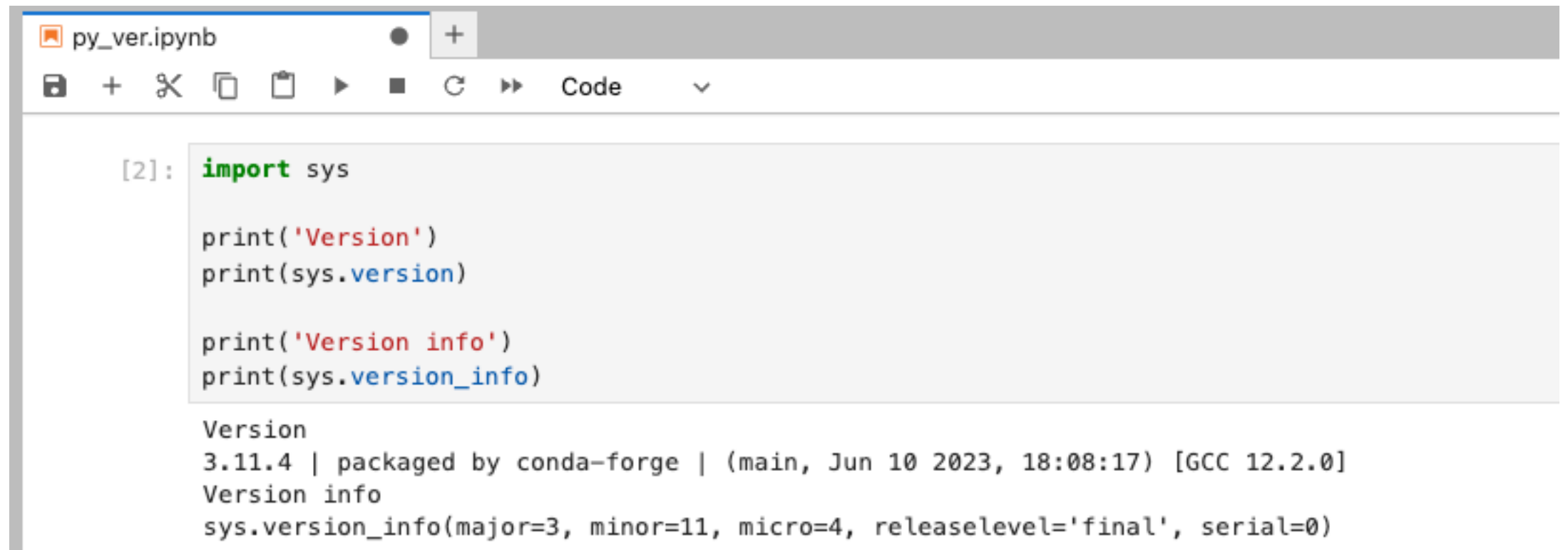
# Create a new Notebook



# Select Notebook languages (Kernels)



# Python



The image shows a Jupyter Notebook window titled 'py\_ver.ipynb'. The interface includes a toolbar with icons for file operations and execution. The code cell contains the following Python code:

```
[2]: import sys

print('Version')
print(sys.version)

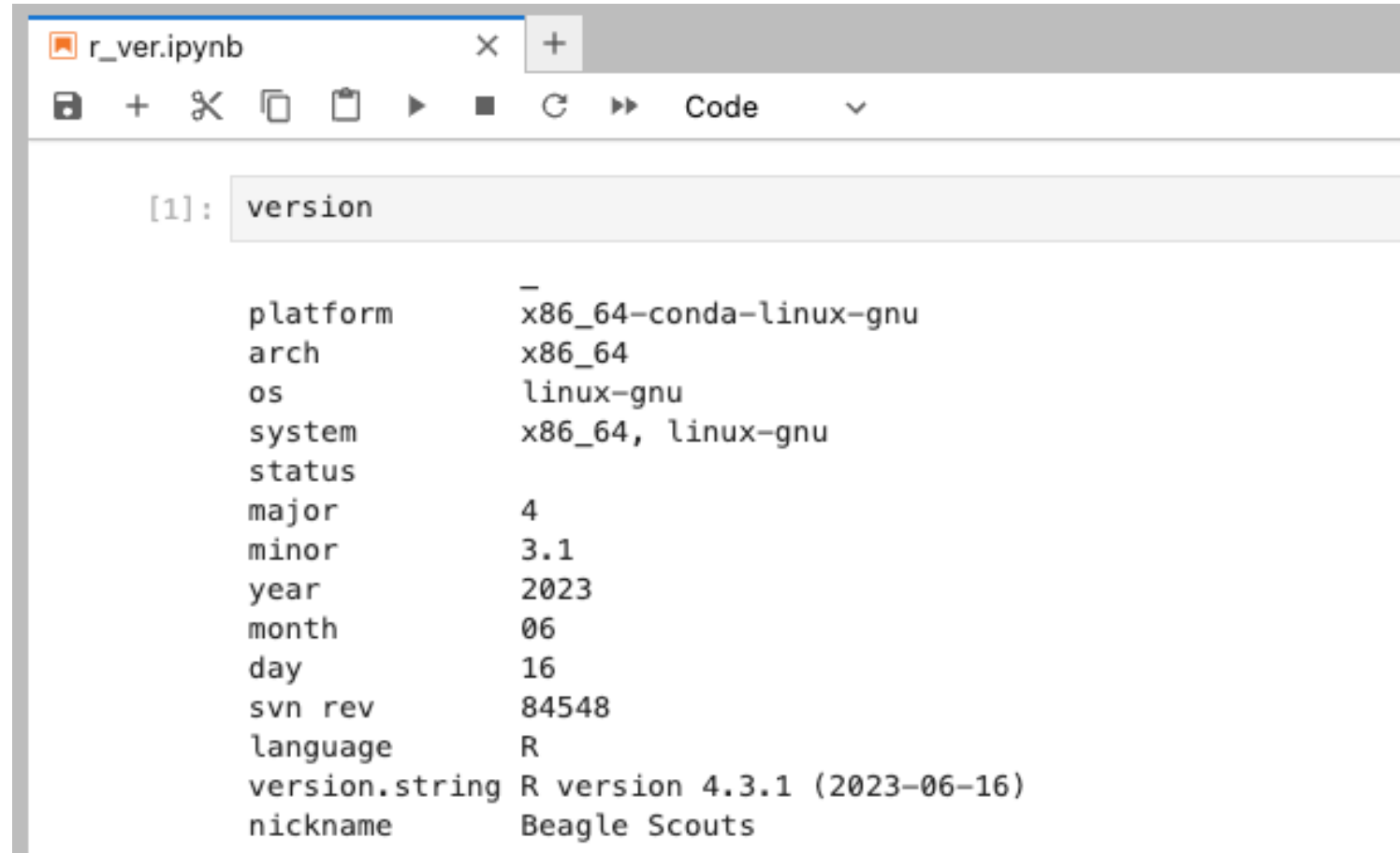
print('Version info')
print(sys.version_info)
```

The output of the code is displayed below the cell:

```
Version
3.11.4 | packaged by conda-forge | (main, Jun 10 2023, 18:08:17) [GCC 12.2.0]
Version info
sys.version_info(major=3, minor=11, micro=4, releaselevel='final', serial=0)
```



# R Language



The screenshot shows a Jupyter Notebook window titled 'r\_ver.ipynb'. The notebook contains a single code cell with the following output:

```
[1]: version
```

platform	x86_64-conda-linux-gnu
arch	x86_64
os	linux-gnu
system	x86_64, linux-gnu
status	
major	4
minor	3.1
year	2023
month	06
day	16
svn rev	84548
language	R
version.string	R version 4.3.1 (2023-06-16)
nickname	Beagle Scouts

# Featured Libraries

- GIS related
  - GeoPandas
  - PyGEOS
  - netCDF4
- Others
  - Dask
  - Xarray
  - Scipy



# GIS Libraries

- GeoPandas
  - Pandas + geometric spatial operations
- PyGEOS
  - Vectorization + geometry functions
- netCDF4
  - Handles Network Common Data Form (NetCDF)
  - Array-oriented scientific data
  - Interface to the netCDF C library



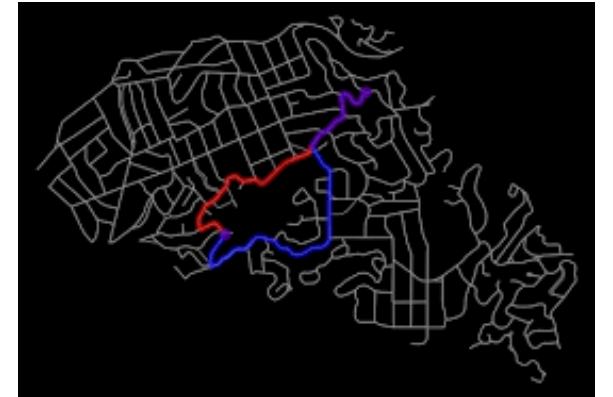
# Other Libraries

- Dask
  - Parallel computing
- Xarray
  - More human-readable multi-dimensional array operations
    - Select rows
    - Insert data
- Scipy
  - Almost everything you need for scientific computation
    - Linear algebra
    - Optimization
    - Image manipulations



# EWD Kernel

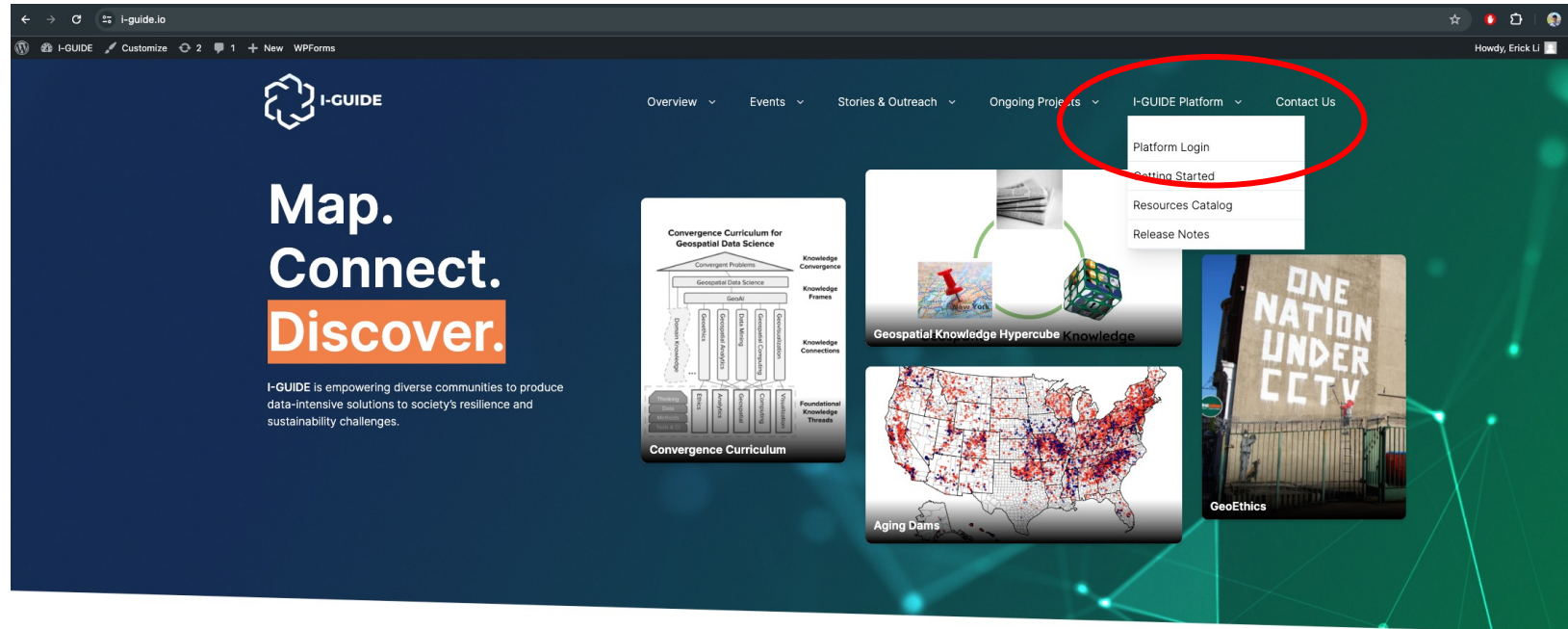
- EWD: Educational Workforce Development
- With libraries for more specific uses
- Featured libraries
  - GDAL: Programs the Geo Data Abstraction Library
  - Rasterio: Handles geospatial raster data
  - PySAL: Analyzes geospatial vector data
  - OSMnx: Operates street network
  - mplleaflet: Combines matplotlib with Leaflet



# I-GUIDE Platform Data Catalog

# Access portal

Go to I-GUIDE website at i-guide.io



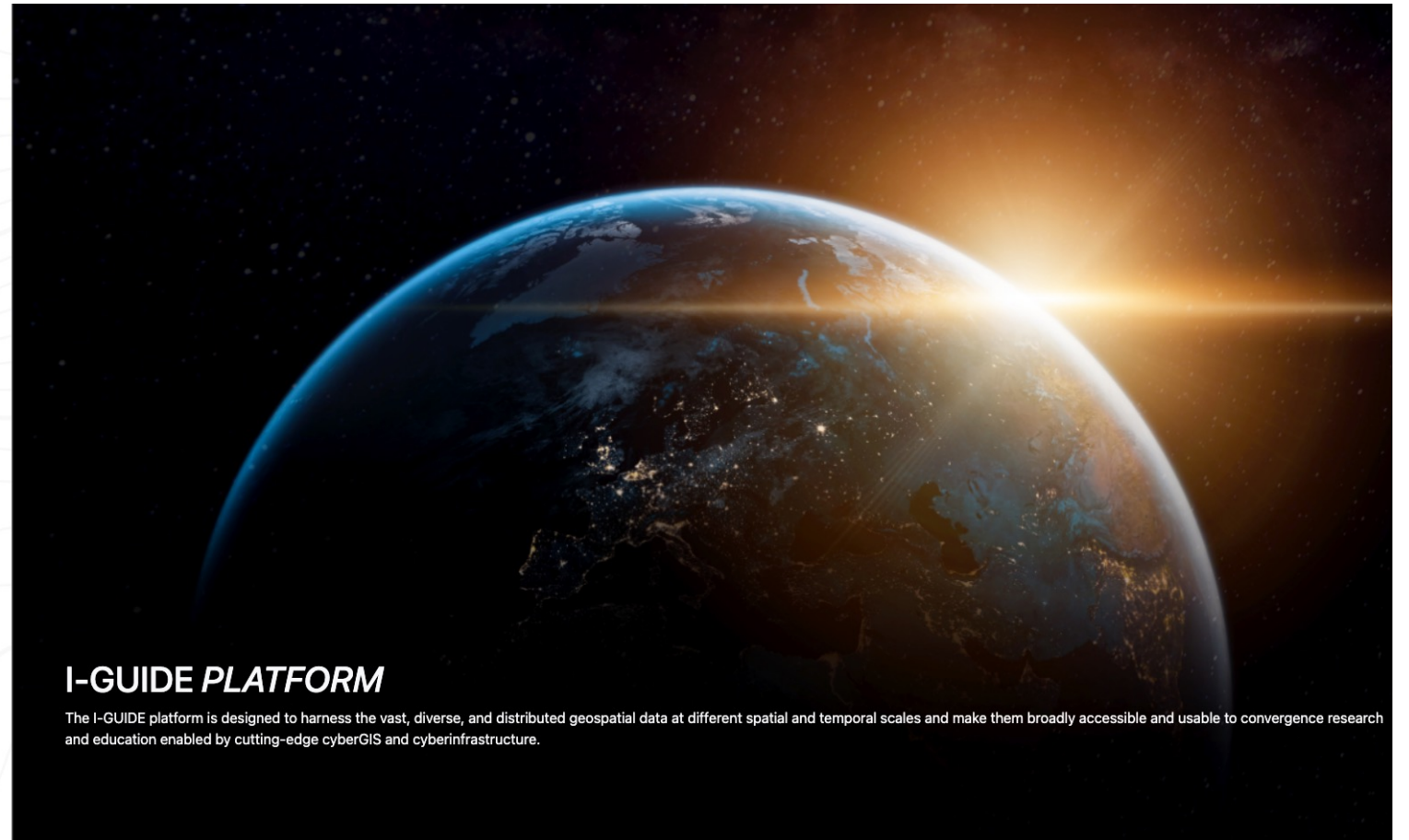
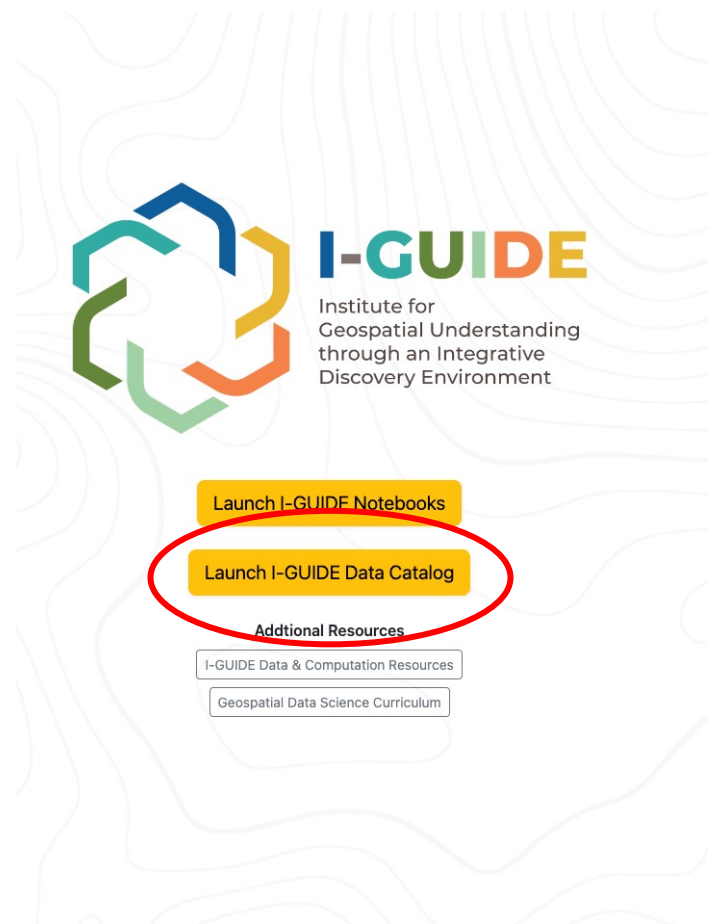
## I-GUIDE

**Vision:** Digital discovery and innovation through harnessing the geospatial data revolution

**Mission:** Transform convergence and geospatial sciences for holistic sustainability solutions



# Landing Page







# Data Catalog

The screenshot shows the homepage of the I-GUIDE Data Catalog. At the top, there is a dark navigation bar with the I-GUIDE logo on the left and a menu with links for HOME, SEARCH, MY SUBMISSIONS, CONTRIBUTE, and REGISTER on the right. Below the navigation bar is a large hero section with a scenic background of a mountain range and a river. The hero section contains the text "Integrative Discovery Starts Here!" and "Institute for Geospatial Understanding through an Integrative Discovery Environment (I-GUIDE)". A search bar is centered in the hero section with the placeholder text "Search the I-GUIDE catalog". Below the search bar, there is a prompt "Not sure what you are looking for?" and a button labeled "BROWSE IGUIDE CATALOG".

Below the hero section is a section titled "Featured Data and Research Products". It includes a sub-header "Click on the links below to view and access I-GUIDE's latest featured data and other research products". There are four featured product cards, each with a date, a title, a "VIEW" button, and a list of tags or authors.

Date	Title	Tags	Authors
May 1, 2019	NOAA National Water Model CONUS Retrospective Dataset	NOAA, National Water Model, Retrospective	National Oceanic and Atmospheric Administration (N...)
May 9, 2023	Analysis of precipitation data across the Logan River Watershed for the Year 2010	2023CIRQDevConf, AORC, Logan River Watershed	Garousi-Nejad, Irene, Castronova, Anthony M.
November 5, 2021	Retrieve SNOTEL Data	Snow Water Equivalent, SNOTEL	Garousi-Nejad, Irene, Tarboton, David
September 1, 2022	Data-driven Reservoir Operations + Reservoirs in Contiguous US	Data-driven Reservoir Operations, Hidden Markov Model	Li, Donghui, Yanan Chen, Xi...

# Catalog list

HOME SEARCH MY SUBMISSIONS CONTRIBUTE REGISTER 

Filter by:

Publication year

1900 2024

Data temporal coverage

1900 2024

Author / Creator name

Repository

CLEAR FILTERS

Search the I-GUIDE catalog

Sort results by: RELEVANCE TITLE DATE CREATED

### Crowdsourced Bathymetry

March 6, 2019 - Crowdsourced bathymetry (CSB) is the collection and sharing of depth measurements from vessels using standard navigation instruments while engaged in routine maritime operations. CSB can be used to supplement the more rigorous and scientific bathymetric coverage done by hydrographic offices, industry, and researchers around the world. Learn more at <https://www.ngdc.noaa.gov/iho/#csb> Update frequency New data is added once a week.

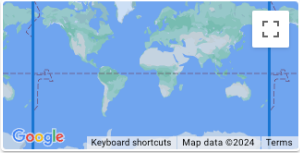
[SHOW MORE...](#)

National Centers for Environmental Information

<https://noaa-bathymetry-pds.s3.amazonaws.com/index.html#csv/>

**Keywords:** NOAA, Bathymetry, Oceanic depth soundings, Hydrographic, Oceanographic

**License:** There are no restrictions on the use of this data.



### Analysis-Ready Tables from International Censuses

March 1, 1990 - The IPUMS International Historical Geographic Information System (IHGIS) provides data tables from population and housing censuses and agricultural censuses from around the world, along with corresponding GIS boundary files. Research using IHGIS data should cite it as: Steven Manson, Tracy A. Kugler, Kathryn Grace, Jonathan Schroeder, David Van Riper, Steven Ruggles. IPUMS International Historical Geographic Information System: Version 2 [dataset]. Minneapolis, MN: IPUMS. 202...

[SHOW MORE...](#)


IPUMS International Historical Geographic Information System (IHGIS)

<https://data.ihgis.ipums.org>



**Keywords:** IPUMS IHGIS, Demographics, Education, Employment, Housing characteristics, Migration in population and housing censuses, Agricultural land ownership, Agricultural workforce, Crops

**Funded by:** Integrated Demographic and Health Survey Data for Population Health Research, Time Use Data for Health and Wellbeing

**License:** IPUMS TERMS OF USE



# Dataset

HOME SEARCH MY SUBMISSIONS CONTRIBUTE REGISTER 

## Dataset

**BASIC INFORMATION**

**Name or title\***  
Streamflow and groundwater droughts for 70 catchments in the Central Alps  
A text string with a descriptive name or title for the resource.

**URL\***  
<http://www.hydroshare.org/resource/52d8d8b291f9457fbb5238d603d39b0>  
A URL for the landing page that describes the resource and where the content of the resource can be accessed. If there is no landing page, provide the URL of the content. 67 / 2083

**Description or abstract\***  
This dataset contains drought events of groundwater (GW), streamflow (Q), precipitation (P) and P-ET (PET) for 70 catchments in the Central Alps retrieved with a variable threshold method from daily time series over the period 1989-2017. It accompanies the paper by Brunner and Chartier-Rescan submitted to GRL.  
A text string containing a description/abstract for the resource.

**Keywords\***  
Groundwater Alps Droughts Streamflow Precipitation  
Keywords or tags used to describe the dataset, delimited by commas.

**Date created\***  
📅 2023-12-19T08:55  
The date on which the resource was created.

**Date modified**  
📅 2024-02-07T13:45  
The date on which the resource was most recently modified or updated.

**Date published**  
📅 2024-02-07T13:45  
Date of first publication for the resource.

# Dataset – spatial visualization

Spatial coverage

Geo

GEOCOORDINATES

GEOSHAPE

Box\*

50.57 17.09 44.47 4.88

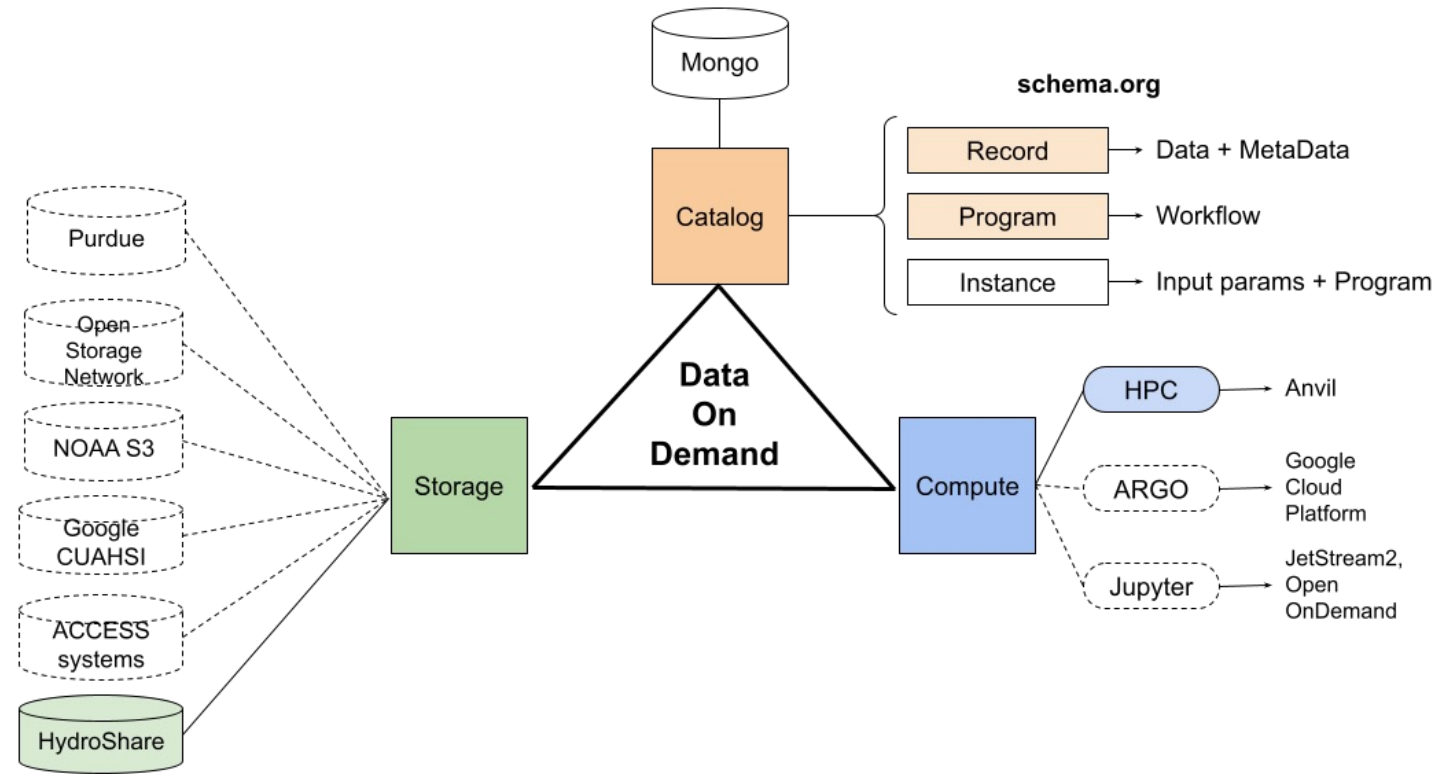
A box is a rectangular region defined by a pair of coordinates representing the south-west and northeast corners of the box.



Specifies the geographic coordinates of the place in the form of a point location, line, or area coverage extent.

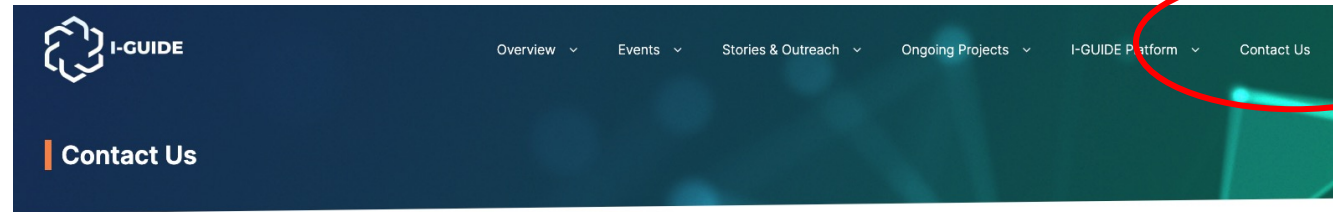
The spatialCoverage of a CreativeWork indicates the place(s) which are the focus of the content. It is a sub property of contentLocation intended primarily for more technical and detailed materials. For example with a Dataset, it indicates areas that the dataset describes: a dataset of New York weather would have spatialCoverage which was the place: the state of New York.

# I-GUIDE Platform Diagram



# I-GUIDE Platform Technical Support

# Technical support or questions



## Interested in our news and updates?

Join I-GUIDE's mailing lists for updates on geospatial discovery and innovation. Stay informed on community priorities, cutting-edge data capabilities, and exciting advancements in various disciplines. Don't miss out on opportunities to participate in shaping the future of geospatial data-intensive sciences. Sign up now!

\* Email

### \*Email Lists

- Annual I-GUIDE Forum
- I-GUIDE Insider (Weekly Opportunities, Events, Talks, and News)
- Quarterly Newsletter
- Summer School
- Talks and Webinars

Sign up now!



Come Find Us At

Natural History Building, Room 1062  
University of Illinois at Urbana-Champaign  
1301 W Green St, Urbana, IL 61801



Email Us At

[help@i-guide.io](mailto:help@i-guide.io)

## Follow us on social media



# Demo



# Future

# Future

- Integrate Hypercube
  - Use machine learning models to extract geographic terms
- Integrate Body of Knowledge to the Data Catalog
  - Search geographic terms and ontology
- Improve the connection between the JupyterHub and Data Catalog
- Increase computational power
  - More GPUs
  - Better equipped for machine learning

# Hypercube

**Article Gallery**

[GEOPARSING RESULTS](#) | [CLASSIFICATION RESULTS](#)

Saginaw and Bay City News | Midland-area residents evacuate to high school after dam failure threatens city | Updated: **May 20, 2020 DATE**  
**3:17 p.m. TIME** | Published: **May 19, 2020 DATE** **10:52 p.m. TIME** | Midland High School **ORG** served as a refuge site for **Midland**  
 residents displaced by **the Edenville Dam LOC** failure on **May 19 DATE**, 2020.1,478sharesBy Cole Waterman |  
 Cole\_Waterman@mlive.com **MIDLAND ORG** MI – Dozens, if not more than a hundred, **Midland** area residents gathered to seek refuge  
 within the walls of **Midland High School ORG** **Tuesday night TIME** after **the Edenville Dam LOC** failed to hold back a deluge of water.

**ARTICLE GALLERY**

**Geolocation Map**

Map | Satellite

Buffer Zone Radius: 2.00 miles (3219 m)

LOC FAC ORG

500ft 1mi 2mi 3mi

INSTRUCTIONS

**Geolocation Map**

Map | Satellite

Buffer Zone Radius: 2.03 miles (3260 m)

LOC FAC ORG

500ft 1mi 2mi 3mi

INSTRUCTIONS

**Geolocation Info** **EXPORT**

Type	Name	Latitude	Longitude
LOC	the Edenville Dam	43.816	-84.385
LOC	the Tittabawassee River	43.528	-84.18
LOC	Eastlawn Drive	39.192	-84.456

# UCGIS Body of Knowledge

## Geographic Information Science & Technology Body of Knowledge Visualization and Search

The domain of geographic information science and its associated technologies (GIS&T)

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Code  Name  Keywords  Description  Learning Objectives  References



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### [UCGIS] GIS&T Body of Knowledge

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This Body of Knowledge documents the domain of geographic information science and its associated technologies (GIS&T). By providing this content in a new digital format, UCGIS aims to continue supporting the GIS&T higher education community and its connections with the practitioners, employers, and clients who comprise the increasingly diverse collection of GIS&T professionals. For more information about the GIS&T BoK, please see <https://www.ucgis.org/gis-t-body-of-knowledge>.

#### Full Topic Description

#### Knowledge areas [10]

- [AM] Analytics and Modeling
- [CP] Computing Platforms
- [CV] Cartography and Visualization
- [DA] Domain Applications
- [DC] Data Capture
- [DM] Data Management
- [FC] Foundational Concepts
- [GS] GIS&T and Society
- [KE] Knowledge Economy
- [PD] Programming and Development

#### Learning Objectives [0]

#### References [0]

#### Author and Citation Info

#### Versioning [1]

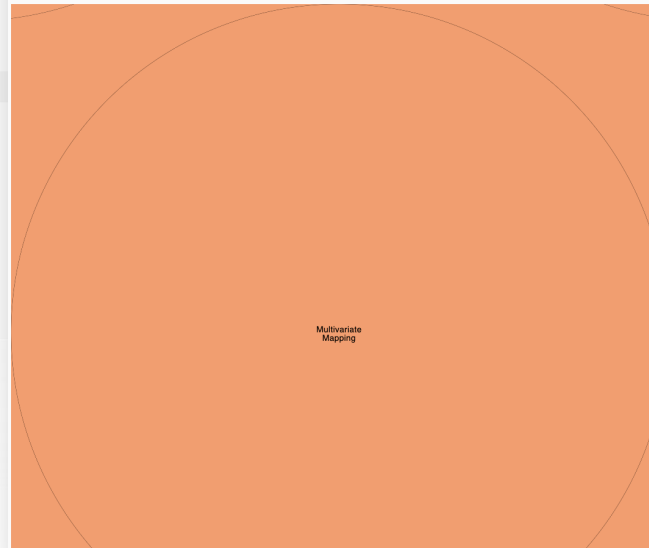
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GIS&T Body of Knowledge

## Geographic Information Science & Technology Body of Knowledge Visualization and Search

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Permalink: <https://gistbok-topics.ucgis.org/CV-04-012> [Copy](#)

### [CV-04-012] Multivariate Mapping

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Bivariate and multivariate maps encode two or more data variables concurrently into a single symbolization mechanism. Their purpose is to reveal and communicate relationships between the variables that might not otherwise be apparent via a standard single-variable technique. These maps are inherently more complex, though offer a novel means of visualizing the nuances that may exist between the variables. As information-dense visual products, they can require considerable effort on behalf of the map reader, though a thoughtfully-designed map and legend can be an interesting opportunity to effectively convey a comparative dimension.

This chapter describes some of the key types of bivariate and multivariate maps, walks through some of the rationale for various techniques, and encourages the reader to take an informed, balanced approach to map design weighing information density and visual complexity. Some alternatives to bivariate and multivariate mapping are provided, and their relative merits are discussed.

**Keywords:** cartographic cognition continuity Gestalt psychology map design techniques symbolization

#### Full Topic Description

#### Supertopic:

[\[CV-04\] Map Design Techniques](#)

#### Related topics [1]

[\[CV-04-011\] Common Thematic Map Types](#)

#### Learning Objectives [8]

- Choose suitable visual dimensions to appropriately represent their multiple variables.
- Consider variations upon, or alternatives to, bivariate and multivariate mapping.
- Create maps that encode multiple variables into map symbolization.
- Describe categories, and specific methods, of bivariate and multivariate mapping.
- Design effective and concise legends for bivariate and multivariate maps.
- Discuss the relative merits of bivariate and multivariate cartography for their topic and audience.
- Explain the nature of relationships between phenomena in a bivariate choropleth map.
- Identify interesting relationships uniquely revealed by their bivariate or multivariate representation.

#### References [10]

#### Author and Citation Info

Nelson, J. (2020). Multivariate Mapping. The Geographic Information Science & Technology Body of Knowledge (1st Quarter 2020 Edition), John P. Wilson (ed.). DOI: [10.25222/gistbok/2020.1.6](https://doi.org/10.25222/gistbok/2020.1.6)

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# Related VCO recording

- VCO on January 17, 2024
  - The I-GUIDE Cyberinfrastructure Platform: Supporting Open, Reproducible Convergence Science at Scale
  - Speaker: Jeff Horsburgh
  - Link: <https://i-guide.io/i-guide-vco/cyberinfrastructure-platform/> or visit I-GUIDE website, then “Events”, then “Virtual Consulting Office”
  - Features more technical and infrastructure side of I-GUIDE Platform

# Questions?

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I-GUIDE technical support: [help@i-guide.io](mailto:help@i-guide.io)