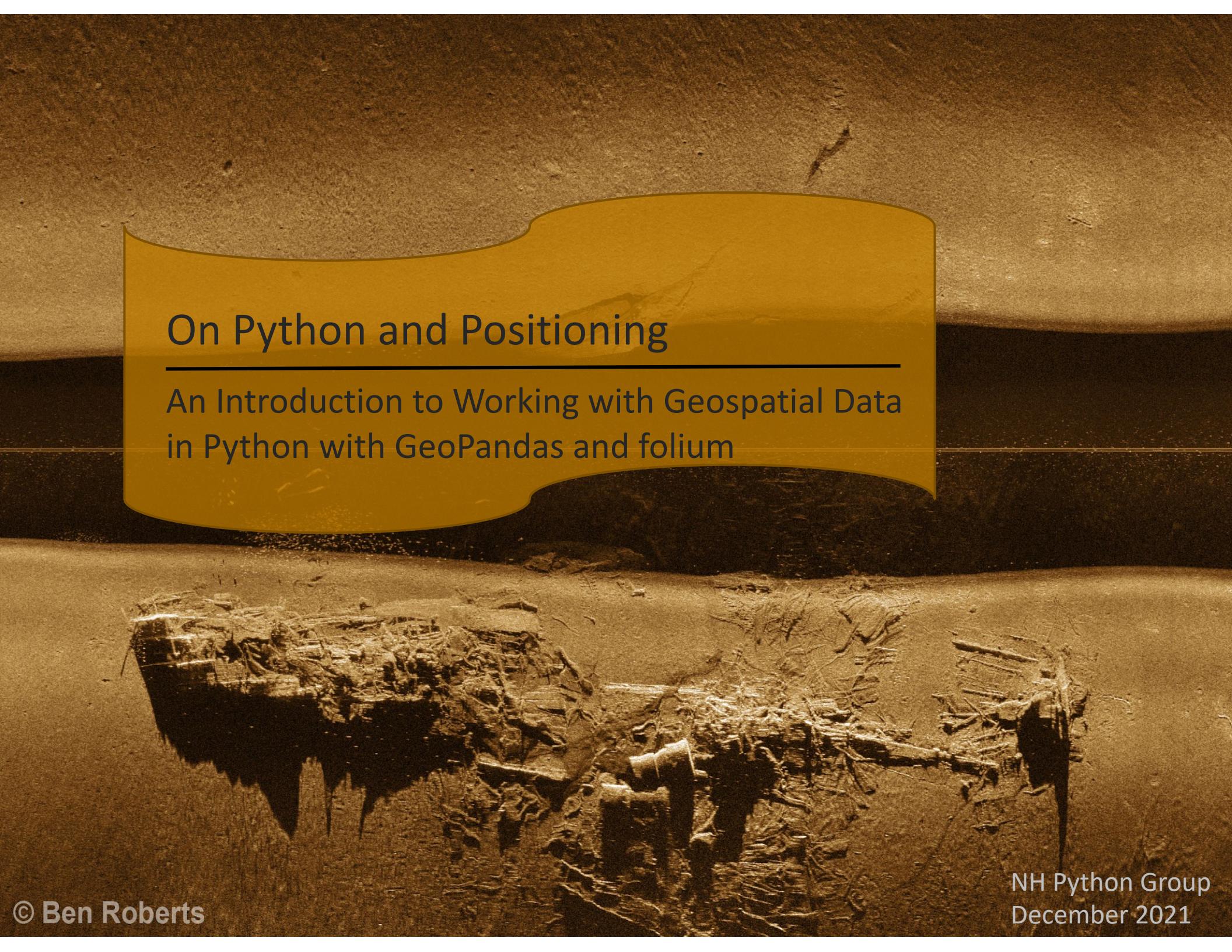
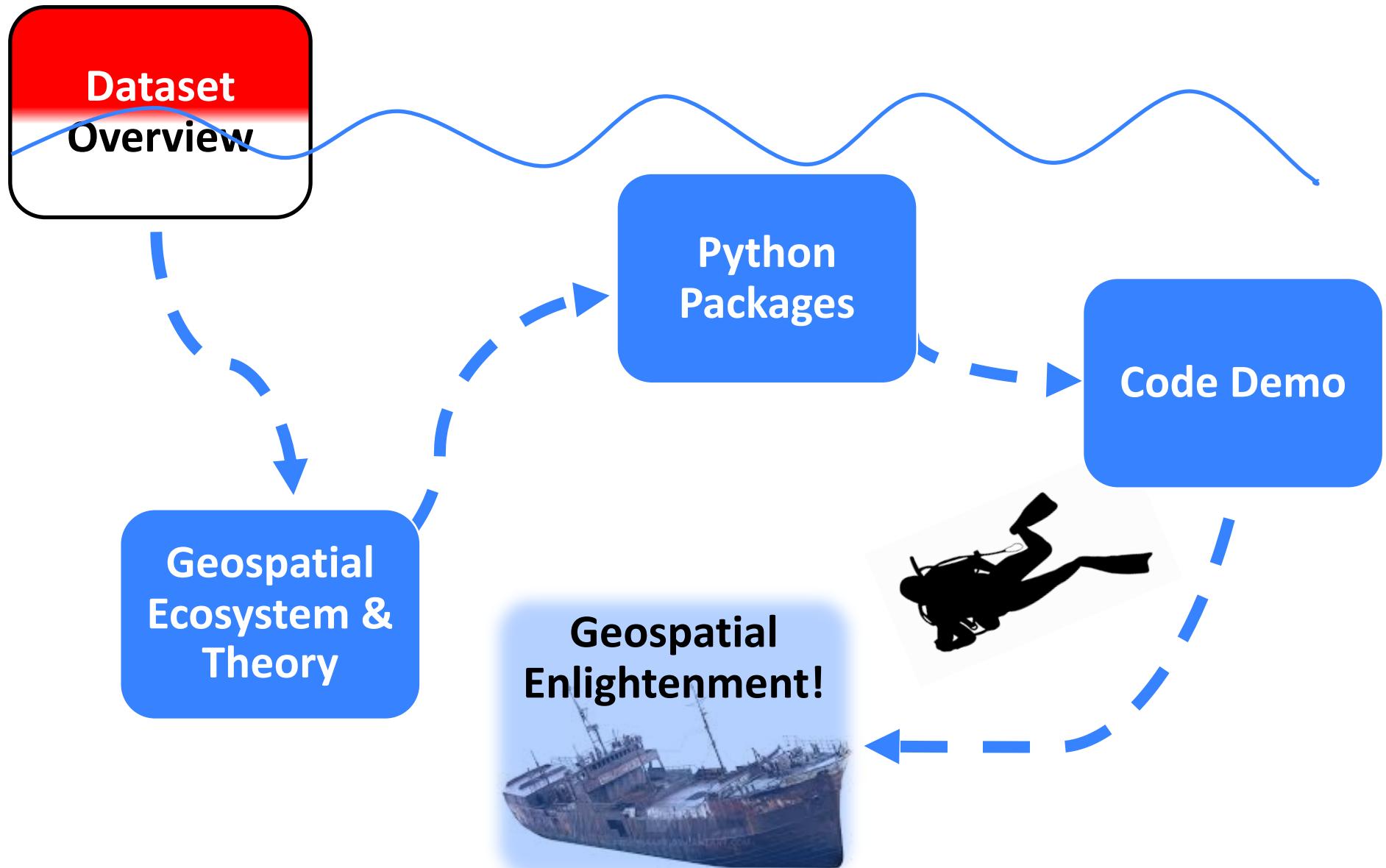


On Python and Positioning

An Introduction to Working with Geospatial Data
in Python with GeoPandas and folium



This Evening's Quest



Sources:

- Cover photo: Sonar image of the SS Biela via Eastern Search & Survey © Ben Roberts, used with permission
- All clipart, except where noted, is from Clipart-library.com, licensed for personal use

Dataset Overview

**National Oceanic
& Atmospheric
Administration
(NOAA)**

- ◆ Three public datasets of NOAA's collection of known wrecks and obstructions in US coastal waters
 - Automated Wreck and Obstruction Information System (AWOIS) wrecks, AWOIS obstructions, and Electronic Navigational Chart (ENC) wrecks
 - <https://nauticalcharts.noaa.gov/data/wrecks-and-obstructions.html>

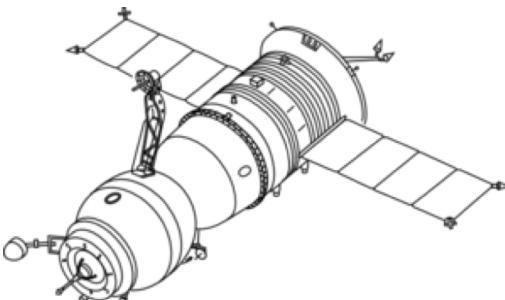
**Eastern Search &
Survey (ESS)**

- ◆ ESS provided coordinates for several hang logs involved in the search for the SS Biela wreck, as well as details and backstory of the search
 - <https://www.facebook.com/Eastern-Search-Survey-109413857123876>

The Geospatial Ecosystem: Geographic Information Systems (GIS)

A GIS is a computer-based system to aid in the collection, maintenance, storage, analysis, output, and distribution of spatial data and information – this can include hardware, software, data, people, and industry protocols¹

Data Collection



Industry Protocols

- ◆ Open Geospatial Consortium (OGC)

Data Storage



GIS Software



- ◆ OSGeo Projects: GDAL/OGR, GEOS, PROJ

- ◆ Desktop Apps: QGIS, ArcGIS, others

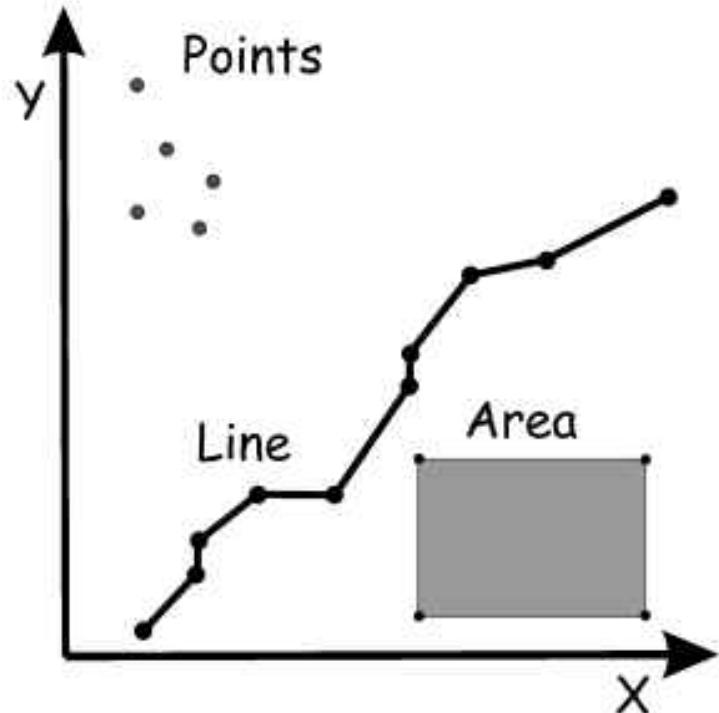
- ◆ Python packages

Note:

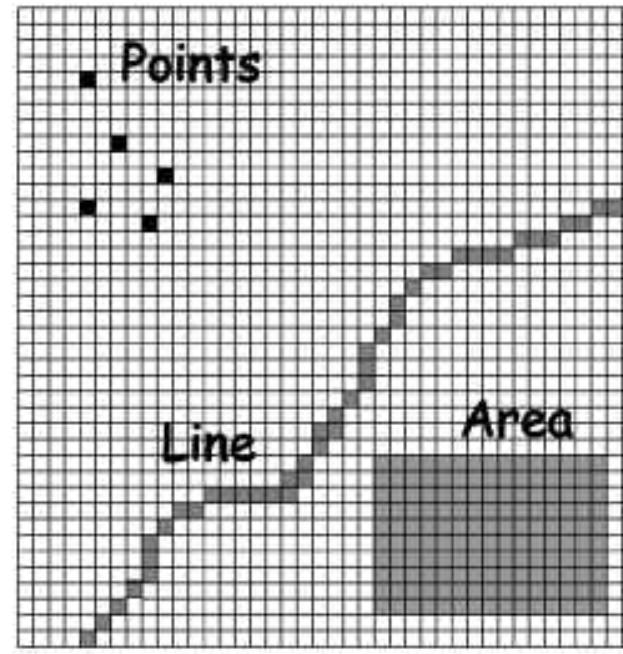
1. Bolstad, Paul. *GIS Fundamentals: a First Text on Geographic Information Systems*. 6th ed., XanEdu, 2019.

Overview of Geospatial Data Models

Vector Data



Raster Data



- Discrete geometries
- Points, lines, polygons described by coordinates
- Continuous, “gridded” data with embedded coordinates
- Elevation, satellite images, ground cover

Geospatial Data Models

File Format Examples

Vector Data

- Shapefile (.shp/.dbf/.shx/.prj)
- GeoJSON (.json), KML (.kml)
- ~90 supported by OGR

Raster Data

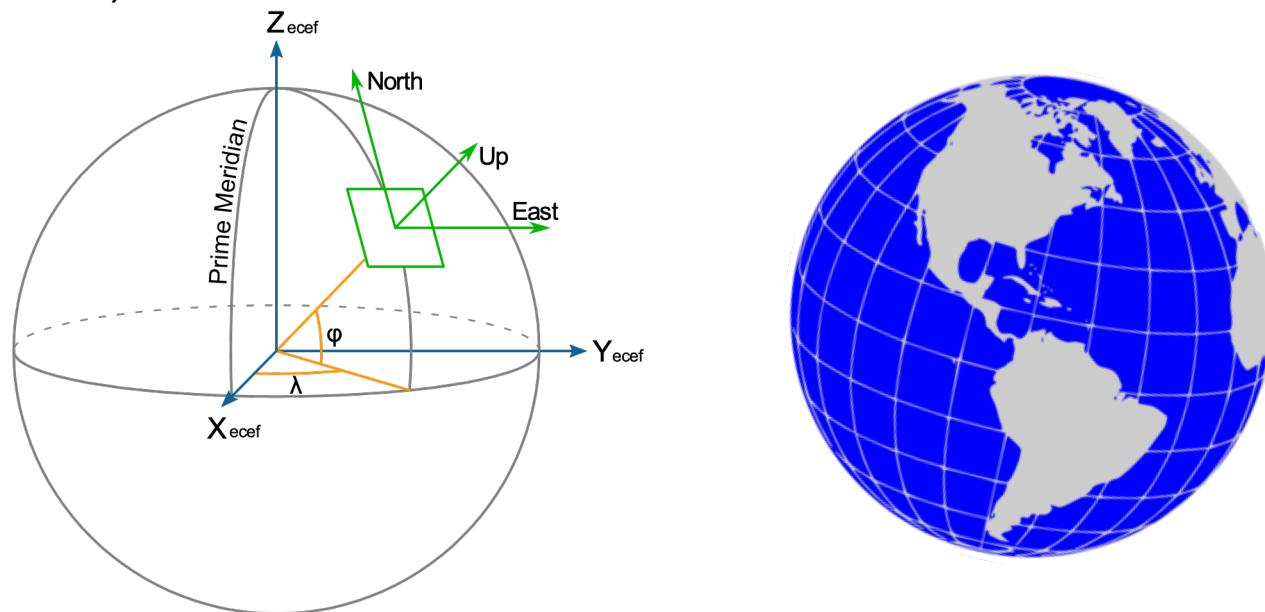
- GeoTIFF (.TIF or .TIFF)
- Image (.img)
- >200 supported by GDAL

Data Attribute
Tables

- Any attribute tied to a location or geometry
- CSV (.csv)
- Database table

Coordinate Reference Systems

- ◆ Coordinate Reference Systems (CRS) tie coordinates to real world places
 - Based on a Datum (geographic measurements of Earth and assumptions)
- ◆ Golden rule: know thy data!
 - Combining datasets
 - Knowing what tools expect
- ◆ Examples of coordinate reference systems:
 - WGS 84: US-centric, used for GeoJSON and most web data
 - Others: NAD 83, ITRF

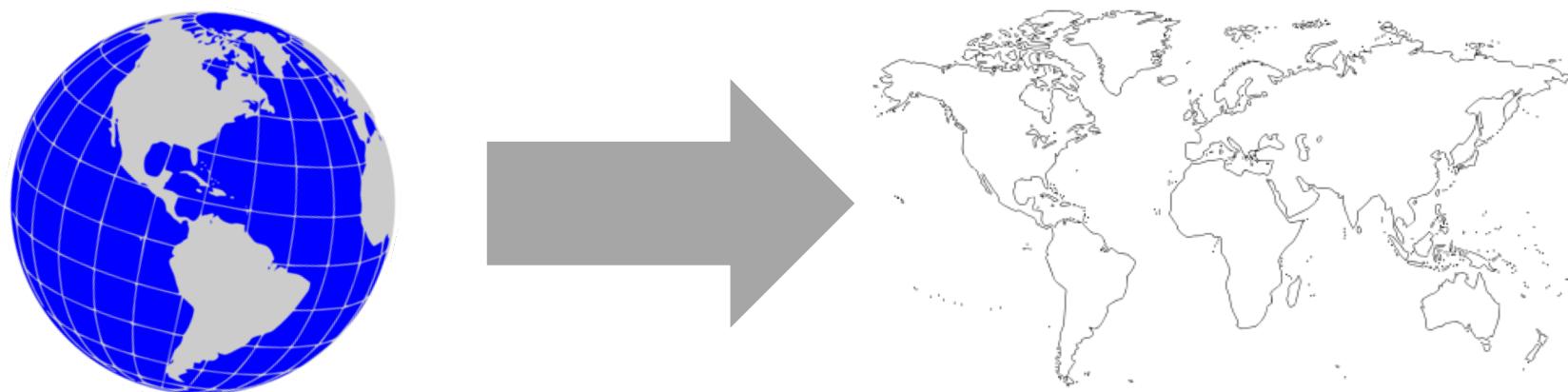


Source:

- Longitude and Latitude (left): By Mike1024 - Based on en:File:EarthTangentialPlane.png by en:User:Raffyl99 (public domain), Public Domain, <https://commons.wikimedia.org/w/index.php?curid=9510652>

Projections: Translating 3D into 2D

- ◆ A projection translates 3D coordinates into a 2D representation
 - All projections add an element of distortion
- ◆ Different projections preserve/distort different aspects of the geographic features
- ◆ Common projection: Spherical (or “Web”) Mercator
 - Used by most web tile providers



Source:

- Projected map: molumen on the Open Clip Art Library, CC0, via Wikimedia Commons

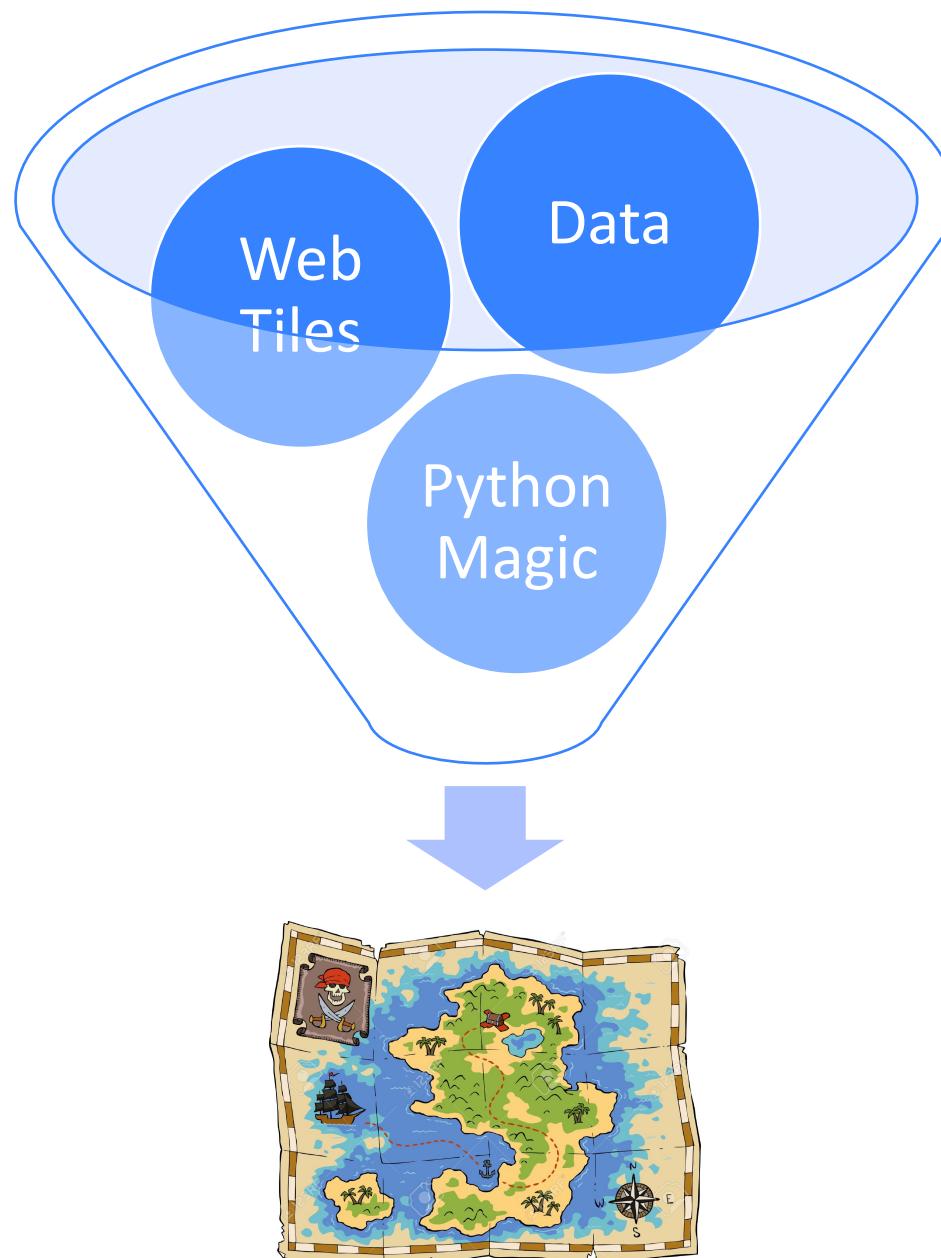
Python Geospatial Packages



- ◆ **General:** GeoPandas
- ◆ **Supporting Packages:**
 - Fiona (vector I/O), Rasterio (raster I/O)
 - pyproj (CRS/projection transformations)
 - Shapely (implements GEOS geospatial functions)
- ◆ **Visualizations:**
 - folium (leaflet.js)
 - matplotlib
 - contextily (web tiles)
- ◆ **Geocoding:** geoPY



Code Demo Time!



APPENDIX A

Resources

Geospatial 'Acronym Soup' Quick Reference

Acronym	Full Name	Who/What It Is
OGC	<ul style="list-style-type: none"> • Open Geospatial Consortium 	<ul style="list-style-type: none"> • Sets standards and protocols for the industry
OSGeo	<ul style="list-style-type: none"> • Open Source Geospatial Foundation 	<ul style="list-style-type: none"> • Finances and maintains many open source geospatial projects
GDAL	<ul style="list-style-type: none"> • Geospatial Data Abstraction Library 	<ul style="list-style-type: none"> • C++ library under OSGeo to handle file I/O for raster formats
OGR	<ul style="list-style-type: none"> • Open GIS Reference Implementation 	<ul style="list-style-type: none"> • Part of GDAL; handles file I/O for vector formats
GEOS	<ul style="list-style-type: none"> • Geometry Engine – Open Source 	<ul style="list-style-type: none"> • C++ library under OSGeo to implement geospatial functions
PROJ	<ul style="list-style-type: none"> • PROJ 	<ul style="list-style-type: none"> • Software under OSGeo to make CRS and projection conversions
EPSG	<ul style="list-style-type: none"> • European Petroleum Survey Group (now synonymous with registry itself) 	<ul style="list-style-type: none"> • Registry (and codes for) datums, spatial reference systems, and transformations

Resources

- ◆ Eastern Search & Survey on Facebook:
 - <https://www.facebook.com/Eastern-Search-Survey-109413857123876>
- ◆ Eastern Search & Survey free interactive Google map:
 - https://www.google.com/maps/d/u/0/viewer?mid=1dMRBuqZSxv1ULdiPi76_ZQCiHB0OkW7NV&ll=40.306301090519035%2C-73.53378835388357&z=7
- ◆ Original GitHub project repository:
 - https://github.com/Data-Science-for-Conservation/Ocean_GIS_for_Python
- ◆ Documentation:
 - GeoPandas: <https://geopandas.org/index.html#>
 - Shapely: <https://shapely.readthedocs.io/en/stable/manual.html>
 - folium: <https://python-visualization.github.io/folium/>
- ◆ Codes for most commonly used CRSs and projections:
 - www.spatialreference.org and <https://epsg.io/>
- ◆ Get help via the GIS stack exchange
 - <https://gis.stackexchange.com/>