Python Data Analysis and Visualization for Unstructured Grid Data

Ian Franda[1,2], Orhan Eroglu[1], Philip Chmielowiec[1], Anissa Zacharias[1]

[1]National Center for Atmospheric Research
[2]University of Wisconsin Madison
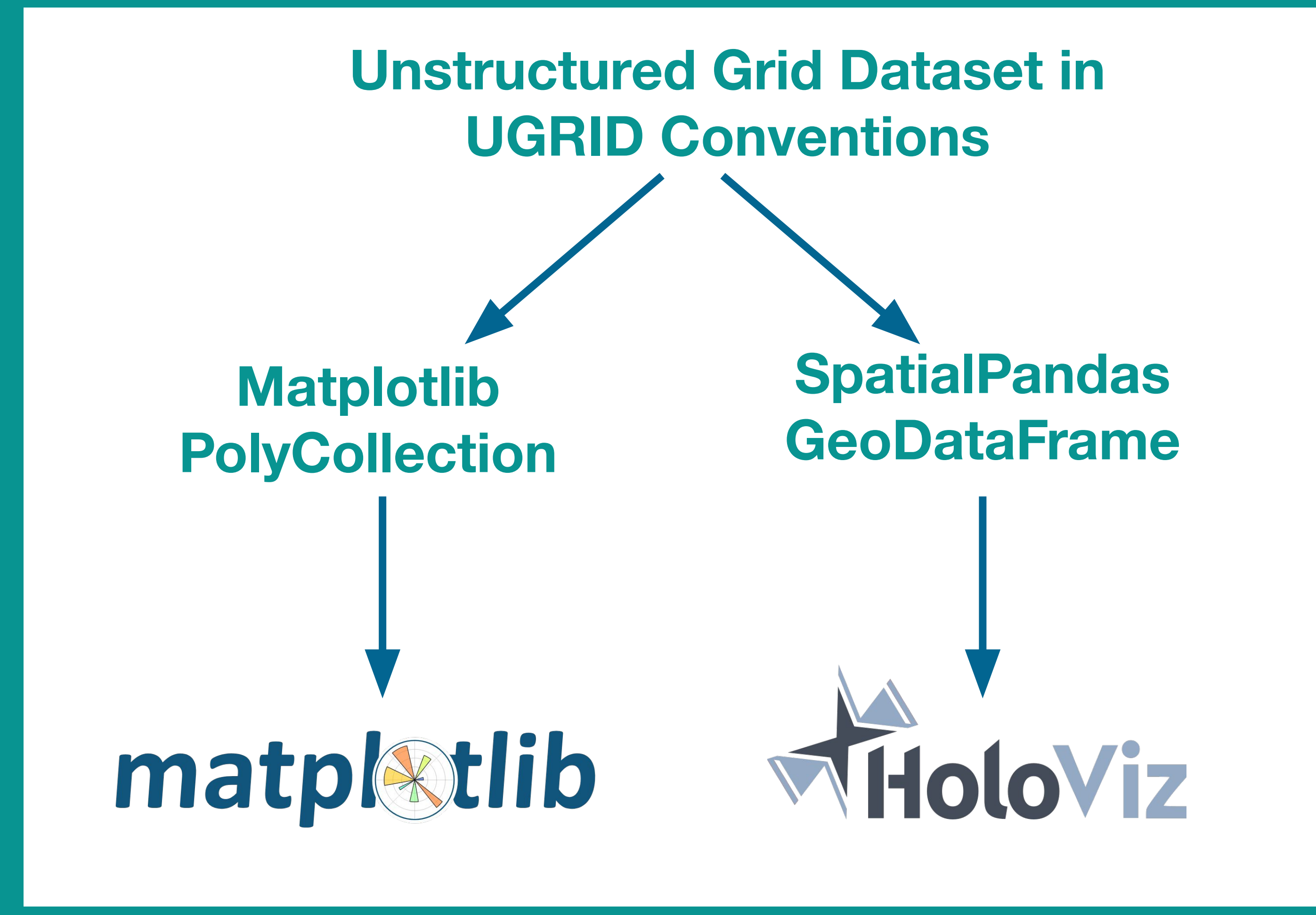
1. Background

Unstructured Grids

➢ Many climate and global weather modeling communities have begun to transition from simple structured grids to more scalable and flexible unstructured grids.

➢ Support for unstructured grids in the Scientific Python Ecosystem is limited, making standard data analysis routines much more challenging.

UXarray

➢ UXarray is a Python package supported by project Raijin that provides tools for standard data analysis techniques that operate directly on unstructured grids.

➢ This year's SIParCS project focused on visualization of unstructured grids, including the development of functions to support visualization and the development of a Jupyter notebook to compare visualization methods.

2. Workflow

Unstructured Grid Dataset in UGRID Conventions

↓

Matplotlib PolyCollection → matplotlib

SpatialPandas GeoDataFrame → HoloViz

3. Antimeridian Splitting

Grids Reside on a Sphere

➢ The Antimeridian is the line at 180°E and 180°W. Polygons that cross this line wrap around the Earth

➢ UXarray uses the Python package **antimeridian** to split these polygons so that they connect to the Antimeridian
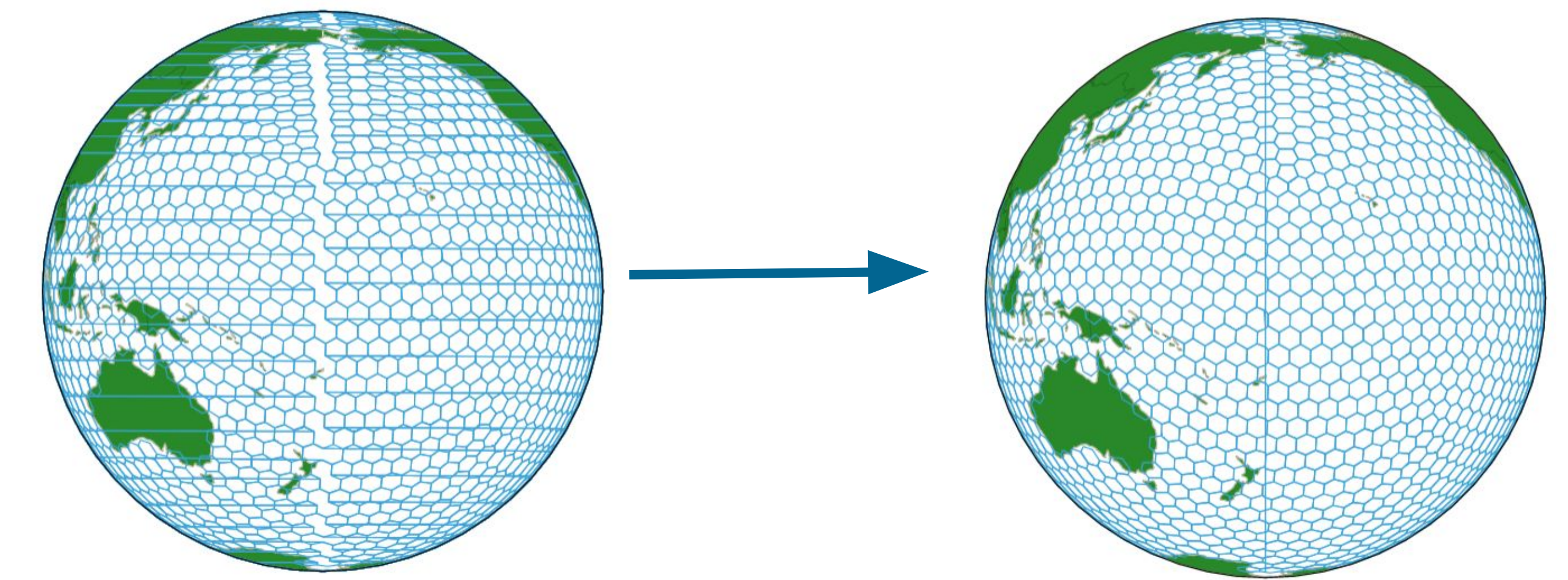
## 4. Visualization Comparisons

Node and Edge Plots

➢ If our goal is to view the geometries of the grid, we can create node plots or edge plots

➢ These are simple to make and quick to compute
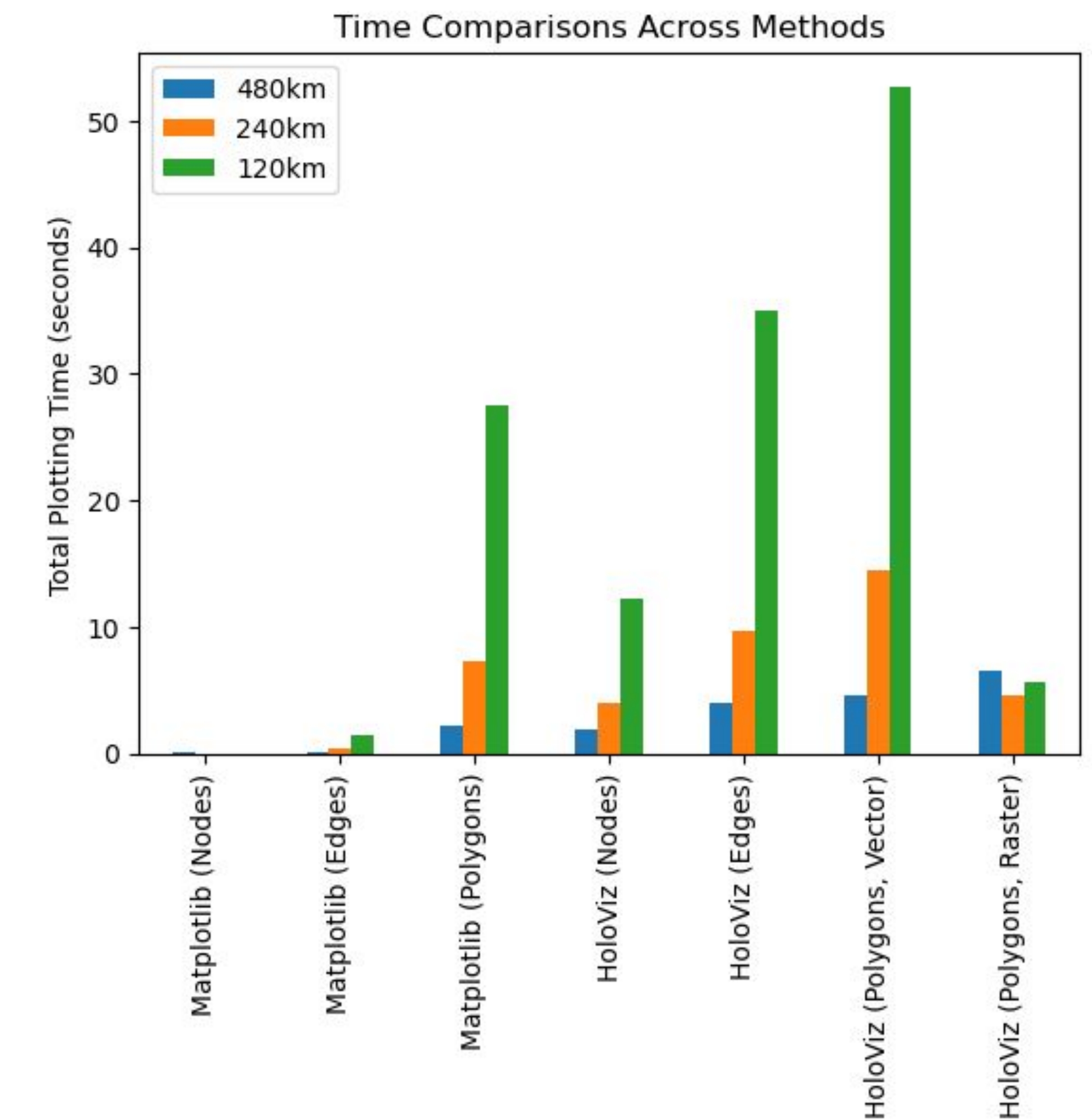
Vector Images

➢ Render each geometry individually

➢ Can be computationally expensive with large datasets

Raster Images

➢ Approximate geometries with a grid of pixels
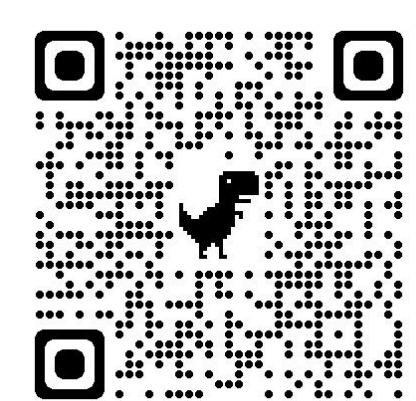
➢ Provide faster rendering
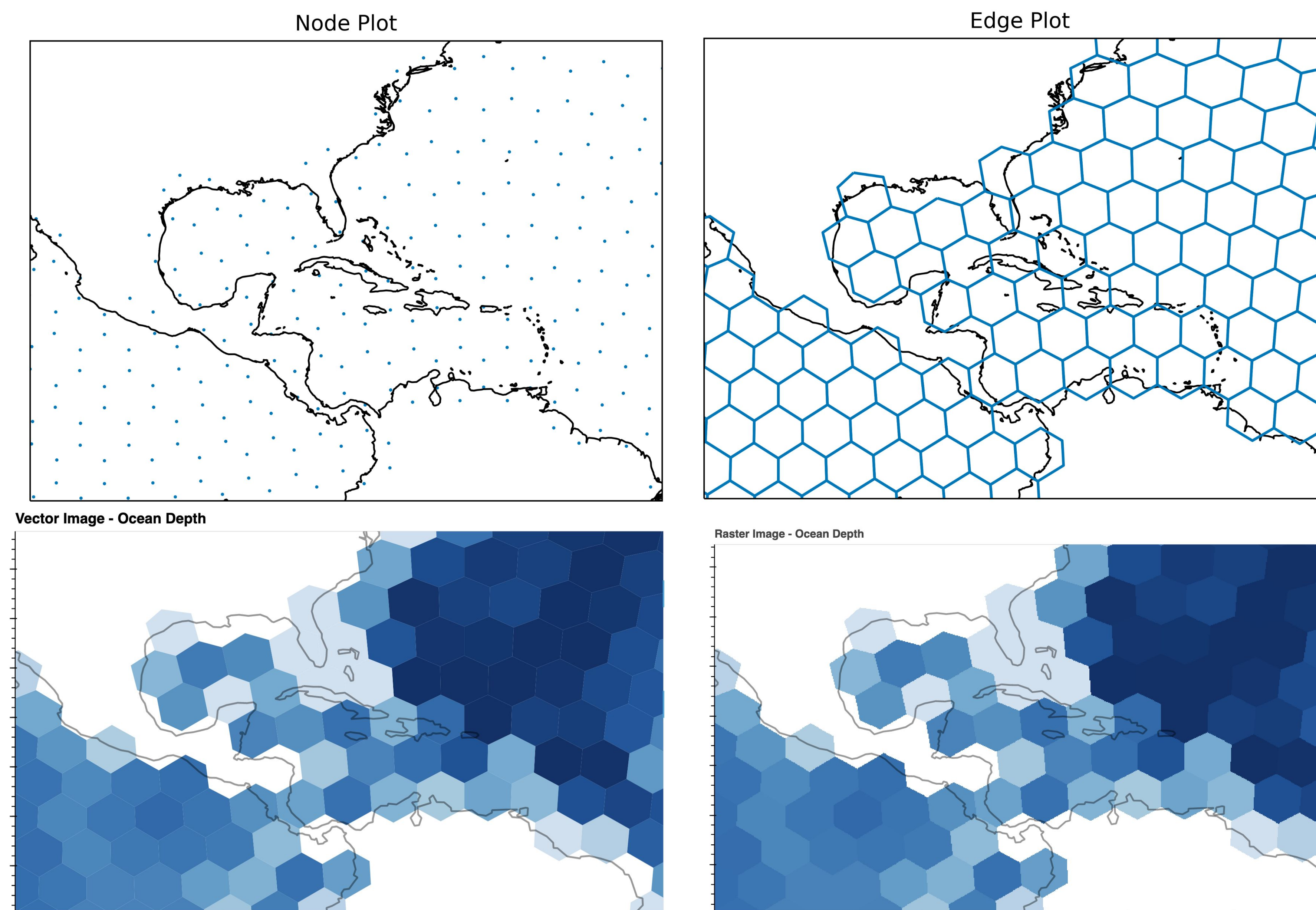
5. Conclusions

Plot Comparisons Across Resolutions

➢ Node and Edge plots render quickly in Matplotlib and are ideal for viewing grid geometries.

➢ Plotting time for raster images are not dependent on the number of faces in a grid, making rasterization ideal for large datasets if image quality is not a priority.

6. Additional Information

Visualization Notebook   **UXarray**

SIParCS BOULDER · CO   PROJECT raijin   GeoCAT   EARTHCUBE