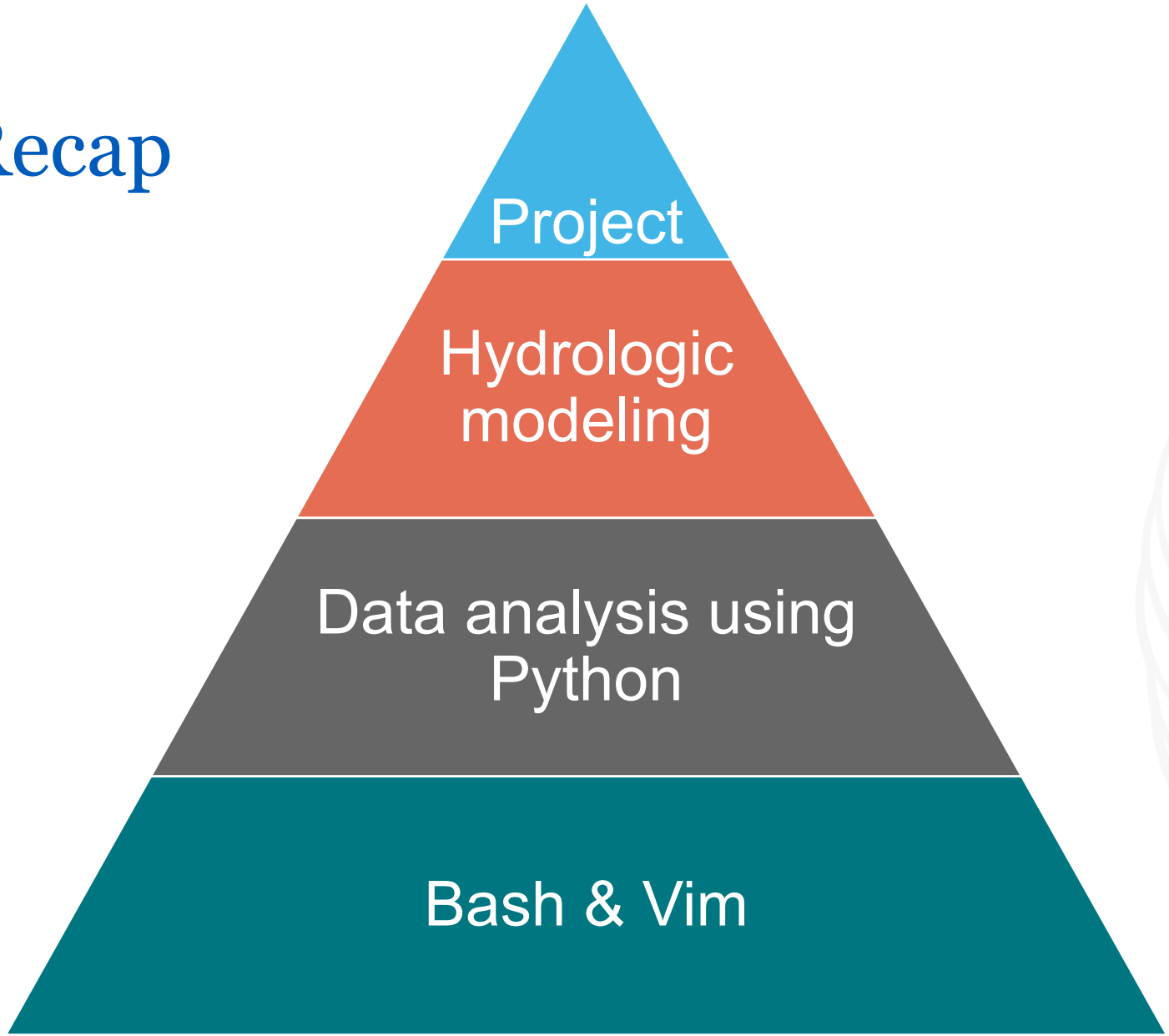
NUMPY & MATPLOTLIB

GLY606 Water Data Analysis & Modeling

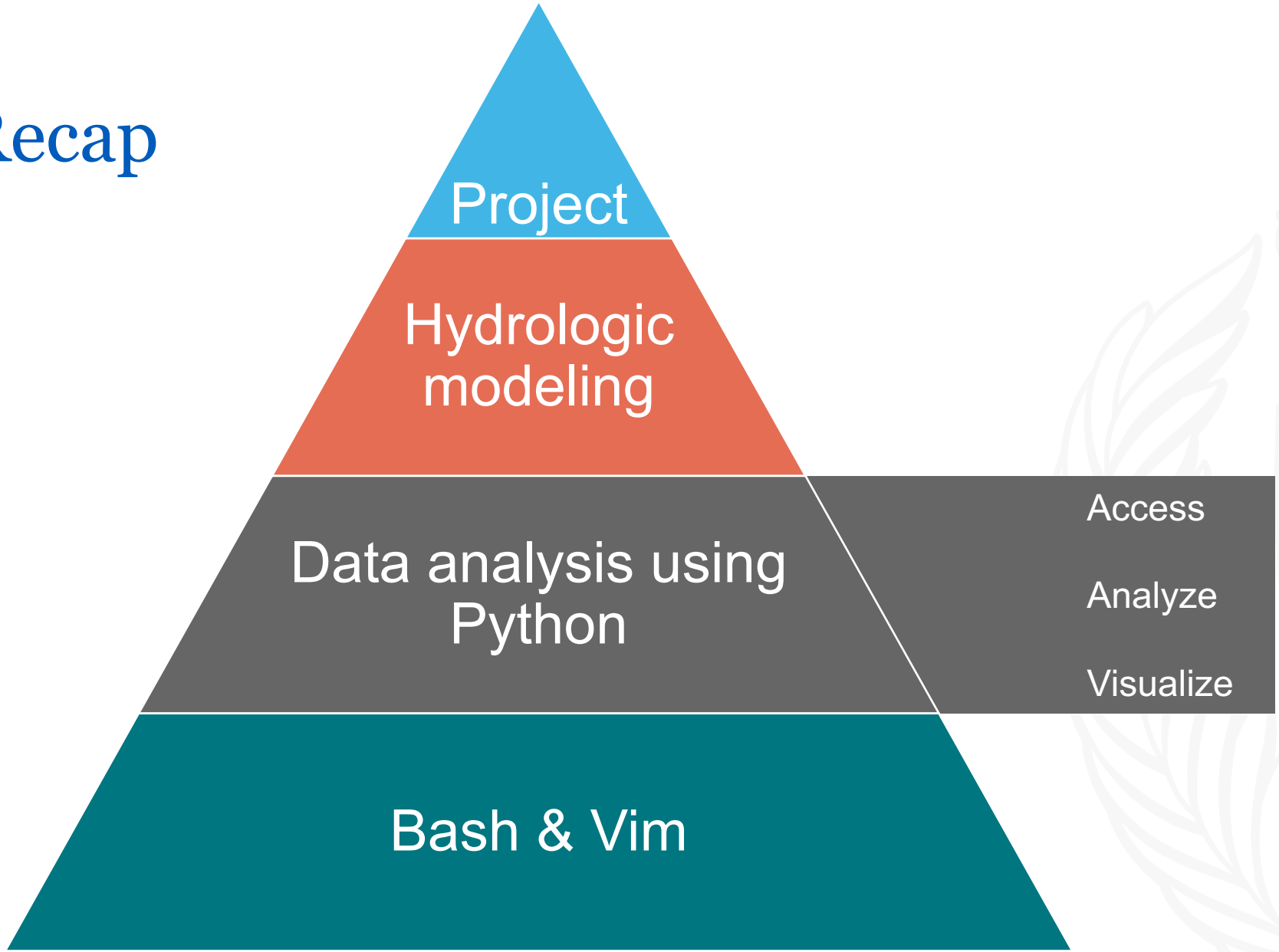
Sep 13th 2024

University at Buffalo The State University of New York

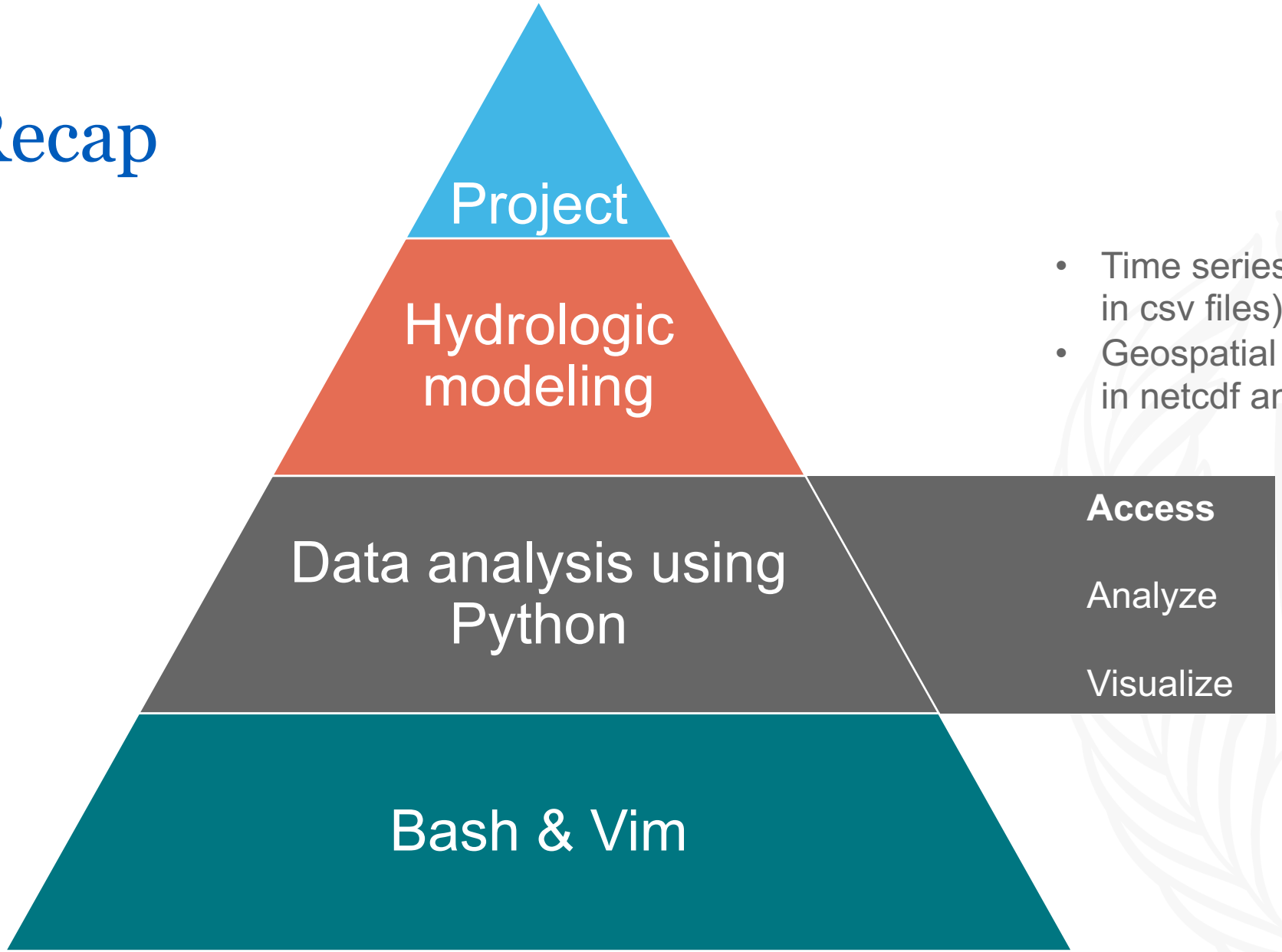
Recap


Project
Hydrologic modeling
Data analysis using Python
Bash & Vim

Recap

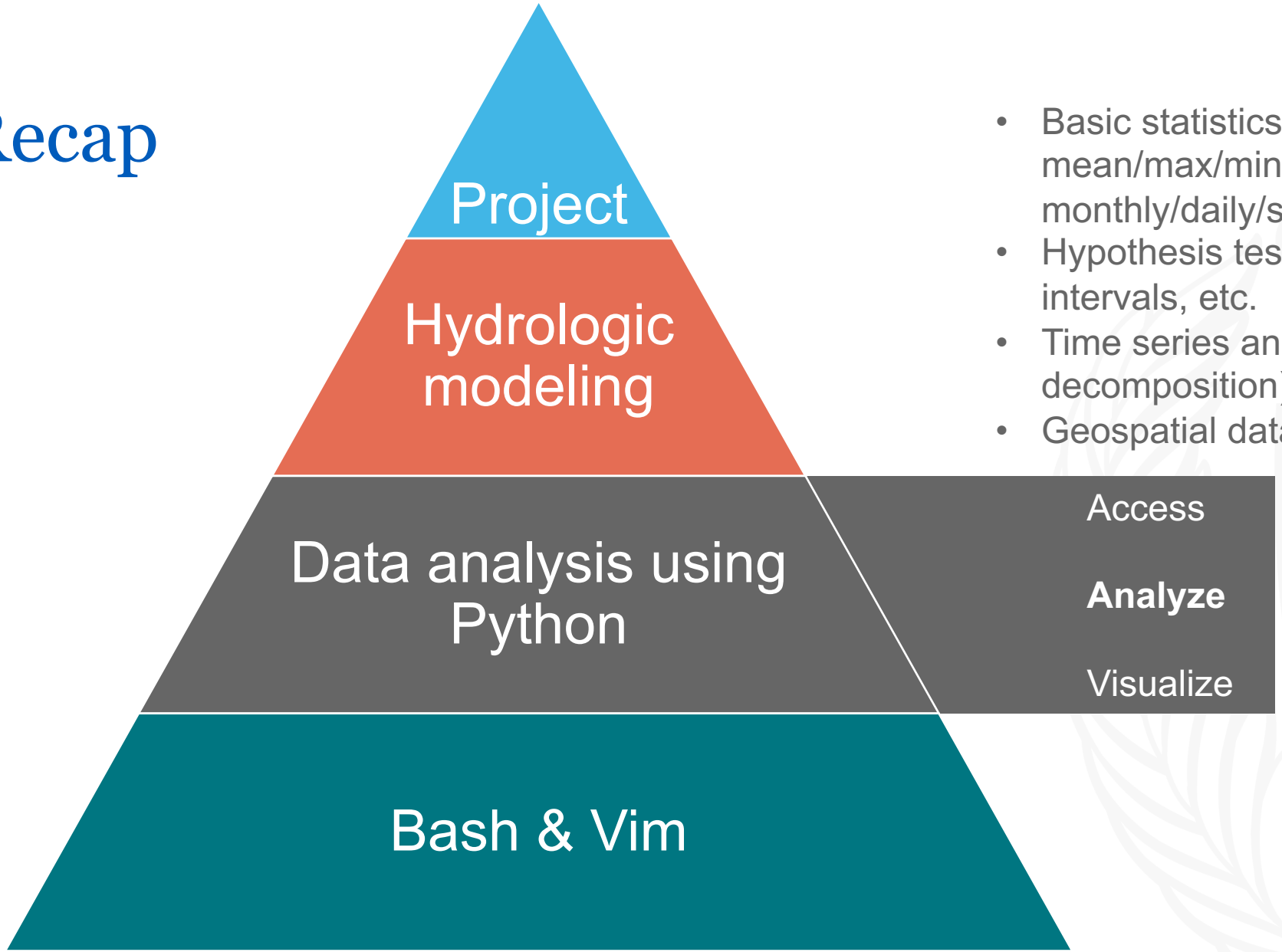

Project
Hydrologic modeling
Data analysis using Python
Access
Analyze
Visualize
Bash & Vim

Recap



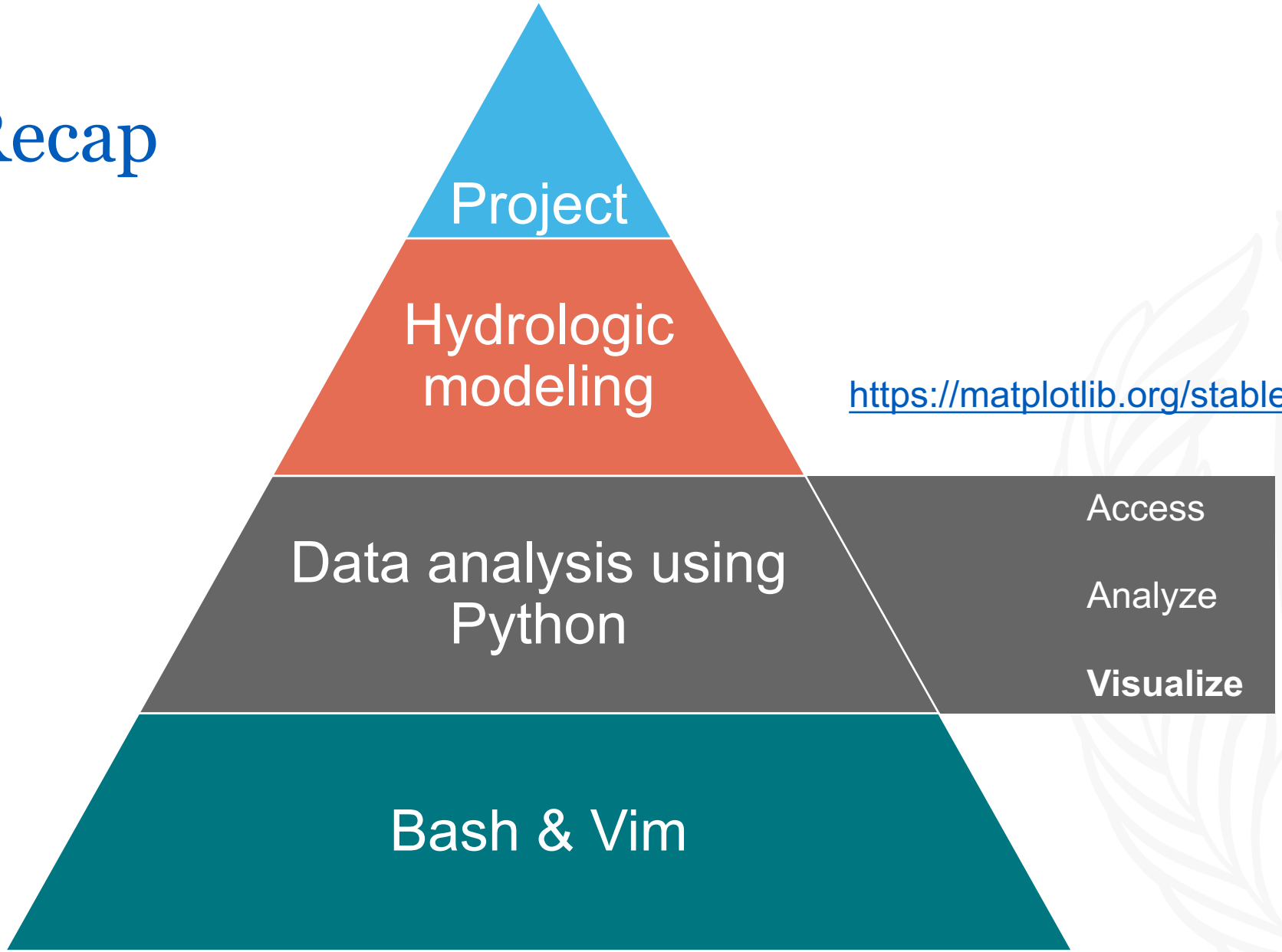
- Time series dataset (usually in csv files)
- Geospatial datasets (usually in netcdf and geotiff files)

Recap



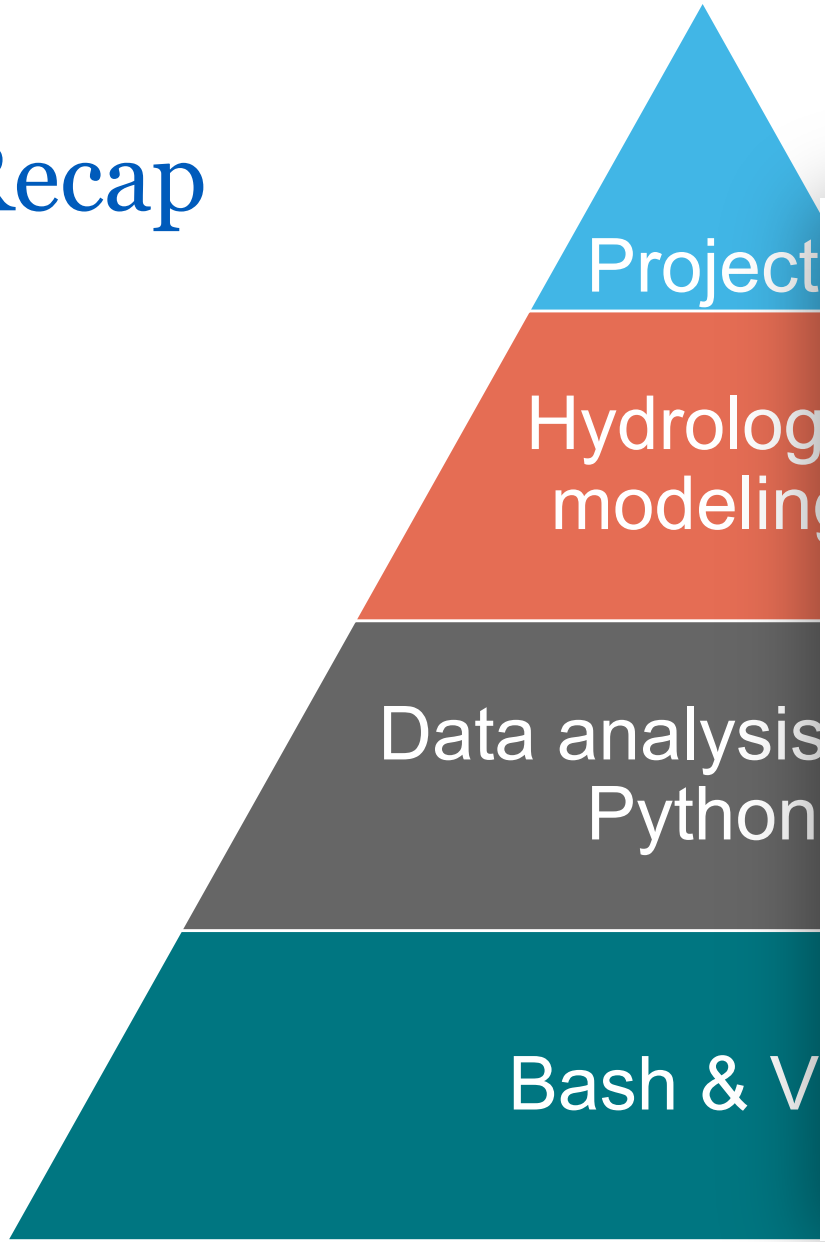
- Basic statistics (such as mean/max/min across monthly/daily/seasonal scales)
- Hypothesis testing, confidence intervals, etc.
- Time series analysis (seasonality, decomposition)
- Geospatial data analysis

Recap

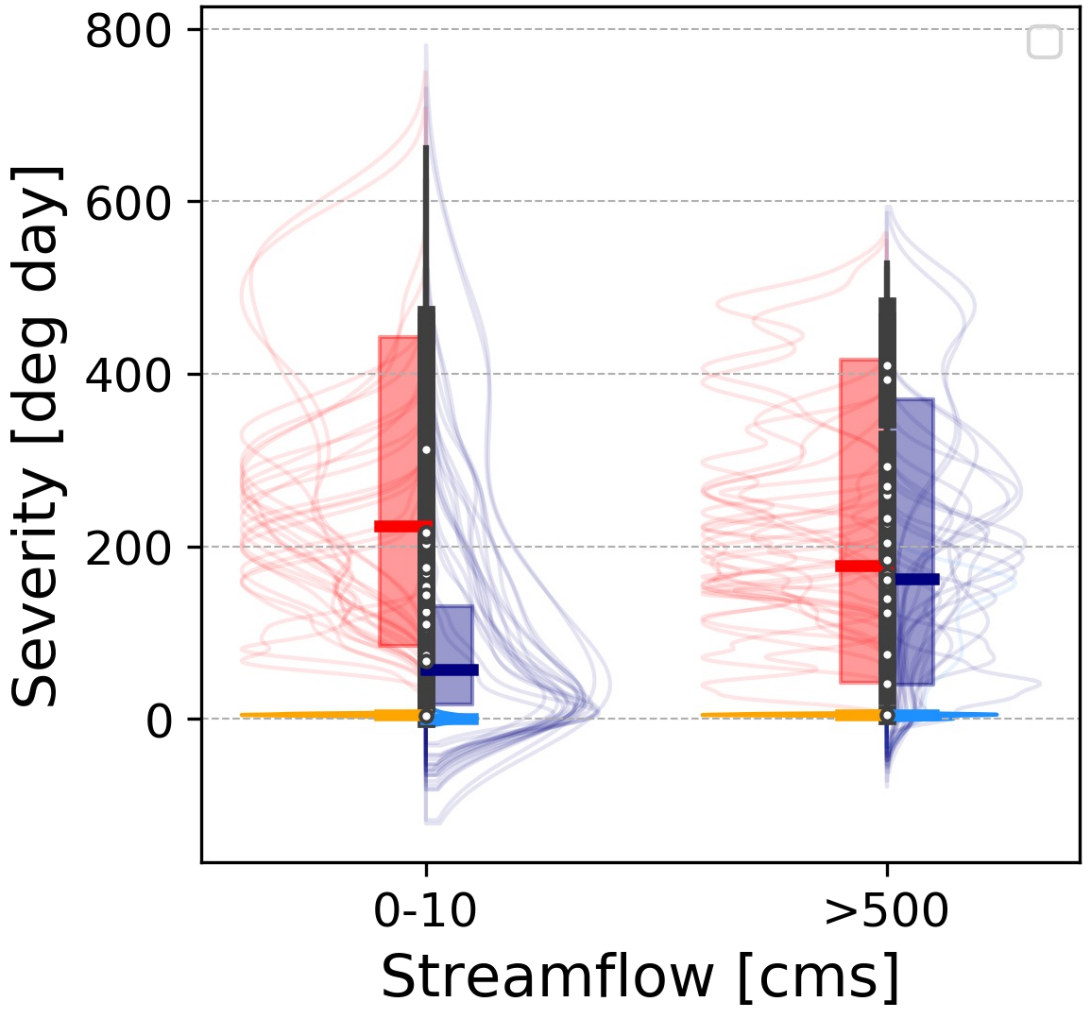


https://matplotlib.org/stable/gallery/index.html

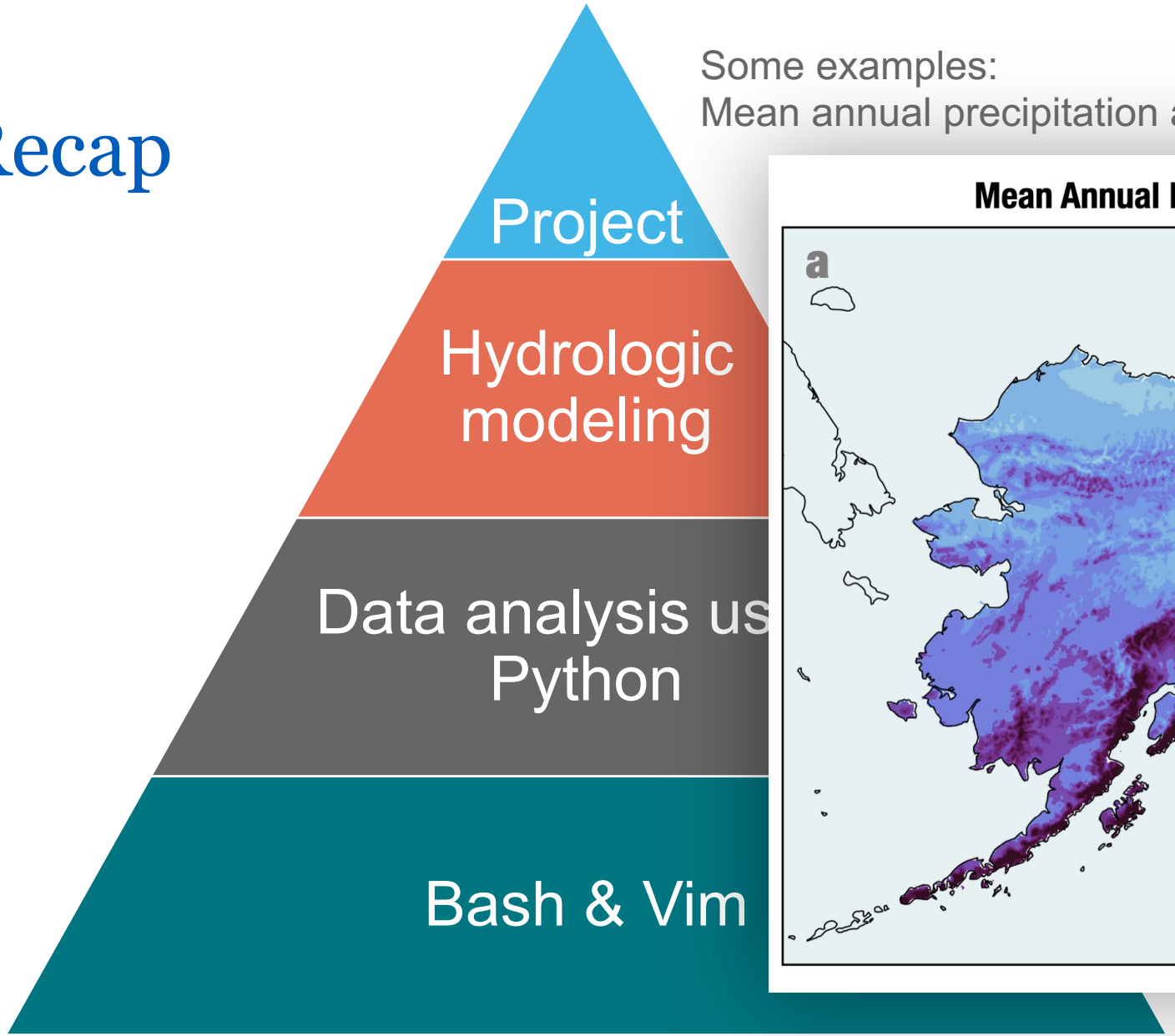
Recap



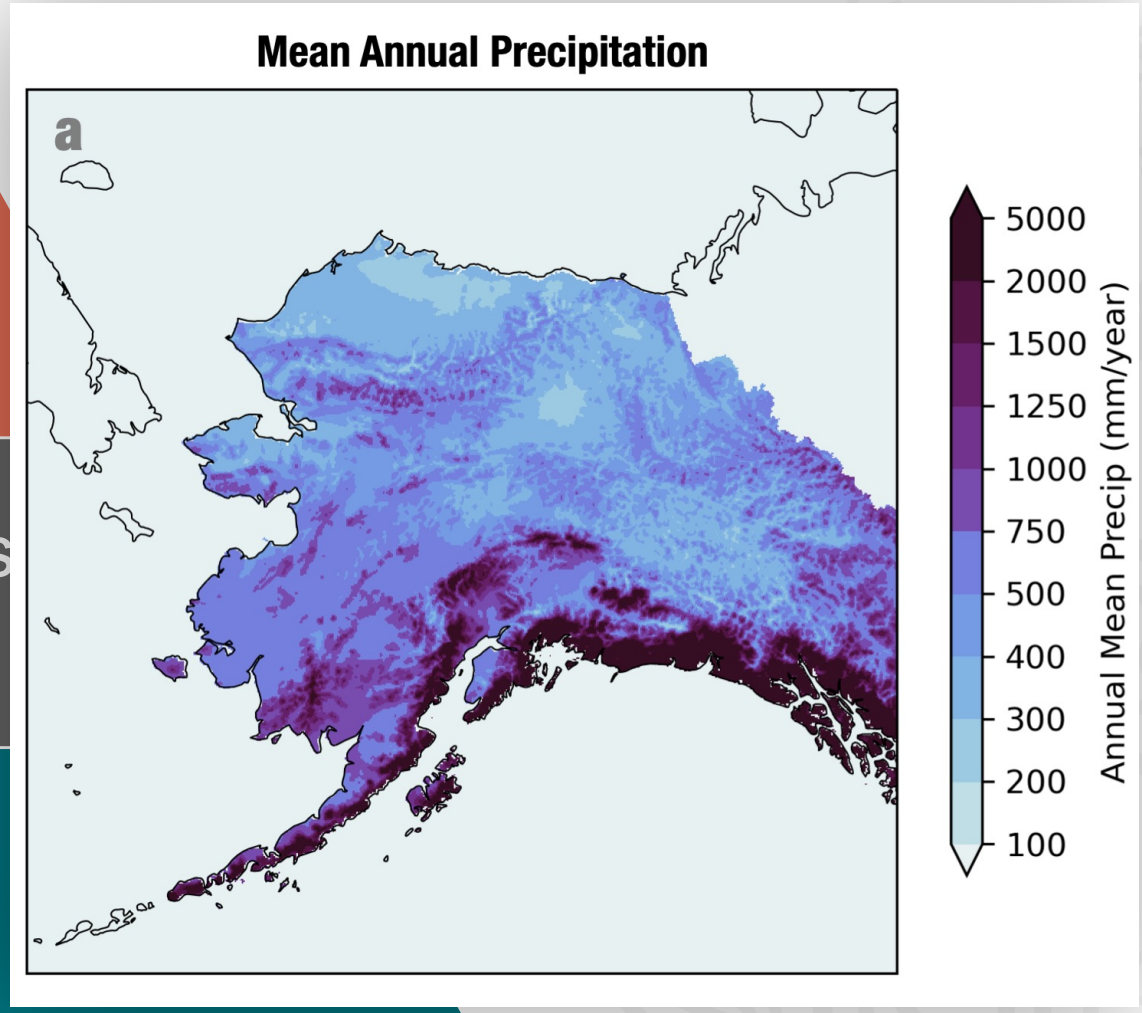
Some examples:
Distribution of projected changes in severity in river temperatures



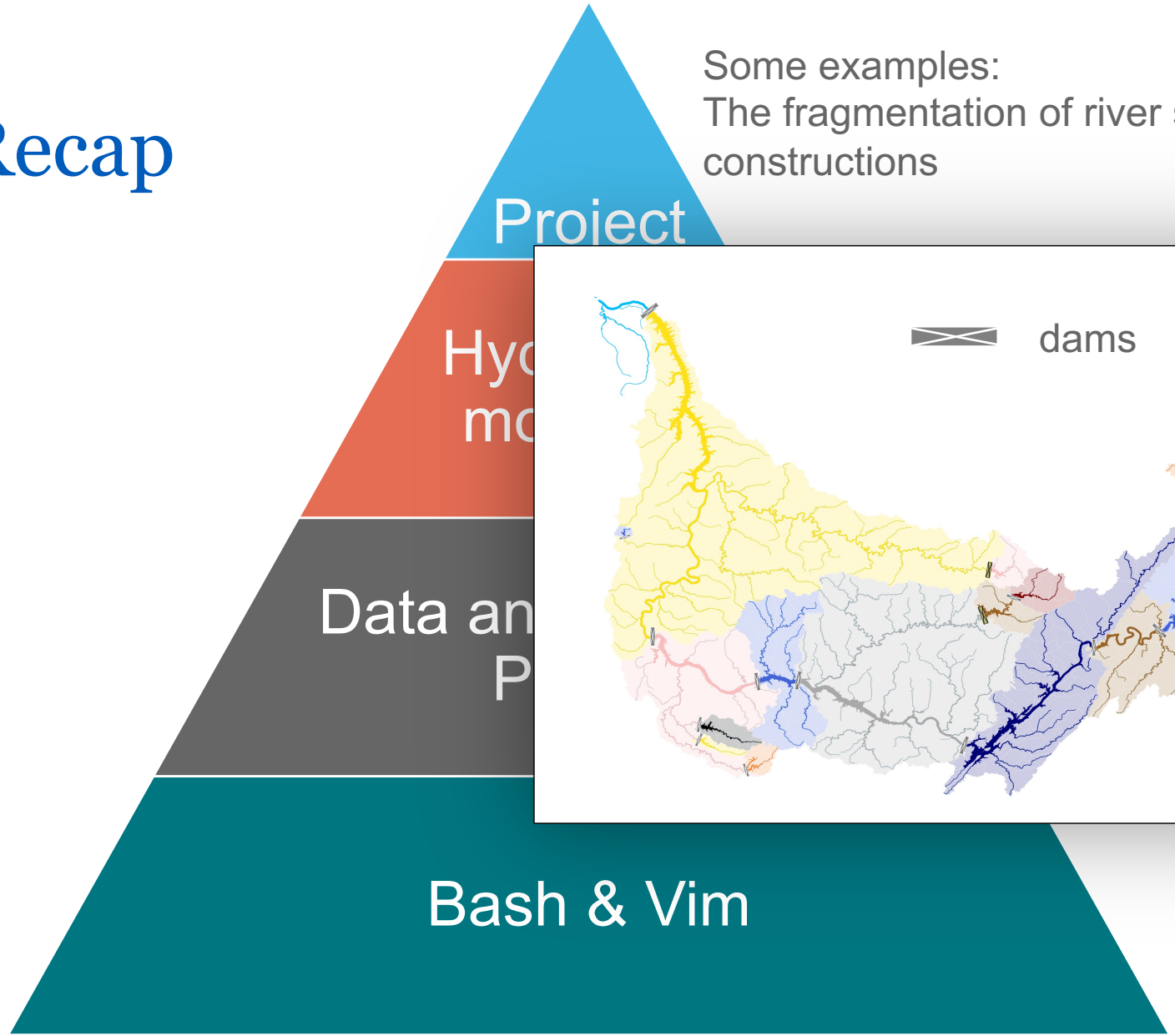
Recap



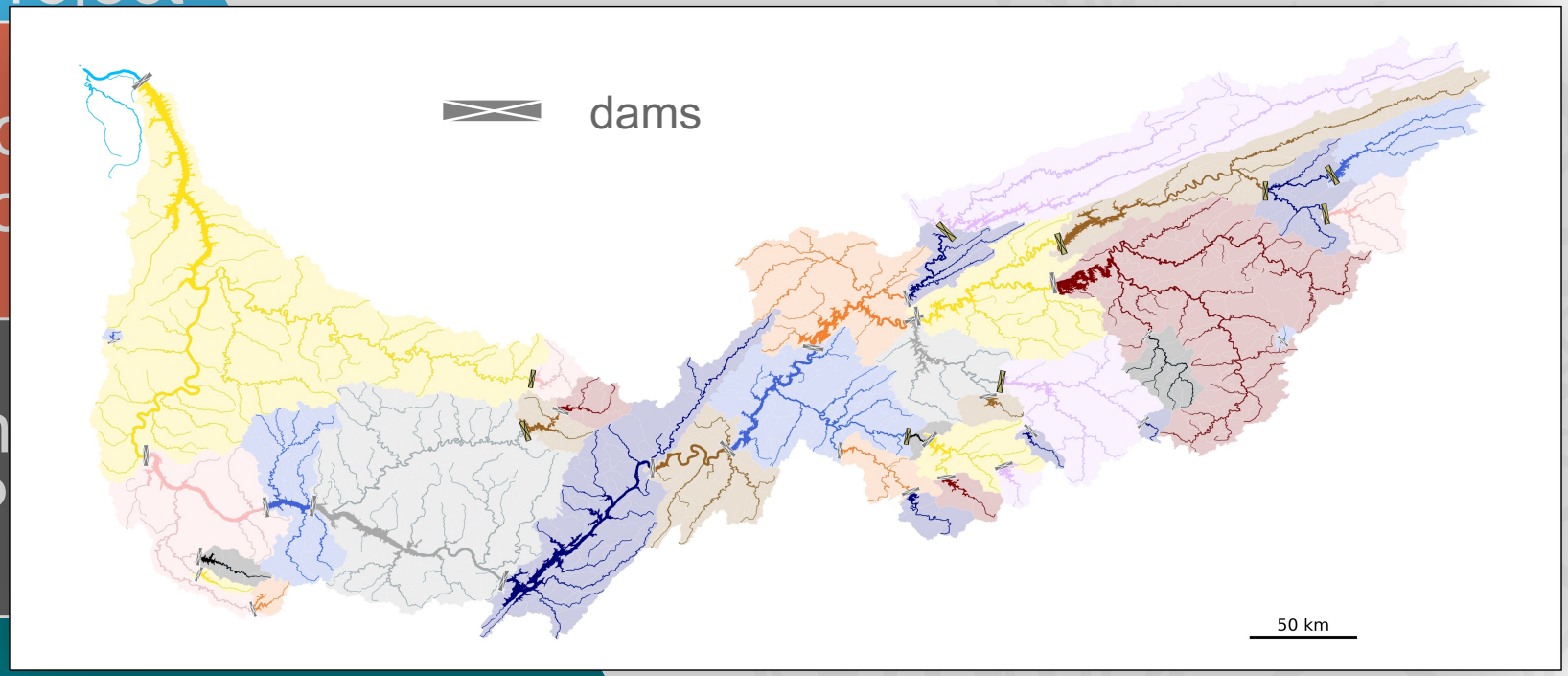
Some examples:
Mean annual precipitation across Alaska and Yukon River Basin



Recap



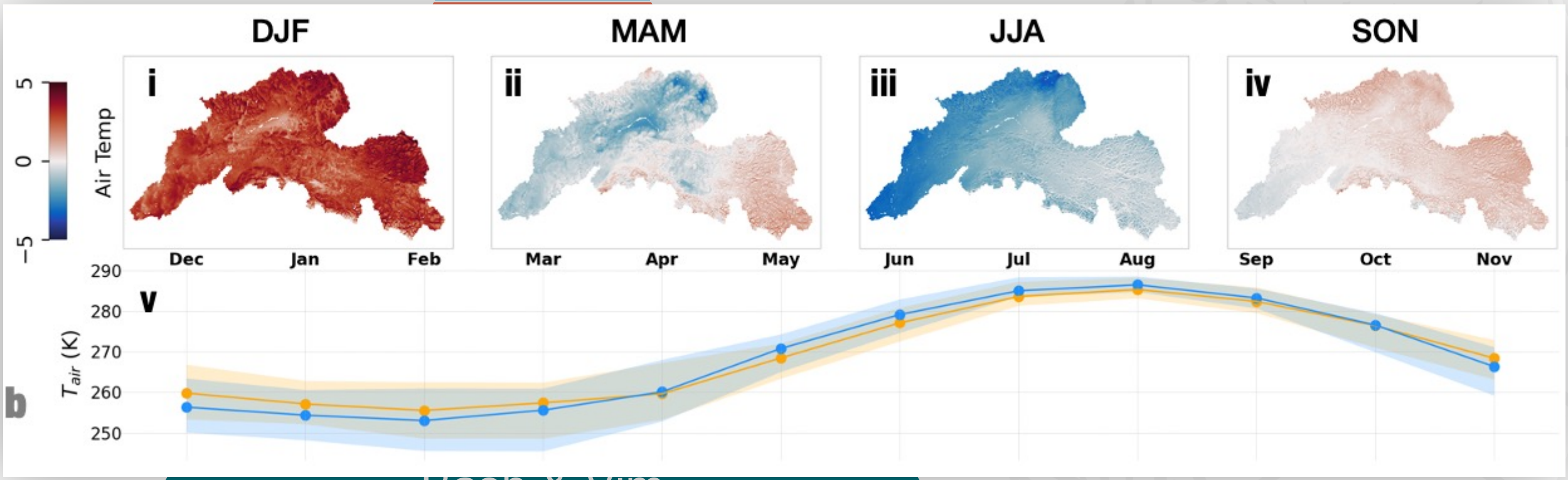
Some examples:
The fragmentation of river systems due to dam constructions



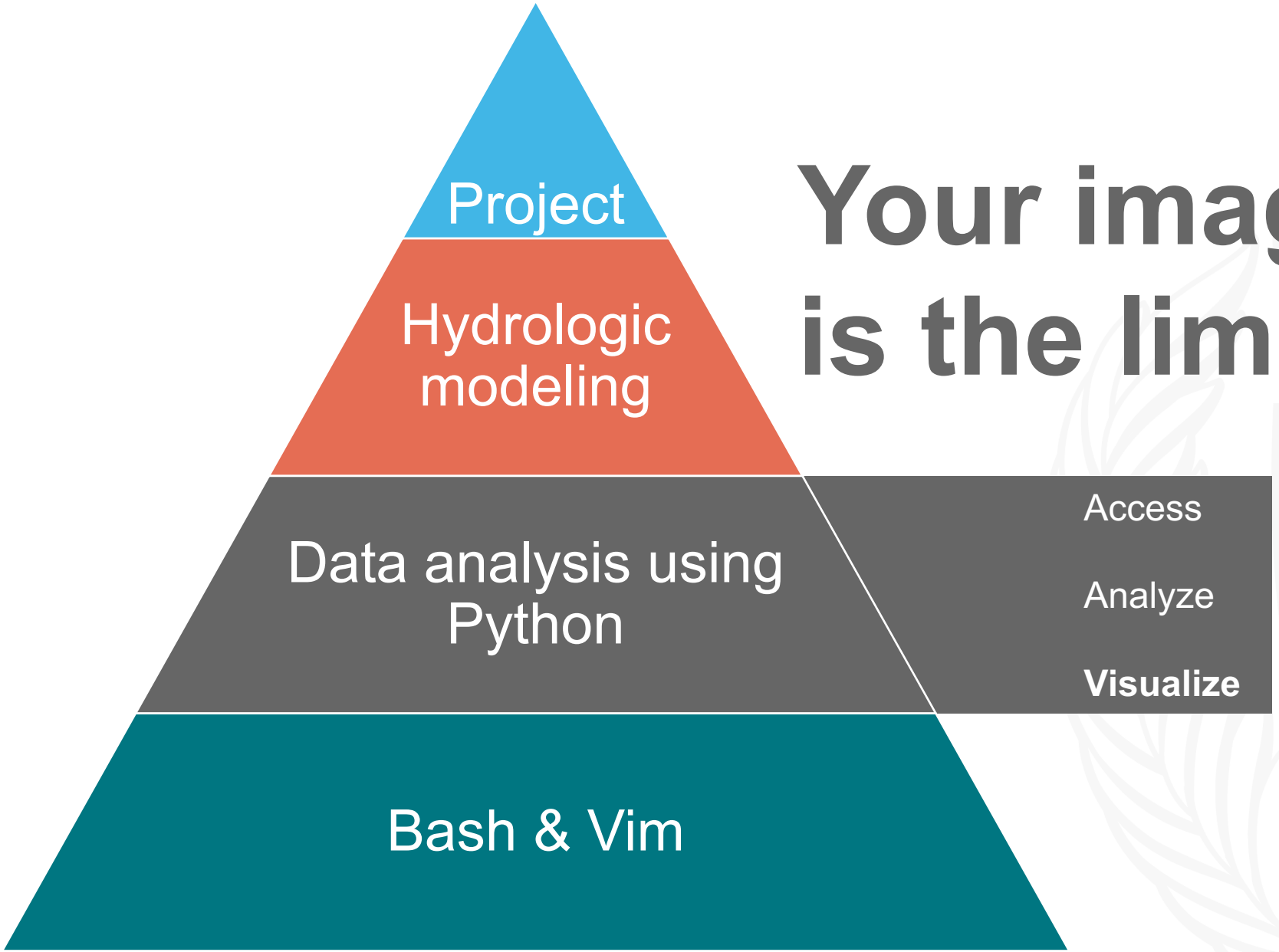
Recap

Project

Some examples:
Evaluating model simulation against observation
Seasonal differences (upper panels) and monthly time series (lower panel)



Bash & Vim



Your imagination is the limit!

Lab: Numpy

- NumPy is a Python library used for numerical computations, particularly with arrays and matrices.
- It's faster and more efficient than Python lists because it uses contiguous memory blocks and optimized C-based operations.

Load the numpy package

```
import numpy as np
```

Create an array

```
arr = np.array([1, 2, 3])
arr2 = arr + 5          # Adds 5 to each element
print(arr2)             # Output: [6 7 8]
arr3 = arr * 2          # Multiplies each element by 2
print(arr3)             # Output: [2 4 6]
```

Common functions

```
np.linspace(0, 1, 5)  # Output: [0.  0.25 0.5  0.75 1.]
np.arange(0, 10, 2)   # Output: [0 2 4 6 8]
```

Lab: Matplotlib

- Matplotlib is the mostly widely used Python library for creating static, animated, and interactive visualizations. It's highly customizable and integrates well with NumPy and Pandas for data visualization.

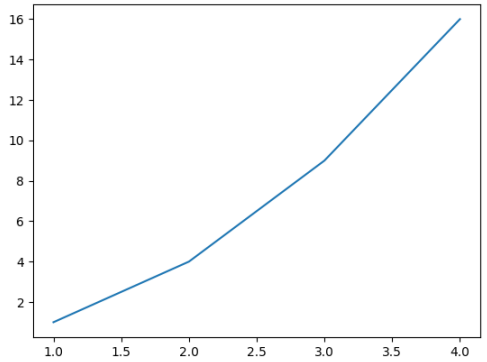
```
import matplotlib as mpl
```

The base **mpl** import is used for high level settings like setting a default figure or font size

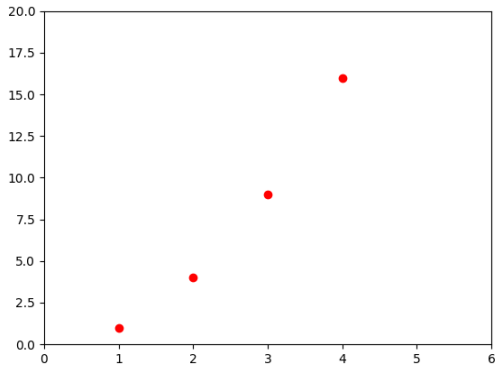
```
import matplotlib.pyplot as plt
```

The import of **plt** provides the main interface to the actual plotting functions

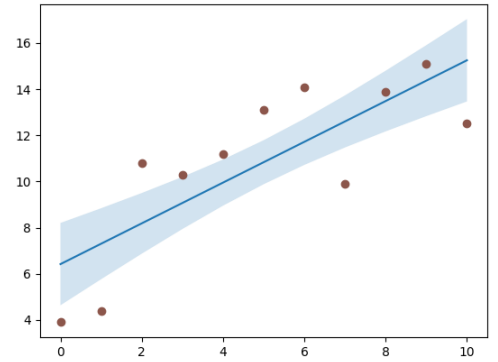
`plt.plot`



`plt.scatter`



`plt.fill_between`



Let's get to exercise!

- Please go to https://github.com/act-hydro/GLY606_2024
- Go to `in_class_practice/python_practice`
- Download `practice 2/3` to your laptop
- Drag the ipynb files to CUAHSI Jupyterhub