

Scientific Data Analysis Application

CU Capstone Project

Group of 6 senior computer science students working to create a python based data analysis web application.

Project Sponsor: Brian Bonnlander

Visualization and Enabling Technologies Section

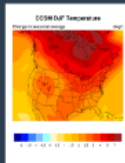
- Hannah Keller
- Seongmin Choi
- Robert Crimi
- Connor Guerrieri
- Bo Han
- Hannah Thomas



Reproducibility without expertise

"Many users of climate model outputs need to make decisions on how or whether to respond to climate change, in some cases within institutions where the reality or importance of climate change is not universally acknowledged"

Committee on a National Strategy for Advancing Climate Modeling



Project Goal

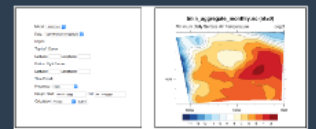
Create a web application that allows users to easily and intuitively:

- Create visual data workflows
- Reproduce workflows
- Automate scientific expertise
- Access intermediate workflow results
- Utilize multiple analysis languages

Tool Research



First Attempt



Second Attempt



DEMO

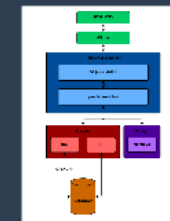
Thank You

hannah.keller@colorado.edu

Final Design



Architecture



- Nodelink
- Pyutilib.workflow
- NCL
- R
- MongoDB

Next Steps

- Implement other steps
 - Unit Conversion
 - Thresholds
 - Download
- Load existing workflow
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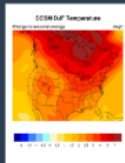
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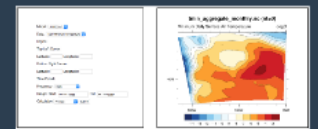
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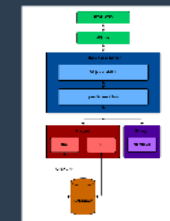
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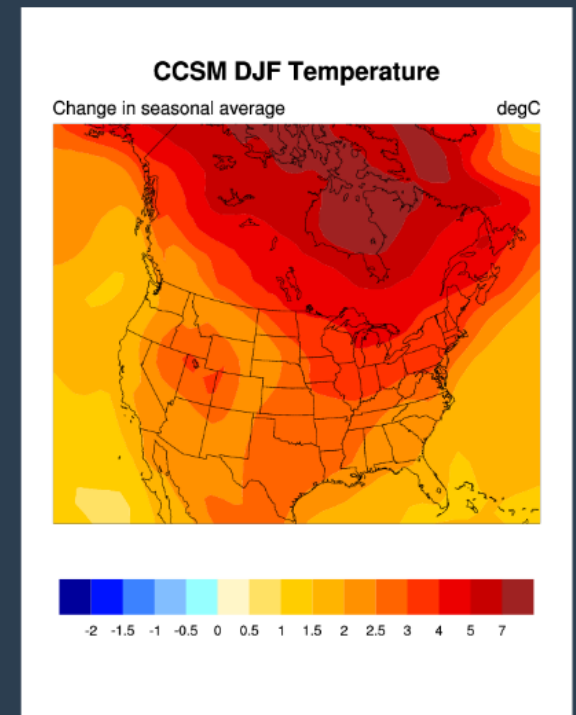
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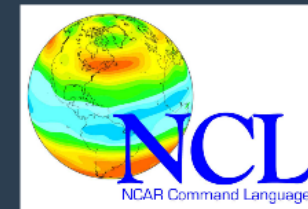
Tool Research

Web Frameworks

django



Analysis tools



Workflow Builders



First Attempt

Model:

Data:

Region:

Top Left Corner:

Latitude: Longitude:

Bottom Right Corner:

Latitude: Longitude:

Time Period:

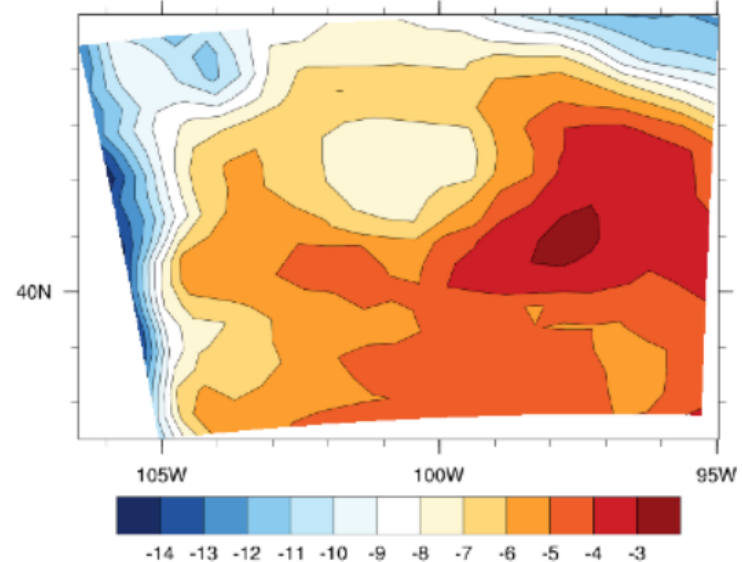
Frequency:

Range: Start: End:

Calculation:

tmin_aggregate_monthly.nc (nt=0)

Minimum Daily Surface Air Temperature degC



Second Attempt

NCAR Scientific-Data

+New Step

What Would You Like To Do?

Subset Data

Analyze Data

View Results

NCAR Scientific-Data

Subset

+New Step

Subset Data

Delete This Subset

Simulation Type *Explanation of Simulation*

NCAR

Variable *Explanation of Variable*

☒ Daily Average Sea Ice Fraction

☐ Maximum Daily 10-Meter Wind Speed

☐ Maximum Daily Surface Air Temperature

☐ Minimum Daily Surface Air Temperature

☐ Surface Specific Humidity

☐ Precipitation

☐ Surface Pressure

☐ Surface Downwelling Shortwave Radiation

☐ Surface Air Temperature

☐ Zonal Surface Wind Speed

☐ Meridional Surface Wind Speed

Region *Explanation of Region*

Southwest Corner

Latitude

Longitude

Northeast Corner

Latitude

Longitude

Time *Explanation of Time*

Begin | 1979 | 12 | 01 | End | 2024 | 11 | 30 |

Regional Climate Model *Explanation of Regional Climate Model*

☒ CRCM

☐ ECP2

☐ HRM3

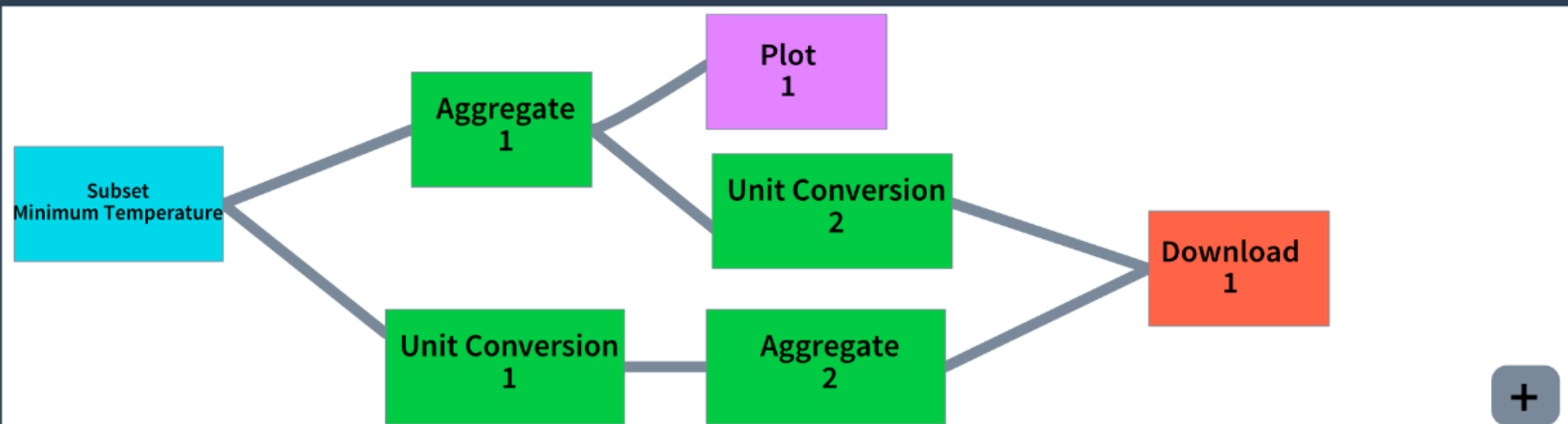
☐ MMSI

☐ RCM3

☐ WRFG

Global Climate Model

Final Design



Subset Data

Simulation Type *Explanation of Simulation Type*

NCEP ▼

Variable *Explanation of Variable*

- | | |
|--|---|
| <input type="radio"/> Daily Average Sea Ice Temperature | <input type="radio"/> Daily Average Sea Ice Temperature |
| <input checked="" type="radio"/> Maximum Daily 10-Meter Wind Speed | <input type="radio"/> Maximum Daily 10-Meter Wind Speed |
| <input type="radio"/> Maximum Daily Surface Air Temperature | <input type="radio"/> Maximum Daily Surface Air Temperature |

Region *Explanation of Region*

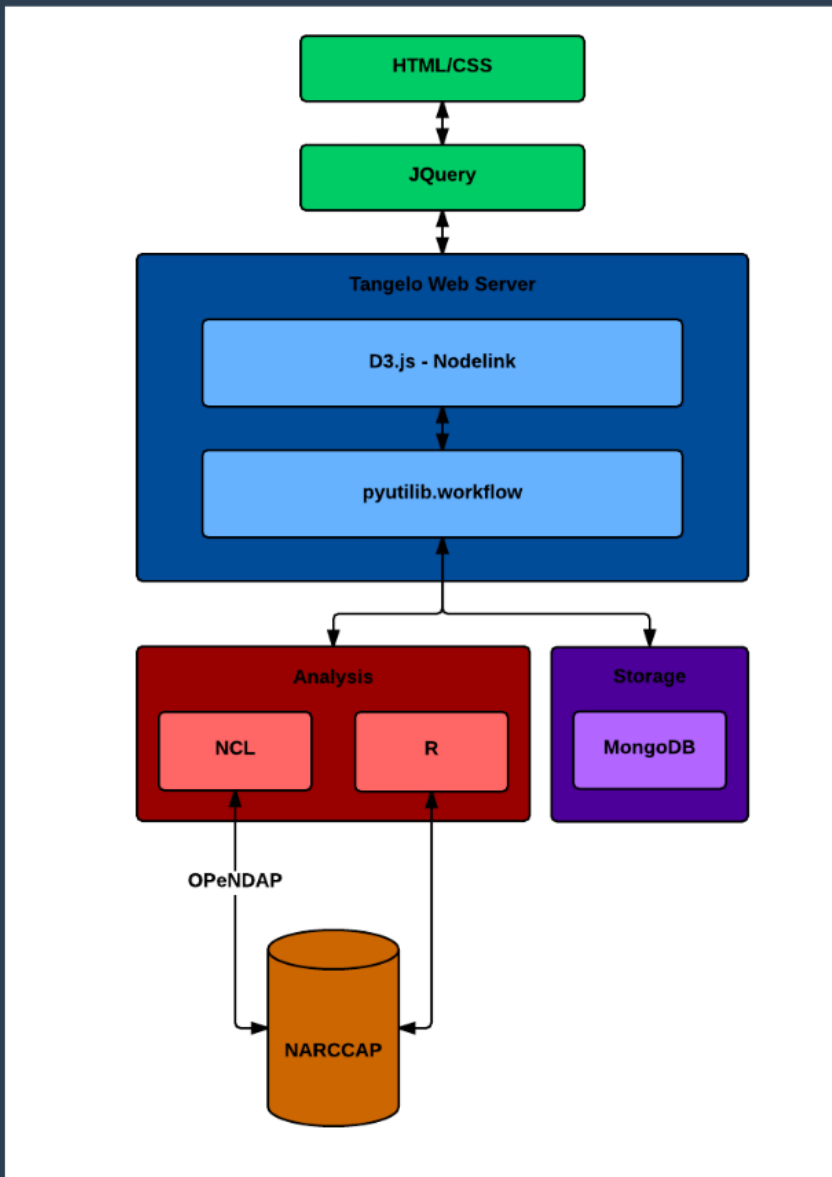
Southwest Corner

Latitude

Longitude

Northeast Corner

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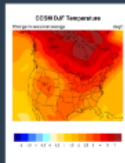
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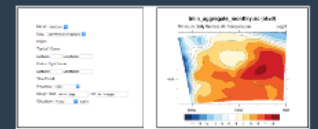
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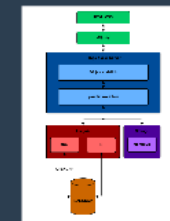
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