



PolarWatch

A NOAA COASTWATCH NODE

Tracking Arctic Sea Ice Concentration: Data Analysis and Visualization

by Tien Ly, Satellite Data Scientist Intern, Summer 2024

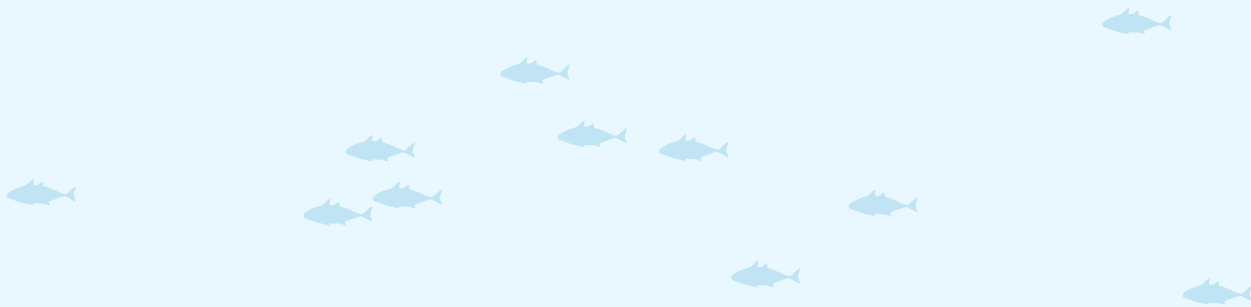
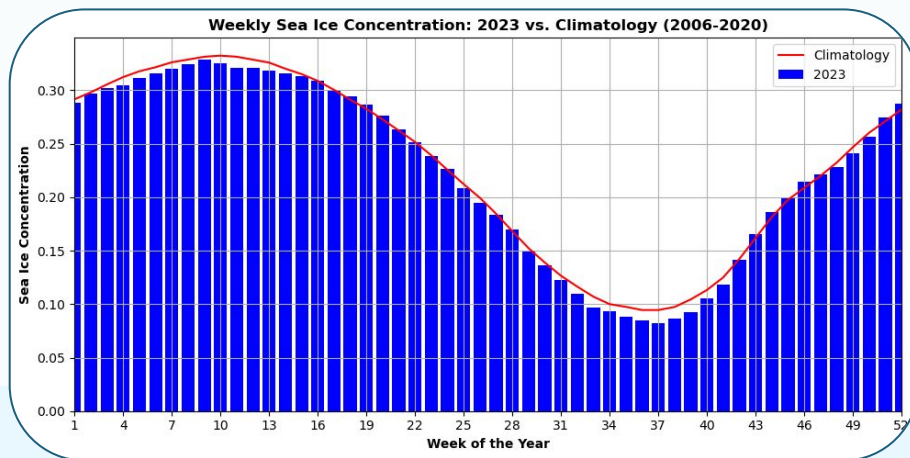


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Summer 2024 Internship at NOAA PolarWatch (06/03 - 08/16)

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Overview of Milestones 1 and 2

Milestone 1: Skills Development

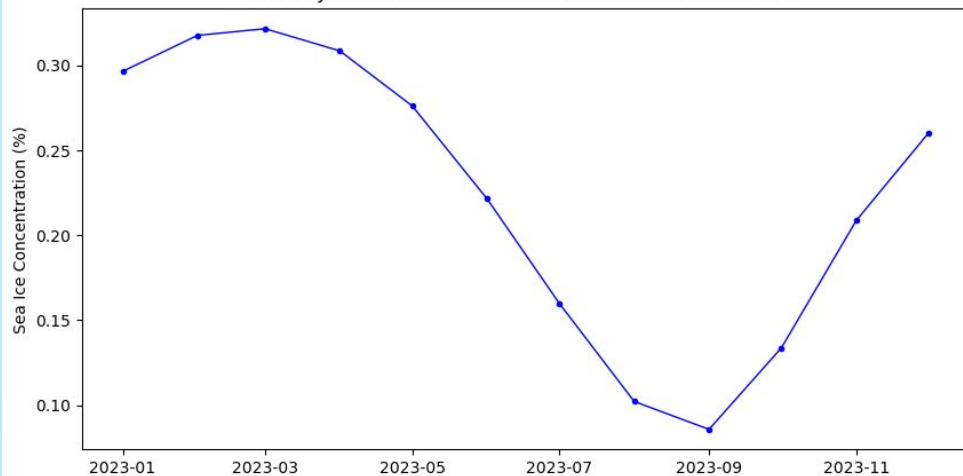
- Understanding satellite products
- Accessing satellite data via ERDDAP
- Using Python for data manipulation
- Git and GitHub for version control and collaboration
- Environment management with conda
- Documentation with Markdown

Milestone 2: Data Analysis and Visualization

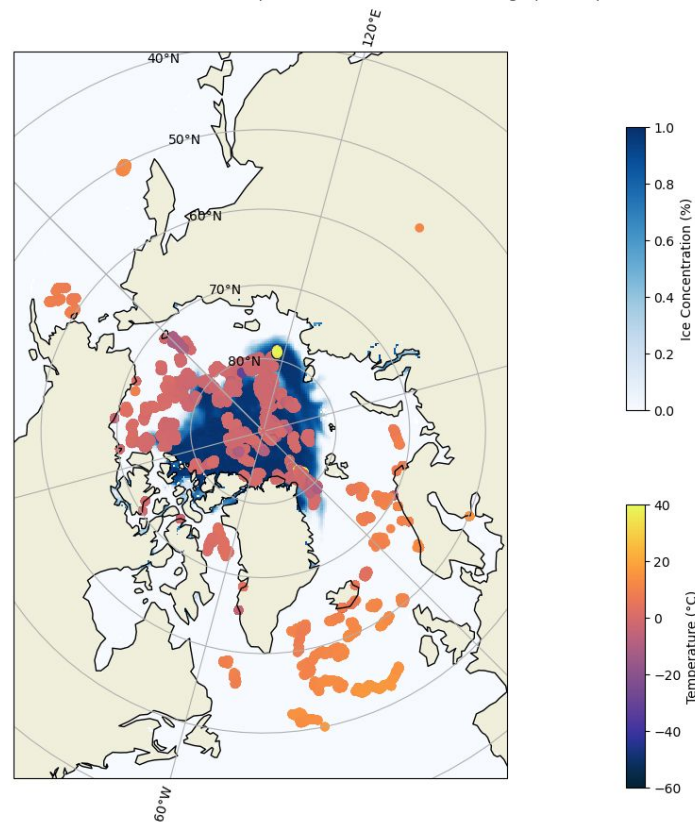
- Exploring PolarWatch data catalog and SIC dataset
- Conducting literature review on SIC applications
- Completing Python tutorials and creating Jupyter notebook
- Handling and analyzing data with xarray
- Visualizing temporal and spatial data

Key Visualizations from Milestone 2

Monthly Mean Sea Ice Concentration in the Arctic in 2023

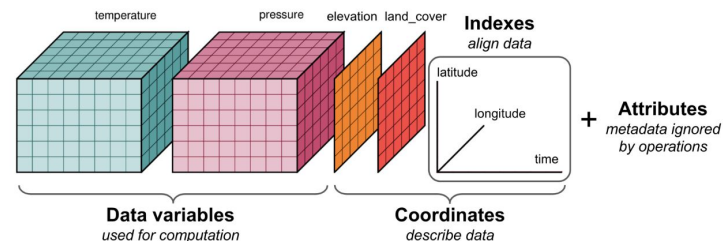


Sea Ice Concentration and Sea Surface Temperature Data on a Polar Stereographic Map



Milestone 3: Weekly Climatology Plots

- Completing tutorials on computing climatology
- Downloading data and computing climatology of sea ice concentration data
- Drafting Jupyter notebook with explanations
- Drafting and presenting data summary



Python for Climate Data Analysis: A Tutorial + Code



Ali Ahmadalipour

Research Scientist at Google[X] | Geospatial, AI, Climate Change, Sustainability

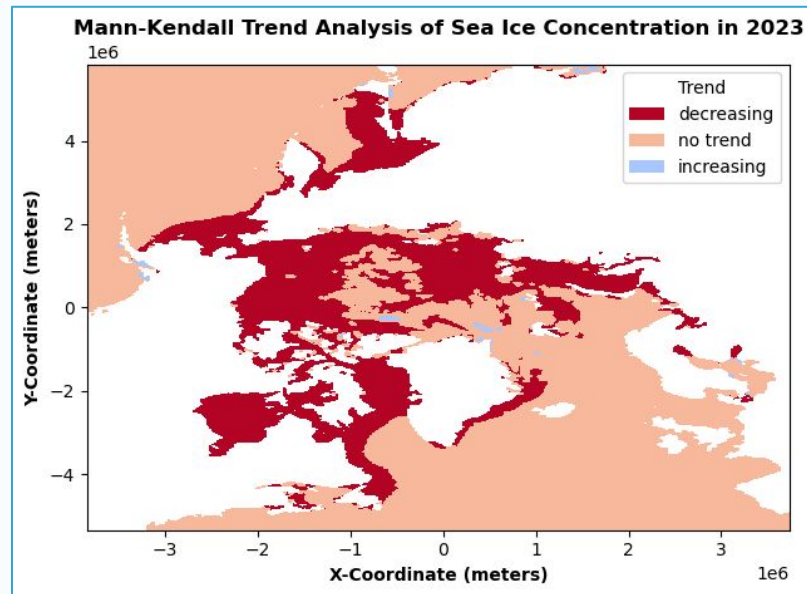


April 5, 2022

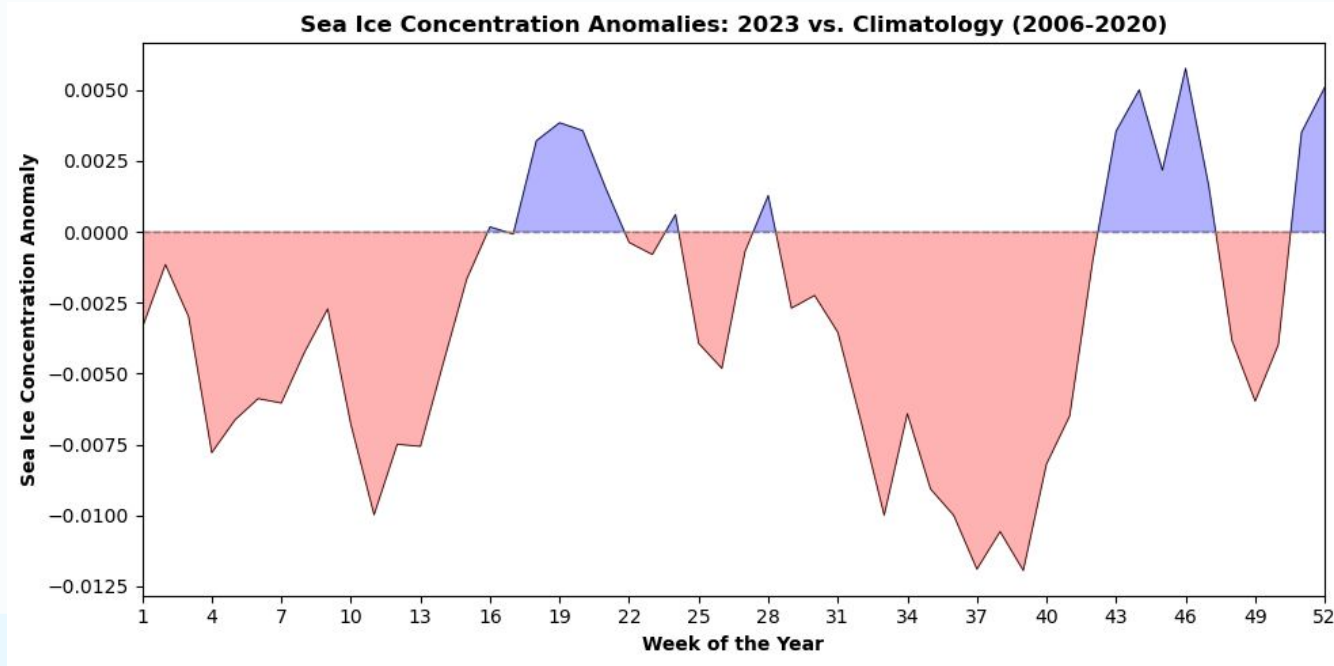
- Link to tutorial on Google Colab: <https://colab.research.google.com/drive/1B7gFBSr0eoZ5lbsA0IY8q3XL8n-3BOn4>

Milestone 3: Weekly Climatology Plots

- Comparing weekly means of sea ice concentration to the current year
- **Computing anomalies** and trends for **2023**
- **Identifying weeks with significant differences**
- **Mapping anomalies and sea ice concentration**



2023 Sea Ice Concentration: Identifying Anomalies



Identifying weeks with significant differences

Performing two-tailed one-sample t-test and identify significant weeks

Perform two-tailed one-sample t-test and identify significant weeks

```
# Initialize lists to store results
p_values = []

# cur_mean: 2023 weekly means
# clim_mean: climatological weekly means
# Loop through each week
for i in range(len(cur_mean)):
    # Calculate the t-statistic
    t_stat = (cur_mean[i] - clim_mean[i]) / (cur_std[i] / np.sqrt(7))

    # Calculate the degrees of freedom
    degrees_of_freedom = 7 - 1

    # Calculate the p-value
    p_value = (1 - t.cdf(abs(t_stat), df=degrees_of_freedom)) * 2

    # Store the p-value
    p_values.append(p_value)

# Convert p-values to an array
p_values = np.array(p_values)

# Determine significant weeks
alpha = 0.05
significant_weeks = np.where(p_values < alpha)[0]

# Print weeks that show significant differences from the climatology
if len(significant_weeks) > 0:
    print(f'Weeks showing significant differences from the climatology (alpha = {alpha}):')
    for week in significant_weeks:
        print(f'week + 1}')
else:
    print('No weeks show significant differences from the climatology.')
```

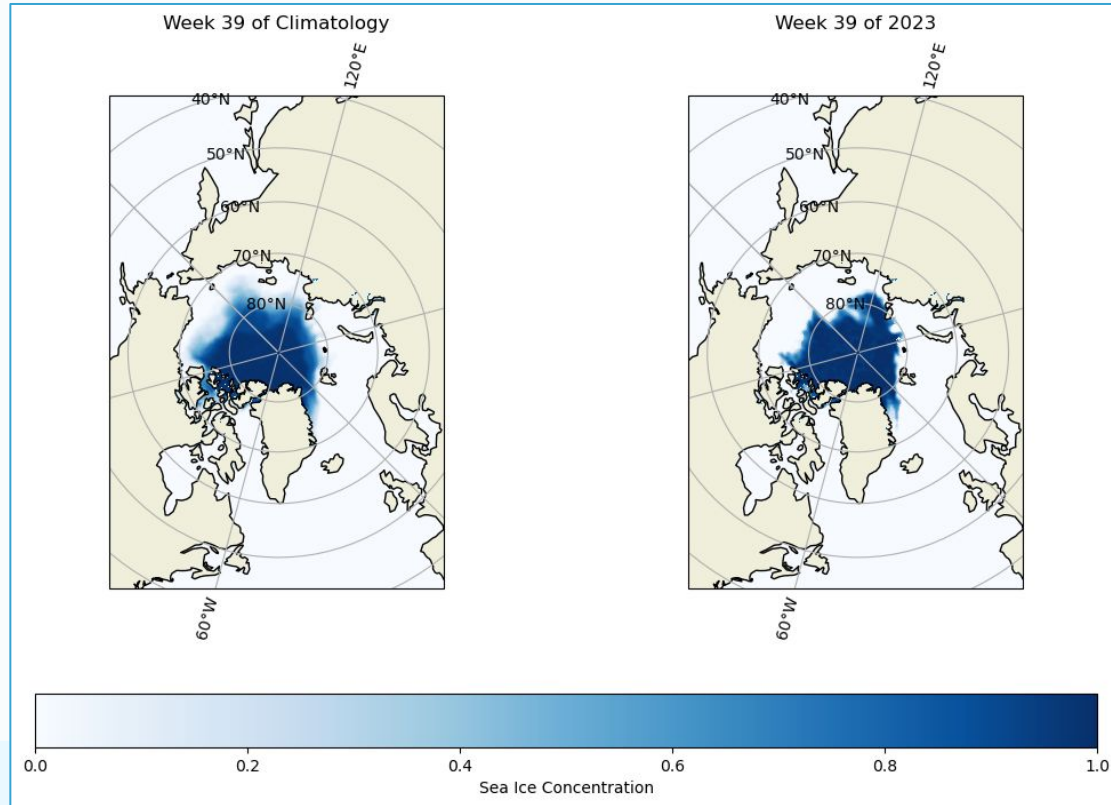
[34] ✓ 0.1s

Python

Weeks showing significant differences from the climatology (alpha = 0.05):

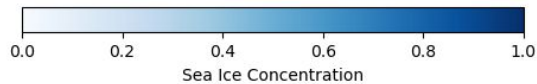
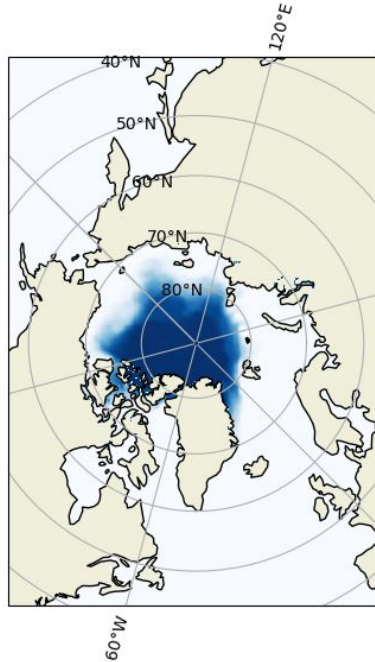
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Mapping anomalies

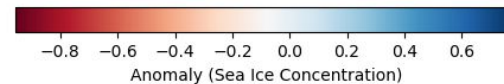
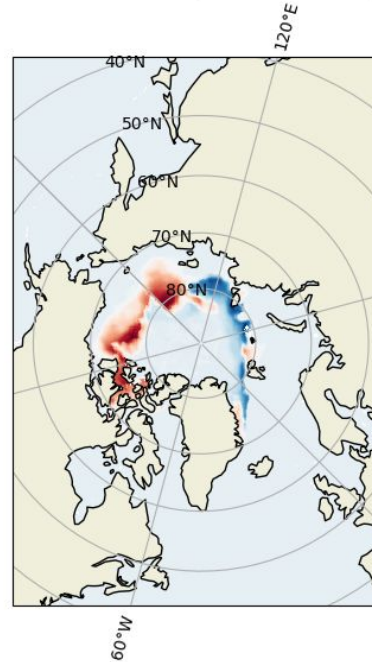


Mapping anomalies

Week 39 of Climatology



Week 39 Anomalies (2023 - Climatology)



Milestone 4: Modeling and Publishing Sea Ice Data

Milestone 4A (07/29 - 08/09)

- Objective: Model sea ice prediction using deep learning approach
- Activity: Replicate the model introduced in the paper, Sea Ice Forecasting using Attention-based Ensemble LSTM

Milestone 4B (08/12 - 08/16)

- Design and develop a project website in Quarto to showcase all the work completed during the internship