

# Greenland Melt Effect on Salinity and Ocean Currents

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# Background

- The Greenland Ice Sheet is one of the two ice sheets left on the planet.
- Human activity has sped up climate change in the arctic, leading to warmer oceans and warmer air [1].
- Greenland melting has led to a large input of freshwater into the ocean, likely changing the salinity of the Arctic Ocean [2].
- There is potential for a decrease in salinity to lead to weakened ocean currents, which could impact temperatures and weather patterns on a global scale [2].



**What effect has the melting of the Greenland Ice Sheet had on the surrounding ocean salinity and ocean currents?**

# Necessary Datasets

## 3 Main Necessities:

- Greenland mass loss over time
- Arctic ocean salinity over time
- Arctic ocean current strength over time

### Greenland Mass Loss Data:

- Found on EPA website
- Data sourced from IMBIE and NASA JPL
- .csv file

### Arctic Ocean Salinity Data:

- Found on Scripps Institution of Oceanography website
- Data sourced from the Argo Program
- Gridded data by latitude and longitude
- .nc file

### Arctic Ocean Current Strength Data:

- Found on Copernicus Marine Service website
- Data is sea surface velocities
- Gridded data by latitude and longitude
- .nc file

## Challenges Faced:

- Finding relevant, accessible data
  - Doesn't go up to present
  - Needed an account to access
  - Unclear dataset titles
- Downloading large datasets
  - Split by year
  - Needed disk for some datasets

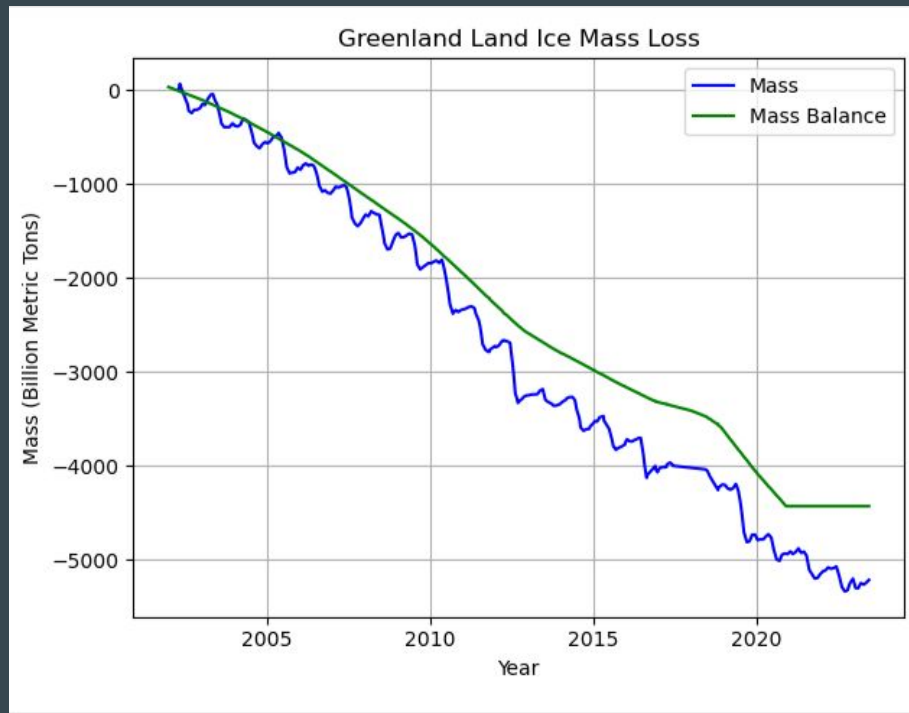
# Greenland Mass Loss Analysis

## Tools and Methods:

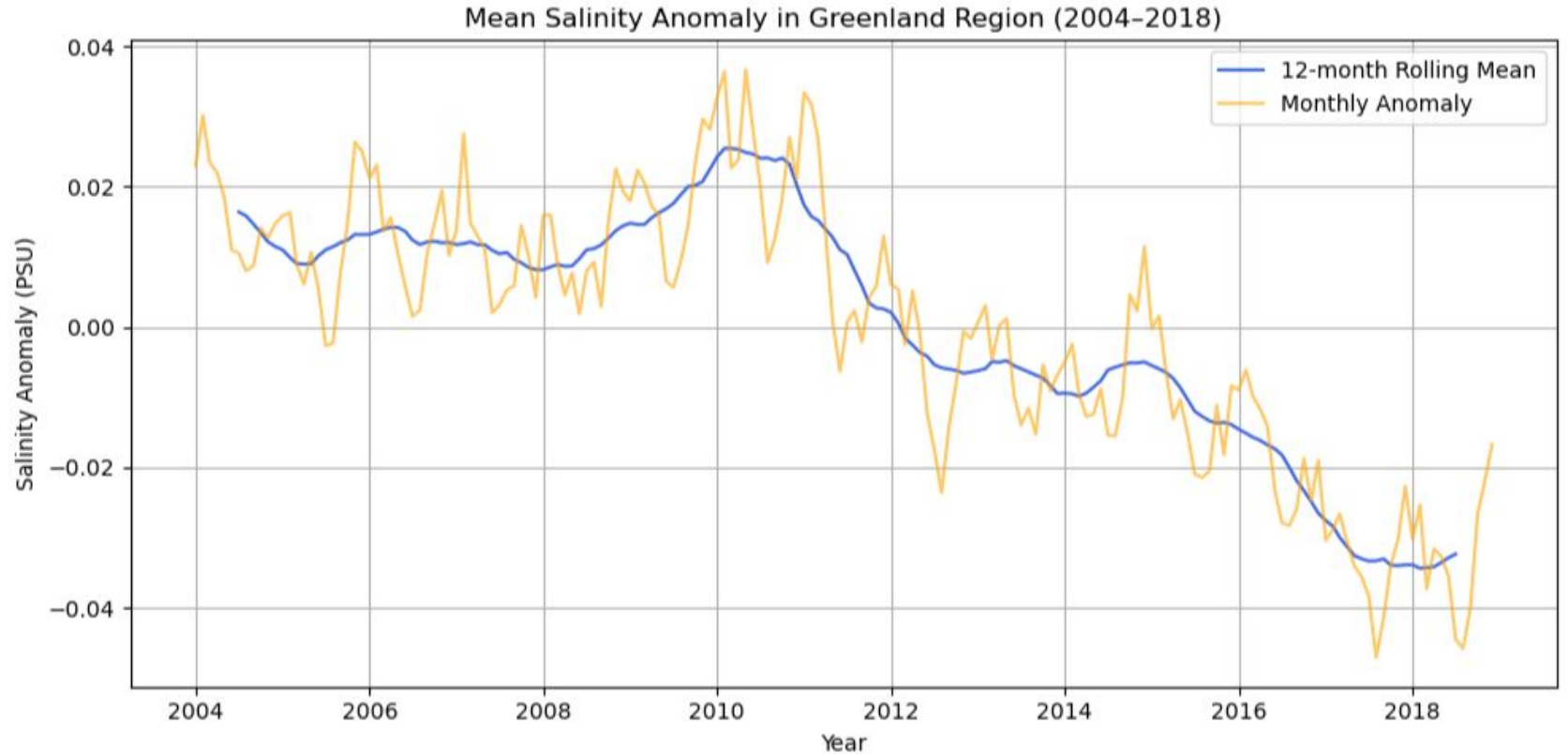
- Matplotlib.pyplot and pandas
- Import data file
- Create a data frame for only Greenland data
- Interpolate data to account for gaps
- Filter years to 2002-2024
- Plot the change in mass and the mass balance

## Analysis:

- Greenland has lost over 5000 billion metric tons of mass in the past 22 years.
- There is a consistent downward trend, with a slight plateau in the past 3 years.



# Arctic Salinity Analysis



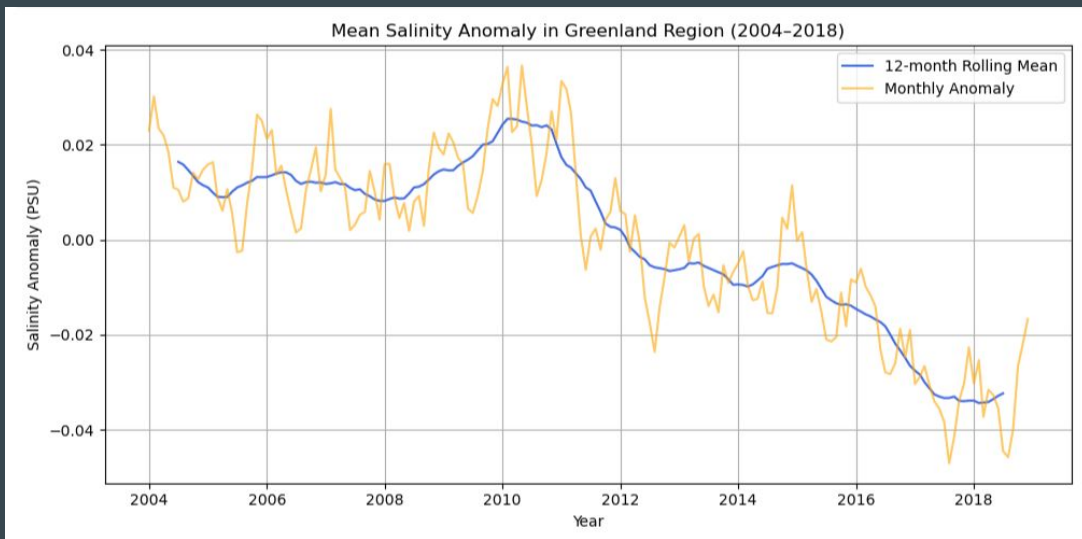
# Arctic Salinity Analysis

## Tools and Methods

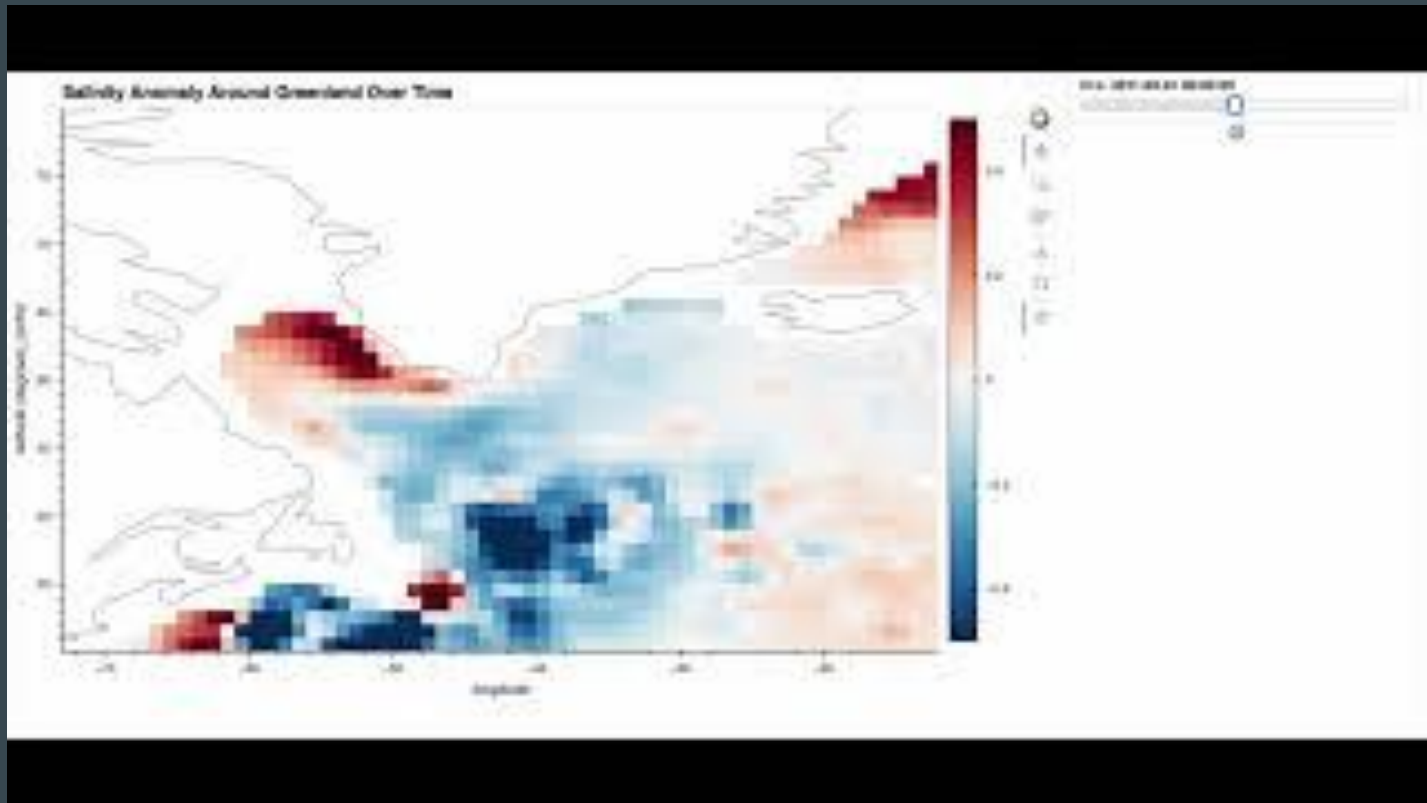
- Matplotlib.pyplot, numpy, xarray, cartopy, hvplot, geoviews, panel
- Import data file
- Narrowed dataframe to focus around Greenland
- Smoothed data to see overall trend
- Plotted change in salinity over time

## Analysis:

- Shows general downward trend
- Decrease of 0.05388 PSU/decade
- Salinity in the studied region generally decreased over time

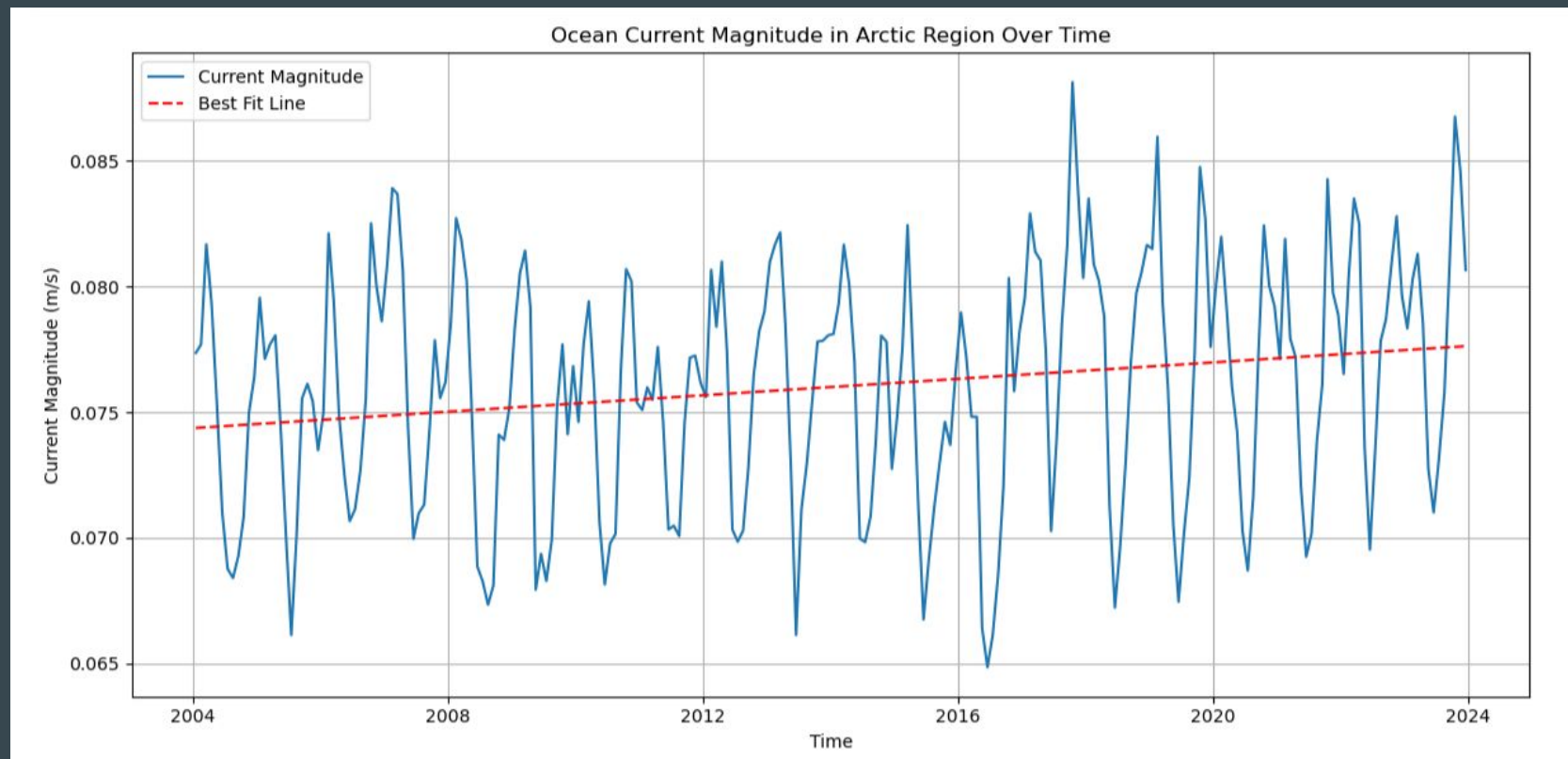


# Arctic Salinity Analysis





# Arctic Current Strength Analysis



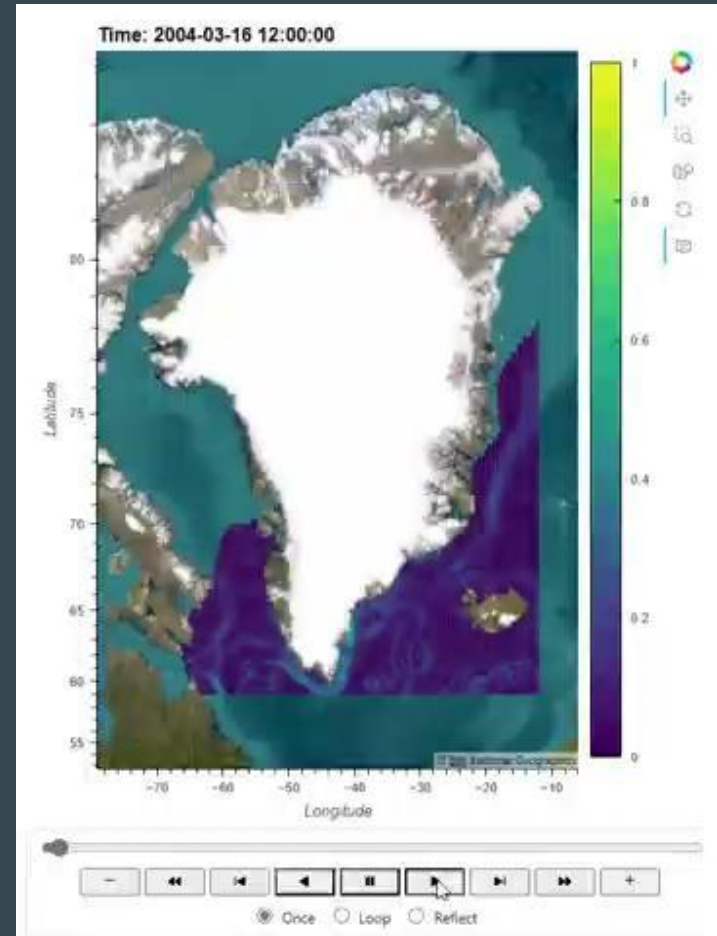
# Arctic Current Strength Analysis

## Tools and Methods:

- Matplotlib.pyplot, xarray, glob, netCDF4, numpy, hvplot, panel,
- Import data files
- Create dataframe combining all years with only relevant data
- Calculate the mean magnitude of sea surface velocity each month
- Slice just the latitude and longitude being analyzed
- Plot results with a line of best fit

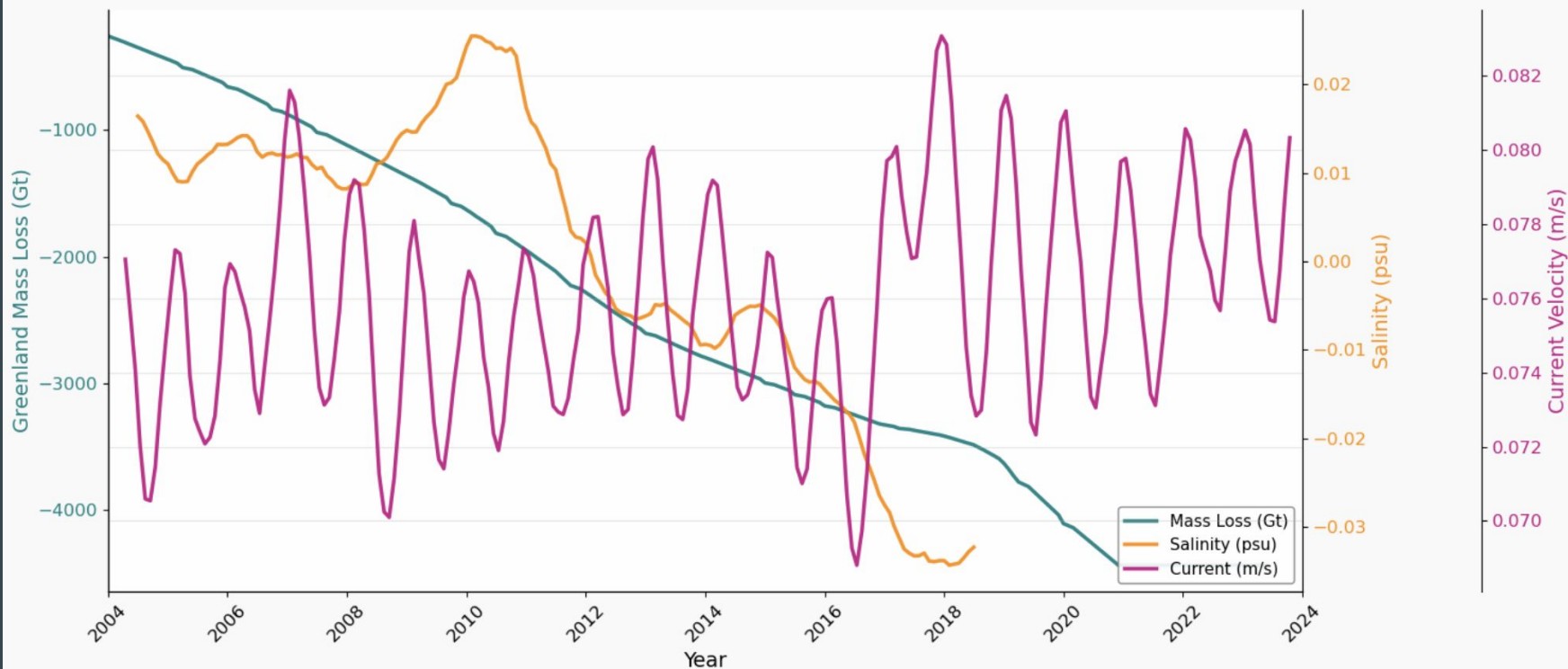
## Analysis:

- Cyclical
- Trend shows a slight increase in current strength over time
- Goes against initial hypothesis

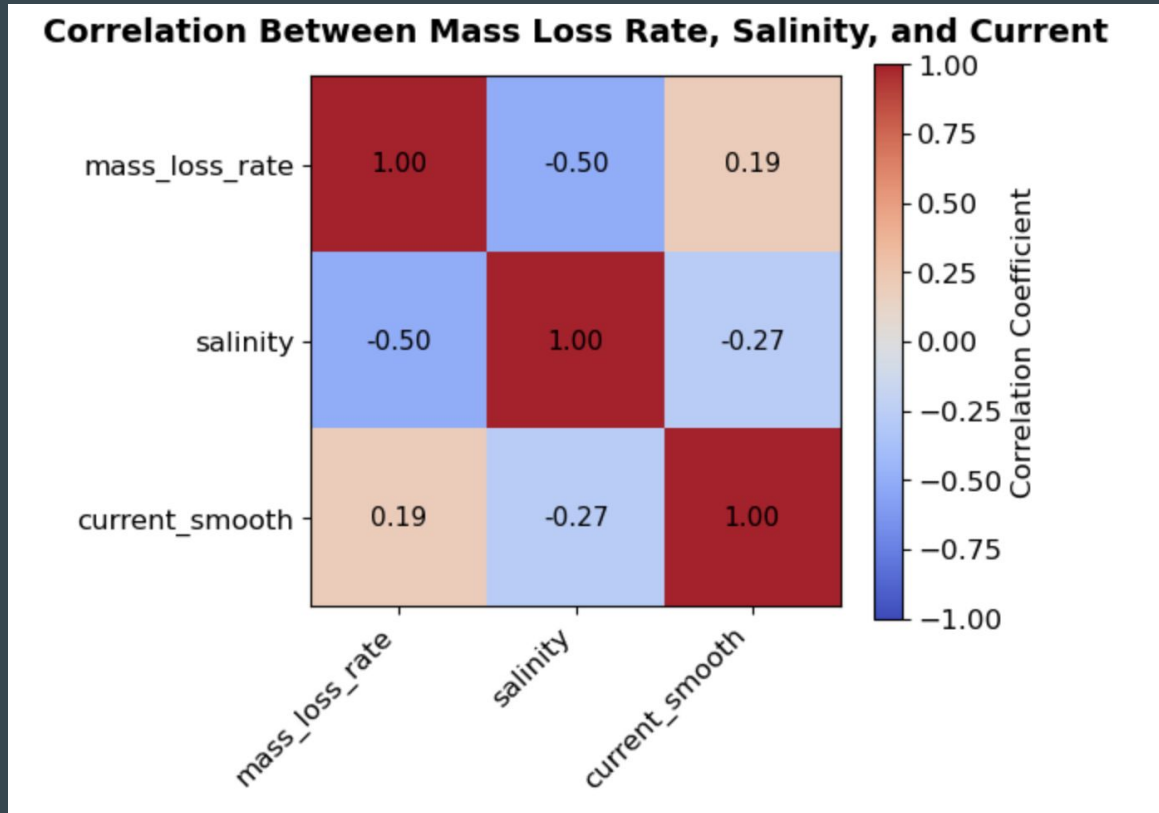


# Bringing It All Together:

Greenland Mass Loss, Ocean Salinity, and Current Velocity (2004-2024)



# Correlation Analysis



# Results

- Findings do NOT align with hypothesis.
- As Greenland loses mass, salinity does decrease, but ocean currents seem either unaffected or actually increase.

Why?

- It is possible sea ice breaking off “churns” the surrounding ocean, creating higher sea surface velocities [3].
- The long term impact of the change in salinity may not have settled.
- Deep ocean currents may have had a different result than sea surface currents.





# Limitations and Weaknesses

- Time Scale
  - Salinity data only went up to 2018
- Geographic Analysis
  - Small area of ocean analyzed
- Only Sea Surface Currents
  - Deep sea currents could have different trend



# Future Research

- Track more long-term
  - a lot of trends we could be seeing could be because of short-term effects are different than long-term
- Look more wide scale
  - We focused solely on the area around Greenland, but seeing the whole ocean could give a bigger picture as to what is happening
- Look at deep water current
  - Our analysis was only on sea surface velocities



# Work Cited

[1] Associated Press, “‘Devastating’ melt of Greenland and Antarctic ice sheets is found,” NBC News.  
<https://www.nbcnews.com/science/environment/devastating-melt-greenland-antarctic-ice-sheets-found-rcna80616>

[2] R. van W. US Henk A. Dijkstra, Michael Kliphuis, The Conversation, “If the Atlantic Ocean Loses Circulation, What Happens Next?,” Scientific American. <https://www.scientificamerican.com/article/if-the-atlantic-ocean-loses-circulation-what-happens-next/>

[3] C. H. News, “Greenland Is Disappearing Quickly, and Scientists Have Found a New Reason Why,” Scientific American, Oct. 13, 2022.  
<https://www.scientificamerican.com/article/greenland-is-disappearing-quickly-and-scientists-have-found-a-new-reason-why/>

## Data Sets:

[1] US EPA, “Climate Change Indicators: Ice Sheets,” [www.epa.gov](http://www.epa.gov), Mar. 18, 2021.  
<https://www.epa.gov/climate-indicators/climate-change-indicators-ice-sheets>

[2] “Roemmich-Gilson Argo Climatology,” Ucsd.edu, 2019. [https://sio-argo.ucsd.edu/RG\\_Climatology.html](https://sio-argo.ucsd.edu/RG_Climatology.html) (accessed Apr. 24, 2025).

[3] “Global Total (COPERNICUS-GLOBCURRENT), Ekman and Geostrophic currents at the Surface and 15m,” Copernicus.eu, 2025, doi:  
<https://doi.org/10.48670/mds-00327>.