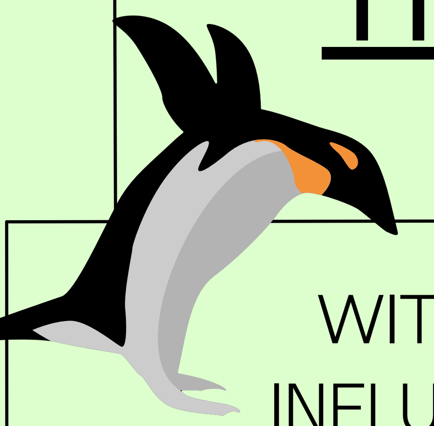
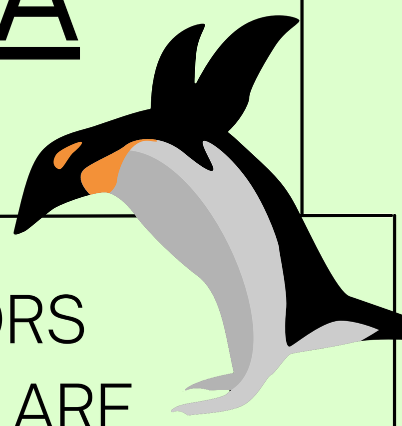


THE SEA ICE AREA ANOMALIES OF ANTARCTICA



WITH THE ADVENT OF CLIMATE CHANGE AND GLOBAL WARMING, ANALYZING CLIMATE FACTORS INFLUENCING THE CONTINENT WITH 90% OF THE WORLD'S ICE AND ITS SURROUNDING OCEANS ARE CRUCIAL TO UNDERSTANDING CLIMATE FEEDBACKS THAT MAY INFLUENCE GLOBAL SEA LEVEL RISE.

AUTHOR

SWARAAG S.

INVESTIGATED LOCATIONS

Eastern Weddell Sea

East Antarctic Coast

Bellingshausen Sea

AFFILIATIONS

LAKESIDE SCHOOL

METHODS

1. After being given data collected by the NOAA and sent to us from Susan Howard, I plotted the **average sea ice area** for all three locations as a function of time. All work was completed in Python
2. I noticed a huge **decrease** in average sea ice area around 2016
3. I removed the seasonal cycle and made an anomaly time series for **average sea ice area, sea surface temperature, air temperature, and sea level pressure**
4. I created a **running mean** for each of these plots to smooth the data (see **Figure 1**)
5. I examined correlations between sea ice anomalies and the anomalies of each other dataset (see **Figures 2-10**). This was completed for all three locations

OBJECTIVE

Our primary objective was to investigate three anomalous locations in Antarctica based on their sea ice area. All three locations witnessed a dip in sea ice area in the middle of the previous decade, and the task was to find out more.

Figure 1 (a) (b) (c)

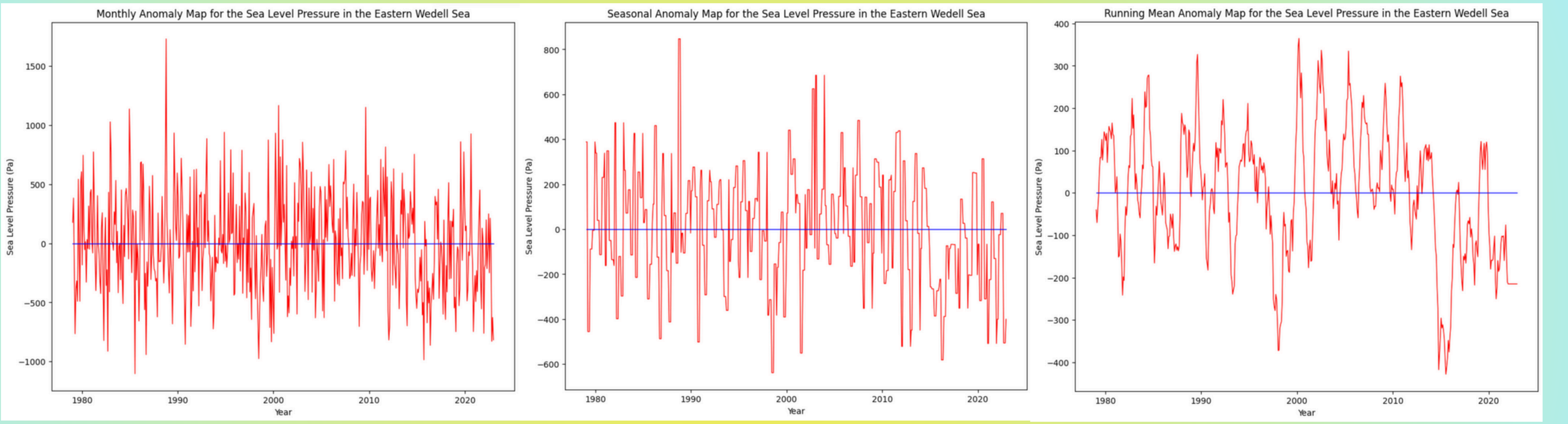


Fig 1. (a) is a monthly anomaly map for sea level pressure in the Eastern Weddell Sea. As you can see, the data is extremely noisy. To solve this, (b), a seasonal anomaly map for sea level pressure, was created. The graph is significantly clearer, but still noisy. So (c), 12-month running mean for the sea level pressure in the third graph, was the solution. The benefit of (c) over the other two is that only anomalies that persist over multiple months will make a difference in the 12-month mean and therefore a datapoint, removing the impact of anomalies that last only for a month. This is an illustration of data filtering.

Figure 2

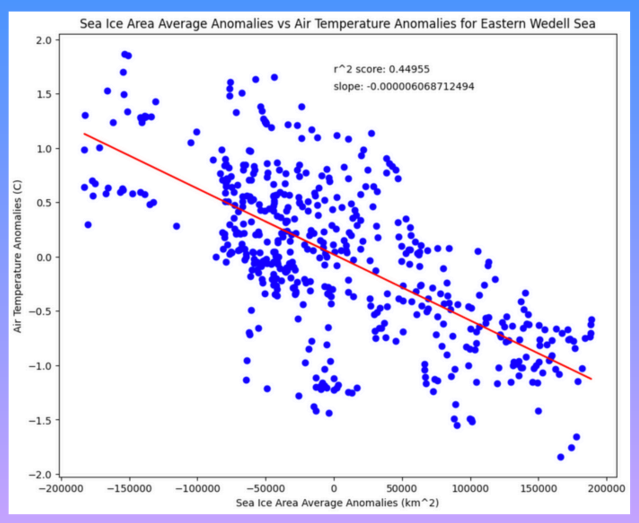


***Fig 2.** A negative correlation between the sea ice area average anomalies and air temperature anomalies for the Eastern Weddell Sea.*

Figure 3

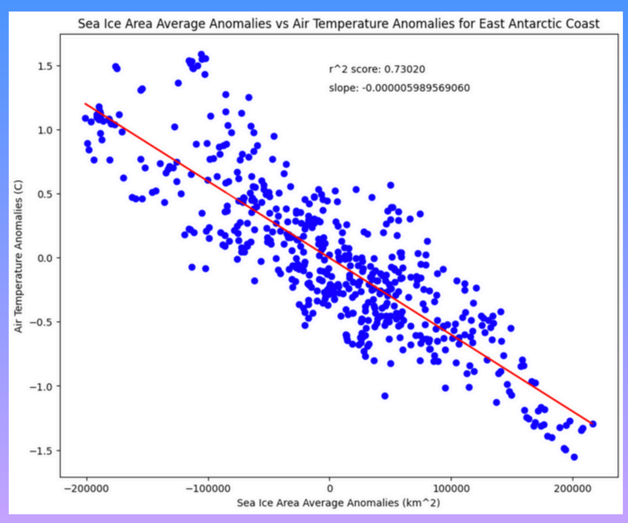


***Fig 3.** A negative correlation between the sea ice area average anomalies and air temperature anomalies for the East Antarctic Coast.*

Figure 4

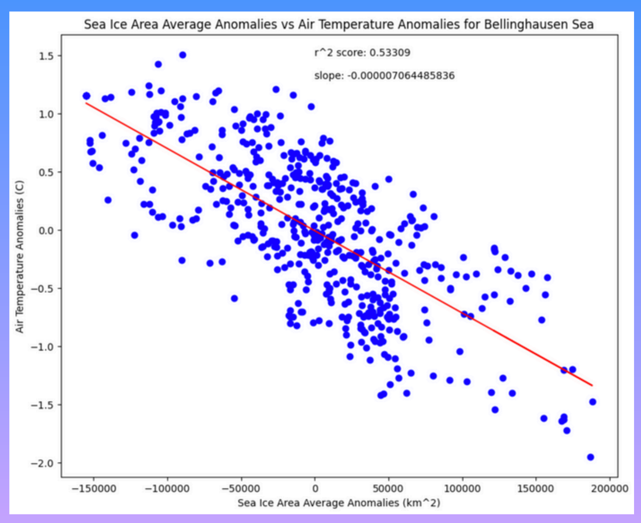


***Fig 4.** A negative correlation between the sea ice area average anomalies and air temperature anomalies for the Bellinghausen Sea.*

Figure 5

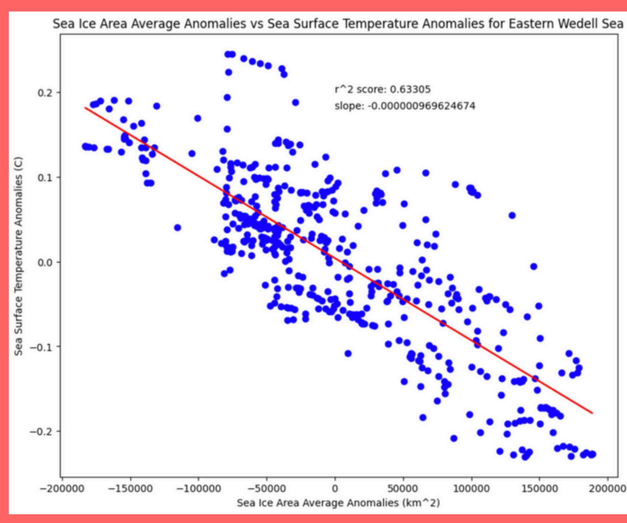


***Fig 5.** A negative correlation between the sea ice area average anomalies and the sea surface temperature anomalies for the Eastern Weddell Sea.*

Figure 6

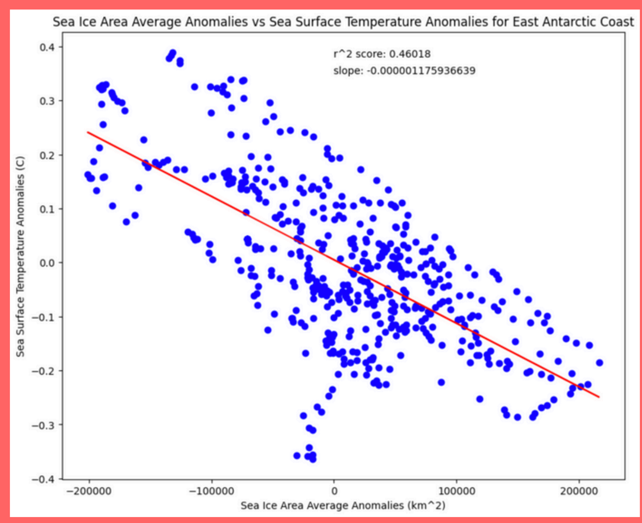


***Fig 6.** A negative correlation between the sea ice area average anomalies and the sea surface temperature anomalies for the East Antarctic Coast.*

Figure 7

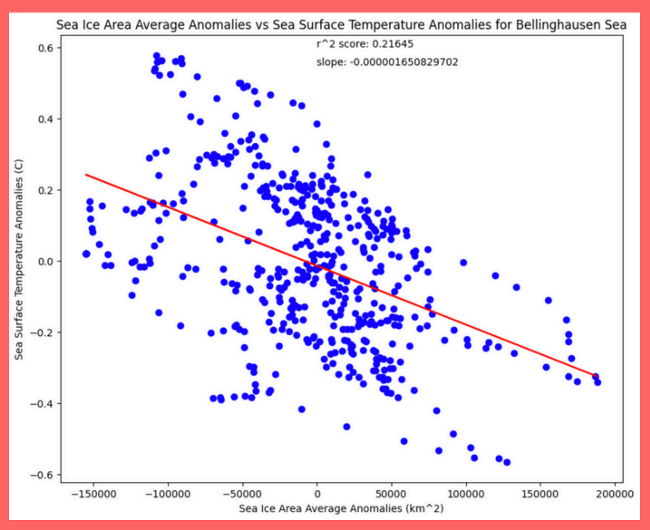


***Fig 7.** Little correlation between the sea surface temperature and the sea ice average anomalies for the East Antarctic Coast.*

Figure 8

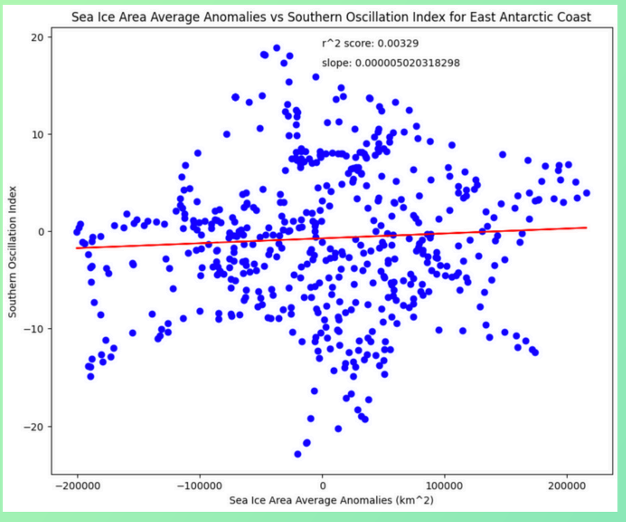


***Fig 8.** Little to no correlation between the Southern Oscillation Index and the sea ice average anomalies for the East Antarctic Coast.*

Figure 9

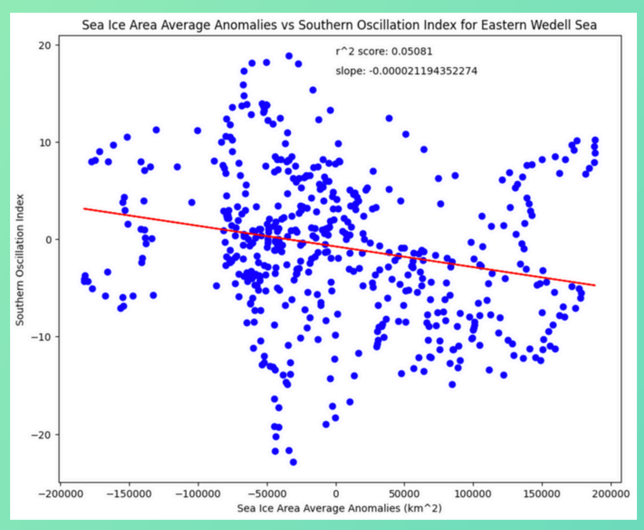


***Fig 9.** Little to no correlation between the Southern Oscillation Index and the sea ice average anomalies for the East Antarctic Coast.*

Figure 10

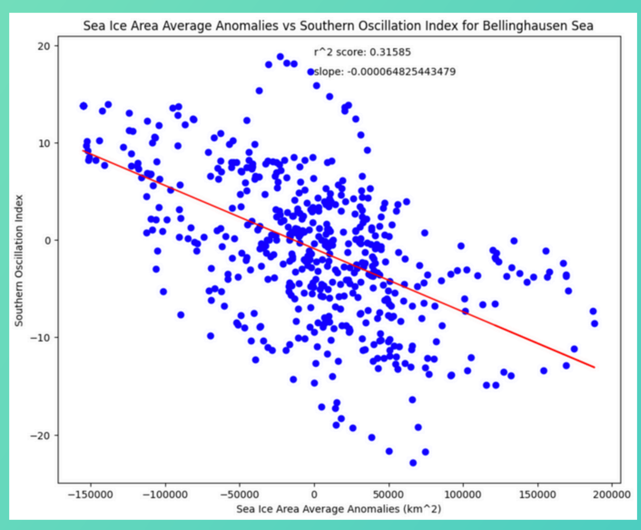


***Fig 9.** Little correlation between the Southern Oscillation Index and the sea ice average anomalies for the East Antarctic Coast.*

RESULTS

Of the three locations examined and of all the datasets provided:

- Air temperature anomalies correlate best with sea ice area average anomalies.
  - **Figures 2, 3, and 4** have r^2 scores of **~0.45, ~0.73, and ~0.53** respectively.
- Other strong correlations included the sea surface temperature anomalies on the sea ice area average anomalies for the Eastern Weddell Sea and the East Antarctic Coast
  - **Figures 5 and 6** have r^2 scores of **~0.63 and ~0.46** respectively.
  - In contrast, **Figure 7** has an r^2 score of **~0.22**, for the Bellingshausen Sea.
- The Southern Oscillation Index struggled to correlate with the sea ice area average anomalies well for two of the three locations, however, it had a substantial correlation with the sea ice area average:
  - **Figures 8 and 9** have an r^2 score of **~0.003 and ~0.05**.
- The Southern Oscillation Index could have a strong delayed correlation, where the index correlate with sea ice area averages months in the future because the effects of southern oscillation are delayed. This is a big area of interest for me in the future.

DISCUSSION

- The results from the graphs above are fascinating: **they tell us about the relationships between the anomalies of certain data in a given area and the anomalies of the sea ice area**. An especially strong correlation is seen between the anomalies of the air temperature of a location and its corresponding sea ice area average.
- One problem that arises from this data is that we don't know if a strong correlation is due to other impacting factors. One example is there could be other factors taking place between the anomaly correlation of sea surface temperature and sea ice area average, such as the fact that a lower sea surface temperature could be solely because **if more of a location is covered in sea ice, then the average temperature of that location's surface will naturally decrease.** This information, for example, would not help us.
- My next steps are (in no particular order):
  - Investigate a potential delayed or **offset southern oscillation index**
  - Investigate, for the data with high anomaly correlations with the sea ice area average, what caused an anomaly in that data that could be correlated with an anomaly in the sea ice area average.
  - **Investigate the impact of climate patterns**, such as ENSO and SAM on sea ice areas.

ACKNOWLEDGEMENTS

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