Title

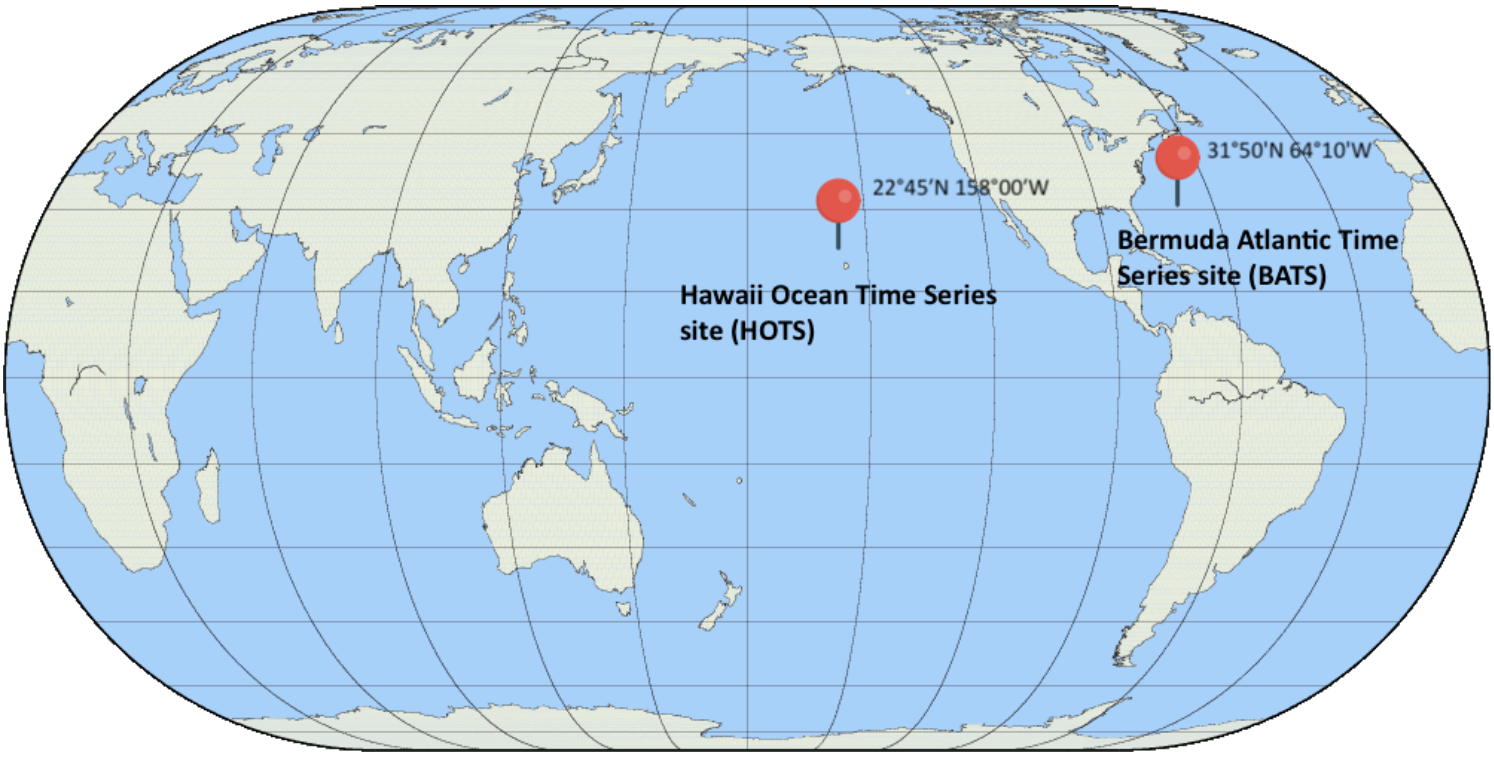
Correlation Analysis between the Annual Mean of Sea Surface Temperature from HOTS and BATS, Water pH level from HOTS and BATS and ENSO index from NOAA from 1989-2014.

Introduction/Abstract (250 words):

Our group analyzed various data found in Hawaii and Bermuda and related pH, sea surface temperature and ENSO data. We were trying to understand if there ENSO effects pH and temperature in the subtropical Pacific or subtropical Atlantic more and if so, which area. To answer this question, we first found credible sources in order to acquire the data. We used the Hawaii Ocean Time Series site (HOTS) and Bermuda Atlantic Time series site (BATS) and found similar pH and sea-surface temperature data. We imported the data into MATLAB which allowed us to analyze and graph the data. Pearson's correlation coefficient was used to measure the strength and direction of a linear association between the variables and the significance level of 0.05 was used to measure the statistical significance. Using the graphs, we were able to determine which variables had significant correlation. Our main finding was that the effect of ENSO was significantly higher in the subtropical Pacific compared to the effect in the subtropical Atlantic.

Map of the station locations

- HOTS: ALOHA (A Long-Term Oligotrophic Habitat Assessment); (22°45'N 158°00'W)
- BATS (Bermuda Atlantic Time Series); in the Sargasso Sea at (31°50'N 64°10'W)



Method

Correlation analysis was used to determine the strength of relationship between two quantitative variables:

1. Hawaii SST vs Hawaii ocean pH
2. Hawaii SST vs ENSO
3. Hawaii pH vs ENSO
4. Bermuda SST vs Bermuda ocean pH
5. Bermuda SST vs ENSO
6. Bermuda pH vs ENSO

Pearson's correlation coefficient was used to measure the strength and direction of a linear association between the variables.

We used the following guideline to interpret the coefficients

Strength of Association	Coefficient r
Negligible	0 ~ (+/-) 0.3
Weak	0.3 ~ (+/-) 0.5
Moderate	0.5 ~ (+/-) 0.7
Strong	0.7 ~ (+/-) 1.0

Variation around the line of best fit was determined through R-squared values

The significance level of 0.05 was used to measure the statistical significance

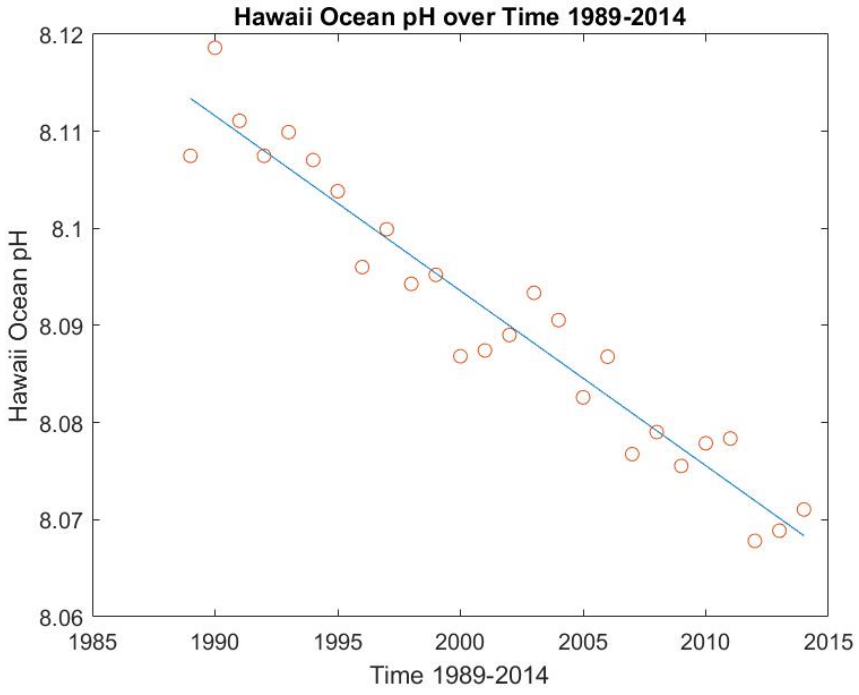


Figure 1. **Hawaii pH vs Time R-squared: 0.932, p-value = 1.5e-15**

Fig. 1. Mean ocean pH annual time series at Hawaii from 1989 to 2014. The data was collected at Station ALOHA and obtained from the Hawaii Ocean Time-series (HOT) website.
-> Statistically significant (p value < 0.05).
-> Decreasing ocean pH over time.

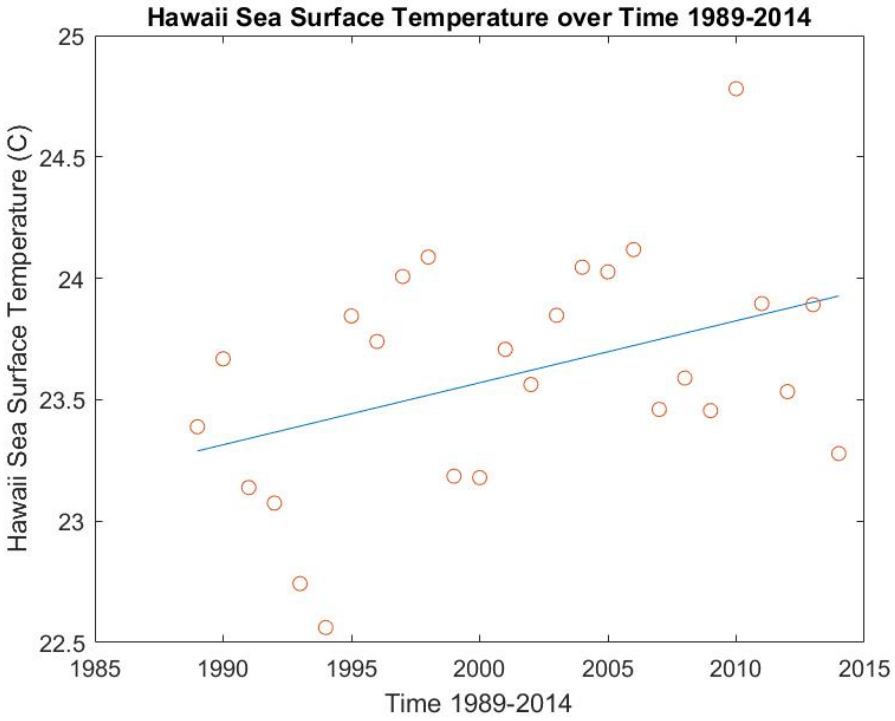


Figure 2. Hawaii SST vs Time R-squared: 0.17, p-value = 0.0366

Fig. 2. Mean Sea Surface Temperature (C) annual time series at Hawaii from 1989 to 2014. The data was obtained from the Environmental Research Division of National Oceanic and Atmospheric Administration (NOAA) website.
-> Statistically significant (p value < 0.05).
-> Increasing sea surface temperature over time.

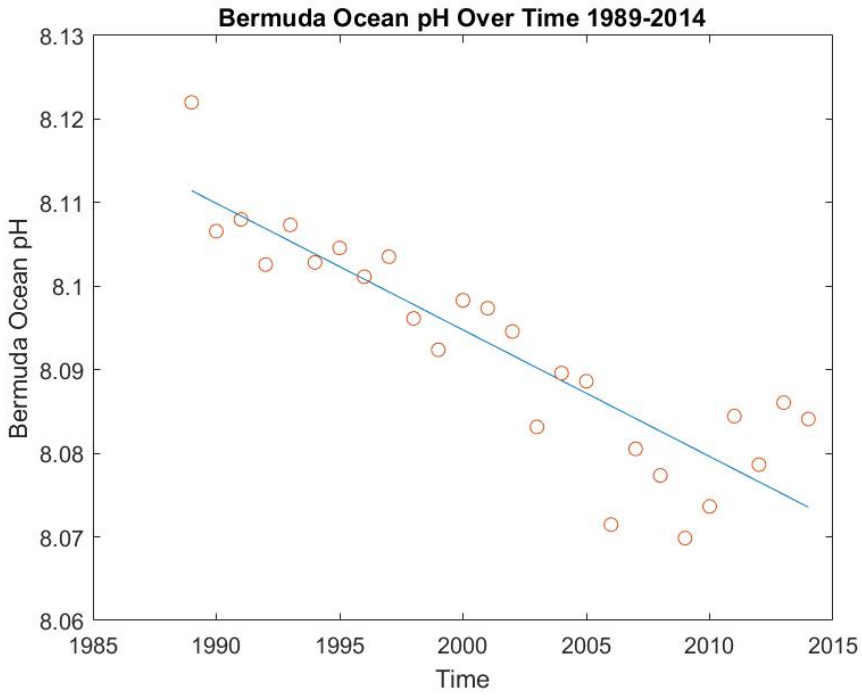


Figure 3. Bermuda pH vs Time R-squared: 0.778, p-value = 2.64e-09

Fig. 3. Mean ocean pH annual time series at Bermuda from 1989 to 2014. The data was obtained from the Bermuda Atlantic Time-series Study (BATS) website.

-> Statistically significant (p value < 0.05).
-> Decreasing ocean pH over time.

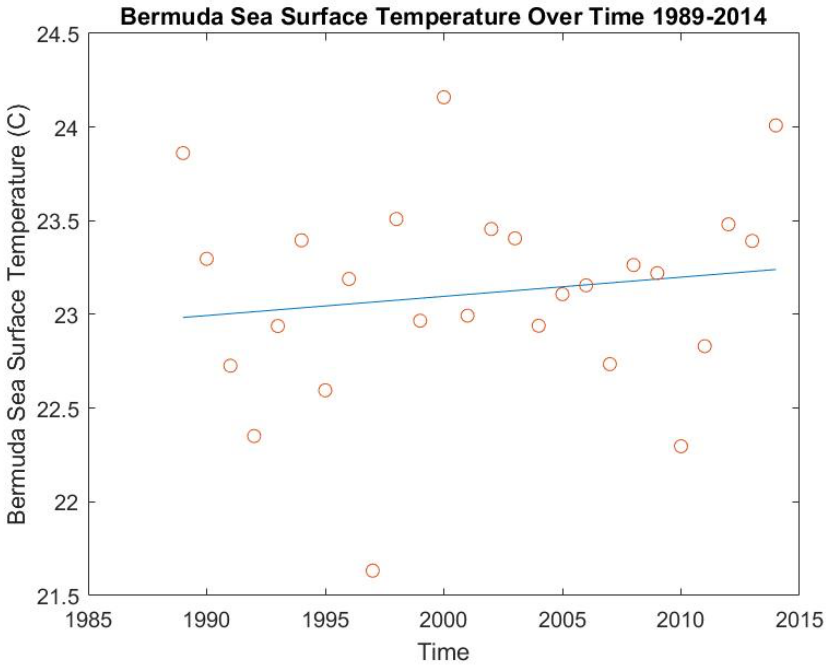


Figure 4. Bermuda SST vs Time R-squared: 0.0208, p-value = 0.482

Fig. 4. Mean Sea Surface Temperature (C) annual time series at Bermuda from 1989 to 2014. The data was measured at a depth of a few meters from Bermuda, St. Georges Island Station and was obtained from the Bermuda Atlantic Time-series Study (BATS) website.

-> Statistically insignificant (p value > 0.05).

-> Cannot conclude that the sea surface temperature at Bermuda increases or decreases over time.

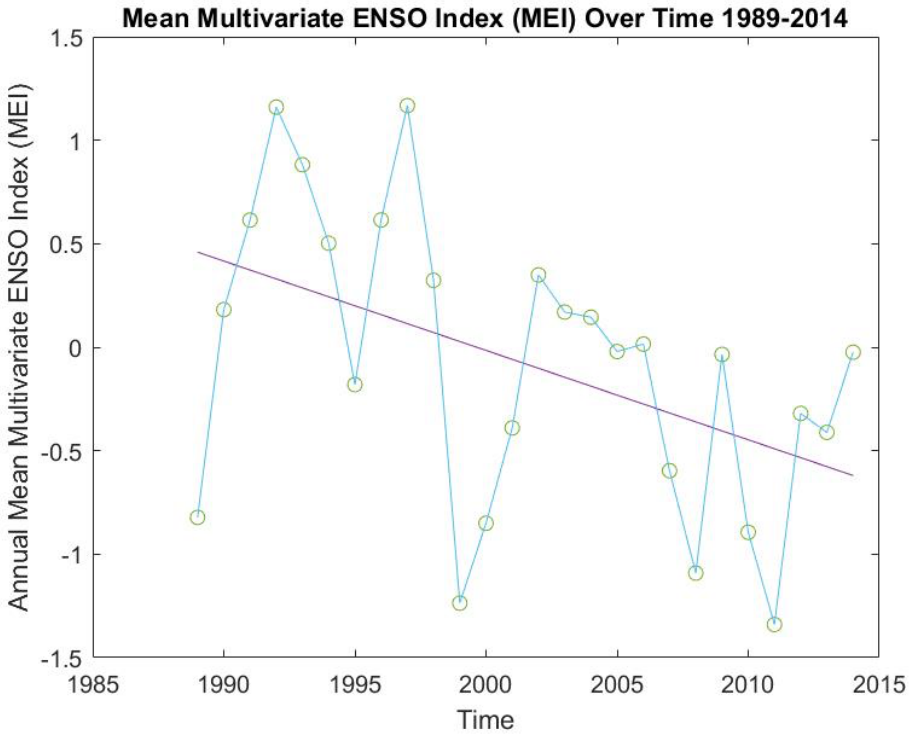


Figure 5. ENSO vs Time R-squared: 0.224, p-value = 0.0146

Fig. 5. Mean Multivariate ENSO Index (MEI) annual time series from 1989 to 2014. The data was obtained from the National Oceanic and Atmospheric Administration (NOAA) website.

-> Statistically significant (p value > 0.05).

-> ENSO pointing toward El Nino

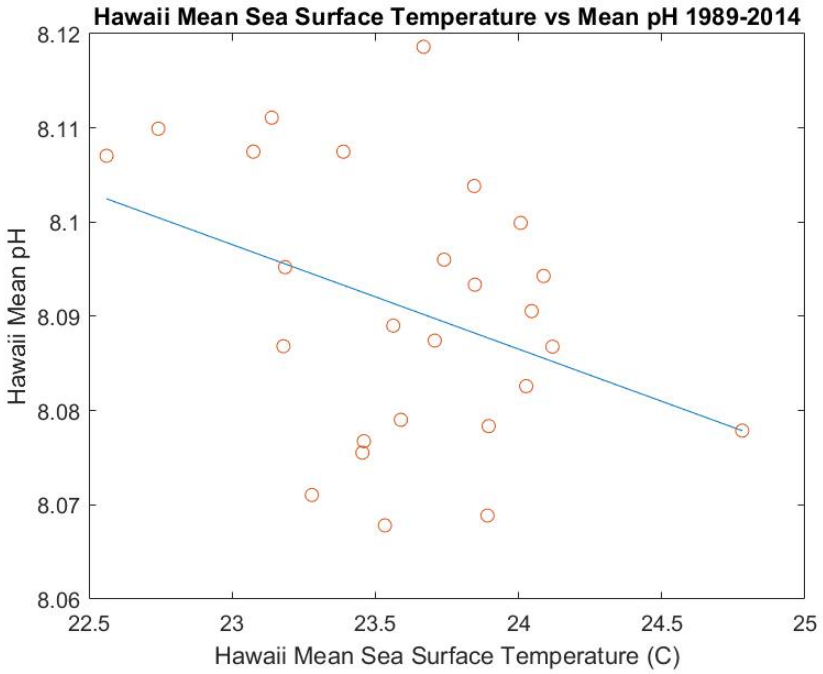


Figure 6. Hawaii Mean Sea Surface Temperature vs Hawaii Mean Surface Ocean pH.

-R-squared: 0.136, p-value = 0.064

-Statistically insignificant p-value > 0.05

-Cannot conclude that there is a statistically significant correlation between the two variables

-Weak negative correlation (r value = between +/-0.3 ~ +/-0.5) based on the Pearson's correlation coefficient measuring the strength of a linear association

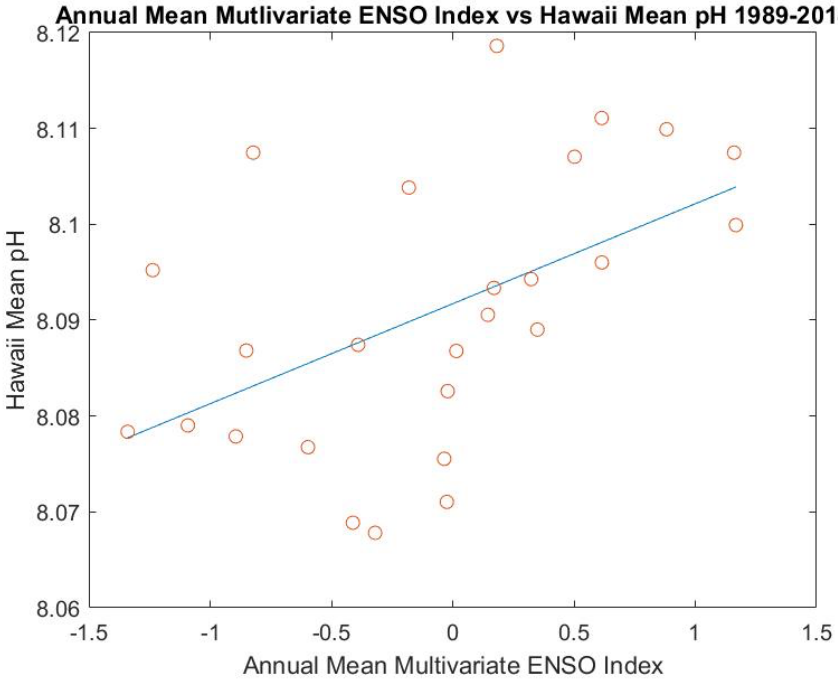


Figure 7. Annual mean MEI vs Hawaii Mean Surface Ocean pH.

R-squared: 0.26, p-value = 0.0078

-Statistically significant p-value < 0.05

-There is a statistically significant correlation between the two variables

-Moderate positive correlation (r = between 0.5-0.7) based on the Pearson's correlation coefficient

Hawaii Temp vs MEI

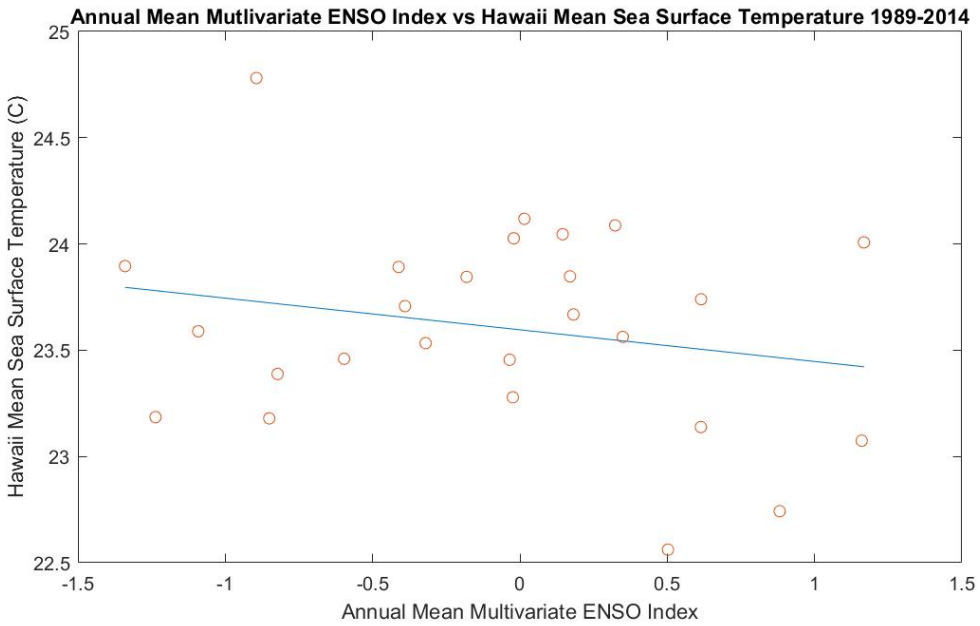


Figure 8. Annual mean MEI vs Hawaii Mean Sea Surface Temperature .

-R-squared: 0.0481, p-value = 0.282

-Statistically insignificant p-value > 0.05

-Cannot conclude that there is a statistically significant correlation between the two variables

-Negligible correlation (r = between 0 ~ +/-0.3) , based on the Pearson's correlation coefficient measuring the strength of a linear association

Bermuda Temp vs pH

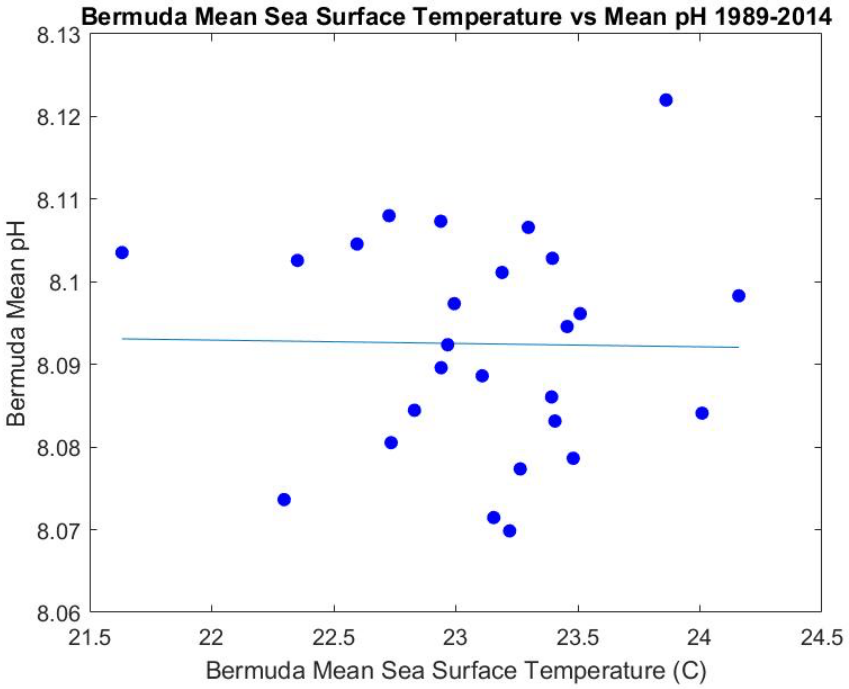


Figure 9. Bermuda Mean Sea Surface Temperature vs Bermuda Mean Ocean pH .

-R-squared: 0.000281, p-value = 0.935

-Statistically insignificant p-value > 0.05

-Cannot conclude that there is a statistically significant correlation between the two variables

-Negligible correlation (r value < +/-0.3), based on the Pearson's correlation coefficient measuring the strength of a linear association

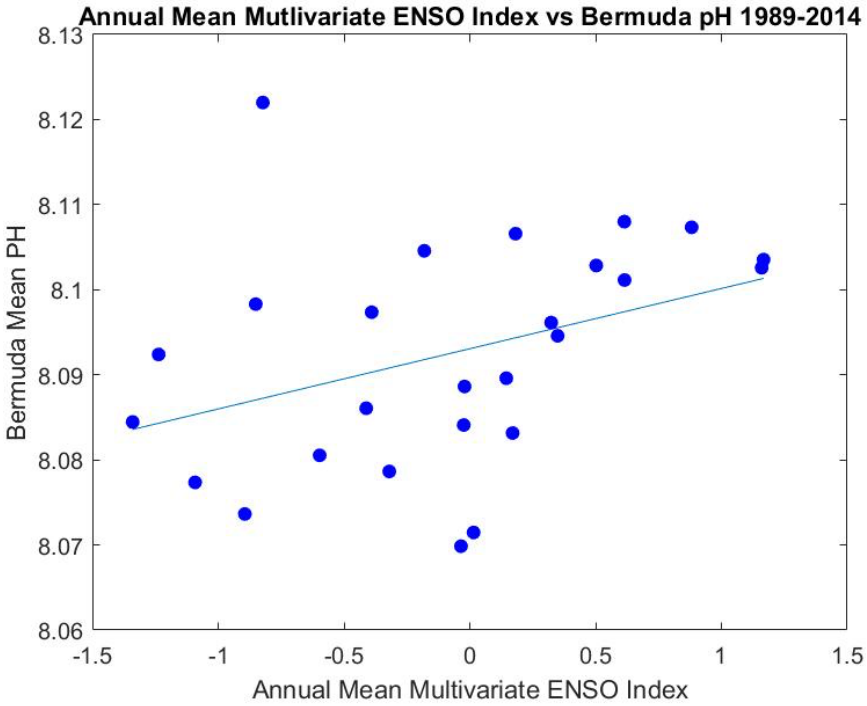


Figure 10. Annual mean MEI vs Bermuda Mean Surface Ocean pH.

R-squared: 0.141, p-value = 0.0585

-Statistically insignificant p-value > 0.05

-Cannot conclude that there is a statistically significant correlation between the two variables

-Weak positive correlation (0.3 < r < 5) based on the Pearson's correlation coefficient

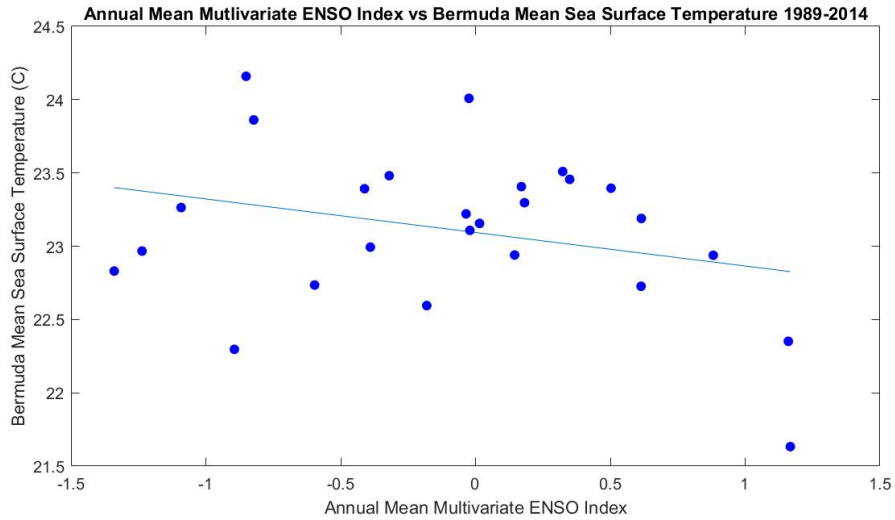


Figure 10. Annual mean MEI vs Hawaii Mean Surface Ocean pH.

R-squared: 0.0865, , p-value = 0.145

-Statistically insignificant p-value > 0.05

-Cannot conclude that there is a statistically significant correlation between the two variables

-Negligible correlation (r value < +/-0.3), based on the Pearson's correlation coefficient measuring the strength of a linear association

- Map of the station

Conclusion:

We found significant results on several of our graphs which allowed us to conclusively answer our research question. We found that the subtropical pacific was significantly more impacted by ENSO than the subtropical Atalantic.