

The Analysis of a Bermuda Time Series

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with Dr. Langston

Abstract

The temperature, salinity, and density of the Atlantic Ocean off of the Bermuda coast will be analyzed to conclude trends and deviations about these parameters with data collected by CTD in May 2019.

After understanding the trends of these three parameters, more datasets will be introduced from additional years of a 15-year difference to conclude how temperature and salinity have changed over time.

Introduction

The study of oceanography examines the ocean properties over time

- The ocean has many benefits including providing oxygen, regulating climate and weather, and advantages in transportation
- Oceanographic or hydrographic stations collect and analyze data in vertical profiles (graphs with depth on the y-axis with sea level at the top of the axis)
- Tracking how the ocean behaves and changes allows scientists to make predictions about the currents, weather patterns, acidity levels, and more

Three main parameters will be examined in this study:

- **Temperature** is a measurement of the heat energy contained within the water.
- **Salinity** is a measure of the salt content, mostly NaCl, in the water.
- **Density** measures the mass per unit volume of water and is affected by both temperature and salinity.

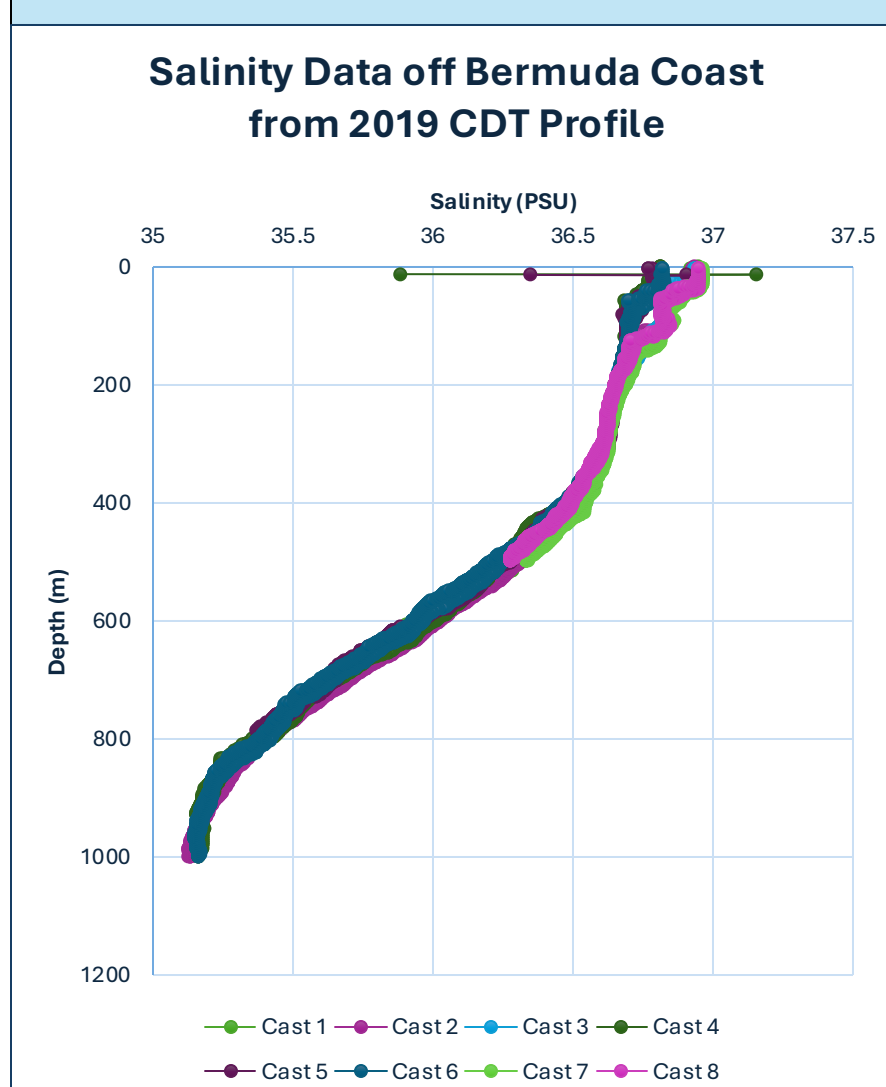
The Biological & Chemical Oceanography Data Management Office (BCO-DMO) works to make large data sets about the world's oceans discoverable and web accessible. Data and project parameters from independent research groups are preserved through BCO-DMO for ease of access and analysis. All datasets for this study were accessed through the BCO-DMO website.

Methods

For the first part of this study, a dataset from the study *Diel physiological rhythms in a tropical oceanic copepod* with principal investigator Dr. Amy Maas.

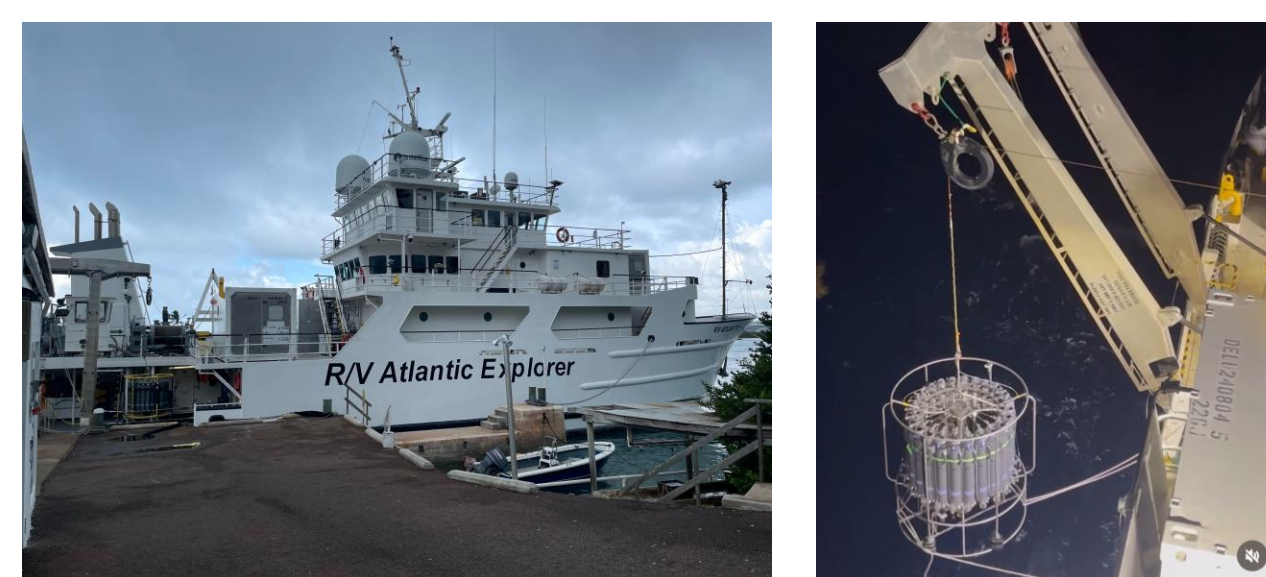
- Deployment AE1910 on R/V Atlantic Explorer 05/20/19

Figure 2. Vertical Profile of Raw Data for all 8 Casts



- Data collected from CTD (Conductivity Temperature Density) instrument
- The Datafile:
 - 8 casts of inconsistent depths
 - Creates a messy plot of raw data from file
- To Clean up Graph:
 - Remove Incomplete Casts
 - Average every 10 m of Data

Figure 1. R/V Atlantic Explorer and CTD



Acknowledgements

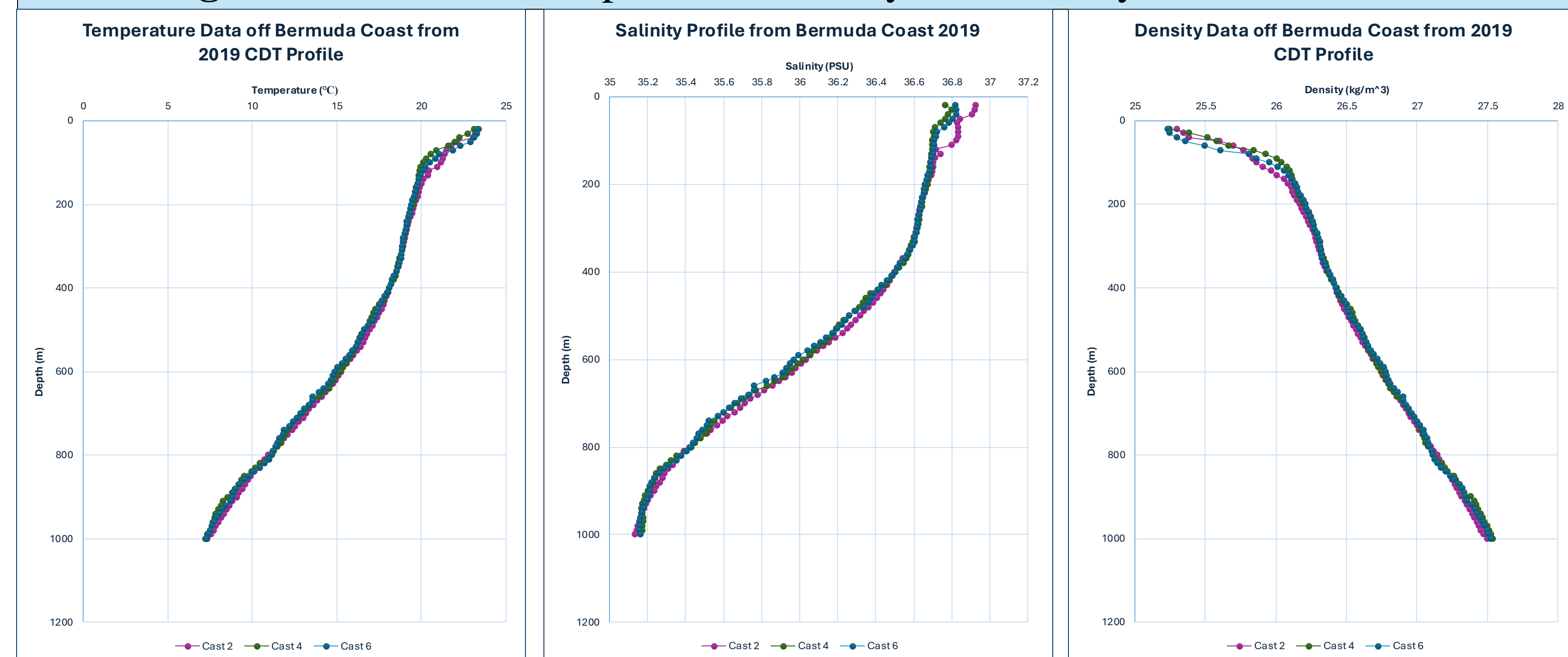
Thank you Dr. Langston and BIOS

References

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Muratore, D., Wilhelm, S. W., Sullivan, M., Weltz, J. (2022) Processed CTD data with thermodynamic calculations from RV Atlantic Explorer cruise AE2207 to the Bermuda Atlantic Time Series (BATS) station in April 2022. Biological and Chemical Oceanography Data Management Office (BCO-DMO), (Version 1) Version Date 2022-07-21. doi:10.26008/1912/bco-dmo.877100.1 [18 September 2024].

Results

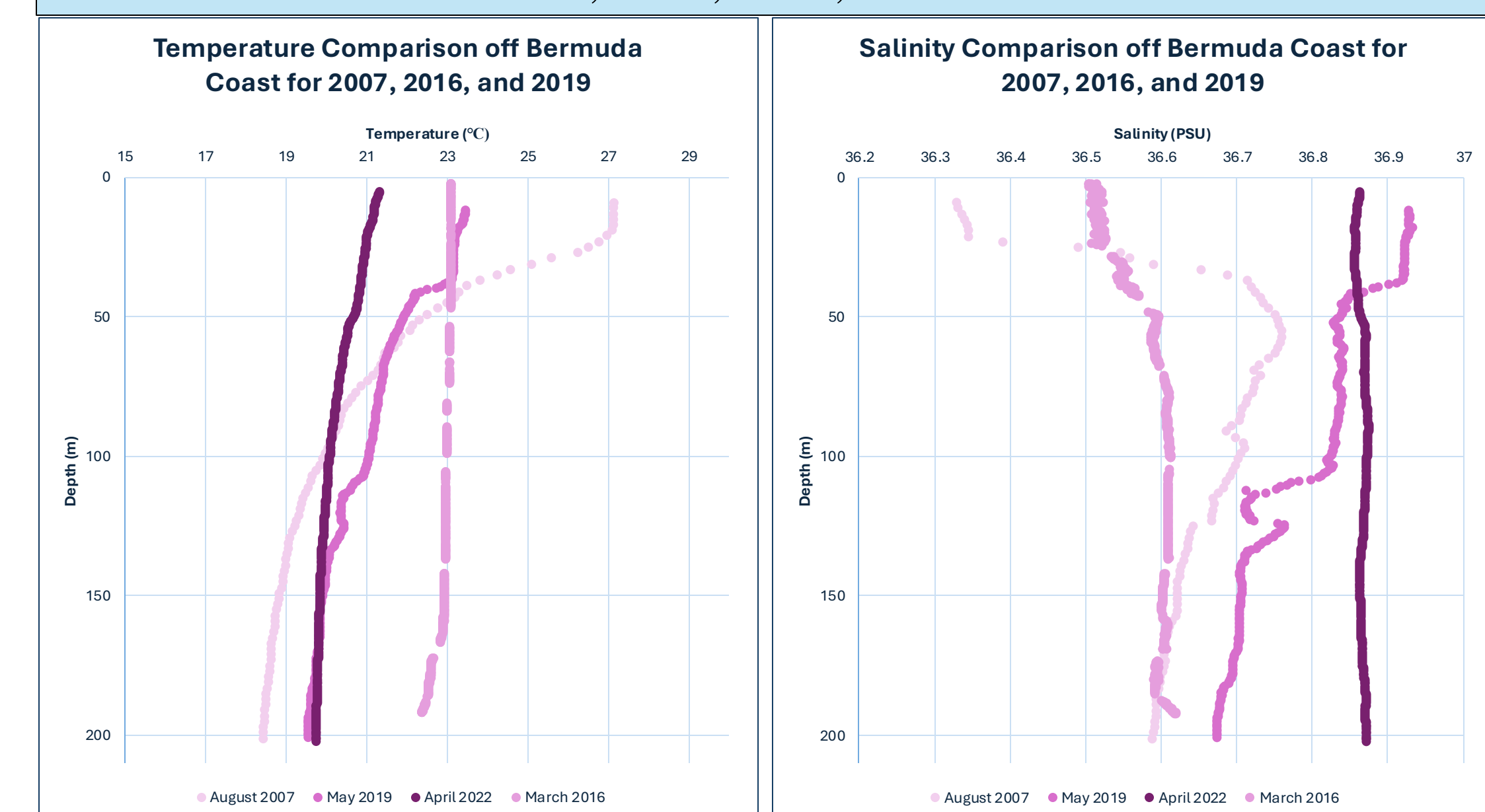
Figure 3. Corrected Temperature, Salinity, and Density Vertical Profiles



- As temperature decreases with depth, salinity also decreases with depth. There is a linear relationship between these parameters.
- As salinity and temperature decrease, density increases. There is an inverse relationship between these parameters.

The additional datasets for the second part of this study were taken from three more deployments; deployment AE2207 with Dr. Steven Wilhelm 04/22/2022, deployment EN575 with Dr. Brice Loose 03/03/2016, deployment with GF226_BATS Dr. Rodney Johnson 08/11/2007

Figure 4. Temperature and Salinity Vertical Profiles with Data from 2007, 2016, 2019, and 2022



- Based on the previously established relationships, it is expected that the year with the highest surface temperature (August 2007) would have the highest surface salinity
- The data shows August 2007 has the lowest surface salinity
- The highest surface salinity value is from May 2019

Conclusion

- The result from the vertical profiles comparing different years suggests that salinity is increasing over time
 - The hottest month (August) should have the highest surface salinity values, however, it had the lowest. This data was from the earliest year (2007), showing the ocean was not as salty then
- This is a universal finding with studies published by NASA and the AGU showing the same trend
 - Curating a study with data from multiple scientists and deployments shows an unbiased trend of salinity increasing over time
- The rise of ocean temperatures, and therefore the increase in surface salinity, caused by the emission of greenhouse gasses is a direct effect of climate change
 - Thermoclines, or rapid changes in temperature over a short depth, in the ocean caused by this phenomenon prevent vertical mixing and harm aquatic life