Climate Variability and Its Impact on Primary Productivity in U.S. West Coast Ecosystems

Amelia Lorenzo
Jennifer Kovacs
Agnes Scott College, Decatur, Georgia 30030

INTRODUCTION

- Primary productivity forms the foundation of all food webs and ecosystems, and autotrophic success reflects ecosystem health. However, rapid and dramatic changes in meteorological conditions due to climate change can disrupt the seasonal cycles of plants or reduce growth rates.
- National Ecological Observatory Network (NEON) monitors a wide range of variables (climate, soil, vegetation, microbes, wildlife). It uses standardized protocols, enabling comparisons across time and space, and vegetation structure data is gathered from permanent plots which makes it ideal for studying perennial plants.
- Perennial plants play a vital role in forest ecosystems by stabilizing soil, supporting biodiversity, and contributing to carbon cycling.
- The predicted correlation is that locations experiencing frequent meteorological changes uncharacteristic to the region will display a reduction in primary productivity success, specifically reduced size and density of plant species. Particularly, a higher soil temperature decreasing overall plant productivity and higher rates of precipitation increasing plant productivity.

METHODS

This study utilizes public ecological datasets available on the National Ecological Observatory Network (NEON), specifically plant productivity data on non-herbaceous perennial vegetation and meteorological data on average annual precipitation and soil temperature from approximately the past eight years (2016-2024). The data was then narrowed to shrub groups and non-woody perennial vegetation in two sites, one in California and one in Washington, selected based on regional data availability, aiming to identify a correlation between changes in plant size and weather conditions.

Datasets Used:

- DP1.10098.001 – Non-perennial vegetation (percent cover, species identity). Measurements collected approximately every month.
- DP1.00006.001 – Soil temperature, collected via automated sensors. Measurements collected every 30 minuted averaged into a yearly mean.
- DP1.00003.001 – Precipitation, recorded from weather stations at NEON sites. Measurements collected every 30 minuted averaged into a yearly mean.

R Packages Used:

- neonUtilities - Inputs data from NEON into R
- dplyr - Assisted in data frame manipulation
- ggplot2 - Created graphs
- tidyr - Assisted in cleaning and merging datasets

RESULTS

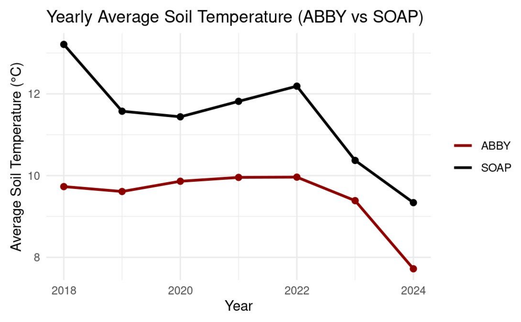


Figure 1.
Average soil temperatures in SOAP (California) and ABBY (Washington) sites.

Figure 2.
Average total precipitation in SOAP and ABBY sites across the measured time.

Figure 3.

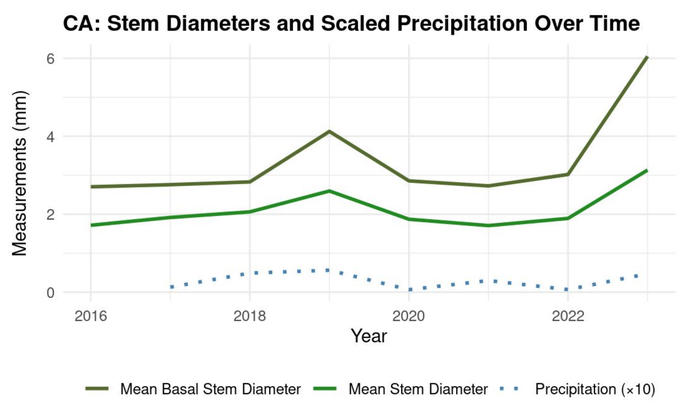
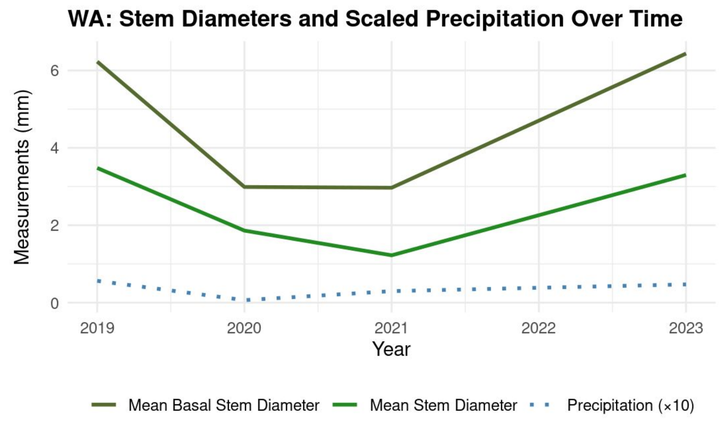
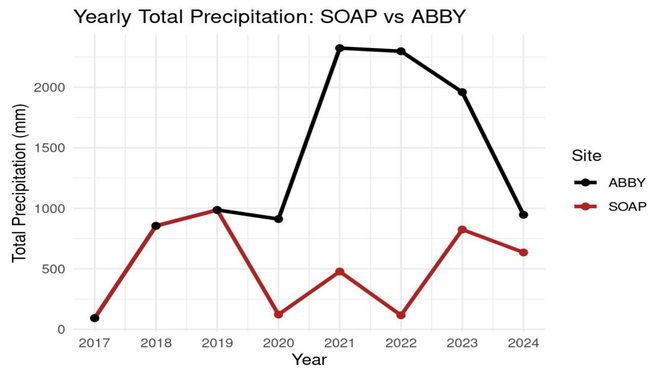


Figure 4.





DISCUSSION

- The model between ABBY site precipitation and stem diameter produced a P-value of 0.102, so it is not statistically significant, but there is a positive relationship.
- The model between ABBY site soil temp mean and stem diameter has p value of 0.259 (The model suggests a negative relationship between soil temperature and mean stem diameter, meaning that as soil temperature increases, mean stem diameter tends to decrease.). One tail P-value is 0.129 so it is not significant that the temperature being higher causes stem diameters to decrease.
- The model between SOAP site precipitation and stem diameter produced a P-value of 0.2337, so it is not statistically significant.
- The model between soap site soil temp and stem diameter produced a P-value of 0.09472, so it is not statistically significant.
- Overall, there was no significant statistical correlation between climate alterations and stem diameter. However, there are positive relationships between the variables across the sites.

Figure 5.

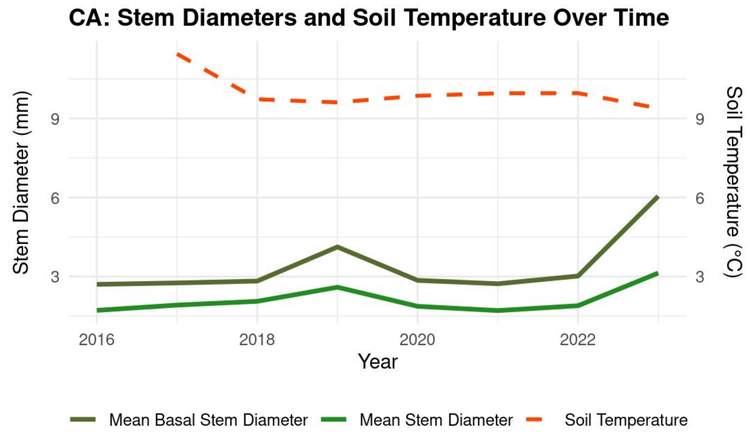


Figure 6.