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Climate Change Project Result

**Introduction:**

In this project, we aim to identify trends within a dataset queried from ERA5 which contains over 80 years of daily ocean data, including sea surface temperature (SST), wave height, and wind speed. Through exploratory data analysis, we observed that sea surface temperatures in the South Pacific Ocean have been rising in recent years. The goal of this project is to model SST data and project future values. We will also look at how SST varies through the year by analyzing seasonal and monthly averages.

**Analysis:**

To start, we will identify and isolate the long-term warming trend in SST using a moving average. We first extracted the SST values and then used a 1-D uniform filter to calculate a one year moving average of SST. This process reduces the amount of noise, smoothing out short term fluctuations and showing the long term trend. In Figure 1, the results show a general increasing trend in warmer SST, particularly over the last 50 years of the time series.

After extracting our trend, we want to forecast it two decades into the future using predictive modeling. We split our dataset so that 80% was used for training and 20% for testing. We will use the one year moving average of SST to predict future SST values using a lag of one year. The model was trained using lagged autoregression, learning from past SST trends to predict future values. Once trained, the model's performance was evaluated using the test data, which gives us a mean absolute error of 0.56 and a root mean squared error of 0.66. To generate the forecast, the time series was extended by 20 years beyond the last date in our data frame. Figure 2 shows the predicted SST trend over the next two decades, showing that our model predicts an increase in SST as the years progress.

Figure 1:

A graph showing the time line

Description automatically generated with medium confidence

Figure 2:  
A graph showing the average of the stock market

Description automatically generated

**Additional Step:**

For the additional step, we’ll be analyzing average SST throughout the year. In Figure 3, we plot the average SST for each of the four seasons using a log scale, which allows us to better see the range of data values. The winter season seems to have the warmest SST of all the seasons. This makes sense since the South Pacific Ocean is in the Southern Hemisphere, where they experience their summer during the winter months.

To further drill down, Figure 4 looks at the individual months. This analysis provides insights into the patterns of SST changes throughout the year. The month with the warmest average SST is February. We see a gradual decrease from March to August. We also observe many outliers in the months of January, February, November, and December.

Figure 3:

A graph of different seasons

Description automatically generated

Figure 4:

A graph of a graph with blue and black squares

Description automatically generated with medium confidence

**Conclusion:**

Our analysis and modeling of SST data in the South Pacific Ocean shows a continued upward trend in the future years. By using a one year moving average to smooth the past data and using regression for prediction, we have made a model that projects future SST. Seeing the model’s prediction along with actual values, it suggest that SST in the South Pacific Ocean will continue to rise, which aligns with general patterns of global climate change. We also looked at seasonal and monthly SST averages and found that the winter months have the warmest SST values, with February being the warmest month.