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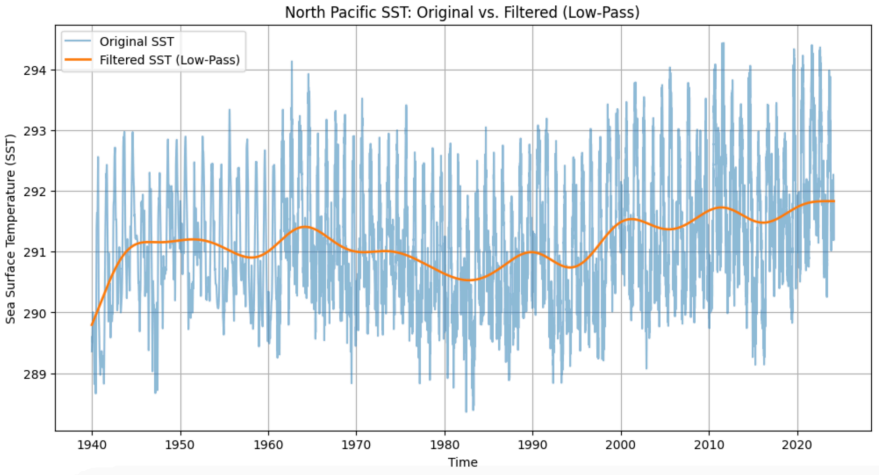
Climate Project

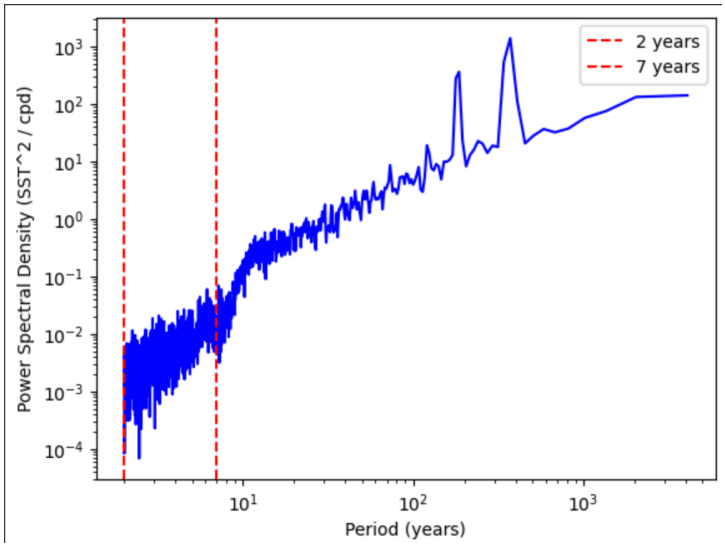
The Data: My goal was to analyze ENSO trends and predict when the next will occur using sea surface temperature (SST) data from the northern and southern Pacific Ocean.

The Question: I will analyze the Pacific basins with an emphasis on sea surface tempurature to identify and predict ENSO events. El Nino can be charactarized as a warming of the ocean, while La Nina is the cooling of the pacific ocean. They each occur every 2-7 years and span about 9-12 months. Let's see if we can identify these trends using tempurature data and predict when they will next occur.

Identifying The Trend: I started by plotting a time series of the temperature data and running a low pass filter using butter:

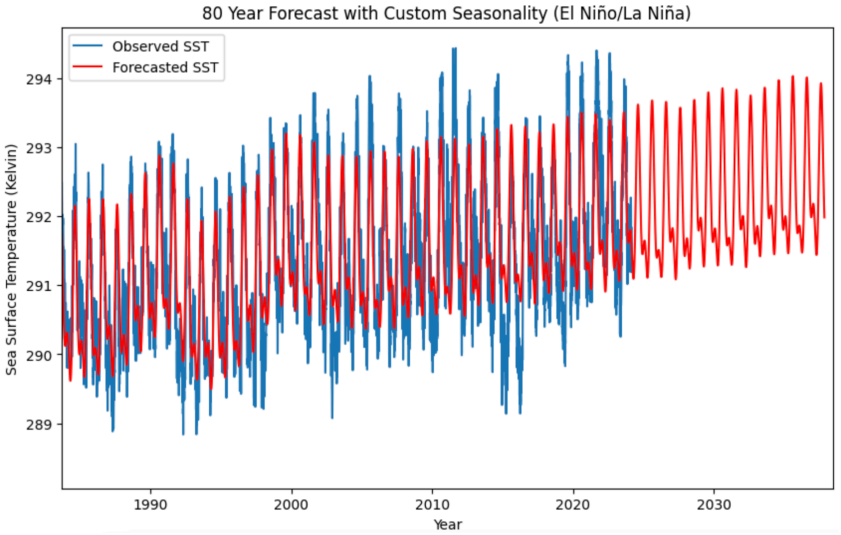


I found that these patterns of 2-7 years (average ENSO occurrence) do seem to exist in looking at the fluctuations. I then wanted to examine these patterns further utilizing spectral analysis.



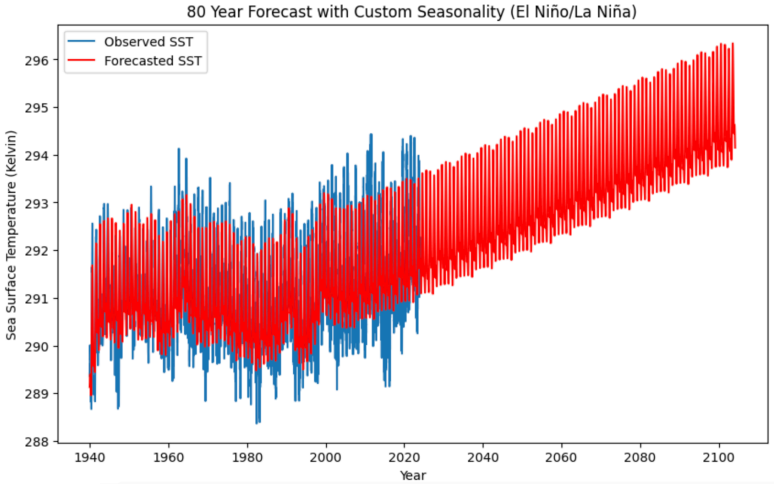
This revealed that there are a lot of repetitive cycles occurring in that 2-7 range as well, outlined by the 2 barriers. There's more noise in that area than other periods.

Forecasting: Having identified ENSO in the data, I wanted to examine how well it could be predicted by using a standard lag regression — it came out to have a 0.15 mean absolute error. A fairly small magnitude of error. Knowing that I then I used prophet with a seasonality component of 5 years to predict future values and find ENSO patterns:



As captured by the model, It's seen that the next el nino (warmer waters) is already occuring and likely done soon, and the next la nina (cooler waters) will be around 2026-2027.

Extra Step: We've looked at how tempurature has changed through a multitude of fluctuations and patterns. Let's now forecast what the tempurature will be 80 years into the future to examine the effects of a larger trend: global warming.



I found that we can expect a roughly 5 degrees (Fahrenheit) increase in sea surface temperature 80 years from now.