Analysis of ENSO in Niño 3.4 Region

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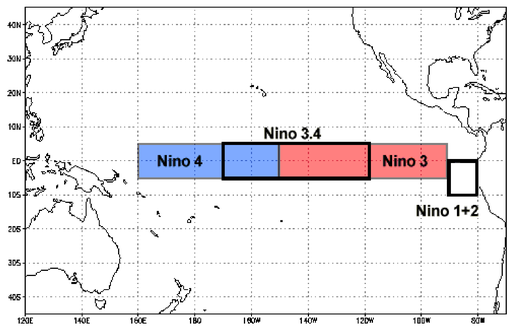
Introduction

ENSO is a climate phenomenon that occurs in the east-central region of the Pacific Ocean. It occurs in three phases – El Niño, La Niña, and Neutral. This phenomenon has a significant effect on weather patterns across the United States. Understanding how ENSO is related to daily and weekly weather patterns is the primary focus of this study.

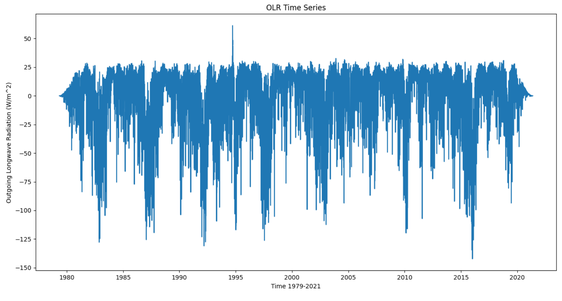
NOA Niño 3.4 time series (1978 - 2020) is the data source used in this analysis of ENSO processes. This data is measured in outgoing longwave radiation in watts per meters squared and corresponds to the heat radiated away from the surface of the Pacific ocean. Larger scale behavior corresponding to El Niño, La Niña, and Neutral are analyzed and compared with smaller frequency behavior.

Figure 1: Map of the Nino 3.4 Region



source ttps://www.ncdc.noaa.gov/monitoring-content/teleconnections/nino-regions.gif

Figure 2: OLR Time Series from 1979-2021 (W/m^2)

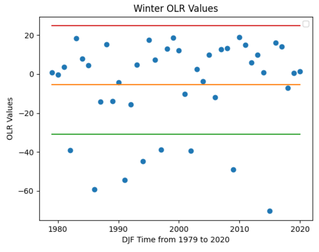


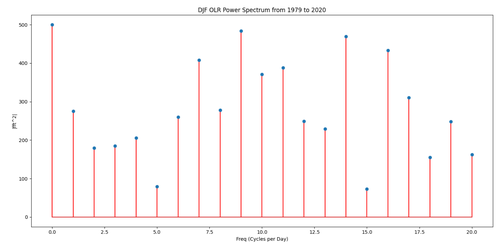
Methods

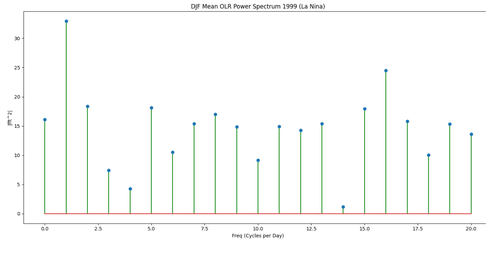
- Outgoing Longwave Radiation of Niño 3.4 (East-Central Pacific Ocean) was downloaded from NOAA
- Time series is filtered to December, February, and January (DFJ) 1979 to 2021.During the summer ENSO activity shifts north outside of the Niño 3.4 region
- DFJ time series chunks are converted into frequency and amplitude, and power spectrum
- The variance and standard deviation of the DFJ Power Spectrum are quantified
- One standard deviation from the mean represents the anomalies in the power spectrum data, which represent El Niño and La Niña respectively
- El Niño and La Niña DJF OLR values are then compared to the daily and weekly OLR

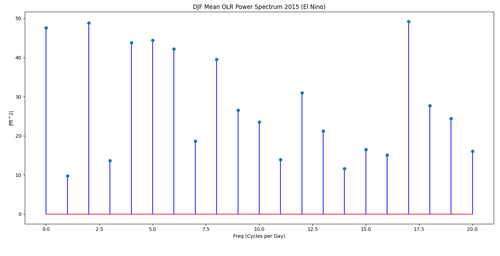
Results

- DJF OLR mean : -5.81 and DJF OLR standard deviation: -31.43
- Below are the mean OLR values from 1979 to 2020 in W/m^2, the mean power spectrum values in DJF from 1979 to 2020, DJF power spectrum values from 2015 (an El Niño Year), and DJF 1999 (a La Niña Year), respectively
- Distribution of data is non-gaussian, so La Niña year values are assumed to be closest to positive standard deviation value
- El Niño years show increased frequencies in the 1 to 5 cycles per day range, and 15 to 17.5 cycles per day range compared with La Nina, respectively









Discussion and Future Research

- The 90-day harmonic can be isolated for each day within DJF to filter out the mean of OLR values for each day within the time series. This would result in a time series of anomalous OLR values.
- Time scales of the data within this new time series can be analyzed to compare large amplitudes (sub seasonal time series) to smaller amplitudes (daily or weekly values)
- As the distribution of OLR data is non-normal, further analysis must be conducted to identify La Niña years
- Further exploration of negative OLR values needs to be conducted. This could be due to La Niña, seasonal variation, or cloud cover over Niño 3.4

References

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