Investigating Sea Breeze Climatology In Tampa, Florida Using Reanalysis Data

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Introduction:

- Tampa is a coastal city situated in the western central peninsula of Florida, this investigation is centered around Tampa International Airport (TPA) at coordinates 27.9° N and 82.5° W, with elevations ranging from 2 to 8 meters above sea level along the coast of Tampa Bay, gradually increasing inland.
- El Niño and La Niña: Planetary climate patterns that influence the sea breeze.
- Sea breeze: it is formed due to the temperature differences between the air over land and the ocean.
- The goal was to investigate sea breeze climatology with the use of reanalysis data.

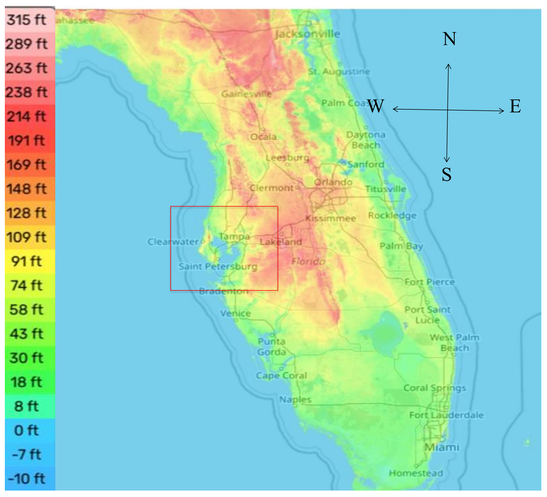


Figure 1: Topographic map of Florida and Tampa area (Source: Topographic Maps, 2024).

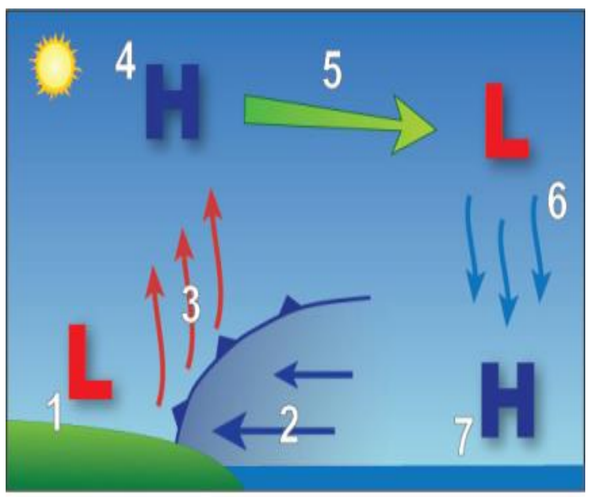


Figure 2: Image of sea breeze flow process (Source: NOAA, 2024).

Data/ Methodology:

- Surface observations from Iowa Environmental Mesonet ASOS at TPA were used to validate the reanalysis data set downloaded from the ECMWF ERA-5 single-level data set for 30 years, 1990-2020.
- Variables: 2-m max wind speed, precipitation.
- The surface observations from 2020 were used to validate the reanalysis data
- The correlations of the variables from the reanalysis data were calculated.
- NOAA's Oceanic Niño Index (ONI) data was downloaded to compare patterns from 1990-2020.

Results:

	Monthly (1990-2020)	Peak Wet Season: July and August (1990-2020)
Correlation	**-0.482**	**0.042**

Table 1: Correlation between wind speed and precipitation from 1990-2020 of averaged monthly data from ECMWF ERA5 Reanalysis dataset. Less than 0.5 is considered an uncorrelated result.

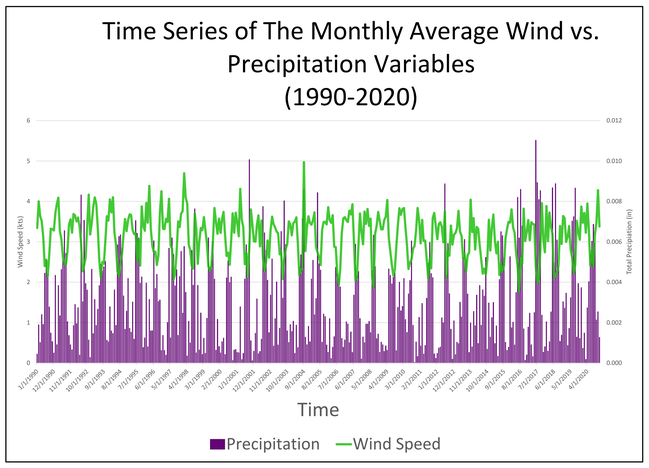


Figure 3: A time series of precipitation (purple clustered columns) versus the wind speed (green line).

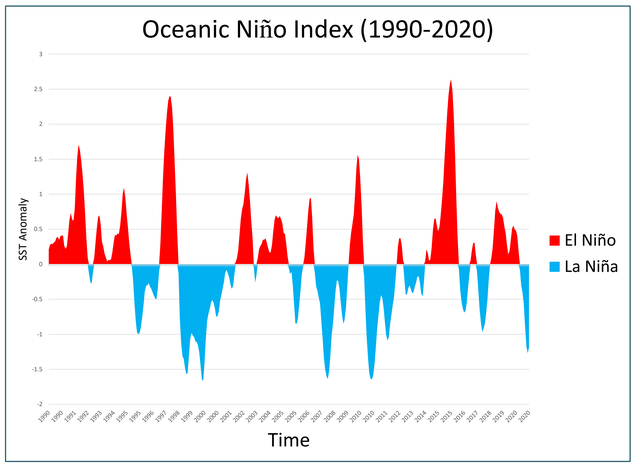


Figure 4: The Oceanic Niño Index (1990-2020).

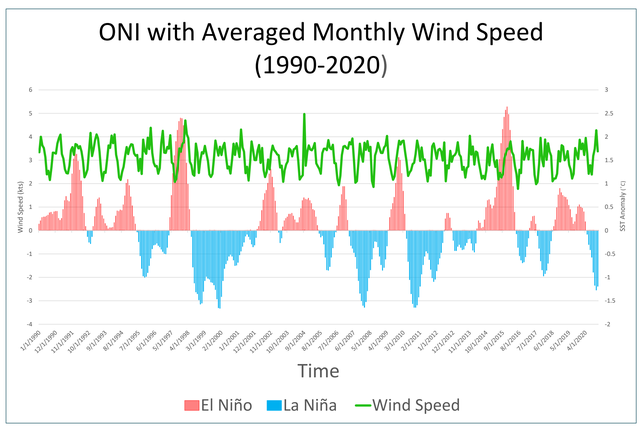


Figure 5: The ONI data (1990-2020) compared to wind speed values (green line).

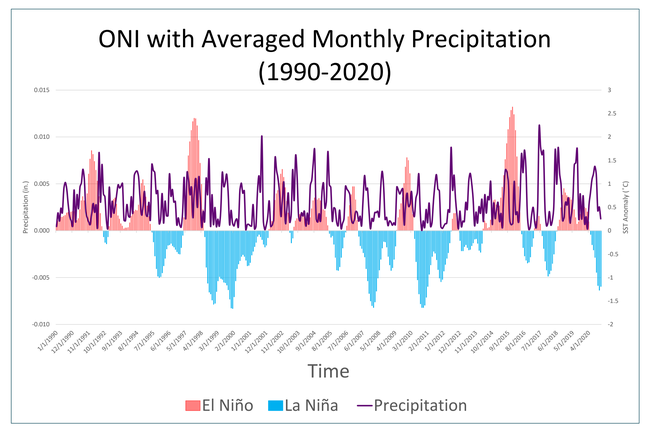


Figure 6: The ONI data (1990-2020) compared to precipitation values (purple line).

Discussion:

- There is a -0.482 correlation between wind speed and precipitation for all months 1990-2020 (Table 1).
- There is an approximately zero (0.042) correlation between the variables for the months of July and August 1990-2020 (Table 1).
- Maximums and minimums of wind speed and precipitation seem to match the ONI patterns (Figure 4).
- Years with the strongest El Niño (red) occurred in 1997 and 2015. And the years with the strongest La Niña (blue) occurred in 1999, 2007, and 2010 (Figure 4).
- Peak maximums in wind speed occurred in 1998, and 2004 (Figure 3,5)
- Peak maximums in precipitation occurred in 2001,2012, and 2017. (Figure 3, 6).

Conclusion/ Future Recommendations:

- More analysis of the variables involved (sea surface temperature, moisture) with the sea breeze needs to be done to create a full understanding of sea breeze climatology. The peak dry season can also be analyzed and compared to the peak wet season to see if any changes in correlation occur due to the time of year.
- Sea breeze is on a small temporal scale, further analysis using daily or even hourly data should be conducted. This is only possible if the reanalysis data can be adjusted so that there will be complete data sets because the only complete available data set was the averaged monthly reanalysis data set.

References:

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