**Analysis of Global Fire Weather Index and Its Correlation to The Oceanic Nino Index in the Amazon Rainforest Region**

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**Background**

The Amazon Rainforest is the biggest rainforest on the planet. It iss home to an estimated 30% of the world’s plant and animal species and 817,000 indigenous Brazilians (Stewart, 2019). The Rainforest is not only important to its local ecosystem, but to the global climate. With greater than 350 billion trees the Amazon stores an estimated 5% of annual CO2 emissions at about 2 billion tons per year (Anna Jean Kaiser, 2019). Considering its importance, it is imperative to be able to protect the region from events that could damage it, namely wildfires. In 2019 the Amazon Rainforest experienced “more than 41,000 ‘fire spots’ between 1 January and 24 August,” burning an estimated 9,060 km2 of forest. (CBS News, 2019, Stewart, 2019). Considering the potential impact of these fires it is imperative to be able to accurately forecast wildfire conditions.

**Methods**

To develop a greater understanding of the conditions that are leading to such large fire events, the global Fire Weather Index (FWI) dataset was processed and analyzed (*Data.GISS: Global Fire WEather Database (GFWED)*, 2015). FWI is based on the Initial Spread Index (ISI), an index using fuel moisture to estimate fire spread conditions, and the Buildup Index (BUI), an index based on moisture and drought conditions (*Fire Weather Index (FWI) System | NWCG*, 2010). FWI is a unitless index that “is a key indicator of extreme fire behavior potential” (*Fire Weather Index (FWI) System | NWCG*, 2010). With this data, an annual trend and correlation to the Oceanic Nino Index (ONI), a three-month running average of equatorial pacific sea surface temperature anomaly, were created (NOAA’s Climate Prediction Center, 2017).

To find a linear trend the FWI data from January 1981 to August 2020 was imputed into the python module scypy’s function linregress (*scipy.stats.linregress — SciPy v1.5.4 Reference Guide*, 2020). This gave a slope and p-value of the linear trend for each location. To visualize this, one map (figure 1) was created to show the slopes of the annual trend and another (figure 2) was created to show the p-values with the statistically significant, p-value less than .05, emphasized.

To estimate the correlation between the ONI and the FWI, the FWI was organized into both a yearly average dataset and three-month running average dataset. For both datasets, the annual trend was removed by subtracting the trend at each point from the dataset. To accomplish this, a trend was calculated for the yearly data and the linear trend calculated earlier was used for the monthly data. After the trend was removed, the seasonal cycle was removed from the monthly data by finding the average value for each three-month period and subtracting that from each value. The monthly data is now processed in a similar way to the ONI data. For the yearly data, the monthly ONI data was averaged to find a yearly average ONI for each point. With these datasets prepared the Pearson Correlation Coefficients was calculated using the python, numpy, function corrcoef (*numpy.corrcoef — NumPy v1.19 Manual*, 2020). Maps of both the monthly (figure 3) and yearly (figure 4) correlation coefficients were produced with this data.

**Results**

The maps of linear slopes and their significance (figure 1, figure 2) show a significant annual increase in the Amazon Rainforest Region, the region is one of the most affected by the annual change in FWI. The monthly correlation maps (figure 3) show a moderate correlation between FWI and ONI in the northeast Amazon Rainforest region suggesting that in months with high ONIs the northeast region may experience an increase in fire-weather

Map

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Description automatically generatedconditions and in fire risk. The yearly correlation map (figure 4) Shows a very strong correlation in the same region, this suggests that in high ONI years the fire weather will likely increase at a proportional rate.

*Figure 3:* Correlation Between Three Month Running Averages of FWI and ONI

*Figure 4:* Correlation Between Yearly Average FWI and ONI

*Figure 2:* P-Value of Global FWI Linear Trend.

*Figure 1:* Slope of Global FWI Linear Trend.

This data shows that the Amazon Rainforest Region is experiencing a significant yearly increase in fire weather, and during years with high ONI, such as El Nino years, the fire weather in the northeast section increases even more. This information could help in the forecasting of fire conditions in the region, specifically in the northeastern region of the Amazon Rainforest.

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