Correlation between El Niño Southern Oscillation Index and Variations of Normalized Difference Vegetation Index in the Northeast North Carolina

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ABSTRACT

When trade winds over a region called NINO 3.4 in the Pacific Ocean are reversed and the sea surface temperature warms over several months in the area it is called an El Niño Southern Oscillation (ENSO). The purpose of the project is to observe how the ENSO can affect northeast North Carolina's vegetation. The sea surface temperature (SST) of NINO 3.4 region will be used because it is the common index used to measure for El Nino. Normalized difference vegetation index (NDVI) for northeast North Carolina will be used, because it reveals the amount of vegetation present in the area of interest. The data was collect from the National Aeronautics and Space Administration dataset website, Giovanni, from the years of 2002-2016 for both the SST and the NDVI. After the data was collected the linear and nonlinear regression for SST versus time, NDVI versus time and SST versus NDVI was created, to show the correlation of the data and whether it had a seasonal variation. The linear regression of both SST versus time, NDVI versus time and SST versus NDVI R squared indicates the correlation were weak, but they still correlate because of the P-values which were good. The nonlinear regression reveals SST having a weak correlation and weak seasonal variation, but NDVI data indicated a strong correlation and a seasonal variation. Overall ENSO and NDVI is shown to have a weak correlation.

INTRODUCTION

- An El Niño Southern Oscillation (ENSO) is when the trade winds over a region in the Pacific Ocean known as area NINO 3.4 are reversed and the sea surface temperature (SST) in that area warm slightly over several months. This is an irregular occurrence that develops in late December.
- The goal of this project is to see how the ENSO can affect northeast North Carolina's vegetation.
- Will be using NINO 3.4 Index sea surface temperature (SST) and the normalized difference vegetation index (NDVI). The reason we are using the NINO 3.4 region is because it is the common index used to measure the SST for El Niño
- NDVI is calculated by satellite and shows how much vegetation is present on a portion of the Earth at a period in time, normally observed monthly.

METHADOLOGY

Collecting the Data

- Collected from NASA Giovanni website
- SST coordinates: 120 W – 170 W, 5N-5S
- NDVI coordinates: 35.45N-36.54N, 78.002W-75.87W
- Time Frame: July 2002- March 2016

Linear Regression

- Shows correlation between the two data.
- Used the Microsoft Excel Software

Non-linear Regression

- Shows the seasonal variation
- Used the Sigma Plot Software

RESULTS

SUMMARY OUTPUT		
Regression Statistics		
R Square	0.0107	
	Coefficients	P-value
Intercept	23.6485	0.0000
X Variable 1	0.0001	0.1865

Graph 1: Linear Regression of SST

Data Source: Data 1 in Notebook1

Equation: Waveform, Sine, 4 Parameter

f = y0+a*sin(2*pi*x/b+c)

R sqr
0.1913

Coe.		P
a	0.6648	<0.0001
b	1127.8416	<0.0001
c	4.7387	0.2968
y0	26.6947	<0.0001

Graph 2: Nonlinear Regression of SST

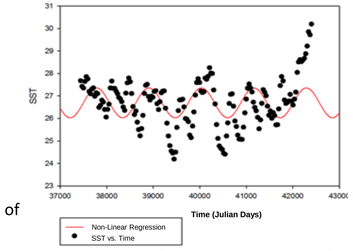

Figure 1: Nonlinear Regression SST of NINO 3.4 Index in Julian Days

SUMMARY OUTPUT		
Regression Statistics		
R Square	0.0006	
	Coefficients	P-value
Intercept	0.6916	0.0028
X Variable 1	0.0000	0.7573

Graph 3: Linear Regression of NDVI

Data Source: Data 1 in Notebook1
Equation: Waveform, Sine, 4 Parameter

f = y0+a*sin(2*pi*x/b+c)
R sqr
0.9374

Coe.		P
a	0.1426	<0.0001
b	366.2723	<0.0001
c	-6.2800	<0.0001
y0	0.6215	<0.0001

Graph 4: Nonlinear Regression of NDVI

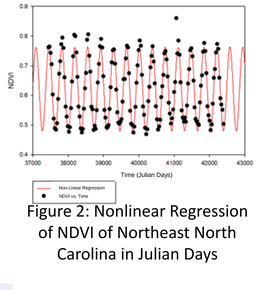

Figure 2: Nonlinear Regression of NDVI of Northeast North Carolina in Julian Days

SUMMARY OUTPUT		
Regression Statistics		
R Sqr	0.0006	
	Coefficients	P-value
Intercept	0.6914	0.0028
X Variable 1	0.0000	0.7578

Graph 5: Linear Regression of SST vs. NDVI

DISCUSSION

After doing the linear regression it revealed there was weak correlation between the sea surface temperature and time. This was shown from the R squared which was very low and being close to 0. When it is close to 0 it means there is weak correlation. The P-values were low, so since they were low it means that the intercept and the x-variable have a high chance not equaling to zero. The nonlinear regression shows there was not a seasonal variation. This was shown by the low R squared being 0.1913 and the b coefficient which it suppose to be close to 365 to show seasonal variation. Instead it was 1127. The belief is because of the El Niño and La Niña that is why there is not a correlation.

After conducting the linear and nonlinear regression for the NDVI we concluded that there is a seasonal variation for NDVI. The nonlinear had a higher R squared value showing that correlation for the seasonal variation. The R squared for the linear regression for the NDVI but the P-value showed that seasonal variation with it being .75.

After inserting the NDVI and SST together and perform a linear regression it showed weak correlation. The R squared and P-values were low. This means there was weak correlation between the two, because of the R squared. The P-value for the intercept was low so it is a high chance it is not equal to zero, but the P-value was higher for the x variable 1 which means there is not a low probability of it not being zero.

FUTURE WORK

Does El Niño or La Nina have any effect on extreme weather in Eastern North Carolina, such as the rainfall, drought, or tornadoes?

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