Impact of 2 Major La Niña's and an El Niño on Food Security for Top 10 Wheat Producing Countries

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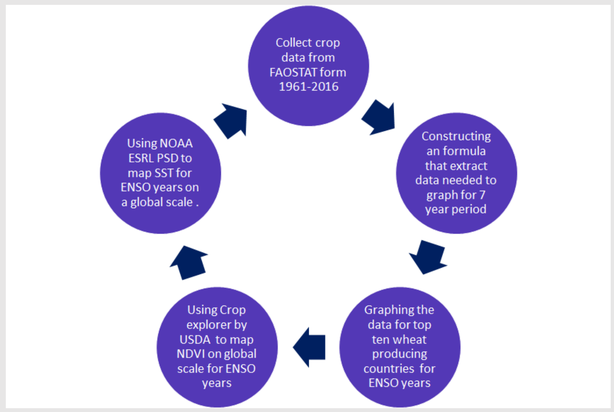
ABSTRACT

El Niño and La Niña (ENSO) are is one of the most predictable climate phenomenon to exist. They occur whenever there is a significant increase or decrease in the oceans sea surface temperature (SST) where you can visualize how it will affect the corresponding countries transversely. Although the general effects can be predicted there is no way of fully knowing how a particular region will be impacted. More specifically, the drastic change in temperature causes a disruption in weather patterns as well as extreme climate events like heavy rainfall, and flooding. Our project revolves around analyzing crop yield and production quantity of the top ten wheat producing countries during two La Niña years and one El Niño year. Our objective is to find a correlation between the effects on crop yield and the unique conditions of ENSO. Our prediction is for the top ten wheat producing countries ENSO would lead to a increase and/or decrease of crop yield due to the shift in temperature that countries typically grow their wheat (summer or winter). To test our hypothesis we graphed the average crop yield data of the top ten wheat producing countries for the years when ENSO occurred and compared the average yield to a range of years. We analyzed the yield data for each country by investigating whether or not they agriculturally benefited during these events. We concluded that ENSO indeed generally impacted wheat yields negatively although there we a few exceptions in the various years.

INTRODUCTION

ENSO refers to the warming or cooling of the Pacific Ocean that creates various changes to the earth's climate. Any change in the natural temperature and precipitation of a country can be detrimental to their agriculture. In this project we are able to see how ENSO events affect the food security of wheat, and whether it increases or decreases wheat production. Our goal was to find a correlation between the change of average yield and the areas affected by ENSO. To accomplish our goal, we had to find the average yield data of two La Niña years (2007-2009, 2010-2011) and one El Niño year (2015-2016) to see if there was a trend in the countries directly affected by ENSO. It is important to study these events because the global effects that ENSO brings can be catastrophic to a region's weather, economy and food security. For example, in 2015 Russia banned all wheat exports due to a crippling drought from an El Niño that caused wheat prices to skyrocket and created a global economic mayhem. If a drought was able to impact the world's economy so drastically, what are the risks when it comes to other crops? The effects of ENSO should be studied in order to prevent and prepare for potential disasters in the future.

METHODOLOGY



RESULTS

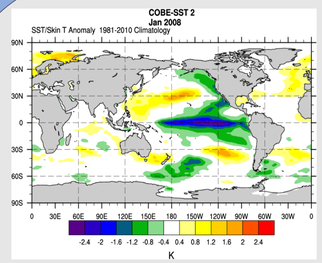
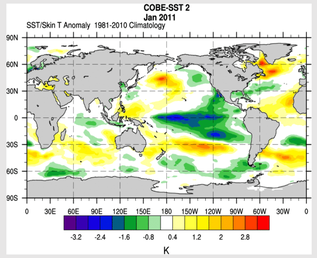


Figure 1



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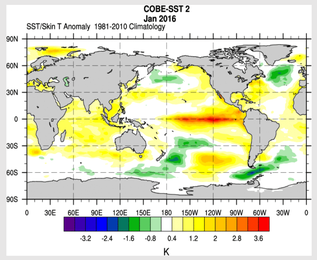


Figure 3

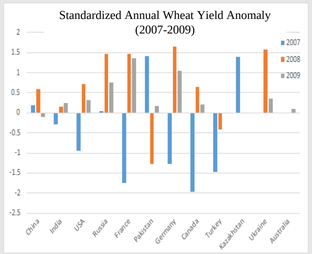


Figure 4

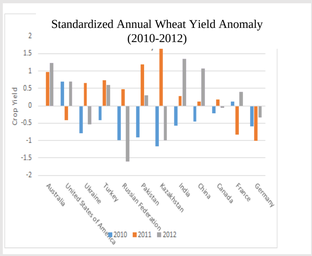


Figure 5

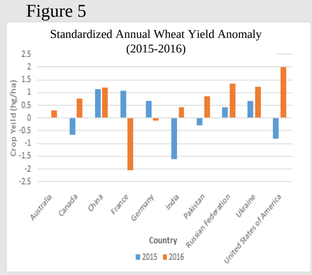
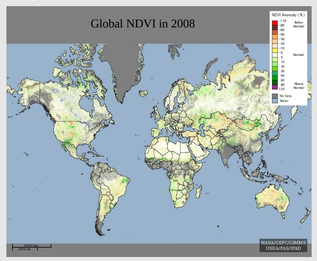


Figure 6



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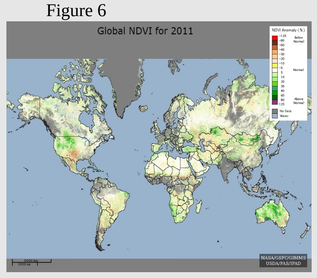

Figure 8

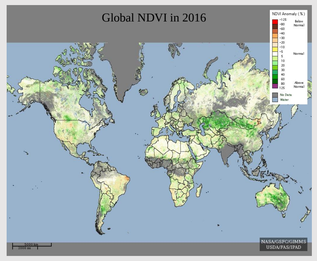

Figure 9

Figures 1-3 : Sea surface temperature for 2008, 2011 & 2016

Figures 4-6: Average yield for Top Ten Wheat Producing countries for corresponding years.

Figures 7-9: NDVI (normalized difference vegetation index) on a global scale.

CONCLUSIONS

Graphs

- After gathering our data from FAOSTAT, plots of the product quantity and crop yield were created using Excel. In order to calculate how ENSO affected the crop yield of the top ten wheat-producing countries, we used the formula $\frac{Y-Ym}{STD}$ which then compares yield in each country during the year of ENSO and that of three years before and after (figures 4-6).
- The year the event occurred and years after are showed because the year were ENSO occurs, can and usually rolls into the next year which is when you likely see impacts and we do a seven year average to take into account any industrial impacts that might have happened.
- Based on the graph, the 2008 La Niña negatively impacted most of the top producing wheat countries. Decrease in yield is illustrated in Germany, France, Turkey, U.S and Canada however, India, China and Kazakhstan had positive impacts .
- Comparing yield differences during ENSO years in Australia showed that La Niña was more beneficial. In comparison the SST and yields for Australia, El Niño showed negative impacts while La Niña showed positive and is supported by the NDVI maps for correlating year (figure 8 and 9).

Maps

NVDI (Normalized Difference Vegetation Index)

- NDVI maps shows the vegetation for corresponding ENSO years. This was used to compare bar graphs to correlate whether the crop yield of a country and its vegetation index matched (figures 7-9). Some countries could not be compared to the to the years and counties with negative yield because there was no data available.
- The effects of the La Niña's on Australia's yield differs with 2008 La Niña significantly lowering yields more than 2011. The SST shows colder climate in 2008 (figure 1) and suggests that La Niña's colder climate had positive impacts on Australia growing region because the NDVI's was above normal (figures 7 and 8).
- SST maps vs. yields for Germany in La Niña years showed opposing impacts. When observing SST Germany's climate was warmer in 2008 and colder in 2011 (figure 1-2). The yield from 2007-2009 was higher than 2010-2012 which benefits Germany's wheat production.

SST (Sea Surface Temperature)

- SST maps (figures 1-3) shows where and how El Niño and La Niña are created and moves throughout the pacific ocean.
- El Niño is the warming of the Pacific Ocean (figure 3) and La Niña is the cooling of the Pacific Ocean (figures 1-2).
- Comparing SST and yield maps for the U.S showed that El Niño was beneficial to the U.S. The SST maps for La Niña shows the Southern U.S was surrounded by colder climate and El Niño brought warmer Climate (figures 2 and 3). El Niño is more beneficial to the growing regions in southern U.S versus La Niña (figures 5 and 6) according to yield.

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