The Climatological Influence of ENSO and Hurricane Frequency in North Carolina

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Introduction

- El-Niño-Southern Oscillation (ENSO) and variability in tropical cyclone activity are known to induce significant seasonal-to-interannual fluctuations in precipitation across the world.
- The purpose of this study was to determine the effects that ENSO and hurricane frequency have on:
  - Annual Precipitation
  - Winter Precipitation
- Atmospheric Scientists use similar research to increase the accuracy of precipitation prediction for large scale patterns.

Data and Methods

- Normal and daily precipitation data from 163 Cooperative Observer Program (COOP) stations through the National Weather Service are located within North Carolina
  - 1981-2010 normal precipitation totals
  - Daily precipitation totals for each year of interest
- Five years of interest are evaluated:
  - 1988 and 1989, a strong La Niña event
  - 1997 and 1998, a very strong El Niño event
  - 2004, an active hurricane season for North Carolina
    - Neutral ENSO Year
- The normal precipitation totals were compared to daily precipitation totals to help determine which event created an increase or decrease in precipitation each year.
- All normal and daily precipitation data were retrieved from the State Climate Office's CRONOS database using RMySQL .

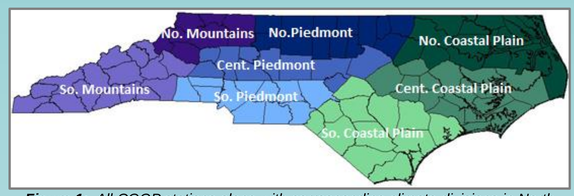

Figure 1: *All COOP stations along with corresponding climate divisions in North Carolina*

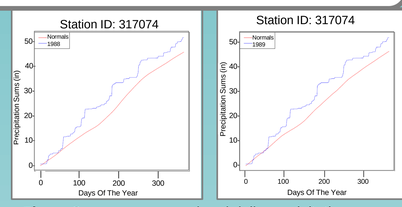

Figure 2 *compares normal and daily precipitation during the 1988-1989 La Niña event*

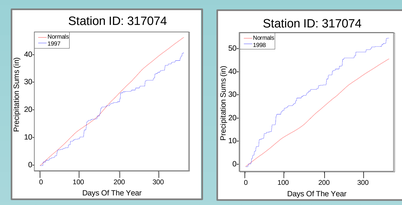

Figure 3 *compares normal and daily precipitation during the 1997-1998 El Niño event*

Results

Annual

Year of Interest	Annual Average North Carolina Precipitation	Annual Departure from Normal
Normal	49.99 in.	----------
1988	39.74 in.	-10.25 in.
1989	62.90 in.	+12.91 in.
1997	47.06 in.	-2.93 in.
1998	53.51 in.	+3.52 in.
2004	50.61 in.	+0.62 in.

Table 1*: Average precipitation totals during both El Niño, La Niña, and the Atlantic Hurricane years of interest*

- Total amount of precipitation for numerical results are to the left. Color plots are to the right.
  - 1988 and 1997 had less precipitation compared to normal
  - 1989 and 1998 had more precipitation compared to normal
  - 2004 had more precipitation compared to normal by less than an inch

Winter

- During the La Niña winter, North Carolina received 31.98% less precipitation than normal making the winter drier than normal.
- During the La Niña winter, North Carolina received 35.48% more precipitation than normal making this winter wetter than normal.
- For both El Niño and La Niña years, 50% of precipitation occurs from September 28th to April 1st
  - El Niño had the most precipitation (41.21 inches)
  - La Niña had the least precipitation (20.66 inches)

Winter of Interest	Average North Carolina Winter* Precipitation	Departure from Normal
Normal	12.1506 in.	----------
1988-1989	8.2646 in.	- 3.886 in.
1997-1998	18.8330 in.	+ 6.682 in.

Table 2: *Average precipitation totals during the winter of the El Niño and La Niña of interest.*

****December 1st through March 1st***

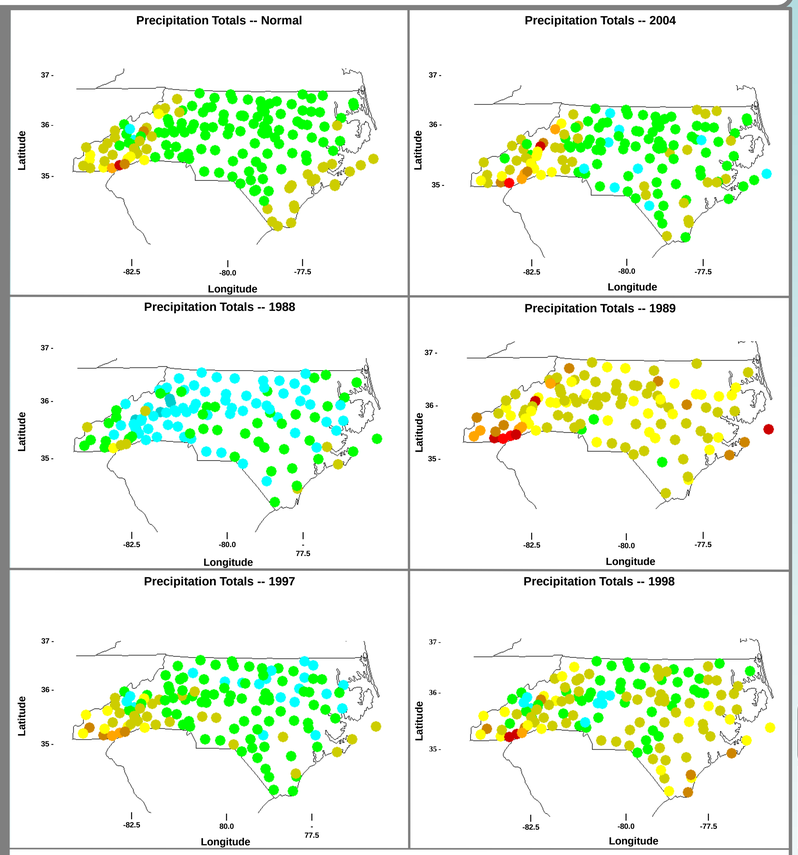

Figure 4: *Normal and total precipitation that occurred in North Carolina during an El Niño, La Niña, and 2004.*

Conclusions

- Southern Mountains received the most precipitation during any given year while the Piedmonts received the least amount of precipitation.
- North Carolina experienced a decrease in precipitation amounts during the winter of 1988-1989.
- North Carolina experienced an increase in precipitation amounts during the winter of 1988-1989.

Future Work

- Build a webpage for the State Climate Office based on this research.
- Continue research to determine if 2004 was a "drought buster" and when these have occurred.

References

Boyles, R., Fishel, G., Holder, C., Raman, S., Robinson, P., P.P., 2006. Calculating A Daily Normal Temperature Range That Reflects Daily Temperature Variability. Journals of the American Meteorological Society. DOI: 10.1175/BAMS-87-6-769

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