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MODIFIED JMA ENSO INDEX AND ITS IMPROVEMENTS TO ENSO  
CLASSIFICATION

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## ABSTRACT

El Nino-Southern Oscillation (ENSO) is a widely known phenomenon that affects many areas including the southeast United States. Over the southeast U.S. the Japan Meteorological Agency (JMA) ENSO index was modified to establish better classifications. In order to properly understand the effects of ENSO on this location a new approach was needed. Spatial resolution was improved by utilization of the PRISM dataset. PRISM provided monthly precipitation and temperature data over the contiguous US at 4 km resolution. Temporal resolution was improved by disregarding the traditional JMA definition of an ENSO year. The new definition requires six consecutive months of 0.5°C anomalies or larger to be listed as an ENSO event. By utilization of this definition, the ENSO index was modified to a monthly index from a yearly index. Many ENSO events begin in the summer months and end before the preceding September, therefore, an adoption of a monthly index is justified. Although several of the effects vary widely over the domain, there are a few prevalent patterns of ENSO effects. During warm phase, from November-April, wet conditions are seen in the coastal areas. July and August are both dry. From fall to spring, Florida and the Atlantic Coast are basically dry, however; the Mississippi River Valley doesn't appear wet as previous studies have indicted. Patterns of temperatures across the southeast are less variable than the precipitation. Differences between the ModJMA and JMA can be seen in several months, especially during late spring and early autumn. This result is not surprising based on the rigid definition of the JMA index. An interesting result presented itself throughout the study. Individual tropical storms can be identified with the increased resolution PRISM data provides. A state by state breakdown of the ModJMA conclusions provides regional summaries. The ModJMA better classifies ENSO periods and leads to a more precise impact of ENSO over the southeast United States.

## 1. INTRODUCTION

The El Niño-Southern Oscillation (ENSO) is one of the most studied cyclical modes of climate variability. Average return interval is every 2-4 years (Bjerknes 1969; Trenberth 1976; Quinn et al, 1978; Rasmusson and Carpenter 1982; Cane 1983; Rasmusson and Wallace 1983; Ropelewski and Halpert 1990). Impacts of this phenomenon are felt worldwide. Just in the United States alone impacts greatly differ from heavy rainfall in California during El Niño (Schonher and Nicholson 1989), warm winters across the Southeastern U.S. during La Niña (Wolter et al. 1999), to an increase in winter cyclones over California and along the Atlantic coast during El Niño events (Noel and Changnon 1998).

There is an increase in heavy snowfall during El Niño in the Northeast Corridor and New England (Patten et al. 2003). Hurricane activity in the Atlantic has been linked to ENSO as well. In general, the Atlantic basin is less active during El Niño events (Gray 1984; Bove et al. 1998; Smith et al. 2007). During El Niño events, factors for agriculture are not as favorable during the winters in Florida leading to a less wintertime vegetable production (Hansen et al, 1999).

This study is confined to the Southeast U.S. (TN, AL, MS, GA, FL, SC and NC). The major scientific purpose is to reexamine the ENSO phases and their impacts over the Southeast using a modified ENSO index along with a high-resolution gridded dataset. A study like can establish a better relationship between ENSO and the southeast U.S. Along with the better understanding, utility companies, water management and agriculture can benefit and create useful applications to better serve the public.

According to Sittel (1994), El Niño tends to produce cooler maximum temperatures across the Southeast in the winter and spring months; wetter conditions along the Atlantic and Gulf are also expected. La Niña events tend to lead to warmer fall and winters. While the Mississippi Valley is typically wet during La Niña events in the fall through spring, Florida and the Atlantic Coast are dry (Green 1997). Gershunov and Barnett, 1998, reports that during El Niño winters the Gulf Coast experiences more heavy precipitation events along with cooler temperatures, whereas in La Niña winters in the eastern Gulf Coast see a decrease in heavy precipitation events. Hanson and Maul (1991)

also reports heavy winter precipitation events in El Niño. Along with the heavy precipitation is an increase in Florida river discharge during El Niño winters (Schmidt et al, 2001). This large difference between warm and cold phase leads to an impact on agriculture. According to Hansen (1998), ENSO phases explain roughly a 26% shift in the average production of corn.

The Southeast United States and its ENSO signal will be analyzed. Section 2 details the data and methodology used. Section 3 shows the results of the study broken down by ENSO phases and month as well as some case studies. Discussions of the differences between two ENSO indices are the focus of section 4. Finally, section 5 summarizes the results and conclusions.

## 2. DATA & METHOD

ENSO can be measured using several indices. During this investigation a modification of the Japan Meteorological Agency (JMA) was used (Marine Department, Japan Meteorological Agency 1991). The JMA defines ENSO events based on SST anomalies over the region of 4°N-4°S, 150°W-90°W. The 5-month running average of SST anomalies must be greater than or equal to 0.5°C (-0.5°C) for at least six consecutive months for the year to be defined as El Niño (La Niña). In addition, the months of October, November, and December have to meet the above criteria. If the above criteria are not met, then the year is designated as neutral. An ENSO year is defined as October through the preceding September.

Since the JMA is basically a yearly index, modifications were needed to increase the temporal resolution. In other words, a modified JMA index will serve as more of a monthly index than a yearly index. This modified index is less rigid than the traditional JMA ENSO index. The requirement of including October, November, and December is discarded, since many ENSO events begin in the summer months and end before the preceding September. It is interesting to note that all warm and cold phases included the months of November and December. Also, an ENSO year is no longer relevant, but instead 'ENSO periods' is the new terminology. Like in the JMA ENSO index, the same domain is used along with the requirement of six consecutive months of 0.5°C anomalies or larger. Table 1, in the appendix, displays the definition of the indices. The occurrences of warm and cold phases by month for the ModJMA Index are shown in table 2.

Table 3a-g shows the differences between the JMA and modified JMA ENSO index along with the 5-month running average of SST anomalies. During the winter months, when the event is usually strongest, there are little differences between the two indices. However, during summer, the differences are large, indicating a shift in the time periods of the individual events between the two indices. For example, the JMA ENSO years sometimes begin as one phase only to have the SST anomalies drop below the 0.5°C criteria during spring. More interesting cases occur when the ENSO year begins as one phase and then reverses phase by spring or summer. October is the same for both indices.

Now the impacts of ENSO phases can be more accurately seen. There are 3 possibilities of how ENSO phases differ from the modified JMA (ModJMA) to the JMA index. First the ENSO event can have a different starting or ending period. Secondly, the ENSO event could occur in basically the same period just slightly shifted. Lastly, and most interesting, is the fact that a ‘new’ El Niño or La Niña could be defined.

Parameter-elevation Regressions on Independent Slope Model or PRISM is a 4 km grid dataset across the continental United States. For the purpose of this study PRISM data was utilized. Monthly averages for precipitation, maximum temperature, minimum temperature and dew point temperature are available since 1895.

PRISM uses point data, a DEM (digital elevation model), and other datasets to generate gridded estimates of monthly and annual averages of climate related parameters (Daly et al, 1994). It has been shown that PRISM produces less mean absolute error than kriging, detrended kriging or cokriging (Daly et al, 1994).

The PRISM data was sorted by month and phase. Precipitation plots were calculated as average percent of neutral over all months that were categorized in a certain phase under the index. Percent of neutral was calculated from 3 simple steps. First, all neutral months for the JMA and ModJMA were averaged separately over each month (monthly neutrals). Next, the La Niña and El Niño months were averaged separately (ENSO monthly average). Finally, the ENSO monthly averages were subtracted from the monthly neutral of the index of interest, then divided by the monthly neutral and multiplied by 100 to give a percentage of neutral.

Temperature plots were calculated as an average shift from neutral. The average shift from neutral is also calculated in 3 steps. First, all neutral months for the JMA and ModJMA were averaged separately over each month (monthly neutrals). Next, the La Niña and El Niño months were averaged separately for the maximum temperature, as well as the minimum temperature (ENSO monthly average). Finally, the ENSO monthly averages were subtracted from the monthly neutral of the index of interest to yield an average shift from neutral.

Once all the data is plotted, anomalies were investigated. The areas chosen for investigation have significant anomalies. Case studies refer to cold phase or La Niña

events unless otherwise noted. Individual station data was often helpful in determining whether there were a few anomalous years leading to this outlying data.

When individual station data was needed the Historical Climatology Network (HCN) was helpful (Neumann et al 1999). Figure 1 shows the locations of all stations, within the domain, in which were referenced. Since no case studies were chosen from TN, GA or SC, there are no stations utilized in those states. Table 4 provides a key for figure 1. If a nearby HCN stations was not available, a COOP (Cooperative Observing Program) station may be used.

Next a comparison between the two indices was performed. For every phase and month the average value for the JMA index was subtracted from the average value for the ModJMA index over the entire domain. Again large anomalies were found; several of these corresponded to the anomalies found before. However, a few new areas of interest were identified and serve as further case studies. An unpaired t-test modeled after Wilks (2006) is performed to determine where differences are significant. Once the t-values are calculated, a table of t-values determines the degrees of freedom used to define the confidence intervals. Only areas that correspond to confidence intervals of 90% (-90%) or greater (less) are displayed.

### 3. RESULTS

All precipitation plots are shown as percentage of neutral. Note that references of above or below neutral refer to at least a 1°C deviation from neutral. Occasionally, individual years were analyzed and the percent neutral for the year is used. Percent neutral for an individual year is defined as the precipitation amount subtracted from the monthly neutral divided by the monthly neutral and then converted into a percentage ( $[(\text{precipitation amount} - \text{monthly neutral}) / \text{monthly neutral}] * 100$ ).

#### 3.1 Precipitation – El Niño

During January, above neutral condition occur over most of Florida, FL, (except for the panhandle) and up the Atlantic coast (figure 2). In central and south FL values of at least 150% dominant the region with some areas registering 160% of neutral. At the same time, much of the Tennessee River Valley (Tennessee, northern Mississippi and northern Alabama) is below neutral. Although these areas don't deviate from neutral as much as the southern part of the domain, values indicate 60-70% of neutral in many parts of northern Tennessee. February – April displays patterns similar to January.

With February comes the vanishing of the below neutral precipitation in the northern domain. The same areas are still above neutral as before, however, the magnitude declines. Also the extent of the above neutral area reaches farther inland. Most notably is the addition of the Gulf coast and the Florida panhandle as above neutral.

March looks quite similar to January, yet there are few below neutral values in northwest Tennessee. The upper Atlantic coast (Carolina coast) is becoming closer to neutral. Once again, there are large positive magnitudes in southwest Florida, 170% percent neutral or higher.

In April the Gulf Coast doesn't deviate much from neutral. It is interesting to note that locations around Pensacola, FL actually display as slightly below neutral. Areas of above neutral are now confined to Florida (except for panhandle) eastern Georgia, South Carolina and western North Carolina. Parts of Florida display similar magnitude to the previous month. However, the spatial coverage of extreme readings is smaller and

they are more confined to central Florida. Also a second location of above neutral is Mississippi.

May looks quite different than previous months (figure 3). Most notably is the abundant below neutral. Although values range only from 70-90% of neutral, they basically cover the domain. The northwest corner (western Tennessee, northern Mississippi, and northwest Alabama) is closer to neutral.

Conversely to May, precipitation in June is abundantly above neutral. Higher values are found in central and eastern Tennessee, northern Alabama, extreme northwest Georgia and east South Carolina (figure 4). In these spots, typical values range as large as 130% of neutral.

During July below neutral values make a return, similar to May. Although, in general, these are somewhat weak, 80-90% of neutral, the region is dominated by this pattern.

Similar to the previous month, August is largely below neutral over the domain (figure 5). However, more area is covered by this deviation as compared to July, Florida is mostly near neutral. Also the magnitudes of deviations increase as well, with areas of 60-70% of neutral in central Alabama and a location in northeast Alabama of 50-60% of neutral.

Spatial coverage of below neutral precipitation is restricted to eastern Florida and the Atlantic coast in September. Also there is a decrease in the strength of the negative deviations. In contrast, pockets of above neutral precipitation appear across southern Mississippi, central Alabama, northwestern Georgia, and eastern Tennessee. Some of these locations are as great as 140% of neutral (figure 6).

Below neutral regions are confined to north Florida and southeast Georgia in October. Although the pattern is similar to September, many of these values are more below neutral. Several areas of notably positive anomalies are seen. One of these is extreme western Florida panhandle, southeast Alabama and eastern Georgia. The area that really stands out is western and central Mississippi, around Jackson, where deviations are 40% above neutral. This anomaly will be examined later.

November and December look quite similar to January in spatial coverage. Although basically the same areas are covered in all months, November and December

display larger magnitudes. The largest deviations from neutral are in Florida, southern Georgia and eastern South Carolina. However, November in Florida is interesting; there is not just one maximum but two, one around Tallahassee and the other around Tampa.

### 3.2 Precipitation – La Niña

During January, the Gulf coast, Florida, southern Georgia, South Carolina, and western North Carolina are below neutral, with values in south and central Florida as low as 40% of neutral. Basically the rest of the domain is close to neutral.

February is similar with the magnitudes of negative deviations increasing and confined to more of a coastal area. Now most of southern and central Florida is 40-50% of neutral. Also the Tennessee River Valley displays positive anomalies of around 20% above neutral.

The Gulf Coast becomes closer to neutral in March, while southern Georgia and South Carolina become below neutral during this time (figure 7). Although the spatial extent of the large negative deviations in Florida decreases, the magnitude increases. Values around Fort Myers are 30% of neutral and lower. January, February and April have similar patterns.

April is less impressive than March in both spatial coverage and magnitude. Most of Florida is still below neutral; however 60% is the current minimum. Two notable areas of positive deviations are shown. Both are similar in magnitude, 120-130% of neutral as the maximum, with one occurring in central Alabama and the other is southern South Carolina.

Positive anomalies are the focus of May. Regions of above neutral conditions occur in western and central Mississippi, southeast Alabama, southwestern and northwestern Georgia, northeast Florida and the western Carolinas (figure 8). Most impressive are the two large positive ‘dots’ on the map. Charlotte, NC and Natchez, MS are the respective centers of these two ‘dots’. Since these areas clearly stand out as a spatially small maximum they will be further discussed later.

On a large scale, June doesn’t stand out (figure 9). However there are two pockets of below neutral condition. The least significant, in terms or magnitude, is

northern Mississippi, while the area of central coastal Florida has a clear minimum of 70-80% of neutral around Sarasota. Also this Florida anomaly will be investigated further.

A large area of above neutral precipitation covering southeastern Mississippi, Alabama, the Florida panhandle, northern and western Georgia, South Carolina, eastern Tennessee, and western North Carolina appears in July (figure 10). Spots of 30-40% above neutral are found in southwestern Mississippi, south Alabama, and western Florida.

In August, below neutral conditions dominate much of the domain including eastern Mississippi, Alabama, western and northern Georgia, the Florida panhandle, northwestern South Carolina (figure 11). A minimum occurs in northeastern Mississippi of 30-40% below neutral.

September is one of the more interesting months with several distinct areas of activity. South Florida is largely dry along with northern Mississippi. Pockets within Georgia, eastern Alabama, southern Mississippi, and South Carolina are above neutral (figure 12). Eastern North Carolina also displays positive deviations. However, this area is quite different than the others. For one, the maximum is larger spatially and forms a target, if you will, over eastern North Carolina. Since this area is quite different than the other positive regions, it will be examined later. That is only one notable feature during this month another is in Mississippi. By themselves, the two anomalies in Mississippi don't warrant investigation. However, they are in vast contrast of each other, with northern Mississippi exhibiting a negative anomaly and southern Mississippi being positively aligned. This dipolar nature of Mississippi during September shows why this area is worth further investigation.

October is similar to the previous month in the respect that there is a large positive area in the Carolinas, however; this time South Carolina is also included. Since such a large area is covered by this deviation and noting that there are very few other positive spots, October cold phase will be an excellent candidate for further investigation. Besides this area, below neutral precipitation appears widely throughout the domain. Regions of below neutral include western Tennessee, northern Mississippi, northern Alabama, southwest Alabama, central Georgia, and northern Florida.

Below neutral is the name of the game in November (figure 13). The Atlantic Coast is at least 50-60% of neutral. Except for central and south Florida the domain shows negative deviations. Perhaps what is more interesting than the large negative coverage and magnitude is the area northeast of Tampa. Not only does this area not follow the pattern, but also it actually shows 10-20% above normal. Needless to say, this area is will come under further investigation.

Much of the previous negative deviations are basically neutral by December. Central and south Florida is the most notable regions of below neutral, 60-70% of neutral. Also South Carolina and eastern Georgia show wide spread negative anomalies with areas along the South Carolina-Georgia border serving as a minimum. Central and eastern Tennessee along with coastal Florida around Apalachicola shows 10-20% above neutral. Overall, this month is similar to March.

### 3.3 Maximum Temperature – El Niño

Much of the domain, south and east Mississippi, Alabama, Florida, Georgia, central Tennessee, and the eastern Carolinas, are below neutral in January (figure 14). Two spots of larger deviations, 2-3°C below neutral, are seen in southern Georgia and one in northern Florida. In February, only Florida, southeastern Alabama and southern Georgia are below neutral. In March the domain is dominated by below neutral. February and March have similar patterns to January for El Niño maximum temperature. Only a small area of cooler than neutral conditions is found along the NC-TN border in April.

During May warmer than neutral conditions appear in extreme northern Tennessee. Just like in April, June only has a cooler than normal area in the mountains. In July conditions are basically neutral throughout the domain. Central Tennessee shows a tendency for above neutral conditions in August. There is also a location of warmer temperatures than neutral in northeast Georgia. September is the same as July. Isolated cooler than neutral condition conditions are present in northern North Carolina in October. During November several random locations of below neutral occur, most concentrated in the mountainous region.

### 3.4 Maximum Temperature – La Niña

During January, only south Florida and most of the Carolinas are not above neutral (figure 15). February is much the same with only south Florida, northwestern Tennessee and extreme northern North Carolina not warmer than neutral. Again south Florida is close to neutral in March along with parts of the Carolinas. In April through June only a pocket along the Tennessee-North Carolina border is below normal. In November locations of above neutral invades western Mississippi. December is similar to January, with Tennessee, Mississippi, Alabama, Georgia, north Florida and western Carolinas being above neutral.

### 3.5 Minimum Temperature –El Niño

Starting in January much of the area is below neutral (figure 16). A smaller portion of the domain is cooler than neutral in February. Isolated pockets within southern Mississippi, southern Alabama, northern Florida, southern Georgia and southern South Carolina display negative deviations.

### 3.6 Minimum Temperature – La Niña

In January, the domain is spilt into two parts: the western half, which is above neutral and the eastern half, which is neutral (figure 17). In March areas of above neutral conditions are in Mississippi, western Alabama and western Tennessee. In November, the only below neutral area is central North Carolina. Above neutral condition reappear in December across Mississippi, southern Alabama and the Florida panhandle.

### 3.7 May Case Study Part I – Natchez, MS

The first case to be investigated is an area around Natchez, MS. For comparison purposes, Hattiesburg, MS was also chosen. Hattiesburg is part of the positive deviation

as well. To begin with, monthly totals for every cold phase year were compared. These data points were taken from the actual PRISM data. Comparing the years, 1954 is clearly an anomaly (table 5). The monthly totals for each site were compared with neutral so that comparisons would be more viable. In 1954 Natchez was 302.62% percent of neutral while Hattiesburg was only 88.21% of neutral. Once it has been determined that this year caused the anomaly, daily data was investigated. Daily summaries from the NWS indicate Natchez received 10.51 inches and Hattiesburg zero on the 1<sup>st</sup> (table 6). This could be an error in reporting, but this is the official HCN value as well. Furthermore, Jackson, MS reported over 4 inches on this day which means the reading could actually be accurate. To summarize, this one extreme precipitation event in Natchez caused this anomaly.

### 3.8 May Case Study Part II – Charlotte, NC

To determine why there is a deviation at the Charlotte area, Asheville and Charlotte were compared. One year, 1975, greatly impacts the overall average for Charlotte (table 5). During this month Charlotte received 350% of neutral while Asheville recorded only 180% of neutral. NWS daily summaries confirm both locations were wetter than normal, with Asheville setting three daily records and Charlotte setting two daily records within the month (table 6). The major difference in the two stations occurs during the 3<sup>rd</sup> when Charlotte receives over 3.5 inches while Asheville reports only 0.15 inches for the 2<sup>nd</sup> and 3<sup>rd</sup>. More widespread flooding occurred on the 30<sup>th</sup> and 31<sup>st</sup>. The Gastonia Gazette (1975) states, 4.55 inches of rain were recorded from Thursday morning to Friday morning 29<sup>th</sup> - 30<sup>th</sup>. Gaston is a neighboring county to Charlotte. According to the NWS, in Charlotte, a new monthly record for May was set, eclipsing the old record by more than an inch. Two flooding events within one month sets this region as an anomaly. Also the effect of localized flooding is seen with Charlotte receiving notable more precipitation.

### 3.9 June Case Study – Western FL

To analyze the negative anomaly in western FL two stations were chosen for comparison, Sarasota (inside the anomaly) and Orlando. From table 7 is clear the year of 1942 stands out with a difference in percent neutral of around 70%. In addition, 1954 and 1956 both have a difference greater than 50%. Belle Glade and St Leo, both HCN stations, were chosen because of their proximity to the area of interest. On June 4, 1942 Belle Glade reports almost 7 inches (table 8). This location is in southeast FL, outside the negative area. On the June 18-19, 1954 Belle Glade was reporting values much larger than the stations around the anomaly.

With no tropical activity in the area, a new hypothesis needs to be formed in order to explain this area. According to the JMA index this anomaly does not exist. This is the major clue. As it would happen the years of 1942 and 1954 are new ModJMA cold years for June, in other words, they were not included in the JMA index. Next, the JMA cold June cases and the ModJMA cold June cases for Sarasota and Orlando were compared. In Orlando the average percent neutral for just the old JMA June cases is 115.02% while the average percent neutral for the new ModJMA June cases is 94.29% (table 9). This is only a percentage difference of about 20%. Sarasota is a bit different; the average percent neutral of the old JMA June cases is 141.72% whereas the average percent neutral for the new ModJMA June cases is 72.29%. This difference of 60% surely would 'create' this negative anomaly in western FL. In other words, the modification of the index creates a widely differing pattern over western FL than previously noted.

### 3.10 September Case Study Part I – Mississippi

To investigate what is occurring in Mississippi, Tupelo (negative) and Jackson (positive) were chosen. By comparing the two stations several years of interest appear. The first is 1906 where Tupelo had 233% of neutral and Jackson had 449% of neutral (table 10). With both locations having such high amounts of precipitation, a tropical system could be influencing the area. According to the hurricane tracks (Neumann 1999), on September 27, 1906 a hurricane hit around Biloxi and then traveled northwest through MS.

The next year of interest is 1942 where the percent neutral for Jackson is 75% higher than Tupelo. However this is before HCN data in the area. Similarly 1949 reports a large difference in the two areas. The two closest HCN stations are Booneville (northeast) and Monticello (south). On September 5<sup>th</sup> Monticello received 3.95 inches while Booneville received only 0.3 inches (table 11). A tropical storm hit around Grand Isle, LA on the 4<sup>th</sup> and moved northeast into MS.

In 1967 there is no single rain event that stands out in the HCN data. From September 24<sup>th</sup> – 25<sup>th</sup>, 1970 Monticello received 2.65 inches, which sets that year as an anomaly. Both 1971 and 1973 there is one day that is largely different between the two stations, the 17<sup>th</sup> and 13<sup>th</sup>, respectively. However, these two events were not influenced by a tropical system. Finally, 1999 displays quite a difference. Tupelo's percent neutral is 12.74% and Jackson's percent neutral is 138.74%. Monticello reported over 0.9 inches on the 5<sup>th</sup> and 1.6 inches for the 29<sup>th</sup>-30<sup>th</sup>. At the same time Booneville received less than one tenth of an inch. So the positive anomaly in this case, is a result of a tropical system and a few heavy rainfall days. The negative anomaly is not so easily resolved. In Tupelo only 4 of 20 years had above neutral rainfall whereas Jackson had 11 of 20 at above neutral. The average September precipitation for Tupelo during cold phases under the ModJMA is 35 mm less than it would be under the JMA (table 12). At the same time, the average for Jackson varies only slightly. Overall, September La Niña events appear to produce a dry pocket in northern MS under the ModJMA.

### 3.11 September Case Study Part II – Eastern North Carolina

Since a wide area in North Carolina shows a positive deviation, the investigation is tailored toward years of extreme precipitation. Fayetteville and Raleigh were chosen as sites since both are located within the positive anomaly. As seen from the chart of monthly precipitation, 2 years stand out 1924 and 1999 (table 10). For 1924 both sites report over 330 mm while in 1999 the value is over 400 mm.

A tropical depression came ashore just south of Perry, FL on the September 29<sup>th</sup> and traveled up through GA and the Carolinas. During the 30<sup>th</sup> this system is over eastern North Carolina. By looking at observations the theory that this system greatly

influences the area can be backed up. Although Fayetteville is a HCN station, its length of record doesn't cover 1924. Therefore, the closest HCN station, which is Lumberton, NC, will be used. On the 29<sup>th</sup>, almost an inch was reported with an additional 5.5 inches on the 30<sup>th</sup> (table 13). As a result, it is clear that a tropical system caused this month to be anomalous.

In 1999 there is stronger evidence for tropical activity Tropical Storm Dennis came ashore south of Cape Hatteras on September 4<sup>th</sup>. This takes the tropical storm through the heart of this positive anomaly. Later in the month, Hurricane Floyd makes landfall very close to Dennis on the 16<sup>th</sup>. However this system travels northeast and proceeds up the coast also impacting Maryland, New Jersey, and Connecticut. Only the actual daily observations will show which system produced the most rain or whether they both attributed equally. Observations from Fayetteville for the 5<sup>th</sup> and 6<sup>th</sup> show less than 2 inches combined (table 13). However, on the 16<sup>th</sup> 6.8 inches were reported. Therefore, Hurricane Floyd set 1999 as an anomalous year. To sum it up, the positive deviation is a result of tropical activity.

### 3.12 October Case Study Part I – Carolinas

This case is similar to the September, eastern North Carolina case. Therefore the same stations will be used. The years of 1942, 1964, 1971, and 1999 each have at least Fayetteville or Raleigh with 150 percent neutral or larger (table 14). A tropical storm came ashore late on the October 11, 1942. The nearest HCN station to landfall is Edenton, NC where 6.69 inches were recorded from October 10<sup>th</sup>-14<sup>th</sup> (table 15). In 1964 Hurricane Isabel made landfall around Cape Hatteras on October 16<sup>th</sup>. Although Edenton received 1.85 inches on the 16<sup>th</sup>, this is not the main reason for this month standing out. On the 4<sup>th</sup> and 5<sup>th</sup> Edenton reported over 6 inches. Another HCN site, Kinston also reported high rainfall on the 5<sup>th</sup>. As reported in The Daily Times-News (1964) in Burlington, NC, floods sent hundreds from their homes. According to the Asheville office of the U.S. Weather Bureau, rainfall ranged from 4 to 14 inches across western NC on the 4<sup>th</sup>. This is attributed to the remnants of Hurricane Hilda.

The next year that stands out is 1971. Using HCN data the excessive rainfall is narrowed down to the 1<sup>st</sup> and 2<sup>nd</sup>. Hurricane Ginger made landfall on the North Carolina coast on September 30 then proceeded through NC into Virginia until entering back into the Atlantic on October 3<sup>rd</sup>. Kinston and Edenton reported 5.2 and 3.1 inches for the first three days of the month respectively. As reported by The Daily Times-News (1971), Ginger caused \$1,000,000 damage on the North Carolina coast. Some areas of NC received close to 9 inches from this storm.

Finally, 1999 also stands as an anomalous year. Heavy rainfall was received in Edenton on the 17<sup>th</sup> and 18<sup>th</sup>. On the 16<sup>th</sup>, hurricane watches were issued along NC coast for Hurricane Irene and upgraded to warnings by the afternoon. However, Irene stayed offshore minimizing damages in the Carolinas. According to the National Climatic Data Center, NCDC, 46 counties in the Carolinas were affected by flooding on October 17<sup>th</sup> (1999). Therefore, the positive anomaly in the Carolinas during October cold phases is caused by tropical activity.

### 3.13 October Case Study Part II – Western Mississippi (El Niño)

The locations of Jackson and Hattiesburg were compared to determine why such a large positive anomaly lies in this area. After computing the percent neutral for each year, at the two locations, the difference between these quantities was of interest. The difference in the percent neutral for Jackson was at least 125% higher than Hattiesburg for the following years: 1905, 1918, 1925, 1982, and 2002 (table 16). On October 9<sup>th</sup>, 1905 a tropical storm came ashore around Racoon Point, LA and proceeded through MS. HCN stations are lacking in the area of the anomaly. The closest two stations are Port Gibson and Canton. Since Biloxi is the only HCN station in the state that has records back to 1905, it is not helpful for verification. During the 7<sup>th</sup> and the 8<sup>th</sup> 1982, 2.89 and 3.53 inches were reported respectively (table 17). The precipitation received on the two days was a significant portion of the monthly totals at the locations, accounting for approximately 75% of the monthly precipitation. In 2002 Hurricane Lili made landfall in southern LA early on the 3<sup>rd</sup>. According to the NCDC, thunderstorms swept over southern MS on the 3<sup>rd</sup> and 4<sup>th</sup> (National Climatic Data Center, 2002).

### 3.14 November Case Study – Tampa, FL

From figure 24 Tampa is located on the border of a positive anomaly. With this hypothesis, Tampa and Orlando were analyzed with the thought being Tampa would show up positive whereas Orlando is clearly located in the negative deviation area. Table 18 shows the percent neutral for every November cold phase. After the average of these percent are calculated, it is determined Tampa is not in the anomaly. Average percent neutral for Tampa is approximately 83%, which is not much different than Orlando at 80%.

Next St. Leo, an HCN station, was analyzed in similar fashion. At this location the average percent of neutral was determined to be nearly 100% (Table 18). Since this area is neutral this is closer to the anomaly. Finally the location of Dade City was chosen. As depicted on the chart, the average here is over 120%, which is in the anomaly.

Now the point of emphasis is shifted toward what has caused this anomaly. Comparing percent neutral for each year at Orlando and Dade City, one-year stand out above the rest, 1998. Although both locations experience significant above neutral precipitation, Dade City is 250% neutral higher than Orlando. It is possible to have tropical activity in this location in November; therefore hurricane tracks were considered. On November 23, 1988, Tropical Storm Keith passed through central FL just south of Tampa. Listed on Table 19 are the daily rainfall amounts for St Leo (basically neutral) and Tarpon Springs. While over 9 inches were recorded in St Leo on the 23<sup>rd</sup> only 6.5 inches were reported at Tarpon Springs. The anomaly was close to St Leo, and Dade City is only 12 km south and 24 km east of St Leo. Using the hurricane track it can be concluded that this tropical storm is the main reason for the positive anomaly around Tampa, FL (Dade City, FL).

## 4. DISCUSSION

### 4.1 May Cold Phase Differences in Indices

Once the average JMA precipitation values for May cold phase are subtracted from the respective ModJMA values, there is a noticeable anomaly on the eastern coast of Florida (figure 18). To further investigate this area, the HCN station of Titusville was chosen. Table 20 shows that the two indices differ quite significantly over this area. The average percent of neutral for only the new ModJMA years is roughly neutral, 97.5%, whereas the average percent of neutral for only the old JMA years is approximately 156%. Three years in the JMA index, which are not in the ModJMA index, had over 250% of neutral, 1923, 1925, 1976; no year in the ModJMA had over 150% of neutral. This is an example of how the slight modification of the index can change what is expected in a specific location. Since a fine resolution dataset was used, this difference between the east and west coast of FL in May cold phase can be distinguished.

### 4.2 June Cold Phase Differences in Indices

In the June difference plot there are two areas of interest, the west coast of FL and north and western MS (figure 19). Since the area in FL showed up in the ModJMA plots and was discussed there, MS will be the focus in this section. The station of Greenville, MS was used for analysis based on its location and its designation as a HCN station. Comparing the two indices, the average percent of neutral for the old JMA years is largely different than the average percent of neutral for the new ModJMA years, 120% and 84% respectively (table 21). Three years sit as outliers in this comparison, 1957, 1974, and 1989.

The next step is to look more closely at these years. Table 22 shows the daily precipitation values at Greenville during June of 1957, 1974, and 1989. June 28, 1957 is one of the higher rainfall days. On this day, the remnants of Hurricane Audrey swept through northern MS. Other heavy rainfall occurred during the beginning of the month

so tropical activity is not the sole reason it is anomalously high. From June 5-8, 1974, 4.9 inches were reported. Most of this rain can be associated with the surface low over TX on the 6<sup>th</sup> ahead of a cold front. This led to southeasterly wind over the Southeast U.S (NOAA, 1974). By the 7<sup>th</sup> squall lines entered MS. Only a very brief explanation of the precipitation is included since the focus of this study is concerned more with when precipitation occurs and not so much the cause.

#### 4.3 July Cold Phase Differences in Indices

During July cold phases, the major difference in the indices is in the south. One of the largest differences is centered on Pensacola, FL (figure 20). Comparing the precipitation values over both indices it is obvious that the ModJMA is averaging 35% higher values based on their respective neutrals (table 23). Three years in the ModJMA stand out as ones in which precipitation was over 175% of neutral: 1916, 1973, and 1975. Since 1975 is in both indices, although different neutral values lead to different percent neutrals, only 1916 and 1973 will be analyzed. On July 5, 1916 a major hurricane made landfall around Biloxi and Gulfport, MS. Although it didn't hit the area of interest, it appears be the reason for extreme rainfall during this month. For 1973 there is not the evidence of tropical activity. Instead there are two extreme rainfall days: July 6 and 28, 1973 where 3.17 and 4.84 inches were reported respectively (table 24). Therefore the modified definition yields a 'new' year with high tropical activity and one with heavy rainfall.

#### 4.4 April Warm Phase Differences in Indices

Difference in indices during April warm phase shows that the ModJMA yields larger values in central FL (figure 21). Orlando is an ideal location within this difference to examine. There is a vast contrast between the two indices evident in table 25. The average for the old JMA years is 65% of neutral while the average for the new ModJMA years is 166% of neutral. Several years in the ModJMA have high precipitation amounts: 1957, 1982, 1991, and 1997. The closest COOP station to Orlando with data

covering these years is Kissimmee. In 1957, a total of 2.2 inches was received on the first two days of April. From April 9-11, 1982 over 1.8 inches were reported. Although these values seem small, they are a large percentage of the monthly totals, as less than 2.5 inches is the monthly average (Southeast Regional Climate Center). In 1991, the story is slightly different. On April 23, 1991 2.25 inches were reported along with 0.72 inches the next day. In April 1997, 4 days received over 0.75 inches of rain. More Aprils contain extreme rainfall events in the ModJMA than in the JMA.

#### 4.5 May Warm Phase Differences in Indices

During May warm events the JMA index is noticeably large in northeastern FL (figure 22). In order to investigate this anomalous difference, Jacksonville was examined. Table 26 displays the precipitation for the ModJMA and JMA for May warm phase. There are several years in the JMA index that lead to a large difference between the two indices, most notably are 1903, 1906, 1952, and 1966. For 1903 and 1906 Fernandina Beach was used instead of Jacksonville because of data availability. On May 8 and 9, 1903 8.55 inches were reported with a total of 16.27 inches for the month (table 27). From May 22-26, 1906 7.75 inches of rainfall fell. On May 1952, 4 days had over 1 inch of precipitation with the 30<sup>th</sup> leading the way with 4.28 inches. May 8, 1966 was a 3-inch rainfall event. Keep in mind the average precipitation for May in Northeast FL is just over 3 inches (Southeast Regional Climate Center), which easily makes these heavy rainfall events exceed the monthly average. Therefore, extreme rainfall events, that occurred during May warm phase in JMA and don't appear in ModJMA May warm phase, leads to a large difference between the two indices in this region.

#### 4.6 August Warm Phase Differences in Indices

In August warm phases there is a wide spread difference in the indices. One of the larger differences is centered on Scottsboro, AL (figure 23). As evident from table 28, the difference in the old years vs. the new years is approximately 60%. JMA years in which at least 150% neutral was experienced during August are: 1906, 1912, 1914, 1926,

1952, 1988, and 2003. HCN records at Scottsboro only go back to 1927. Therefore the last 3 years will be the focus (table 29). In 1952 no one day stands out, only several days of notable precipitation accumulating in a monthly total over 9 inches. Two days with at least 1.5 inches were seen in August 1988. August 3, 2003 with 3.81 inches evaluates this year as anomalous. With average August precipitation for Scottsboro being about 3.5 inches, it is quite obvious that these rain events push their respective months well above normal.

In order to investigate the other 5 years, Talladega was utilized rather than Scottsboro. This is the only HCN station in AL that has data coverage sufficient for this purpose. Since the difference between the two indices is so widespread there shouldn't be a great difference when using Talladega. On the other hand, Talladega is not in the heart of the large differences like Scottsboro. In 1906, 1912 and 1926, there is at least one day with over 2 inches. Of these years, 1919 is the least impressive with only just over an inch above normal. During August 1914, 4 days reported rainfall at or greater than one inch. This is another example of how a few scattered days of heavy rainfall throughout the dataset can significantly influence the results.

#### 4.7 September Warm Phase Differences in Indices

A significance difference between the ModJMA and JMA index in September warm phase appears in southern AL, the FL panhandle and southern MS (figure 24). The largest of these anomalies is in the vicinity of Troy, AL. Although several JMA years have a large percentage of neutral, 1926 and 1998 are by far the largest with 322% and 457% of neutral respectively (table 30). For numbers such as these there should be a noticeable system passing through the area during these times. On September 20, 1926 a hurricane was located just off shore of the Apalachicola area and moved northwest before making landfall in southern AL. Since Troy doesn't contain records this far back Coffee Springs was used instead. Luckily, this station is fairly close to Troy. Confirming the hurricane tracks, 8.10 inches were reported on the 20<sup>th</sup> (table 31). On September 28, 1998 hurricane Georges made landfall in Biloxi, MS. Then this system turned northeast and began traveling eastwardly. On the 29<sup>th</sup> the tropical depression entered AL and

traveled along the FL-AL and FL-GA line until entering the Atlantic. Precipitation values from Troy will be used with this year since Coffee Springs was offline by this time. From September 29-30, 8.25 inches were received. Therefore, the ModJMA index excludes two Septembers in which tropical activity was a major contributor to this small area of southern MS and AL and the FL panhandle.

#### 4.8 Precipitation Warm Phase Significant Differences

Very few isolated location have significant differences in March warm phase. The area of Wilmington, NC is negatively significant along with a pocket within SC. Mobile and surrounding areas are positively significant. April is the first month where several areas show differences. Central FL is significant and most is significant at the 95% confidence level (figure 25). Also there is an area of positively significant difference along the SC coast. In May 4 large areas of negative significance are seen: southern GA, northeast FL, Wilmington, NC and the upper NC coast (figure 26). During June warm phase, most of the significant differences are located in northern TN and northern NC (figure 27). In July there are several areas that are significant (figure 28). Areas within central TN and central AL are significant at a -95% confidence interval. In addition, there are significant locations in SC, western MS, GA and western TN. About half of the domain is negatively significant in August warm phase (figure 29). During September warm phase areas of positive significance are confined to eastern NC, eastern TN, western SC, northern GA, and central TN (figure 30). Also of interest is the area of negative significance in southern AL.

#### 4.9 Precipitation Cold Phase Significant Differences

Positive significances are found during April cold phase in SC and GA (figure 31). Two large areas in which differences are significant to -95% are seen in June. One of these areas is the central Gulf Coast of FL while the other is southwest TN and northern MS (figure 32). In July positive significances are dominant (figure 33). August cold phase displays positively significant differences in NC, SC and eastern TN. At the

same time, isolated areas of negative significance are located in AL, northern FL, and western GA (figure 34). During September cold phase there are two major areas of focus. An area of negative significance is seen in northeastern MS while an area of positively significant differences is located south of the Sarasota region (figure 35).

#### 4.10 Maximum Temperature Warm Phase Significant Differences

Several areas are positively significant in May warm phase (figure 36). The major areas include, MS, western AL, northern FL, southern GA, northern NC and western and eastern TN. MS, AL and TN are positively significant in August warm phase (figure 37). In September the northern edge of the domain is negatively significant (figure 38).

#### 4.11 Maximum Temperature Cold Phase Significant Differences

Positively significant areas are located throughout eastern NC, SC coast and GA coast in May cold phase (figure 39). During July cold phase the significance are found in the southern coastal areas of FL (figure 40). In August cold phase the differences in maximum temperature is positively significant on the southeastern coast of FL. During September cold phase, negatively significant differences are found in central FL and eastern NC.

#### 4.12 Minimum Temperature Warm Phase Significant Differences

Central and south FL are positively significant in April (figure 41). In May warm phase MS, TN and western AL are positively significant (figure 42). Most of the negative significant areas are located in northeastern FL in July cold phase (figure 43). This area is still negatively significant in August, as well as areas of SC and eastern NC (figure 44). During September warm phase, areas of negative significance appear in north and south FL, eastern NC, MS, and AL (figure 45).

#### 4.13 Minimum Temperature Cold Phase Significant Differences

Scattered areas of positively significant differences are seen throughout the northern portion of the domain during July (figure 46). A large percentage of the southeast has differences that are positively significant in August (figure 47). The coastal areas, except for the peninsula of FL, are negatively significant in September cold phase (figure 48).

## 5. SUMMARY AND CONCLUSIONS

During warm phase, from November-April, wet conditions are seen in the coastal areas. July and August are both dry. From fall to spring, Florida and the Atlantic Coast are basically dry, however; the Mississippi River Valley doesn't appear wet as previous studies have indicated.

Patterns of temperatures across the southeast are less variable than the precipitation. During cold phase winters, much of southeast experiences warm conditions when compared to neutral. Conversely, during warm phase cooler than neutral conditions are seen from January-March. Both of these patterns are more easily seen in the maximum temperatures than in the minimum temperatures.

Individual tropical storms can also be identified with the increased resolution PRISM data provides. Several examples of this are seen throughout the time period. Western NC during September cold phase displays precipitation as much as 60% above neutral as a result of tropical activity. In October cold phase, the Carolinas experienced as much as 150% of neutral precipitation because of tropical activity. Not only does the ModJMA allow for a better temporal resolution, the PRISM data allows for a better spatial resolution as well.

Since the impacts of ENSO events have been seen over the southeast U.S., a state-by-state break down of the ModJMA conclusions will follow to provide more regional summaries. Seasonal breakdowns are as follows: spring (March-May), summer (June-August), fall (September-November), and winter (December-February).

### 5.1 Tennessee

#### 5.1.1 Warm Phase

Winters begin with 10%-30% above neutral precipitation then transition into 10%-40% below neutral and finally return to near neutral. TN experiences approximately neutral precipitation during the spring. In June, precipitation is 10%-40% above neutral. In July and August, below neutral precipitation dominates. Precipitation is close to neutral in fall except for the mountainous area in September (110%-140% of neutral).

Maximum temperatures in December are neutral whereas January, February, and March experience a shift of -2 to -1 °C. The rest of the year has maximum temperatures that are approximately neutral. In January, minimum temperatures are 1 to 2°C below neutral in the mountainous areas. For the remainder of the year, minimum temperatures are close to neutral.

#### 5.1.2 Cold Phase

In January, precipitation in TN is approximately neutral. Precipitation ranges from 10%-40% below neutral in February. During the spring, precipitation is near neutral. The summer doesn't experience much deviation from neutral either. Southwestern TN is below neutral in June; eastern TN is above neutral in July; extreme southern TN is below neutral in August. An area of 10%-30% below neutral precipitation occurs along the southern border during September. In October, the western half of the state is below neutral with the eastern half of the state joining as well during November. During December, the eastern portion of the state is no more than 20% above neutral.

During January cold phase, maximum temperatures are 1 to 2° C greater than neutral for the entire state except for part of the mountains. In February this area of difference shifts to the eastern portion of TN. Maximum temperature is 1 to 2°C greater than neutral statewide in March. Until December there are no notable differences. In December, western TN experiences a shift in maximum temperatures up to 2°C greater than neutral. In January, minimum temperatures are 1 to 2° C greater than neutral for the west and central. Except for isolated areas in extreme western TN, where minimum temperatures are 1 to 2° C greater than neutral in March, the state is near neutral throughout the remainder of the year.

### 5.2 Mississippi

#### 5.2.1 Warm Phase

During January, the northern 2/3 of the states experiences precipitation 60%-90% of neutral. This area is near neutral during the remainder of the winter. Coastal areas of MS are slightly above neutral in the winter. In spring, much of the state is slightly above neutral except for May in which the southern portion is 10%-40% below neutral. In June

precipitation is roughly neutral, whereas in July and August, below neutral precipitation dominates. In September and October, central MS is above neutral. However, in November precipitation is approximately neutral.

Maximum temperatures in December are neutral whereas January experiences a shift of -2 to -1 °C in the south. February switches back to neutral. Maximum temperatures are 1 to 2°C below neutral in March. The rest of the year has maximum temperatures that are basically neutral. In January, minimum temperatures are 1 to 2°C below neutral in the south. The rest of the year, minimum temperatures are close to neutral.

### 5.2.2 Cold Phase

In January, precipitation is 10%-30% below neutral in southern MS. Similarly, during February below neutral is seen in the south. However there is 10%-30% above neutral in the north. During the spring, the coastal areas are below neutral. In addition, precipitation in May is 10%-30% above neutral in the central portion of the state. Precipitation is 10%-30% below neutral in the north during June. The southeast, locations experience above neutral precipitation in July. In August below neutral precipitation is seen in eastern MS. During September, the north is up to 40% below neutral while the south is up to 50% above. In October, the above neutral area disappears and in November the entire state is below neutral. December is basically neutral.

During winters and March, maximum temperatures in MS are 1 to 2°C greater than neutral. Until November, maximum temperature is close to neutral. During November portions of western MS are 1 to 2°C greater than neutral. In January, minimum temperatures are 1 to 2° C greater than neutral statewide. A few areas in central MS still display this shift in February. During March, minimum temperatures in the northeast and around Jackson are 1 to 2° C greater than neutral. Most of the southern and central portions of MS have minimum temperatures 1 to 2° C greater than neutral in December.

## 5.3 Alabama

### 5.3.1 Warm Phase

During January, the northern portion of the state experiences precipitation 70%-90% of neutral. The rest of winter this is a near neutral area. Coastal areas of AL are slightly above neutral in the winter. The spring is neutral except for May in which south AL is slightly below neutral. In June, precipitation is 10%-40% above neutral in the northern portion of the state. Whereas in July and August, below neutral precipitation dominates. Precipitation in south AL is slightly above neutral during the fall.

Maximum temperatures in December are neutral whereas January experiences a shift of -2 to -1 °C. February then switches back to neutral. Maximum temperature is 1 to 2°C below neutral in March. The rest of the year has maximum temperatures that are basically neutral. In January, minimum temperatures are 1 to 2°C below neutral. Isolated pockets of below neutral minimum temperatures are seen in February. The rest of the year, minimum temperatures are close to neutral.

### 5.3.2 Cold Phase

In January, precipitation is 10%-30% below neutral in southern AL. Similarly, February has below neutral in the south; however, there is 10%-30% above neutral in the north. March is similar to January. In April, precipitation in central AL is above neutral and the southeastern portion is above neutral in May. June is approximately neutral. Precipitation in July is above neutral statewide and below neutral throughout in August. During September, eastern central AL is as much as 160% of neutral and the northwestern corner is slightly below neutral. Precipitation in October is below neutral in the north and extreme south. In November, the entire state is below neutral. December is basically neutral.

During winters and March, maximum temperatures in AL are 1 to 2°C greater than neutral. During the rest of the year maximum temperatures are close to neutral. In January, minimum temperatures are 1 to 2° C greater than neutral statewide. The only other notable departure from neutral includes isolated areas in February, March, and December.

## 5.4 Georgia

### 5.4.1 Warm Phase

Precipitation in southern GA is as low as 40% of neutral in winters. Precipitation in southern GA ranges from 10%-30% above neutral in the spring, except during May where the entire state is 60%-90% of neutral. In June, precipitation ranges from neutral to 20% above neutral. In July and August, below neutral precipitation dominates. In September and October, the northern portion of the state is slightly above neutral and the coastal areas experience below neutral conditions. In November the entire state is above neutral by as much as 70%.

Maximum temperatures in December are neutral whereas January experiences a shift of -3 to -1 °C. February is only below neutral in the south. Maximum temperatures are 1 to 2°C below neutral in March. During the remainder of the year, maximum temperatures are basically neutral. In January, minimum temperatures are 1 to 2°C below neutral in the south. Isolated pockets of below neutral minimum temperatures are seen in February. The rest of the year, minimum temperatures are close to neutral.

#### 5.4.2 Cold Phase

In January through March, southern GA is 60%-90% of neutral. April is approximately neutral and isolated areas throughout GA are above neutral in May. June is approximately neutral. In July, precipitation is above neutral in the north and west. Precipitation in August is below neutral in the north and west. In September, precipitation is above neutral or neutral statewide. Conversely, precipitation in October is below neutral or neutral statewide. In November, the entire state is below neutral. December returns to basically a neutral state.

In general, winters and March experience maximum temperatures that are 1 to 2°C greater than neutral. During December, maximum temperatures are 1 to 2°C greater than neutral in the central and south, except for the coastal areas. Portions of northern GA have minimum temperatures that are 1 to 2°C greater than neutral in January. Otherwise, minimum temperatures are near neutral.

### 5.5 Florida

#### 5.5.1 Warm Phase

During wintertime, FL (except for the panhandle) ranges from 10%-70% above neutral for precipitation. In the spring, precipitation in FL (except for the panhandle) ranges from 10%-70% above neutral. However, in May, the entire state experiences

below neutral precipitation. In June precipitation is slightly above neutral in the north and south. In July the state is roughly neutral and in August, the panhandle experiences below neutral precipitation. In September precipitation on the east coast of FL is slightly below neutral. In October the northeast portion is as much as 60% of neutral. A change comes in November when the state is well above neutral.

Maximum temperatures in December are neutral whereas January and February experiences a shift of -2 to -1 °C. Maximum temperatures are 1 to 2°C below neutral in March. The rest of the year has maximum temperatures that are approximately neutral. In January, minimum temperatures are 1 to 2°C below neutral in the south. Isolated pockets of below neutral minimum temperatures are seen in February. The rest of the year, minimum temperatures are close to neutral.

#### 5.5.2 Cold Phase

During the winter, precipitation in FL is below neutral, however December is neutral in the far north. In March and April, FL is below neutral by as much as 70%. May is basically neutral. During June, the central Gulf Coast of FL is below neutral. In July only the panhandle is above neutral. Conversely, in August the panhandle is below neutral. In September, south FL is below neutral, 10%-30% of neutral. North FL is below neutral in October with isolated pockets of above neutral in the south. November is widely below neutral except for around the Tampa area.

In January and February, maximum temperatures are up to 2°C greater than neutral down to around Orlando. During March, the extent of this temperature shift pushes down to the Lake Okeechobee area. Near neutral conditions are seen until December when northern FL is once again 1 to 2°C greater than neutral. In January, minimum temperatures are 1 to 2°C greater than neutral in the western panhandle. During February, this shift is even more restricted to only the extreme western panhandle.

### 5.6 South Carolina

#### 5.6.1 Warm Phase

The coastal areas of SC are around 20% above neutral in winters. Except for May, springs in SC have neutral or slightly above neutral precipitation. In June, precipitation is 10%-40% above neutral in the southern portion of the state. Whereas in

July and August, below neutral precipitation dominates. During the fall, near neutral conditions dominate except in November where some areas are as high as 160% of neutral.

Maximum temperatures in December are neutral whereas January experiences a shift of -2 to -1 °C. February then switches back to neutral. Maximum temperature is 1 to 2°C below neutral in March. The rest of the year has maximum temperatures that are approximately neutral. In January, minimum temperatures are 1 to 2°C below neutral in the east. Isolated pockets of below neutral minimum temperatures in the south are seen in February. The rest of the year, minimum temperatures are close to neutral.

### 5.6.2 Cold Phase

Wintertime precipitation along the SC coast is 10% to 30% below neutral. In March, the entire state is below neutral. During April, precipitation is slightly above neutral on the SC coast. May is roughly neutral. In the summer, the coastal section of SC is above neutral by no more than 20%. Also in July this area of above neutral precipitation covers the state. In September, the west is 10%-20% below neutral. The north is up to 150% of neutral in October. November is largely below neutral, as much as 60% of neutral.

In January, the northwestern corner of the state experiences a maximum temperature shift of up to 2°C greater than neutral. During February, this shift is felt statewide and in March the coastal areas experience greater maximum temperature than neutral. Except for a small area of maximum temperatures 1 to 2°C greater than neutral in central SC during December, the rest of the year is approximately neutral. In January, minimum temperatures are 1 to 2°C greater than neutral in the west. Otherwise, minimum temperatures are basically in a near neutral state.

## 5.7 North Carolina

### 5.7.1 Warm Phase

The coastal areas of NC are around 20% above neutral in winters. Except for May, spring in NC has neutral or slightly positive precipitation. In June precipitation is 10%-40% above neutral in the eastern portion of the state. Whereas in July and August,

below neutral precipitation dominates. Precipitation in the fall, ranges from 70%-130% of neutral.

Maximum temperatures in December are neutral whereas January experiences a shift of -2 to -1 °C in the east. February switches back to neutral. Maximum temperature is 1 to 2°C below neutral in March. During the remainder of the year, maximum temperatures are approximately neutral. Isolated pockets of below neutral minimum temperatures are seen in January. Minimum temperatures are approximately neutral the rest of the year.

#### 5.7.2 Cold Phase

In January, the western portion of NC has below neutral precipitation. During February and March this below neutral area is confined to the coast. April is approximately neutral and above neutral areas appears in May in the west. The summer has precipitation at or slightly above neutral. Precipitation in September and October is highly above neutral in the eastern half of the state, up to 170% of neutral. November is largely below neutral (as much as 60% below neutral) whereas December is near neutral.

From January through March, maximum temperatures across western NC are 1 to 2°C greater than neutral. In February, the entire state is included, and in March only the central and south coast areas are not included. Spring and summer are near neutral except for a small area along the NC-TN border with maximum temperature up to 2°C below neutral in April, May, and June. Also areas along this same border and a pocket in the southeast are 1 to 2°C greater than neutral in December. Minimum temperatures are approximately neutral throughout the year.

### 5.8 ModJMA vs JMA Differences

Noticeable difference between the ModJMA and JMA ENSO index has been seen. With the increased resolution provided by PRISM, features that were previously unseen are brought to light. Very little difference is seen between these two indices during the winter. The biggest differences between the two indices occur during spring and summer. Since several ENSO events started before October, (as would be defined in the JMA index), these months experience some of the most outstanding differences.

This can be seen in the August plots, especially precipitation warm phase. In August El Niño drier conditions prevail throughout much of the southeast. These dry conditions are more widespread than previously known.

Besides August, the spring, mostly April, also has large differences. The reason for the differences seen in April wasn't quite so easy to explain before this study. Nearly half, 25 of 53, ENSO phases end before April in the ModJMA, whereas in the JMA they would not end until September. Wetter conditions in central FL are seen during El Niño which reinforces the El Niño spring impacts known in this area. During May and June La Niña drier conditions are seen in central FL. This reinforces what is previously known about La Niña impacts in this region. Also in June La Niña there is a second pocket of drier conditions located in west TN and MS. Unlike in central FL this region was previously not included in drier conditions for spring La Niña.

Several areas close to the coast are significantly different between the two indices during the summer and fall months. In the most part, these differences are a result of tropical activity impacting these areas during the months that are only included in one of the indices. This is evident in NC during August La Niña in which wetter conditions are widespread. These wetter conditions were not seen in the JMA indicating more tropical activity during summer La Niña than previously known.

These are only a handful of the noticeable difference seen between the ModJMA and the JMA. Although, in most cases, these differences are not widespread, they play a vital role in understanding and planning for ENSO related effects on a regional scale.

In conclusion, the ModJMA defines ENSO events on a monthly time scale instead of a yearly time scale and provides an increased resolution in the temporal scale. With the increased resolution in the spatial and temporal scales, ENSO events are now better defined. As a result, the regions of impacts are shown with a greater accuracy than in previous studies. Also by better defining ENSO events it is seen that ENSO often ends much sooner than or begins before the traditional JMA way of thinking. With this knowledge energy management, agriculture and water management can be better prepared for ENSO events. Since these agencies are better prepared they will be able to more properly manage their financial resources.

## APPENDIX

Table 1: Definition for the JMA and modified JMA ENSO Index

<b>JMA vs Mod JMA</b>		
	<i>JMA</i>	<i>Mod JMA</i>
Location of SST anomalies	4°N-4°S, 150°W-90°W	
Classification	ENSO Year Oct - Sept	ENSO Period (monthly)
Threshold SST anomalies	0.5 ° C -0.5 ° C	
SST values used	5 month running average of SST anomalies	
Selection Criteria	SST values must meet threshold value for 6 consecutive months and Oct, Nov and Dec must meet threshold	SST values must meet threshold value for 6 consecutive months

Table 2: Warm and Cold Phase Occurrences by month in the ModJMA index. The combined total of warm and cold phases are also represented.

# Mod JMA Warm and Cold Phase Occurrences												
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
26	24	24	20	18	19	20	20	20	25	27	27	Cold
26	23	16	20	23	25	24	25	26	25	26	26	Warm
52	47	40	40	41	44	44	45	46	50	53	53	Total

Table 3a-g: ENSO periods along with 5-month running average of SST anomalies. The SST anomalies are plotted in the solid line. ENSO periods according to the JMA are plotted in the long dashed line. ENSO periods according to the ModJMA are plotted in the short dashed line and offset with a secondary y-axis on the right hand side. For the ENSO periods, '0' represents neutral, '10' represents El Niño and '-10' represents La Niña.

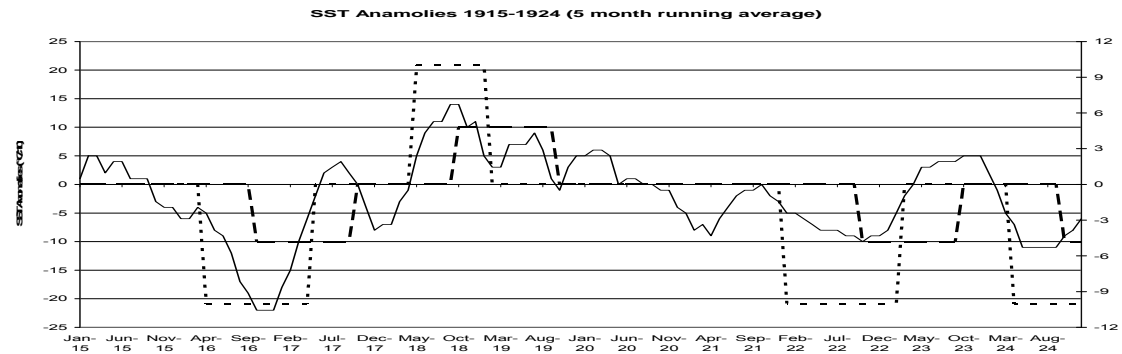
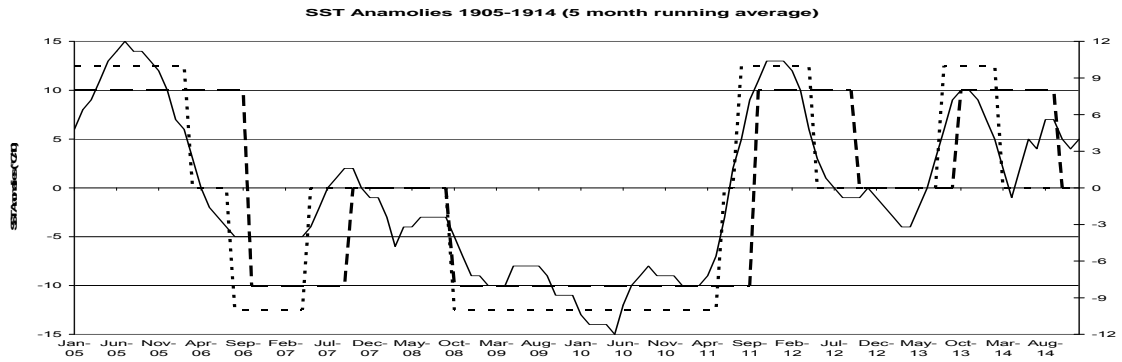
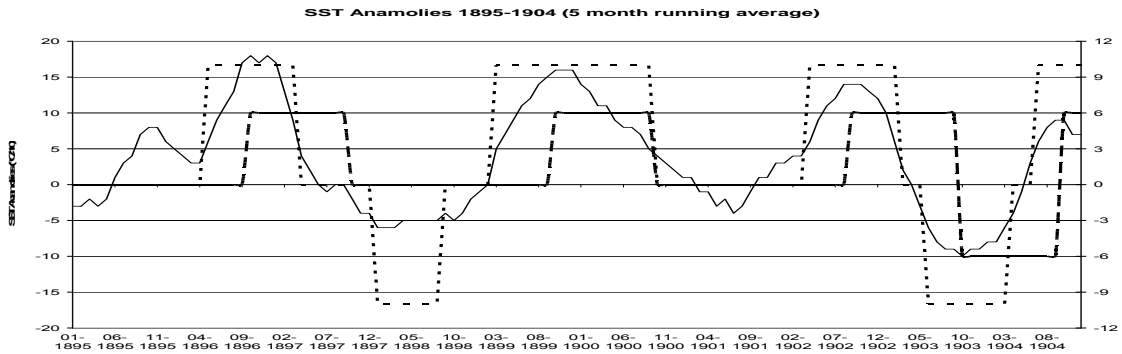


Table 3- continued

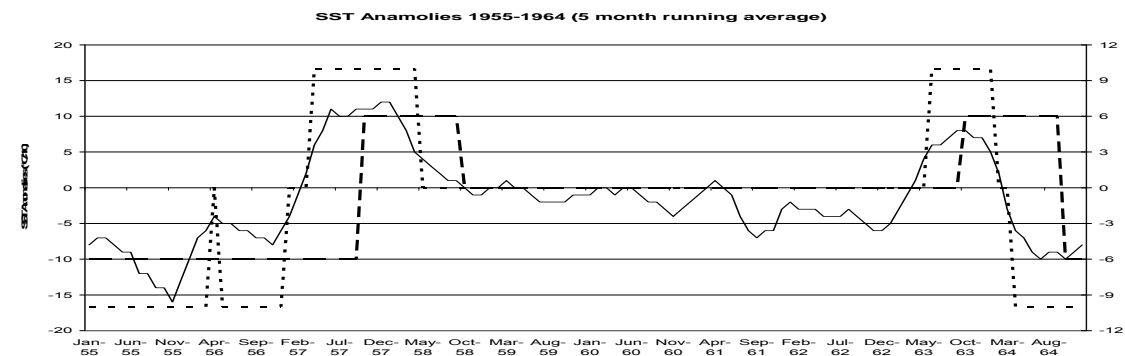
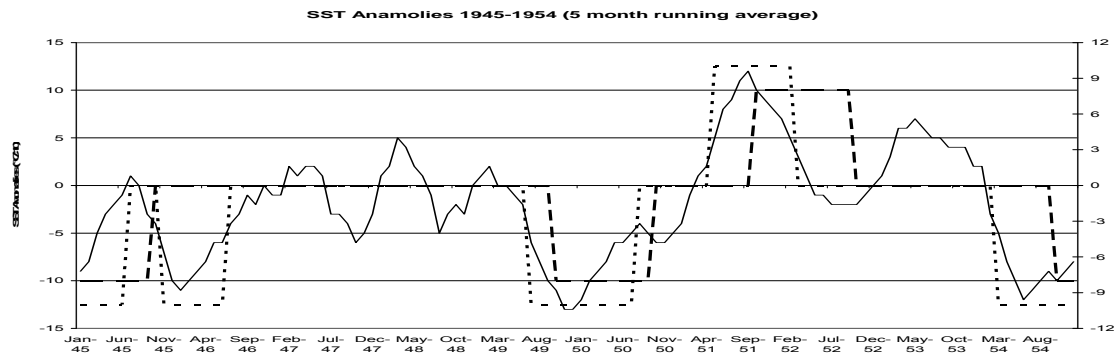
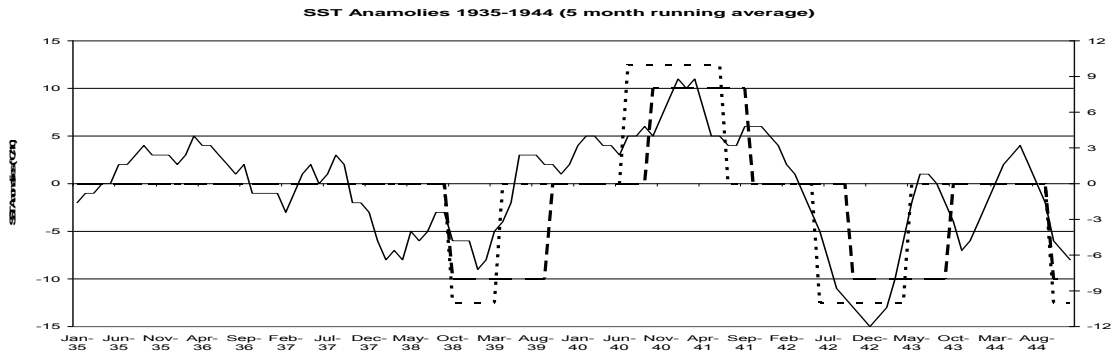
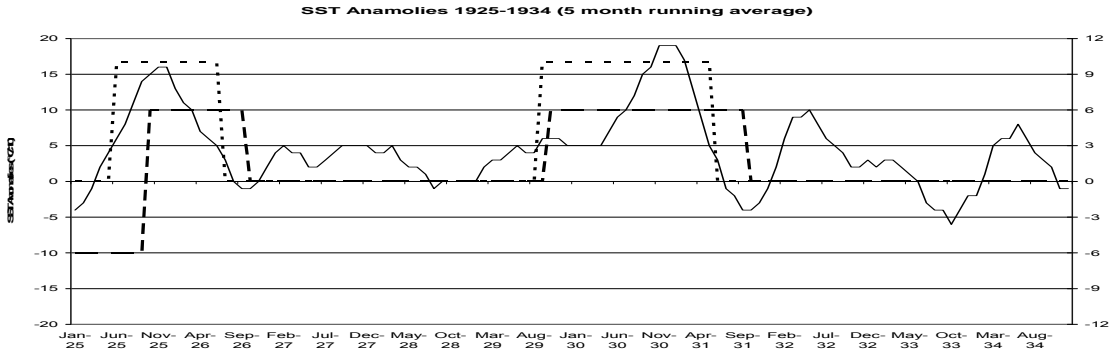
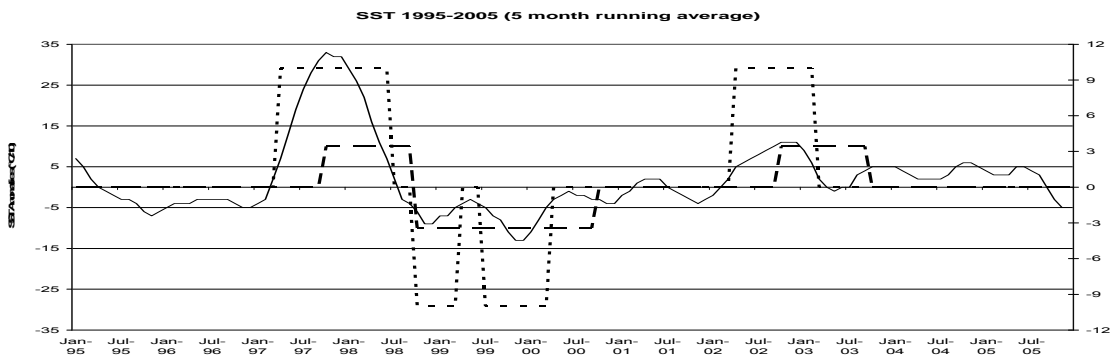
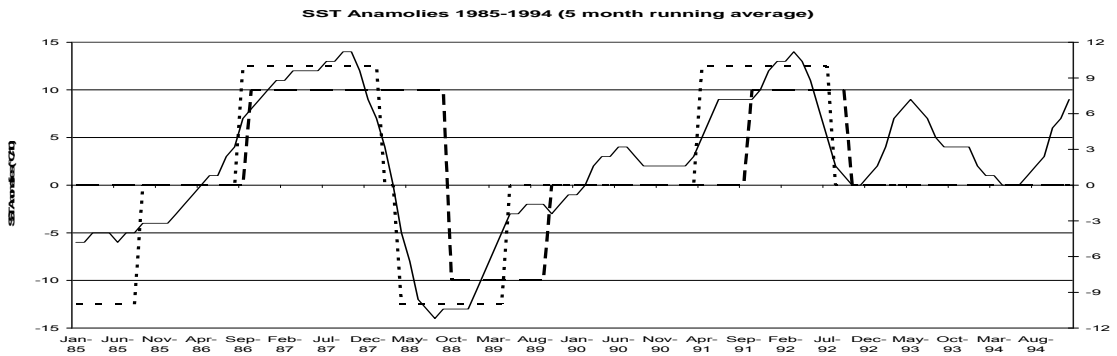
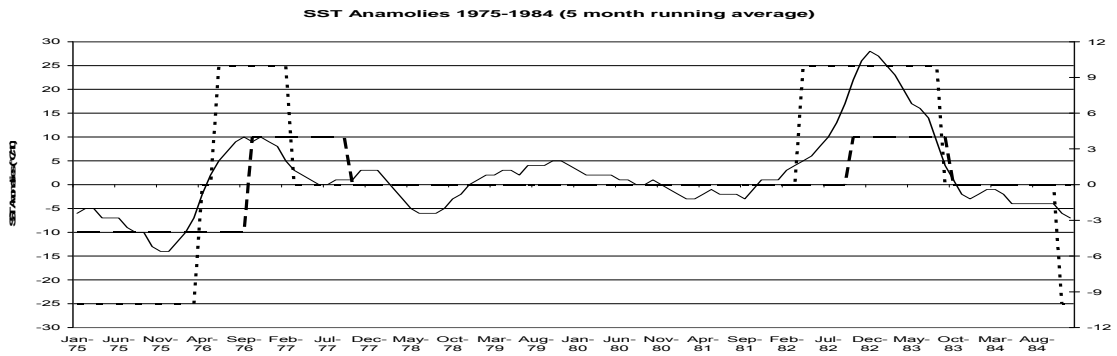
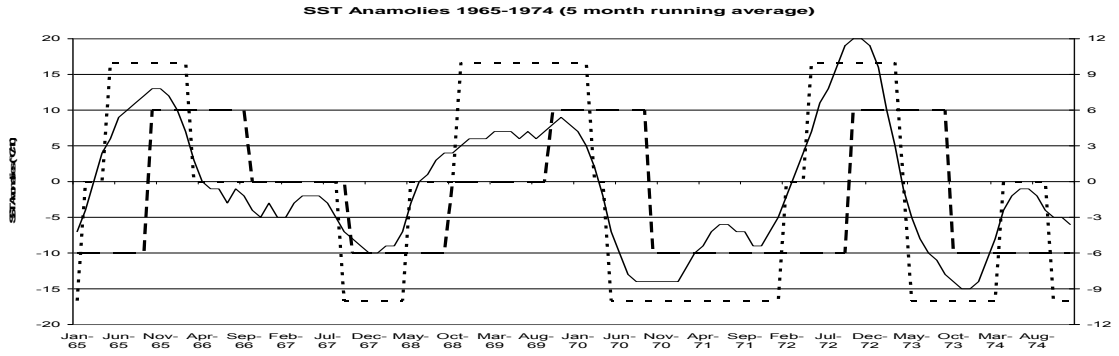


Table 3- continued



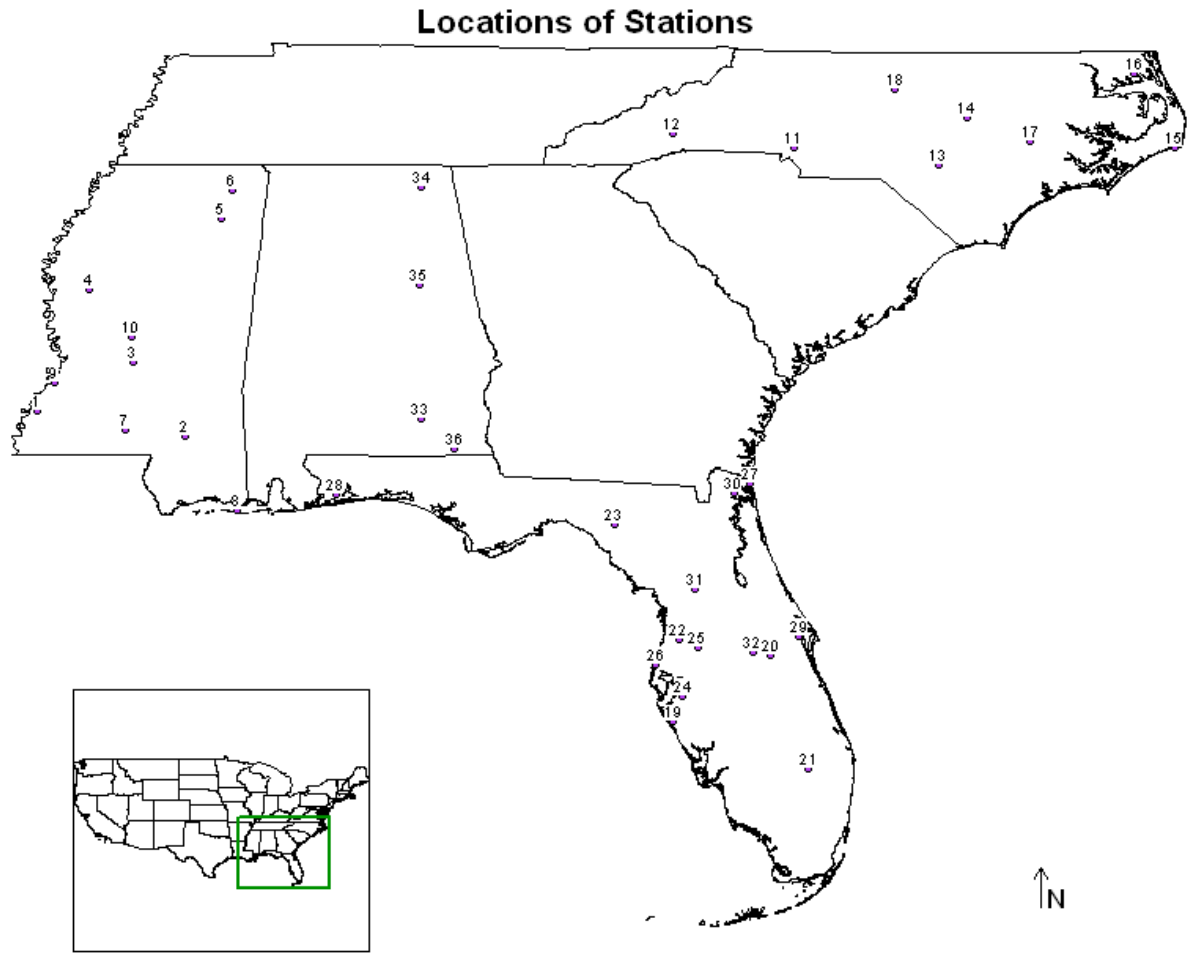


Figure 1: Locations of stations used in investigations. Refer to Table 14 for stations names

Table 4: Station key for figure 1. HCN stations are indicated.

<b>Station Key</b>			
ID #	Station	State	HCN
1	Natchez	MS	Y
2	Hattiesburg	MS	Y
3	Jackson	MS	N
4	Greenville	MS	Y
5	Tupelo	MS	N
6	Booneville	MS	Y
7	Monticello	MS	Y
8	Biloxi	MS	Y
9	Port Gibson	MS	Y
10	Canton	MS	Y
11	Charlotte	NC	N
12	Asheville	NC	N
13	Fayetteville	NC	Y
14	Raleigh	NC	N
15	Cape Hatteras	NC	Y
16	Edenton	NC	Y
17	Kinston	NC	Y
18	Burlington	NC	Y
19	Sarasota	FL	N
20	Orlando	FL	N
21	Belle Glade	FL	Y
22	St Leo	FL	Y
23	Perry	FL	N
24	Tampa	FL	N
25	Dade City	FL	N
26	Tarpon Springs	FL	Y
27	Fernandina Beach	FL	Y
28	Pensacola	FL	N
29	Titusville	FL	Y
30	Jacksonville	FL	N
31	Ocala	FL	Y
32	Kissimmee	FL	N
33	Troy	AL	Y
34	Scottsboro	AL	Y
35	Talladega	AL	Y
36	Coffee Springs	AL	N

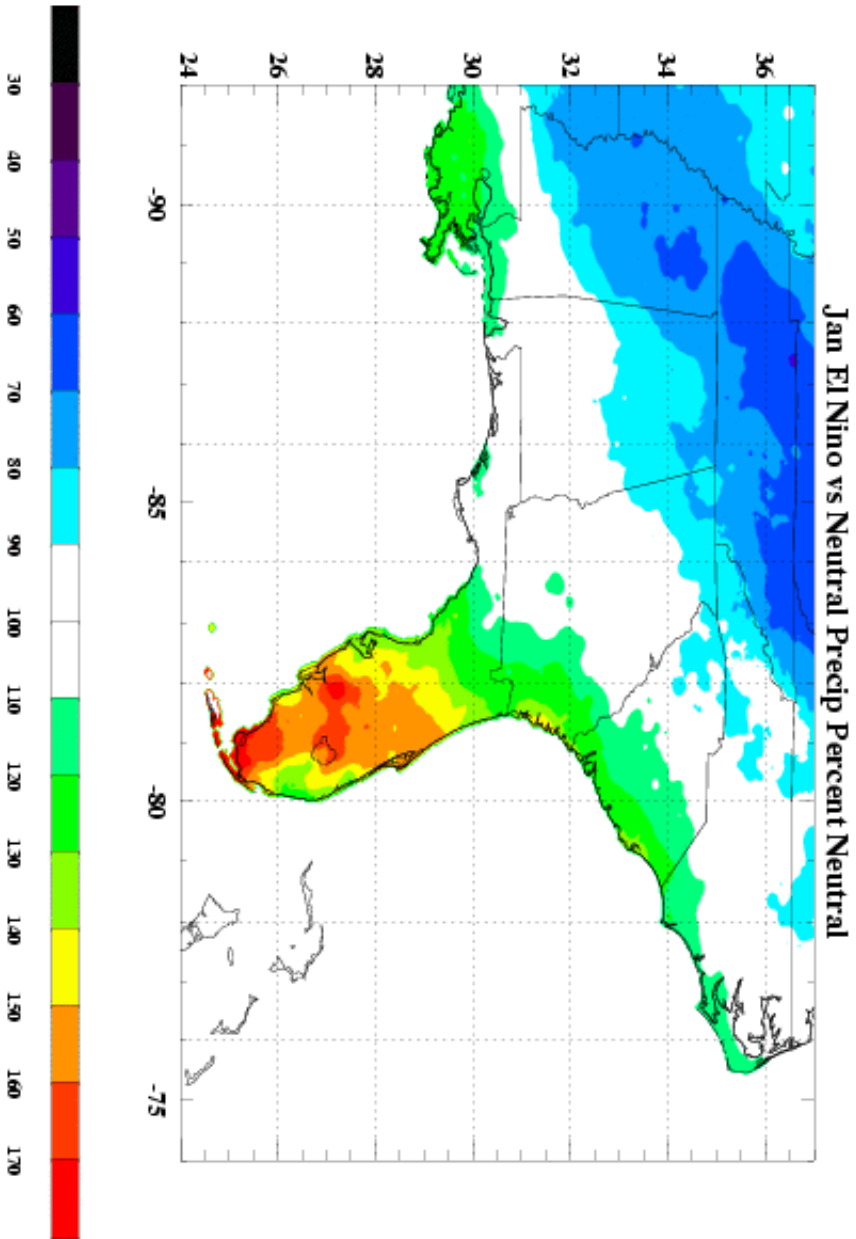


Figure 2: Jan El Niño vs Neutral Precipitation plot.  
 This plot represents average El Niño percent of  
 neutral precipitation

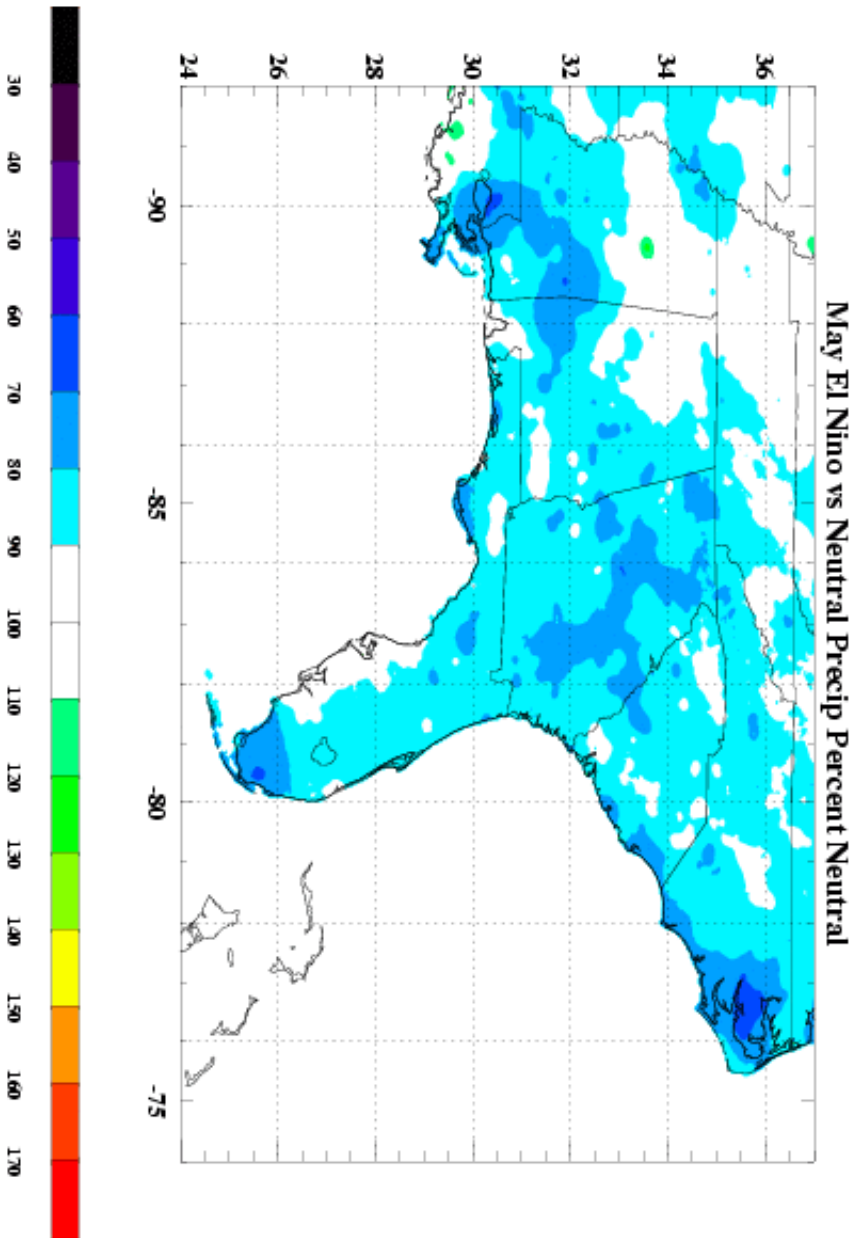


Figure 3: May El Niño vs Neutral Precipitation plot.  
 This plot represents average El Niño percent of neutral precipitation

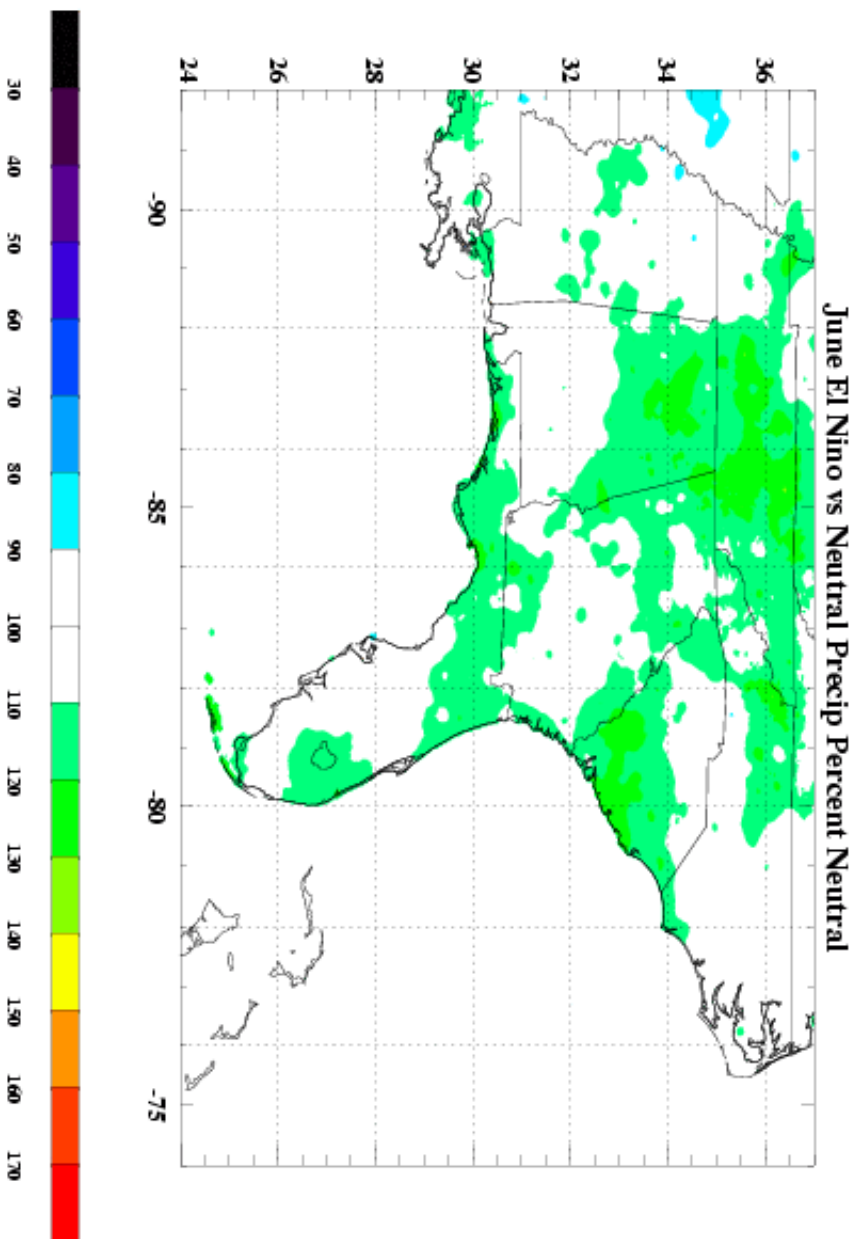


Figure 4: Jun El Niño vs Neutral Precipitation plot.  
 This plot represents average El Niño percent of  
 neutral precipitation

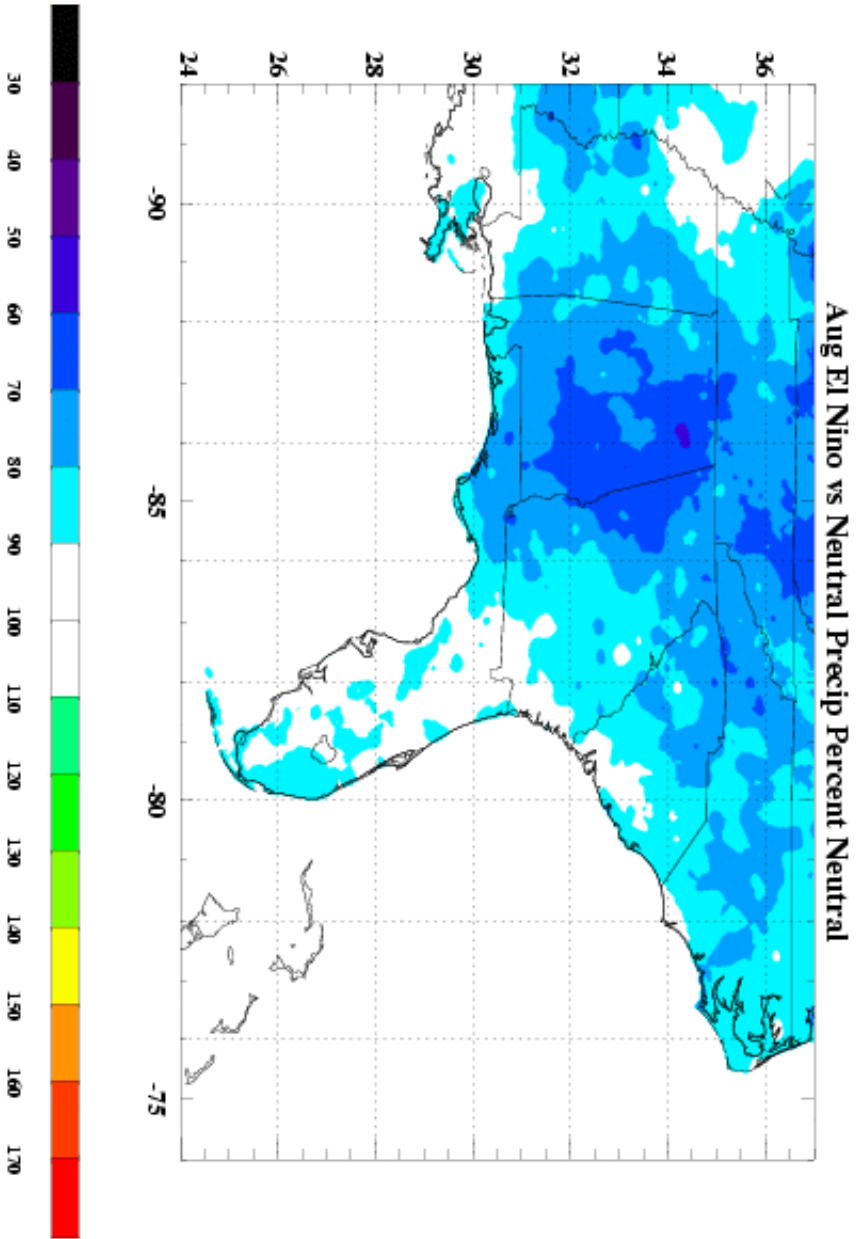


Figure 5: Aug El Nino vs Neutral Precipitation plot.  
 This plot represents average El Niño percent of neutral precipitation

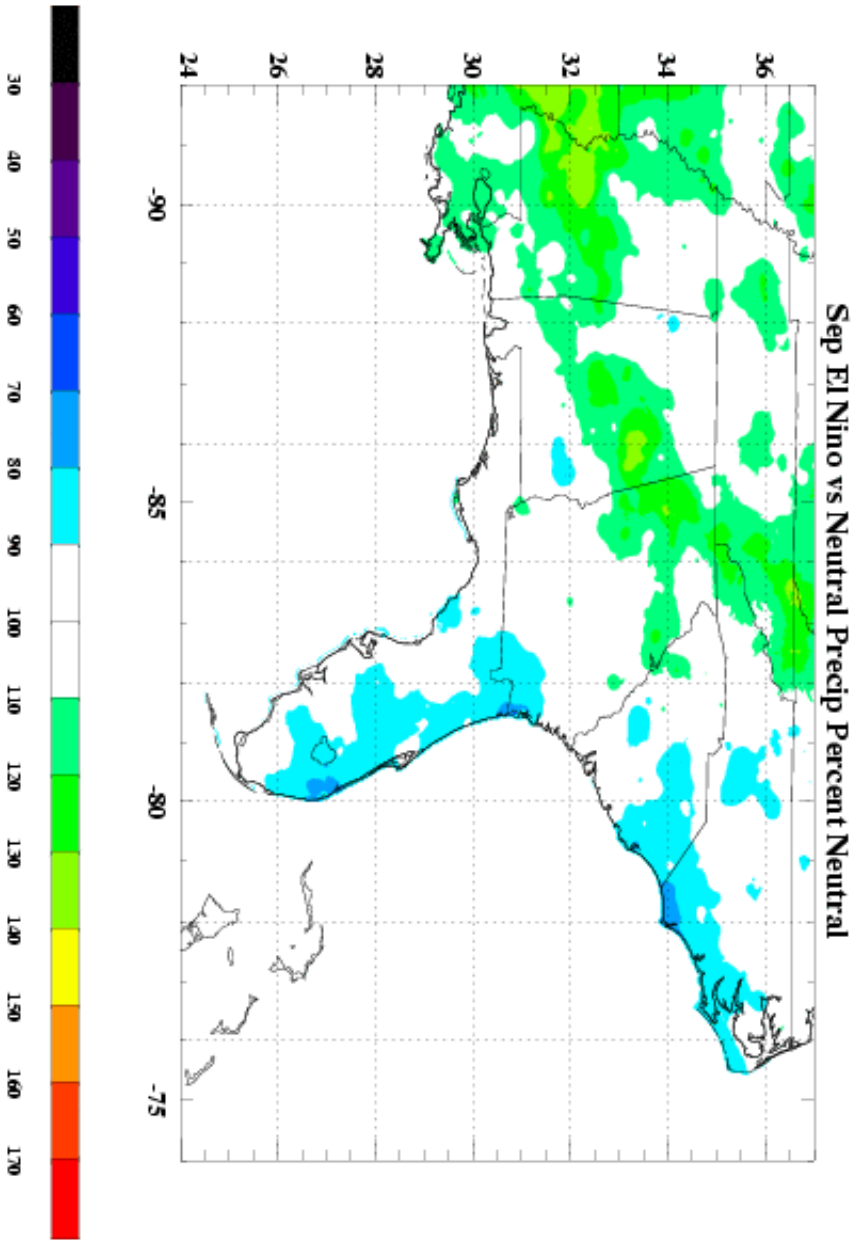


Figure 6: Sep El Niño vs Neutral Precipitation plot.  
 This plot represents average El Niño percent of neutral precipitation

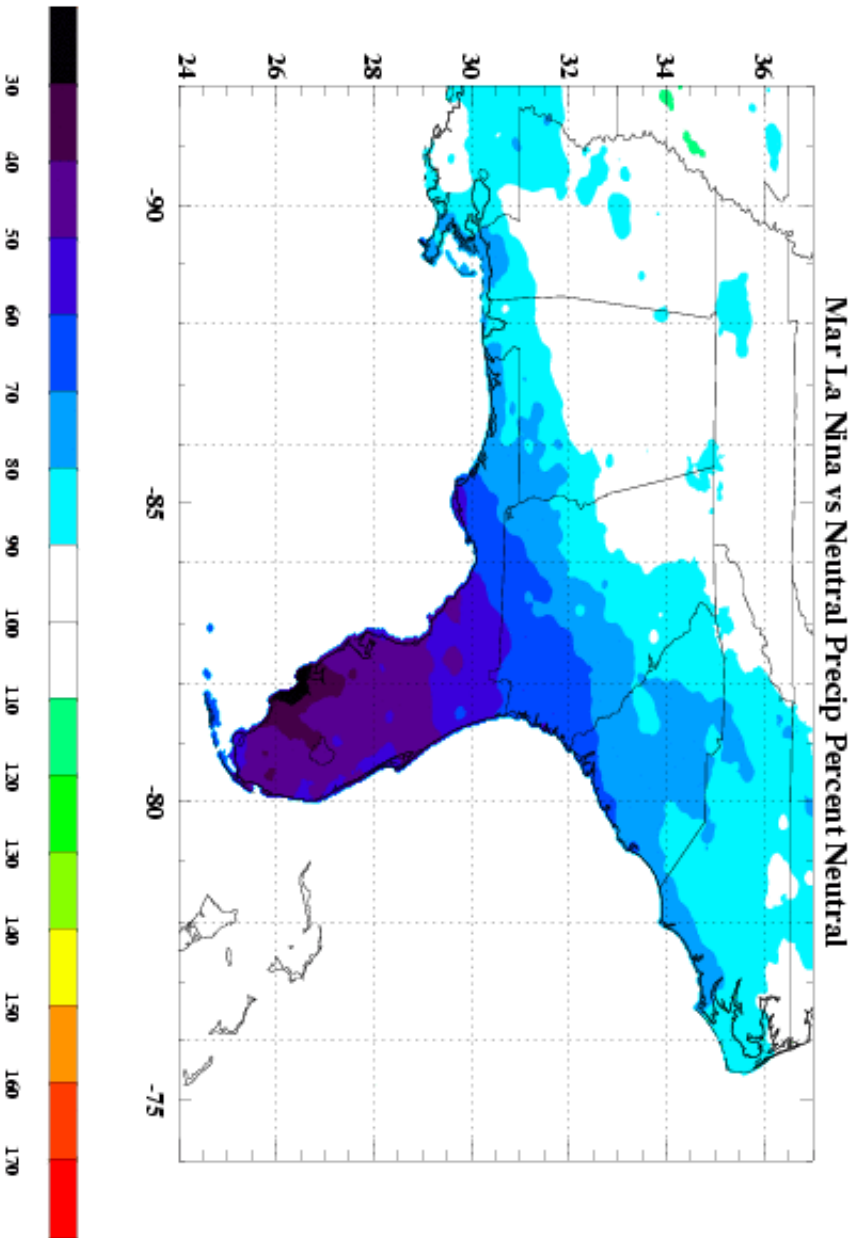


Figure 7: Mar La Niña vs Neutral Precipitation plot.  
 This plot represents average La Niña percent of  
 neutral precipitation

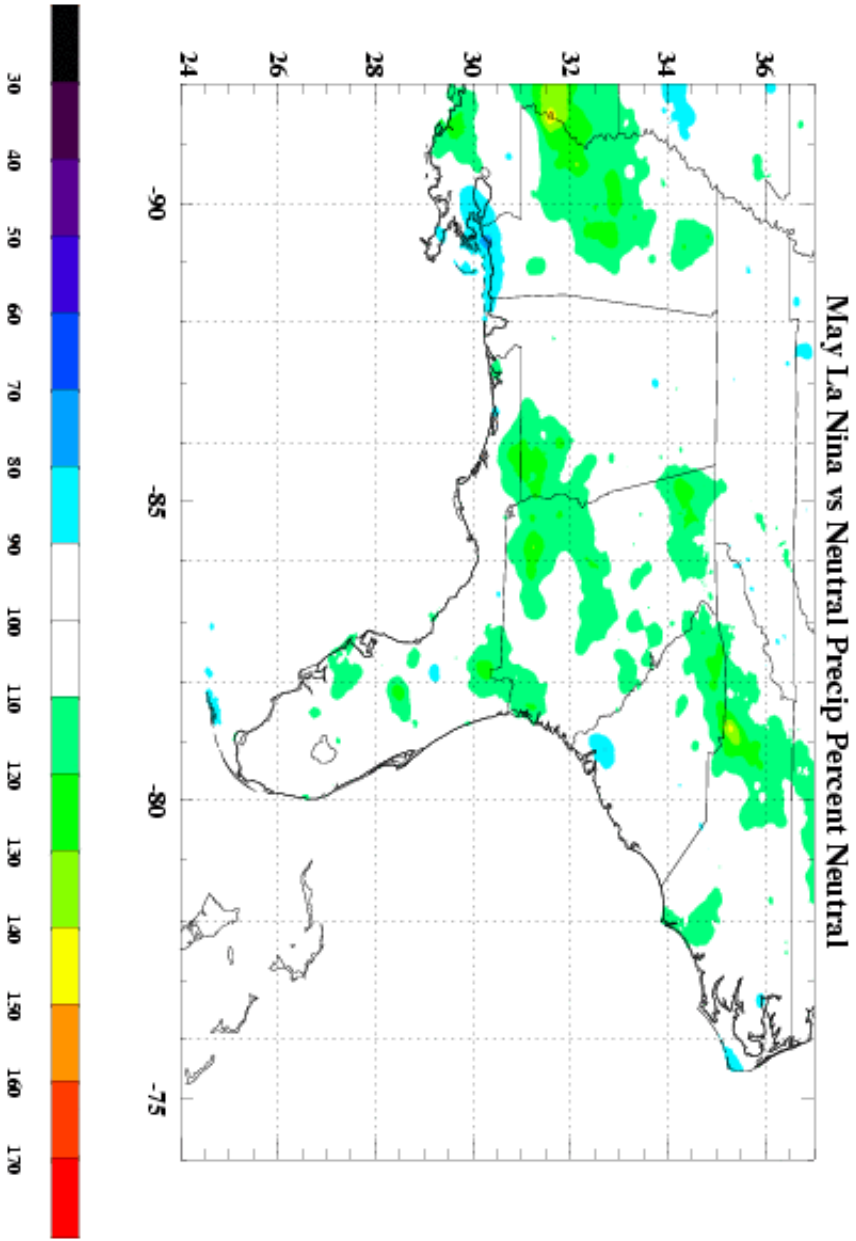


Figure 8: May La Niña vs Neutral Precipitation plot.  
 This plot represents average La Niña percent of  
 neutral precipitation

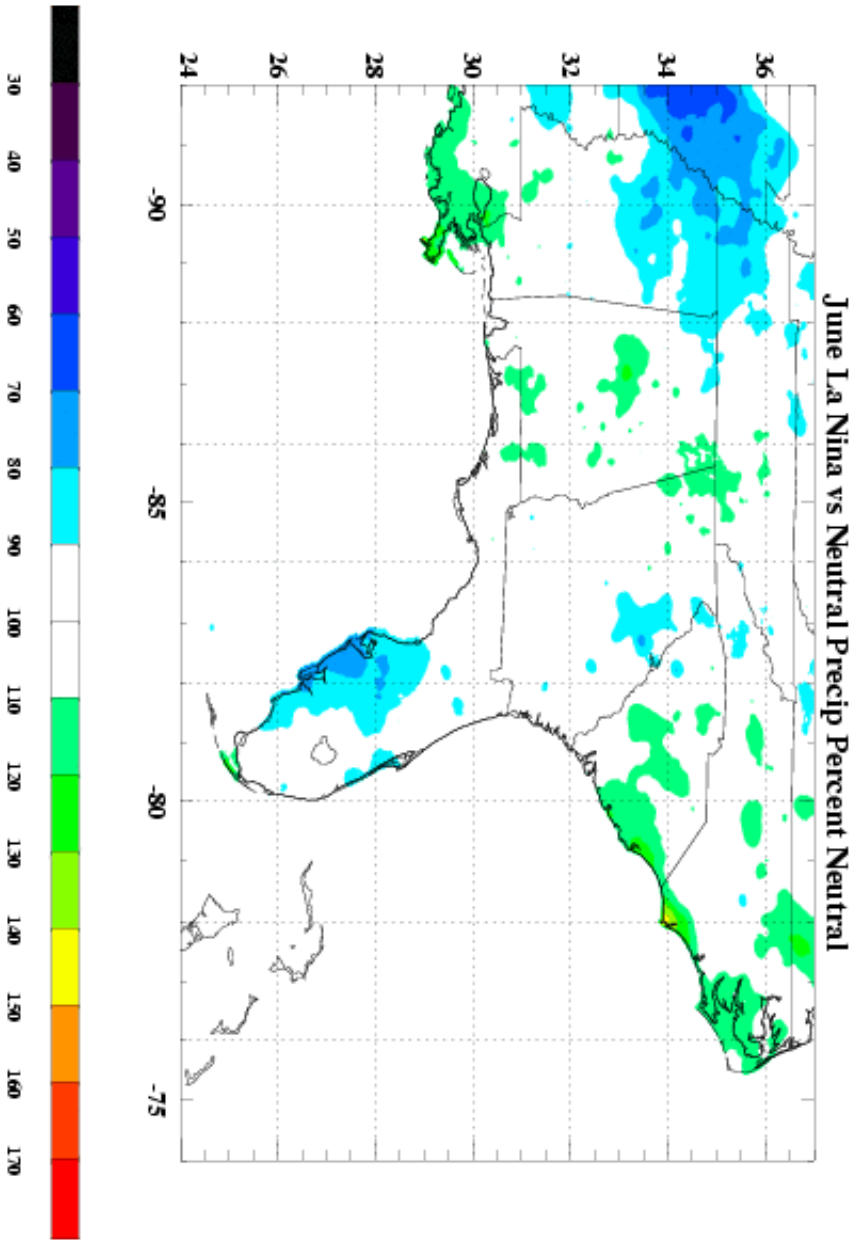


Figure 9: June La Niña vs Neutral Precipitation plot.  
 This plot represents average La Niña percent of neutral precipitation

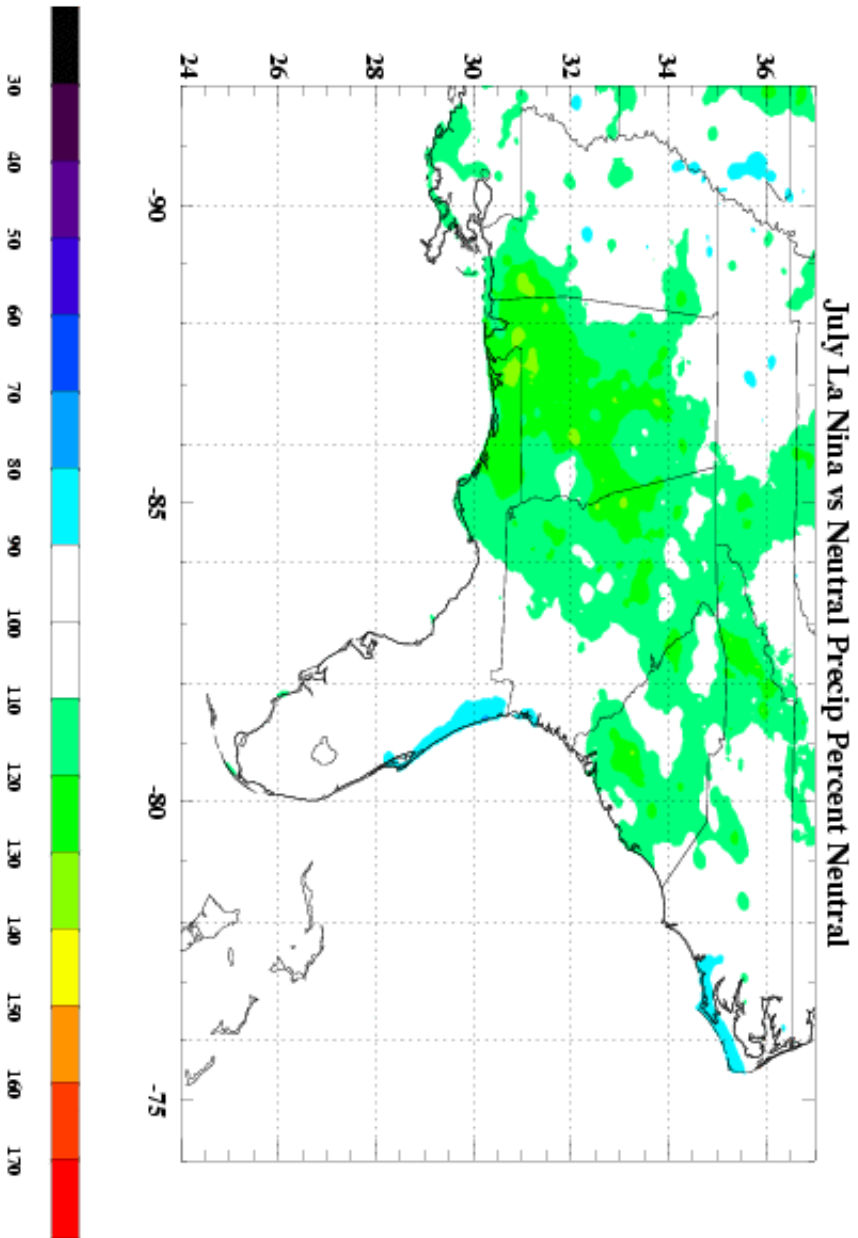


Figure 10: July La Niña vs Neutral Precipitation plot.  
 This plot represents average La Niña percent of neutral precipitation

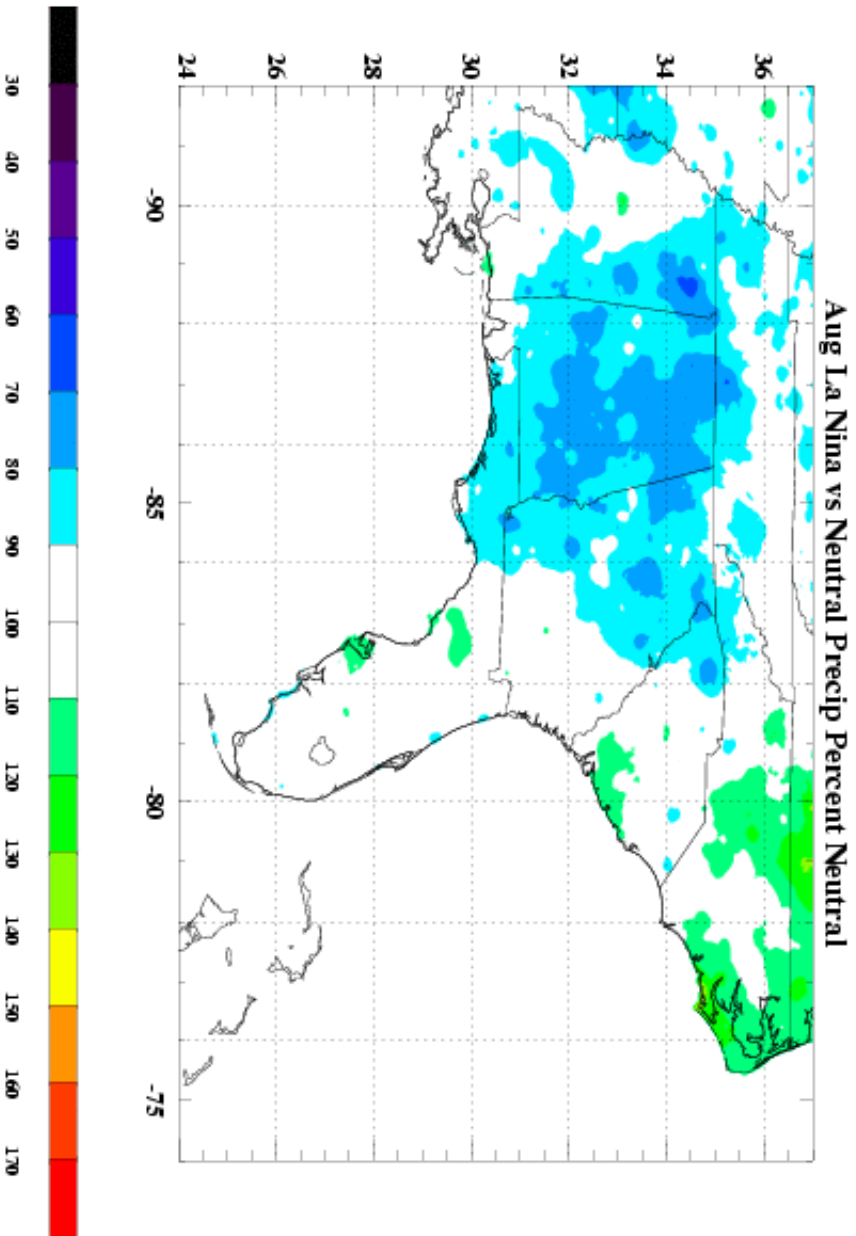


Figure 11: Aug La Niña vs Neutral Precipitation plot.  
 This plot represents average La Niña percent of neutral precipitation

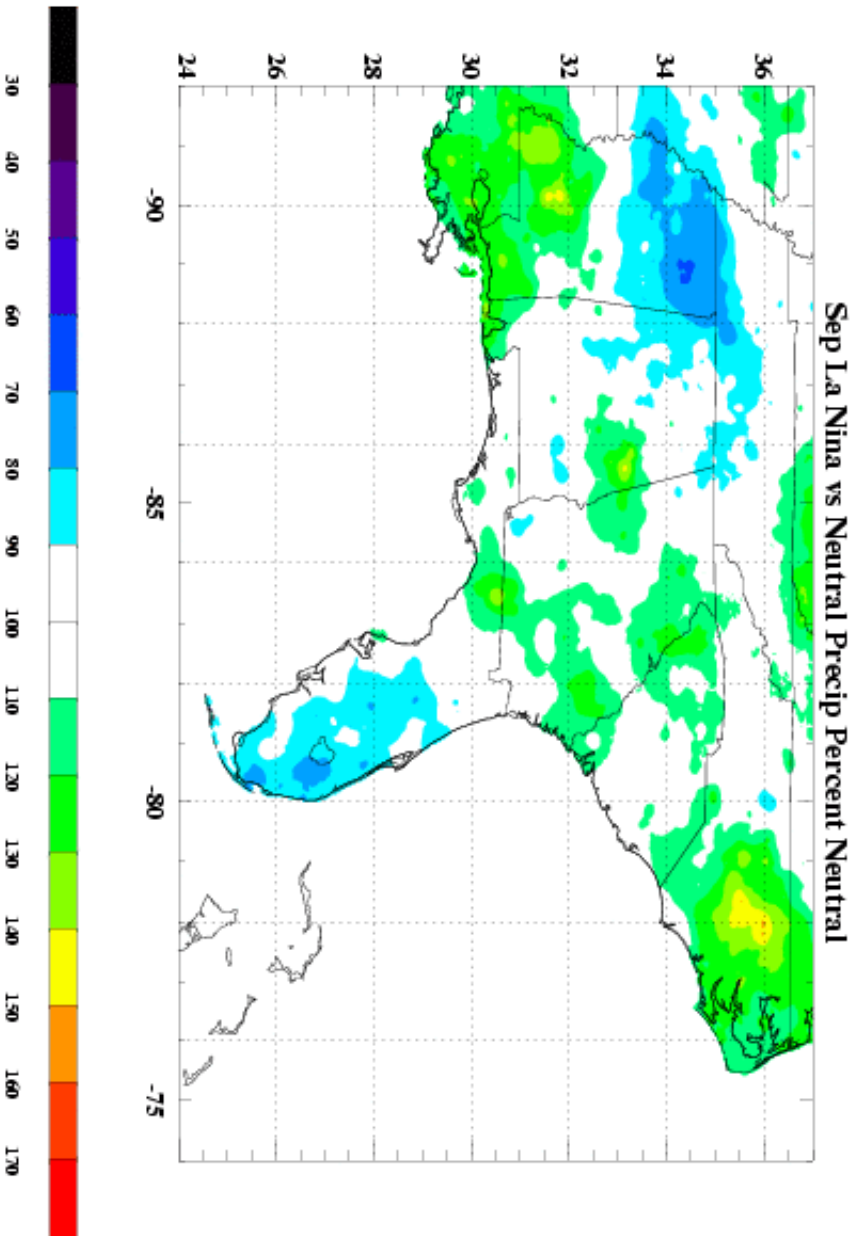


Figure 12: Sep La Niña vs Neutral Precipitation plot.  
 This plot represents average La Niña percent of  
 neutral precipitation

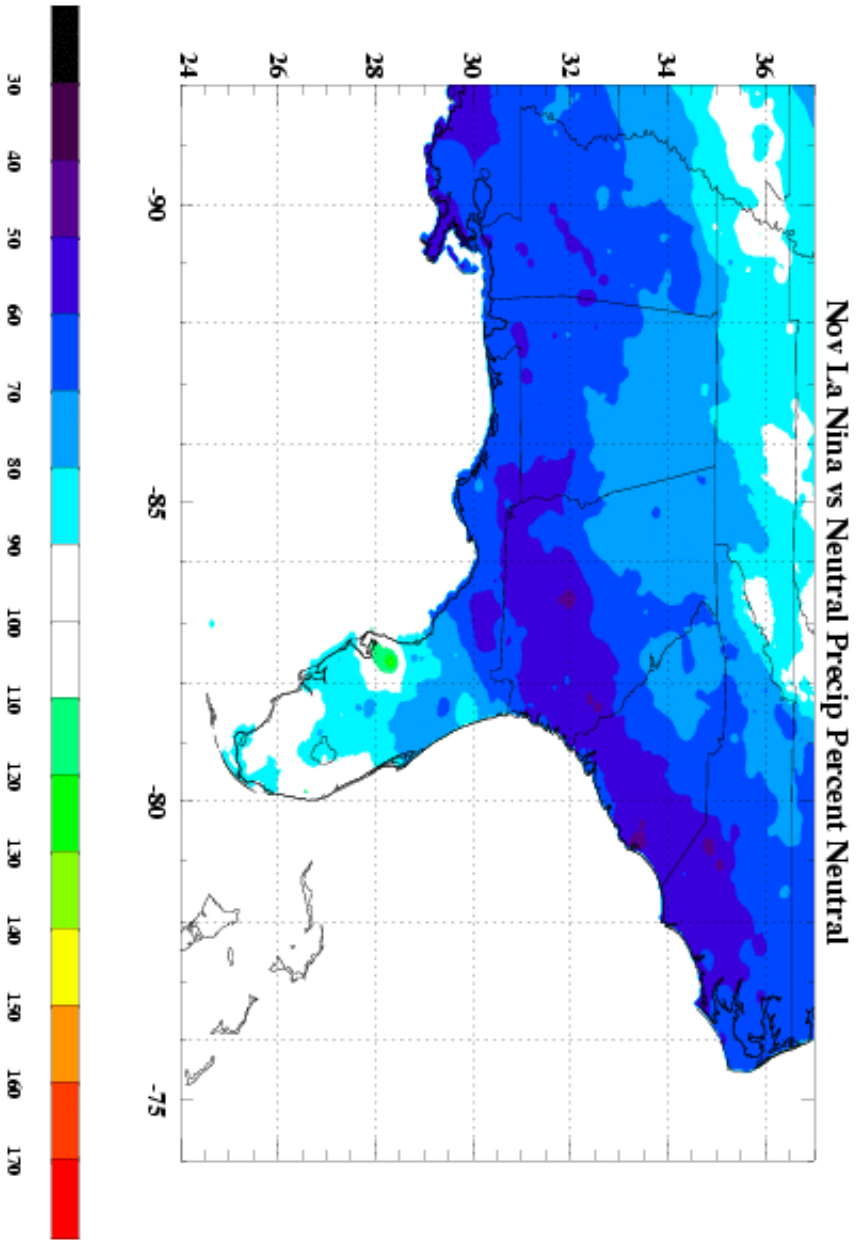


Figure 13: Nov La Niña vs Neutral Precipitation plot.  
 This plot represents average La Niña percent of neutral precipitation

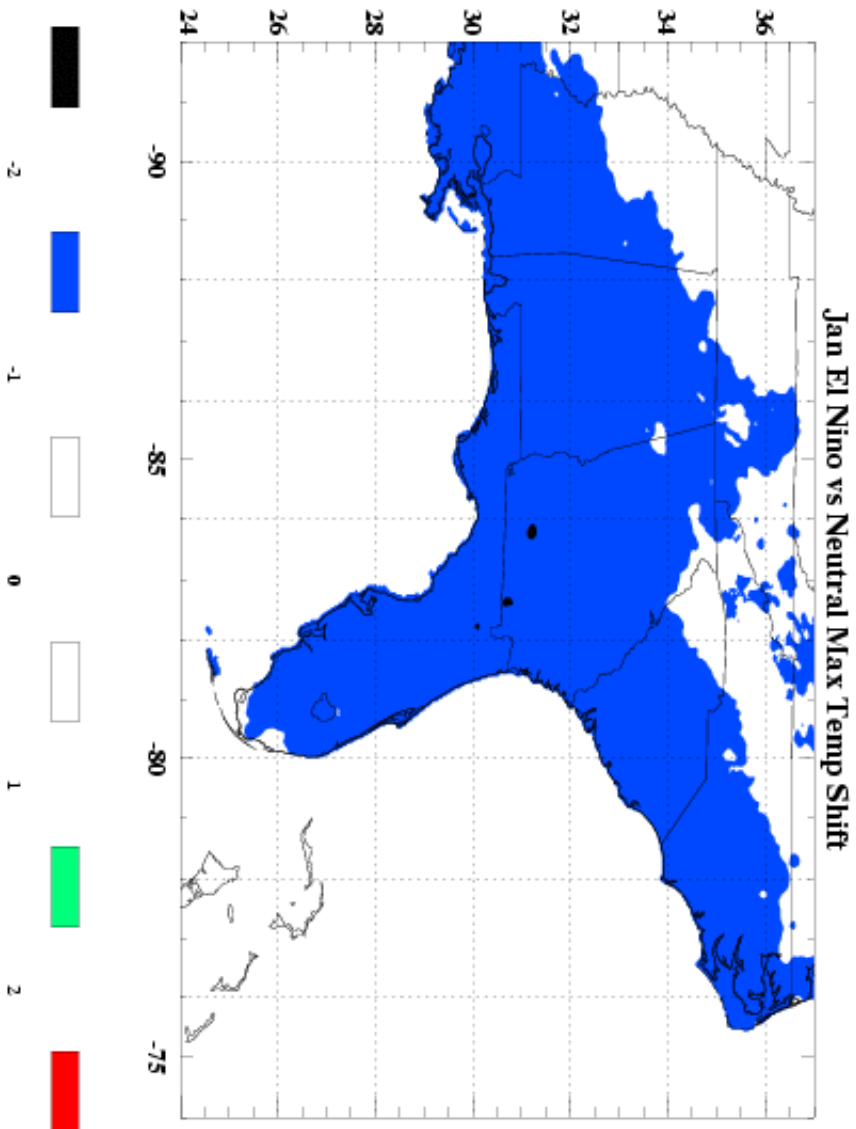


Figure 14: Jan El Niño vs Neutral Max Temp plot.  
 This plot represents shift in average maximum temperature during El Niño events from neutral

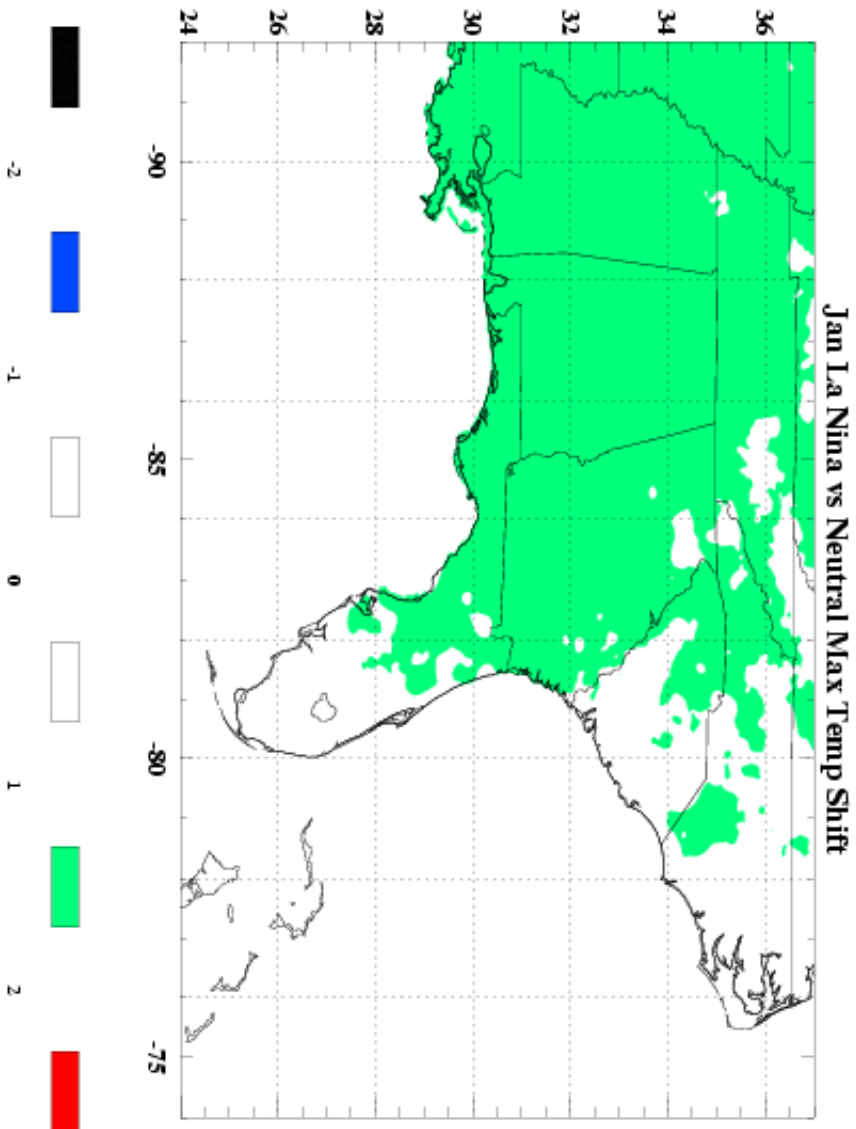


Figure 15: Jan La Niña vs Neutral Max Temp plot.  
 This plot represents shift in average maximum temperature during La Niña events from neutral

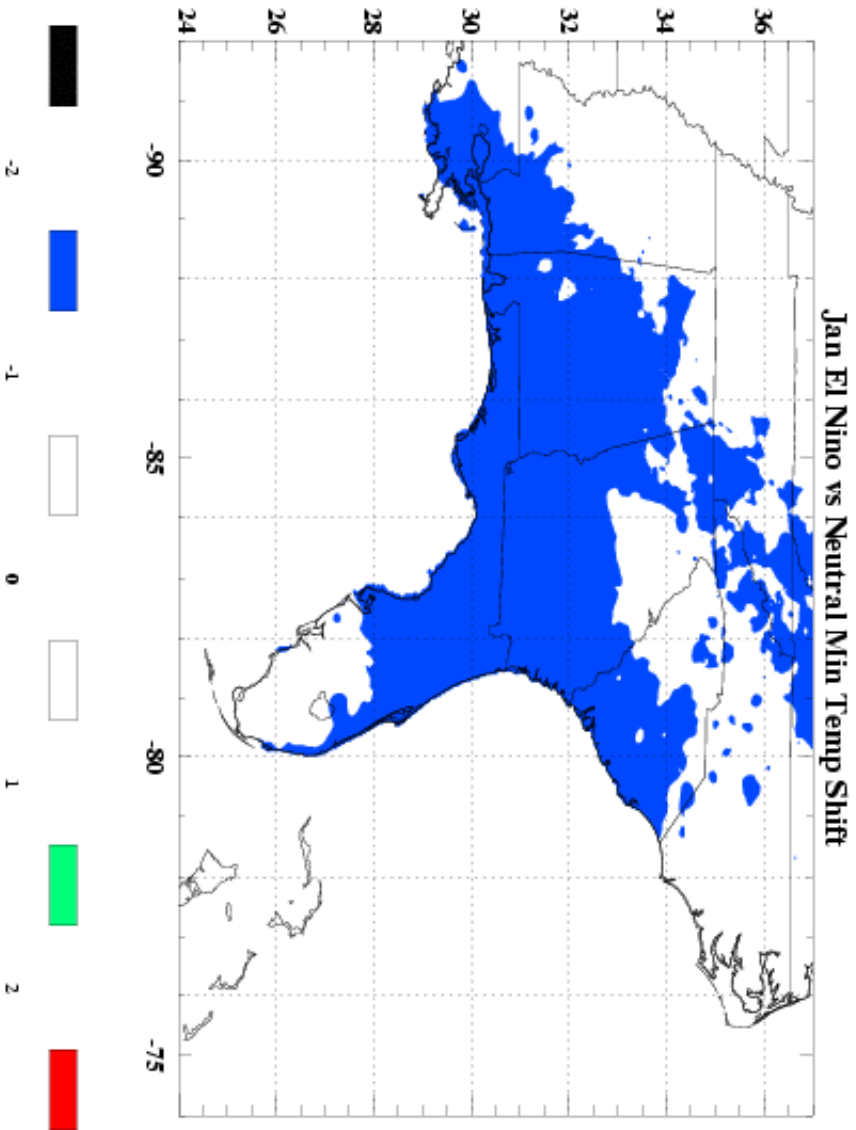


Figure 16: Jan El Niño vs Neutral Min Temp plot.  
 This plot represents shift in average minimum temperature during El Niño events from neutral

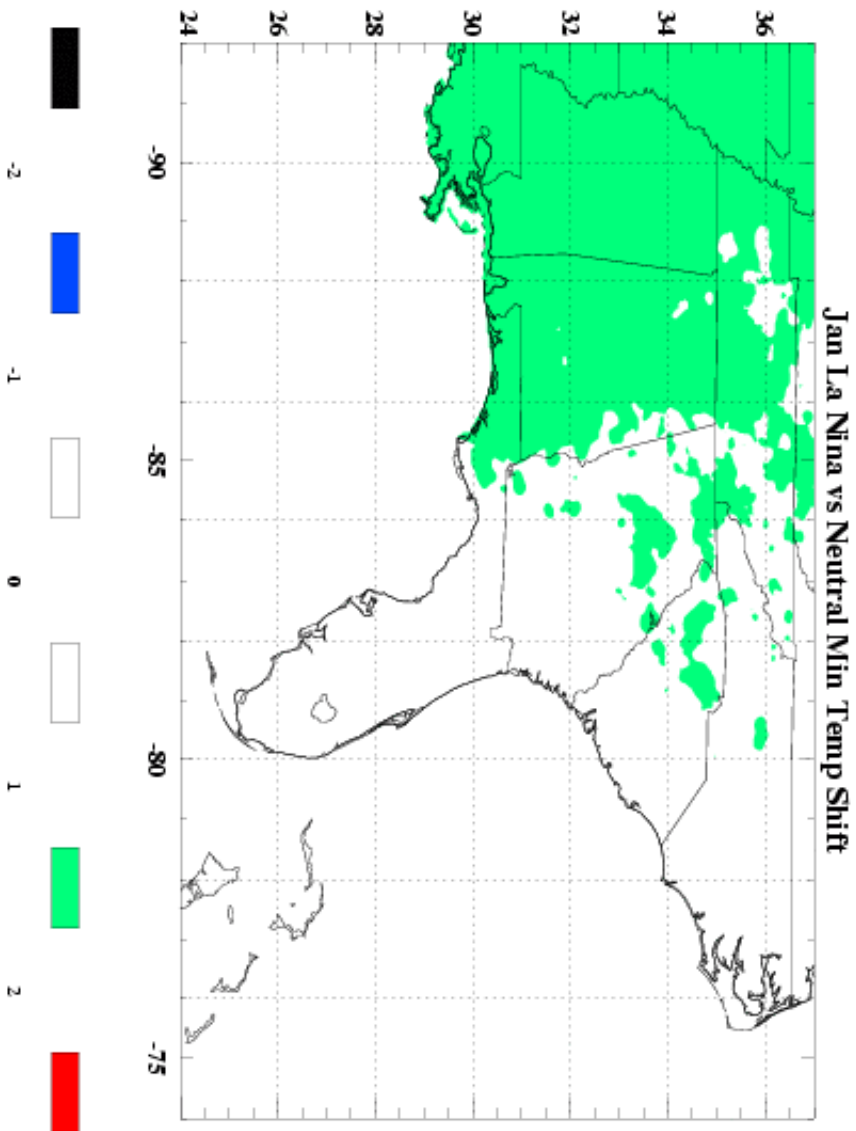


Figure 17: Jan La Niña vs Neutral Min Temp plot.  
 This plot represents shift in average minimum temperature during La Niña events from neutral

Table 5: Precipitation in mm for May Cold phases according to the ModJMA index at Charlotte, Asheville, Natchez, and Hattiesburg.

May Cold ModJMA Precipitation (mm)								
Year	Charlotte, NC	Asheville, NC	Natchez, MS	Hattiesburg, MS	Charlotte % Neutral	Asheville % Neutral	Natchez % Neutral	Hattiesburg % Neutral
1909	181.37	173.75	276.49	169.87	210.77	159.78	226.00	135.87
1910	96.68	158.84	248.34	169.57	112.35	146.07	202.99	135.63
1911	22.48	35.74	44.70	96.91	26.12	32.87	36.54	77.52
1916	91.21	133.81	270.98	204.47	106.00	123.05	221.50	163.55
1922	103.76	139.34	93.49	173.06	120.58	128.14	76.42	138.43
1924	104.36	87.24	170.45	78.43	121.28	80.23	139.32	62.73
1946	98.14	137.83	212.19	290.14	114.05	126.75	173.44	232.07
1950	102.92	113.87	184.08	136.38	119.60	104.72	150.47	109.09
1954	67.88	85.88	370.22	110.28	78.88	78.98	302.62	88.21
1955	120.96	136.17	116.29	125.96	140.57	125.23	95.05	100.75
1956	98.59	63.83	97.59	80.67	114.57	58.70	79.77	64.53
1964	25.52	34.13	76.98	76.09	29.66	31.39	62.92	60.86
1970	76.62	59.54	106.02	116.90	89.04	54.75	86.66	93.51
1971	131.06	102.73	221.22	133.02	152.31	94.47	180.82	106.40
1973	104.20	218.72	228.87	135.27	121.09	201.14	187.08	108.20
1975	302.94	195.45	271.27	222.72	352.05	179.74	221.73	178.15
1985	127.82	59.21	52.78	35.20	148.54	54.45	43.14	28.16
1988	55.68	29.84	18.70	22.30	64.71	27.44	15.29	17.84
Average	106.23	109.22	170.04	132.07				
Neutral	86.05	108.74	122.34	125.02				

Table 6: Daily precipitation in inches for Asheville, Charlotte, Natchez and Hattiesburg. Values for Asheville and Charlotte are from May 1975 whereas values for Natchez and Hattiesburg are from May 1954. Daily records are noted in italics. Daily records were not available for Natchez and Hattiesburg

NC May Precipitation (in)				
	1975		1954	
Date	Asheville	Charlotte	Natchez	Hattiesburg
1	0.15	0.57	10.51	0.00
2	0.00	0.00	0.00	0.00
3	0.15	<i>3.67</i>	4.57	2.12
4	0.00	0.00	0.00	0.18
5	0.00	0.00	0.00	0.00
6	0.12	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00
8	0.30	0.00	0.03	0.00
9	0.23	0.15	0.00	0.00
10	0.00	0.14	0.01	0.01
11	0.00	0.00	0.62	0.01
12	<i>1.35</i>	0.34	0.04	0.00
13	0.00	0.00	0.90	0.11
14	0.00	0.00	0.00	0.00
15	1.41	1.32	0.00	0.00
16	0.00	0.25	0.00	0.00
17	0.90	0.04	0.00	0.00
18	<i>1.24</i>	1.72	0.00	0.00
19	0.00	0.00	0.24	0.34
20	0.00	0.00	0.35	0.34
21	0.00	0.00	0.00	0.00
22	0.00	0.00	0.00	0.00
23	0.00	0.41	0.00	0.00
24	0.00	0.00	0.00	0.00
25	0.00	0.66	0.00	0.00
26	0.06	0.01	0.01	0.00
27	0.00	0.05	0.58	0.07
28	0.00	0.01	0.21	0.03
29	0.44	0.46	0.00	0.52
30	0.03	<i>2.52</i>	0.00	0.00
31	<i>1.79</i>	0.16	0.00	0.00

Table 7: Precipitation in mm for June Cold phases according to the ModJMA index at Orlando and Sarasota.

June Cold ModJMA Precipitation (mm)								
Years	Sarasota	Orlando	Sarasota % Neutral	Orlando % Neutral	Wilmington	Fayetteville	Wilmington % Neutral	Fayetteville % Neutral
1903	178.09	208.30	92.43	110.05	176.08	126.32	137.16	106.30
1909	236.86	194.72	122.94	102.88	156.76	143.95	122.11	121.14
1910	214.24	246.56	111.20	130.27	219.67	237.15	171.11	199.57
1916	144.65	148.97	75.08	78.71	135.45	167.14	105.51	140.65
1922	159.39	173.41	82.73	91.62	241.93	223.97	188.45	188.48
1924	154.72	197.50	80.30	104.35	225.40	157.10	175.57	132.21
1942	176.49	304.27	91.60	160.76	145.47	117.56	113.31	98.93
1946	144.79	177.62	75.15	93.84	186.13	68.50	144.98	57.65
1950	150.00	109.57	77.85	57.89	86.53	137.16	67.40	115.43
1954	136.28	232.66	70.73	122.92	23.03	51.73	17.94	43.53
1955	106.67	135.13	55.36	71.40	140.89	117.98	109.74	99.28
1956	62.61	157.40	32.50	83.16	137.62	74.72	107.20	62.88
1964	142.01	113.44	73.71	59.94	200.65	130.40	156.29	109.74
1970	131.49	145.47	68.25	76.86	84.73	99.59	66.00	83.81
1971	97.35	149.04	50.53	78.74	141.40	66.99	110.14	56.37
1973	105.60	150.71	54.81	79.63	184.47	143.71	143.69	120.94
1975	157.17	199.77	81.57	105.55	172.21	58.11	134.14	48.90
1985	129.76	164.83	67.35	87.09	118.39	115.02	92.22	96.79
1988	68.14	124.47	35.37	65.76	64.83	142.57	50.50	119.98
Average	141.91	175.47			149.56	125.25		
Neutral	192.67	189.27			128.38	118.83		

Table 8: Precipitation in inches for Saint Leo, Belle Glade and Sarasota during June 1942 and 1954

FL June Precipitation, 1942 and 1954 (in)						
Day	Saint Leo		Belle Glade		Sarasota	
	1942	1954	1942	1954	1942	1954
1	0.00	0.00	1.32	0.79	N/A	0.07
2	0.35	0.00	0.53	0.01	N/A	0.00
3	0.38	0.35	1.75	0.24	N/A	0.27
4	0.00	4.98	6.96	0.13	N/A	0.72
5	0.17	0.16	0.11	0.21	N/A	0.00
6	1.42	0.00	1.18	0.07	N/A	0.00
7	0.00	0.00	0.23	0.02	N/A	0.47
8	1.94	0.55	0.09	0.01	N/A	0.34
9	1.84	0.00	0.64	0.00	N/A	0.00
10	0.19	0.00	2.66	0.00	N/A	0.00
11	0.05	0.00	0.01	0.00	N/A	0.00
12	0.00	0.20	0.70	0.00	N/A	0.00
13	0.00	0.00	1.87	0.08	N/A	0.00
14	0.00	0.00	0.00	0.10	N/A	0.00
15	0.00	0.00	0.00	0.41	N/A	0.47
16	0.00	0.00	0.00	0.14	N/A	0.35
17	0.30	0.06	0.03	0.25	N/A	0.12
18	0.00	0.10	0.25	2.08	N/A	0.04
19	0.00	0.12	0.00	3.30	N/A	0.50
20	0.76	0.08	0.89	1.23	N/A	0.52
21	0.47	0.00	0.03	0.05	N/A	0.00
22	0.29	0.00	1.65	0.01	N/A	0.00
23	0.51	0.00	0.00	0.17	N/A	0.02
24	0.53	0.00	0.06	1.51	N/A	0.00
25	0.18	0.00	0.00	0.31	N/A	0.00
26	0.10	0.00	0.02	0.00	N/A	0.01
27	0.02	0.00	0.11	0.00	N/A	0.00
28	0.04	0.00	1.93	0.00	N/A	0.00
29	0.99	0.00	1.08	0.00	N/A	0.00
30	0.05	0.00	0.01	0.00	N/A	0.15
Total	10.58	6.60	24.11	11.12		4.05

Table 9: Precipitation in mm for June Cold phases according to the JMA index at Orlando and Sarasota. The average values for the years of the ModJMA index that are not a part of the JMA index are included ('new'). Similarly, years of the JMA index that are not in the ModJMA index are defined as 'old', shown in italics.

June cold JMA Precipitation (mm)				
Years	Sarasota	Orlando	Sarasota % Neutral	Orlando % Neutral
<i>1904</i>	187.73	201.37	97.44	106.39
<i>1907</i>	199.62	164.12	103.61	86.71
<i>1909</i>	236.80	194.72	122.90	102.88
<i>1910</i>	214.24	246.56	111.20	130.27
<i>1911</i>	132.30	130.24	68.67	68.81
<i>1917</i>	171.10	135.39	88.80	71.53
<i>1923</i>	194.63	163.13	101.02	86.19
<i>1925</i>	160.95	147.92	83.54	78.15
<i>1939</i>	317.24	287.19	164.65	151.74
<i>1943</i>	534.31	165.31	277.32	87.34
<i>1945</i>	299.99	420.36	155.70	222.10
<i>1950</i>	150.00	109.57	77.85	57.89
<i>1955</i>	106.67	135.13	55.36	71.40
<i>1956</i>	62.61	157.40	32.50	83.16
<i>1957</i>	286.63	146.54	148.77	77.42
<i>1965</i>	233.65	170.21	121.27	89.93
<i>1968</i>	368.87	381.14	191.45	201.37
<i>1971</i>	97.35	149.04	50.53	78.74
<i>1972</i>	171.04	167.07	88.77	88.27
<i>1974</i>	351.48	371.05	182.43	196.04
<i>1975</i>	157.17	199.77	81.57	105.55
<i>1976</i>	279.44	213.67	145.04	112.89
<i>1989</i>	211.53	164.22	109.79	86.76
<i>1999</i>	211.63	261.94	109.84	138.39
<i>2000</i>	136.19	160.65	70.69	84.88
Average	218.93	201.75		
Neutral	174.38	186.03		
<i>Average Old JMA</i>	247.13	213.97		
Average New MJMA	139.28	178.47		
Average % Neutral Old	141.72	115.02		
Average % Neutral New	72.29	94.29		

Table 10: Precipitation in mm for September Cold phases according to the ModJMA index at Fayetteville, Raleigh, Tupelo and Jackson

Sept Cold ModJMA Precipitation (mm)								
Years	Fayetteville, NC	Raleigh, NC	Fayetteville % Neutral	Raleigh % Neutral	Tupelo, MS	Jackson, MS	Tupelo % Neutral	Jackson % Neutral
1903	49.74	59.62	47.15	60.35	0.93	9.19	1.13	13.70
1906	60.08	63.37	56.95	64.15	192.18	301.57	233.88	449.50
1909	71.35	58.79	67.63	59.51	72.43	85.60	88.15	127.59
1910	62.17	71.72	58.93	72.60	14.25	45.87	17.34	68.37
1916	38.45	66.08	36.45	66.89	19.02	45.89	23.15	68.40
1922	24.70	19.24	23.41	19.48	9.63	25.23	11.72	37.61
1924	339.03	363.72	321.36	368.17	38.24	34.34	46.54	51.18
1942	77.06	124.26	73.04	125.78	59.69	105.26	72.64	156.89
1949	82.25	97.36	77.96	98.55	66.28	116.79	80.66	174.08
1954	21.89	36.72	20.75	37.17	41.95	50.05	51.05	74.60
1955	229.62	286.79	217.65	290.30	24.67	49.03	30.02	73.08
1956	144.77	158.39	137.22	160.33	21.08	10.98	25.65	16.37
1964	120.57	153.92	114.28	155.81	102.50	75.90	124.74	113.13
1967	110.89	96.26	105.11	97.44	31.39	65.09	38.20	97.02
1970	78.38	60.15	74.29	60.89	26.11	75.70	31.78	112.83
1971	68.80	44.33	65.21	44.87	65.82	147.13	80.10	219.30
1973	46.42	43.71	44.00	44.25	36.12	126.12	43.96	187.99
1975	238.22	223.39	225.80	226.13	157.11	69.28	191.20	103.26
1988	163.74	105.90	155.20	107.20	162.69	100.60	197.99	149.95
1999	411.93	525.43	390.45	531.87	10.47	93.08	12.74	138.74
Average	122.00	132.96			57.63	81.64		
Neutral	105.50	98.79			82.17	67.09		

Table 11: Precipitation in inches from HCN stations of Booneville and Monticello, MS during September 1949, 1967, 1970, 1971, 1973 and 1999.

Sept HCN Precipitation Monticello and Booneville												
	1949		1967		1970		1971		1973		1999	
Day	Boon	Mont	Boon	Mont	Boon	Mont	Boon	Mont	Boon	Mont	Boon	Mont
1	0.00	0.00	0.00	0.00	0.00	0.00	1.04	0.90	0.00	0.08	0.00	0.16
2	0.00	0.00	0.00	0.00	0.00	0.00	0.03	1.09	0.22	0.25	0.00	0.00
3	0.00	0.00	0.00	0.00	0.00	0.21	0.34	0.09	0.00	0.07	0.00	0.30
4	0.34	0.04	0.42	0.00	0.16	0.06	0.00	0.05	0.00	0.72	0.00	0.00
5	0.30	3.95	0.00	0.00	0.00	0.00	0.00	0.70	0.00	0.55	0.00	0.93
6	0.44	0.00	0.00	0.48	0.00	0.00	0.00	0.10	0.00	0.25	0.04	0.00
7	0.00	0.00	0.00	0.88	0.00	0.00	0.22	0.23	0.11	0.22	0.00	0.50
8	0.00	0.00	0.29	0.00	0.07	0.07	0.00	0.00	0.00	0.00	0.00	0.00
9	0.00	1.22	0.12	0.67	0.00	0.27	0.00	0.00	0.00	0.00	0.13	0.12
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.00	0.00
11	0.00	0.00	0.00	0.21	0.00	0.50	0.00	0.91	0.00	0.00	0.00	0.00
12	0.00	0.00	0.00	0.00	0.00	0.25	0.26	0.52	0.00	0.55	0.00	0.00
13	0.00	1.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.70	0.00	0.00
14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.26	0.02	0.00	0.05
15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	0.07	0.00	0.00	0.00	0.00	0.00	0.06	0.87	0.00	0.00	0.00	0.00
17	0.93	0.20	0.00	0.00	0.00	0.08	0.74	2.58	0.00	0.00	0.00	0.00
18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19	0.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	0.00	0.00	0.00	0.00	0.00	0.00	0.28	0.45	0.00	0.00	0.00	0.00
21	0.00	0.00	0.00	0.00	0.00	0.00	0.13	0.05	0.00	0.00	0.00	0.00
22	0.00	0.74	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
24	0.00	0.00	0.00	0.00	0.00	1.20	0.00	0.33	0.00	0.00	0.00	0.00
25	0.00	0.00	0.00	0.00	0.00	1.45	0.00	0.35	0.00	0.00	0.00	0.00
26	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.00
27	0.12	0.00	0.00	0.00	0.23	0.00	0.82	0.20	0.00	0.07	0.00	0.00
28	0.00	0.00	0.44	0.70	0.00	0.00	0.00	0.00	0.00	0.47	0.00	0.00
29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.55	0.05	0.66
30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.14	0.03	0.94
Totals	2.35	7.18	1.34	2.94	0.46	4.09	3.98	9.42	0.80	6.74	0.25	3.66

Table 12: Precipitation in mm for September Cold phases according to the JMA index at Tupelo and Jackson. The average values for the years of the ModJMA index that are not a part of the JMA index are included ('new'). Similarly, years of the JMA index that are not in the ModJMA index are defined as 'old', shown in italics.

Sept Cold JMA Precipitation (mm)				
Years	Tupelo	Jackson	Tupelo % Neutral	Jackson % Neutral
<i>1904</i>	39.18	49.30	47.68	73.48
<i>1907</i>	54.60	101.65	66.45	151.51
<i>1909</i>	72.40	85.60	88.11	127.59
<i>1910</i>	14.25	45.87	17.34	68.37
<i>1911</i>	33.02	34.91	40.18	52.03
<i>1917</i>	88.54	43.33	107.75	64.58
<i>1923</i>	40.29	25.57	49.03	38.11
<i>1925</i>	107.19	49.40	130.45	73.63
<i>1939</i>	35.13	74.87	42.75	111.60
<i>1943</i>	143.73	101.84	174.92	151.80
<i>1945</i>	91.13	34.26	110.90	51.07
<i>1950</i>	175.03	53.95	213.01	80.41
<i>1955</i>	24.67	49.03	30.02	73.08
<i>1956</i>	21.08	10.98	25.65	16.37
<i>1957</i>	152.33	245.93	185.38	366.57
<i>1965</i>	85.79	168.88	104.41	251.72
<i>1968</i>	120.22	63.15	146.31	94.13
<i>1971</i>	65.82	147.13	80.10	219.30
<i>1972</i>	148.18	115.36	180.33	171.95
<i>1974</i>	98.43	133.35	119.79	198.76
<i>1975</i>	157.11	69.28	191.20	103.26
<i>1976</i>	123.05	88.89	149.75	132.49
<i>1989</i>	142.21	146.01	173.07	217.63
<i>1999</i>	10.47	93.08	12.74	138.74
<i>2000</i>	45.38	77.79	55.23	115.95
Average	83.57	84.38		
Neutral	81.32	72.69		
<i>Average Old JMA</i>	95.75	89.36		
Average New MJMA	60.52	87.06		
Average % Neutral Old	117.74	122.93		
Average % Neutral New	73.65	129.77		

Table 13: Daily precipitation in inches for Lumberton and Fayetteville, NC. Values for Lumberton are from September 1924 whereas values for Fayetteville are from September 1999.

NC Sep Precipitation (in)		
Day	Lumberton 1924	Fayetteville 1999
1	0.00	0.00
2	0.00	0.00
3	0.29	0.00
4	0.00	0.00
5	0.00	0.35
6	0.00	1.40
7	0.00	0.37
8	0.00	0.00
9	0.08	0.00
10	0.00	0.03
11	0.00	0.00
12	0.00	0.00
13	0.00	0.00
14	0.19	0.00
15	2.50	0.41
16	1.02	6.80
17	1.07	0.02
18	0.00	0.00
19	0.00	0.00
20	0.00	0.00
21	0.00	0.95
22	0.00	1.17
23	0.43	0.05
24	0.22	0.00
25	0.09	0.00
26	0.34	0.00
27	0.22	1.64
28	1.10	0.22
29	0.94	0.61
30	5.54	0.69

Table 14: Precipitation in mm for October Cold phases according to the ModJMA index at Fayetteville and Raleigh.

Oct Cold ModJMA Precipitation (mm)				
Years	Fayetteville, NC	Raleigh, NC	Fayetteville % Neutral	Raleigh % Neutral
1903	104.29	140.58	154.66	196.75
1906	77.49	66.86	114.92	93.58
1908	83.13	87.62	123.28	122.63
1909	26.42	36.90	39.18	51.64
1910	77.45	95.33	114.86	133.42
1916	81.99	71.46	121.59	100.01
1922	136.94	126.37	203.08	176.86
1924	39.33	52.52	58.33	73.51
1938	21.42	32.97	31.77	46.14
1942	59.30	179.03	87.94	250.57
1944	74.89	54.42	111.06	76.17
1949	89.35	43.61	132.51	61.04
1954	127.93	99.52	189.72	139.29
1955	45.61	34.34	67.64	48.06
1956	98.51	118.70	146.09	166.13
1964	230.42	242.54	341.72	339.45
1967	32.24	31.68	47.81	44.34
1970	80.19	101.99	118.92	142.74
1971	171.91	215.31	254.95	301.34
1973	12.04	103.50	17.86	144.86
1974	30.28	46.89	44.91	65.63
1975	45.89	37.76	68.06	52.85
1988	46.18	82.67	68.49	115.70
1998	36.93	30.17	54.77	42.23
1999	167.20	125.91	247.96	176.22
Average	79.89	90.35		
Neutral	67.43	71.45		

Table 15: Daily precipitation in inches for Edenton, Kinston and Lumberton, NC. Values for Edenton are from October 1942, 1964, 1971 and 1999; values for Kinston are from October 1964, 1971, and 1999; and values for Lumberton are from October 1971 and 1999.

NC Oct Precipitation (in)									
	1942	1964		1971			1999		
Day	Edenton	Edenton	Kinston	Edenton	Lumberton	Kinston	Edenton	Kinston	Southport
1	0.00	0.17	0.52	3.10	0.95	4.05	0.00	0.00	0.00
2	0.00	0.16	0.06	0.30	3.40	0.37	0.00	0.00	0.00
3	0.00	0.00	0.07	0.05	0.74	0.84	0.00	0.00	0.00
4	0.00	2.25	0.06	0.10	0.00	0.06	0.28	0.00	0.00
5	0.00	4.10	2.35	0.00	0.00	0.00	1.22	0.46	0.00
6	0.52	0.00	2.00	0.55	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.04	0.02	0.00	0.00	0.05
8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	1.87	0.93	0.84	0.08	0.00	0.00
11	1.58	0.00	0.00	0.10	0.44	0.54	0.00	0.12	0.00
12	0.80	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.01
13	0.93	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.50
14	3.38	0.00	0.00	0.00	0.00	0.00	0.00	0.22	0.00
15	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	0.04	1.85	0.16	0.00	0.64	0.00	0.00	0.00	N/A
17	0.00	0.23	0.42	0.00	0.25	0.11	2.58	1.35	2.50
18	0.00	0.00	0.10	0.04	0.00	0.05	4.20	4.02	2.60
19	0.00	0.00	0.00	0.42	0.00	0.00	0.00	1.35	0.00
20	0.00	0.20	0.03	0.07	0.00	0.00	1.48	0.02	0.00
21	0.15	0.00	0.18	0.00	0.03	0.15	1.05	0.35	0.75
22	0.98	0.00	0.00	1.12	0.12	0.02	0.00	0.00	0.00
23	0.00	0.00	0.00	1.95	0.64	2.17	0.00	0.00	0.00
24	0.03	0.00	0.00	0.10	0.09	0.43	0.00	0.00	0.00
25	0.00	0.00	0.00	0.22	0.25	0.92	0.00	0.00	0.00
26	0.47	0.00	0.00	0.03	0.01	0.00	0.00	0.00	0.00
27	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00
28	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.00
29	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00
30	0.00	0.00	0.03	0.01	0.01	0.05	0.00	0.00	0.00
31	0.00	0.00	0.00	0.03	0.39	0.04	0.00	0.00	0.00
Total	8.91	8.96	5.98	10.19	8.93	10.66	10.91	7.91	6.41

Table 16: Precipitation in mm for October Warm phases according to the ModJMA index at Jackson and Hattiesburg, MS.

Oct Warm ModJMA Precipitation (mm)				
Years	Jackson, MS	Jackson % Neutral	Hattiesburg, MS	Hattiesburg % Neutral
1896	93.80	153.54	50.41	68.53
1899	18.01	29.48	17.66	24.01
1902	53.08	86.89	115.14	156.53
1904	0.54	0.88	5.85	7.95
1905	169.78	277.92	80.87	109.94
1911	26.05	42.64	37.11	50.45
1913	62.90	102.96	71.02	96.55
1918	285.19	466.84	237.92	323.44
1925	214.73	351.50	206.12	280.21
1929	65.69	107.53	108.59	147.62
1930	78.80	128.99	57.56	78.25
1940	17.41	28.50	18.07	24.56
1951	15.17	24.83	39.72	54.00
1957	76.20	124.73	62.96	85.59
1963	1.88	3.08	2.55	3.47
1965	29.02	47.50	31.18	42.39
1969	51.41	84.15	62.34	84.75
1972	65.74	107.61	85.02	115.58
1976	75.23	123.15	111.30	151.31
1982	116.75	191.11	51.67	70.24
1986	134.70	220.49	100.85	137.10
1987	10.04	16.43	1.63	2.22
1991	63.52	103.98	33.11	45.01
1997	119.49	195.60	85.36	116.04
2002	197.21	322.82	187.29	254.61
Average	81.69		74.45	
Neutral	61.09		73.56	

Table 17: Daily precipitation in inches for Port Gibson and Canton, MS. Values are for October 1982.

MS Oct Precipitation, 1982 (in)		
Day	Port Gibson	Canton
1	0.00	0.00
2	0.00	0.00
3	0.00	0.00
4	0.00	0.00
5	0.00	0.00
6	0.04	0.00
7	0.34	2.37
8	2.55	1.16
9	0.00	0.00
10	0.55	0.79
11	0.00	0.05
12	0.04	0.04
13	0.27	0.32
14	0.00	0.00
15	0.00	0.00
16	0.00	0.00
17	0.00	0.00
18	0.00	0.00
19	0.00	0.00
20	0.00	0.00
21	0.04	0.00
22	0.00	0.00
23	0.00	0.00
24	0.00	0.00
25	0.00	0.00
26	0.00	0.00
27	0.00	0.00
28	0.00	0.00
29	0.00	0.00
30	0.02	0.00
31	0.00	0.00
Total	3.85	4.73

Table 18: Precipitation in mm for November Cold phases according to the ModJMA index at Tampa, St Leo and Dade City, FL.

Nov Cold ModJMA Precipitation (mm)								
Years	Tampa	Tampa % Neutral	St Leo	St Leo % Neutral	Orlando	Orlando % Neutral	Dade City	Dade City % Neutral
1903	58.70	137.37	49.16	113.12	44.29	99.06	64.72	158.59
1906	15.23	35.64	15.93	36.65	14.97	33.48	15.61	38.25
1908	55.47	129.82	65.56	150.85	60.10	134.42	59.64	146.14
1909	10.64	24.90	16.34	37.60	16.96	37.93	14.13	34.62
1910	27.88	65.25	55.82	128.44	30.17	67.48	54.60	133.79
1916	11.79	27.59	180.79	415.99	87.43	195.55	145.28	355.99
1922	30.49	71.36	32.83	75.54	17.16	38.38	58.00	142.12
1924	8.32	19.47	7.06	16.24	7.31	16.35	5.92	14.51
1938	17.62	41.24	28.85	66.38	37.88	84.72	32.32	79.20
1942	11.33	26.52	10.02	23.06	4.12	9.21	14.64	35.87
1944	12.63	29.56	24.53	56.44	15.45	34.56	32.64	79.98
1945	7.98	18.68	12.74	29.31	23.92	53.50	9.87	24.19
1949	47.43	111.00	40.27	92.66	38.67	86.49	40.97	100.39
1954	111.37	260.64	59.65	137.25	69.42	155.27	67.21	164.69
1955	40.01	93.63	75.72	174.23	48.67	108.86	88.70	217.35
1956	12.16	28.46	14.51	33.39	11.12	24.87	25.30	61.99
1964	19.41	45.42	7.97	18.34	13.23	29.59	7.75	18.99
1967	14.74	34.50	6.57	15.12	1.94	4.34	12.40	30.38
1970	31.06	72.69	22.40	51.54	11.14	24.92	21.07	51.63
1971	48.80	114.21	49.59	114.10	29.89	66.85	74.90	183.53
1973	36.33	85.02	43.55	100.21	11.88	26.57	75.76	185.64
1974	6.73	15.75	9.54	21.95	13.14	29.39	10.80	26.46
1975	12.43	29.09	37.44	86.15	24.08	53.86	49.91	122.30
1984	80.89	189.30	52.49	120.78	68.36	152.90	33.07	81.03
1988	131.24	307.14	165.01	379.68	158.86	355.31	247.79	607.18
1998	76.92	180.01	30.61	70.43	55.98	125.21	33.91	83.09
1999	21.37	50.01	55.60	127.93	52.57	117.58	53.71	131.61
Average	35.52	83.12	43.35	99.76	35.88	80.25	50.02	122.58
Neutral	42.73		43.46		44.71		40.81	

Table 19: Daily precipitation in inches for St Leo and Tarpon Springs, FL. Values are for November 1988.

FL Nov HCN Precipitation, 1988 (in)		
Day	St Leo	Tarpon Springs
1	0.10	0.00
2	0.02	0.01
3	0.22	0.01
4	0.92	0.57
5	0.70	0.02
6	0.02	0.53
7	0.00	0.01
8	0.00	0.01
9	0.00	0.01
10	0.00	0.01
11	0.00	0.01
12	0.00	0.00
13	0.00	0.00
14	0.01	0.03
15	0.01	0.10
16	0.00	0.00
17	0.00	0.01
18	0.00	0.00
19	0.00	0.00
20	0.00	0.00
21	0.00	0.00
22	0.99	0.60
23	9.27	6.50
24	0.01	0.50
25	0.00	0.02
26	0.00	0.02
27	0.00	0.00
28	0.20	0.08
29	0.00	0.08
30	0.01	0.00
Total	12.48	9.13

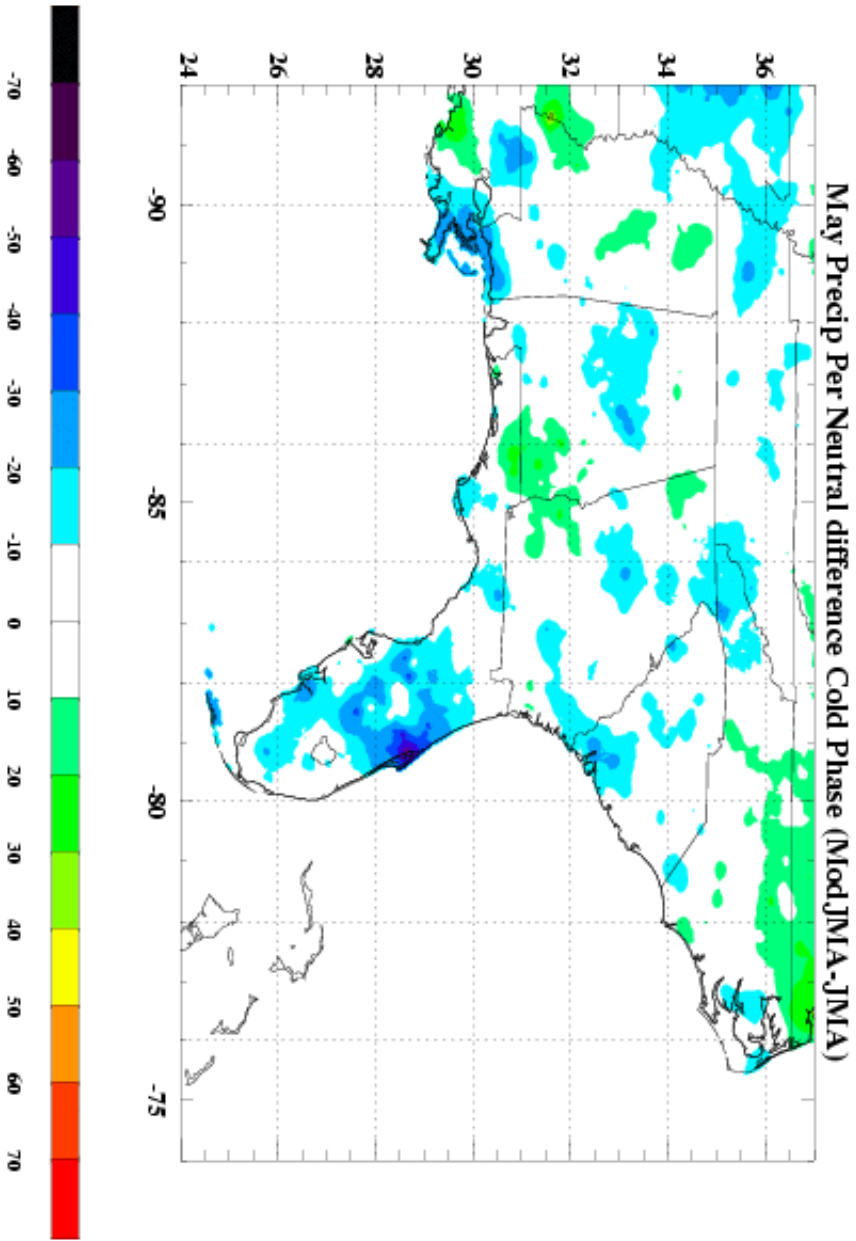


Figure 18: May ModJMA-JMA Cold Phase Percent Neutral Precipitation plot. This plot represents the difference in percent neutral precipitation between the two indices for May cold phase

Table 20: ModJMA and JMA percent neutral precipitation for May cold phase at Titusville, FL. The average values for the years of the ModJMA index that are not a part of the JMA index are included ('new'). Similarly, years of the JMA index that are not in the ModJMA index are defined as 'old'. Both new and old years are shown in italics.

Titusville, FL May Cold Precipitation (mm)					
ModJMA			JMA		
Years	Precipitation	% Neutral	Years	Precipitation	% Neutral
1909	105.30	106.55	<i>1904</i>	<i>30.19</i>	<i>35.67</i>
1910	75.53	76.42	<i>1907</i>	<i>183.15</i>	<i>216.41</i>
1911	126.69	128.19	1909	105.30	124.42
<i>1916</i>	<i>105.14</i>	<i>106.38</i>	1910	75.53	89.25
<i>1922</i>	<i>170.50</i>	<i>172.52</i>	1911	126.69	149.70
<i>1924</i>	<i>24.95</i>	<i>25.25</i>	<i>1917</i>	<i>75.53</i>	<i>89.25</i>
<i>1946</i>	<i>116.00</i>	<i>117.37</i>	<i>1923</i>	<i>445.45</i>	<i>526.35</i>
1950	33.89	34.29	<i>1925</i>	<i>247.98</i>	<i>293.02</i>
<i>1954</i>	<i>126.08</i>	<i>127.57</i>	<i>1939</i>	<i>133.50</i>	<i>157.75</i>
1955	113.10	114.44	<i>1943</i>	<i>86.62</i>	<i>102.35</i>
1956	24.03	24.31	<i>1945</i>	<i>19.90</i>	<i>23.51</i>
<i>1964</i>	<i>61.93</i>	<i>62.66</i>	1950	33.89	40.04
<i>1970</i>	<i>96.72</i>	<i>97.87</i>	1955	113.10	133.64
1971	62.99	63.74	1956	24.03	28.39
<i>1973</i>	<i>96.78</i>	<i>97.93</i>	<i>1957</i>	<i>184.45</i>	<i>217.95</i>
1975	144.78	146.49	<i>1965</i>	<i>38.11</i>	<i>45.03</i>
<i>1985</i>	<i>80.84</i>	<i>81.80</i>	<i>1968</i>	<i>142.08</i>	<i>167.88</i>
<i>1988</i>	<i>85.45</i>	<i>86.46</i>	1971	62.99	74.43
			<i>1972</i>	<i>136.12</i>	<i>160.84</i>
			<i>1974</i>	<i>107.98</i>	<i>127.59</i>
			1975	144.78	171.07
			<i>1976</i>	<i>234.56</i>	<i>277.16</i>
			<i>1989</i>	<i>43.24</i>	<i>51.09</i>
			<i>1999</i>	<i>129.96</i>	<i>153.56</i>
			<i>2000</i>	<i>9.90</i>	<i>11.70</i>
Average	91.71			117.40	
Neutral	98.83			84.63	
Average % Neutral New	97.58				
Average % Neutral Old	156.30				

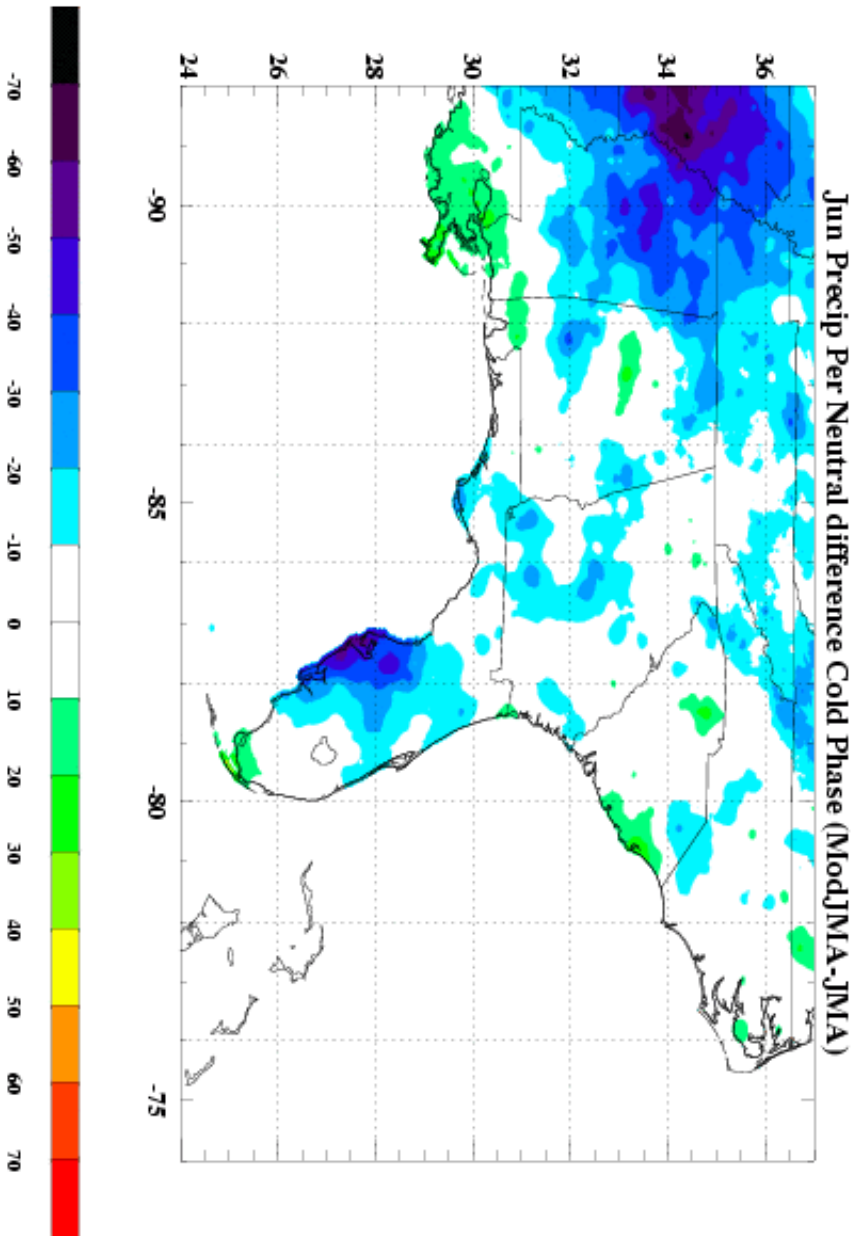


Figure 19: June ModJMA-JMA Cold Phase Percent Neutral Precipitation plot. This plot represents the difference in percent neutral precipitation between the two indices for June cold phase

Table 21: ModJMA and JMA percent neutral precipitation for June cold phase at Greenville, MS. The average values for the years of the ModJMA index that are not a part of the JMA index are included ('new'). Similarly, years of the JMA index that are not in the ModJMA index are defined as 'old'. Both new and old years are shown in italics.

Greenville, MS June Cold Precipitation (mm)					
ModJMA			JMA		
Years	Precipitation	% Neutral	Years	Precipitation	% Neutral
<i>1903</i>	<i>55.20</i>	<i>60.12</i>	<i>1904</i>	<i>88.14</i>	<i>97.12</i>
<i>1909</i>	<i>138.26</i>	<i>150.59</i>	<i>1907</i>	<i>56.44</i>	<i>62.19</i>
<i>1910</i>	<i>131.60</i>	<i>143.34</i>	<i>1909</i>	<i>138.26</i>	<i>152.35</i>
<i>1916</i>	<i>144.03</i>	<i>156.88</i>	<i>1910</i>	<i>131.60</i>	<i>145.01</i>
<i>1922</i>	<i>102.70</i>	<i>111.86</i>	<i>1911</i>	<i>120.07</i>	<i>132.31</i>
<i>1924</i>	<i>24.70</i>	<i>26.90</i>	<i>1917</i>	<i>71.54</i>	<i>78.83</i>
<i>1942</i>	<i>124.40</i>	<i>135.50</i>	<i>1923</i>	<i>112.22</i>	<i>123.66</i>
<i>1946</i>	<i>168.43</i>	<i>183.45</i>	<i>1925</i>	<i>47.21</i>	<i>52.02</i>
<i>1950</i>	<i>121.15</i>	<i>131.96</i>	<i>1939</i>	<i>103.12</i>	<i>113.63</i>
<i>1954</i>	<i>32.06</i>	<i>34.92</i>	<i>1943</i>	<i>52.44</i>	<i>57.79</i>
<i>1955</i>	<i>76.32</i>	<i>83.13</i>	<i>1945</i>	<i>116.18</i>	<i>128.02</i>
<i>1956</i>	<i>59.85</i>	<i>65.19</i>	<i>1950</i>	<i>121.15</i>	<i>133.50</i>
<i>1964</i>	<i>24.72</i>	<i>26.93</i>	<i>1955</i>	<i>76.32</i>	<i>84.10</i>
<i>1970</i>	<i>114.65</i>	<i>124.88</i>	<i>1956</i>	<i>59.85</i>	<i>65.95</i>
<i>1971</i>	<i>88.93</i>	<i>96.86</i>	<i>1957</i>	<i>213.54</i>	<i>235.31</i>
<i>1973</i>	<i>37.73</i>	<i>41.10</i>	<i>1965</i>	<i>69.61</i>	<i>76.71</i>
<i>1975</i>	<i>123.39</i>	<i>134.40</i>	<i>1968</i>	<i>47.00</i>	<i>51.79</i>
<i>1985</i>	<i>69.66</i>	<i>75.87</i>	<i>1971</i>	<i>88.93</i>	<i>97.99</i>
<i>1988</i>	<i>28.11</i>	<i>30.62</i>	<i>1972</i>	<i>94.52</i>	<i>104.15</i>
			<i>1974</i>	<i>189.43</i>	<i>208.74</i>
			<i>1975</i>	<i>123.39</i>	<i>135.97</i>
			<i>1976</i>	<i>144.02</i>	<i>158.70</i>
			<i>1989</i>	<i>249.66</i>	<i>275.11</i>
			<i>1999</i>	<i>114.17</i>	<i>125.81</i>
			<i>2000</i>	<i>83.76</i>	<i>92.30</i>
Average	87.68			108.50	
Neutral	91.81			90.75	
Average % Neutral New	84.09				
Average % Neutral Old	120.79				

Table 22: Daily precipitation in inches for Greenville, MS. Values are for June 1957, 1974, and 1989.

Greenville, MS HCN June Cold Precipitation (in)			
Day	1957	1974	1989
1	0.05	0.76	0.67
2	0.04	0.00	0.12
3	1.33	0.00	0.04
4	0.20	0.00	1.25
5	1.79	1.57	0.04
6	1.05	1.11	0.00
7	0.01	0.27	0.98
8	0.04	1.95	0.00
9	0.75	0.00	0.00
10	0.50	0.55	0.00
11	0.00	0.00	0.00
12	0.00	0.94	0.00
13	0.63	0.00	0.95
14	0.20	0.00	0.36
15	0.00	0.26	0.00
16	0.00	0.03	0.00
17	0.00	0.00	0.00
18	0.00	0.04	0.00
19	0.00	0.00	0.00
20	0.00	0.00	0.00
21	0.00	0.00	0.00
22	0.30	0.00	0.00
23	0.77	0.22	0.00
24	0.14	0.00	0.00
25	0.00	0.00	0.00
26	0.00	0.00	0.20
27	0.00	0.00	0.60
28	1.83	0.00	2.10
29	0.00	0.00	0.38
30	0.00	0.00	1.55
Total	9.63	7.70	9.24

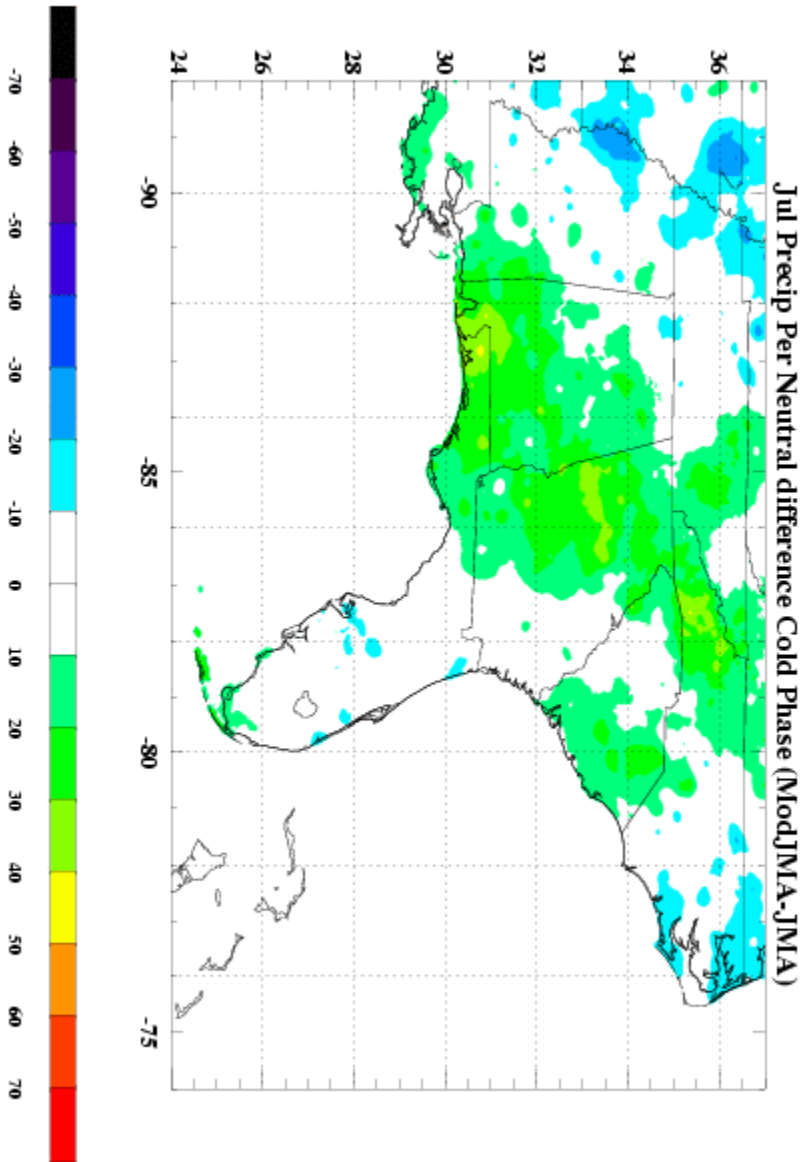


Figure 20: July ModJMA-JMA Cold Phase Percent Neutral Precipitation plot. This plot represents the difference in percent neutral precipitation between the two indices for June cold phase

Table 23: ModJMA and JMA percent neutral precipitation for July cold phase at Pensacola, FL. The average values for the years of the ModJMA index that are not a part of the JMA index are included ('new'). Similarly, years of the JMA index that are not in the ModJMA index are defined as 'old'. Both new and old years are shown in italics.

Pensacola, FL July Cold Precipitation (mm)					
ModJMA			JMA		
Years	Precipitation	% Neutral	Years	Precipitation	% Neutral
<i>1903</i>	<i>203.21</i>	<i>120.63</i>	<i>1904</i>	<i>240.12</i>	<i>124.81</i>
<i>1909</i>	<i>122.25</i>	<i>72.57</i>	<i>1907</i>	<i>226.30</i>	<i>117.63</i>
<i>1910</i>	<i>186.44</i>	<i>110.67</i>	<i>1909</i>	<i>122.25</i>	<i>63.54</i>
<i>1916</i>	<i>409.57</i>	<i>243.13</i>	<i>1910</i>	<i>186.44</i>	<i>96.91</i>
<i>1922</i>	<i>172.04</i>	<i>102.13</i>	<i>1911</i>	<i>87.26</i>	<i>45.36</i>
<i>1924</i>	<i>184.25</i>	<i>109.37</i>	<i>1917</i>	<i>113.15</i>	<i>58.81</i>
<i>1942</i>	<i>142.83</i>	<i>84.79</i>	<i>1923</i>	<i>168.21</i>	<i>87.43</i>
<i>1949</i>	<i>267.36</i>	<i>158.71</i>	<i>1925</i>	<i>182.01</i>	<i>94.60</i>
<i>1950</i>	<i>252.44</i>	<i>149.85</i>	<i>1939</i>	<i>180.16</i>	<i>93.64</i>
<i>1954</i>	<i>161.81</i>	<i>96.05</i>	<i>1943</i>	<i>138.85</i>	<i>72.17</i>
<i>1955</i>	<i>119.30</i>	<i>70.82</i>	<i>1945</i>	<i>171.40</i>	<i>89.09</i>
<i>1956</i>	<i>222.27</i>	<i>131.94</i>	<i>1950</i>	<i>252.44</i>	<i>131.21</i>
<i>1964</i>	<i>259.64</i>	<i>154.13</i>	<i>1955</i>	<i>119.30</i>	<i>62.01</i>
<i>1970</i>	<i>62.04</i>	<i>36.83</i>	<i>1956</i>	<i>222.27</i>	<i>115.53</i>
<i>1971</i>	<i>175.00</i>	<i>103.88</i>	<i>1957</i>	<i>132.37</i>	<i>68.80</i>
<i>1973</i>	<i>316.04</i>	<i>187.61</i>	<i>1965</i>	<i>143.13</i>	<i>74.40</i>
<i>1975</i>	<i>408.14</i>	<i>242.28</i>	<i>1968</i>	<i>126.88</i>	<i>65.95</i>
<i>1985</i>	<i>159.42</i>	<i>94.63</i>	<i>1971</i>	<i>175.00</i>	<i>90.96</i>
<i>1988</i>	<i>333.10</i>	<i>197.73</i>	<i>1972</i>	<i>105.01</i>	<i>54.58</i>
<i>1999</i>	<i>231.03</i>	<i>137.14</i>	<i>1974</i>	<i>152.84</i>	<i>79.44</i>
			<i>1975</i>	<i>408.14</i>	<i>212.14</i>
			<i>1976</i>	<i>155.17</i>	<i>80.65</i>
			<i>1989</i>	<i>275.91</i>	<i>143.41</i>
			<i>1999</i>	<i>231.03</i>	<i>120.08</i>
			<i>2000</i>	<i>63.19</i>	<i>32.84</i>
Average	219.41	130.24		175.15	91.04
Neutral	168.46			192.39	
Average % Neutral New	132.14				
Average % Neutral Old	81.39				

Table 24: Daily precipitation in inches for Pensacola, FL. Values are for July 1973.

Pensacola, FL July Cold COOP Precipitation (in)	
Day	1973
1	0.16
2	0.00
3	0.00
4	0.00
5	0.00
6	3.17
7	0.75
8	0.00
9	0.00
10	0.00
11	0.00
12	0.00
13	0.06
14	0.53
15	0.00
16	0.00
17	0.00
18	0.08
19	0.85
20	0.00
21	0.49
22	0.01
23	0.14
24	0.21
25	0.25
26	0.00
27	0.44
28	4.84
29	0.21
30	0.00
31	0.73
Total	12.92

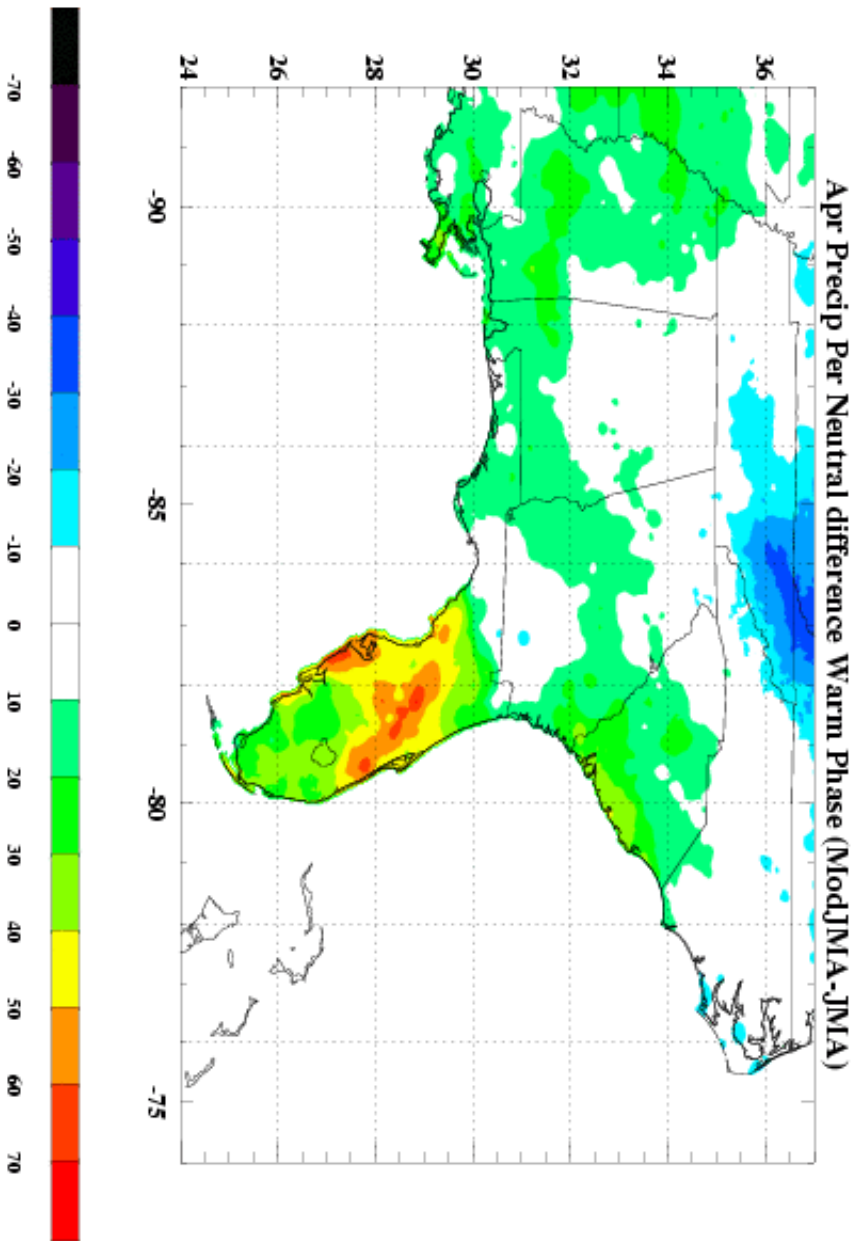


Figure 21: April ModJMA-JMA Warm Phase Percent Neutral Precipitation plot. This plot represents the difference in percent neutral precipitation between the two indices for June cold phase

Table 25: ModJMA and JMA percent neutral precipitation for April warm phase at Orlando, FL. The average values for the years of the ModJMA index that are not a part of the JMA index are included ('new'). Similarly, years of the JMA index that are not in the ModJMA index are defined as 'old'. Both new and old years are shown in italics.

Orlando April Warm Precipitation (mm)					
ModJMA			JMA		
Years	Precipitation	% Neutral	Years	Precipitation	% Neutral
<i>1899</i>	72.83	128.45	<i>1897</i>	56.54	89.77
1900	89.08	157.11	1900	89.08	141.44
<i>1902</i>	33.02	58.24	<i>1903</i>	7.60	12.07
1905	59.63	105.17	1905	59.63	94.68
1912	57.55	101.50	<i>1906</i>	35.26	55.99
1926	132.45	233.60	1912	57.55	91.38
1930	87.47	154.27	<i>1914</i>	54.27	86.17
1931	103.50	182.54	<i>1919</i>	20.41	32.41
1941	120.69	212.86	1926	132.45	210.30
<i>1957</i>	127.73	225.27	1930	87.47	138.89
1958	108.20	190.83	1931	103.50	164.34
<i>1969</i>	54.01	95.26	1941	120.69	191.63
<i>1982</i>	141.91	250.28	<i>1952</i>	51.84	82.31
1983	86.96	153.37	1958	108.20	171.80
1987	12.48	22.01	<i>1964</i>	60.73	96.43
<i>1991</i>	170.50	300.71	<i>1966</i>	43.36	68.85
1992	178.46	314.74	<i>1970</i>	22.77	36.15
<i>1997</i>	115.34	203.42	<i>1973</i>	74.17	117.77
1998	23.63	41.68	<i>1977</i>	6.96	11.05
<i>2002</i>	39.85	70.28	1983	86.96	138.08
			1987	12.48	19.82
			<i>1988</i>	42.35	67.24
			1992	178.46	283.36
			1998	23.63	37.52
			<i>2003</i>	56.94	90.41
Average	90.76			63.73	
Neutral	56.70			62.98	
Average % Neutral New	166.49				
Average % Neutral Old	65.12				

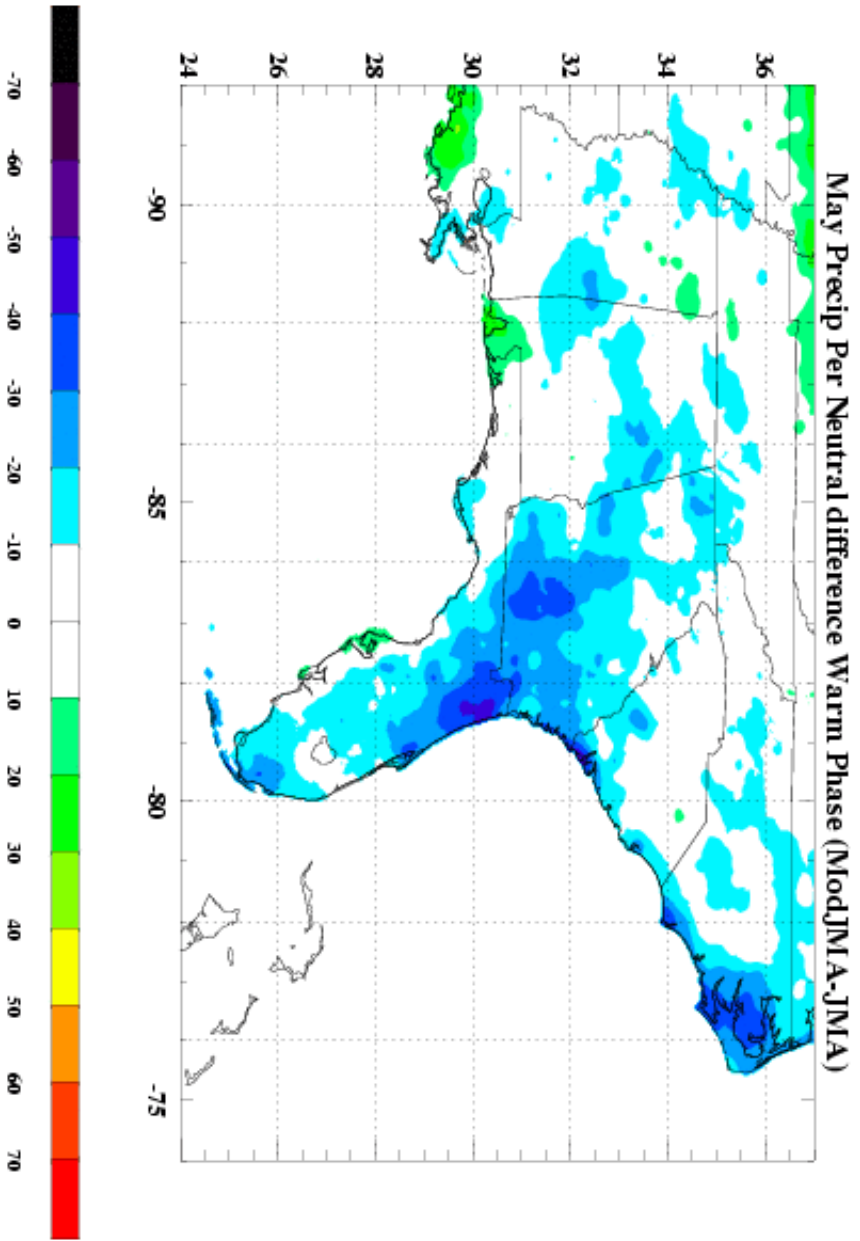


Figure 22: May ModJMA-JMA Warm Phase Percent Neutral Precipitation plot. This plot represents the difference in percent neutral precipitation between the two indices for June cold phase

Table 26: ModJMA and JMA percent neutral precipitation for May warm phase at Jacksonville, FL. The average values for the years of the ModJMA index that are not a part of the JMA index are included ('new'). Similarly, years of the JMA index that are not in the ModJMA index are defined as 'old'. Both new and old years are shown in italics.

Jacksonville, FL May Warm Precipitation (mm)					
ModJMA			JMA		
Years	Precipitation	% Neutral	Years	Precipitation	% Neutral
<i>1896</i>	28.50	34.23	<i>1897</i>	26.40	35.13
<i>1899</i>	29.42	35.34	1990	52.32	69.61
1900	52.32	62.84	<i>1903</i>	162.25	215.87
<i>1902</i>	41.38	49.70	1905	155.90	207.42
1905	155.90	187.24	<i>1906</i>	252.67	336.18
<i>1918</i>	31.31	37.61	<i>1912</i>	101.00	134.38
1926	41.63	50.00	<i>1914</i>	37.38	49.73
1930	41.28	49.58	<i>1919</i>	115.04	153.06
1931	84.20	101.13	1926	41.63	55.39
1941	28.06	33.70	1930	41.28	54.92
<i>1951</i>	37.36	44.87	1931	84.20	112.03
<i>1957</i>	134.81	161.91	1941	28.06	37.33
<i>1965</i>	46.35	55.67	<i>1952</i>	207.23	275.72
<i>1969</i>	95.59	114.81	<i>1958</i>	94.17	125.29
<i>1972</i>	206.47	247.98	<i>1964</i>	121.04	161.04
<i>1982</i>	89.73	107.77	<i>1966</i>	263.11	350.07
1983	35.46	42.59	<i>1970</i>	54.96	73.12
1987	19.58	23.52	<i>1973</i>	134.48	178.92
<i>1991</i>	218.65	262.61	<i>1977</i>	76.89	102.30
1992	131.17	157.54	1983	35.46	47.18
<i>1997</i>	84.53	101.53	1987	19.58	26.05
1998	24.04	28.87	<i>1988</i>	43.05	57.28
<i>2002</i>	36.29	43.59	1992	131.17	174.52
			1998	24.04	31.99
			<i>2003</i>	69.55	92.54
Average	73.65			94.91	
Neutral	83.26			75.16	
Average % Neutral New	99.82				
Average % Neutral Old	156.04				

Table 27: Daily precipitation in inches for Jacksonville and Fernandina Beach, FL. Values for May 1903 and 1906 are from Fernandina Beach. Values for May 1952 and 1966 are from Jacksonville.

FL May Warm COOP Precipitation (in)				
	Fernandina Beach		Jacksonville	
Day	1903	1906	1952	1966
1	0.00	0.00	0.00	0.00
2	0.01	0.00	0.00	0.63
3	0.00	0.00	0.00	0.06
4	0.00	0.07	0.00	0.00
5	0.00	0.05	0.00	0.06
6	0.09	0.00	0.00	0.04
Total	16.27	8.12	11.87	8.82
7	1.49	0.36	0.00	0.04
8	3.10	0.04	0.00	3.00
9	5.45	0.00	0.00	0.24
10	0.28	0.00	0.02	0.00
11	1.55	0.00	0.72	0.00
12	0.05	0.00	0.00	0.00
13	2.60	0.00	0.00	0.00
14	0.94	0.00	0.00	0.11
15	0.55	0.85	0.00	0.00
16	0.16	0.04	0.00	0.00
17	0.00	0.00	0.00	1.49
18	0.00	0.00	0.06	0.00
19	0.00	0.00	1.60	0.00
20	0.00	0.00	0.49	0.00
21	0.00	0.00	0.24	0.10
22	0.00	1.35	1.60	0.00
23	0.00	0.45	0.02	1.01
24	0.00	2.05	0.04	0.02
25	0.00	1.90	2.05	0.55
26	0.00	2.00	0.00	0.30
27	0.00	0.02	0.00	1.20
28	0.00	0.00	0.00	0.59
29	0.00	0.00	0.53	0.16
30	0.00	0.00	4.28	0.02
31	0.00	0.00	0.02	0.00

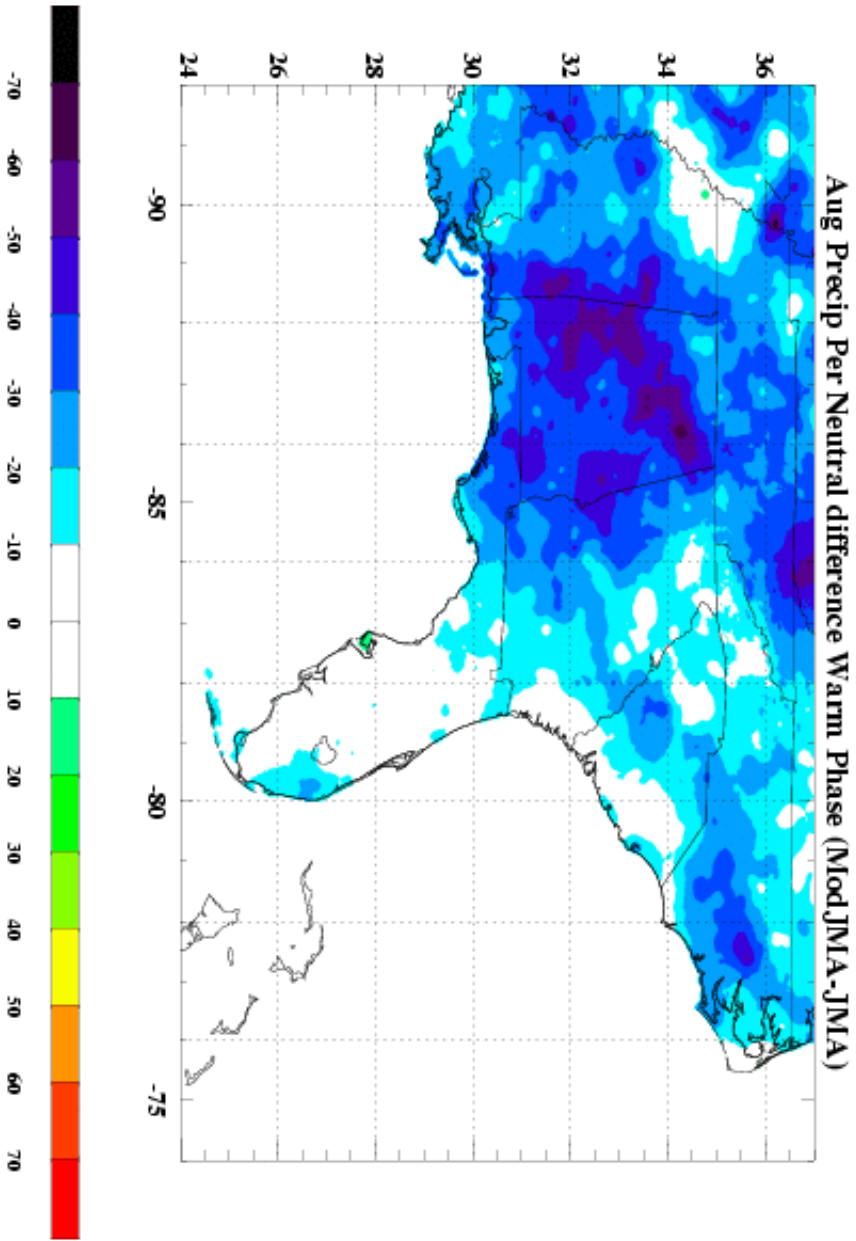


Figure 23: August ModJMA-JMA Warm Phase Percent Neutral Precipitation plot. This plot represents the difference in percent neutral precipitation the two indices for June cold phase

Table 28: ModJMA and JMA percent neutral precipitation for August warm phase at Scottsboro, AL. The average values for the years of the ModJMA index that are not a part of the JMA index are included ('new'). Similarly, years of the JMA index that are not in the ModJMA index are defined as 'old'. Both new and old years are shown in italics.

Scottsboro, AL Aug Warm Precipitation (mm)					
ModJMA			JMA		
Years	Precipitation	% Neutral	Years	Precipitation	% Neutral
<i>1896</i>	19.81	19.14	<i>1897</i>	59.39	64.95
<i>1899</i>	103.21	99.74	1900	61.58	67.34
1900	61.58	59.51	<i>1903</i>	84.28	92.17
<i>1902</i>	103.03	99.57	1905	94.24	103.06
<i>1904</i>	97.65	94.37	<i>1906</i>	167.92	183.64
1905	94.24	91.07	<i>1912</i>	161.64	176.77
<i>1911</i>	100.84	97.45	<i>1914</i>	174.43	190.76
<i>1913</i>	92.15	89.05	<i>1919</i>	144.14	157.63
<i>1918</i>	30.14	29.13	<i>1926</i>	142.86	156.23
<i>1925</i>	22.10	21.36	1930	47.28	51.71
1930	47.28	45.69	<i>1931</i>	102.93	112.57
<i>1940</i>	60.64	58.60	<i>1941</i>	57.37	62.74
<i>1951</i>	93.02	89.89	<i>1952</i>	213.06	233.01
<i>1957</i>	32.80	31.70	<i>1958</i>	71.59	78.29
<i>1963</i>	5.71	5.52	<i>1964</i>	59.59	65.17
<i>1965</i>	90.46	87.42	<i>1966</i>	91.12	99.65
<i>1969</i>	83.95	81.13	<i>1970</i>	123.81	135.40
<i>1972</i>	46.59	45.02	<i>1973</i>	85.60	93.61
<i>1976</i>	109.27	105.60	<i>1977</i>	96.84	105.91
<i>1982</i>	58.07	56.12	1983	53.14	58.11
1983	53.14	51.35	1987	68.30	74.69
1987	68.30	66.00	<i>1988</i>	144.39	157.91
<i>1991</i>	63.03	60.91	<i>1992</i>	102.77	112.39
<i>1997</i>	66.47	64.23	<i>1998</i>	71.51	78.20
<i>2002</i>	131.34	126.92	<i>2003</i>	179.58	196.39
Average	69.39			106.37	
Neutral	103.48			91.44	
Average % Neutral New	64.90				
Average % Neutral Old	127.67				

Table 29: Daily precipitation in inches for Scottsboro and Talladega, AL.  
 Values for Aug 1952, 1988 and 2003 are from Scottsboro. Values for Aug  
 1906, 1912, 1914 and 1926 are from Talladega.

AL Aug Warm HCN Precipitation (in)								
Day	Scottsboro			Talladega				
	1952	1988	2003	1906	1912	1914	1919	1926
1	0.80	0.00	0.10	0.00	0.00	0.00	0.00	1.00
2	0.00	0.00	0.00	0.00	0.00	0.40	0.10	0.05
3	0.33	0.00	3.81	0.16	0.00	0.00	0.00	0.12
4	0.30	0.00	0.10	0.13	0.00	1.00	0.00	0.90
5	0.55	0.88	0.00	0.01	0.00	0.00	0.00	0.00
6	0.70	0.25	0.00	0.00	0.00	0.00	0.00	0.00
7	1.35	0.00	1.49	0.00	0.00	0.00	0.00	0.00
8	0.00	0.00	0.00	0.00	2.90	1.42	0.00	0.00
9	0.80	0.05	0.00	0.00	0.54	0.00	0.00	0.00
10	0.70	0.00	0.04	0.25	0.50	1.30	0.00	0.00
11	0.00	0.22	0.00	0.33	1.18	0.60	0.35	0.00
12	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.00
13	0.13	0.00	0.35	0.79	0.00	0.00	0.00	0.75
14	0.07	0.00	0.76	0.35	0.00	0.50	1.30	0.00
15	0.00	0.00	0.00	2.10	0.00	0.00	0.40	0.00
16	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.47
17	0.00	0.02	0.00	1.23	0.00	0.00	0.00	0.00
18	0.00	0.00	0.09	0.33	0.00	0.00	0.00	0.00
19	0.65	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	0.00	0.59	0.00	0.03	0.00	0.00	0.00	0.00
21	0.00	1.60	0.00	0.00	0.56	0.00	0.80	0.00
22	0.89	0.00	0.00	0.00	0.00	1.30	0.00	0.00
23	0.00	0.00	0.25	0.00	2.25	0.00	0.75	0.06
24	0.00	1.90	0.00	0.23	0.00	0.00	0.00	2.20
25	0.00	0.00	0.00	0.00	0.11	0.00	0.00	0.00
26	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.00
27	0.00	0.00	0.10	0.03	0.00	0.00	0.00	0.00
28	0.00	0.00	0.56	0.00	0.00	0.00	0.00	0.00
29	0.70	0.00	0.00	1.10	0.00	0.00	0.75	0.00
30	1.06	0.00	0.00	0.00	0.00	0.00	0.10	0.00
Total	9.03	5.51	7.70	7.07	8.10	6.52	4.75	5.55

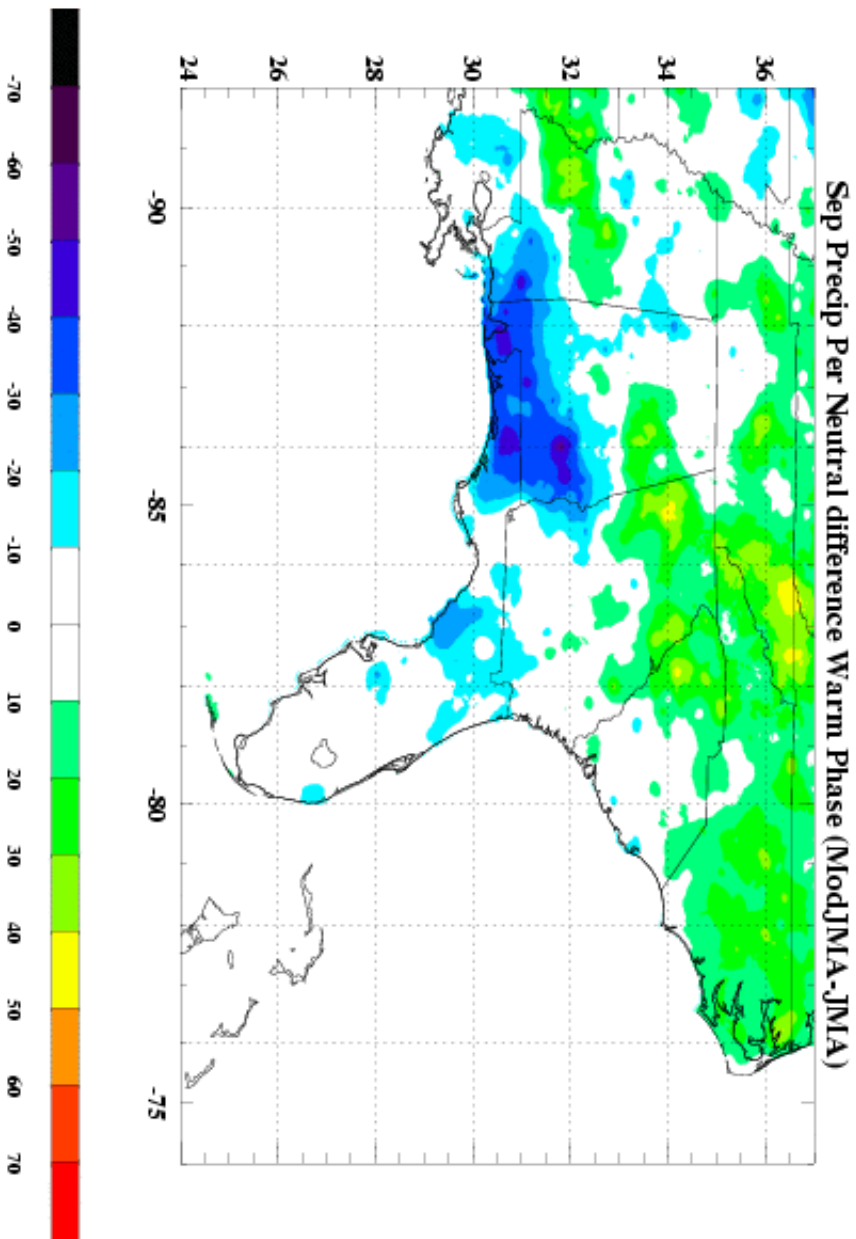


Figure 24: September ModJMA-JMA Warm Phase Percent Neutral Precipitation plot. This plot represents the difference in percent neutral precipitation the two indices for June cold phase

Table 30: ModJMA and JMA percent neutral precipitation for September warm phase at Troy, AL. The average values for the years of the ModJMA index that are not a part of the JMA index are included ('new'). Similarly, years of the JMA index that are not in the ModJMA index are defined as 'old'. Both new and old years are shown in italics.

Troy, AL Sept Warm Precipitation (mm)					
ModJMA			JMA		
Years	Precipitation	% Neutral	Years	Precipitation	% Neutral
<i>1896</i>	<i>22.69</i>	<i>22.74</i>	<i>1897</i>	<i>21.11</i>	<i>22.29</i>
<i>1899</i>	<i>11.09</i>	<i>11.12</i>	1900	107.53	113.56
1900	107.53	107.79	<i>1903</i>	<i>59.55</i>	<i>62.89</i>
<i>1902</i>	<i>116.53</i>	<i>116.81</i>	1905	65.10	68.75
<i>1904</i>	<i>30.03</i>	<i>30.10</i>	<i>1906</i>	<i>191.86</i>	<i>202.62</i>
1905	65.10	65.26	<i>1912</i>	<i>173.71</i>	<i>183.45</i>
<i>1911</i>	<i>54.95</i>	<i>55.08</i>	<i>1914</i>	<i>140.45</i>	<i>148.33</i>
<i>1913</i>	<i>137.41</i>	<i>137.74</i>	<i>1919</i>	<i>43.48</i>	<i>45.92</i>
<i>1918</i>	<i>61.82</i>	<i>61.97</i>	<i>1926</i>	<i>305.66</i>	<i>322.80</i>
<i>1925</i>	<i>35.75</i>	<i>35.84</i>	1930	212.51	224.43
<i>1929</i>	<i>157.39</i>	<i>157.77</i>	<i>1931</i>	<i>22.14</i>	<i>23.38</i>
1930	212.51	213.02	<i>1941</i>	<i>67.94</i>	<i>71.75</i>
<i>1940</i>	<i>13.46</i>	<i>13.49</i>	<i>1952</i>	<i>58.02</i>	<i>61.27</i>
<i>1951</i>	<i>129.22</i>	<i>129.53</i>	<i>1958</i>	<i>119.90</i>	<i>126.62</i>
<i>1957</i>	<i>224.52</i>	<i>225.06</i>	<i>1964</i>	<i>129.43</i>	<i>136.69</i>
<i>1963</i>	<i>176.14</i>	<i>176.56</i>	<i>1966</i>	<i>65.56</i>	<i>69.24</i>
<i>1965</i>	<i>98.84</i>	<i>99.08</i>	<i>1970</i>	<i>38.83</i>	<i>41.01</i>
<i>1969</i>	<i>159.57</i>	<i>159.95</i>	<i>1973</i>	<i>93.88</i>	<i>99.14</i>
<i>1972</i>	<i>44.79</i>	<i>44.90</i>	<i>1977</i>	<i>140.13</i>	<i>147.99</i>
<i>1976</i>	<i>65.76</i>	<i>65.92</i>	<i>1983</i>	<i>128.43</i>	<i>135.63</i>
<i>1982</i>	<i>67.38</i>	<i>67.54</i>	<i>1987</i>	<i>85.06</i>	<i>89.83</i>
<i>1986</i>	<i>109.56</i>	<i>109.82</i>	<i>1988</i>	<i>197.67</i>	<i>208.75</i>
1987	85.06	85.26	<i>1992</i>	<i>54.96</i>	<i>58.04</i>
<i>1991</i>	<i>27.23</i>	<i>27.30</i>	<i>1998</i>	<i>433.05</i>	<i>457.33</i>
<i>1997</i>	<i>58.09</i>	<i>58.23</i>	<i>2003</i>	<i>117.51</i>	<i>124.10</i>
<i>2002</i>	<i>137.13</i>	<i>137.46</i>			
Average	92.68			122.94	
Neutral	99.76			94.69	
Average % Neutral New	88.36				
Average % Neutral Old	130.92				

Table 31: Daily precipitation in inches for Coffee Springs and Troy, AL. Values for September 1998 are from Coffee Springs. Values for September 1926 are from Troy.

AL Sept Precipitation (in)		
	1926	1998
Day	Coffee Springs	Troy
1	0.00	0.02
2	0.00	0.00
3	0.00	1.50
4	0.51	0.00
5	0.00	0.00
6	0.00	0.00
7	0.00	0.00
8	0.00	0.00
9	0.00	0.00
10	0.06	0.00
11	0.00	0.00
12	0.00	0.00
13	0.00	0.00
14	0.00	0.00
15	0.00	0.00
16	0.00	0.04
17	0.15	0.00
18	0.09	0.70
19	0.00	0.00
20	8.10	0.00
21	1.07	1.90
22	0.00	0.85
23	0.00	0.00
24	0.00	0.00
25	0.00	0.00
26	0.00	0.00
27	0.00	0.00
28	0.22	0.03
29	0.00	3.35
30	0.00	4.90
Total	10.20	13.29

Apr Significant Warm Phase Differences in Percent Neutral Precip at 90% and 95% (ModJMA-JMA)

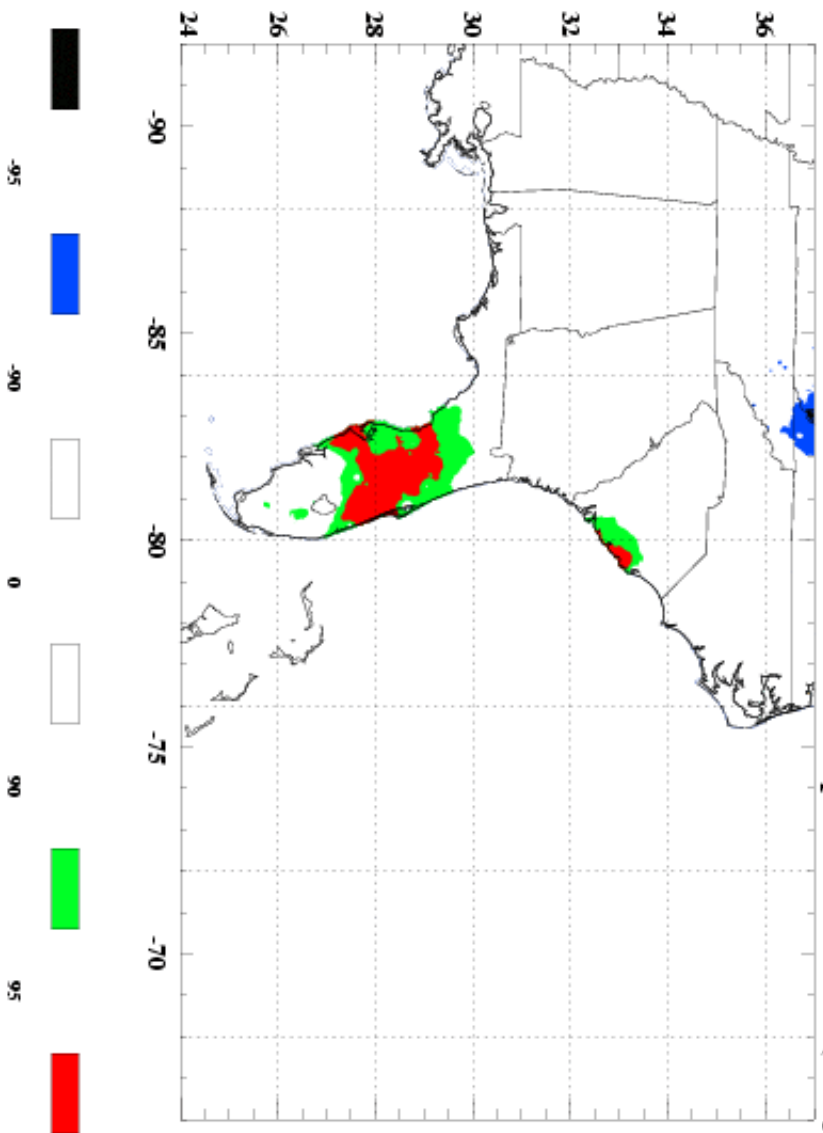


Figure 25: April ModJMA-JMA Warm Phase Percent Neutral Precipitation Significance plot. Differences of -95%, -90%, 90% and 95% are displayed.

May Significant Warm Phase Differences in Percent Neutral Precip at 90% and 95% (ModJMA-JMA)

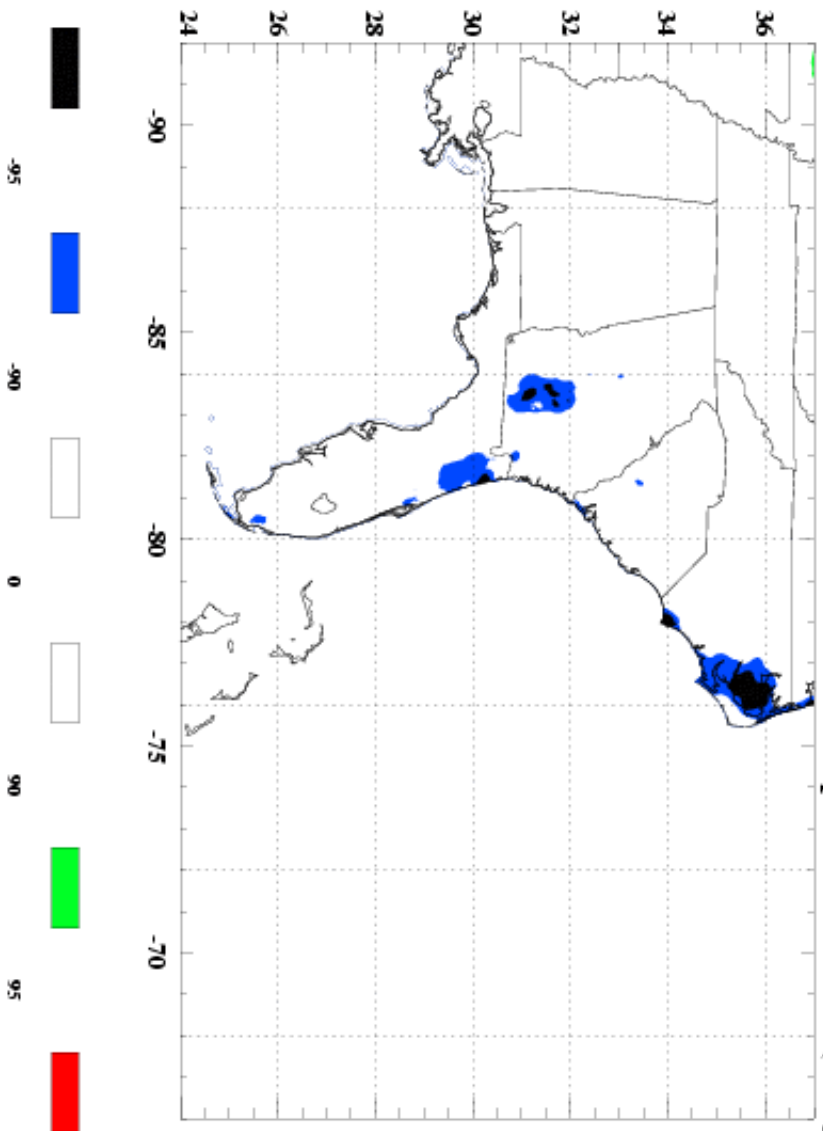


Figure 26: May ModJMA-JMA Warm Phase Percent Neutral Precipitation Significance plot. Differences of -95%, -90%, 90% and 95% are displayed.

June Significant Warm Phase Differences in Percent Neutral Precip at 90% and 95% (ModJMA-JMA)

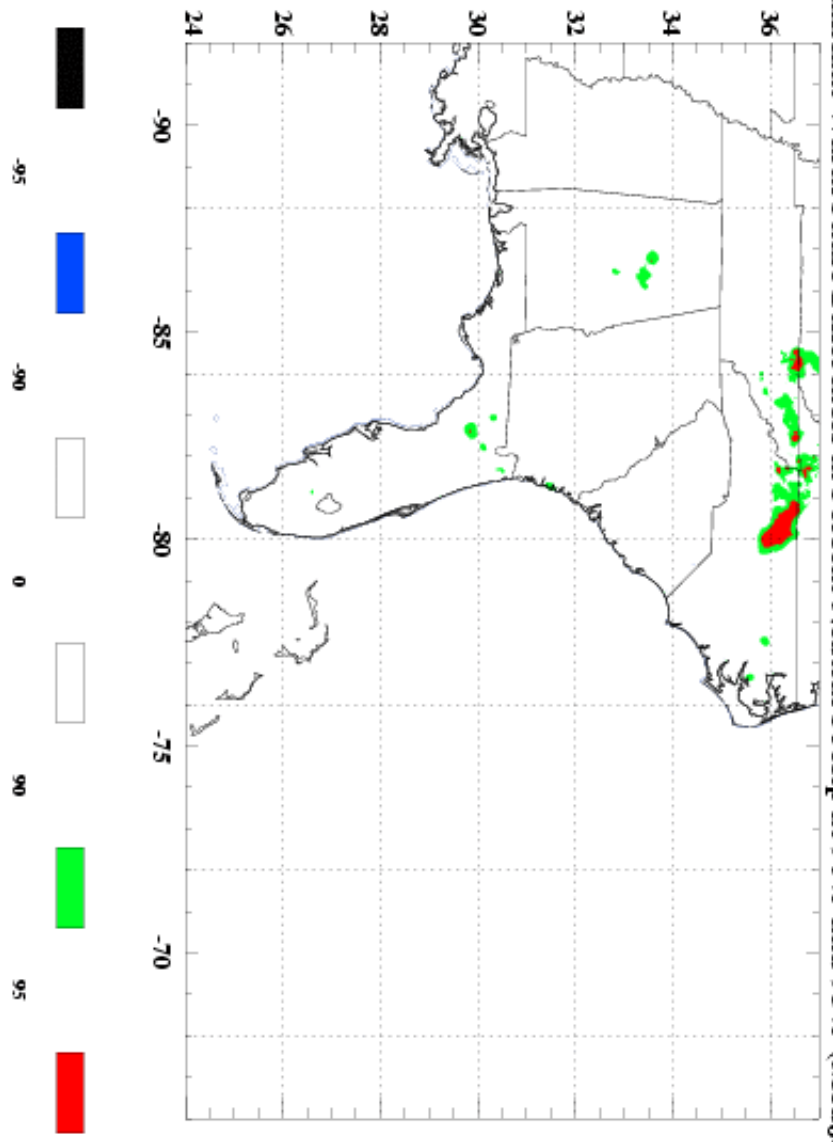


Figure 27: June ModJMA-JMA Warm Phase Percent Neutral Precipitation Significance plot. Differences of -95%, -90%, 90% and 95% are displayed.

July Significant Warm Phase Differences in Percent Neutral Precip at 90% and 95% (ModJMA-JMA)

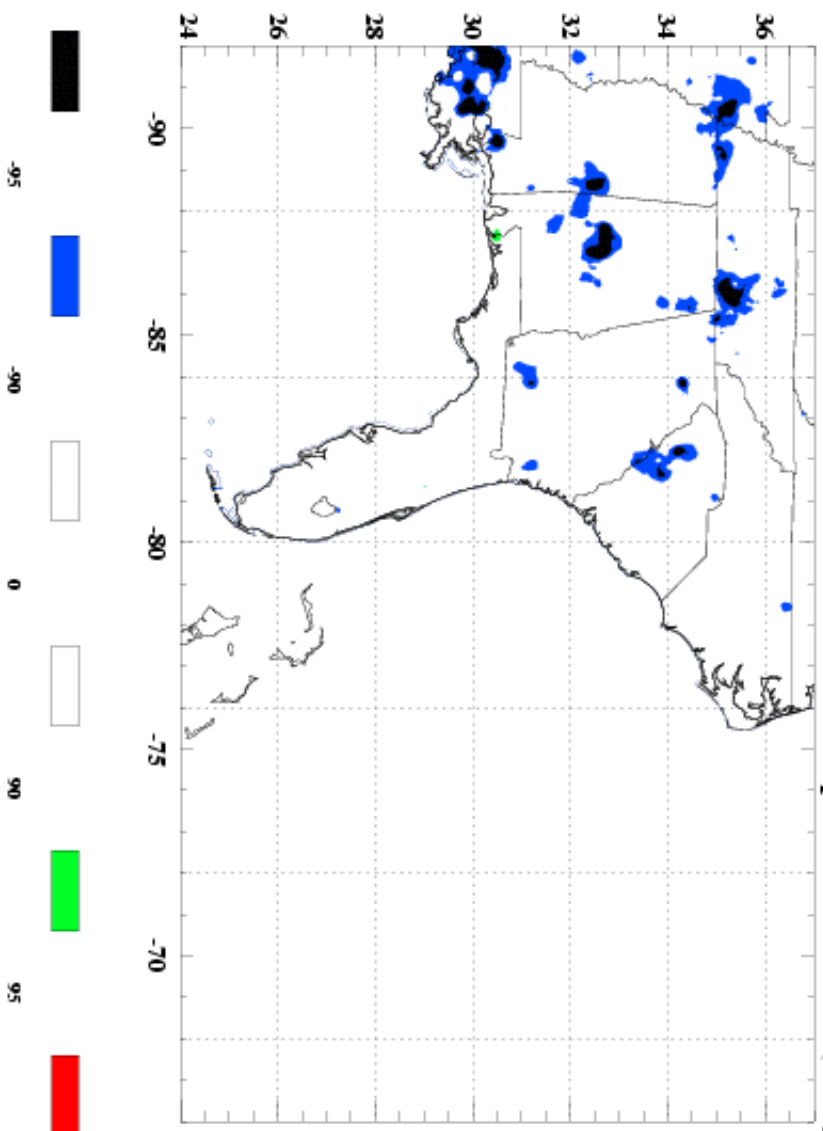


Figure 28: July ModJMA-JMA Warm Phase Percent Neutral Precipitation Significance plot. Differences of -95%, -90%, 90% and 95% are displayed.

Aug Significant Warm Phase Differences in Percent Neutral Precip at 90% and 95% (ModJMA-JMA)

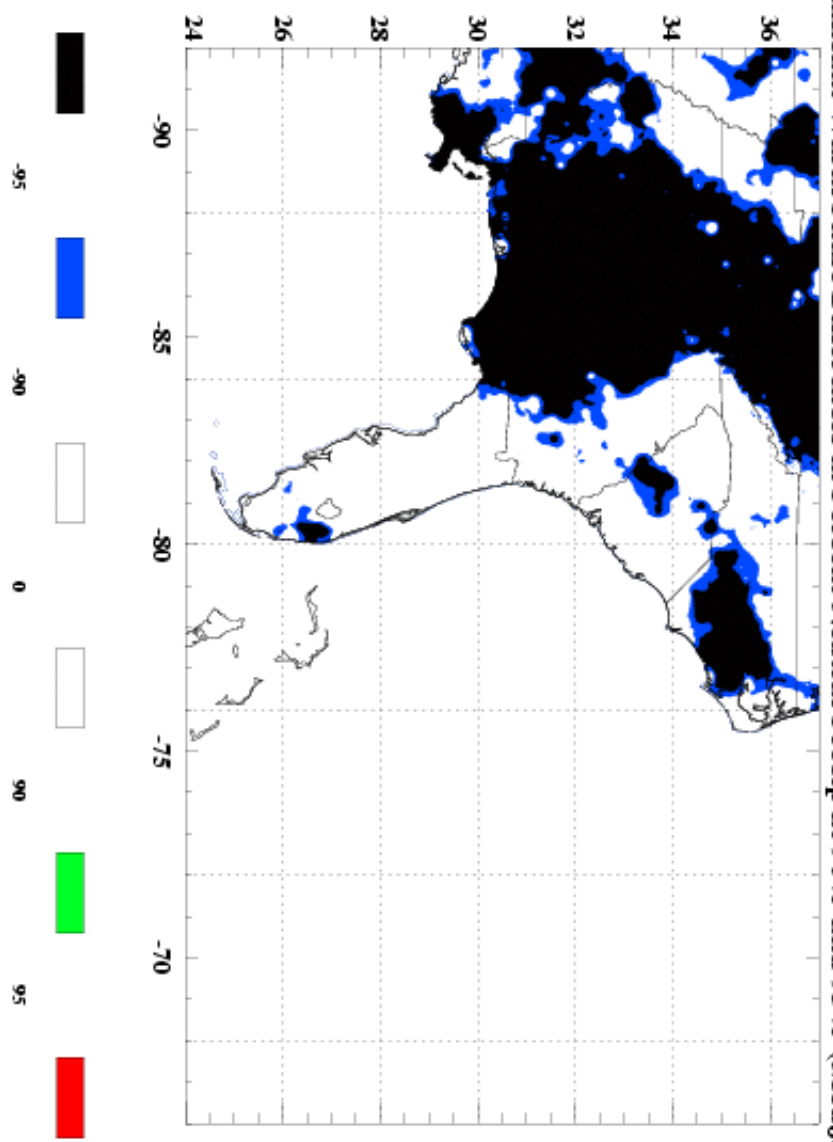


Figure 29: August ModJMA-JMA Warm Phase Percent Neutral Precipitation Significance plot. Differences of -95%, -90%, 90% and 95% are displayed.

**Sep Significant Warm Phase Differences in Percent Neutral Precip at 90% and 95% (ModJMA-JMA)**

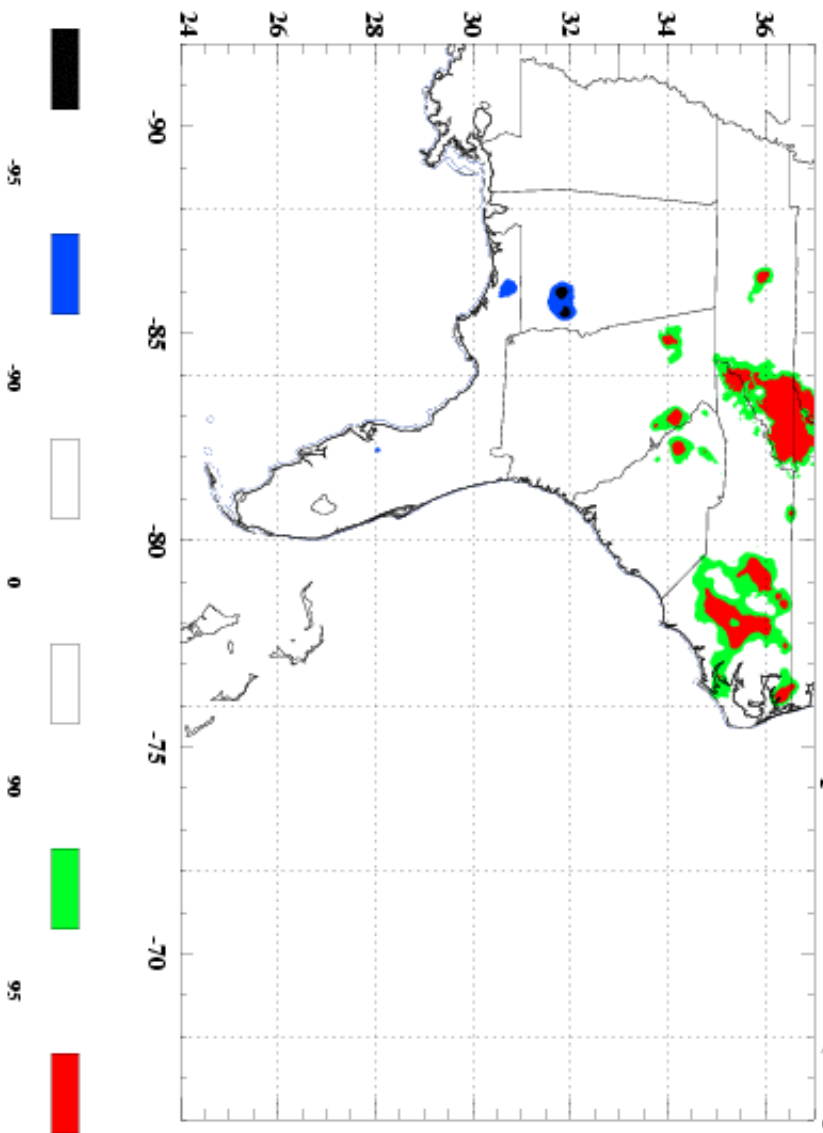


Figure 30: September ModJMA-JMA Warm Phase Percent Neutral Precipitation Significance plot. Differences of -95%, -90%, 90% and 95% are displayed.

Apr Significant Cold Phase Differences in Percent Neutral Precip at 90% and 95% (ModJMA-JMA)

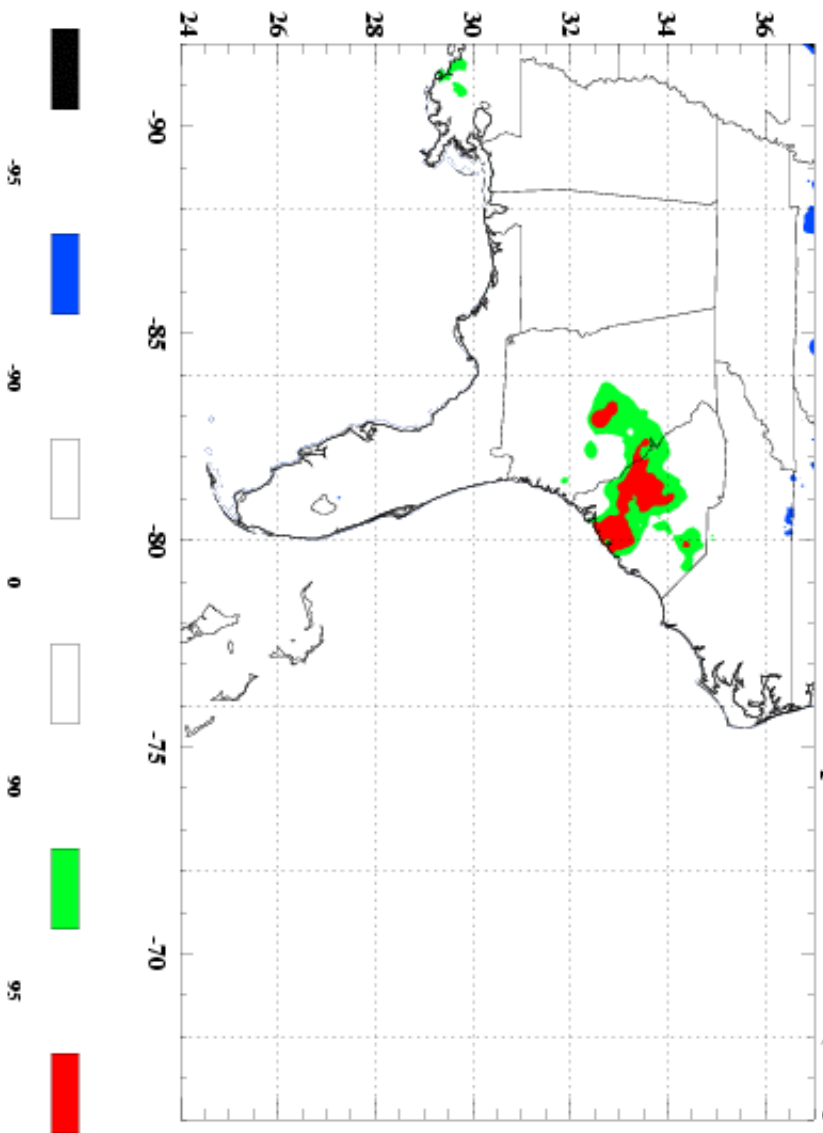


Figure 31: April ModJMA-JMA Cold Phase Percent Neutral Precipitation Significance plot. Differences of -95%, -90%, 90% and 95% are displayed.

June Significant Cold Phase Differences in Percent Neutral Precip at 90% and 95% (ModJMA-JMA)

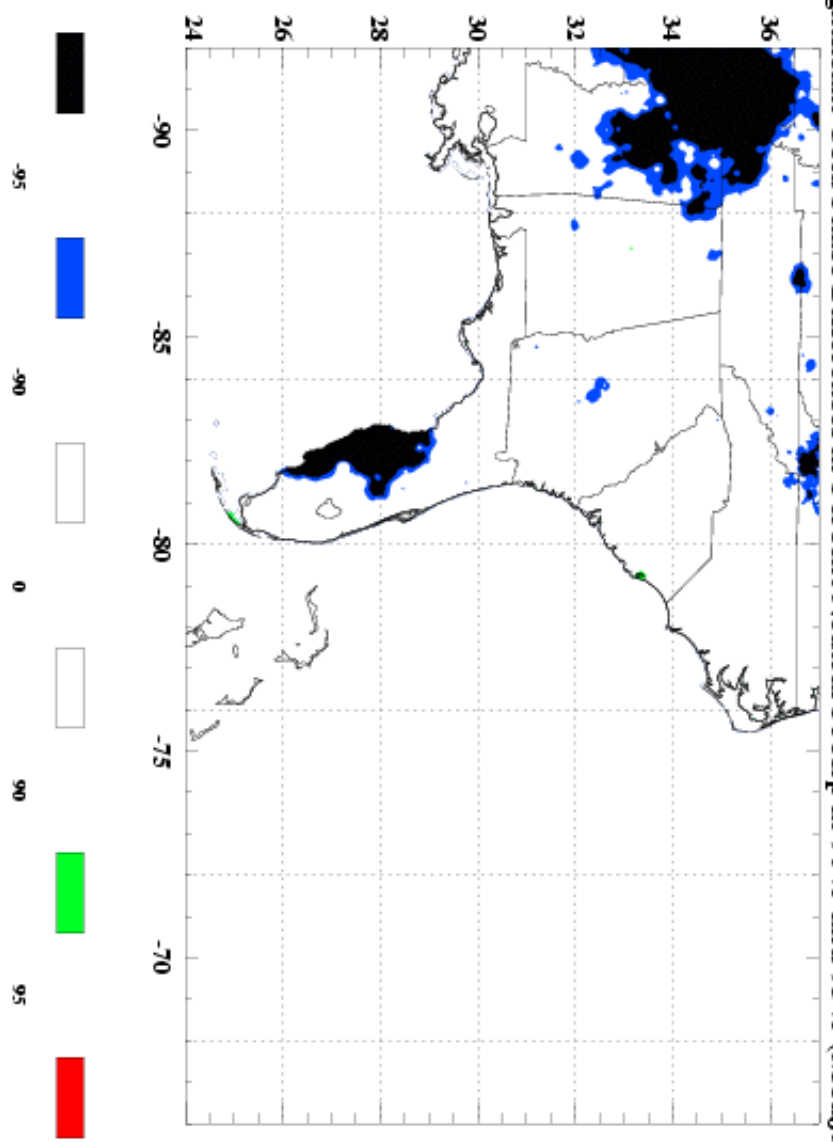


Figure 32: June ModJMA-JMA Cold Phase Percent Neutral Precipitation Significance plot. Differences of -95%, -90%, 90% and 95% are displayed.

July Significant Cold Phase Differences in Percent Neutral Precip at 90% and 95% (ModJMA-JMA)

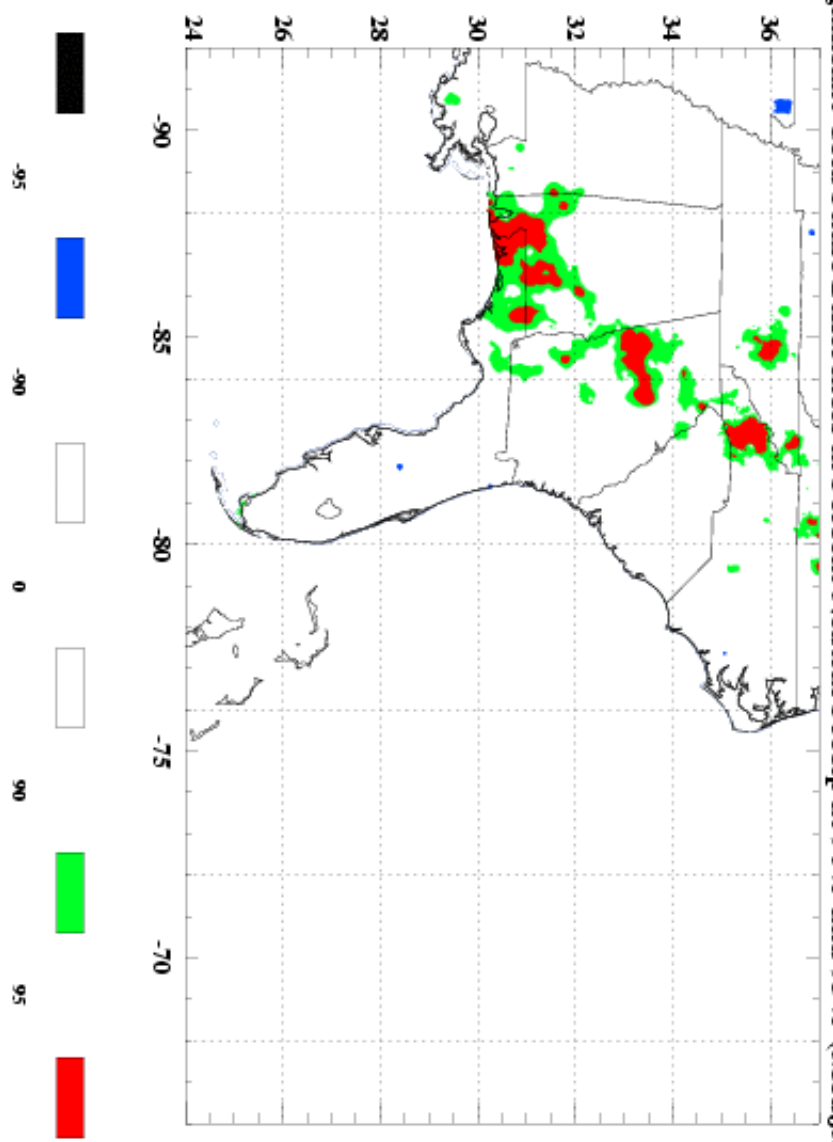


Figure 33: July ModJMA-JMA Cold Phase Percent Neutral Precipitation Significance plot. Differences of -95%, -90%, 90% and 95% are displayed.

**Aug Significant Cold Phase Differences in Percent Neutral Precip at 90% and 95% (ModJMA-JMA)**

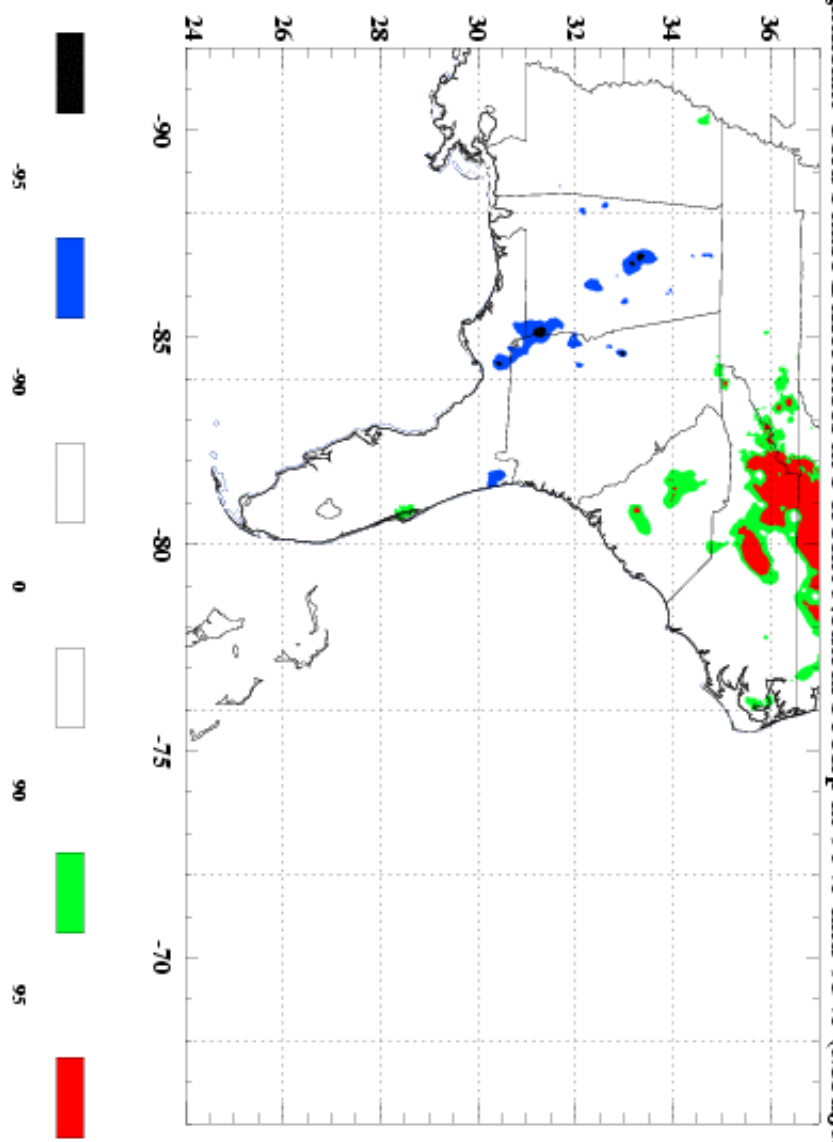


Figure 34: August ModJMA-JMA Cold Phase Percent Neutral Precipitation Significance plot. Differences of -95%, -90%, 90% and 95% are displayed.

Sep Significant Cold Phase Differences in Percent Neutral Precip at 90% and 95% (ModJMA-JMA)

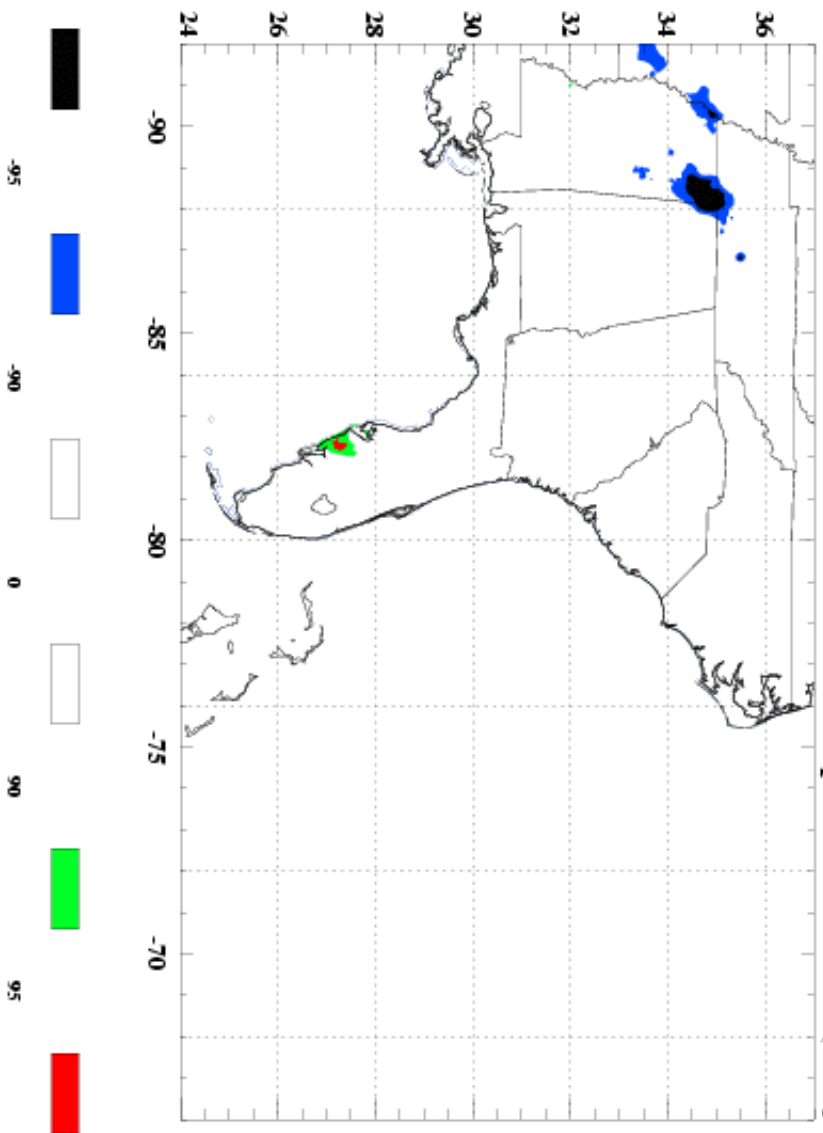


Figure 35: September ModJMA-JMA Cold Phase Percent Neutral Precipitation Significance plot. Differences of -95%, -90%, 90% and 95% are displayed.

May Significant Warm Phase Differences in Max Temp at 90% and 95% (ModJMA-JMA)

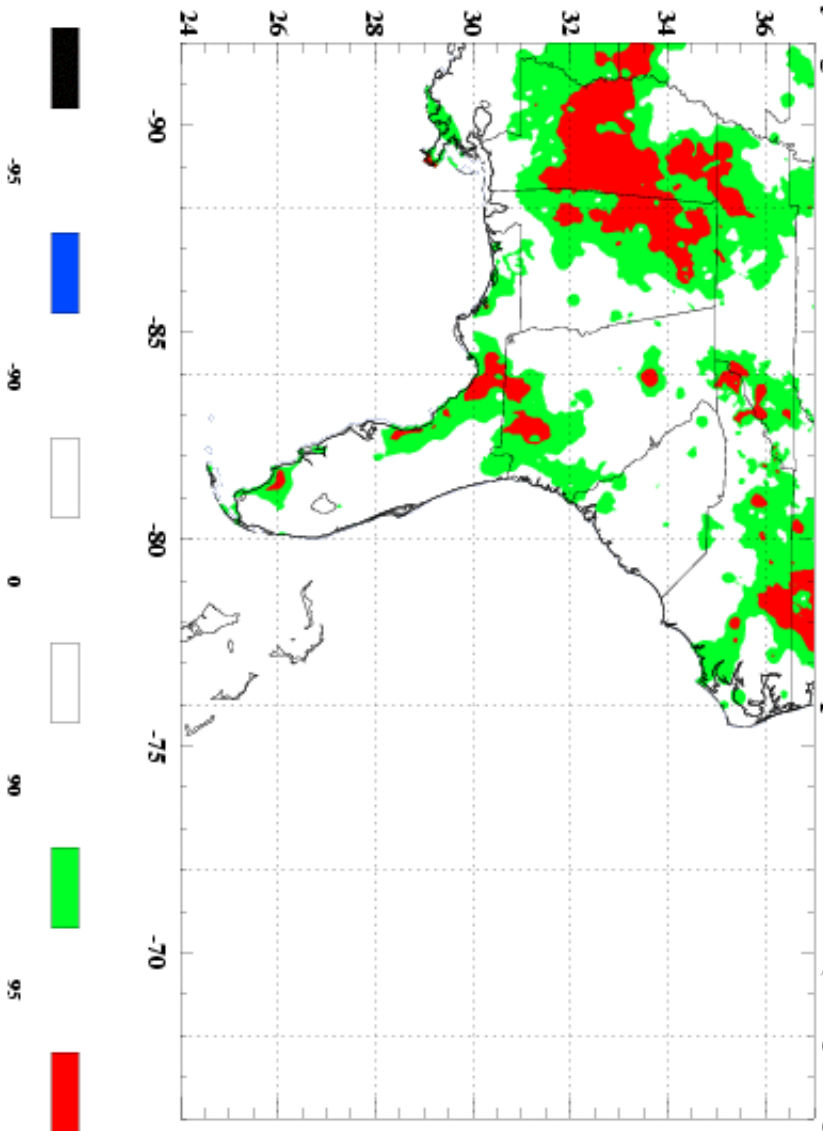


Figure 36: May ModJMA-JMA Warm Phase Max Temp Shift Significance plot. Differences of -95%, -90%, 90% and 95% are displayed.

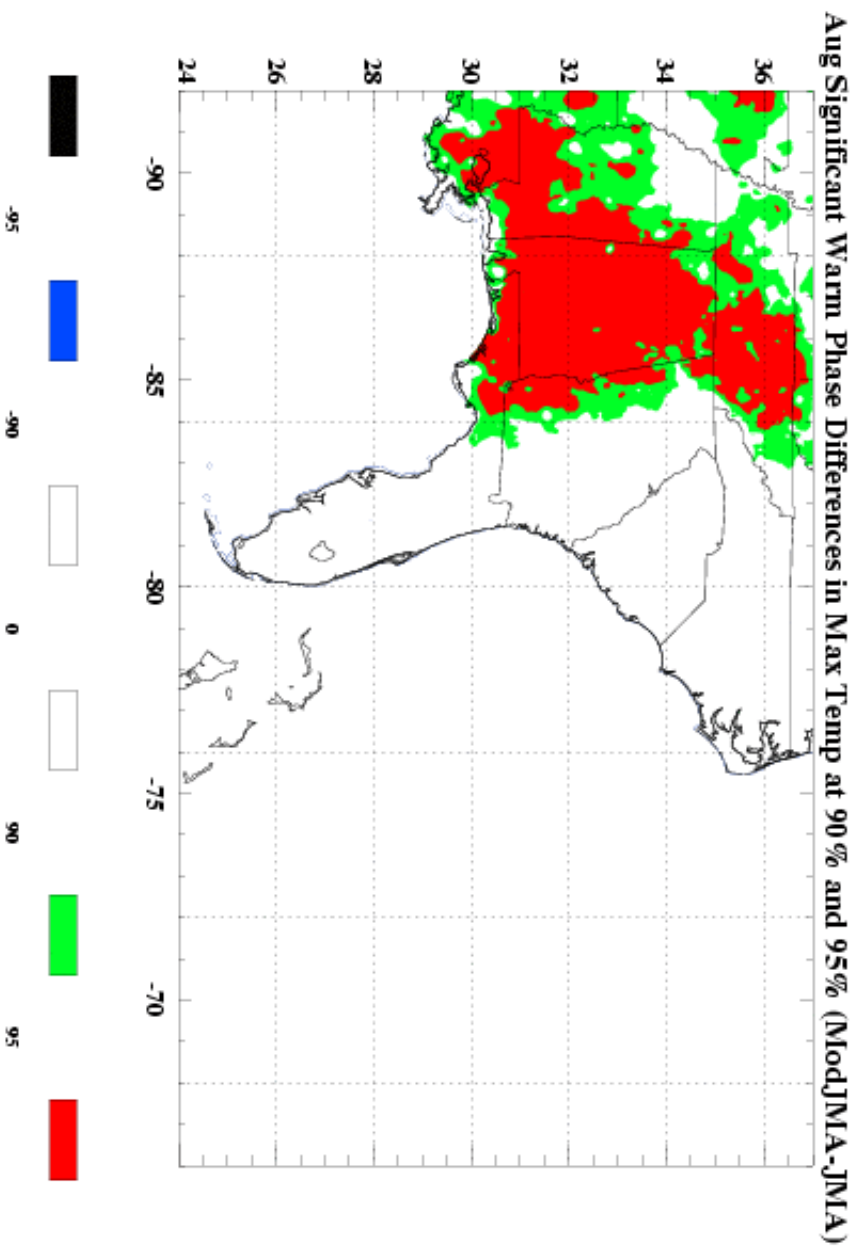


Figure 37: August ModJMA-JMA Warm Phase Max Temp Shift Significance plot. Differences of -95%, -90%, 90% and 95% are displayed.

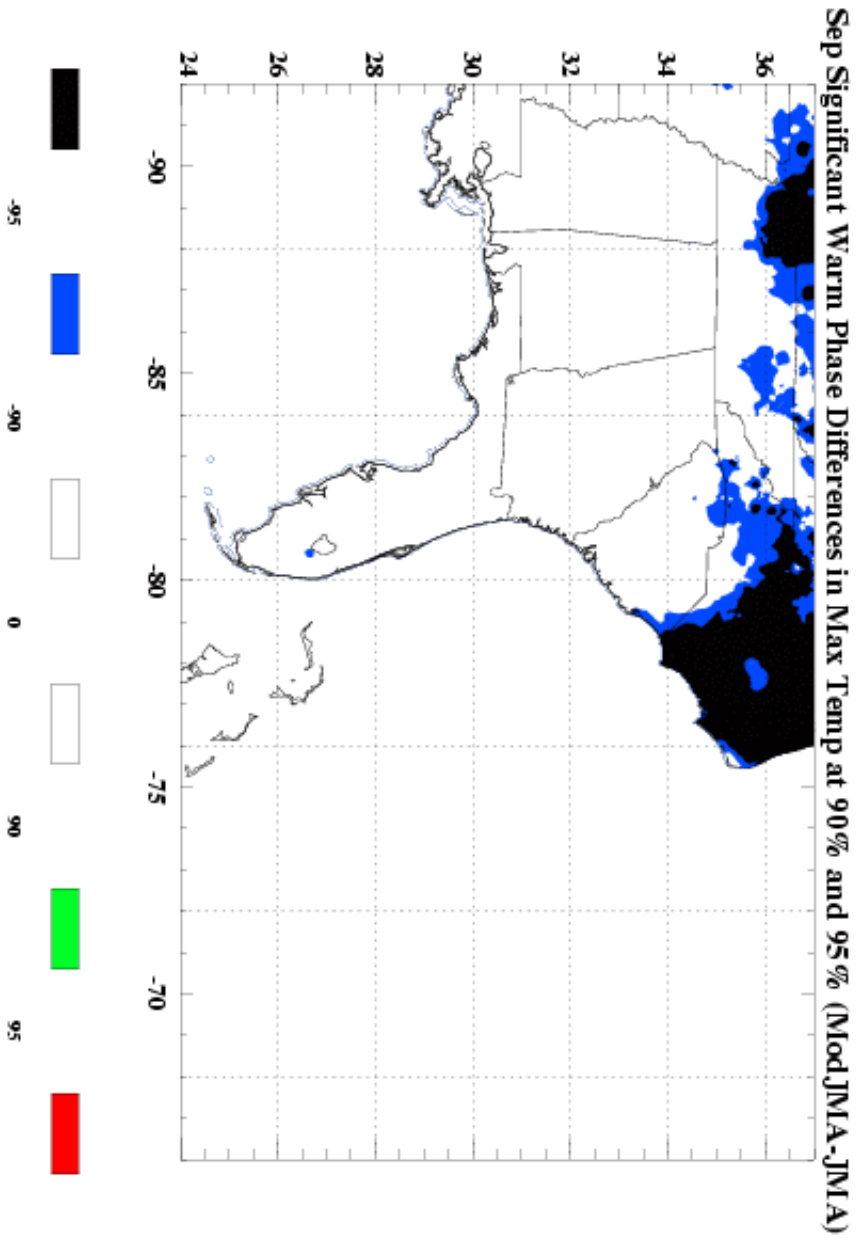


Figure 38: September ModJMA-JMA Warm Phase Max Temp Shift Significance plot. Differences of -95%, -90%, 90% and 95% are displayed.

May Significant Cold Phase Differences in Max Temp at 90% and 95% (ModJMA-JMA)

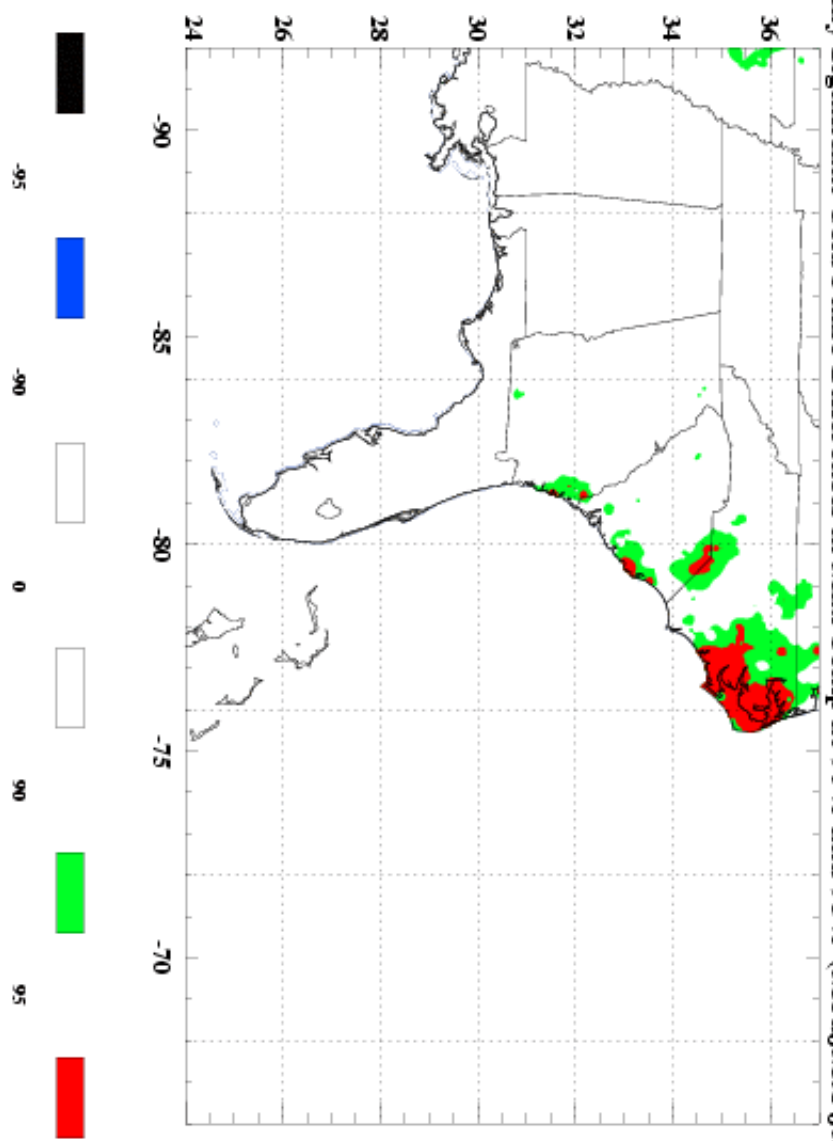


Figure 39: May ModJMA-JMA Cold Phase Max Temp Shift Significance plot. Differences of -95%, -90%, 90% and 95% are displayed.

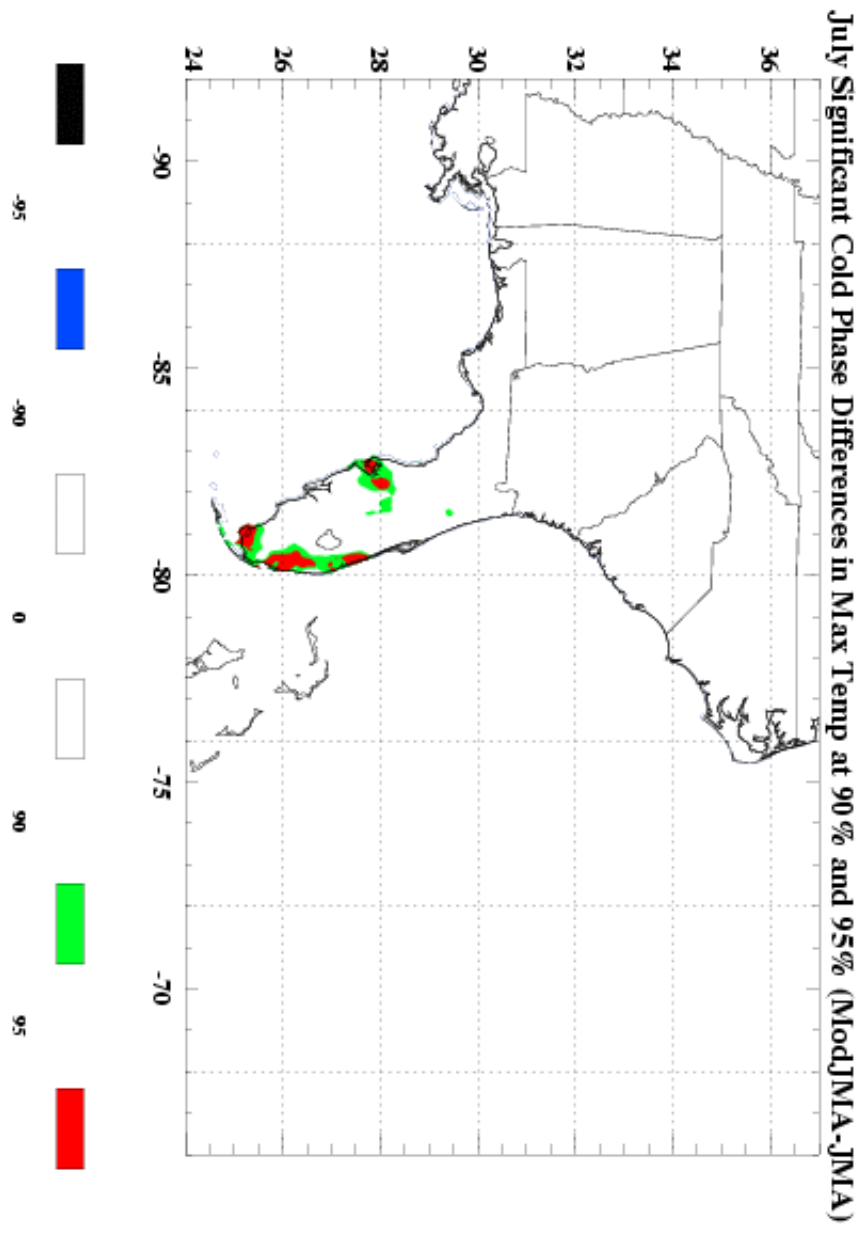


Figure 40: July ModJMA-JMA Cold Phase Max Temp Shift Significance plot. Differences of -95%, -90%, 90% and 95% are displayed.

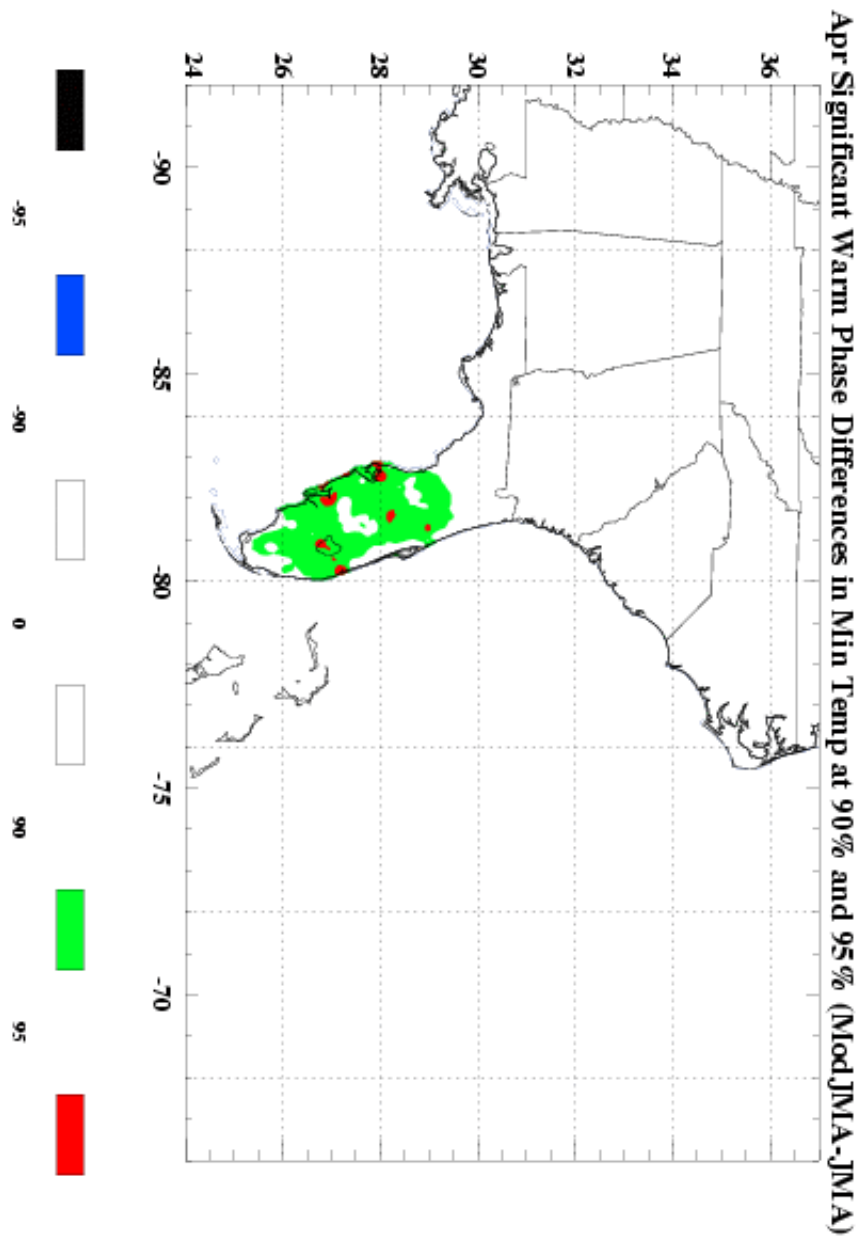


Figure 41: April ModJMA-JMA Warm Phase Min Temp Shift  
 Significance plot. Differences of -95%, -90%, 90% and 95% are displayed.

May Significant Warm Phase Differences in Min Temp at 90% and 95% (ModJMA-JMA)

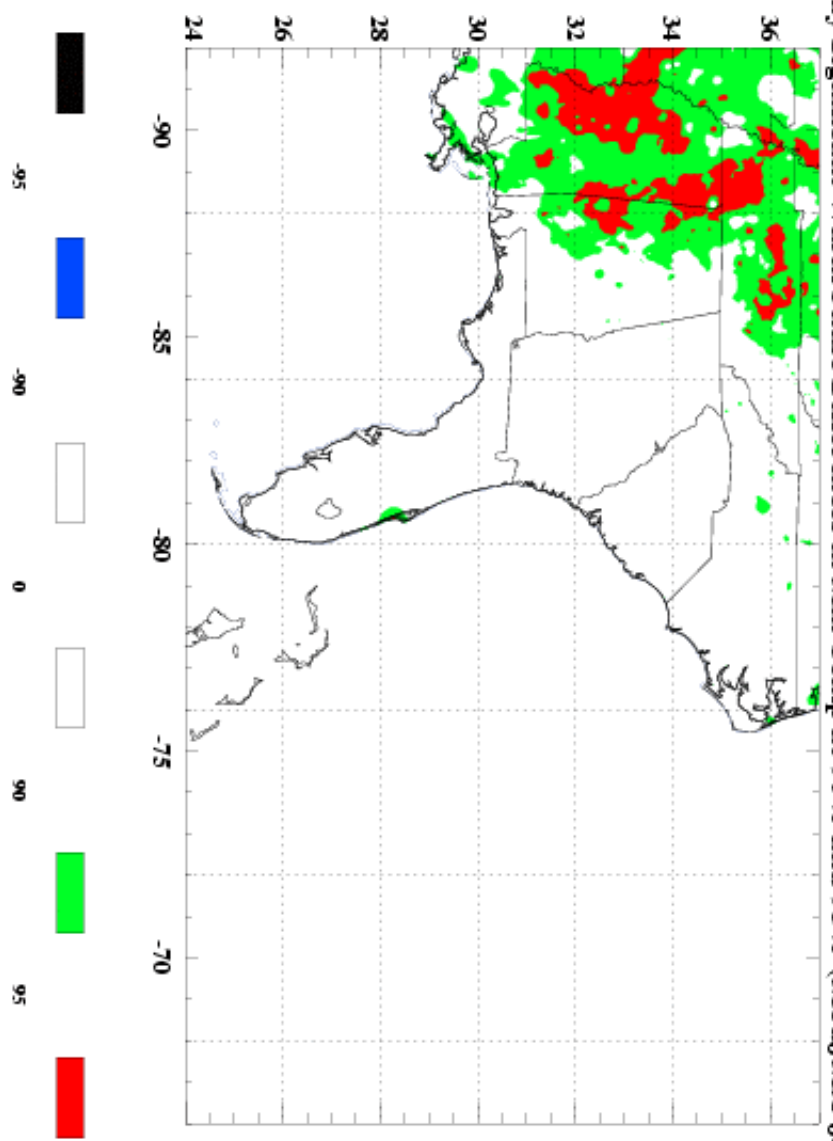


Figure 42: May ModJMA-JMA Warm Phase Min Temp Shift Significance plot. Differences of -95%, -90%, 90% and 95% are displayed.

July Significant Warm Phase Differences in Min Temp at 90% and 95% (ModJMA-JMA)

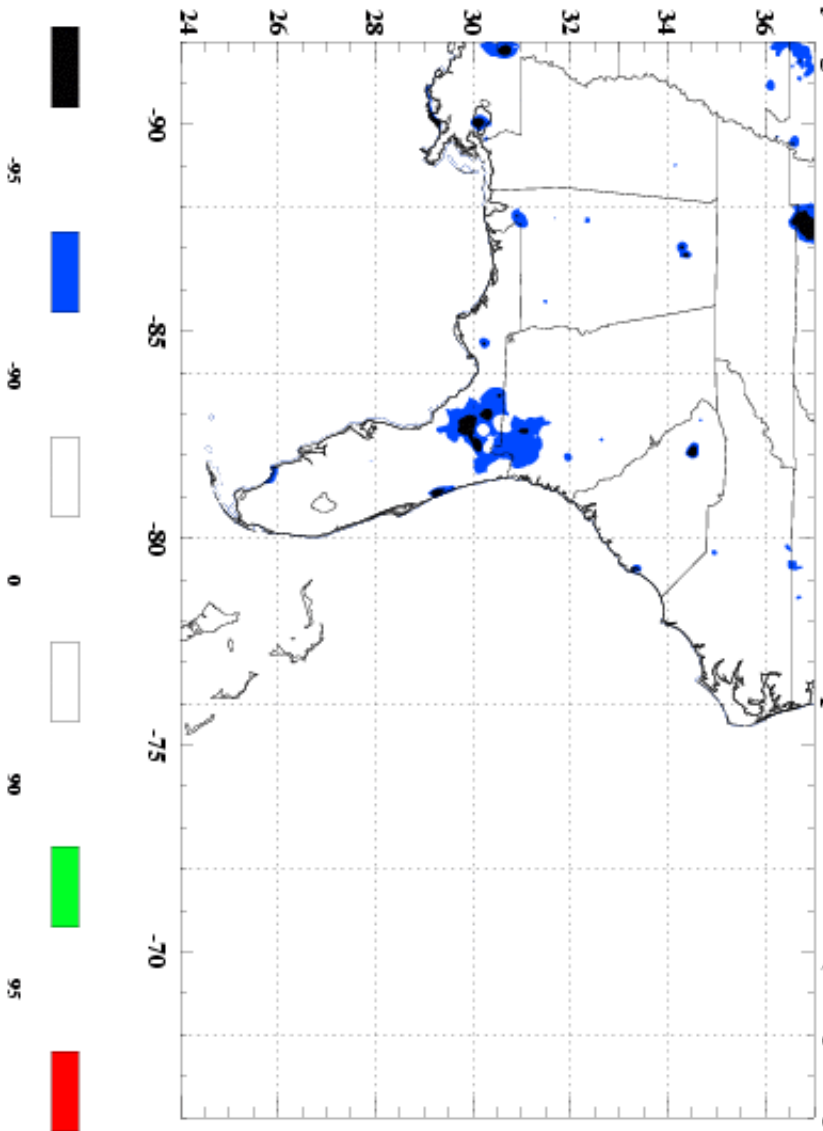


Figure 43: July ModJMA-JMA Warm Phase Min Temp Shift Significance plot. Differences of -95%, -90%, 90% and 95% are displayed.

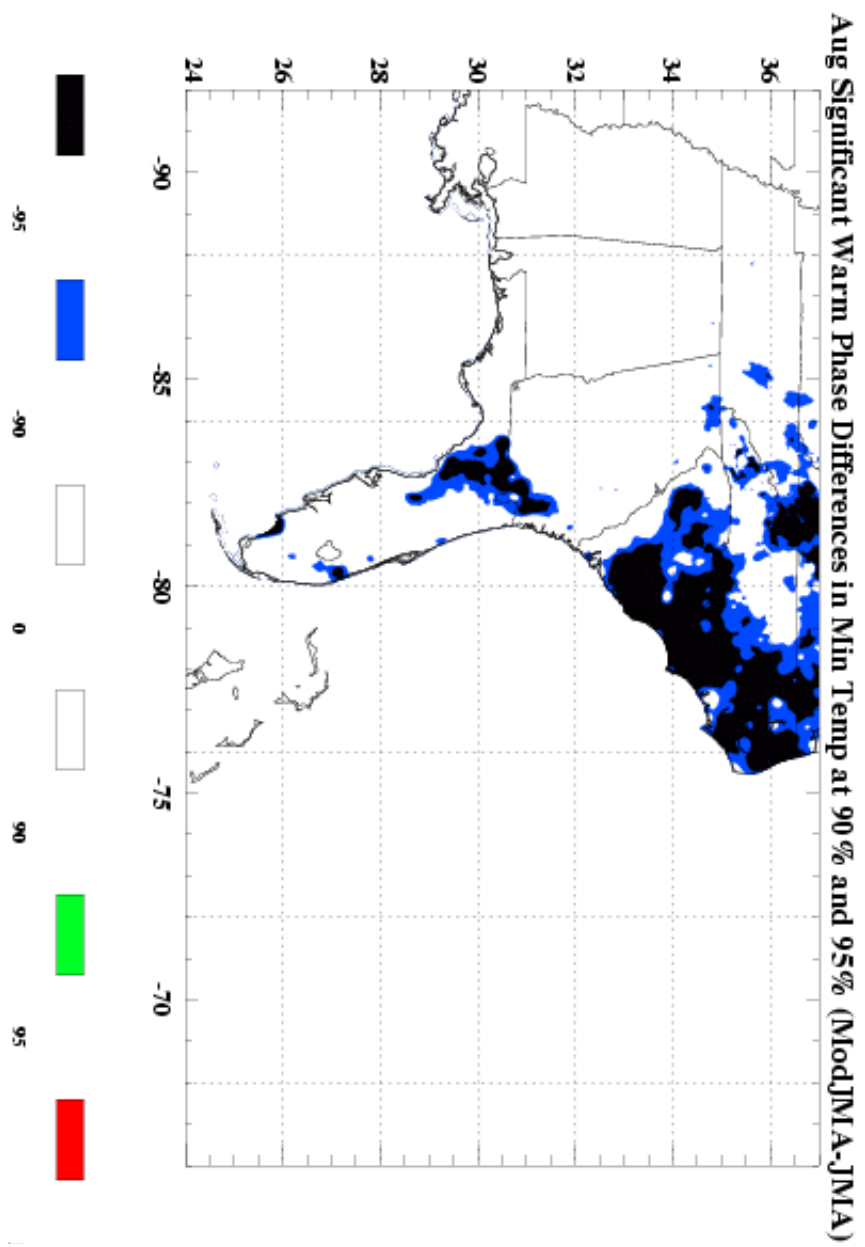


Figure 44: August ModJMA-JMA Warm Phase Min Temp Shift Significance plot. Differences of -95%, -90%, 90% and 95% are displayed.

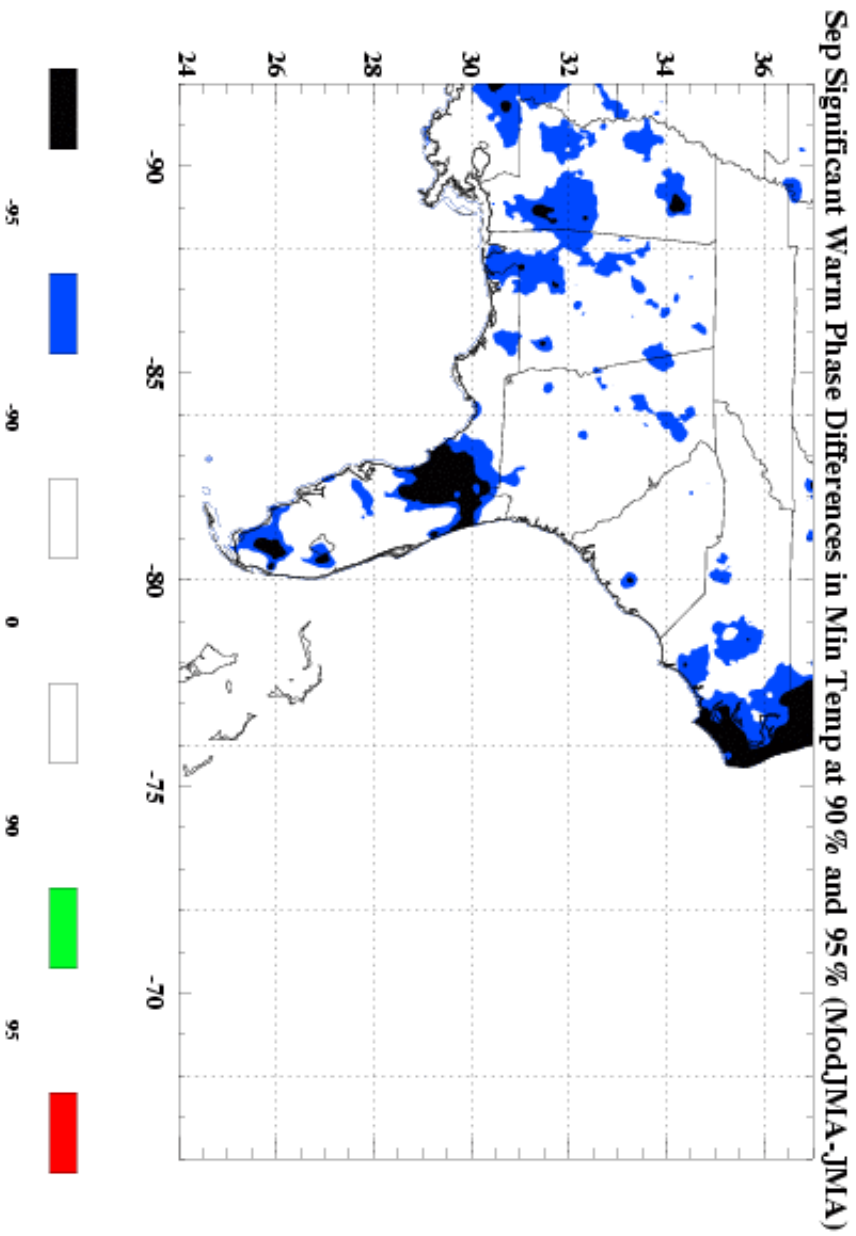


Figure 45: September ModJMA-JMA Warm Phase Min Temp Shift Significance plot. Differences of -95%, -90%, 90% and 95% are displayed.

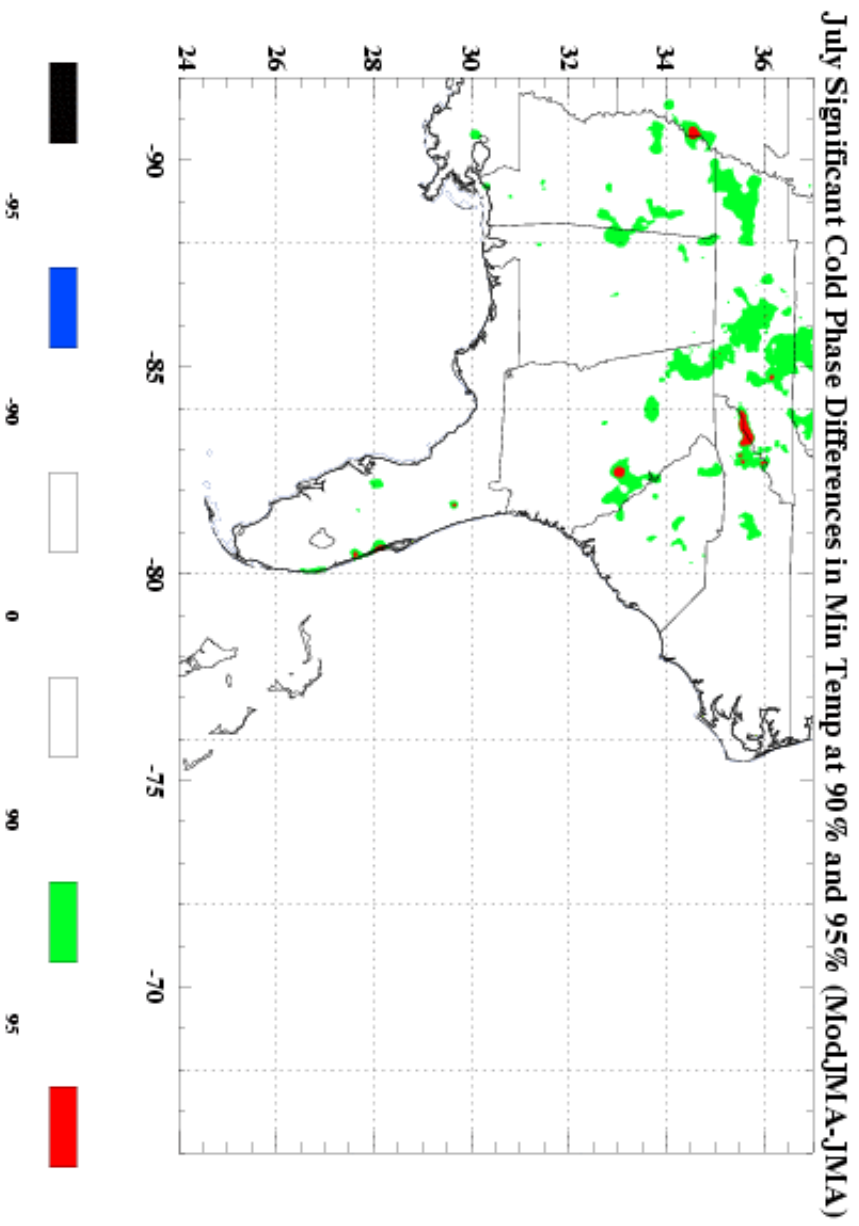


Figure 46: July ModJMA-JMA Cold Phase Min Temp Shift  
Significance plot. Differences of -95%, -90%, 90% and 95% are displayed.

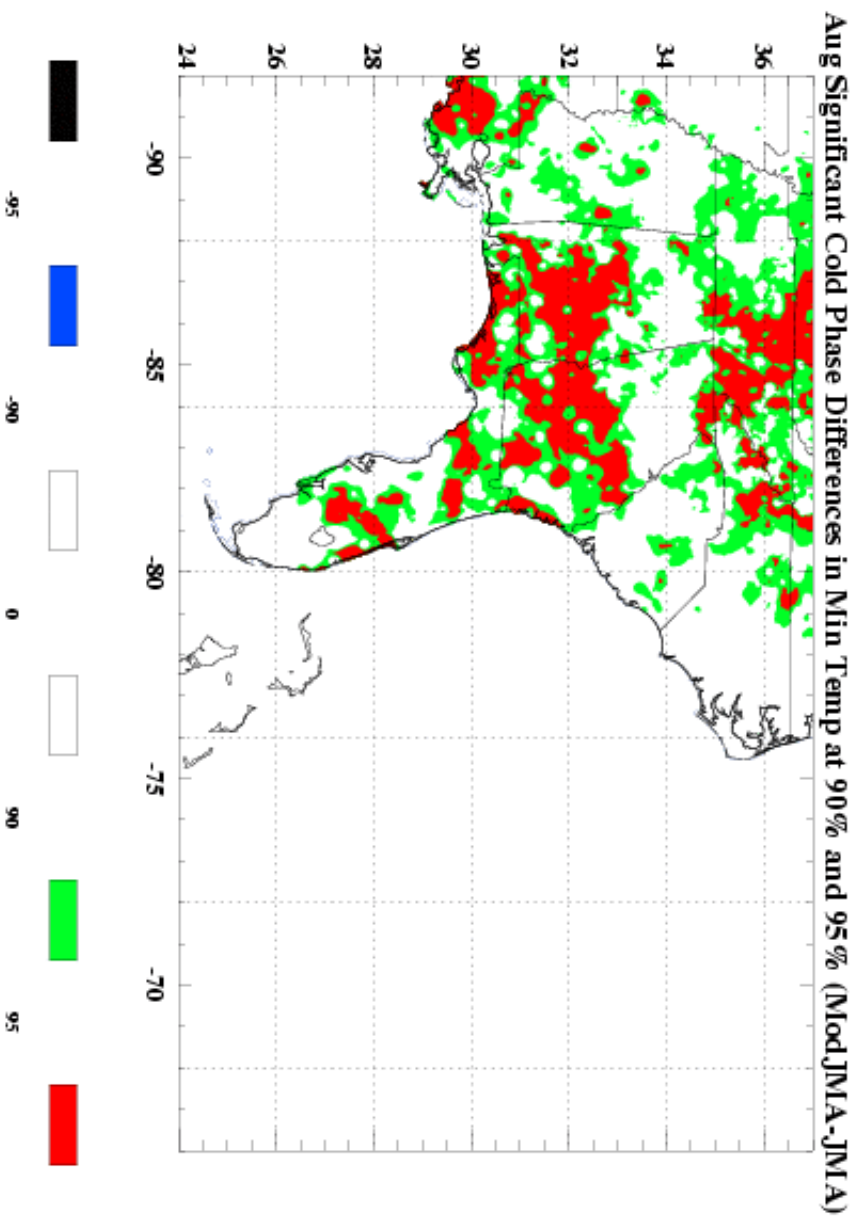


Figure 47: August ModJMA-JMA Cold Phase Min Temp Shift Significance plot. Differences of -95%, -90%, 90% and 95% are displayed.

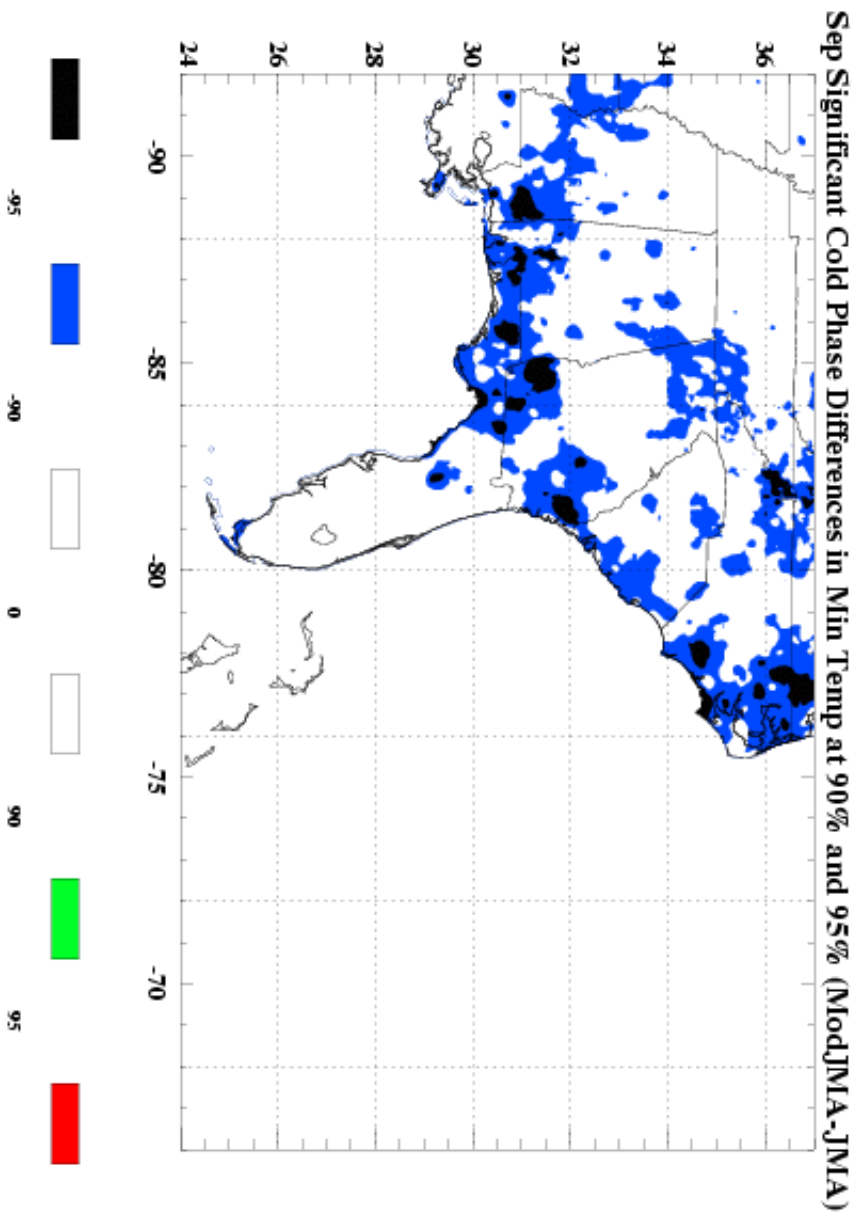


Figure 48: September ModJMA-JMA Cold Phase Min Temp Shift Significance plot. Differences of -95%, -90%, 90% and 95% are displayed.

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## **BIOGRAPHICAL SKETCH**

Being born in Hopkinsville, KY on Nov 4, 1981 I was raised in Todd County. My college experience began at Hopkinsville Community College where I received an AA and AS before continuing on to Western Kentucky University. At this location I majored in Geography with an emphasis in meteorology as well as mathematics. I worked with the Department of Geography and Geology in the GIS Lab and with the KY Climate Center. After I obtained my BS I moved to FSU for grad school in meteorology. Here I worked with COAPS.