

A Land of Flowers on a Latitude of Deserts: aiding conservation and management of Florida's biodiversity reanalysis

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&

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Coupled Land Atmosphere Regional Reanalysis for the Southeast US at
10km

Project Partners

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Cathy Langtimm (SESC, USGS)

Dan Slone (SESC, USGS)

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E. Chassignet (COAPS, FSU)

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- Mr. Steven DiNapoli
- Ms. Lauren Moeller

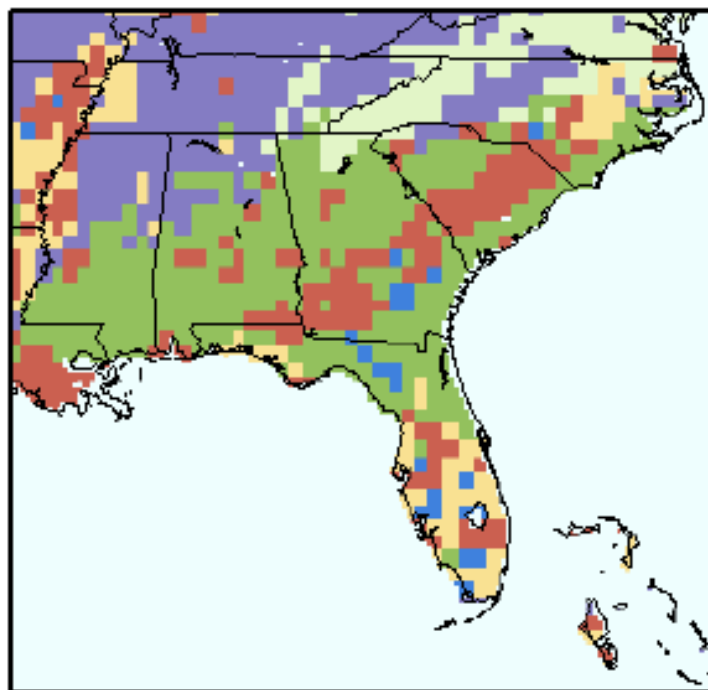
Project Goals

- I) Provide assessments over peninsular Florida of:
 - Changes in precipitation and temperature
 - Changes in seasonality
 - Changes in frequency of derivative products like chill days, extreme heat days, frost days, wild fire threat
 - Changes in mean regional circulation, evapo-transpiration
- II) Assess the uncertainties/sensitivity in the above from greenhouse gas concentration changes and LULC
- III) Develop scenarios for selected species/habitats/ecosystems based on above

Downscaling Domain and Model

Regional Model: National Centers for Environmental Prediction (NCEP) / Experimental Climate Prediction Center (ECPC) Regional Spectral Model (RSM)

Regional domain



Downscaling Experiments

- 20 century: 1979-2000 for reanalyses (R2 and ERA-40), 1969-2000 for models (CCSM, GFDL, HadCM3)
- 21 century: A2 scenario 2039-2070
- Blue (reanalyses) and Green (climate scenarios): completed
- Yellow: pending

	20 century			21 century (A2)		
	Historic veg	Current veg	Future veg	Historic veg	Current veg	Future veg
R2						
ERA-40						
CCSM						
GFDL						
HadCM3						

Climate model fidelity and projections of climate change

J. Shukla,^{1,2} T. DelSole,^{1,2} M. Fennessy,³ J. Kinter,^{1,2} and D. Paolino³

“The models that have lower values of relative entropy, hence have higher fidelity in simulating the present climate, produce higher values of global warming for a doubling of CO₂. This suggest that the projected global warming due to increasing CO₂ is likely to be closer to the highest projected estimates among the current generation of climate models”.



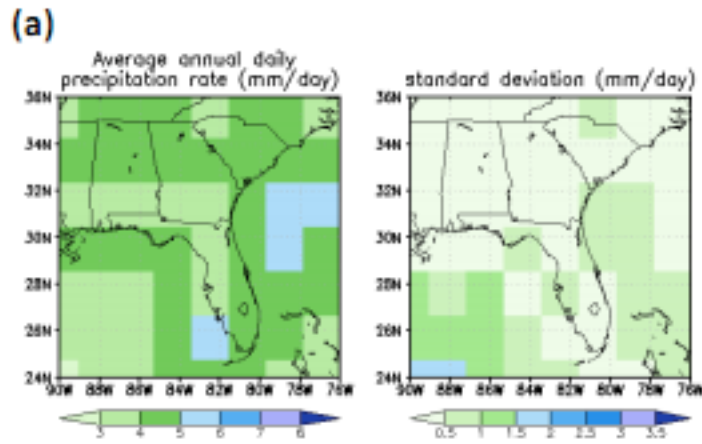
Climate projections: Past performance no guarantee of future skill?

C. Reifen¹ and R. Toumi¹

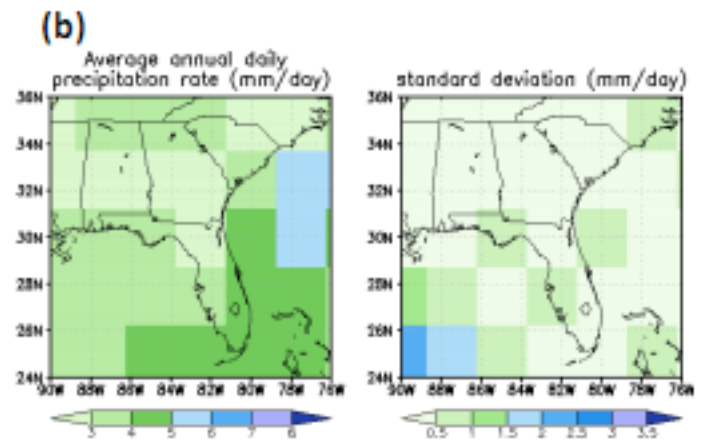
“In our analysis there is no evidence of future prediction skill delivered by past performance-based model selection. We speculate that the cause of this behavior is the non-stationarity of the climate feedback strengths. Models that respond accurately in one period are likely to have the correct feedback strength at that time. However the feedback strength and forcing is not stationary, favoring no particular model or groups of models consistently.”

Annual mean climatological precipitation (mm/day)

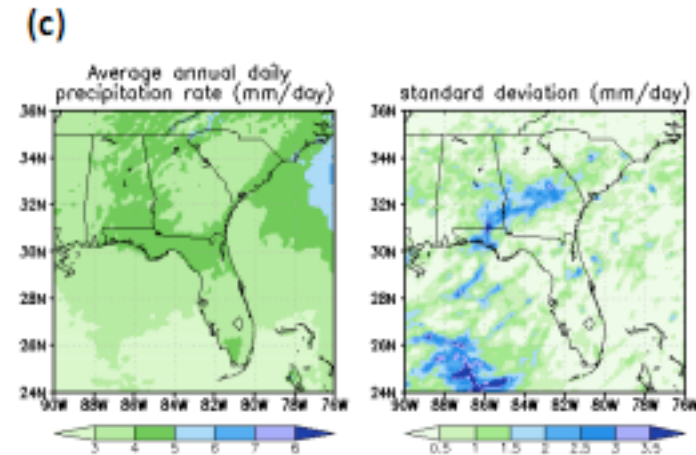
R2



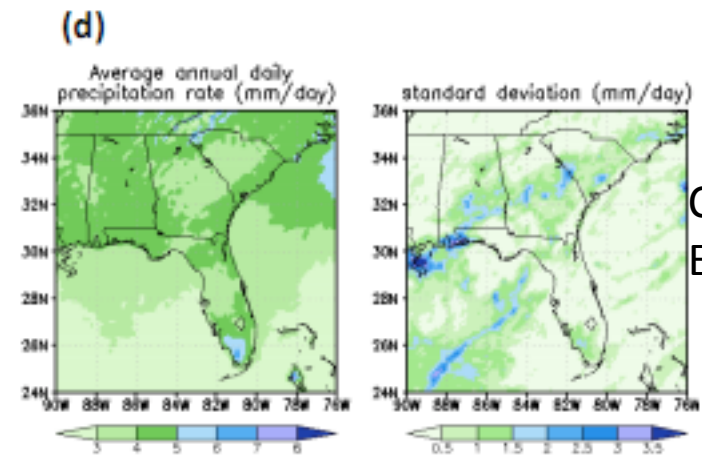
ERA40



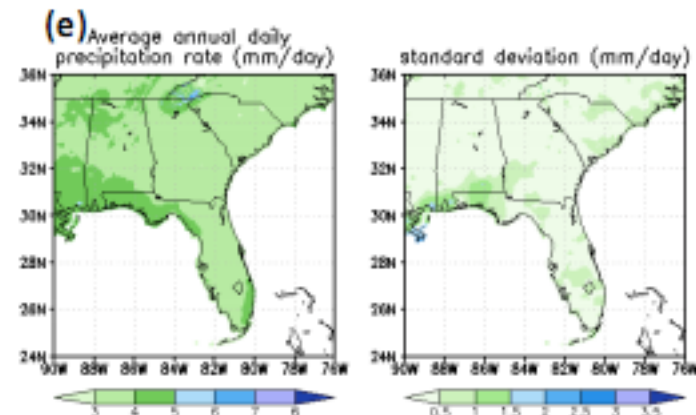
CLARReS1
0-R2



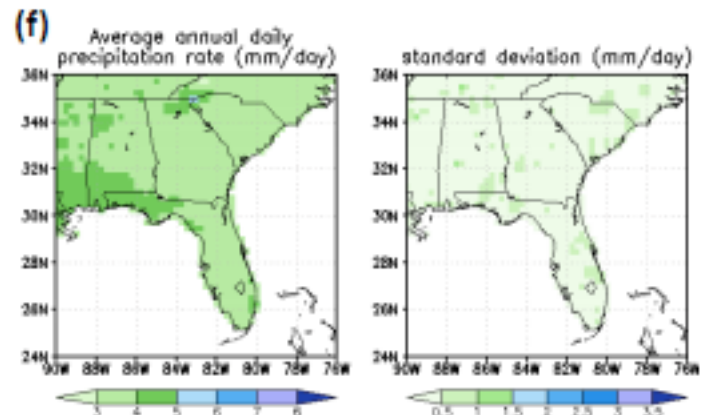
CLARReS10-
ERA



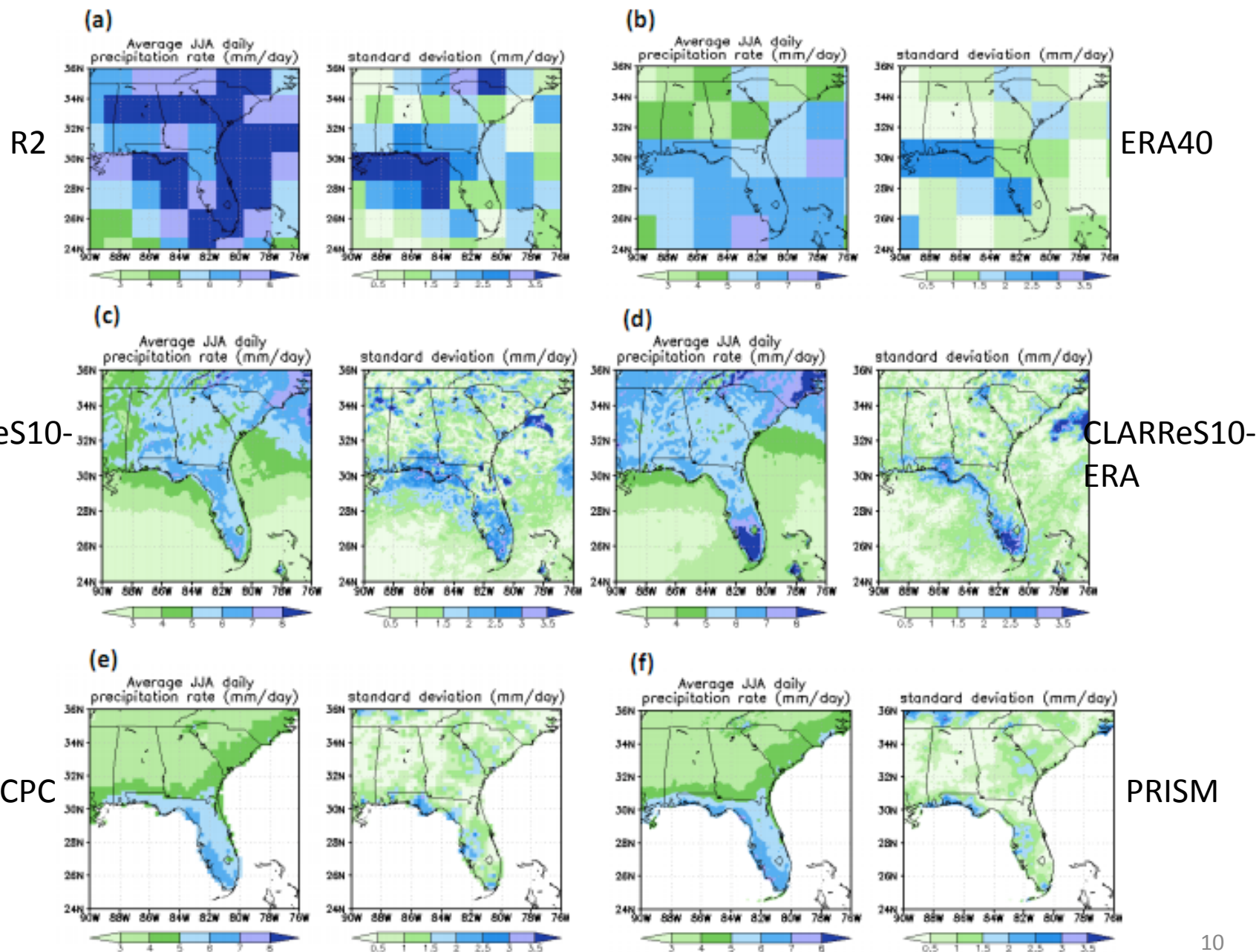
CPC



PRISM

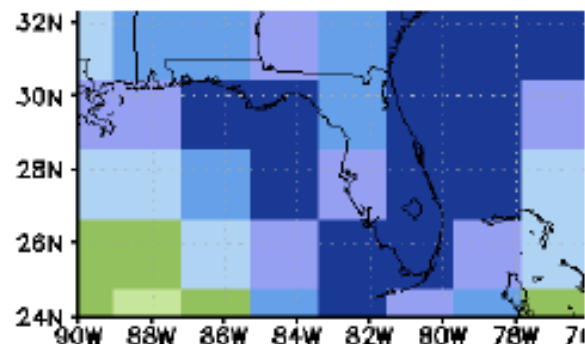


June-July-August mean climatological precipitation (mm/day)

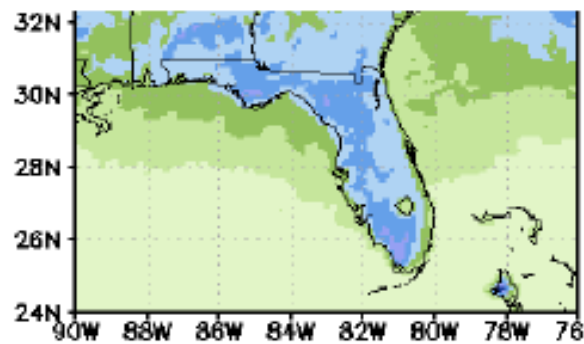


Climatology: Summer (JJA) Precipitation Rate

R2

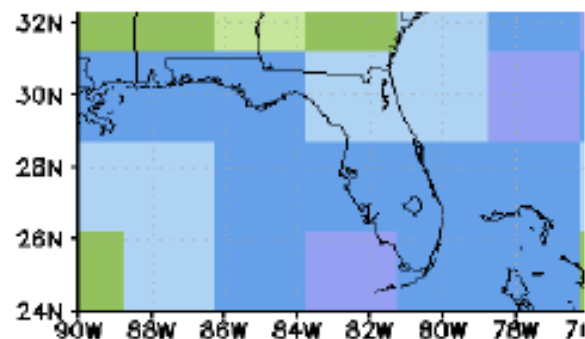


CLARReS-R2

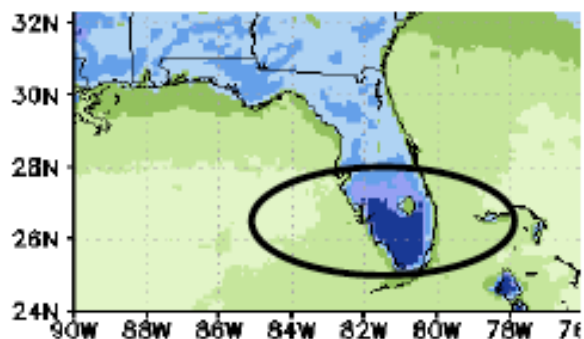


mm/day

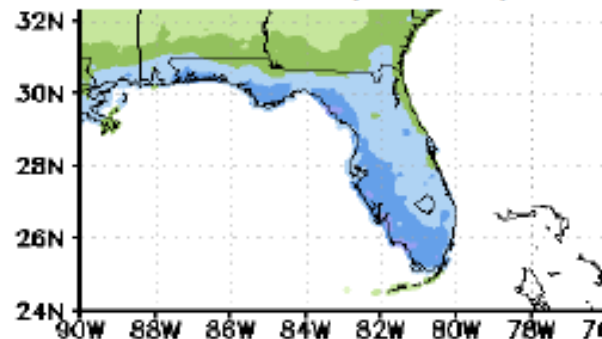
ERA-40



CLARReS-ERA-40



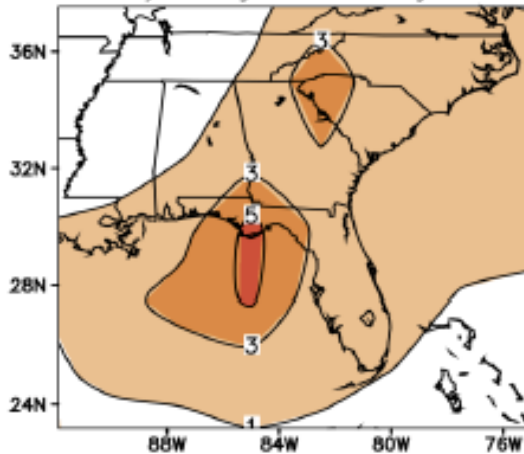
Observations (PRISM)



Tropical Cyclone Associated Precipitation (inches)

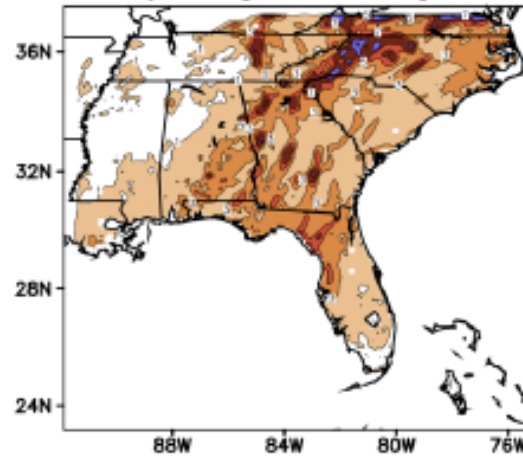
Global Reanalysis

Berly: 14Aug1994 - 19Aug1994



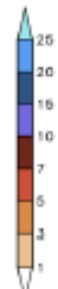
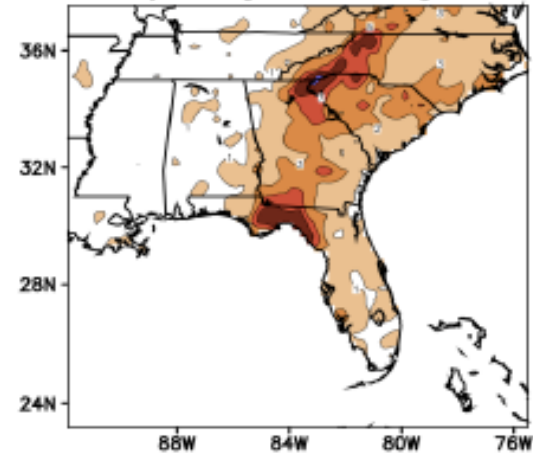
CLARReS

Berly: 14Aug1994 - 19Aug1994



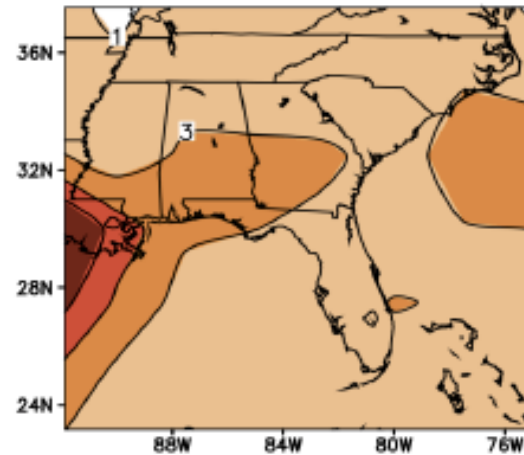
Observation

Berly: 14Aug1994 - 19Aug1994



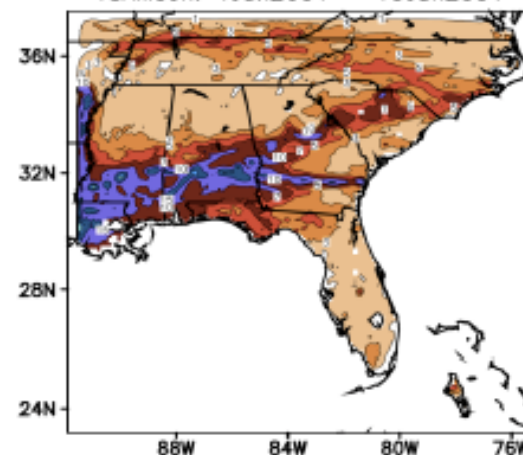
Global Reanalysis

TSAllison: 4Jun2001 - 15Jun2001



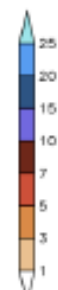
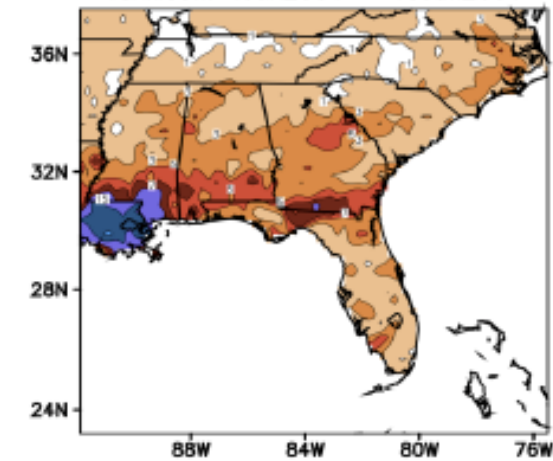
CLARReS

TSAllison: 4Jun2001 - 15Jun2001



Observation

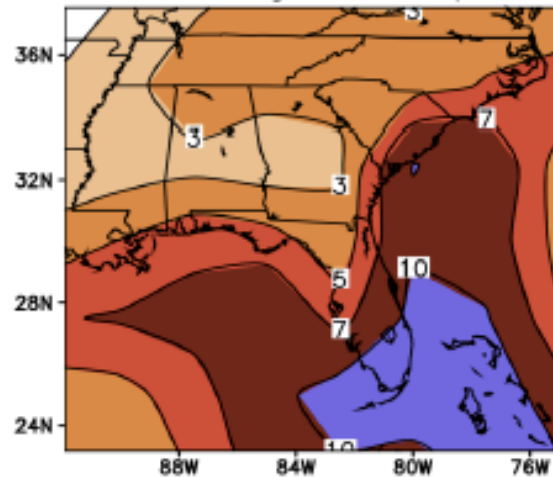
TSAllison: 4Jun2001 - 15Jun2001



Tropical Cyclone Associated Precipitation (inches)

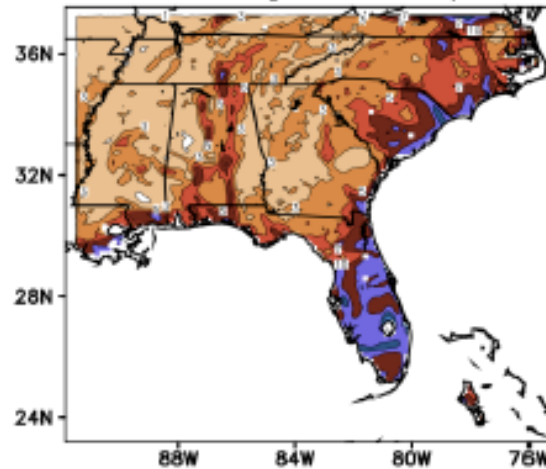
Global Reanalysis

Frederic: 29Aug1979 - 15Sep1979



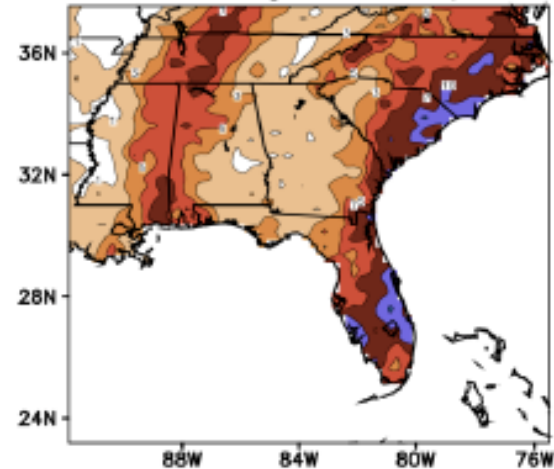
CLARReS

Frederic: 29Aug1979 - 15Sep1979



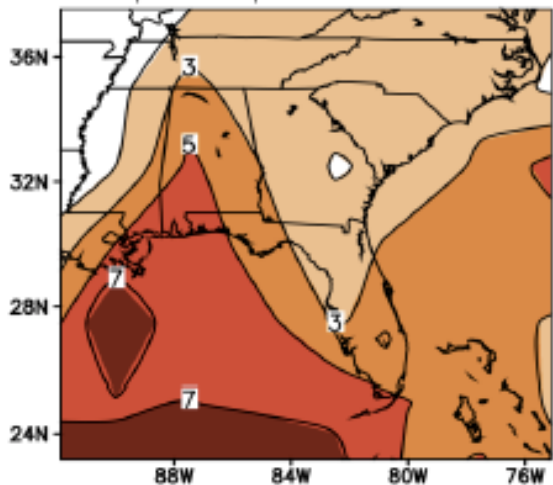
Observation

Frederic: 29Aug1979 - 15Sep1979



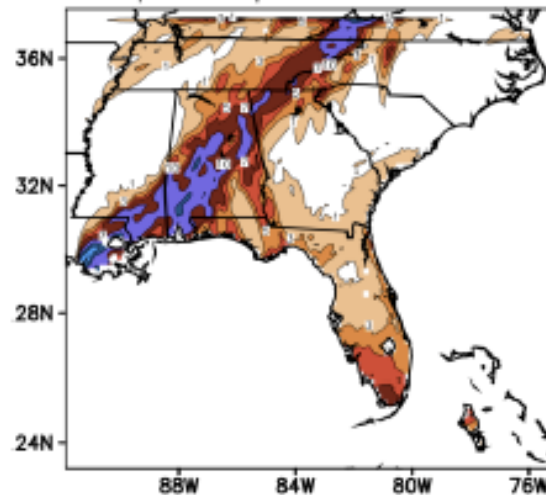
Global Reanalysis

Opal: 27Sep1995 - 50Oct1995



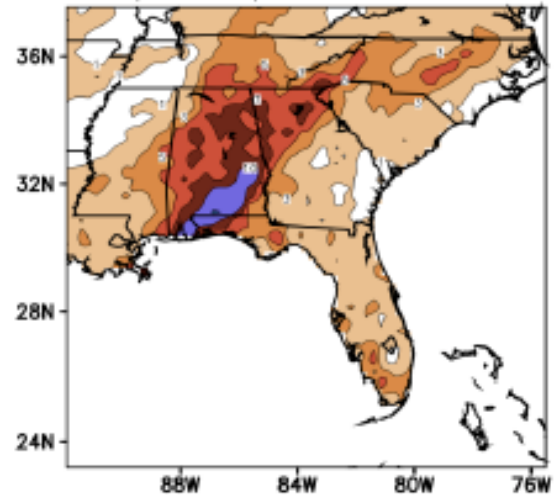
CLARReS

Opal: 27Sep1995 - 50Oct1995



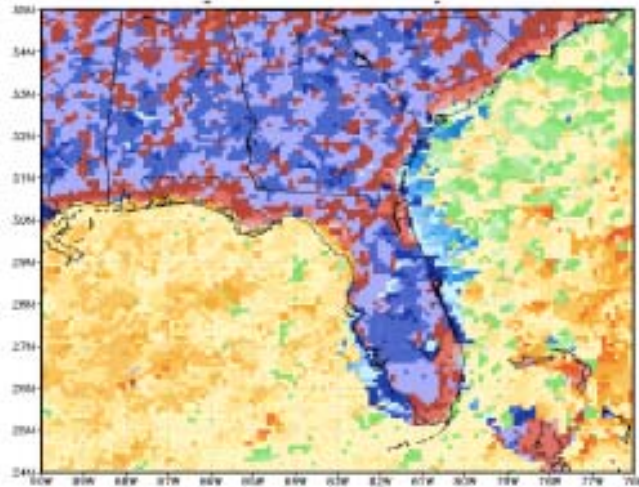
Observation

Opal: 27Sep1995 - 50Oct1995

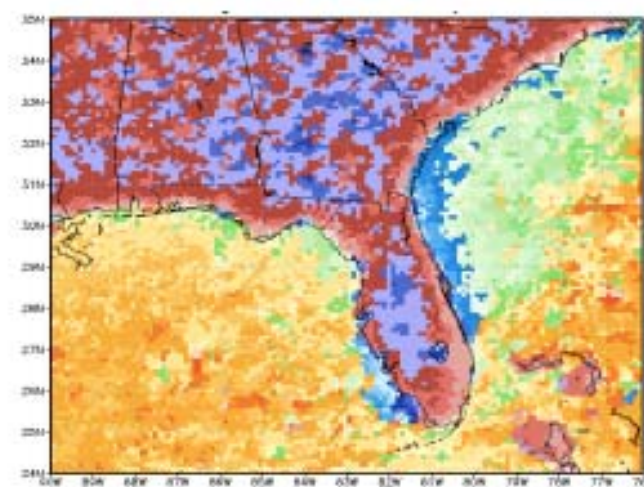


Timing of diurnal zenith of precipitation

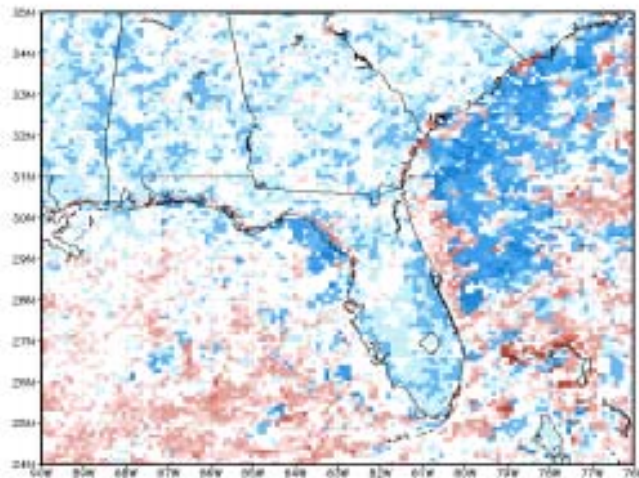
CLARReS-R2



CLARReS-ERA40



Diff. betn top two panels



Observations

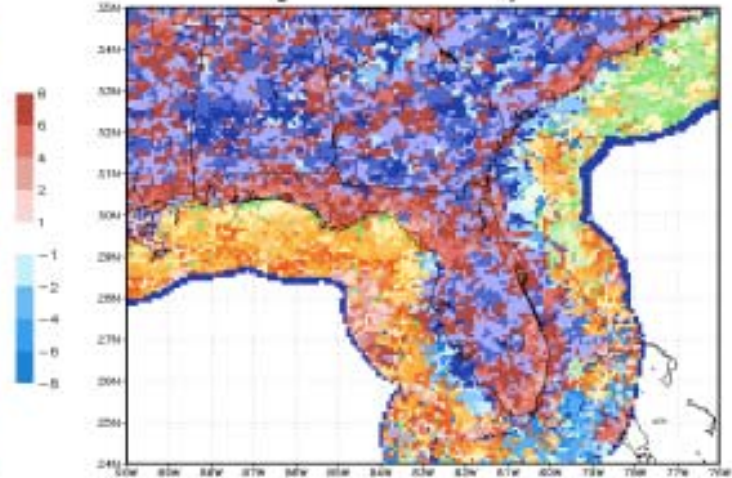
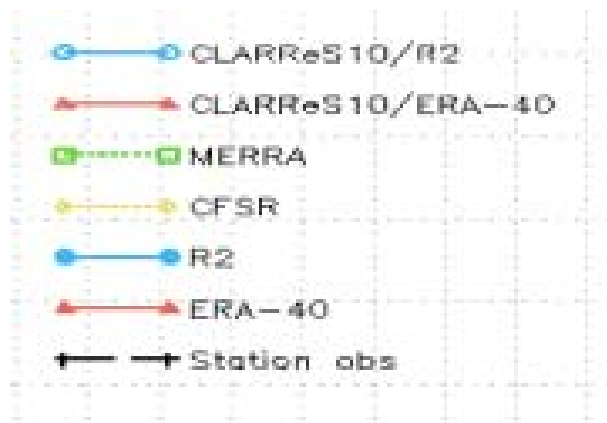
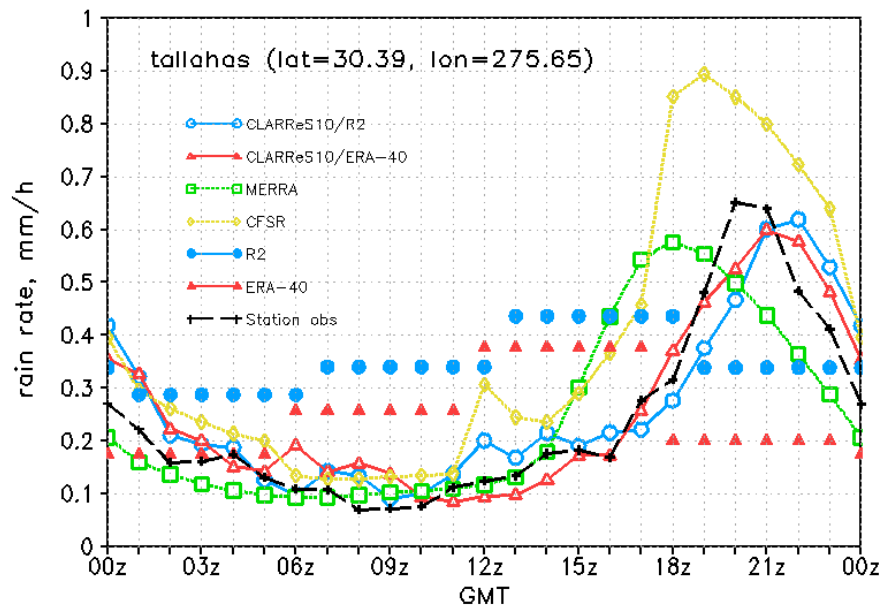
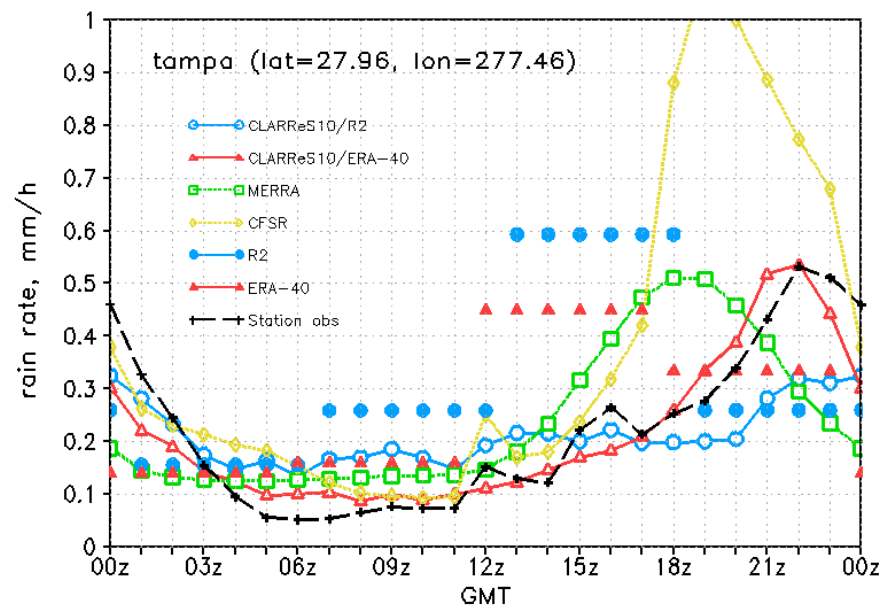


Fig. 11 Average timing of 1979-2001 JJA diurnal maximum (GMT) between CLARReS10-R2 (top left) and CLARReS10-ERA40 (top right); the difference in timing (CLARReS10-R2 minus CLARReS10-ERA40) (bottom left); and the average timing of JJA diurnal maximum from NCEP/EMC multi-sensor estimate for 2004-2009 (bottom right)

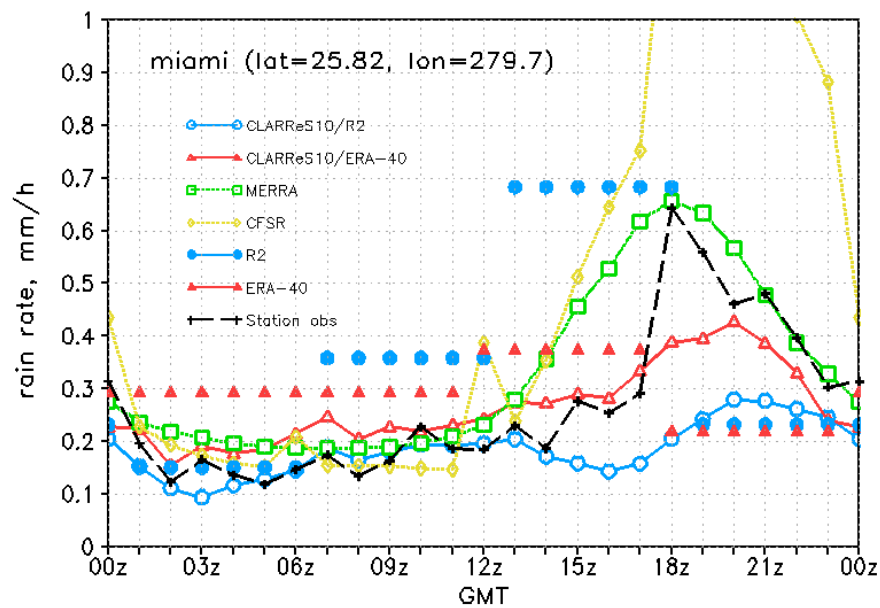
Climatological (1981–2000) mean JJA diurnal cycle



Climatological (1981–2000) mean JJA diurnal cycle



Climatological (1981–2000) mean JJA diurnal cycle



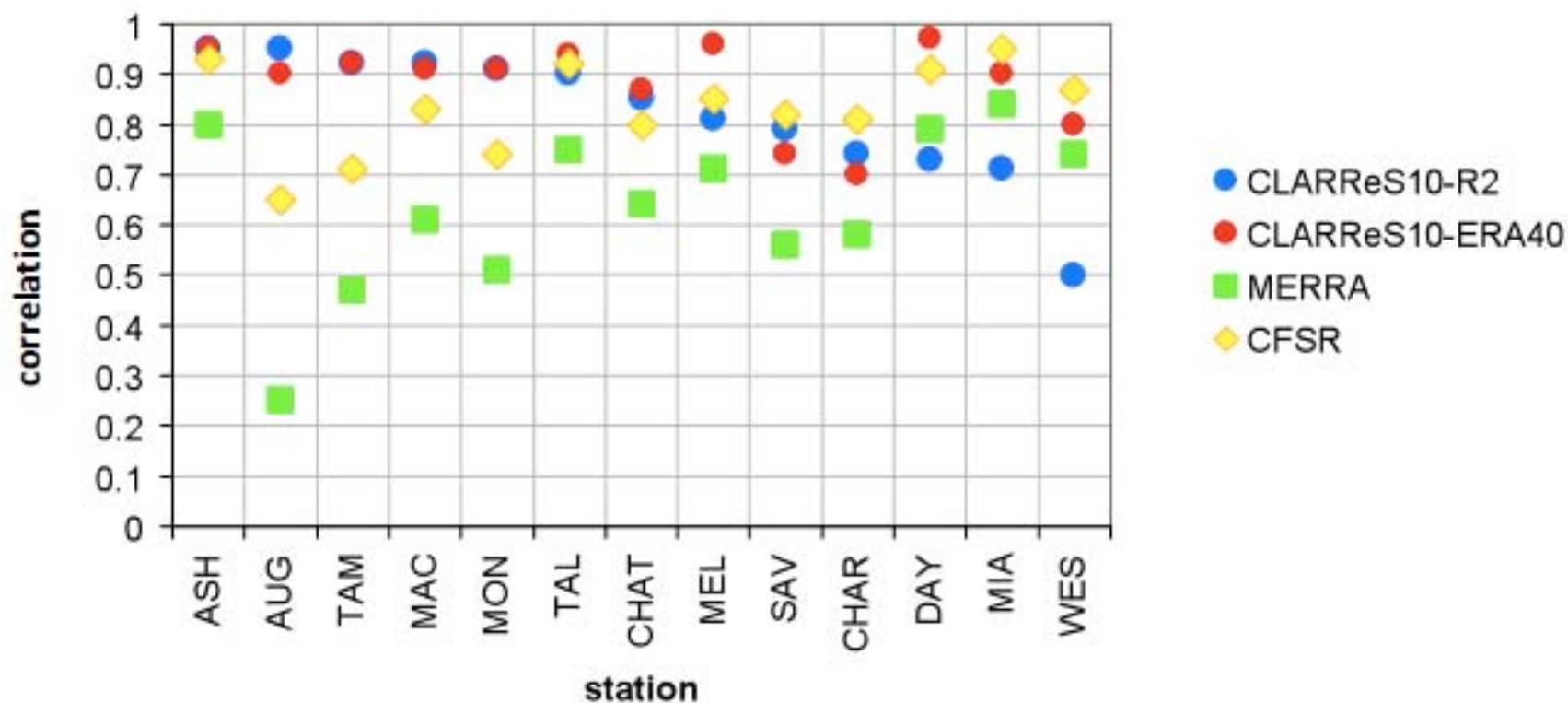


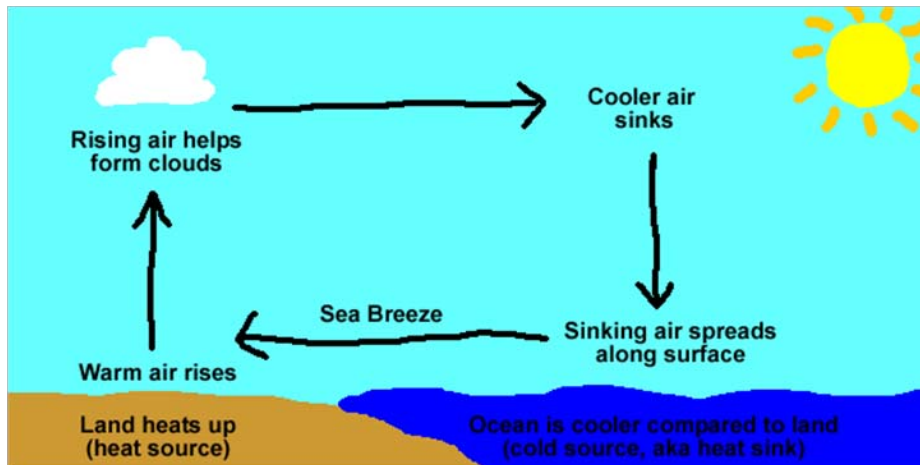
Fig. 13 Correlation of the JJA average daily cycle with observed station data for CLARReS10-R2, CLARReS10-ERA40, MERRA, and CFSR. The series have been sorted by descending value of the correlation of CLARReS10-R2 with station observations. The station abbreviations on the abscissa are as follows: ASH – Ashville, NC; AUG – Augusta, GA; CHAR – Charleston, SC; DAY – Daytona, FL; MAC – Macon, GA; MEL – Melbourne, FL; MIA – Miami, FL; MON – Montgomery, AL; TAM – Tampa, FL; WES – West Palm Beach; TAL – Tallahassee, FL; SAV – Savannah, GA. Note that while at a number of stations the diurnal cycle of CFSR has correlations comparable to CLARReS10, the actual precipitation amounts (Fig. 12) significantly exceed those observed.

Conclusions I

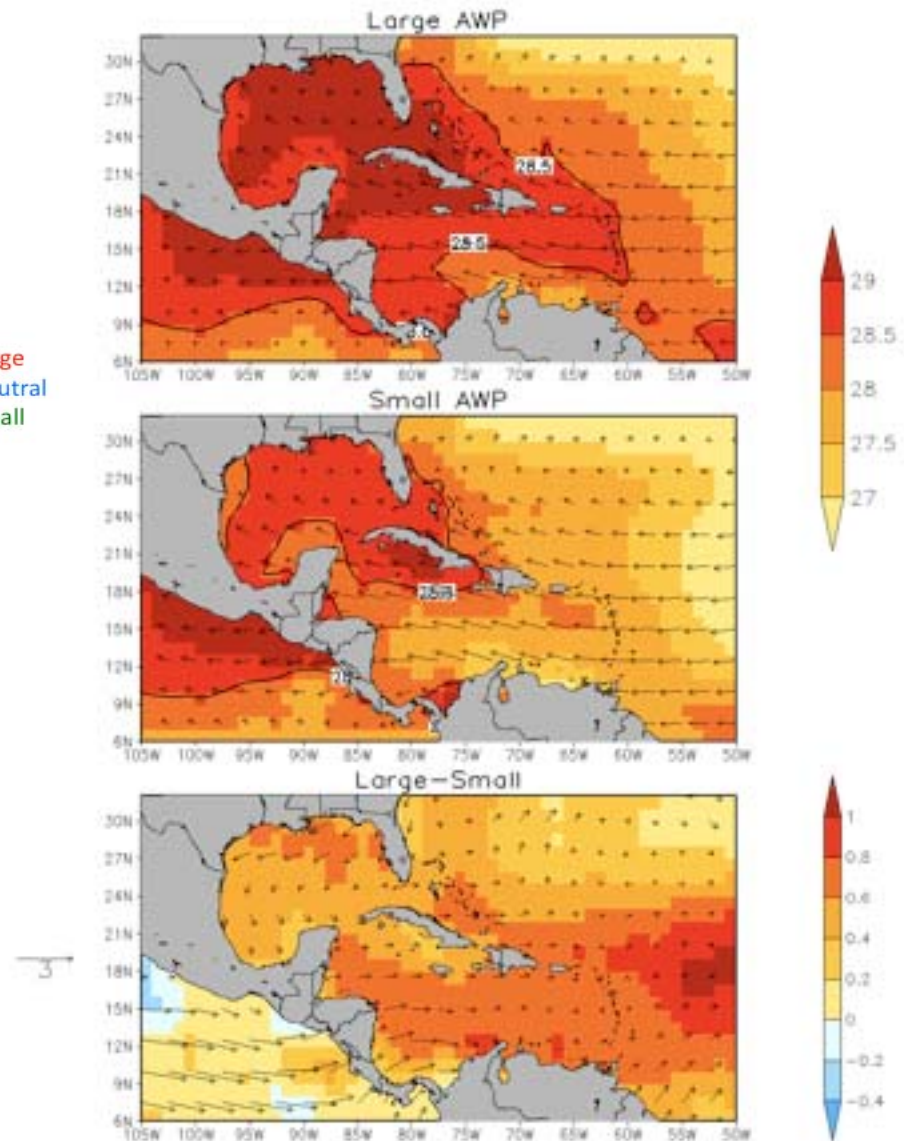
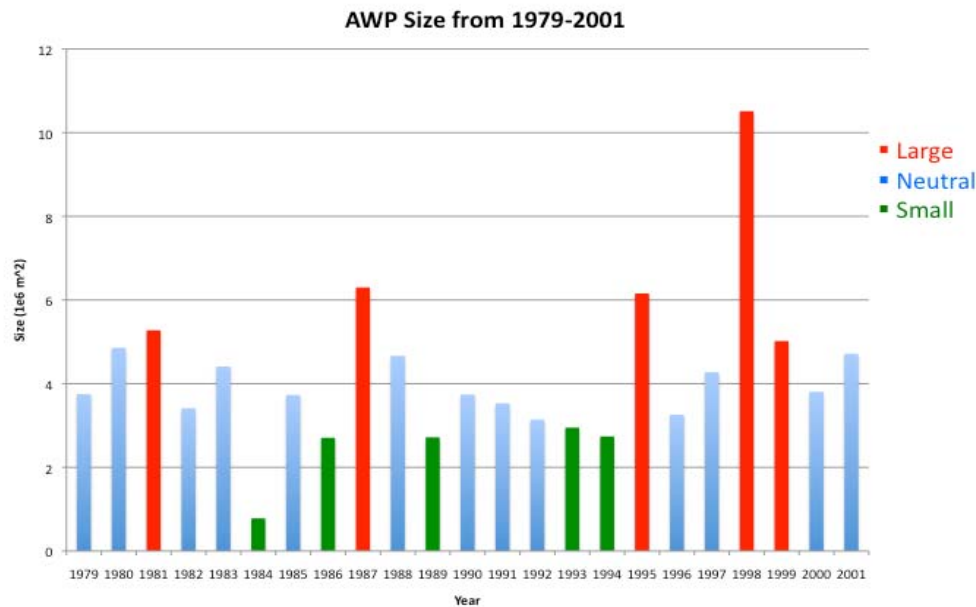
- CLARReS10 is cheap, effective way of producing consistent atmospheric analysis for the Southeast US that could be used for retrospective analysis.
- CLARReS10 is comparable or even better than CFSR and MERRA
- With bias correction, CLARReS10 has been successfully applied for hydrological applications in South Florida.
- Some issues with cloud forcing were found in SFWMD

Low Frequency variations of sea breeze using CLARReS10

Sea Breeze

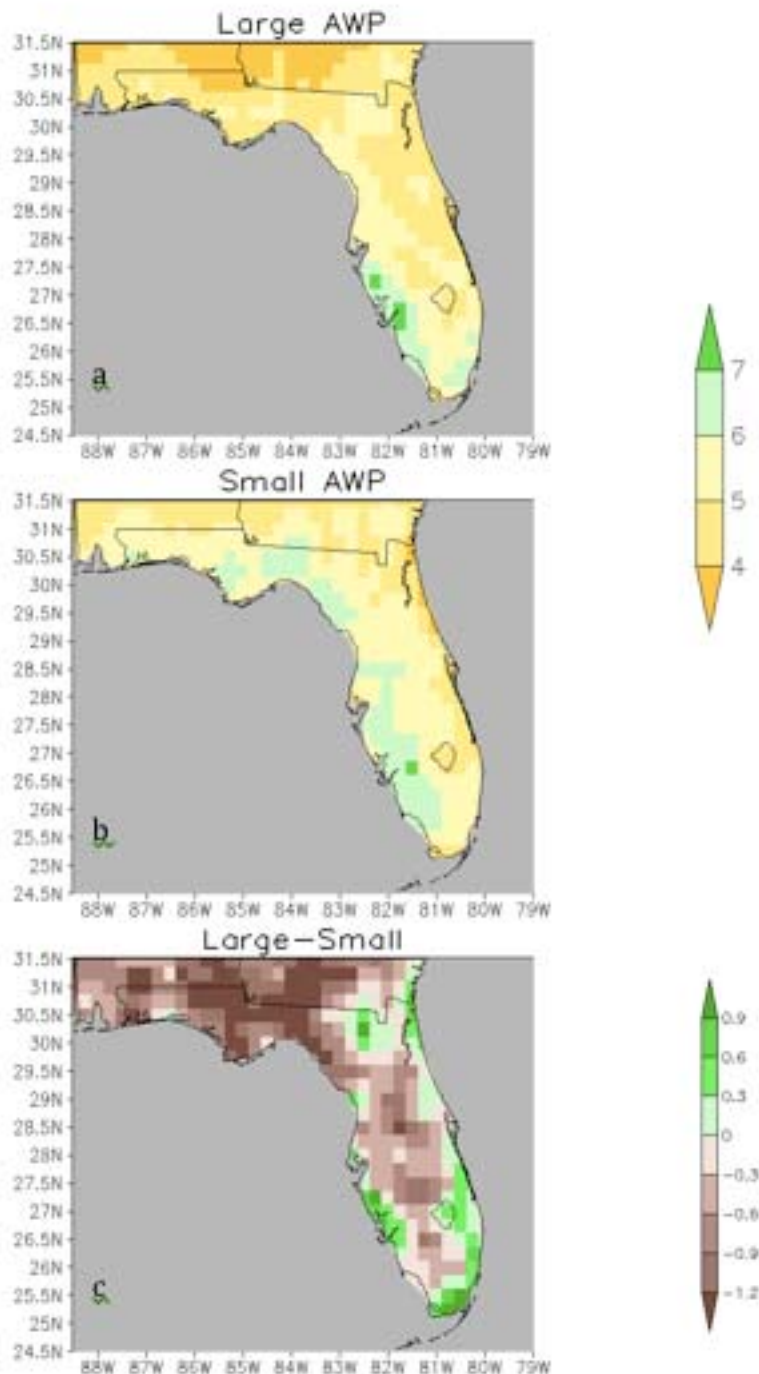


- ❖ Thermal circulation arises due to differential heating (Biggs and Graves 1962)
- ❖ Strongest during the summer



Observed JJA SST (ERSSTV3) and 850hPa winds (R2) for 5 large (1981, 1987, 1995, 1998, 1999) and small (1984, 1986, 1989, 1993, 1994) AWP years

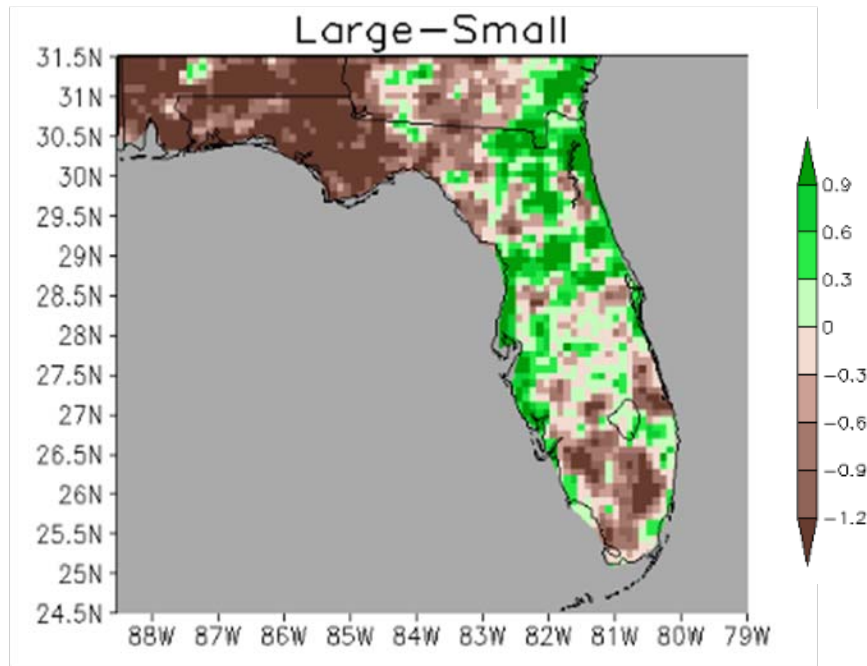
Observed JJA rainfall from CPC rain gauge based rainfall (Higgins et al. 2000) for the 5 large and the small AWP years.



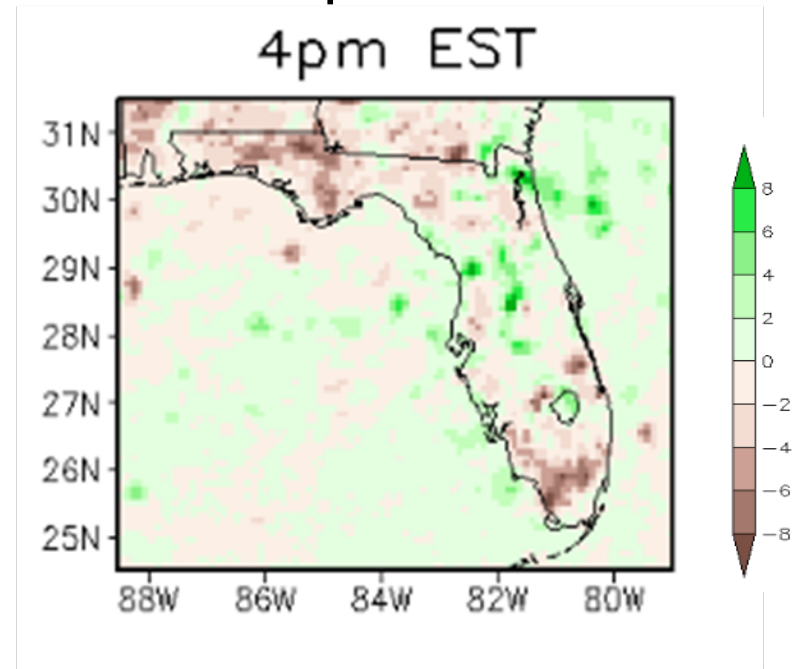
AWP Composite Difference

Precip in mm/day

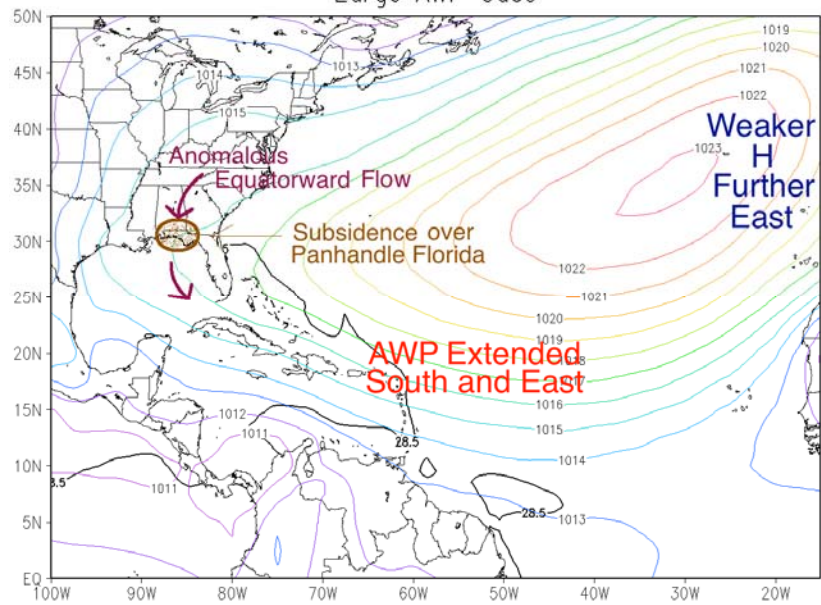
Seasonal



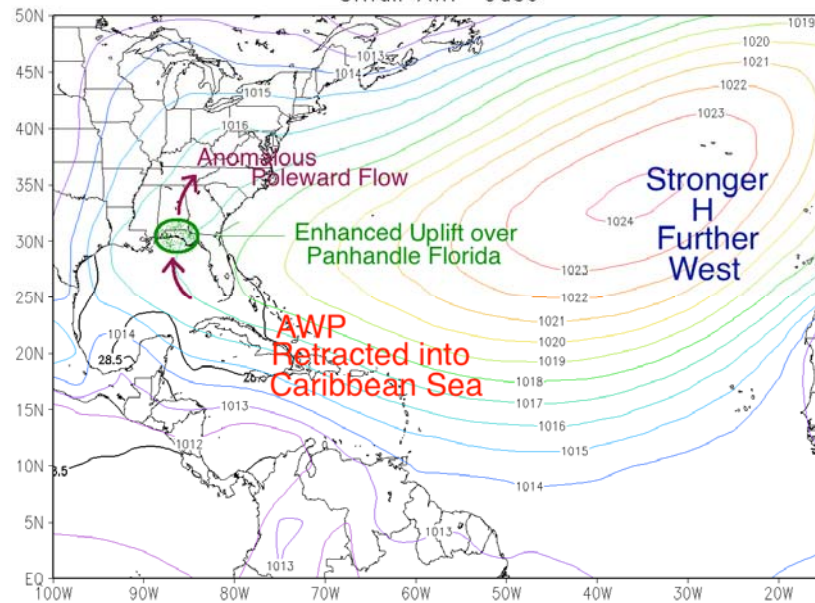
4pm



Large AWP Case



Small AWP Case



Length of the Wet Season (LOWS)

Defining length of the season

$$A(day) = \sum_{n=1}^{day} (R(n) - \bar{R})$$

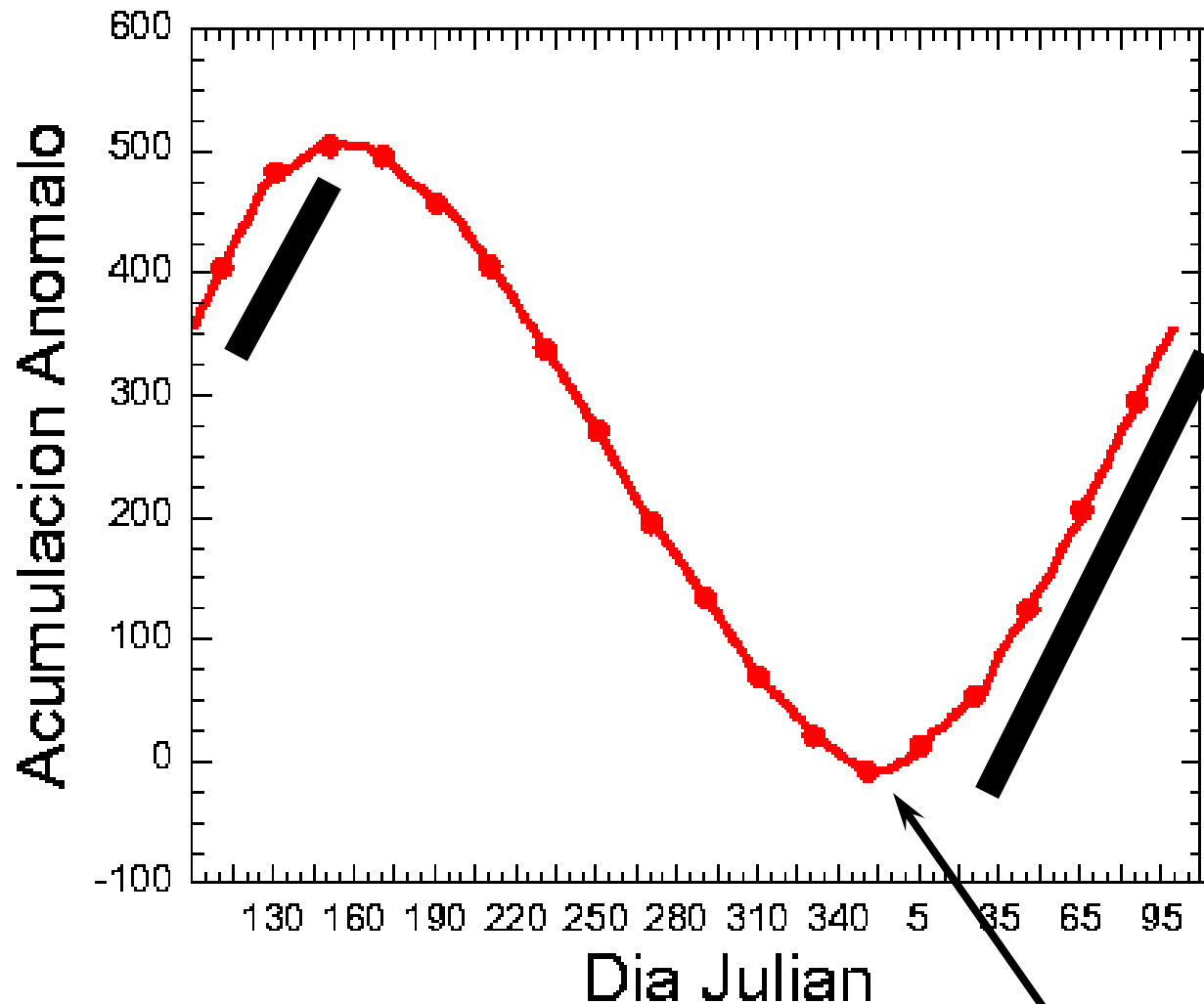
$A(day)$ = Anomalous accumulation

$R(n)$ = daily rainfall

$\bar{R}$ = annual average daily precipitation

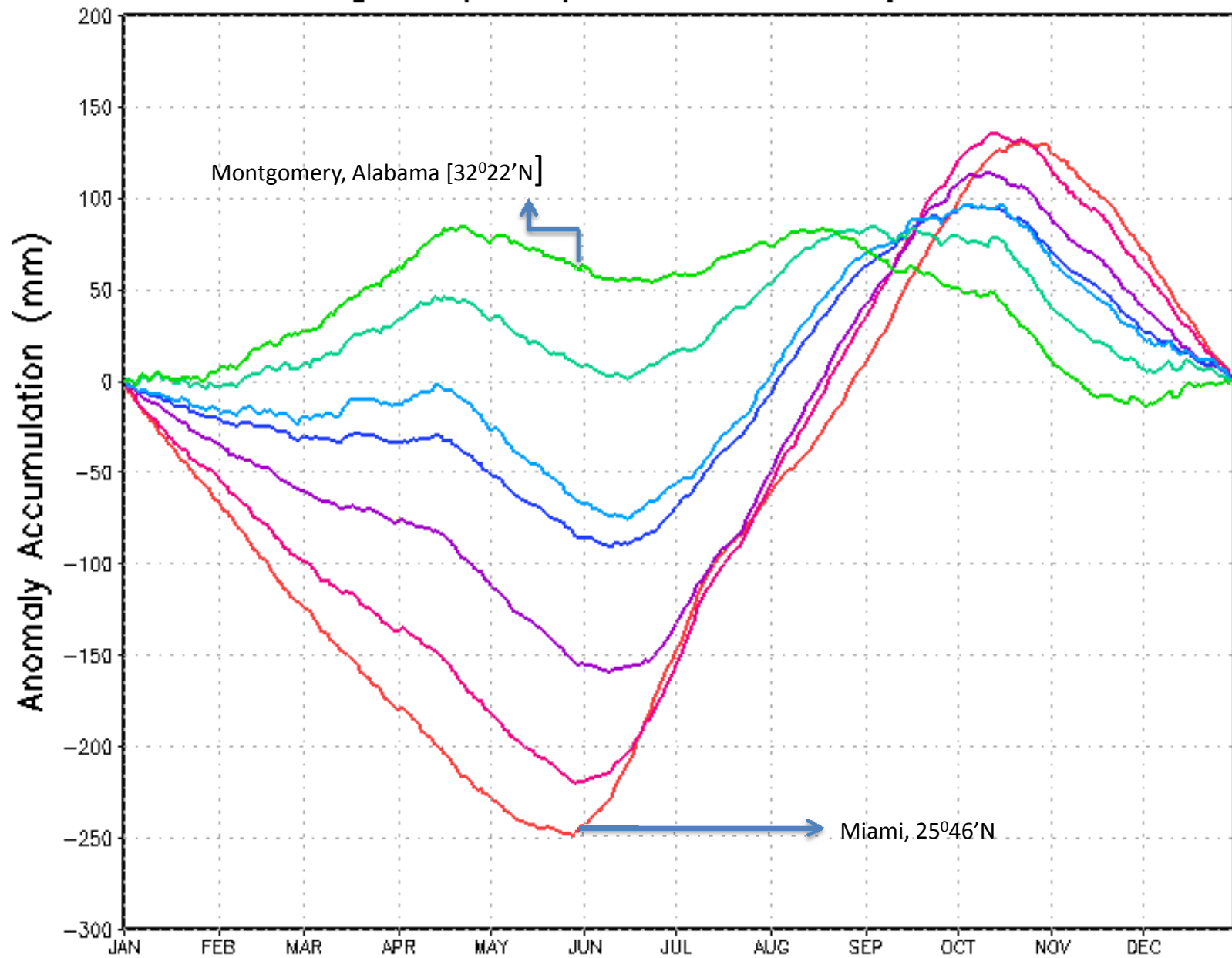
The rainy season is considered to be when the slope of the curve is positive.

East Central Amazon

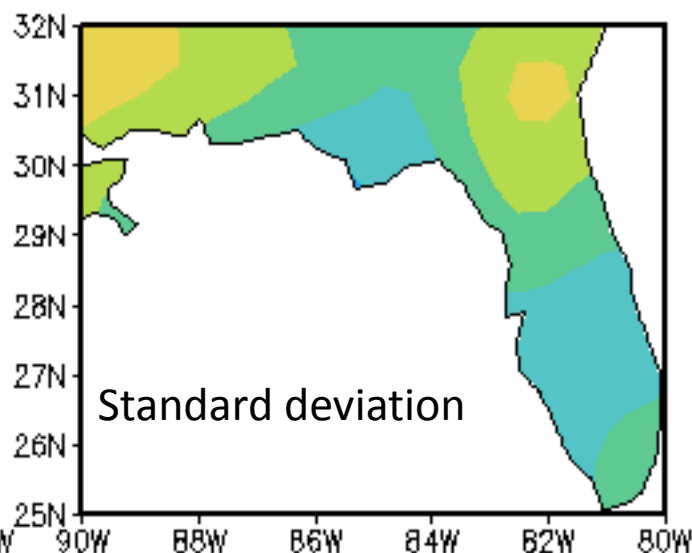
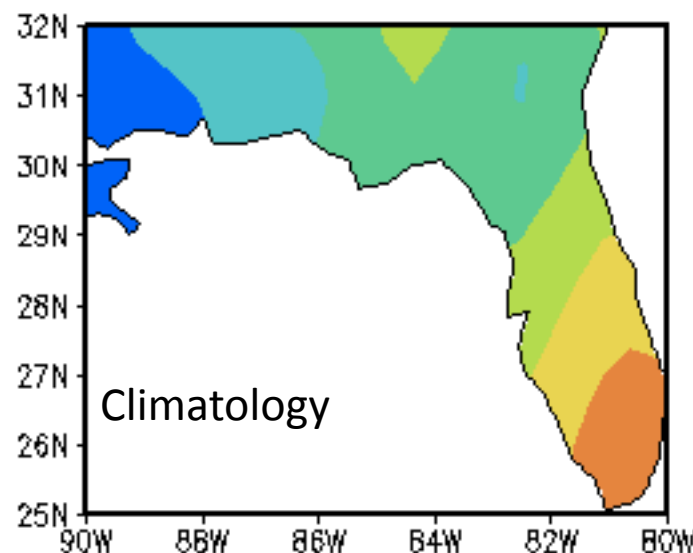


Average date of initiation: 30 December

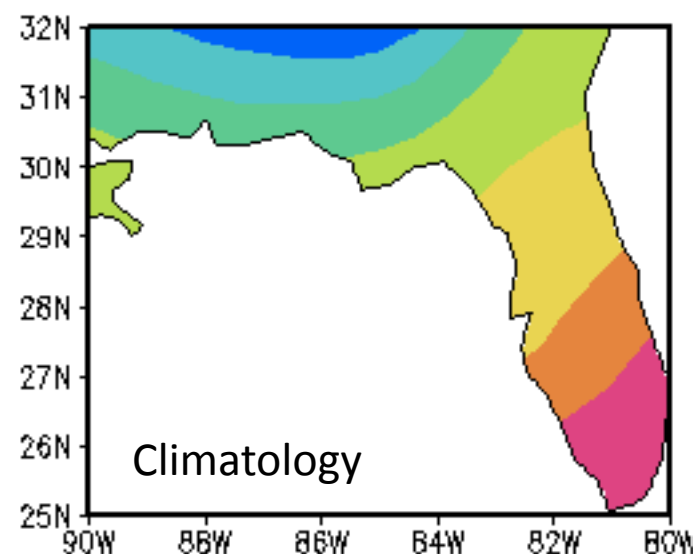
Climatological precipitation anomaly accumulation



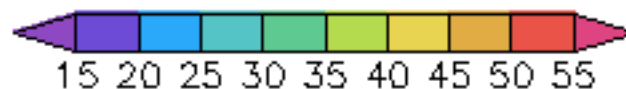
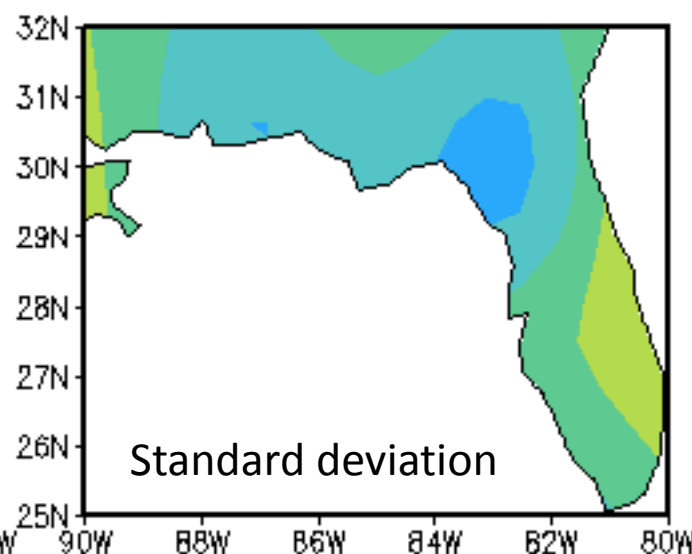
NCEP-R2 Mean LOWS NCEP-R2 σ LOWS



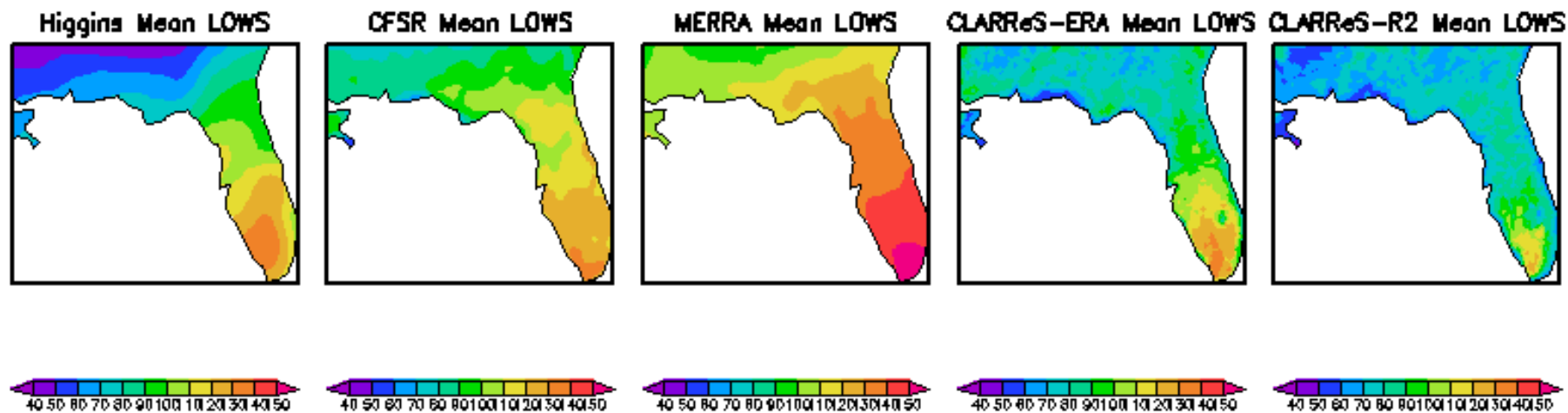
ERA40 Mean LOWS



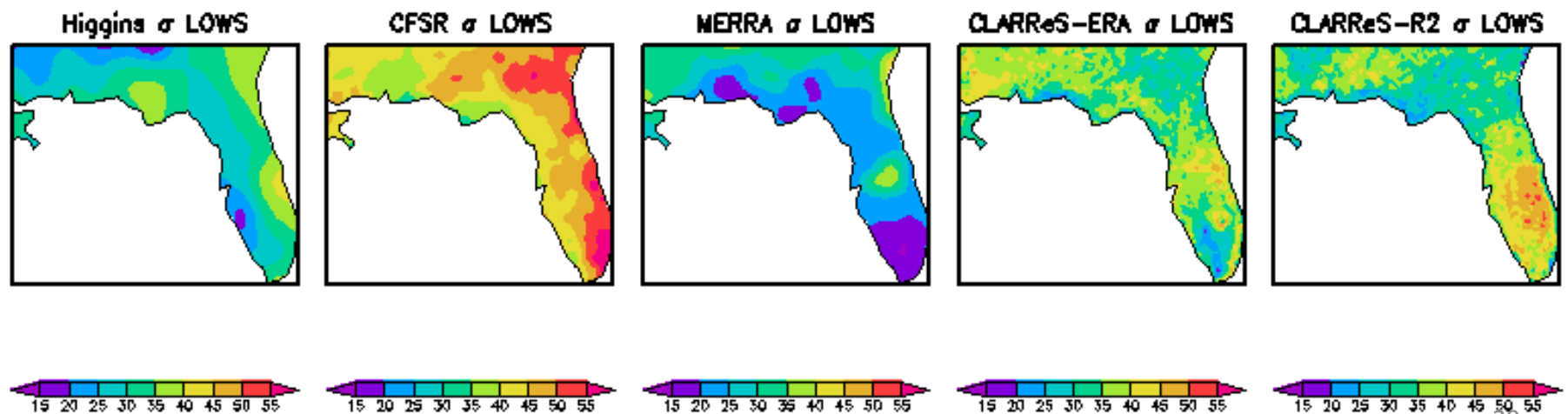
ERA40 σ LOWS

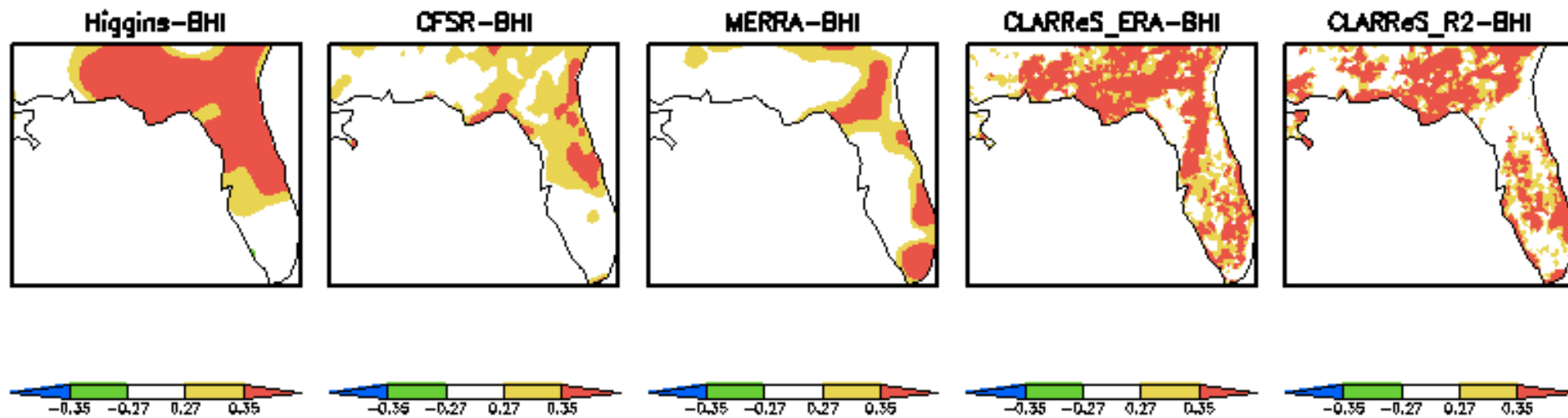


Climatology of LOWS



Standard deviation of LOWS





Significant correlation between LOWS and Bermuda High Index (BHI) at 90% confidence interval. BHI= JJA MSLP difference between Bermuda (35°N , 65°W) and New Orleans (30°N , 90°W).

Conclusions--II

- CLARReS10 offers opportunity to examine low frequency features of local scale phenomenon
- The seabreeze along Panhandle FL and possibly further westward is modulated by the Bermuda high.

Future work

- Analyze the model runs with increased concentrations of CO₂
- Analyze the model runs with change in land cover