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

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

Project Partners

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Acknowledgements

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- Dr. Steven Chan
- 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

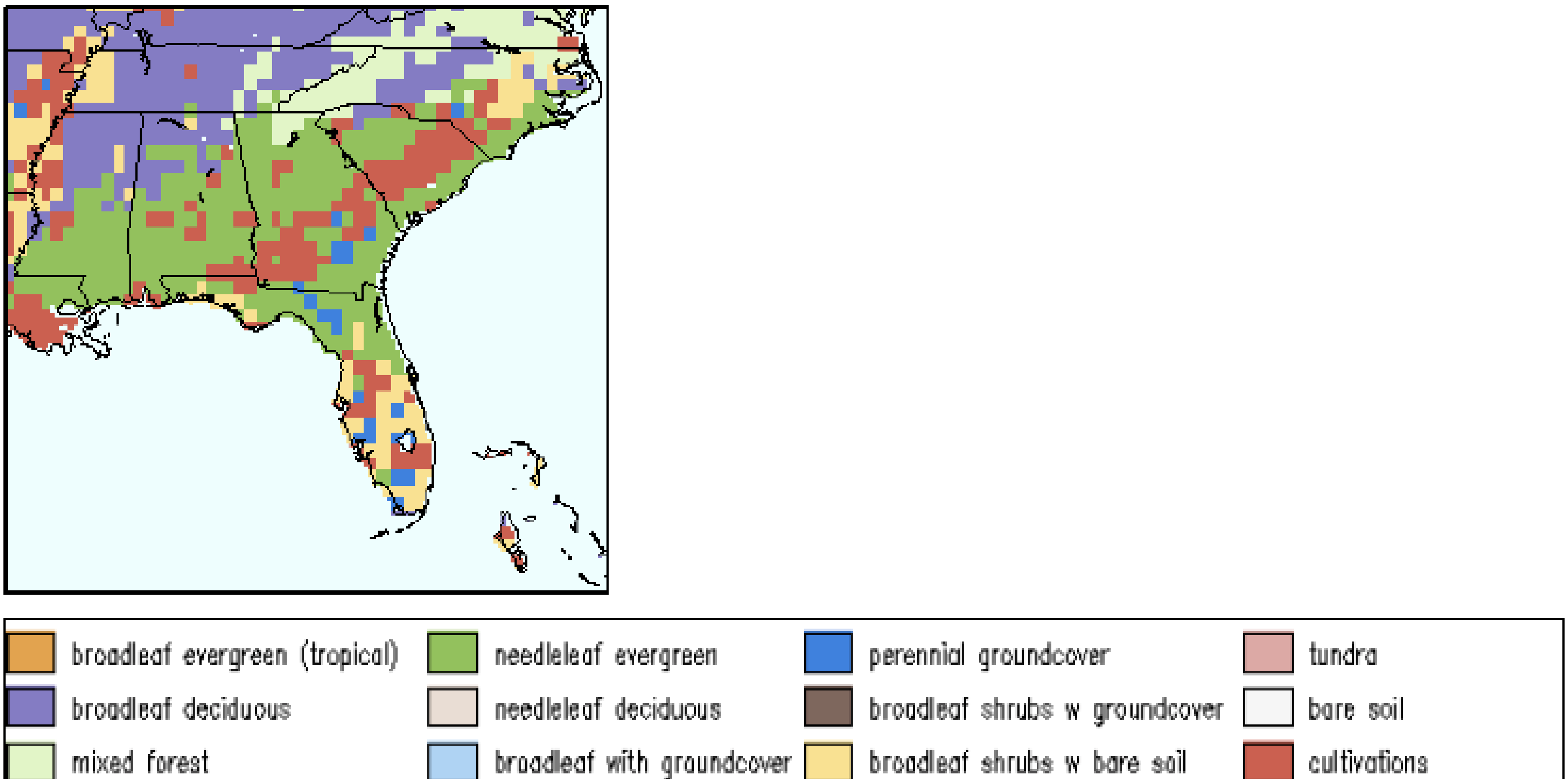
II) Assess the uncertainties/sensitivity in the above from greenhouse gas concentration changes and LULC

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						

GEOPHYSICAL RESEARCH LETTERS, VOL. 33, L07702, doi:10.1029/2005GL025579, 2006

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. Paolino[3]

"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".

GEOPHYSICAL RESEARCH LETTERS, VOL. 36, L13704, doi:10.1029/2009GL038082, 2009

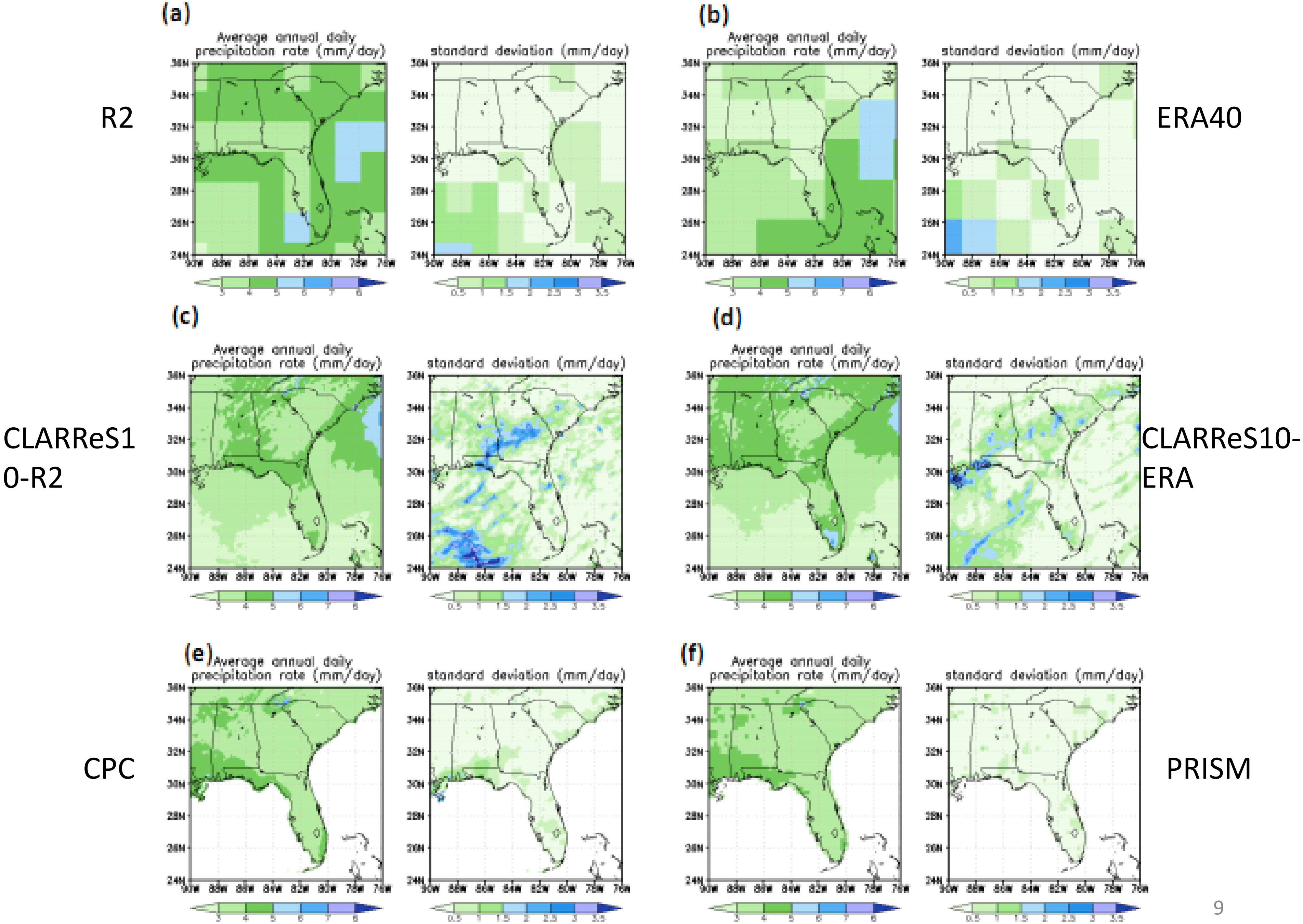
Click Here for Full Article

Climate projections: Past performance no guarantee of future skill?

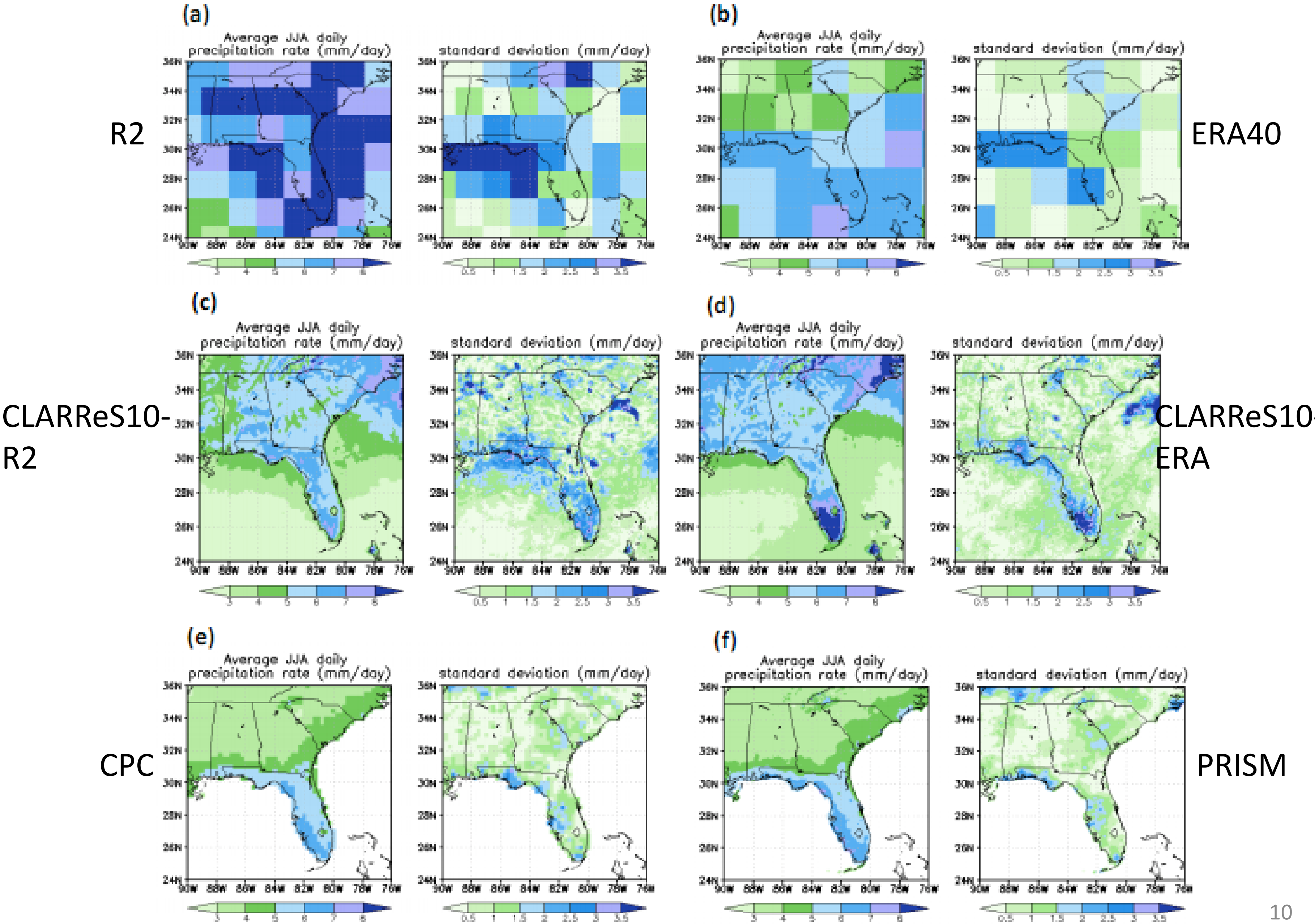
C. Reifen[1] and R. Toumi[1]

"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."

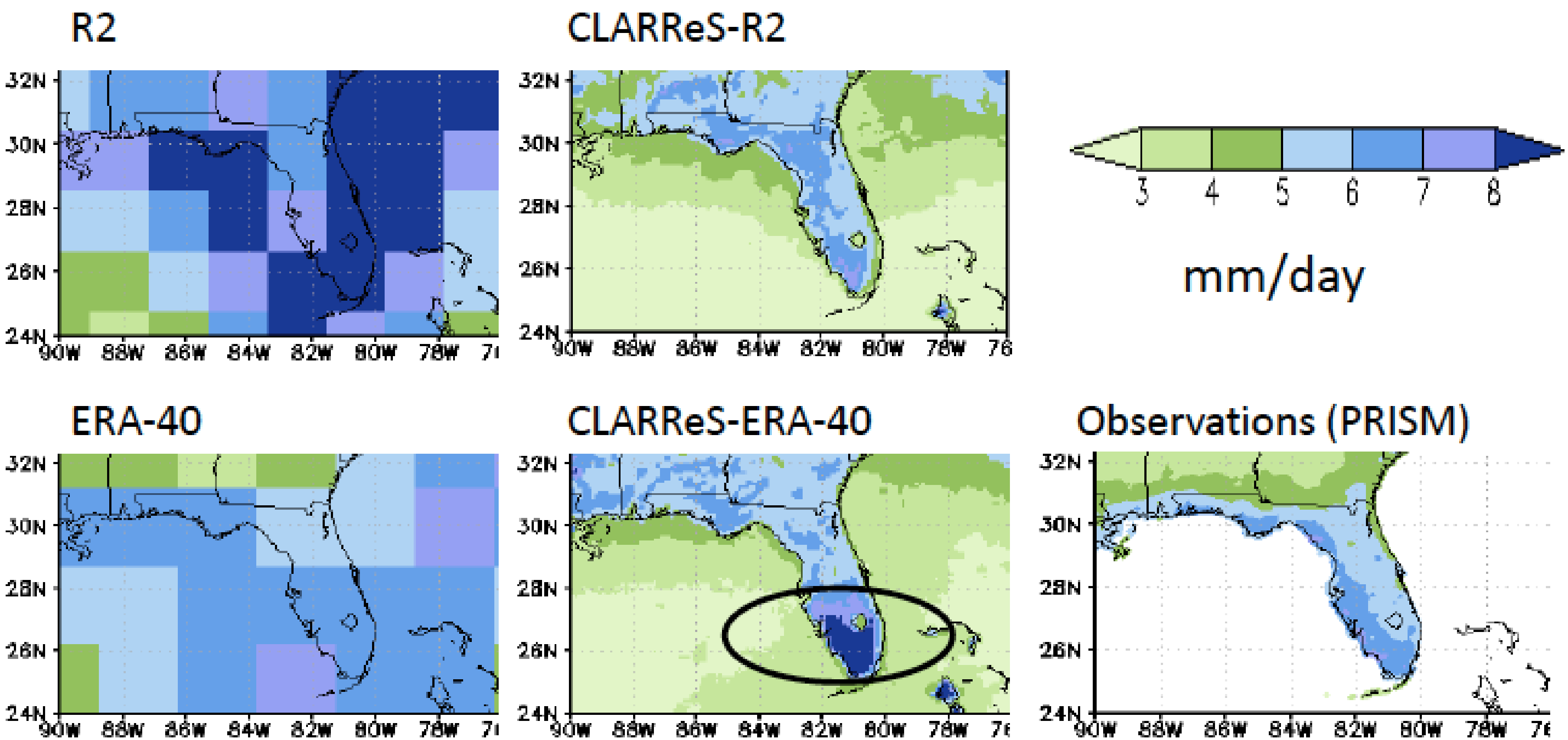
Annual mean climatological precipitation (mm/day)



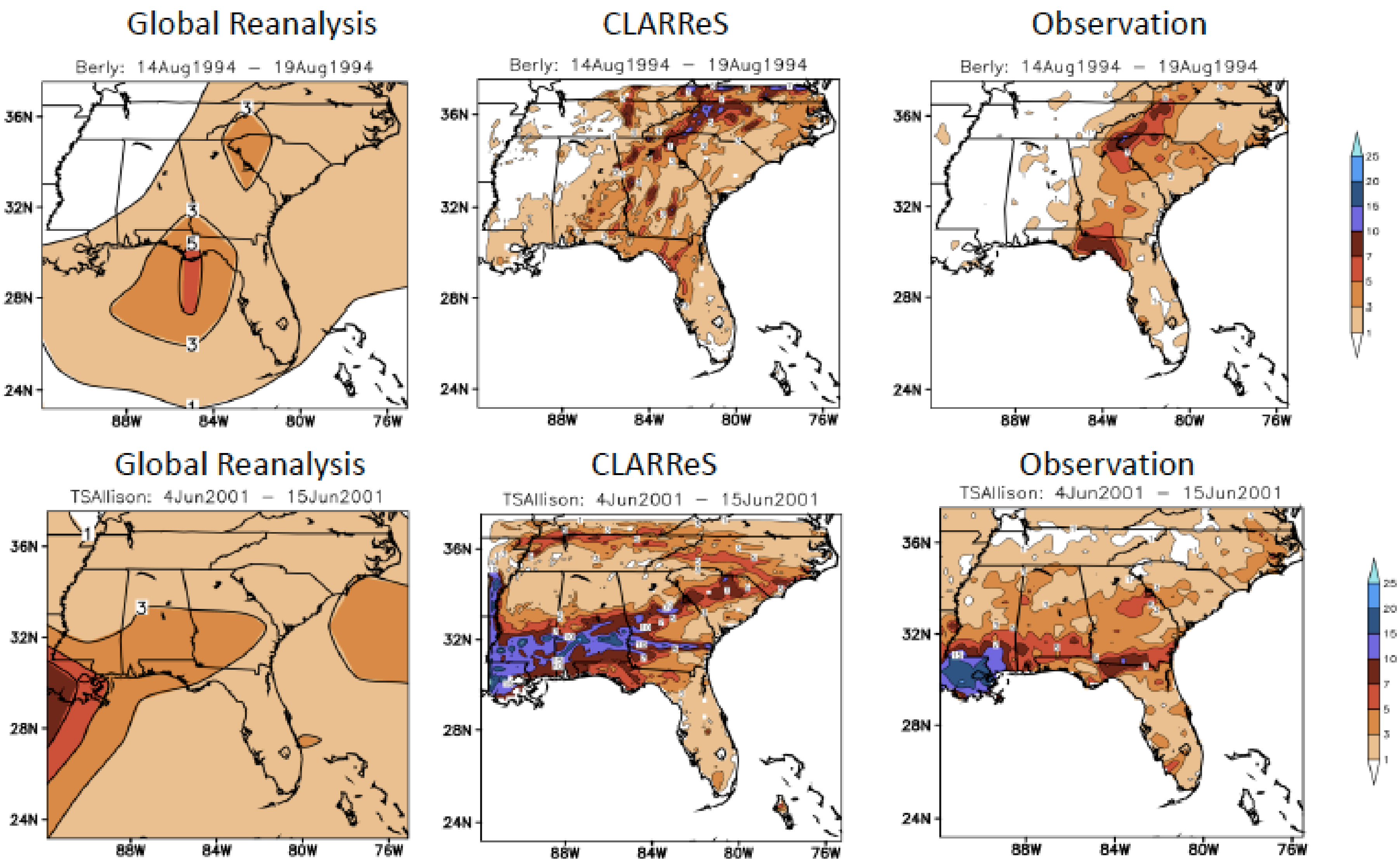
June-July-August mean climatological precipitation (mm/day)



Climatology: Summer (JJA) Precipitation Rate

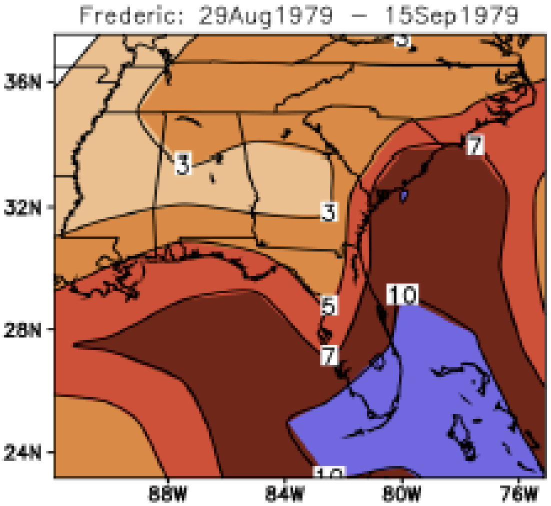


Tropical Cyclone Associated Precipitation (inches)

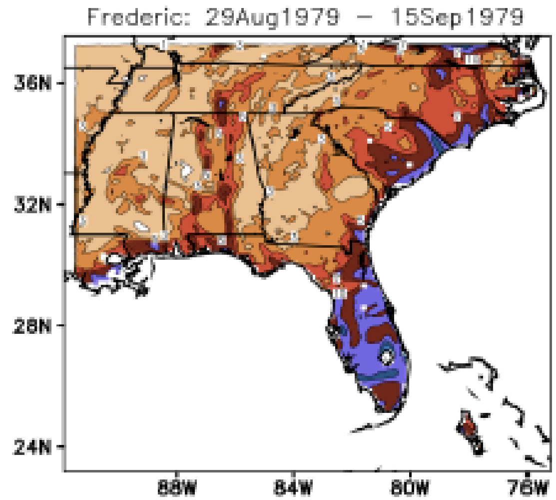


Tropical Cyclone Associated Precipitation (inches)

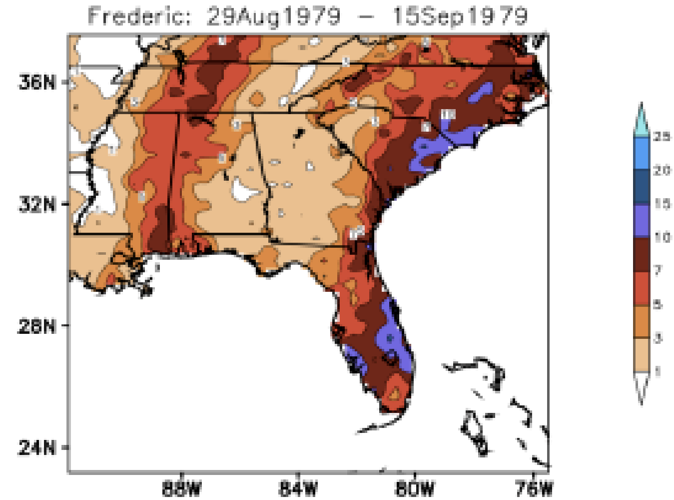
Global Reanalysis



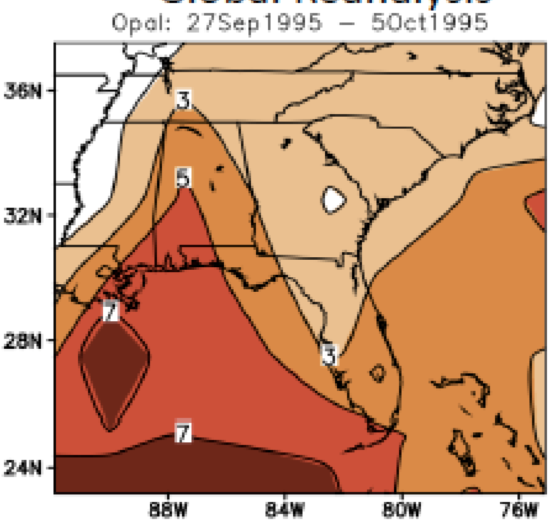
CLARReS



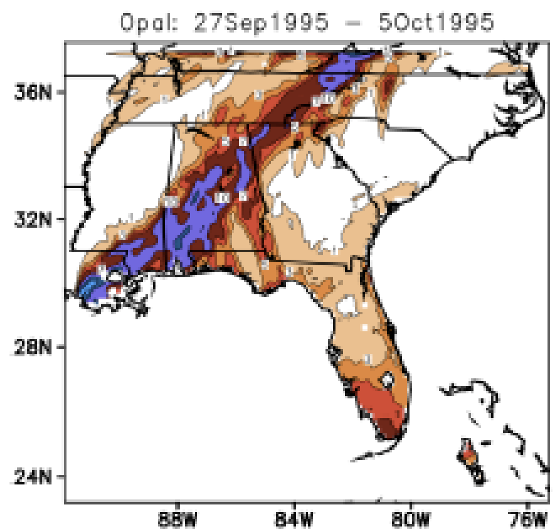
Observation



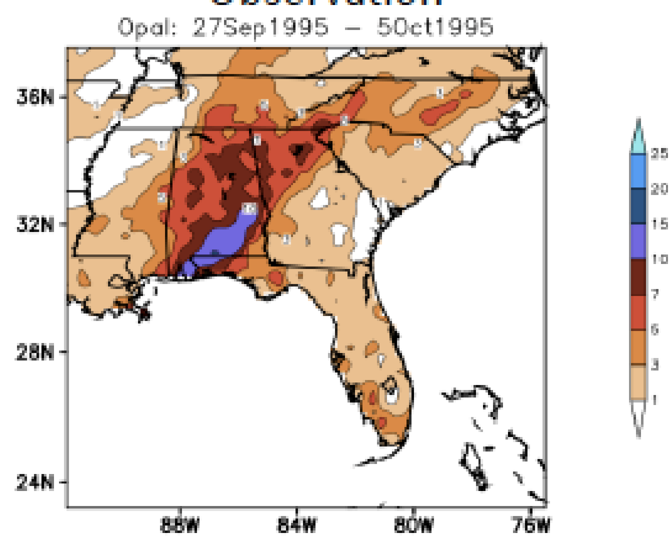
Global Reanalysis



CLARReS



Observation



Timing of diurnal zenith of precipitation

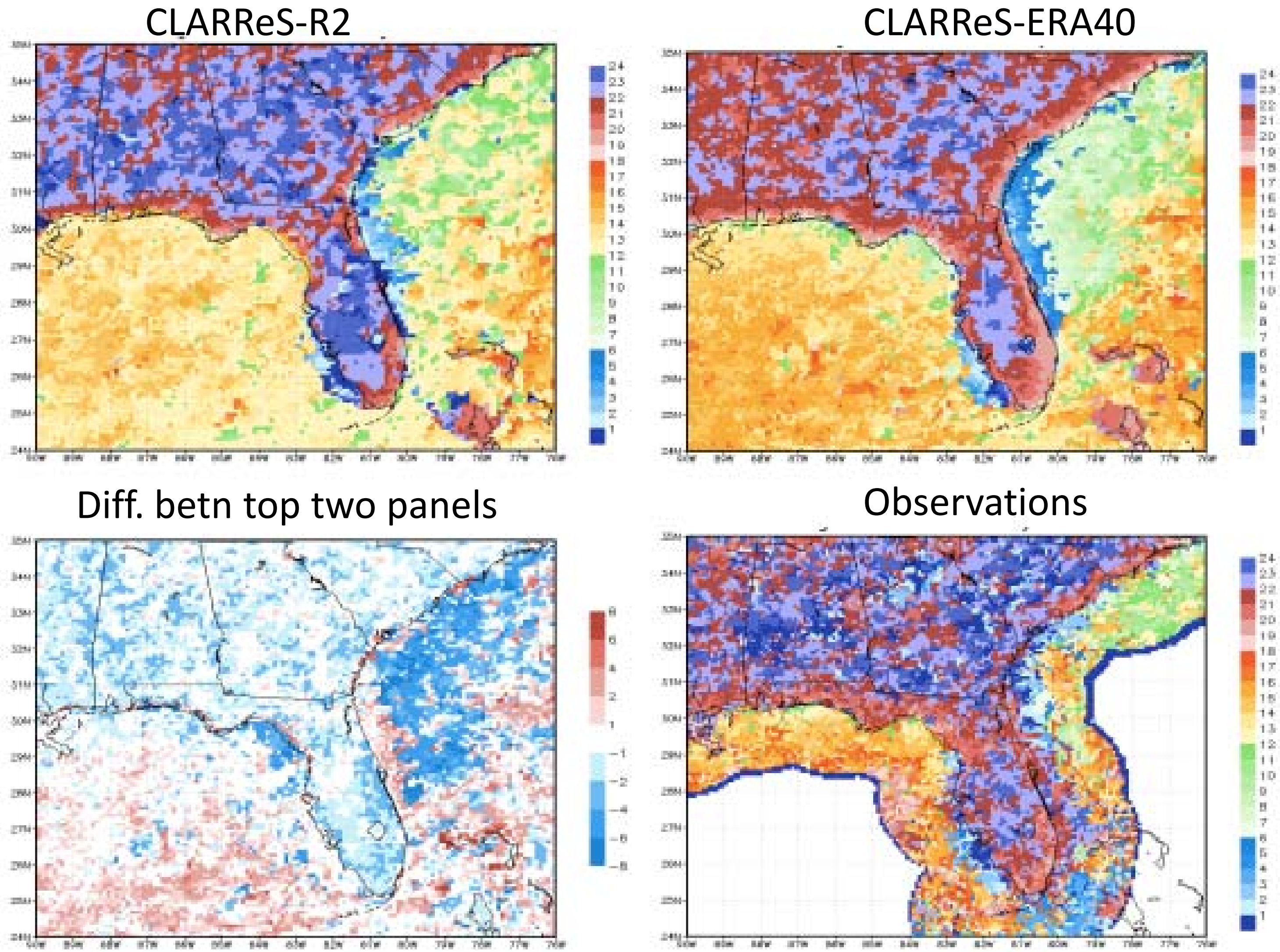
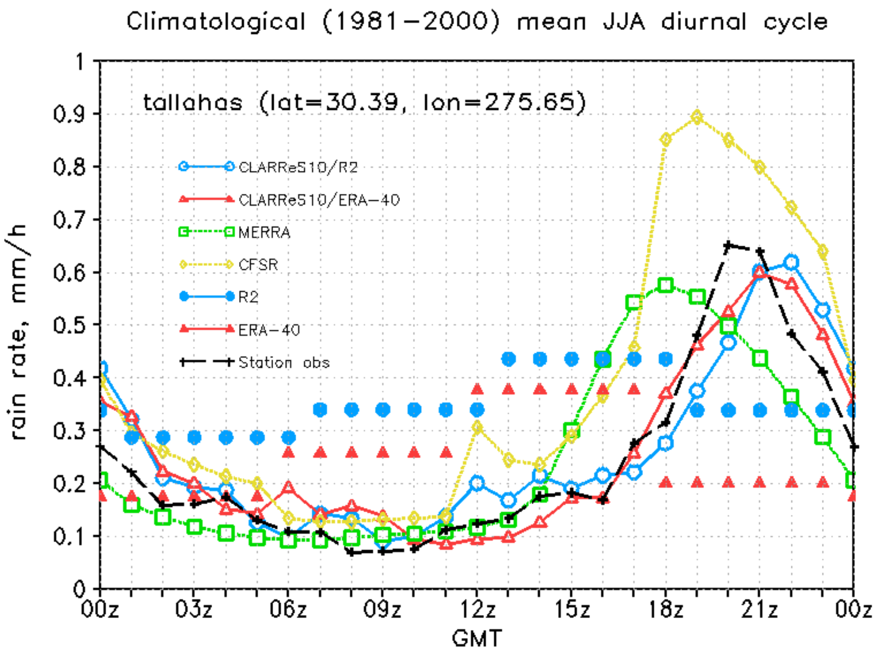
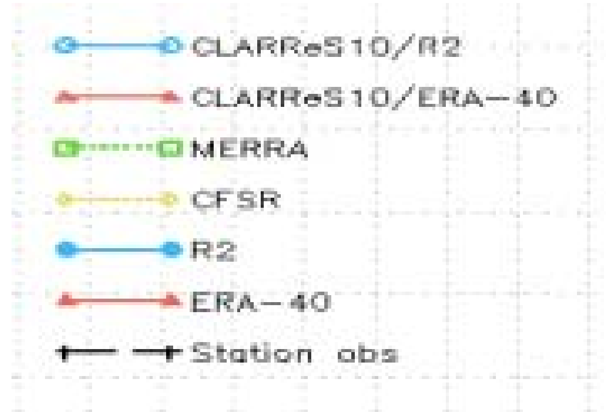
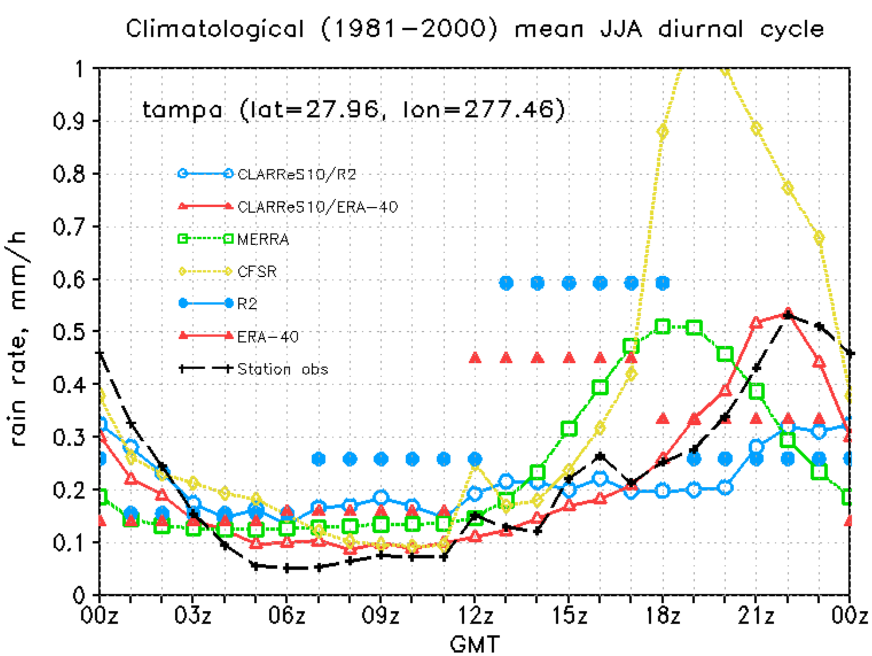
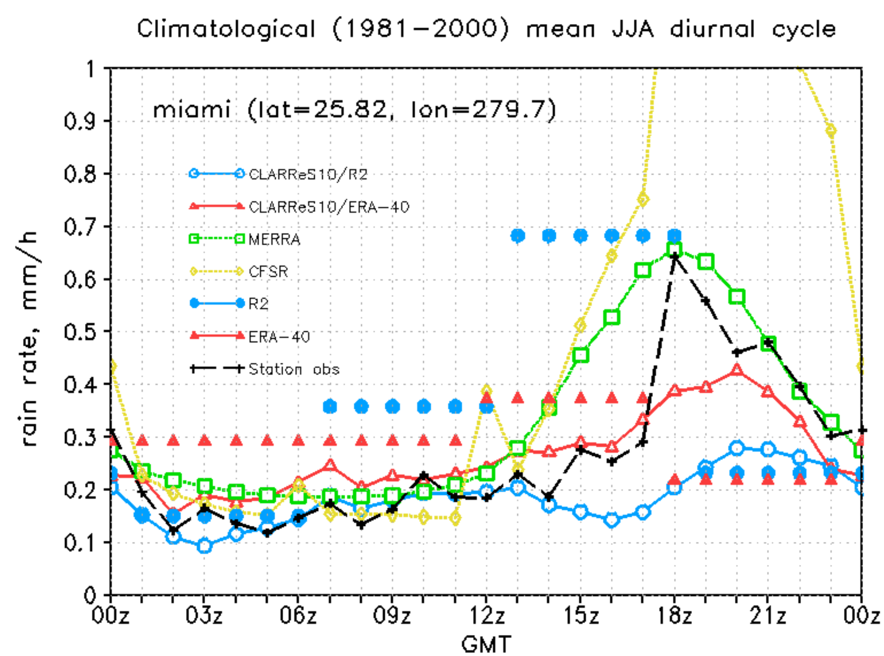


Fig. 11 Average timing of 1979-2001 JJA diurnal maximum (GMT) between CLARReS10-R2 (top left) and CLARReS10-ERA40 (top right); the difference in timing (CLARReS10-R2 minus CLARReS10-ERA40) (bottom left); and the average timing of JJA diurnal maximum from NCEP/EMC multi-sensor estimate for 2004-2009 (bottom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


Climatological (1981–2000) mean JJA diurnal cycle
tallahas (lat=30.39, lon=275.65)
CLARReS10/R2
CLARReS10/ERA–40
MERRA
CFSR
R2
ERA–40
Station obs
rain rate, mm/h
GMT
00z
03z
06z
09z
12z
15z
18z
21z
00z


CLARReS10/R2
CLARReS10/ERA–40
MERRA
CFSR
R2
ERA–40
Station obs


Climatological (1981–2000) mean JJA diurnal cycle
tampa (lat=27.96, lon=277.46)
CLARReS10/R2
CLARReS10/ERA–40
MERRA
CFSR
R2
ERA–40
Station obs
rain rate, mm/h
GMT


Climatological (1981–2000) mean JJA diurnal cycle
miami (lat=25.82, lon=279.7)
CLARReS10/R2
CLARReS10/ERA–40
MERRA
CFSR
R2
ERA–40
Station obs
rain rate, mm/h
GMT

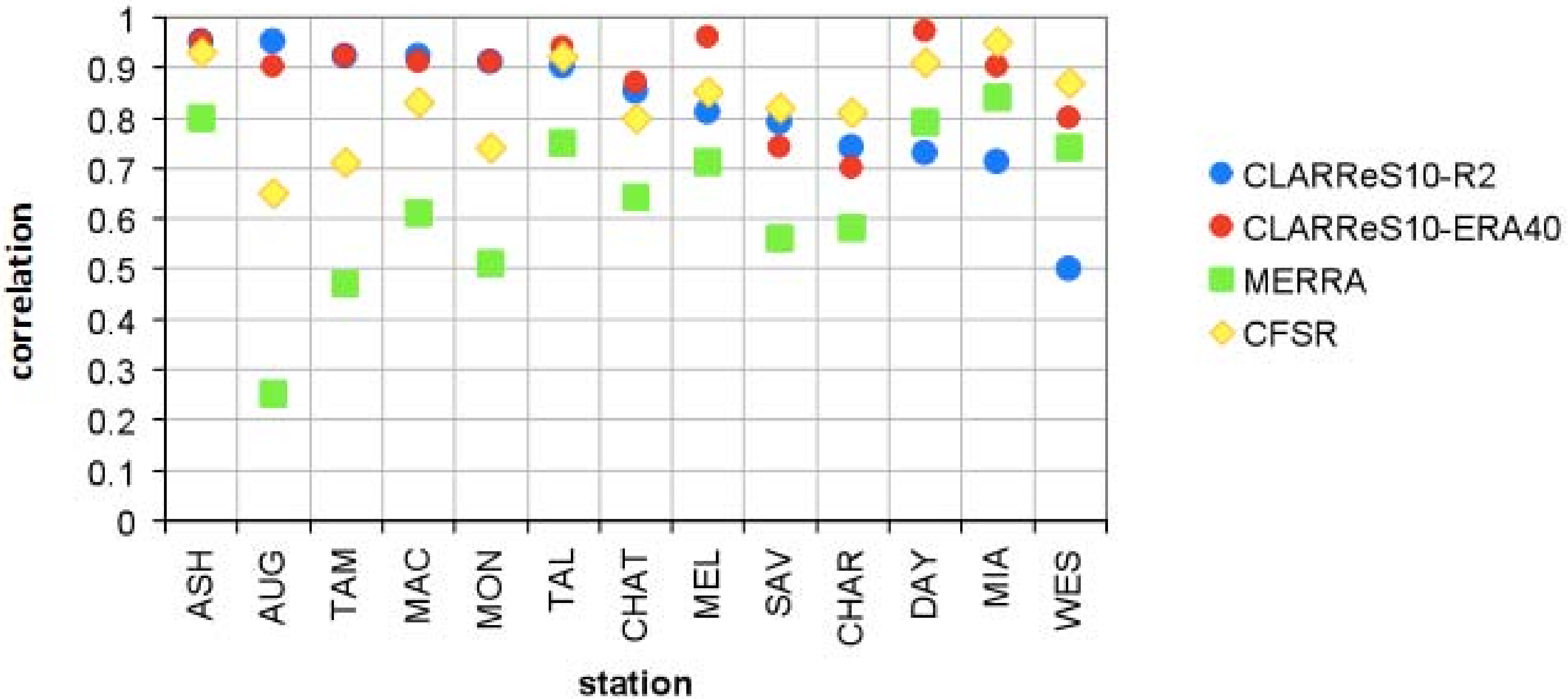


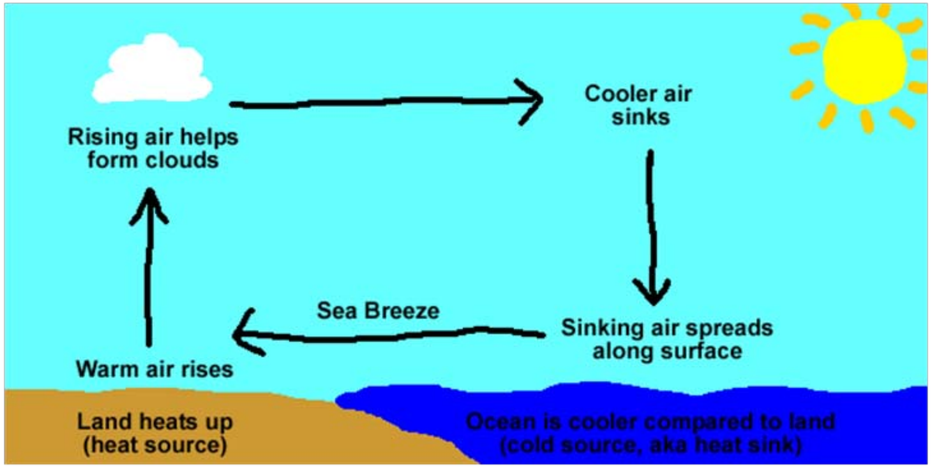
Fig. 13 Correlation of the JJA average daily cycle with observed station data for CLARReS10-R2, CLARReS10-ERA40, MERRA, and CFSR. The series have been sorted by descending value of the correlation of CLARReS10-R2 with station observations. The station abbreviations on the abscissa are as follows: ASH – 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

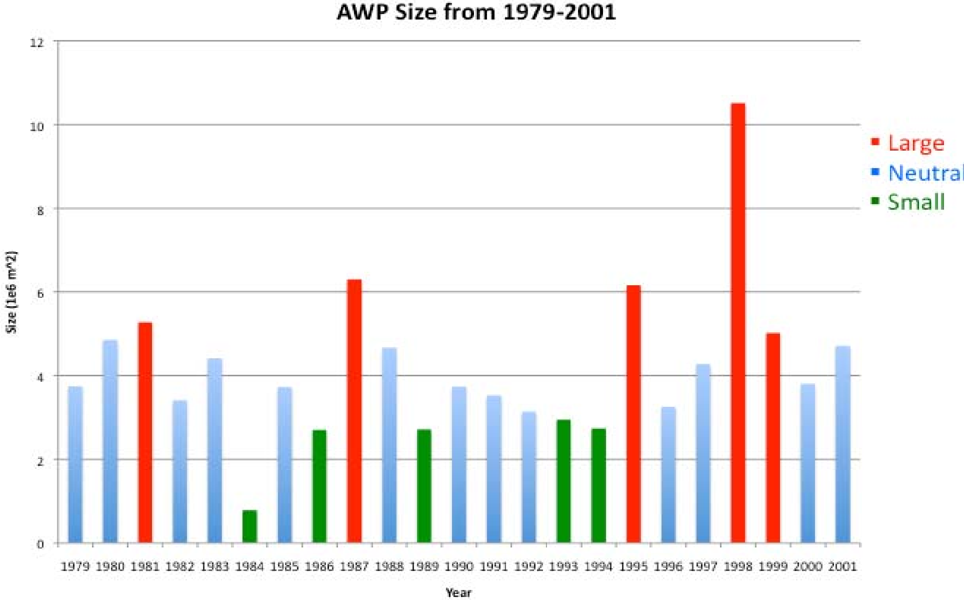
- CLARReS10 is cheap, effective way of producing consistent atmospheric analysis for the Southeast US that could be used for retrospective analysis.
- CLARReS10 is comparable or even better than CFSR and MERRA
- With bias correction, CLARReS10 has been successfully applied for hydrological applications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

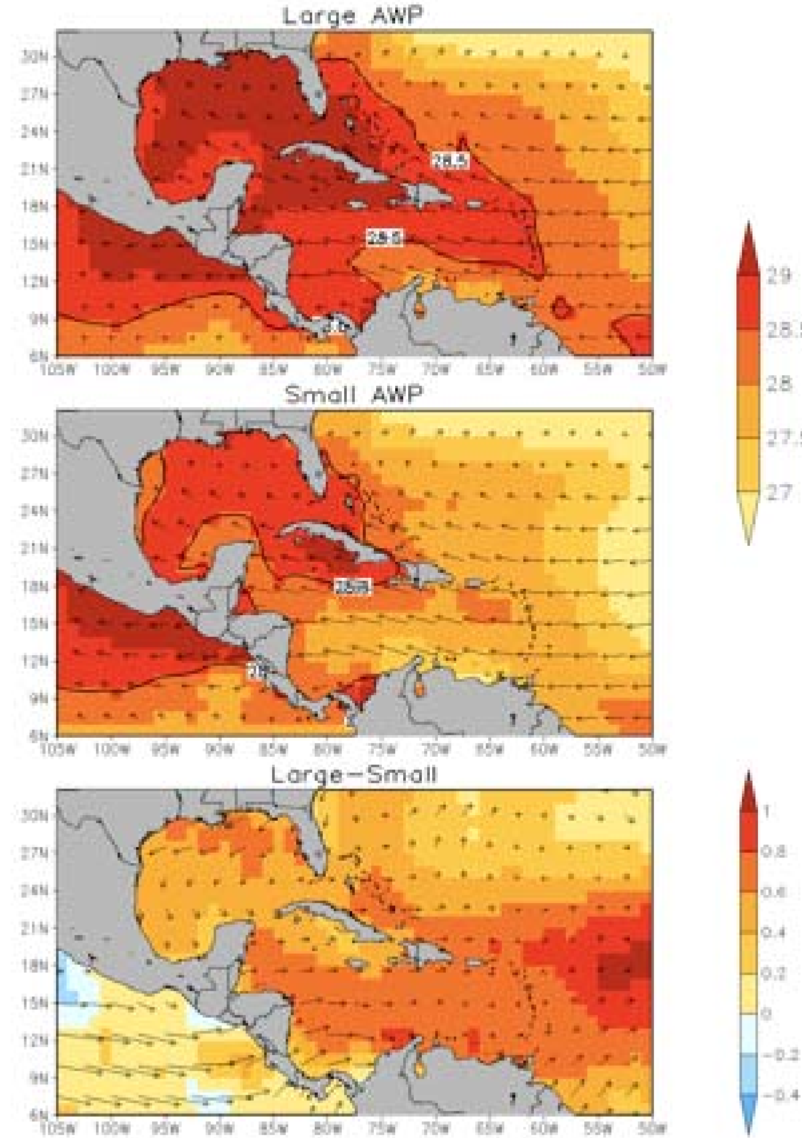
Low Frequency variations of sea breeze using CLARReS10

Sea Breeze

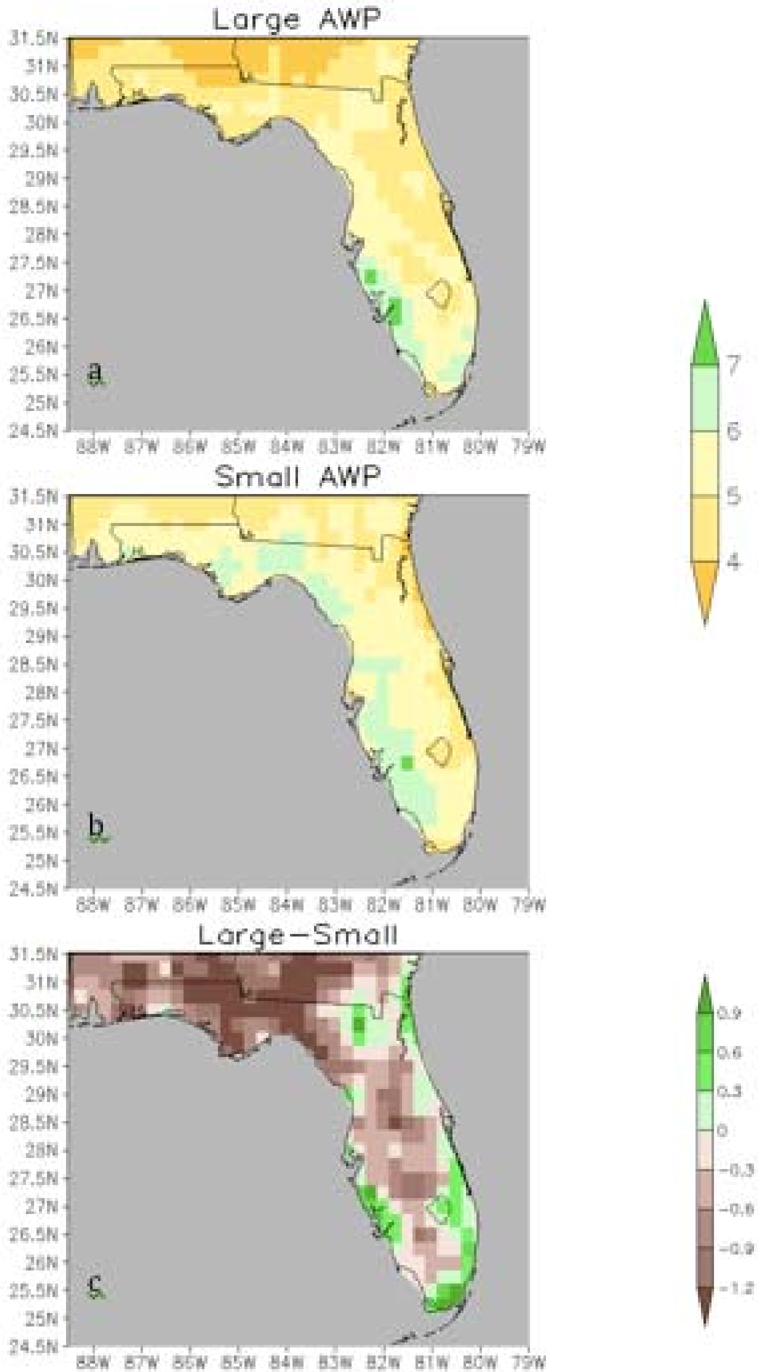


- Thermal circulation arises due to differential heating (Biggs and Graves 1962)
- Strongest during the summer





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

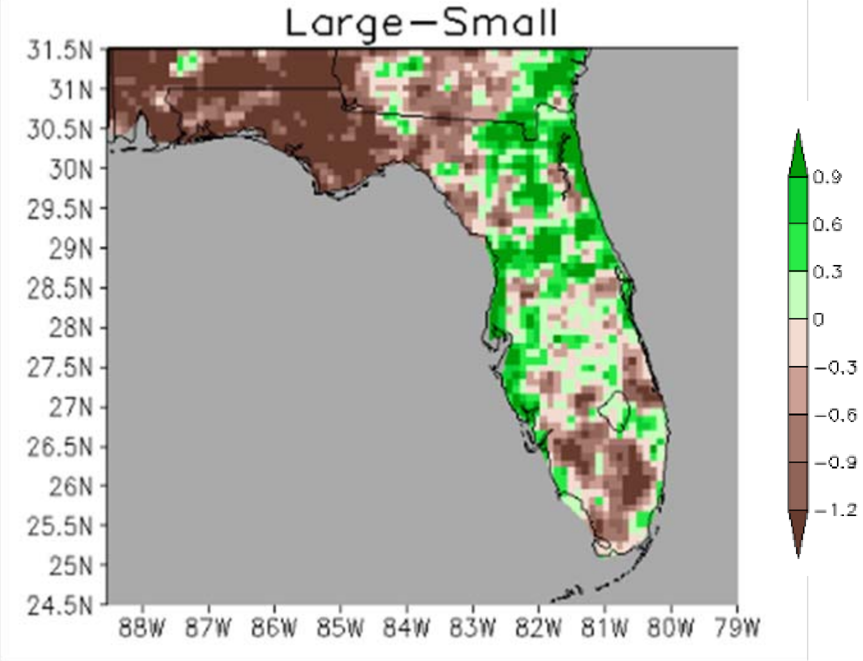


Observed JJA rainfall from CPC rain gauge based rainfall (Higgins et al. 2000) for the 5 large and the small AWP years.

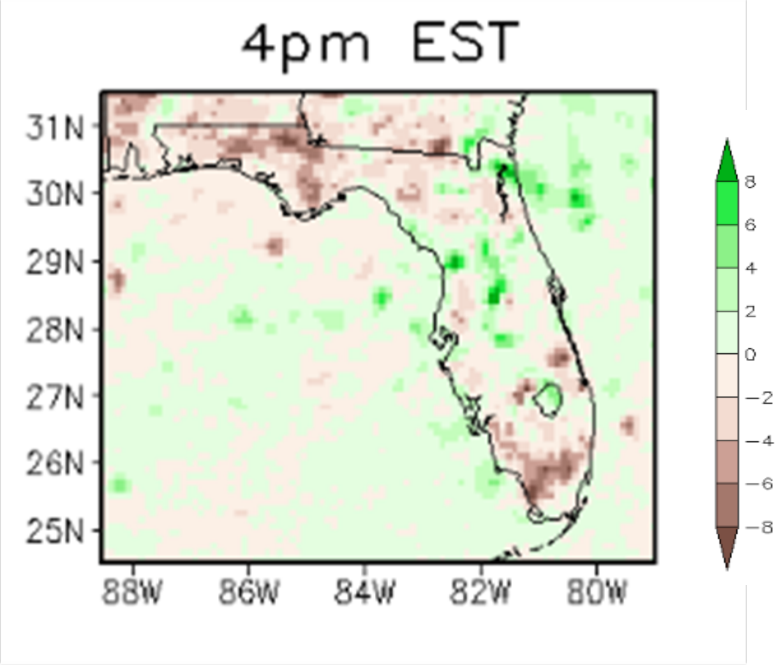
AWP Composite Difference

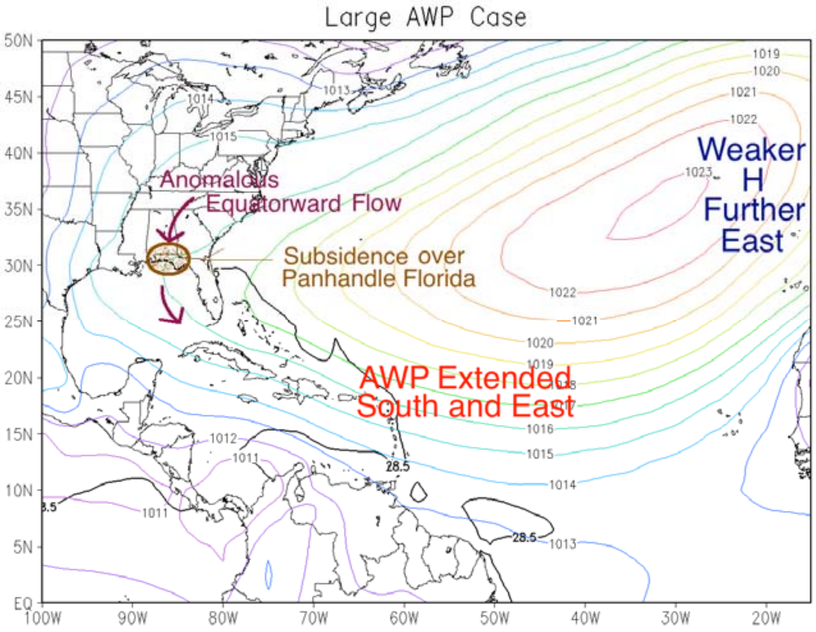
Precip in mm/day

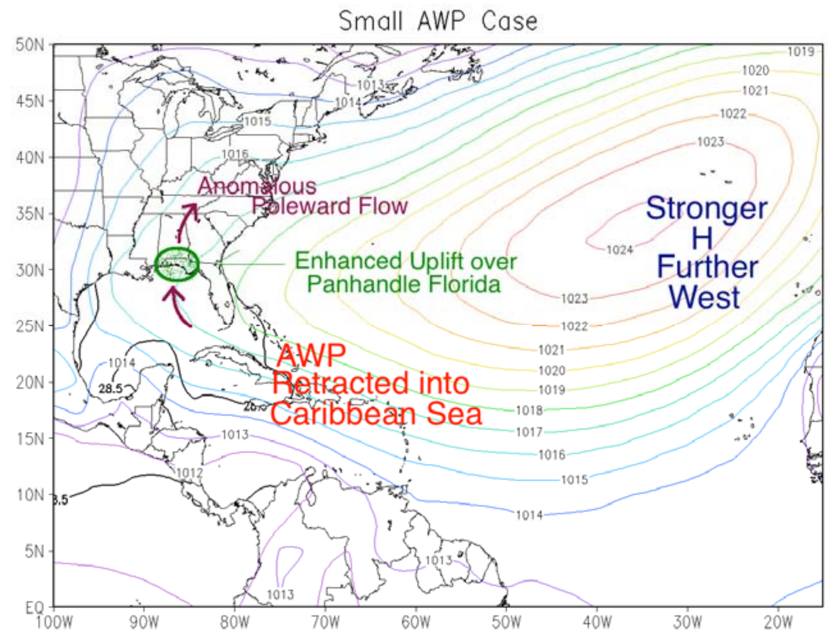
Seasonal



4pm




Large AWP Case
Weaker H Further East
Anomalous Equatorward Flow
Subsidence over Panhandle Florida
AWP Extended South and East


Small AWP Case
Anomalous Poleward Flow
Enhanced Uplift over Panhandle Florida
Stronger H Further West
AWP Retracted into Caribbean Sea

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

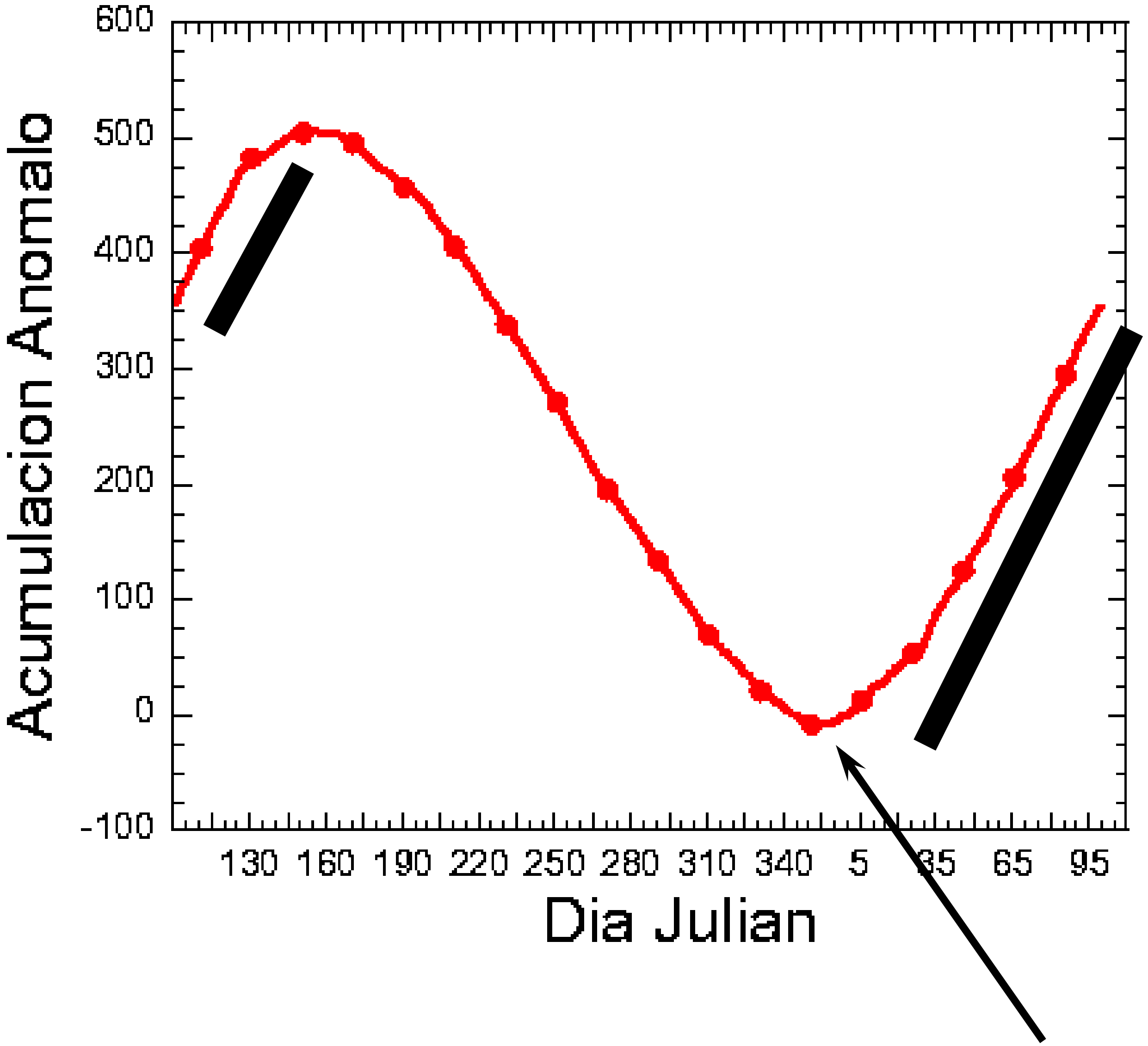
$R(n)$ = daily rainfall

R = annual average daily precipitation

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

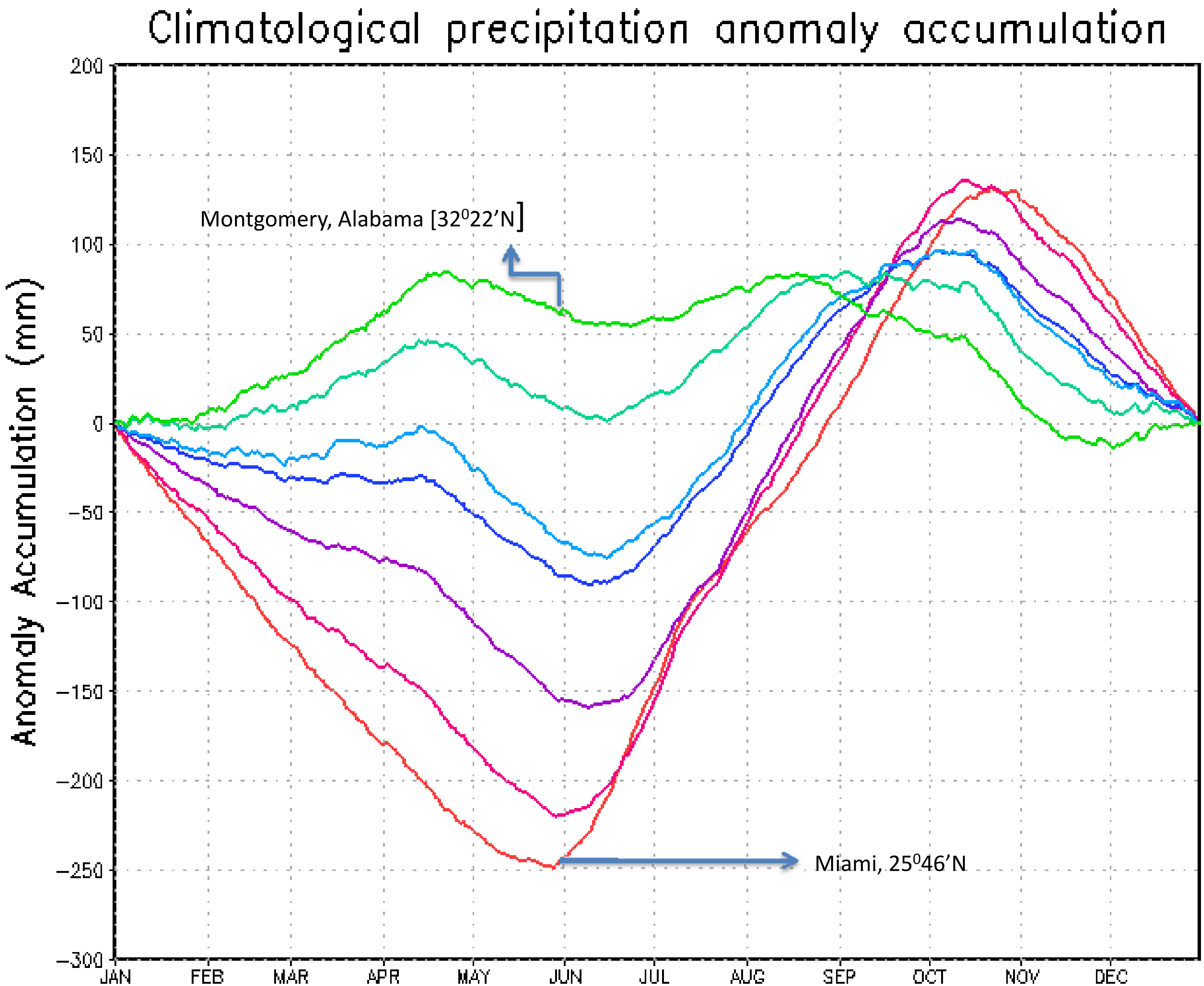
Courtesy: Brant Liebmann/NOAA-CIRES

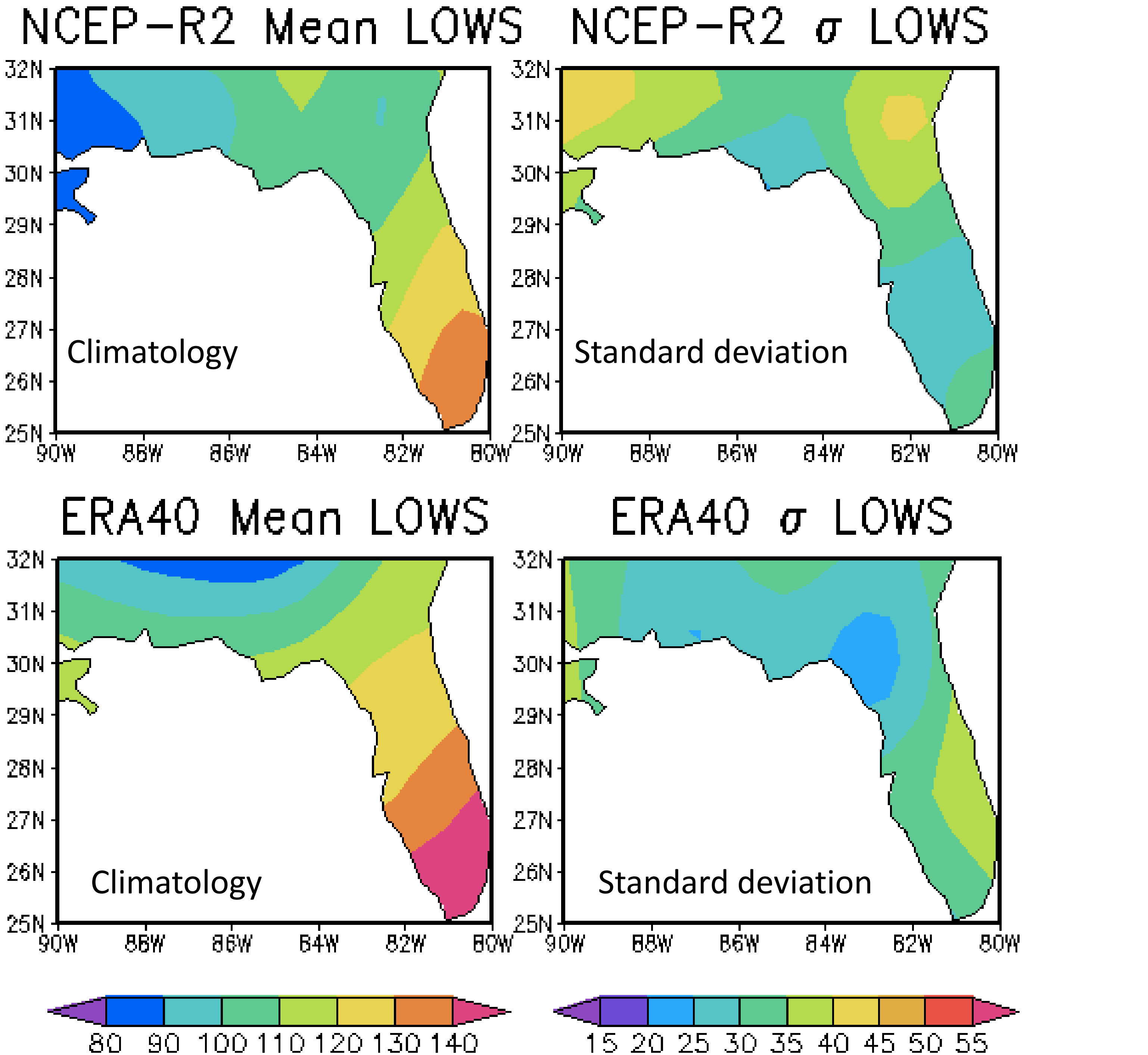
East Central Amazon



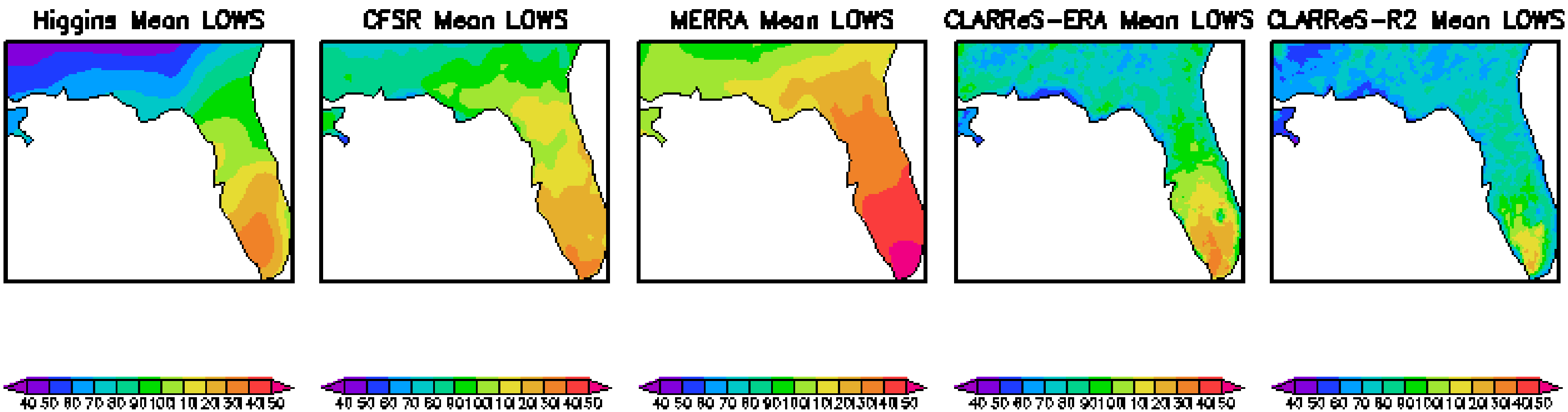
Average date of initiation: 30 December

Courtesy: Brant Liebmann/NOAA-CIRES

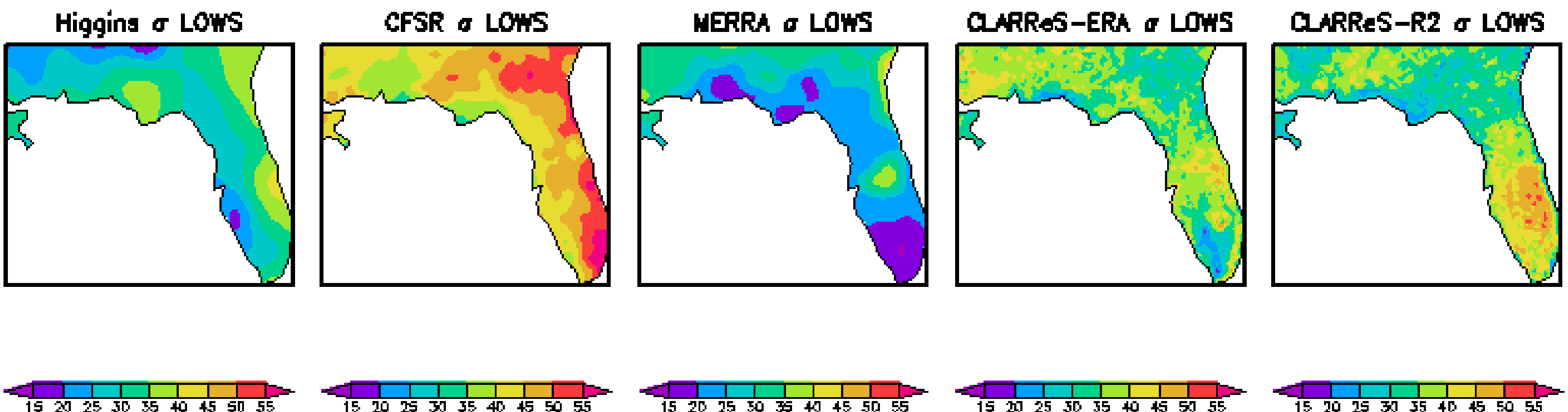

Climatological precipitation anomaly accumulation
Anomaly Accumulation (mm)
200
150
100
50
0
−50
−100
−150
−200
−250
−300
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
Montgomery, Alabama [32⁰22’N]
Miami, 25⁰46’N

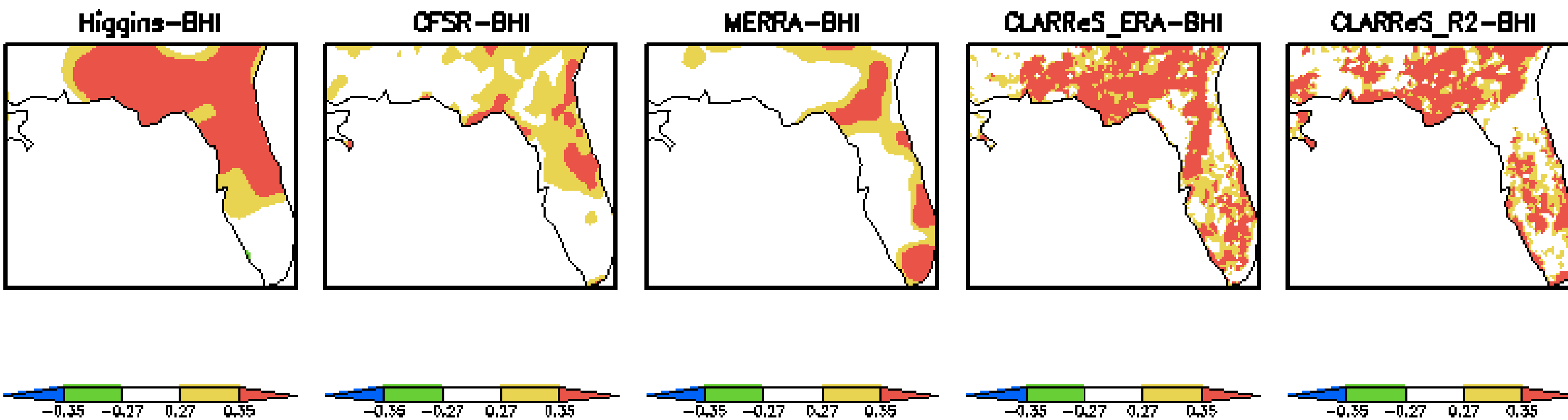

NCEP-R2 Mean LOWS
NCEP-R2 σ LOWS
Climatology
Standard deviation
ERA40 Mean LOWS
ERA40 σ LOWS
Climatology
Standard deviation
32N 31N 30N 29N 28N 27N 26N 25N
90W 88W 86W 84W 82W 80W
80 90 100 110 120 130 140
15 20 25 30 35 40 45 50 55

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 (35^0N, 65^0W) and New Orleans (30^0N, 90^0W).

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 CO_2
- Analyze the model runs with change in land cover