Regional Climate Impacts

Chris Martinez
Associate Professor
Agricultural and Biological Engineering
University of Florida

Florida Water & Climate Alliance

UF University of Florida IFAS Extension

Florida Climate Institute

Southeast Climate Consortium

The Florida Water and Climate Alliance

- Partnership of:
  - Water utilities
  - State agencies
  - Researchers
  - Local governments
- Formed in 2010

Florida Water & Climate Alliance

UF IFAS UNIVERSITY of FLORIDA

Florida Climate Institute

Southeast Climate Consortium

The Florida Water and Climate Alliance

<u>Goal</u>:

To **<u>increase the regional relevance and usability</u>** of climate and sea level rise models for the specific needs of water suppliers and resources managers in Florida.

Florida Water & Climate Alliance

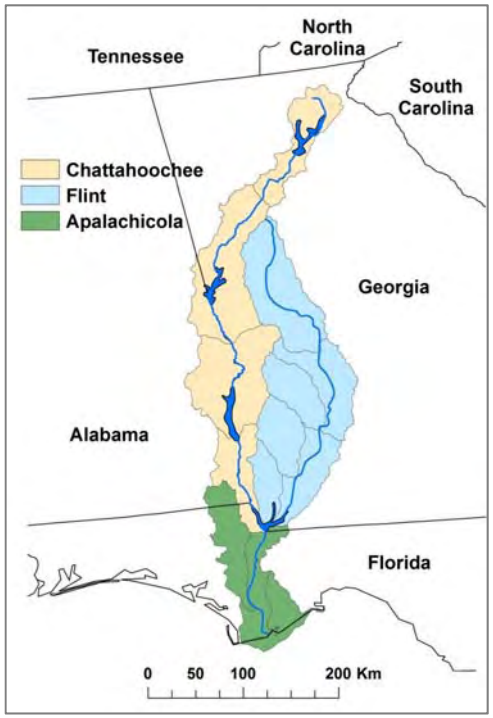
UF IFAS UNIVERSITY of FLORIDA

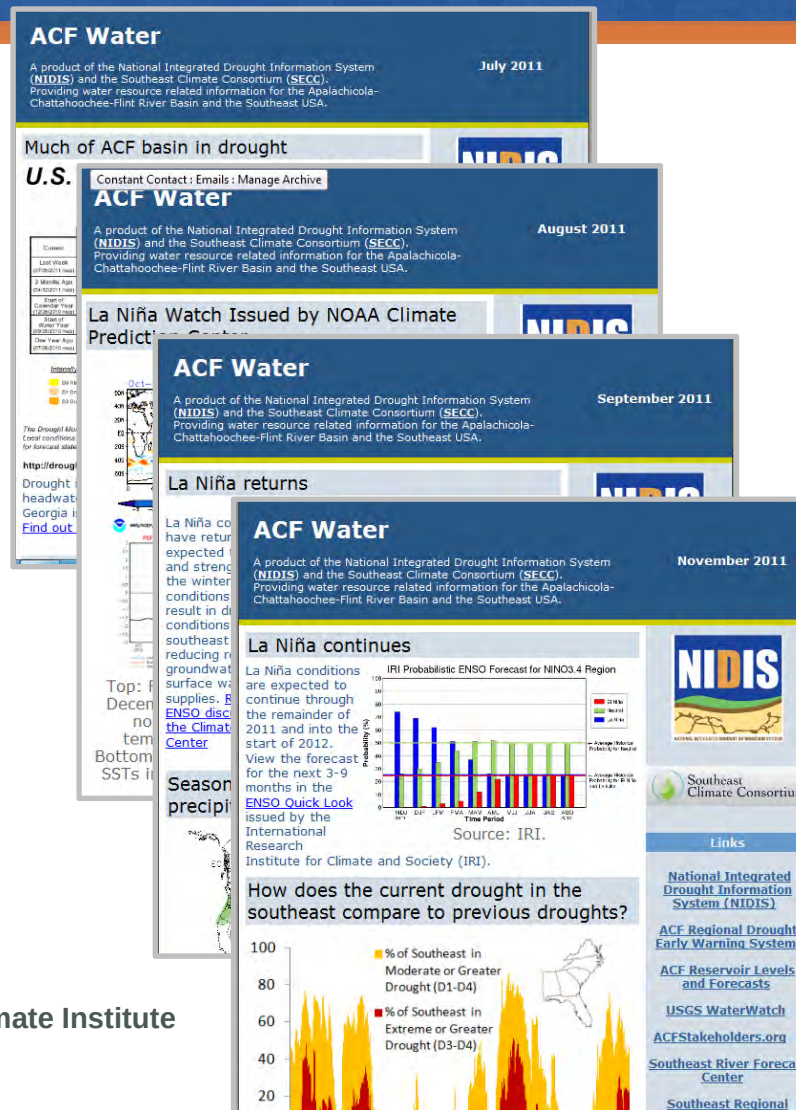
Florida Climate Institute

Southeast Climate Consortium

National Integrated Drought Information System (NIDIS)

- Research
- Outreach





FAS of FLORIDA

Florida Climate Institute

NIDIS SE Pilot Motivation

- 2007-2008 and 2011-2012 droughts linked, in part, to La Niña events.
- Both drought events were forecasted many months in advance.

HOME PAGE | TODAY'S PAPER | VIDEO | MOST POPULAR | TIMES TOPICS

The New York Times — U.S.

WORLD | U.S. | N.Y. / REGION | BUSINESS | TECHNOLOGY | SCIENCE | HEALTH | SPORTS | OPINION

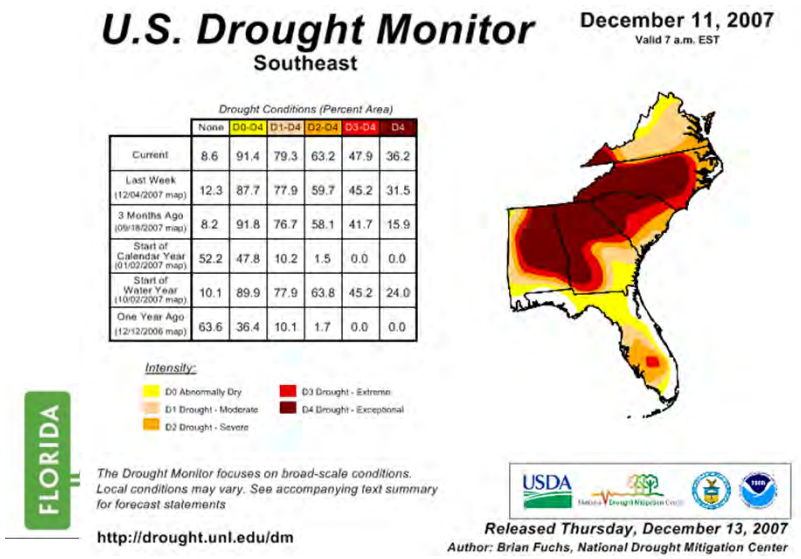
New to Being Dry, the South Struggles to Adapt

Erik S. Lesser for The New York Times

Val Perry of the Lake Lanier Association walking from his dock last week. The governor of Georgia wants the Army Corps of Engineers to reduce the amount of water it releases from the lake.

By SHAILA DEWAN and BRENDA GOODMAN
Published: October 23, 2007

TWITTER



U.S. Drought Monitor
Southeast

December 11, 2007
Valid 7 a.m. EST

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	8.6	91.4	79.3	63.2	47.9	36.2
Last Week (12/04/2007 map)	12.3	87.7	77.9	59.7	45.2	31.5
3 Months Ago (09/18/2007 map)	8.2	91.8	76.7	58.1	41.7	15.9
Start of Calendar Year (01/02/2007 map)	52.2	47.8	10.2	1.5	0.0	0.0
Start of Water Year (10/02/2007 map)	10.1	89.9	77.9	63.8	45.2	24.0
One Year Ago (12/12/2006 map)	63.6	36.4	10.1	1.7	0.0	0.0

Intensity:
D0 Abnormally Dry
D1 Drought - Moderate
D2 Drought - Severe
D3 Drought - Extreme
D4 Drought - Exceptional

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements

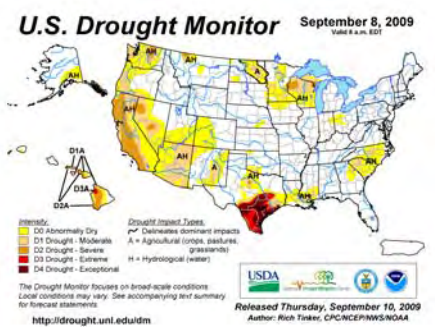
http://drought.unl.edu/dm

Released Thursday, December 13, 2007
Author: Brian Fuchs, National Drought Mitigation Center

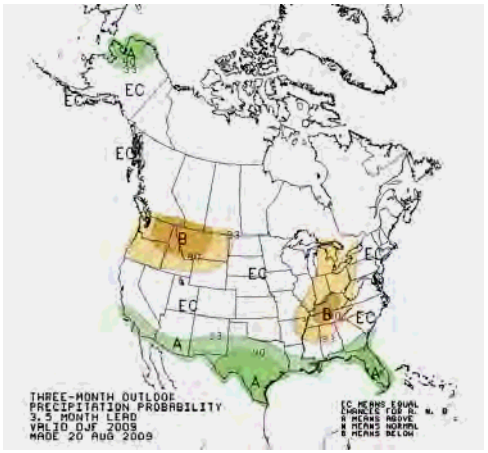
Give Our Georgia Friends a Drink Day

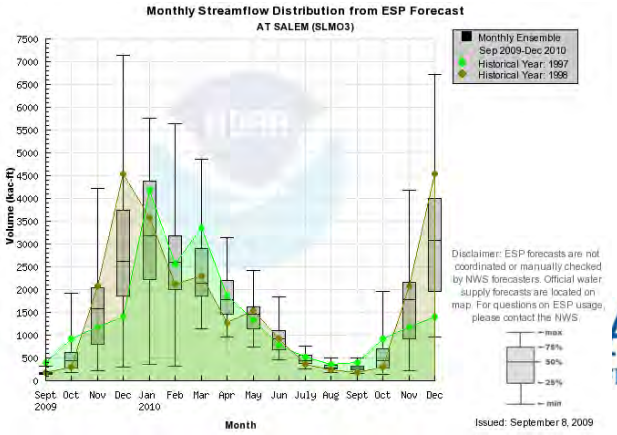
Florida Climate In nsortium

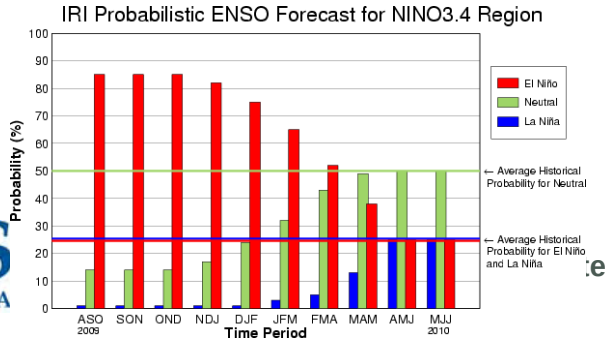
Issues in the Application of Climate Science for Decisions

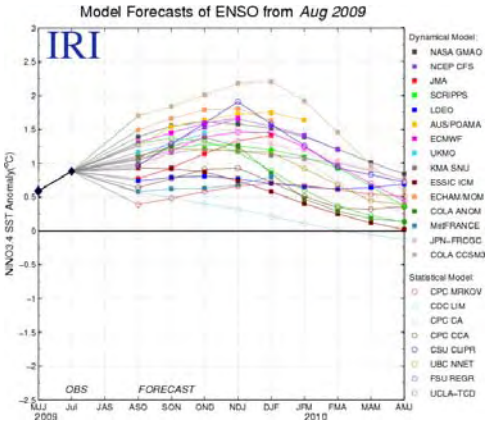


1. Mismatches of scales
2. Awareness and easy access
3. Misinterpretations
4. Perceptions of poor skill
5. Institutional conservatism
6. Regulatory constraints

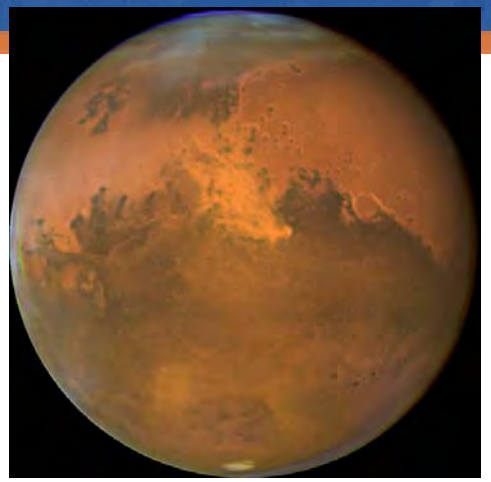








Hydrologists are from Venus and Climatologists are from Mars



Hydrologists

Watershed to Local Scale

Deterministic Models

'High' Model Skill (R^2 ~ 0.9)

Climatologists

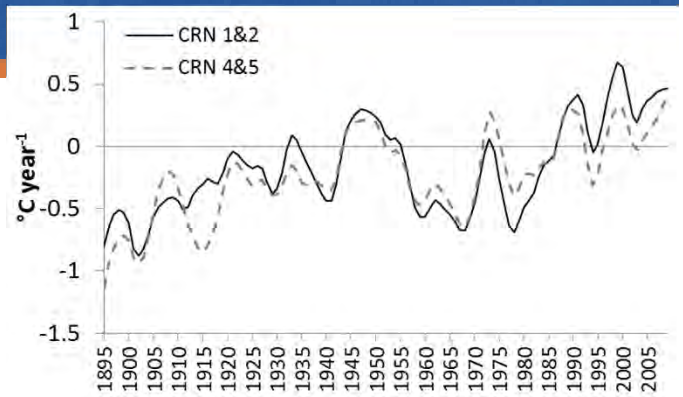
Continental to Global Scale

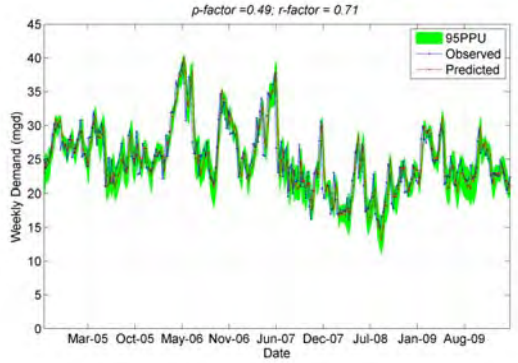
Probabilistic Models

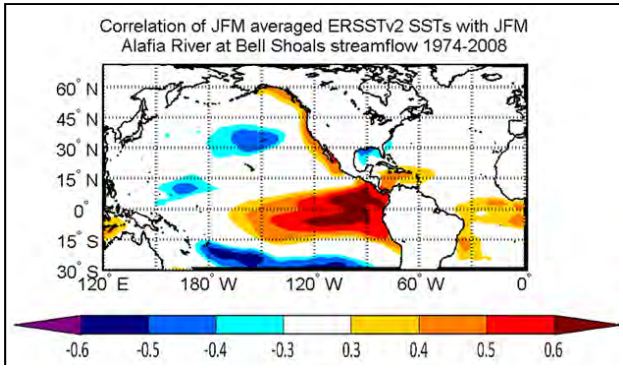
'Low' Model Skill (R^2 ~ 0.2?)

Products at Multiple Scales

- Historical Trends
  - Florida IS warming!
- Weekly Urban Demand Forecasts
  - Global Ensemble Forecast System (GEFS)
  - Reduced uncertainty
- Seasonal Streamflow Forecasts
  - El Niño/Southern Oscillation
  - Probability of Exceedance

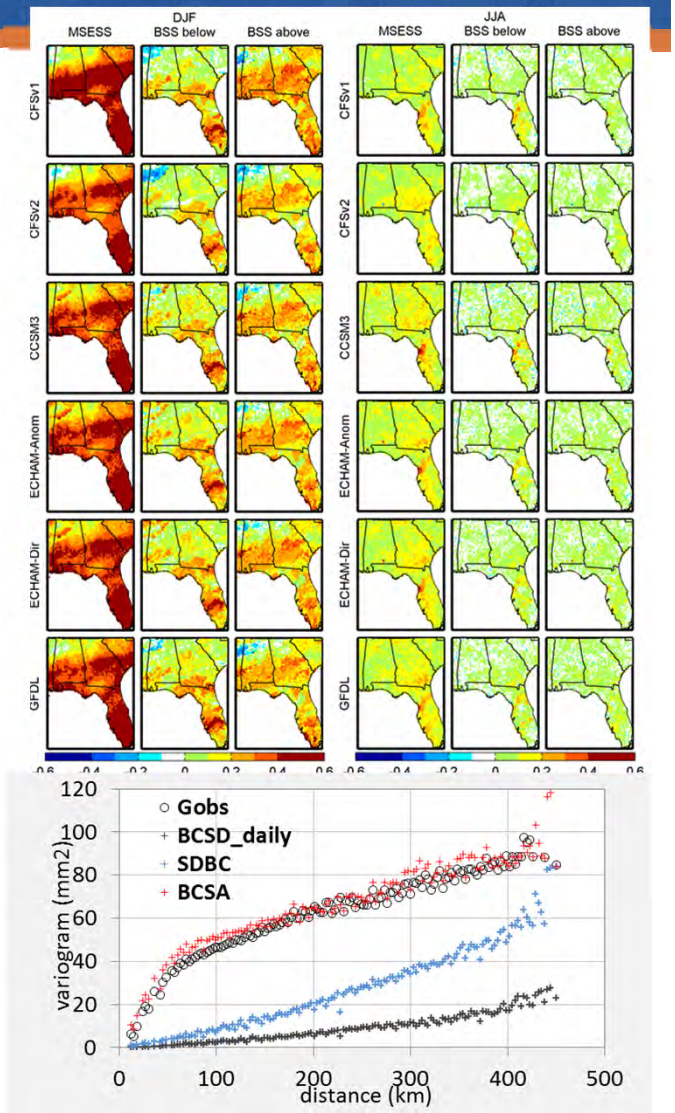






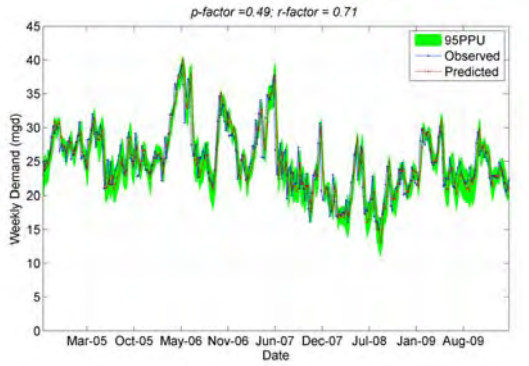
Products at Multiple Scales

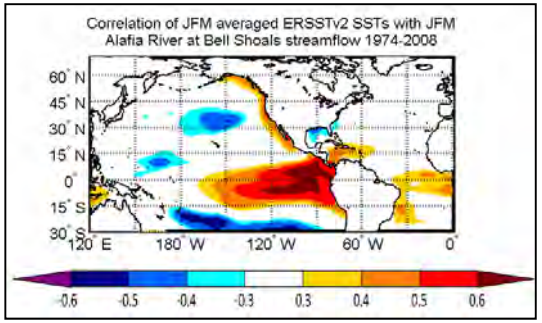
- Downscaled Seasonal Forecasts
  - North American Multi-Model Ensemble (NMME)
  - 6 GCMs
  - 12 km grid
- Downscaled Projections
  - CMIP3
  - CMIP5
  - Multiple GCMs and downscaling methods
  - Hydrologic applications

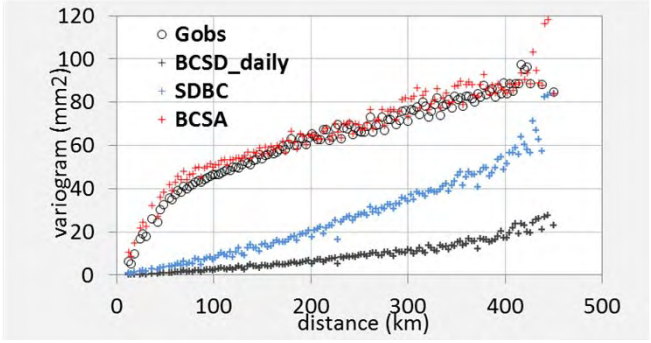


Products at Multiple Scales

- Weekly Urban Demand Forecasts
  - Global Ensemble Forecast System (GEFS)
  - Reduced uncertainty
- Seasonal Streamflow Forecasts
  - El Niño/Southern Oscillation
  - Probability of Exceedance
- Downscaling Future Climate
  - Multiple GCMs
  - Hydrologic Applications

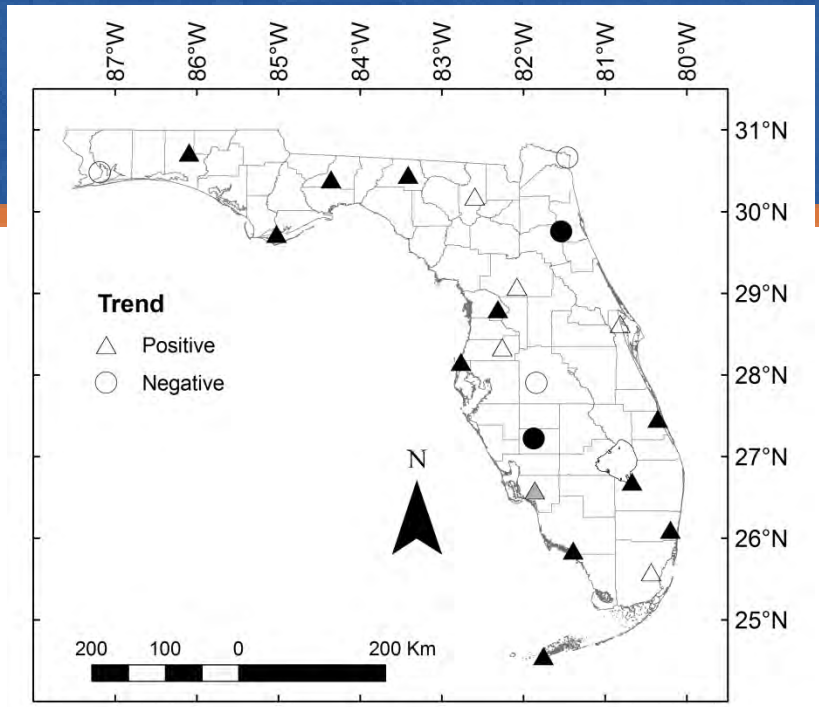


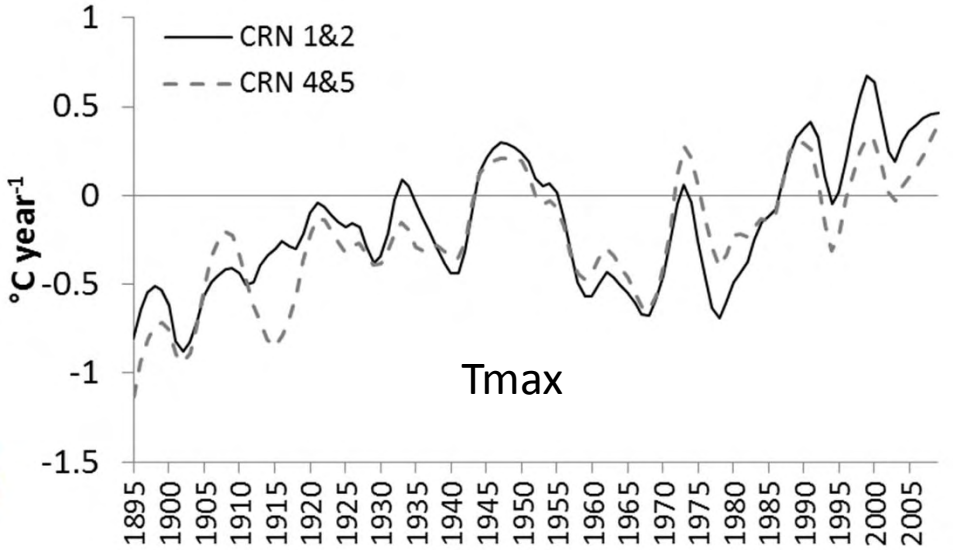




Historical Trends

- Negative trends in May rain (1970-2009)
- Trends in Mean, Max, Min monthly T
- T trends impacted by station siting quality and land use



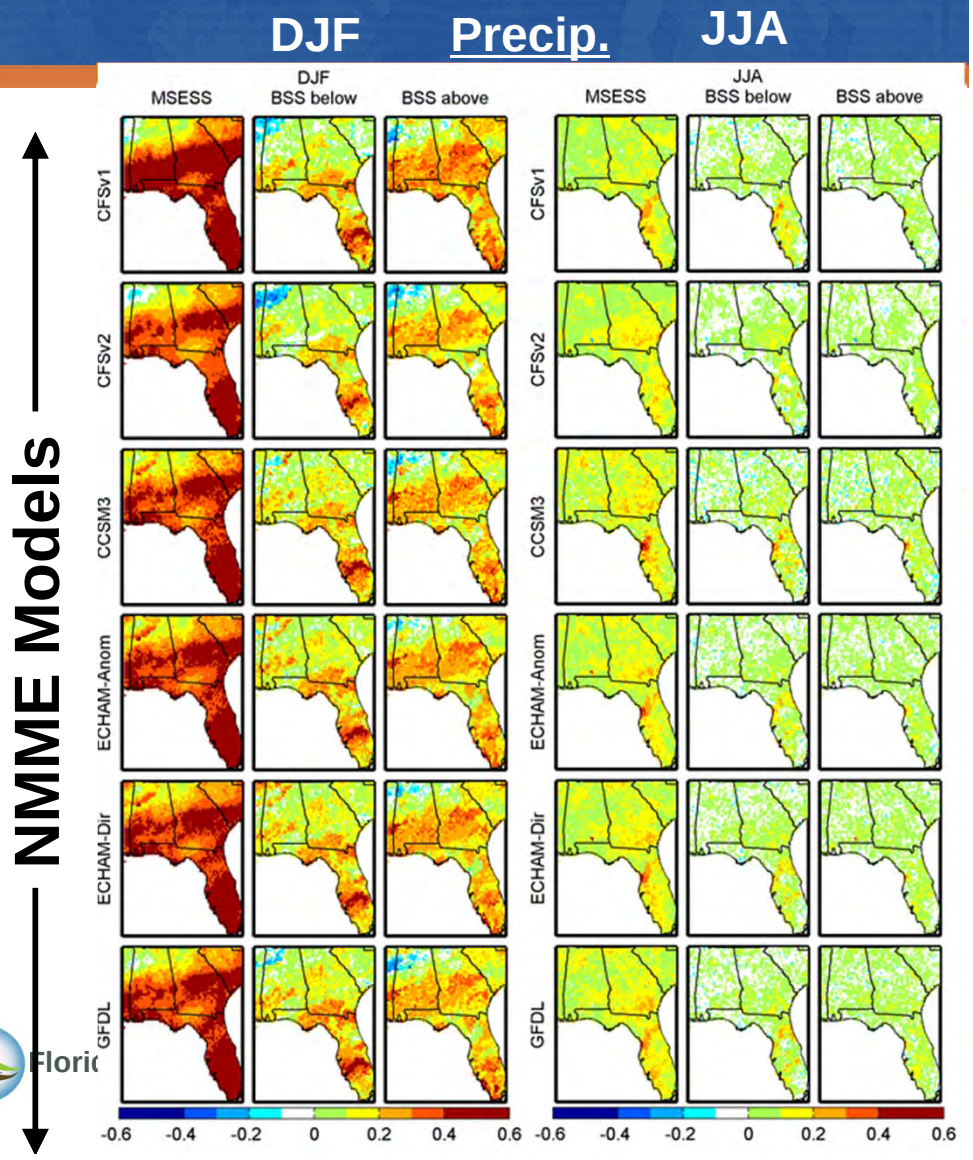


Florida Water & Climate Alliance

UF IFAS UNIVERSITY of FLORIDA

Seasonal Scale Forecasts using the North American Multi-Model Ensemble (NMME)

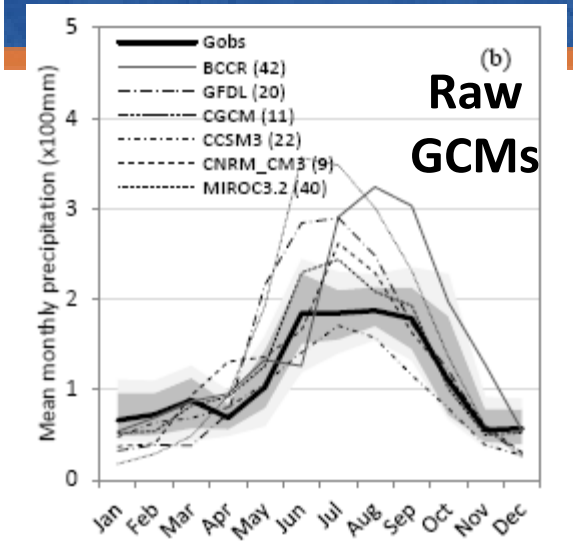
- 6 GCMs downscaled to 12 km
- Multiple downscaling methods

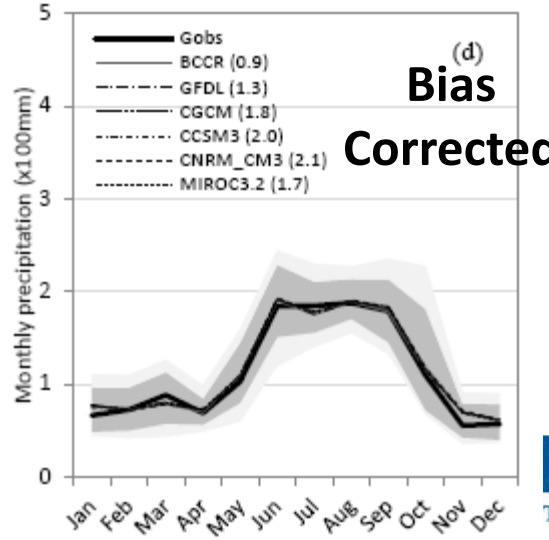


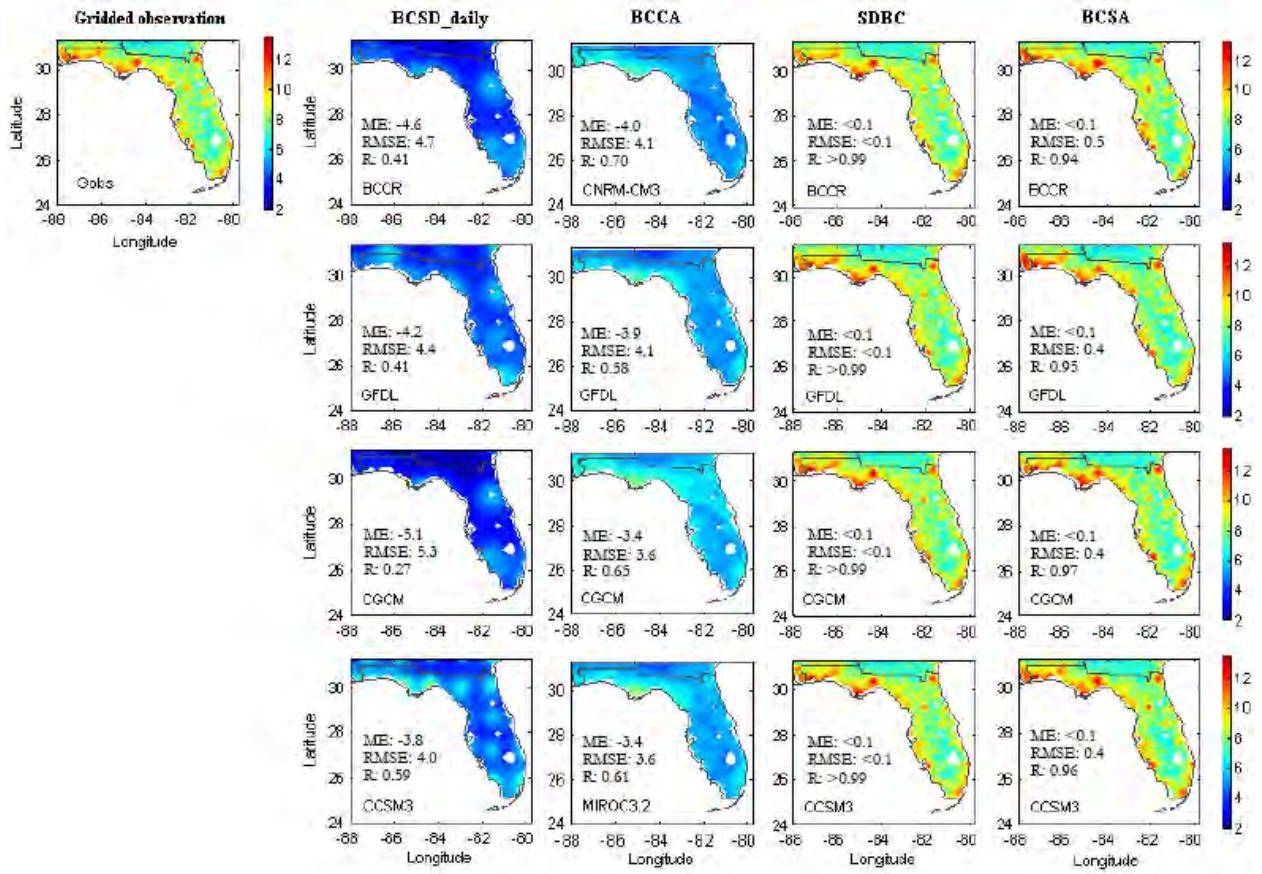
Florida Water & Climate Alliance

UF IFAS UNIVERSITY of FLORIDA

Downscaled and Bias-Corrected Climate Change Projections







IFAS
TY of FLORIDA

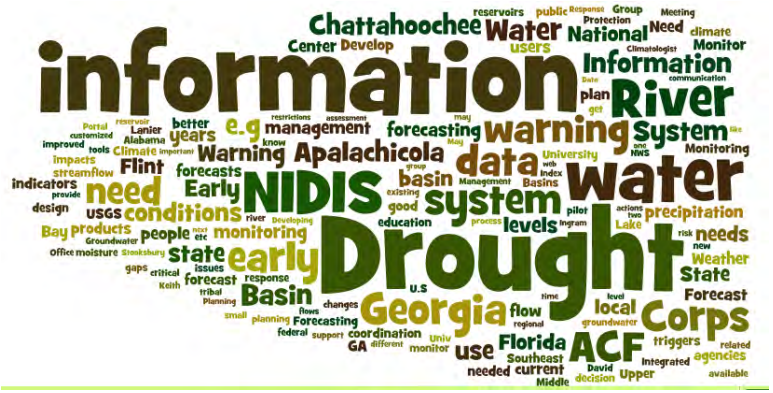
But do they capture the day to day variability needed for hydrological modeling??

What do stakeholders think about?

Florida WCA

www.FloridaWCA.org

NIDIS in the ACF



www.Drought.gov

(Created using wordle.net)

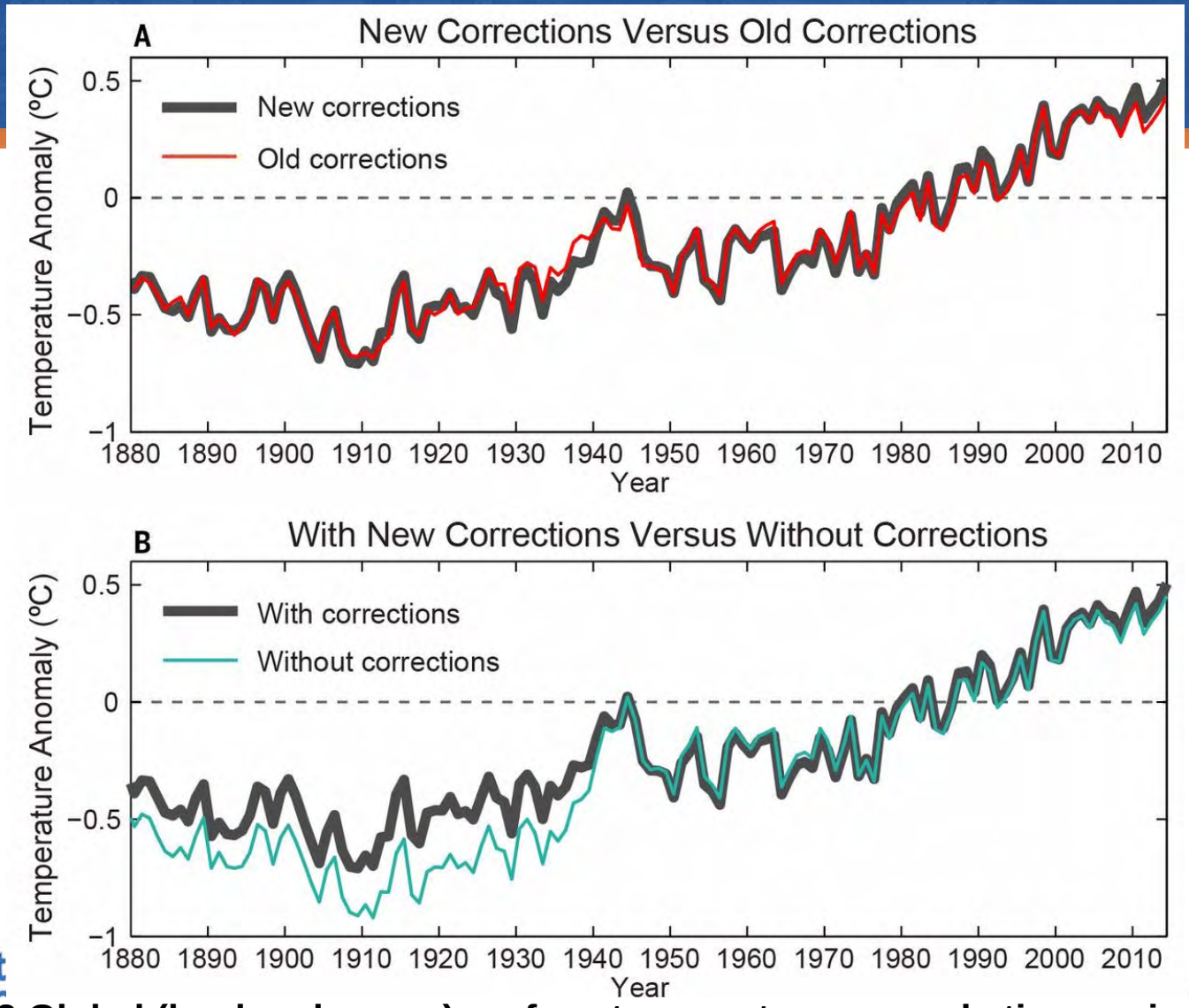
Florida Water & Climate Alliance

UF IFAS UNIVERSITY of FLORIDA

Florida Climate Institute

Southeast Climate Consortium

Global Temperature Rise Hiatus?

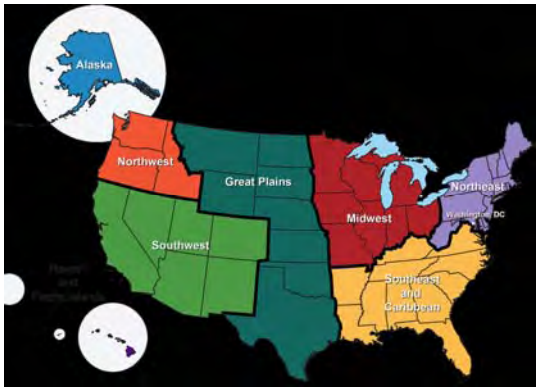


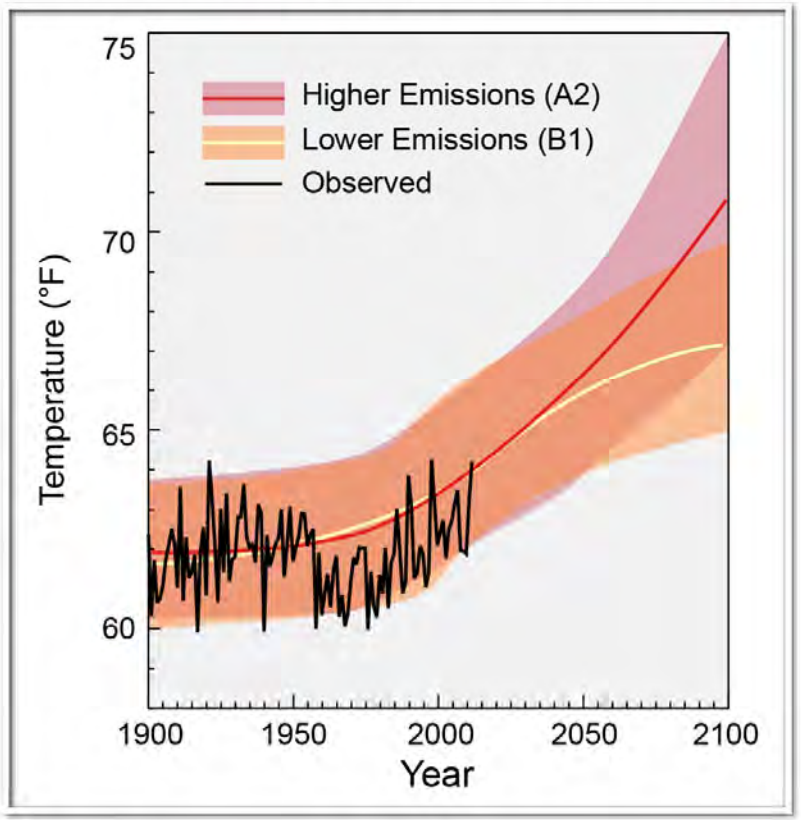
Karl et al.
2015 Science

Science
AAAS

Fig. 2 Global (land and ocean) surface temperature anomaly time series with new analysis, old analysis, and with and without time-dependent bias corrections.

Southeast Temperature





Carter et al. 2014. Ch. 17: Southeast and the Caribbean. Climate Change Impacts in the United States: The Third National Climate Assessment. USGCRP. Figure 17-3. (Figure adapted from Kunkel et al. 2013)

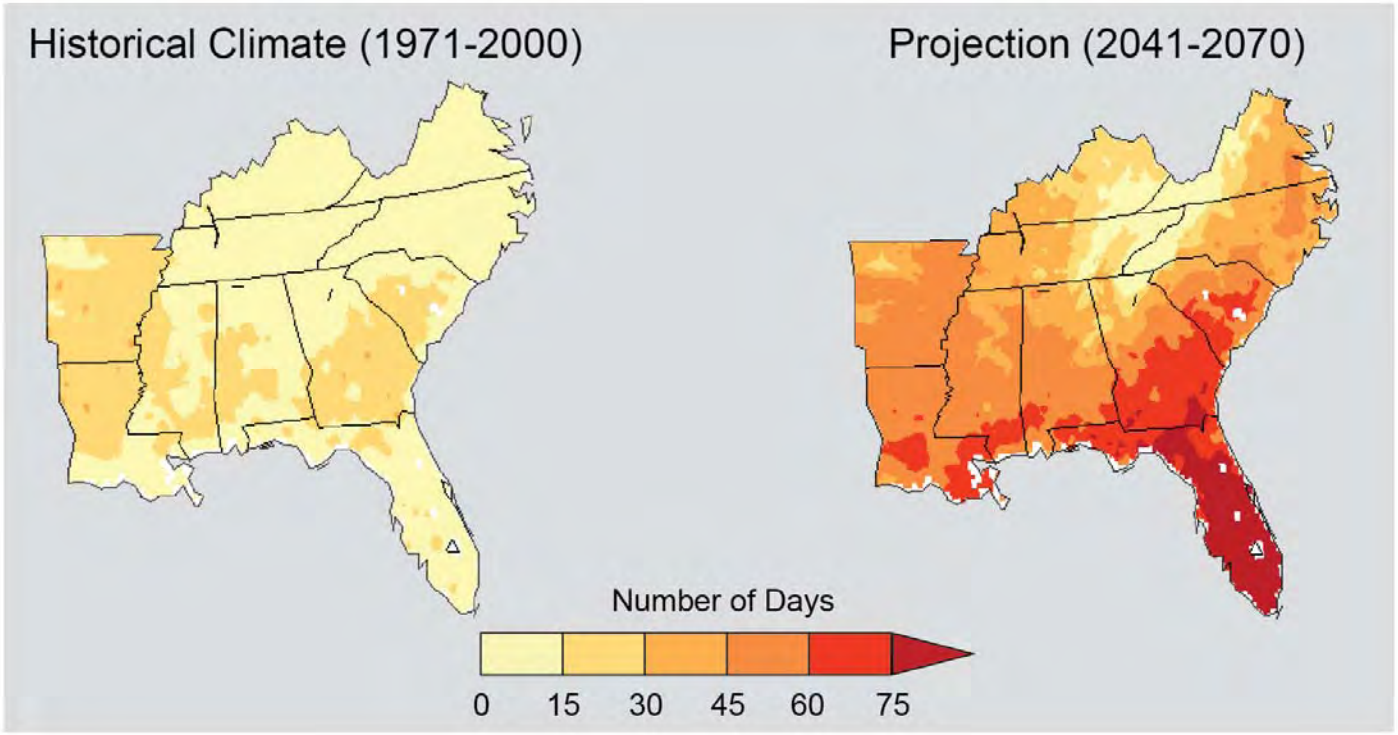
Florida Water & Climate Alliance

UF IFAS UNIVERSITY of FLORIDA

Florida Climate Institute

Southeast Climate Consortium

Projected Change in Number of Days Over 95° F (2041-2070)



Carter et al. 2014. Ch. 17: Southeast and the Caribbean. Climate Change Impacts in the United States: The Third National Climate Assessment. USGCRP. Figure 17-4. (Figure source: NOAA NCDC / CICS-NC)

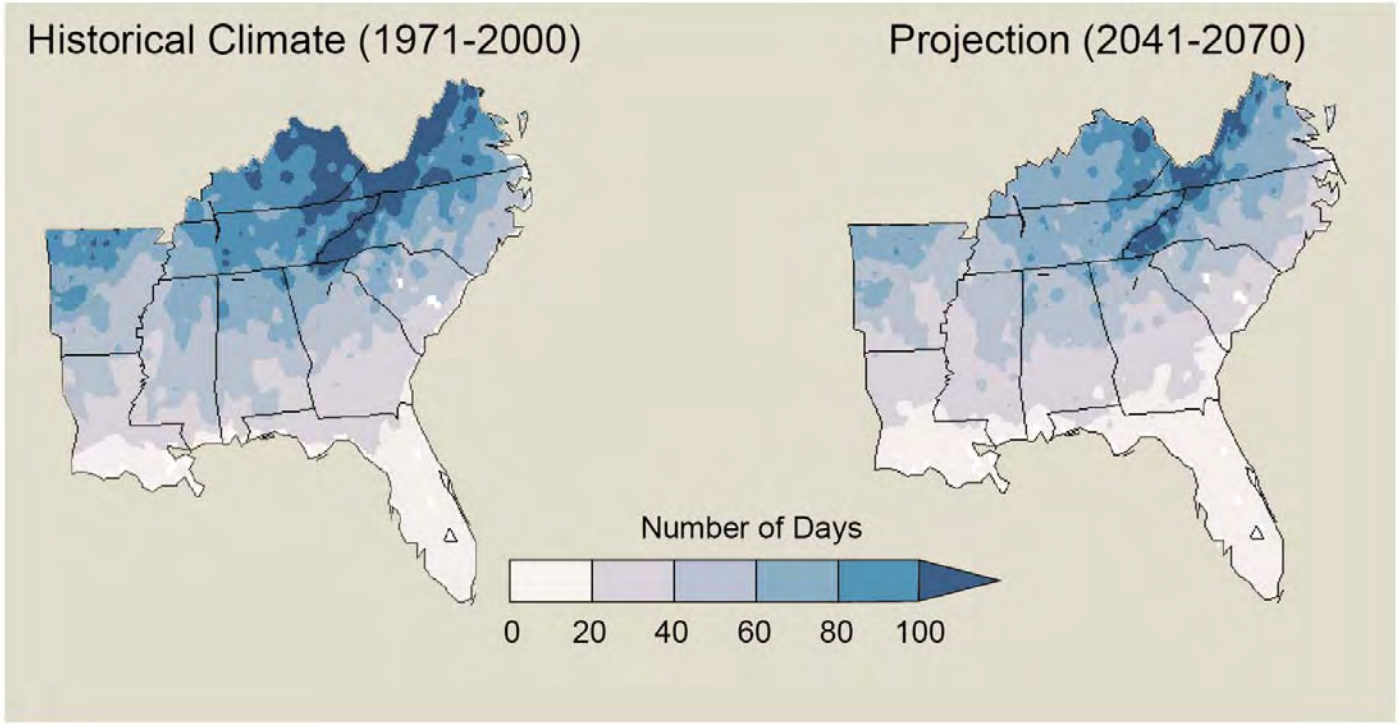
Florida Water & Climate Alliance

UF IFAS UNIVERSITY of FLORIDA

Florida Climate Institute

Southeast Climate Consortium

Projected Change in Number of Nights below 32° F (2041-2070)



Carter et al. 2014. Ch. 17: Southeast and the Caribbean. Climate Change Impacts in the United States: The Third National Climate Assessment. USGCRP. Figure 17-5. (Figure source: NOAA NCDC / CICS-NC)

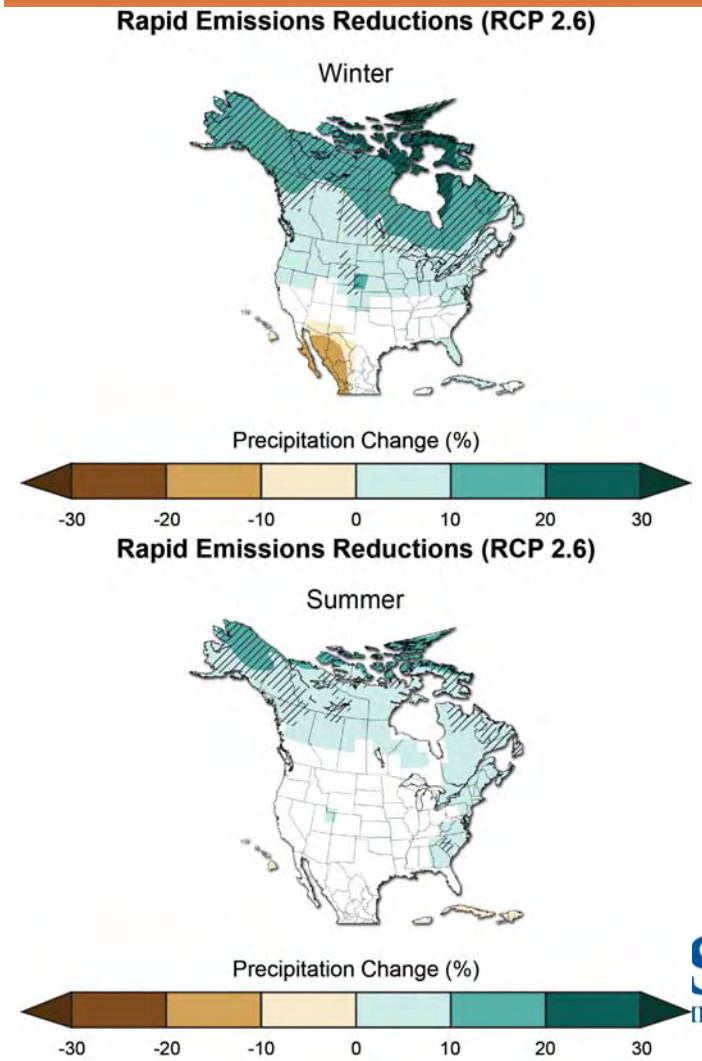
Florida Water & Climate Alliance

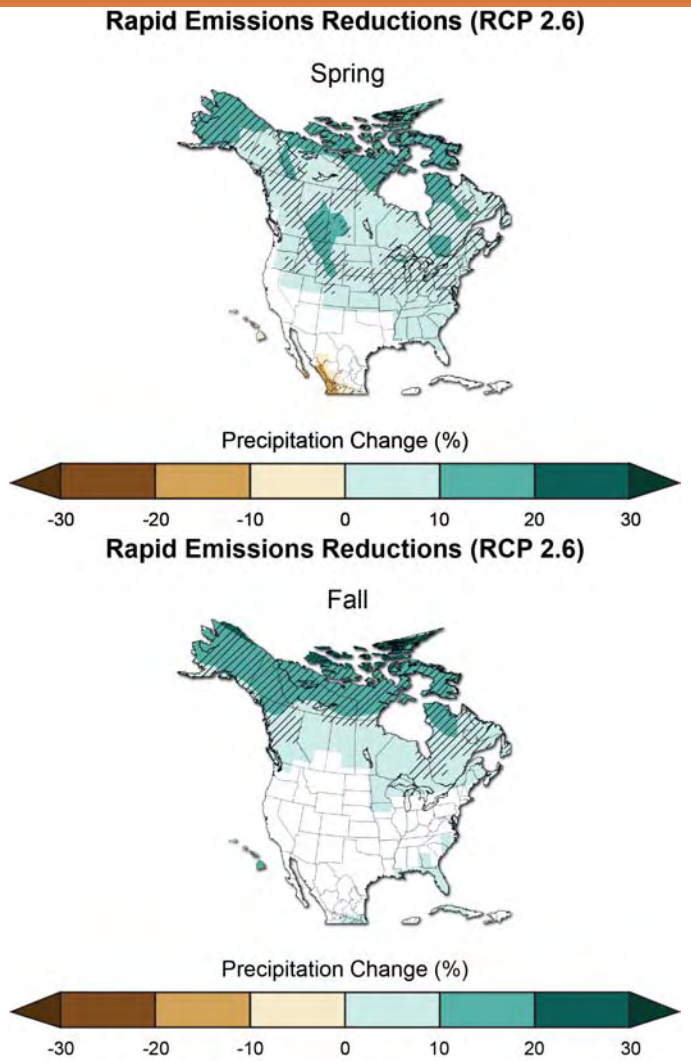
UF IFAS UNIVERSITY of FLORIDA

Florida Climate Institute

Southeast Climate Consortium

Seasonal precipitation 2071-2099 vs 1970-1999 (Rapid Emission Reductions)





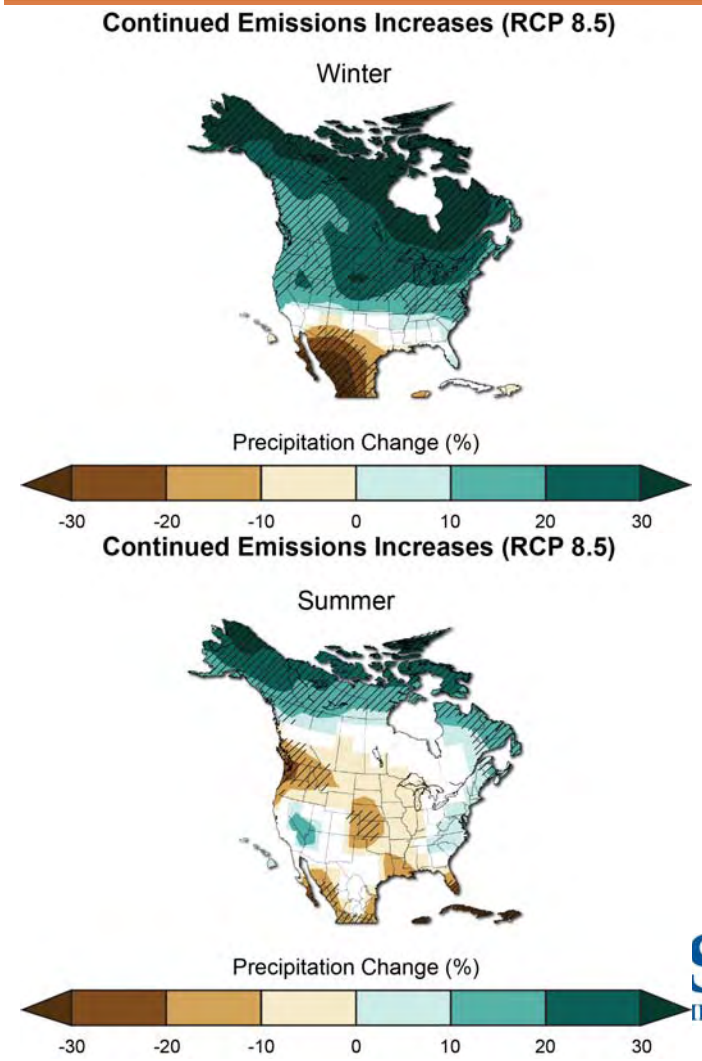
Walsh et al. 2014. Ch. 2: Our Changing Climate. Climate Change Impacts in the United States: The Third National Climate Assessment. USGCRP. Figure 2-15. (Figure source: NOAA NCDC / CICS-NC)

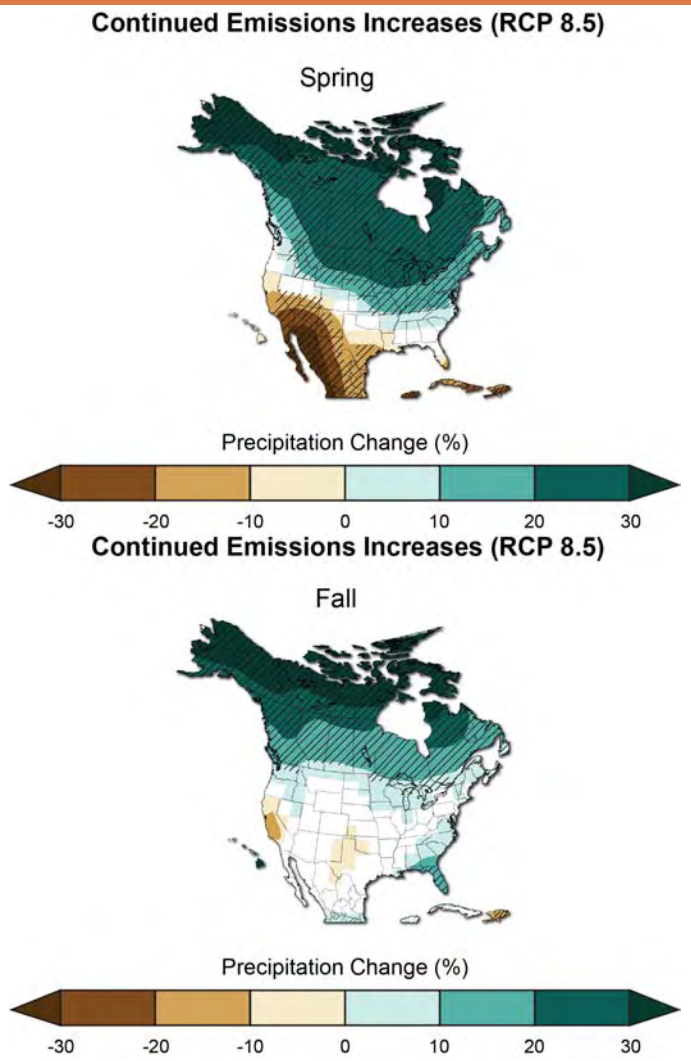
Hatched areas show significant and consistent changes among models

SIDA

Southeast Climate Consortium

Seasonal precipitation 2071-2099 vs 1970-1999 (Continued Emission Increases)





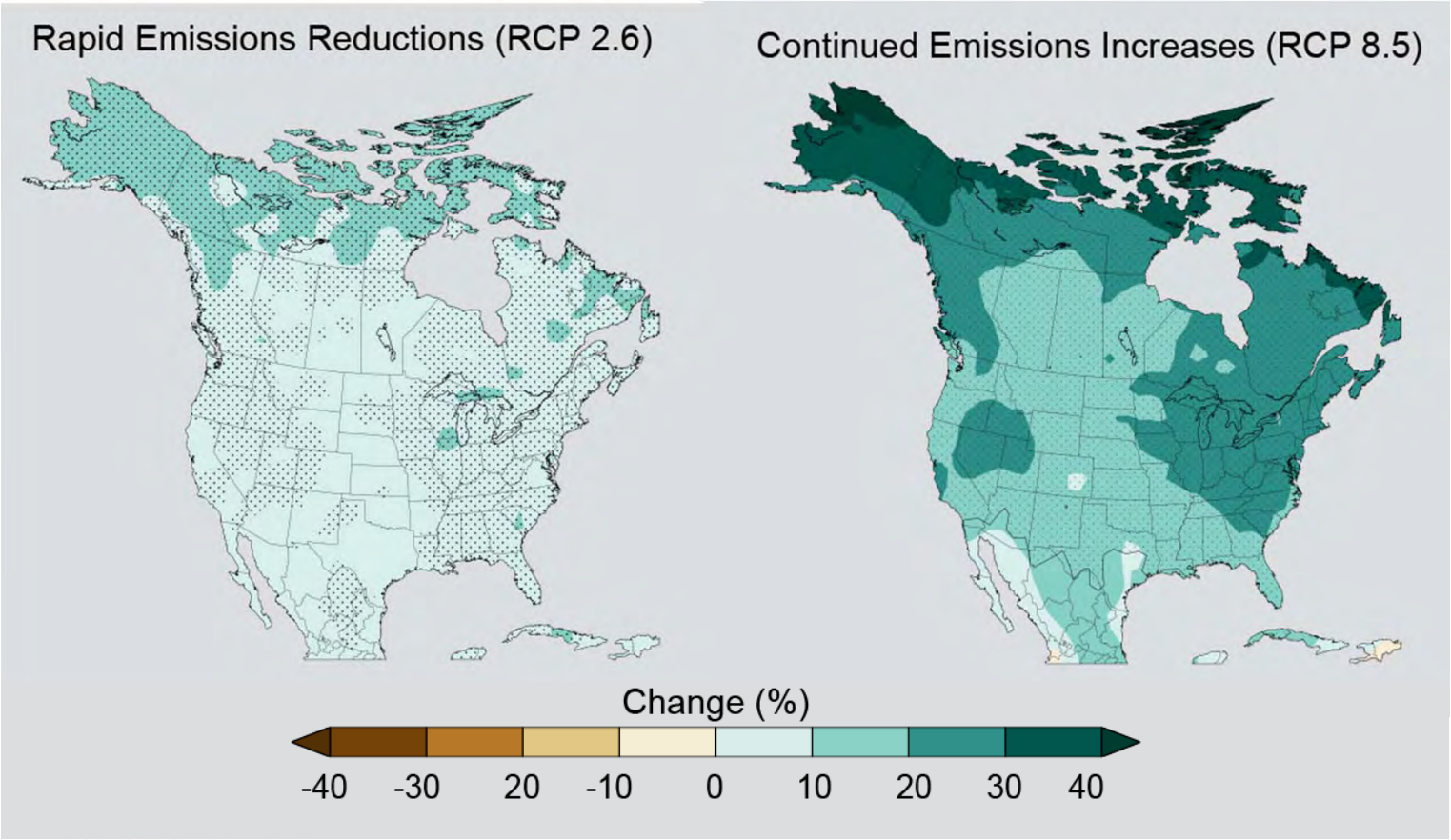
Walsh et al. 2014. Ch. 2: Our Changing Climate. Climate Change Impacts in the United States: The Third National Climate Assessment. USGCRP. Figure 2-15. (Figure source: NOAA NCDC / CICS-NC)

Hatched areas show significant and consistent changes among models

SIDA

Southeast Climate Consortium

Annual Maximum Daily Precipitation 2070-2099 compared to 1971-2000



Walsh et al. 2014. Ch. 2: Our Changing Climate. Climate Change Impacts in the United States: The Third National Climate Assessment. USGCRP. Figure 2-13. (Figure source: NOAA NCDC / CICS-NC)

Stippling shows where at least 80% of models agree

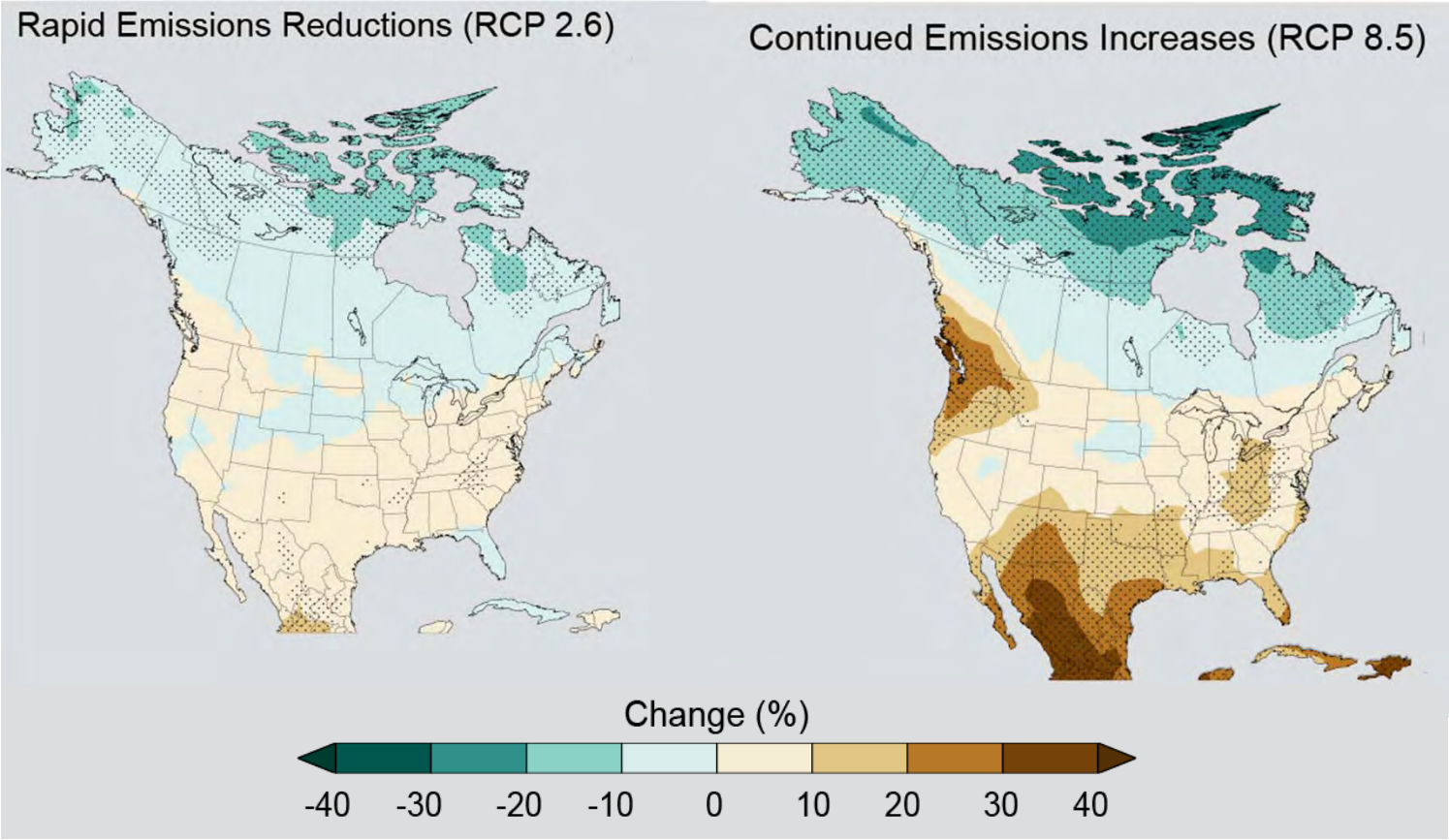
Florida Water & Climate Alliance

UF IFAS UNIVERSITY of FLORIDA

Florida Climate Institute

Southeast Climate Consortium

Number of Consecutive Dry Days 2070-2099 compared to 1971-2000



Walsh et al. 2014. Ch. 2: Our Changing Climate. Climate Change Impacts in the United States: The Third National Climate Assessment. USGCRP. Figure 2-13. (Figure source: NOAA NCDC / CICS-NC)

Stippling shows where at least 80% of models agree

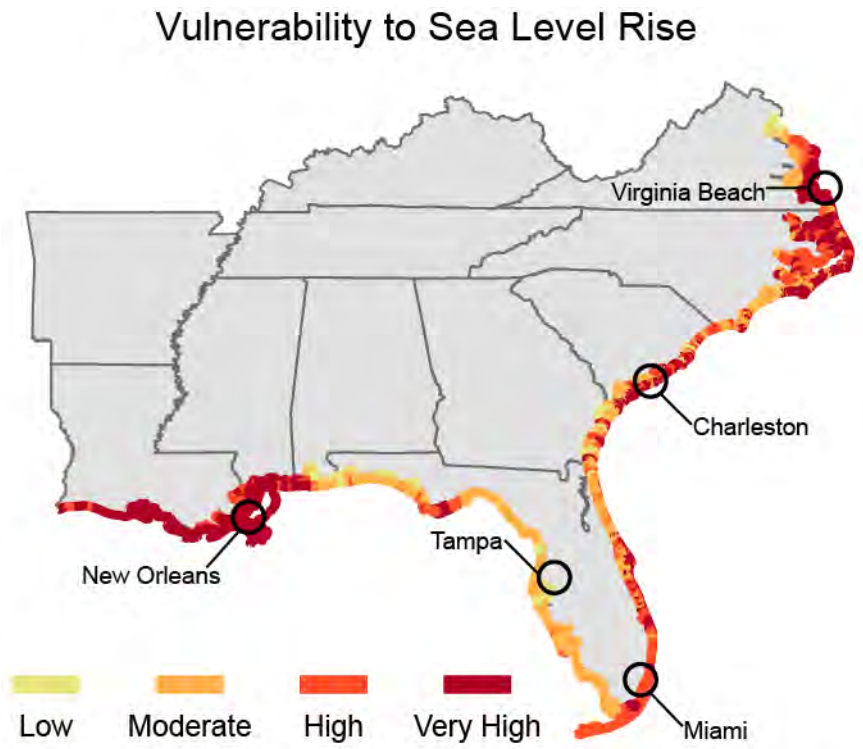
Florida Water & Climate Alliance

UF IFAS UNIVERSITY of FLORIDA

Florida Climate Institute

Southeast Climate Consortium

Vulnerability to Sea Level Rise



Carter et al. 2014. Ch. 17: Southeast and the Caribbean. Climate Change Impacts in the United States: The Third National Climate Assessment. USGCRP. Figure 17-6. (Data from Hammar-Klose and Thieler 2001)

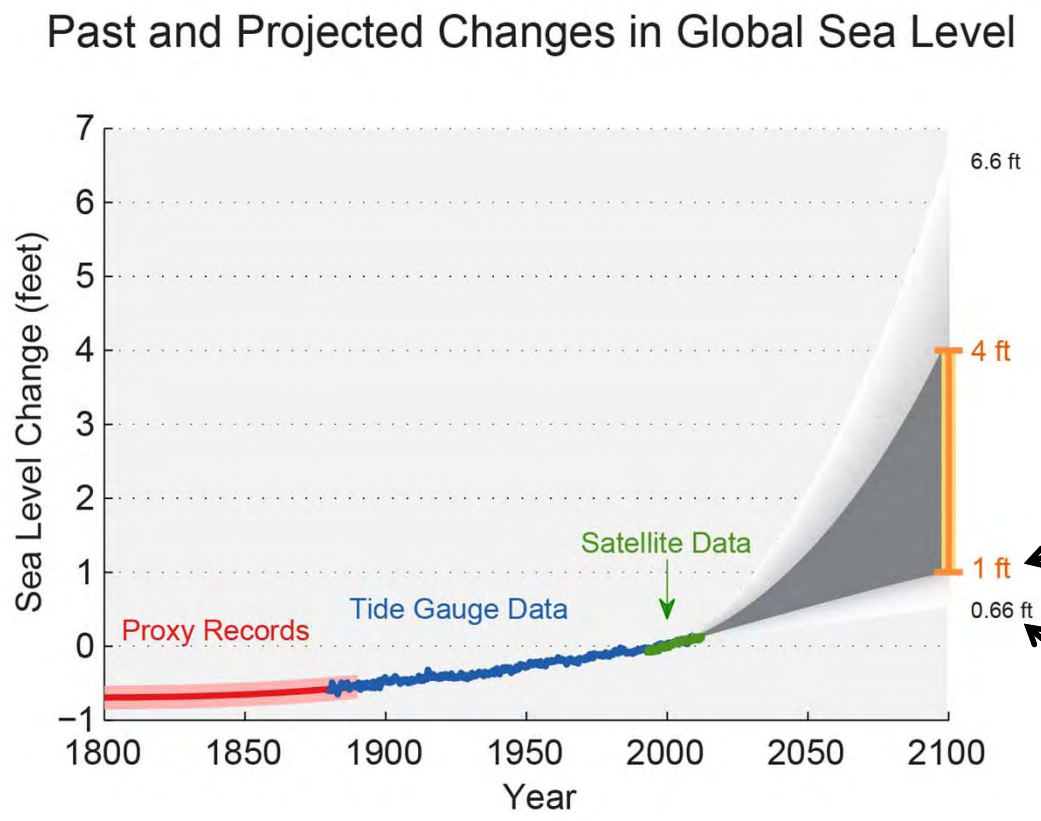
Florida Water & Climate Alliance

UF IFAS UNIVERSITY of FLORIDA

Florida Climate Institute

Southeast Climate Consortium

Projected Sea Level Rise



Walsh et al. 2014. Ch. 2: Our Changing Climate. Climate Change Impacts in the United States: The Third National Climate Assessment. USGCRP. Figure 2-26. ((Figure source: Adapted from Parris et al. 2012 with contributions from NASA Jet Propulsion Laboratory)

No contribution from Greenland or Antarctica

Extrapolation of historical

Florida Water & Climate Alliance

UF IFAS UNIVERSITY of FLORIDA

Florida Climate Institute

Southeast Climate Consortium

Tropical Storms

- No clear trend in occurrence
- Increase in strongest hurricanes – category 4 & 5

Florida Water & Climate Alliance

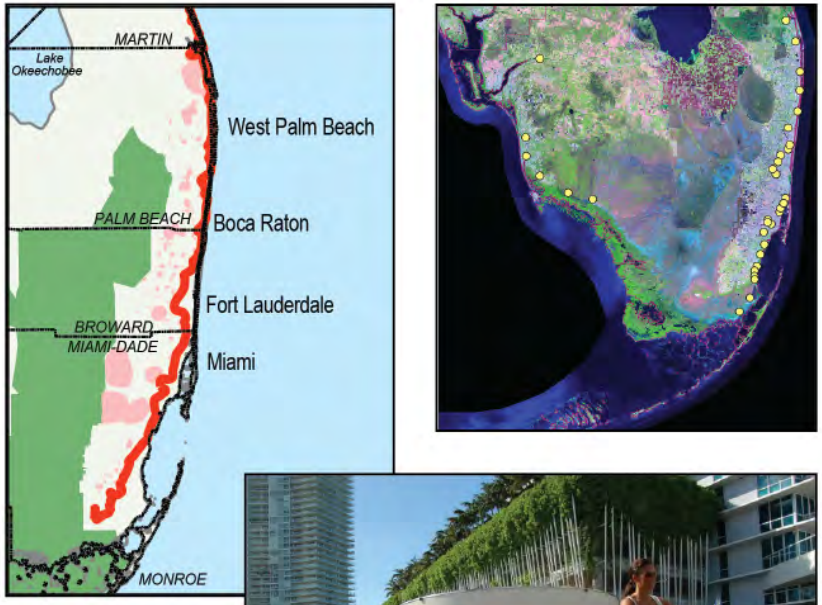
UF IFAS UNIVERSITY of FLORIDA

Florida Climate Institute

Southeast Climate Consortium

South Florida

South Florida: Uniquely Vulnerable to Sea Level Rise



Carter et al. 2014. Ch. 17: Southeast and the Caribbean. Climate Change Impacts in the United States: The Third National Climate Assessment. USGCRP. Figure 17-8. (Maps: SFWMD, Photo: Luis Espinoza)

Well field protection – Pink
Salt/Fresh water Interface – Red
Coastal Water Control Structures - Yellow

FLORIDA Alliance

UNIVERSITY of FLORIDA

da Climate Institute

Southeast Climate Consortium

Questions?

chrisjm@ufl.edu

http://FloridaWCA.org

Florida Water & Climate Alliance

UF IFAS UNIVERSITY of FLORIDA

Florida Climate Institute

Southeast Climate Consortium