

Drought Indicators and NIDIS Early Warning

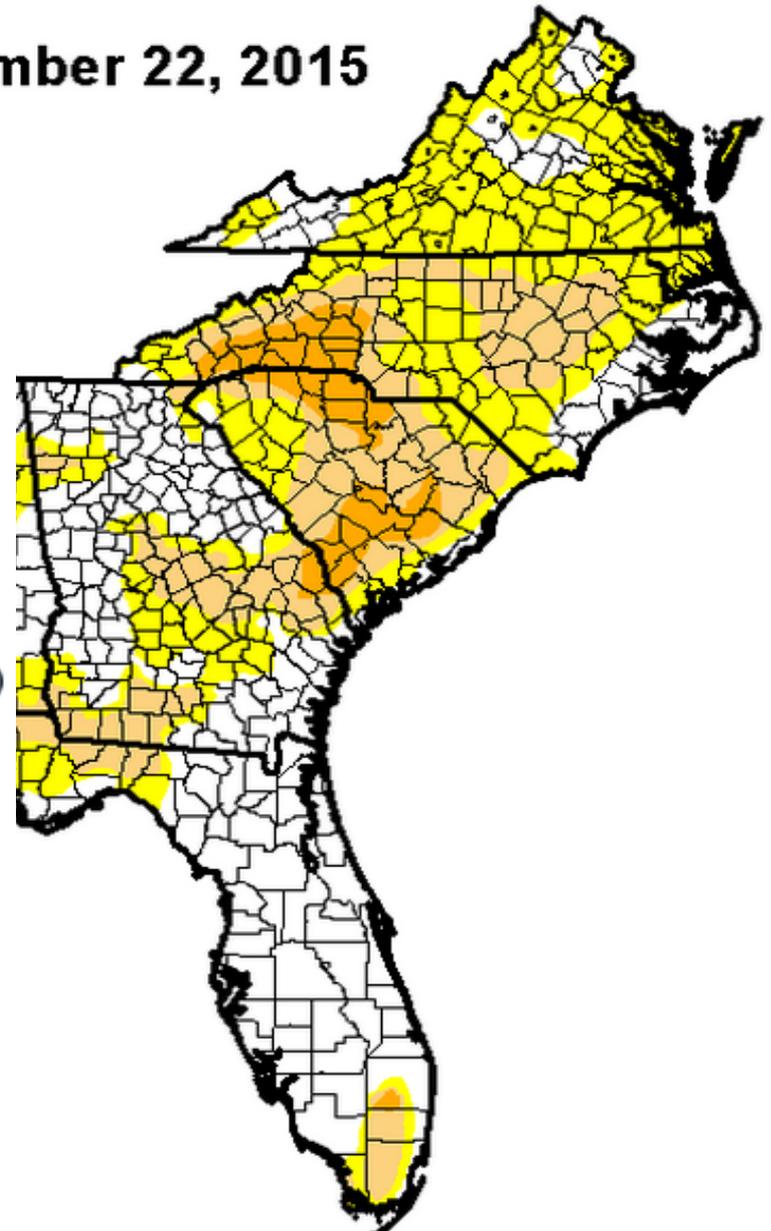
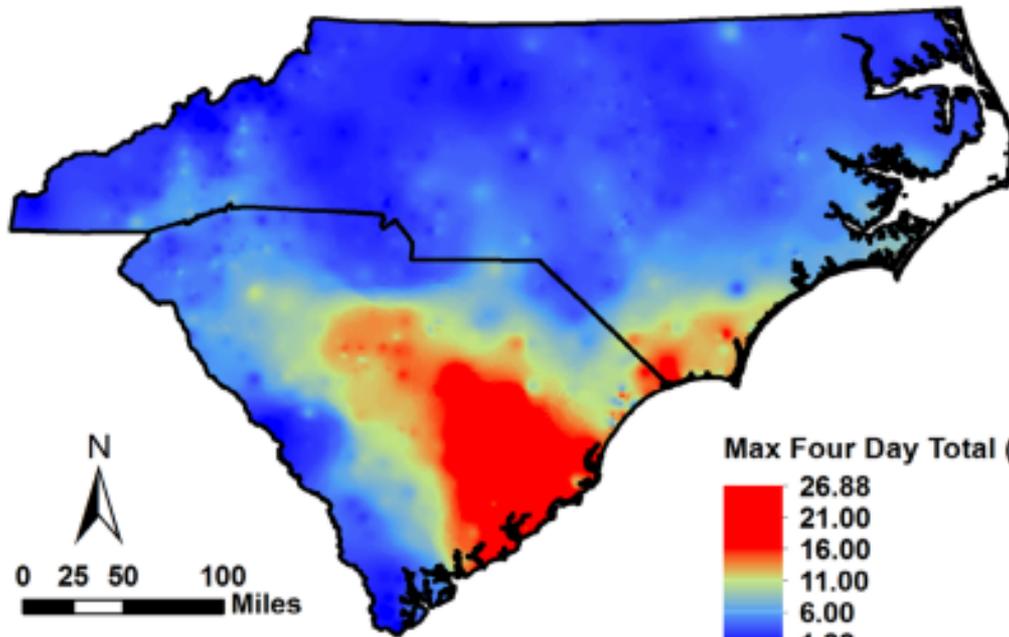
Paul Conrads

USGS – South Atlantic Water Science Center

October 20, 2015

September 22, 2015

4-Day rainfall October 2-5, 2014



Map by Gao Peng, CISA

Hydrologic extremes –two weeks

USGS H. Joaquin/Flood Response

- **235 Flow measurements**
- **Over 590 High-water elevation measurements**
- **17 Real-time rapid deployment gages deployed**
- **29 Storm-tide sensor deployed**
- **14 wave sensors deployed**

USGS Flood Event View

The screenshot displays the USGS Flood Event Viewer interface. The browser address bar shows the URL `stn.wim.usgs.gov/Joaquin/`. The page title is "Appalachian Floods and Hurricane Joaquin Data Viewer". The USGS logo is visible in the top left corner.

The interface includes a sidebar on the left with the following sections:

- Basemaps (dropdown arrow)
- Map Layers (dropdown arrow)
- Event Data
 - NOAA Tropical Cyclone Tra
 - Barometric
 - Meteorological
 - Rapid Deploy Gage
 - Storm Tide
 - Wave Height
 - High-water Marks
 - USGS real-time NWIS gages
 - NWS Doppler Radar

The main map area shows a geographic view of Richland County, SC, with several brown diamond markers indicating high-water marks. Labels on the map include "Irmo", "Seven Oaks", "St Andrews", "Lexington", "Springdale", "Cayce", and "Greensboro". A scale bar at the bottom left of the map shows coordinates `1:144,448` and `34.096 | -81.115`.

A data popup window titled "High-water Mark 11504" is overlaid on the right side of the map. It contains the following information:

Event:	Joaquin
Elevation(ft):	150.20000000000002
Waterbody:	Gills Creek
County:	Richland County
State:	SC
Latitude, Longitude (DD):	33.9832, -80.9752
HWM ID:	11504
STN Site Name:	SCRIC14796
Description:	good seed line on siding at stairs of apt 8 inside stairwell at N wall
Type:	Seed line
Full data link:	HWM 11504

<http://water.usgs.gov/floods/FEV/>

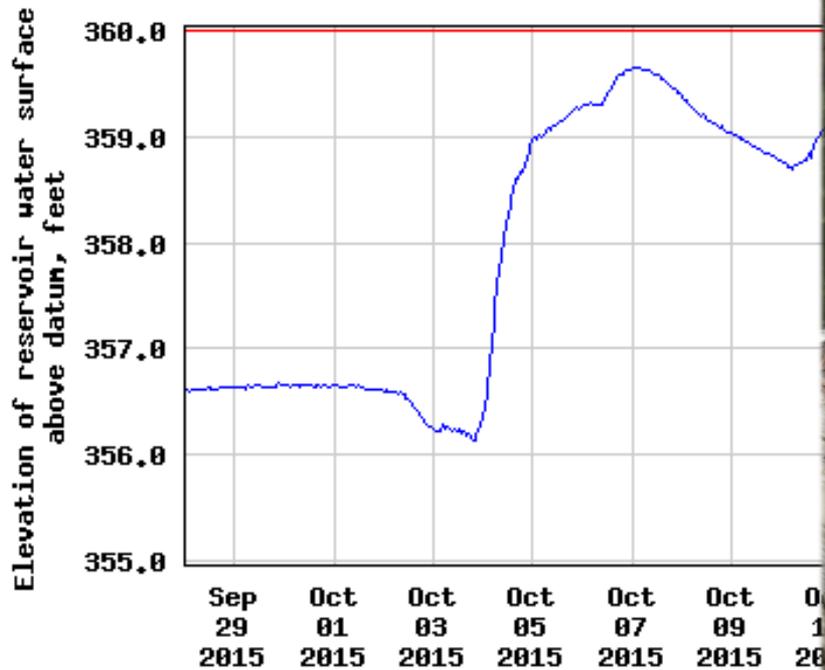
Preliminary Peak Stage and Streamflow Data at Selected USGS Streamgaging Stations for the South Carolina Flood of October 2015

- 86 real-time gages – computed annual peaks
 - 17 peaks of record
 - 8 with over twenty years of record
 - 15 with peaks on the top five
 - 13 with 20 years of record
 - Black River highest in 87 years (NWS highest since 1895)
 - Congaree Columbia peaked at 185,000 cfs
 - ranked 8 of 123
 - peak 364,000 in 1908
 - last exceeded 231,000 cfs in 1936.

Lake Murray



USGS 02168500 LAKE MURRAY NEAR



----- Provisional Data Subject

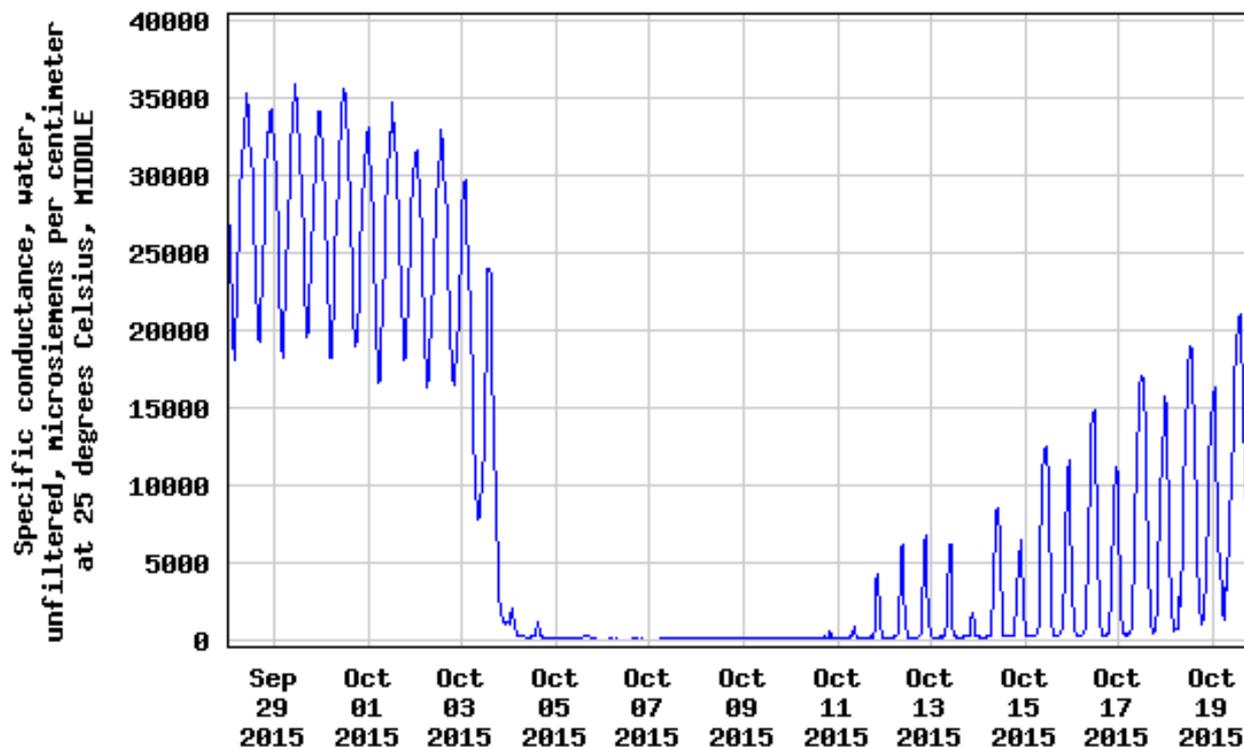
- Elevation of reservoir water
- Full pool elevation



Ashley River/Charleston Harbor



USGS 021720869 ASHLEY RIVER NEAR NORTH CHARLESTON, SC



----- Provisional Data Subject to Revision -----

- **Effects on:**
 - Tidal marsh**
 - Shellfisheries**
 - Vibrio pathogen transport**

Largest stressor:
—salinity



The Impact of Drought on Coastal Ecosystems in the Carolinas

Executive Summary January 2012

Steve Gilbert, US Fish & Wildlife Service and National Oceanic and Atmospheric Administration (retired)

Kirsten Lackstrom, University of South Carolina,
Department of Geography,
Carolinas Integrated Sciences & Assessments

Dan Tufford, Ph.D., University of South Carolina,
Department of Biological Sciences,
Carolinas Integrated Sciences & Assessments

cisa ■ ■ ■ ■ ■
carolinas integrated sciences & assessments

Standardized Precipitation Index (SPI)

- Similarity of SPI and cumulative Z-scores
- Normalize precipitation with probability distribution
- Index values are standard deviation from the median
- Index for dry and wet conditions
- SPIs comparable for different locations

Benefits for a Coastal Drought Index (CDI)

- Compute for multiple time periods
 - 1-month, 3-month, 6-months, etc.
 - Difference time periods used for different drought response variable
- Index for fresher and saltier conditions
- Real-time computation of SSI
- Challenges
 - Limited number of long-term sites
 - Missing record – estimating data gaps

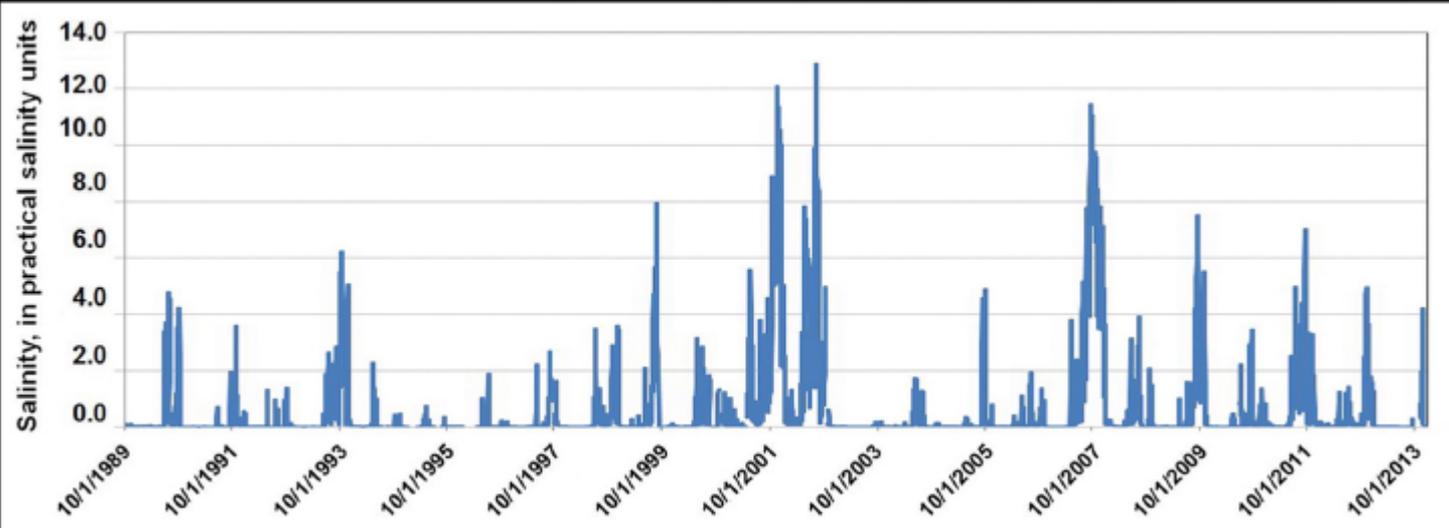


Figure 1. Daily salinity values for Waccamaw River at Hagley Landing, South Carolina.

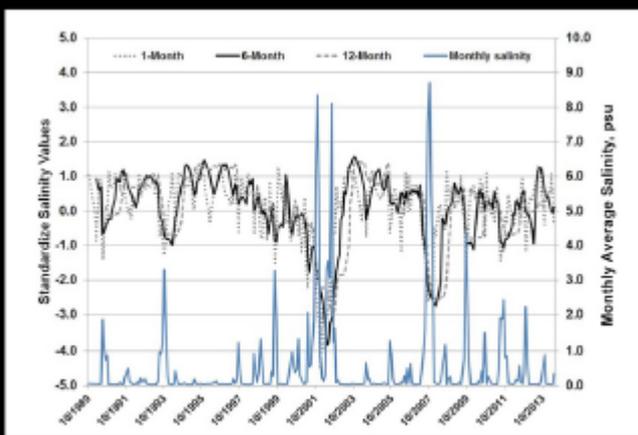


Figure 3. The 1-, 6-, and 12-month standardize salinity values for the Waccamaw River at Hagley Landing, South Carolina.

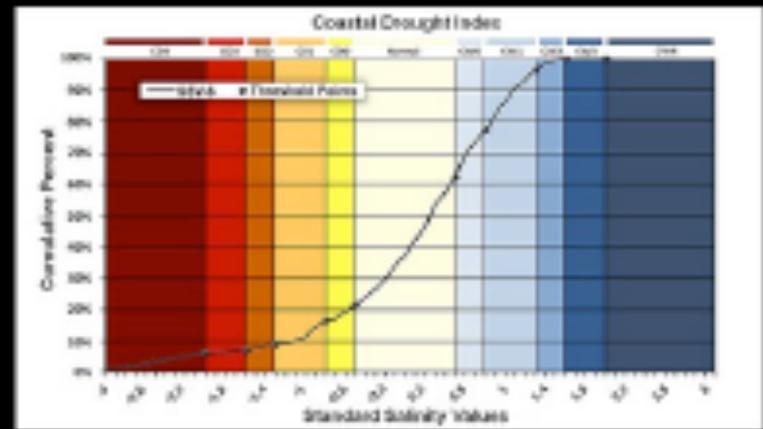
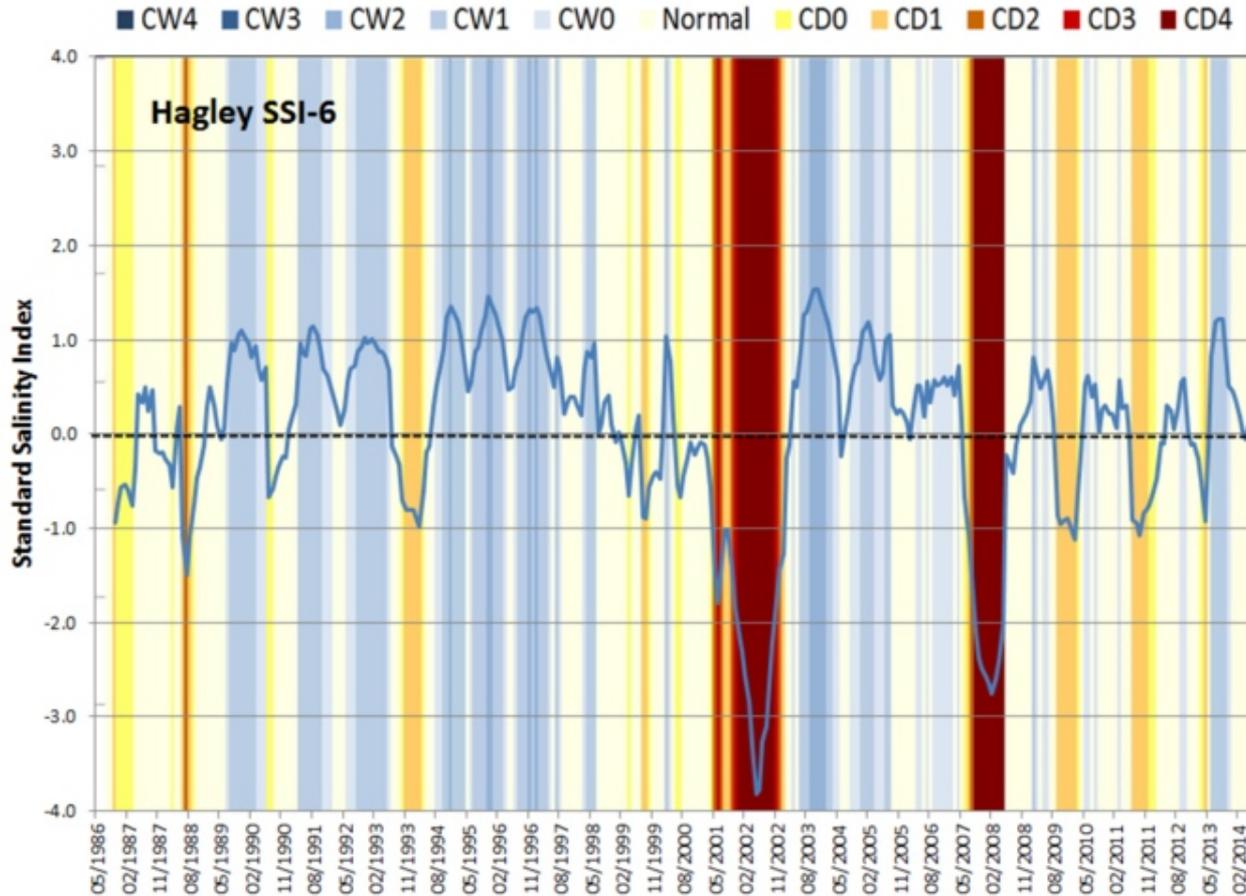


Figure 4. The cumulative frequency curve for the 6-month standardize salinity value (SSV) for the Waccamaw River at Hagley Landing, South Carolina (fig. 3).

Use for Drought and Wet declarations

Hagley Landing

Declaration	Description	SSI Threshold
W4	Exceptional wet	2
W3	Extreme Wet	1.6
W2	Severe Wet	1.3
W1	Moderate Wet	0.8
W0	Abnormally Wet	0.5
N0	Normal	0
D0	Abnormally Dry	-0.5
D1	Moderate Drought	-0.8
D2	Severe Drought	-1.3
D3	Extreme Drought	-1.6
D4	Exceptional Drought	-2

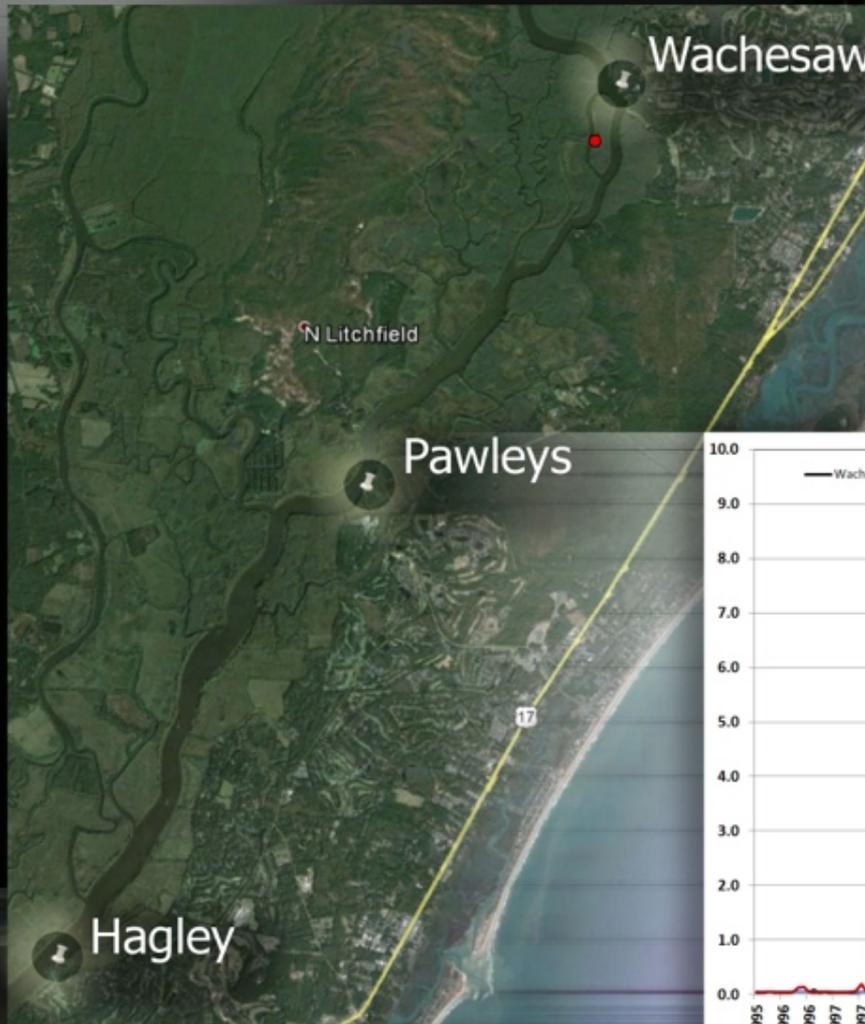


1996 - 2014

Other CDI issues

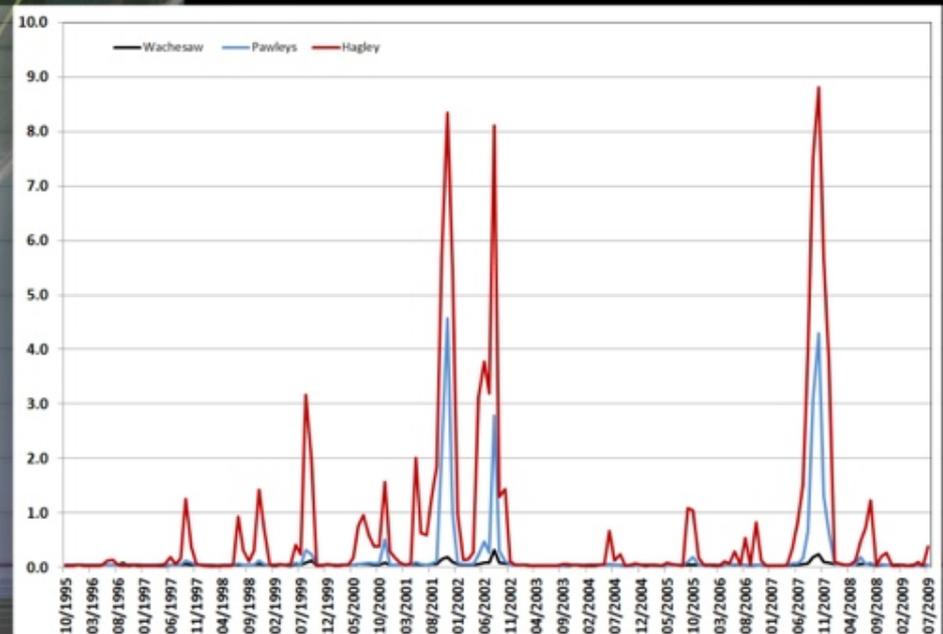
- Period of record
- Estuary types
- Regional comparisons

How do the SSIs from different sites on the same river look?

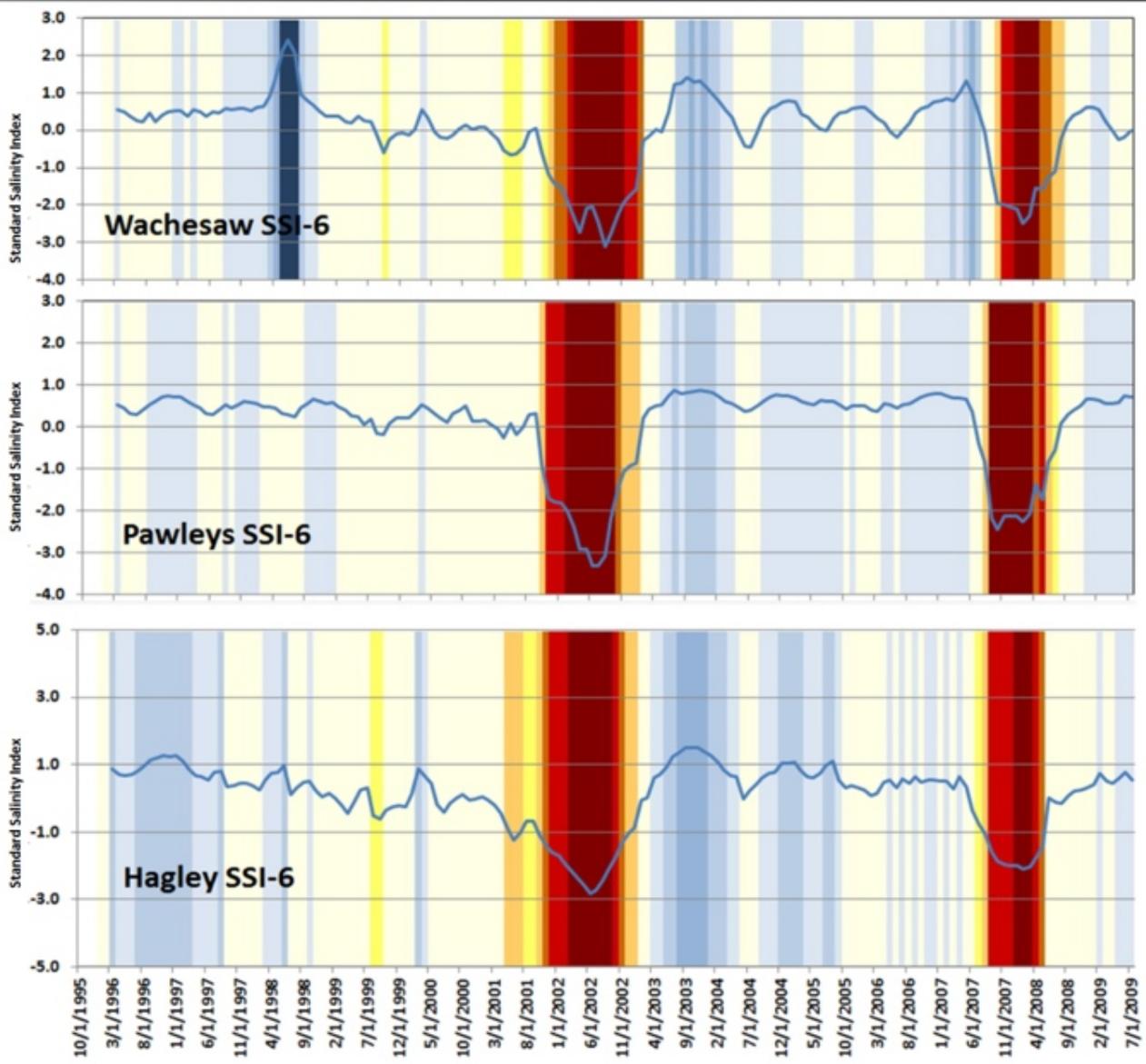


~14-years of measured and simulated data

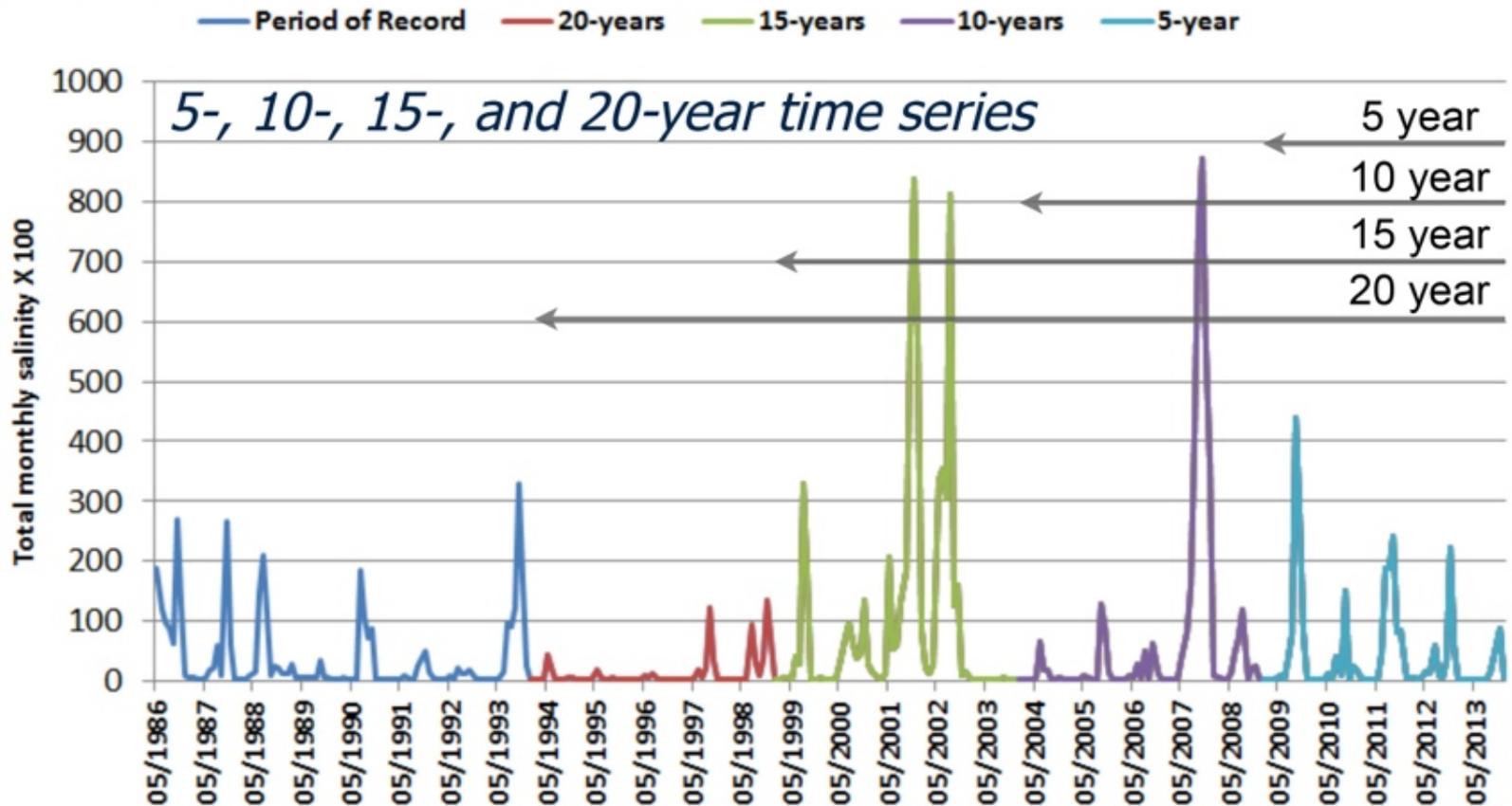
October 1995 – July 2014



CW4
 CW3
 CW2
 CW1
 CW0
 Normal
 CD0
 CD1
 CD2
 CD3
 CD4

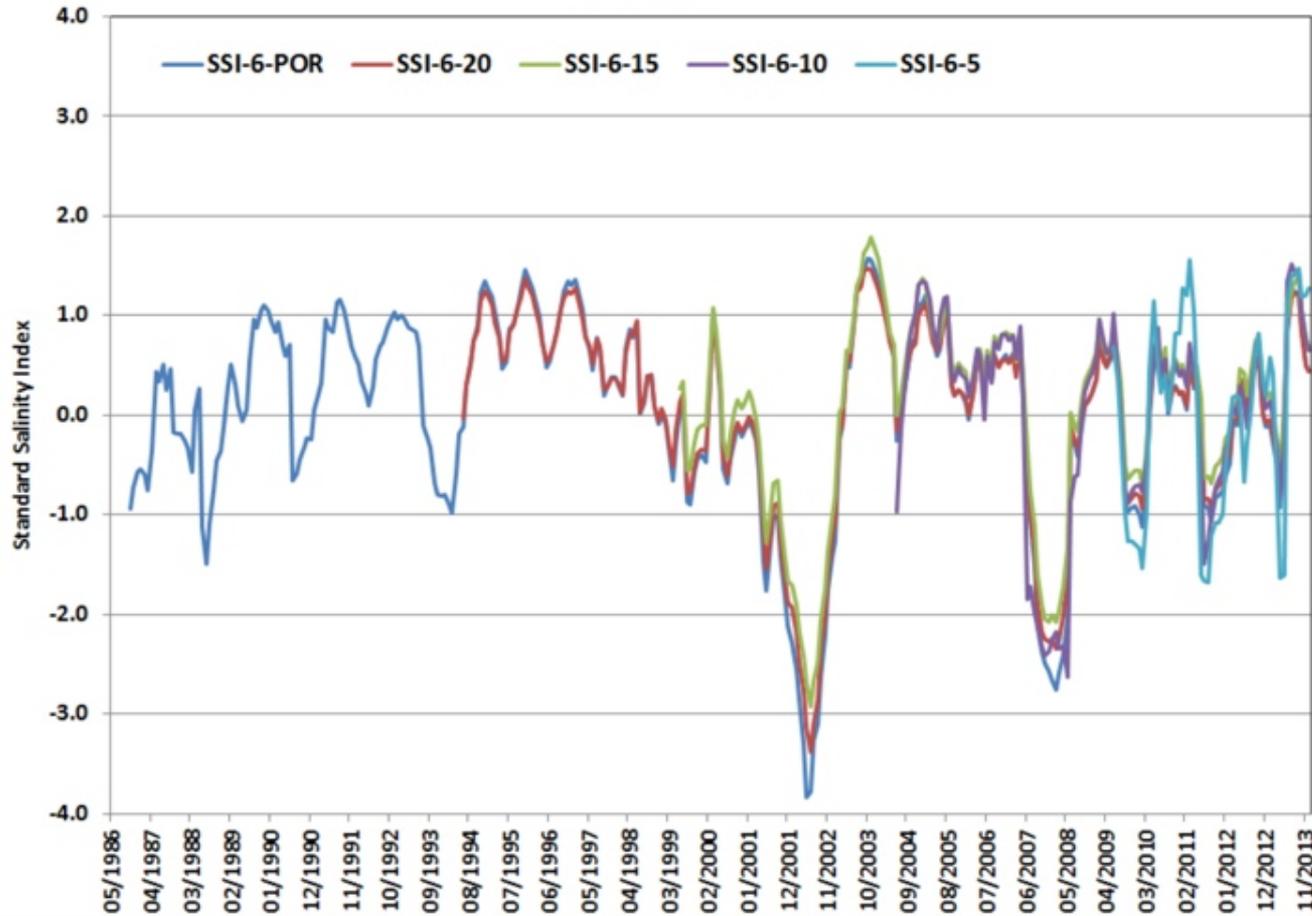


What are the effects of using different time periods?



Range of historical record for 10-year data set is > that the other longer time series.

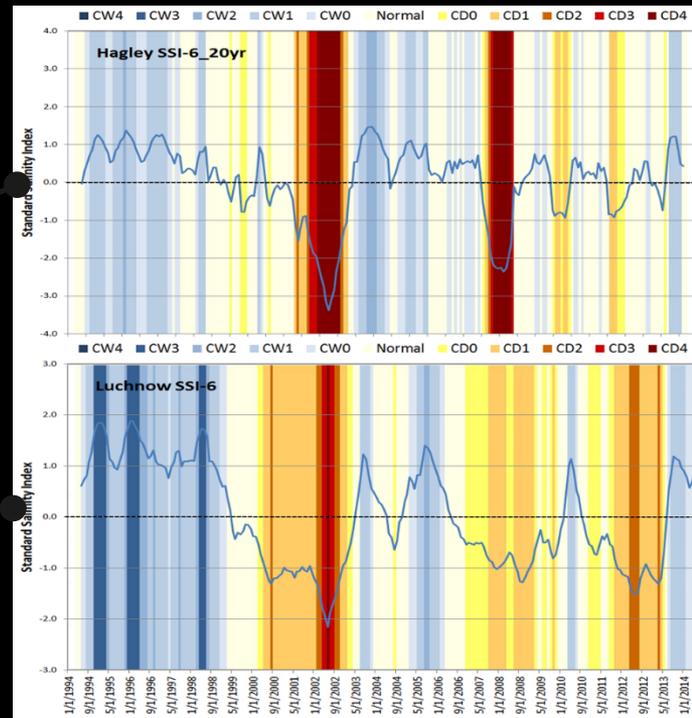
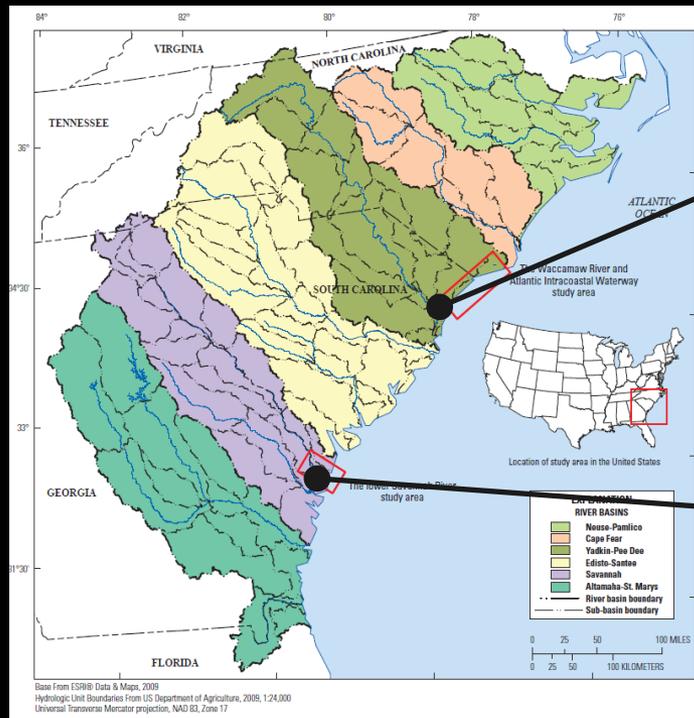
Hagley SSI



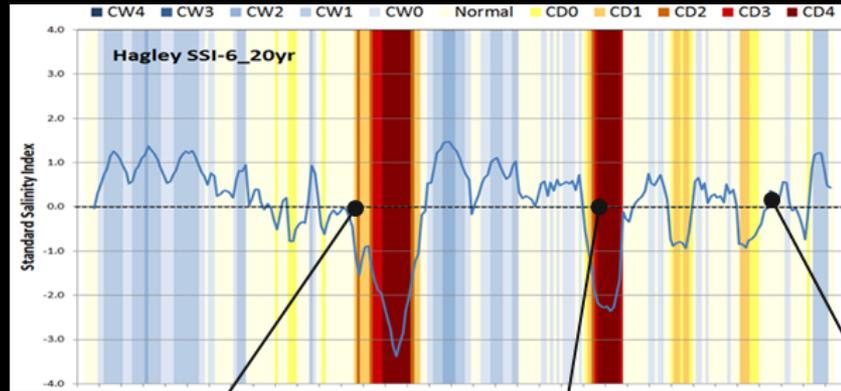
Results for 10-year and longer very similar.
The 5-year didn't have the range of conditions as the other datasets.

Regional Comparison

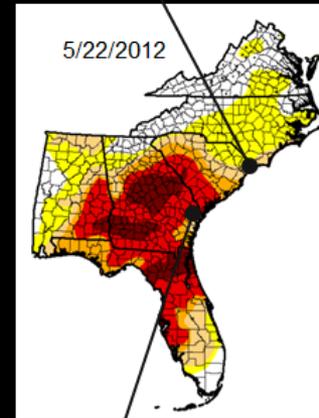
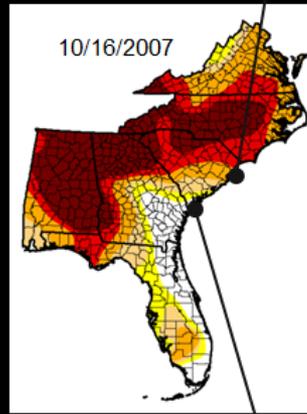
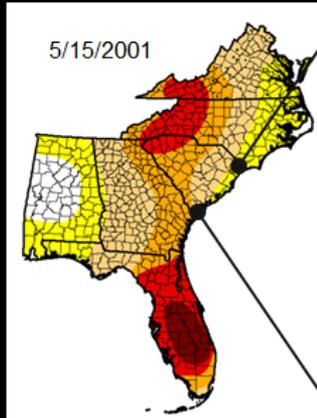
Is the CDI a site specific index or can it be used to regional comparisons?



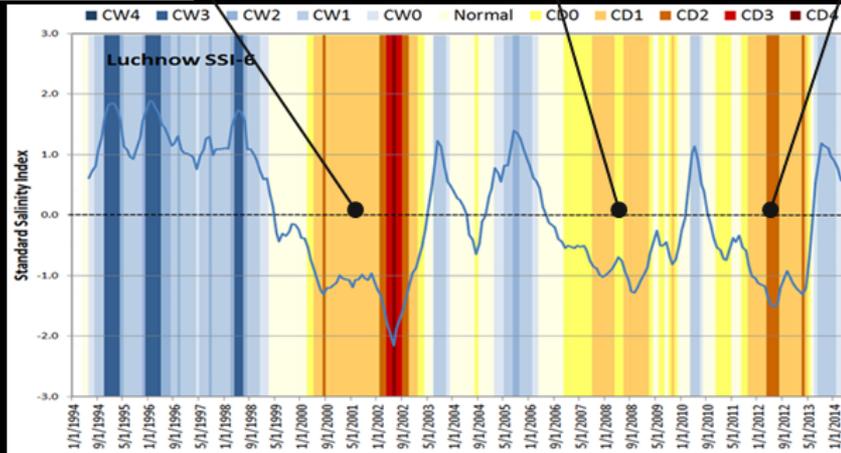
Yadkin-Pee
Dee River
Basin



Waccama
w River



Savannah
River Basin



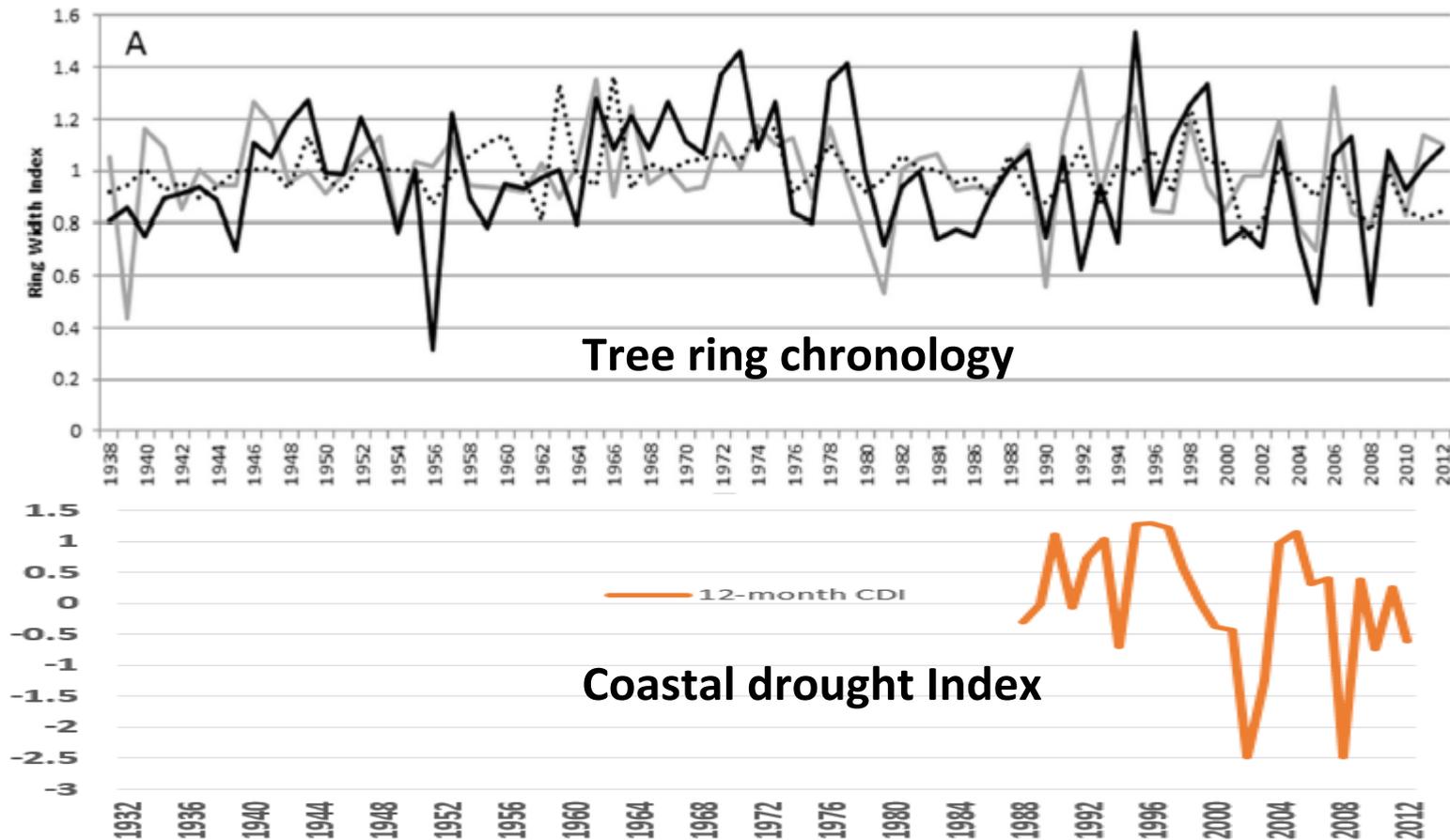
Little Back
River

Immediate Needs

- Tied the CDI to an Response Variable, such as:
 - Shellfisheries – blue crab, oysters
 - Tidal fresh water forests – cypress trees
 - Vibrio bacteria transport
 - Harmful algal blooms

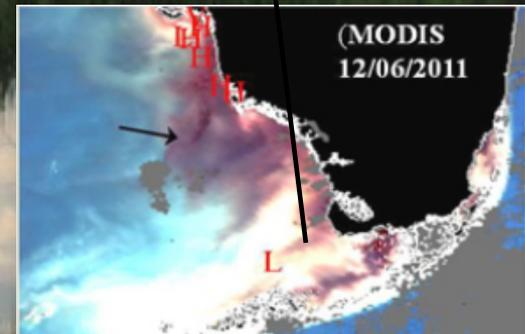
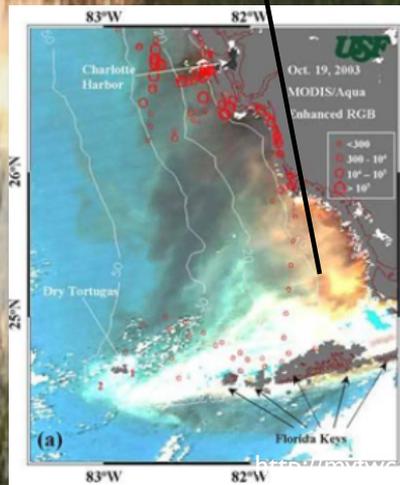
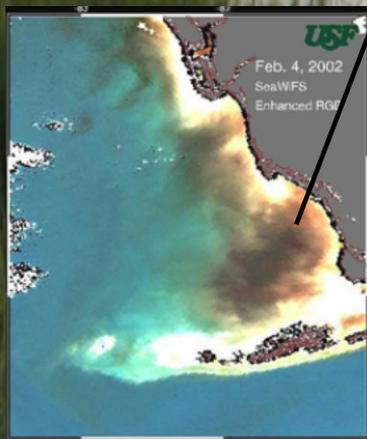
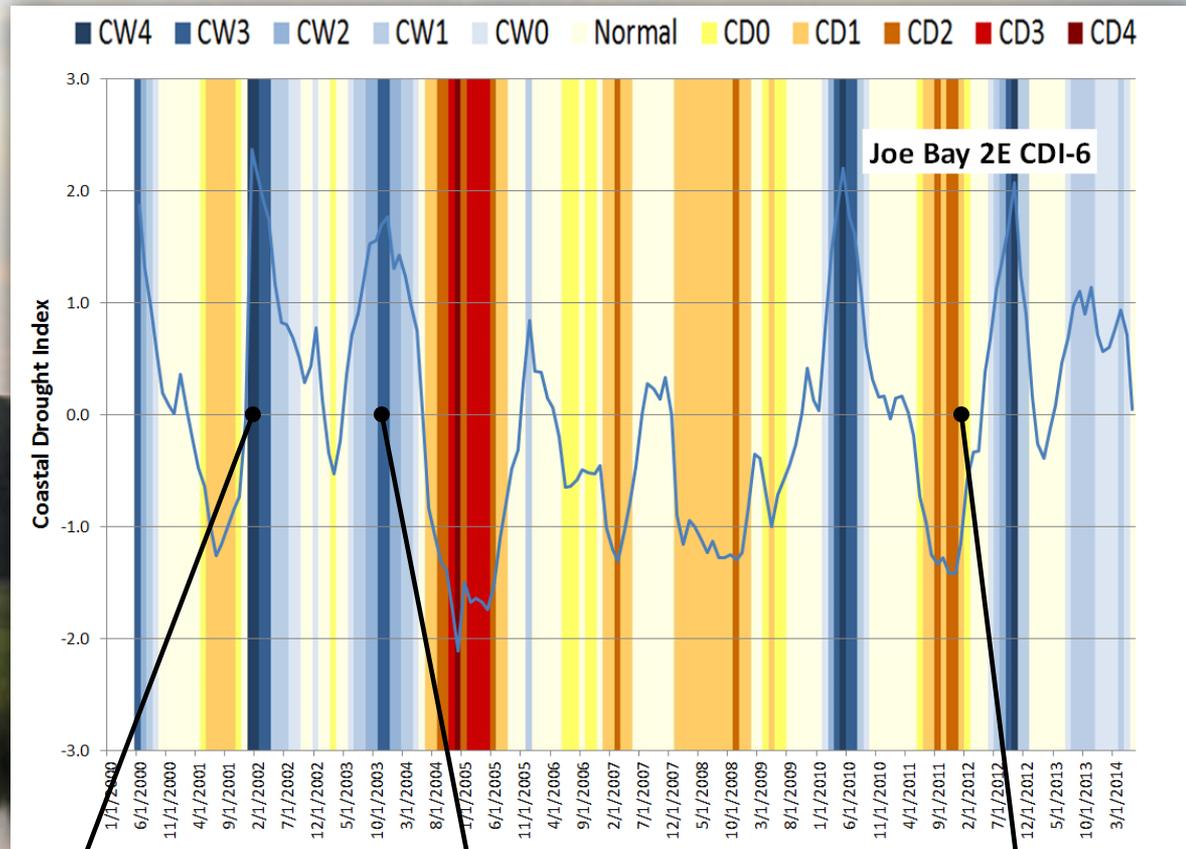
Annual Growth Patterns of Baldcypress (*Taxodium distichum*) Along Salinity Gradients

Brenda L. Thomas¹ • Thomas Doyle² • Ken Krauss²



Dark water events in Southern Florida

Size of the 2011 event much smaller than the one 10 years earlier



Discussion

Next steps:

Correlate CDI to drought response variable

Prototype real-time computation and display of CDI

Develop App to standardize CDI computation

Apply to more salinity data sets

Determine optimal values for coefficients in the gamma function.