Climate and Water Resources in South Carolina:

Science for Decision-Making

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Science for Decision-Making

"The job of a scientist is to make sure that information is provided clearly and appropriately, so people can make a better decision."

Mark Jacobson
Professor, Civil and Environmental Engineering
Stanford University

Objectives

- Provide insight into how science goes about addressing policy and management questions
- Articulate a few of the critical water / climate issues
- Provide examples of research and tools that seek to address the issues

Acknowledgements

- Collaborators
  - Greg Carbone – USC Geography
  - Kirstin Dow – USC Geography
  - Paul Conrads – US Geological Survey
  - Jessica Whitehead – SC Sea Grant Consortium
  - John Kupfer – USC Geography
  - Geoff Scott – NOAA CCEHBR
  - Jan Moore – NOAA CCEHBR
- CISA team
- Many stakeholder groups
- Several graduate students
- Funding – NOAA, NPS, NIDIS

Carolinas Integrated Sciences and Assessments (CISA)

- Part of Regional Integrated Sciences and Assessments (RISA) program
  - NOAA Climate Program office
- CISA conducts research
  - in collaboration with water and coastal stakeholders across the Carolinas
  - to produce usable, useful, and accessible climate information for decision making

cisa
carolinas integrated sciences & assessments

Carolinas Integrated Sciences and Assessments (CISA)

- Potential users of this information
  - municipal water supply planners
  - natural area/refuge managers
  - regulatory staff involved in mitigation or restoration activities
  - coastal emergency planning staff
- Focus areas include drought, watershed and climate modeling, coastal climate, health, and adaptation.
- Web site – http://www.cisa.sc.edu

cisa
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Water resource / climate issues

- Through the climate lens
  - Impact of variability
    - seasonal, interannual, long-term
  - Impact of extreme events, e.g.
    - Drought
    - Tropical storms
  - Sea level rise
- Resource management
  - Domestic water supply
  - Wildlife habitat
  - Reservoir management
  - Adaptation / mitigation
  - Water related regulations, e.g.
    - Water quality, wetlands
  - Land use change

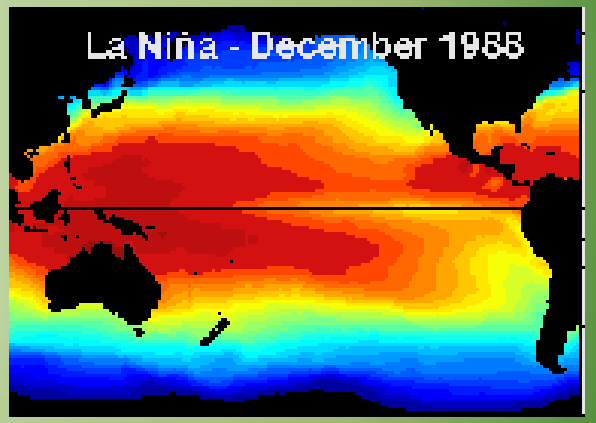
Lake Marion Sparkleberry Cut, Oct 2007 (www.dnr.sc.gov)

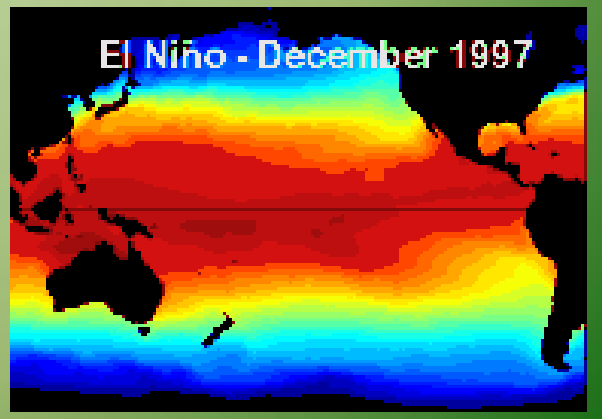
Research / tools

- Topics
  - Global climate anomalies
    - El Niño Southern Oscillation (ENSO)
    - Atlantic Multidecadal Oscillation (AMO)
  - Long-term climate change
  - Sea level rise
  - Water supply
  - Public health
  - Habitat management
- Some of this is current, ongoing work

ENSO / AMO

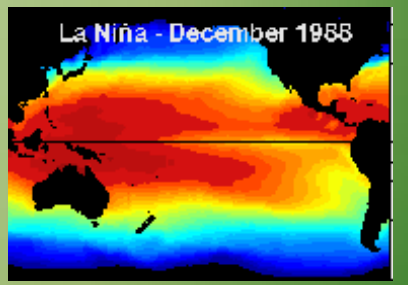
- ENSO phases
  - Sea surface temperature
    - tropical Pacific Ocean
  - Cool, neutral, warm phases
  - Short to medium duration
  - Global effects on weather
    - Regional variability
- AMO
  - Sea surface temperature
    - Northern Atlantic Ocean
  - Cool and warm phases
  - 20 – 40 years duration

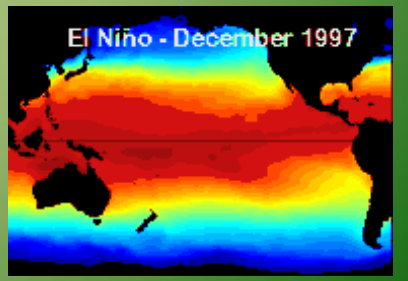




ENSO / AMO

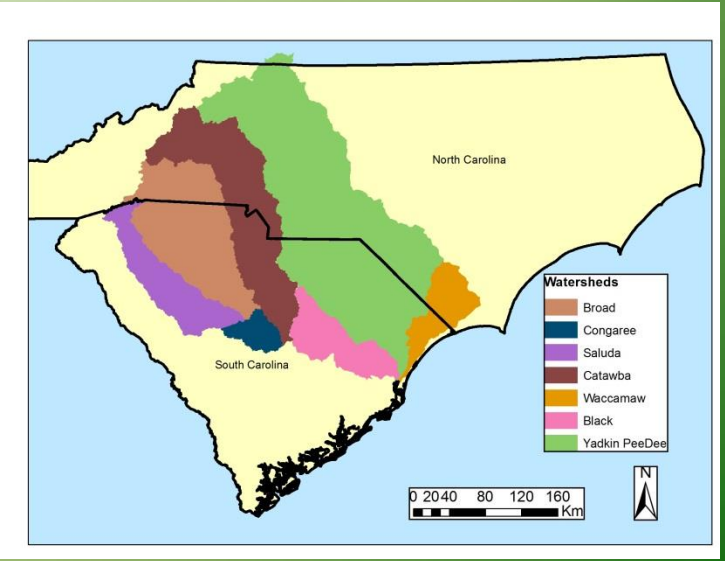
- ENSO / AMO interaction in NC / SC
  - Precipitation and streamflow
    - 1950 - 2012
  - Seasonal variability
  - Subregional variability
- Winter / spring streamflow
  - Greater during warm ENSO
    - Only if warm AMO also
- Autumn streamflow
  - Greater at coast during cool ENSO
    - Unrelated to AMO
  - Greater in Piedmont during cool ENSO
    - Only if warm AMO also





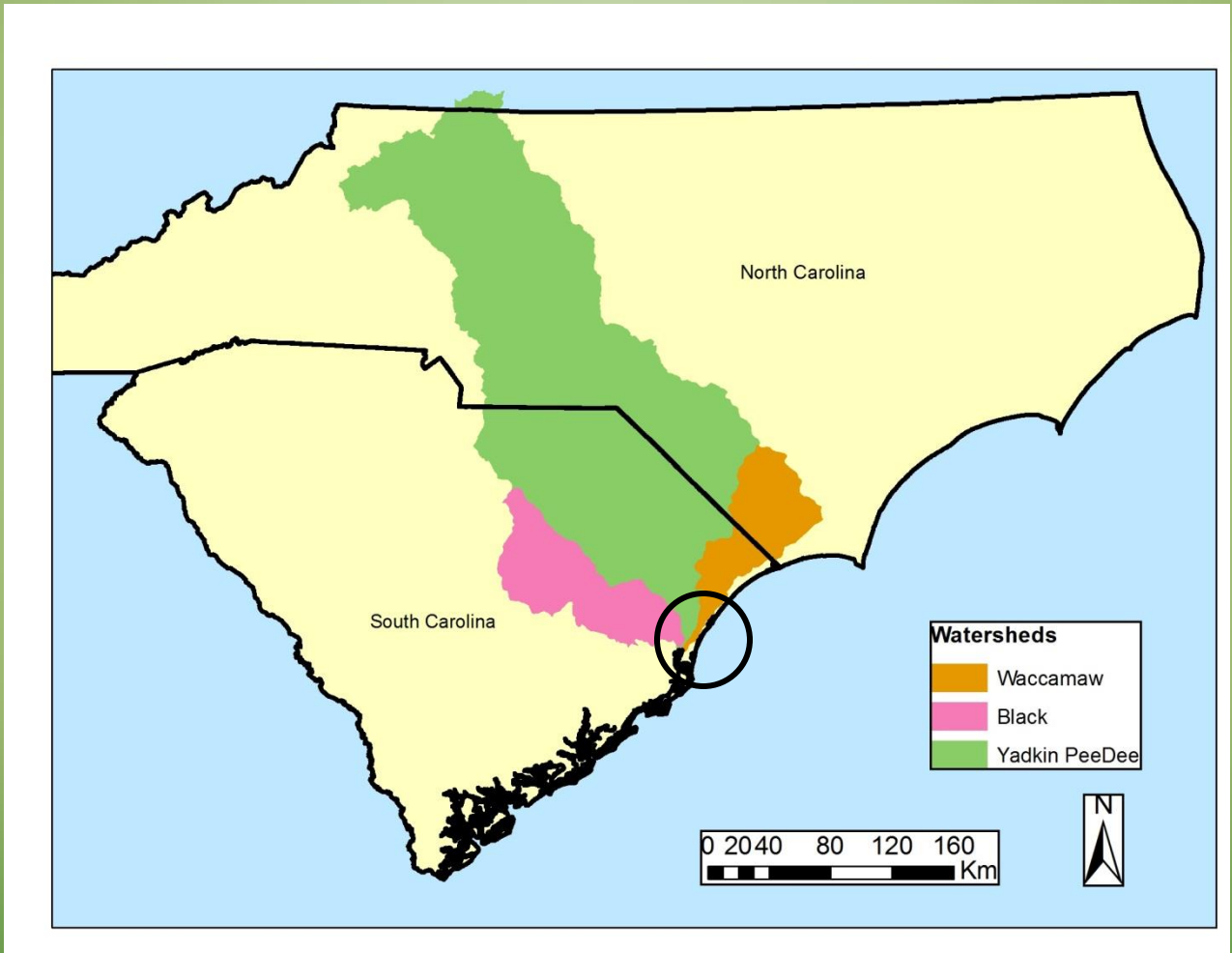
Watershed streamflow modeling

- Hydrologic Simulation Program-Fortran (HSPF)
- Simulate daily streamflow
- Also working with water quality
- Calibrate at sub-HUC8 scale
- Can address questions
  - Whole basin
  - HUC 8
  - Local watershed

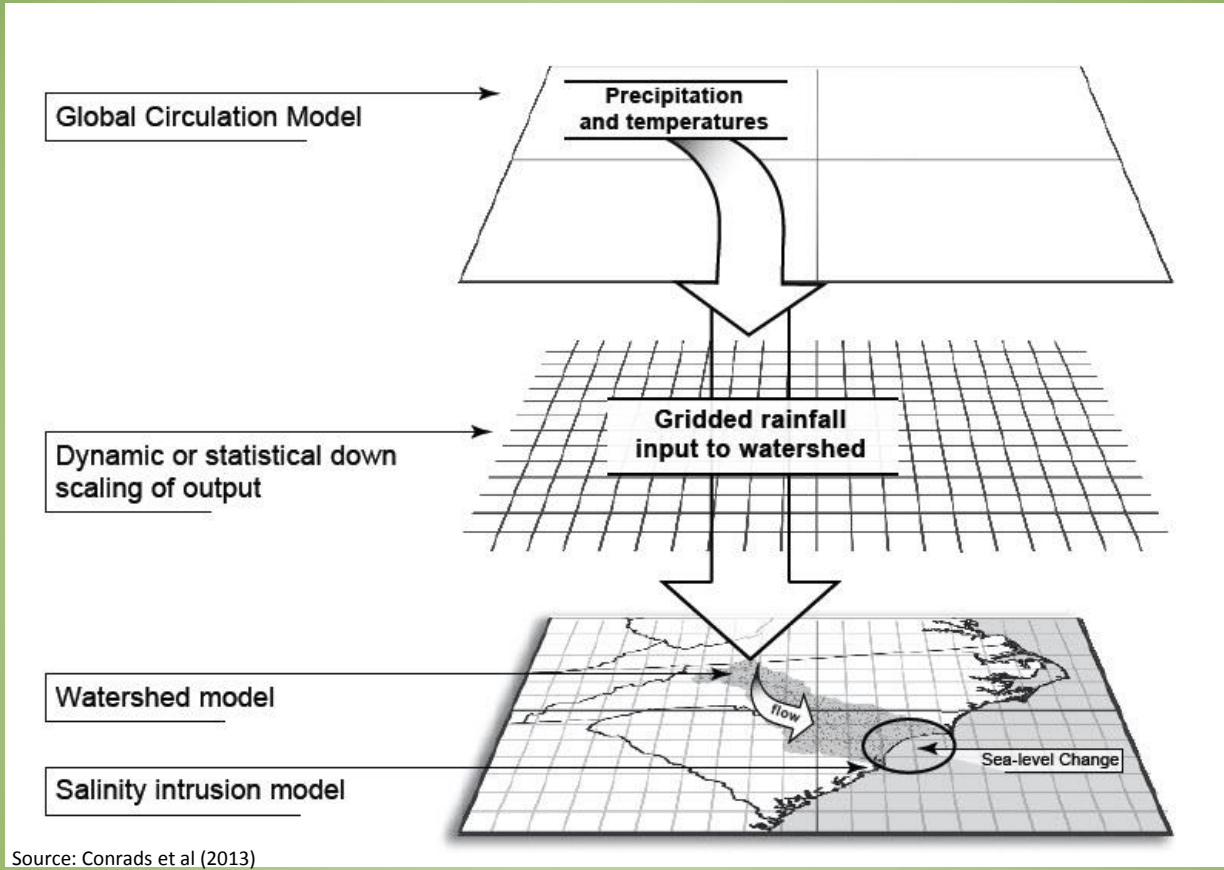


Surface salinity intrusion

PRISM2 model

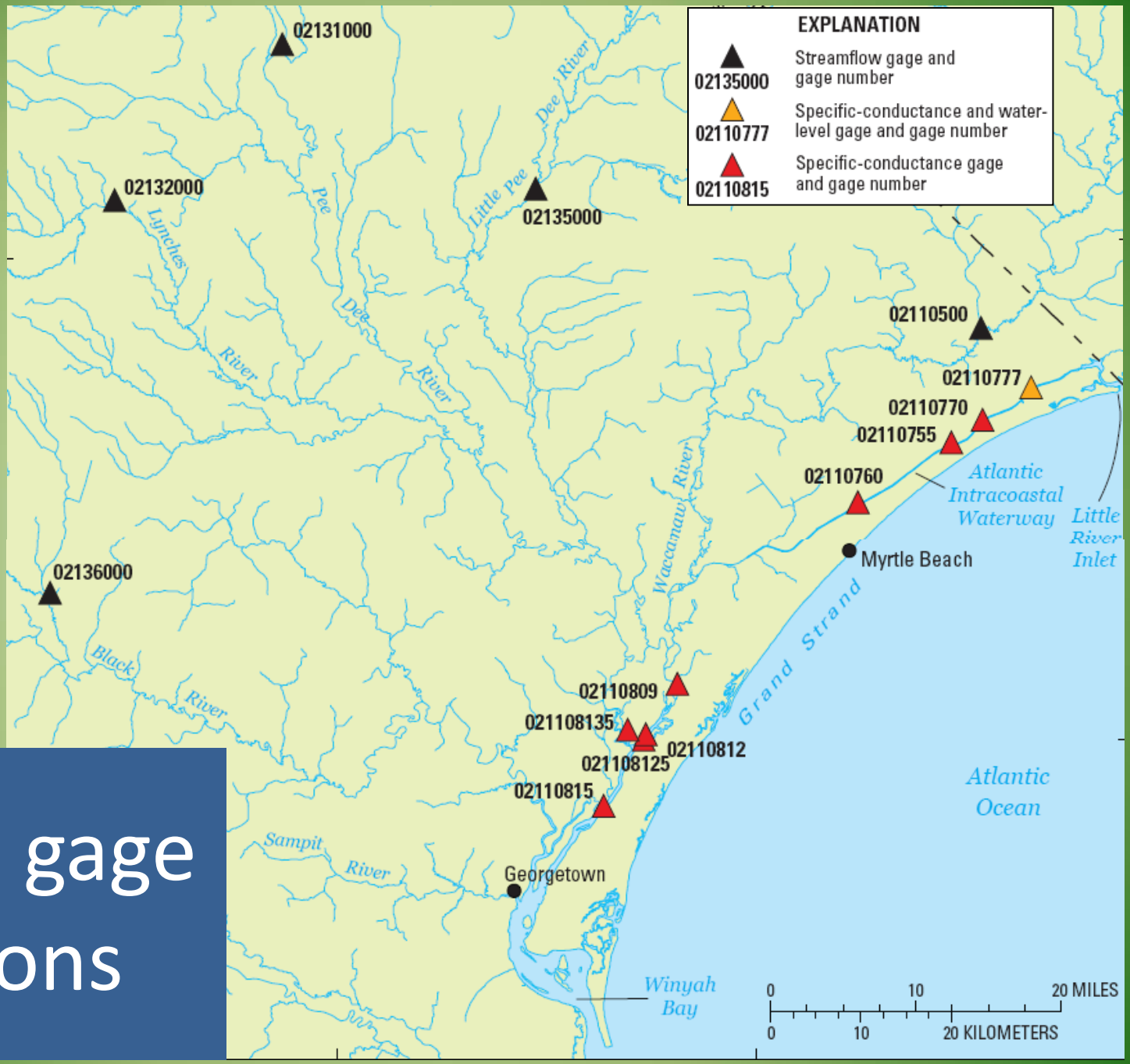


Climate downscaling for the watershed model



Source: Conrads et al (2013)

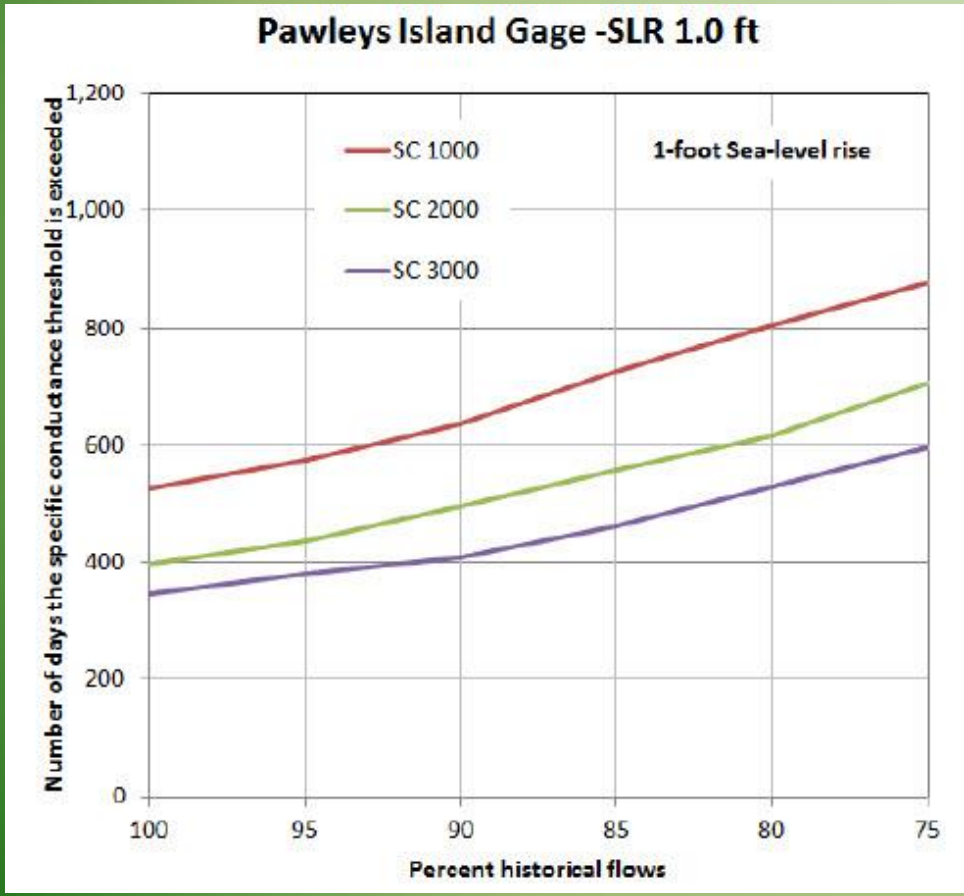
- We used five different GCMs – spanning a range of predictions
- Two simulation periods
  - Historic 1981 – 2010
  - Future 2041 – 2070

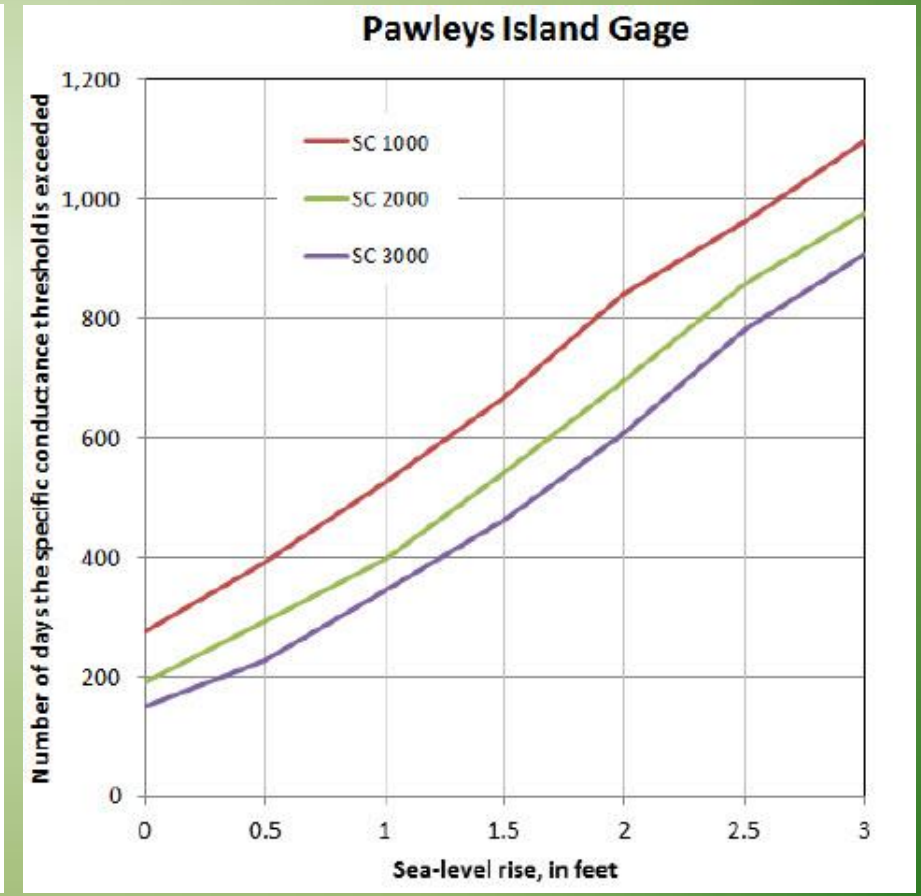


PRISM2 gage locations

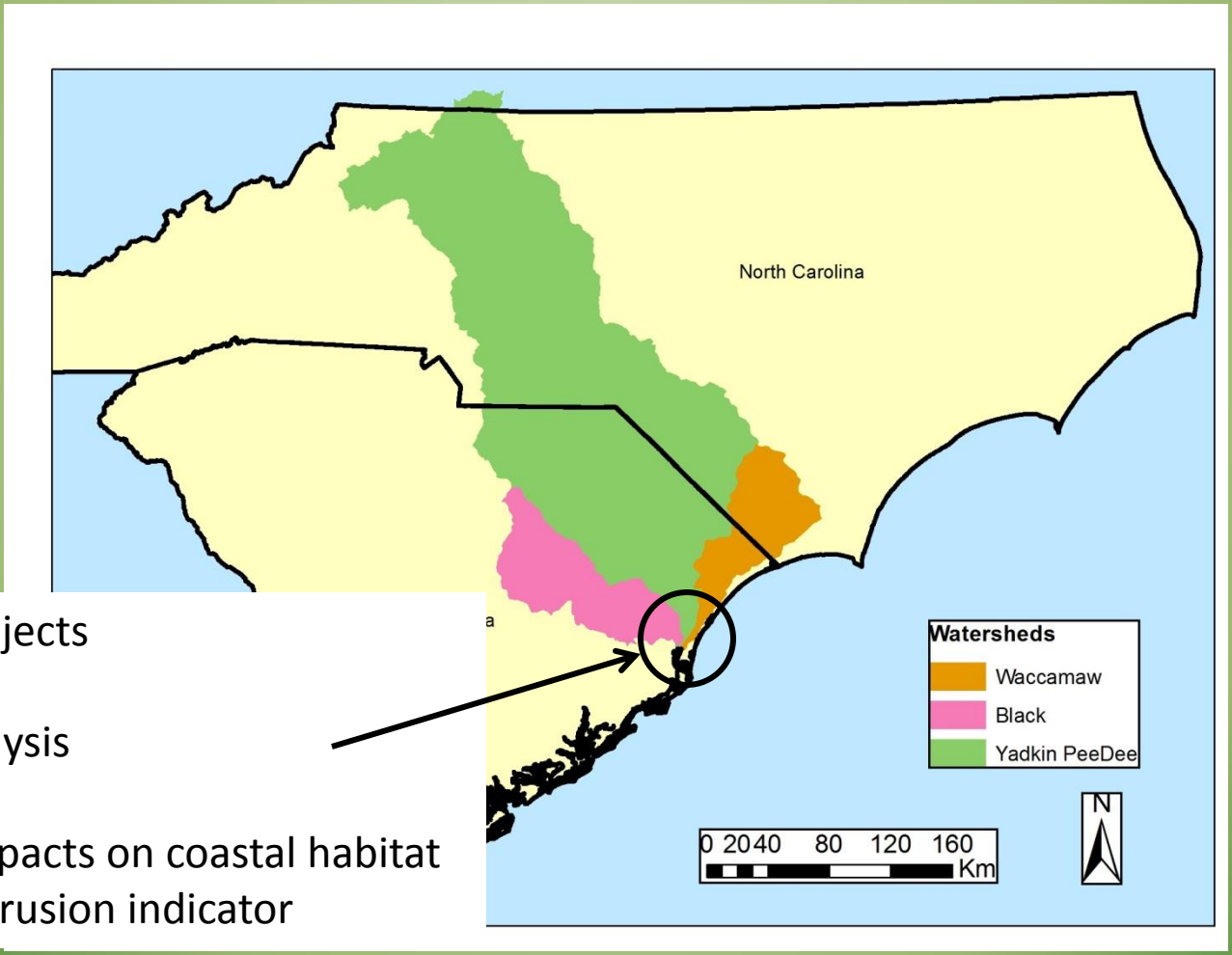
PRISM2 results

14 year simulation





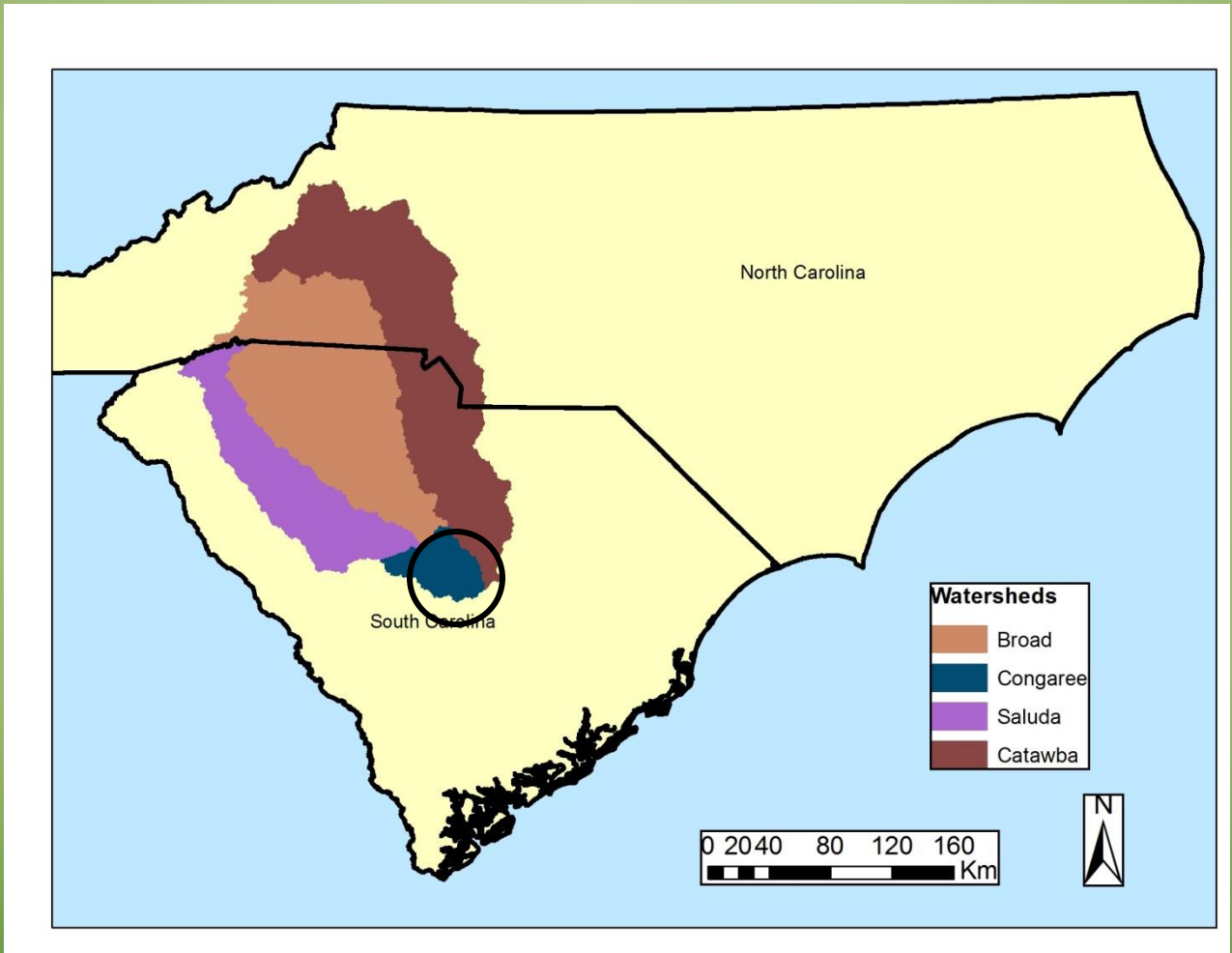
Winyah Bay watershed



Additional projects

- Current
  - *Vibrio* analysis
- Future
  - Salinity impacts on coastal habitat
  - Salinity intrusion indicator

Congaree National Park



Congaree National Park (CNP)

- Impact of changing flows on CNP ecosystems
- Three components
  - Watershed scale streamflow simulation - HSPF
  - Floodplain hydraulics model - TUFLOW
  - Ecosystem impacts
- Future climate scenarios
  - Derived as for Winyah Bay models

Study Ar

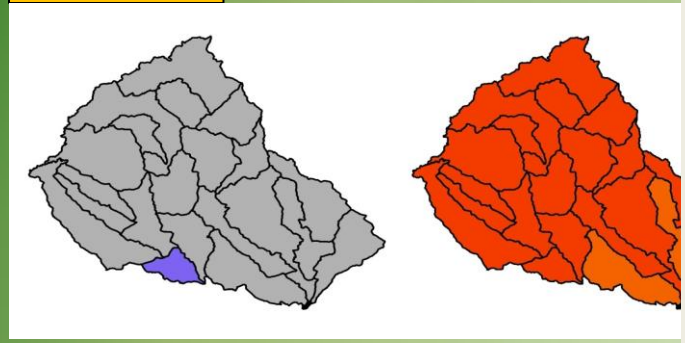
Surface water salinity intrusion

Google Maps, 2012

Floodplain habitat in Congaree National Park

Daily discharge: GFDL General Circ. Model

JULY



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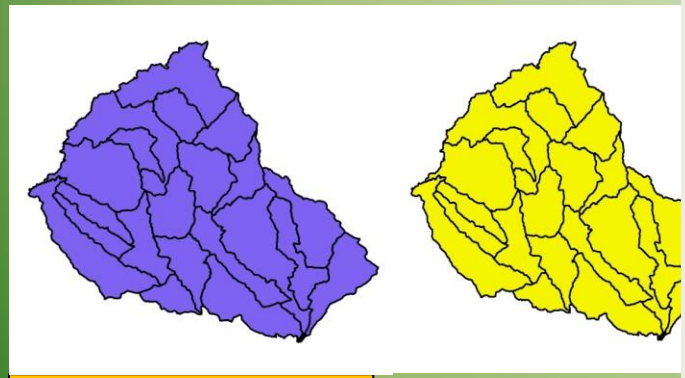
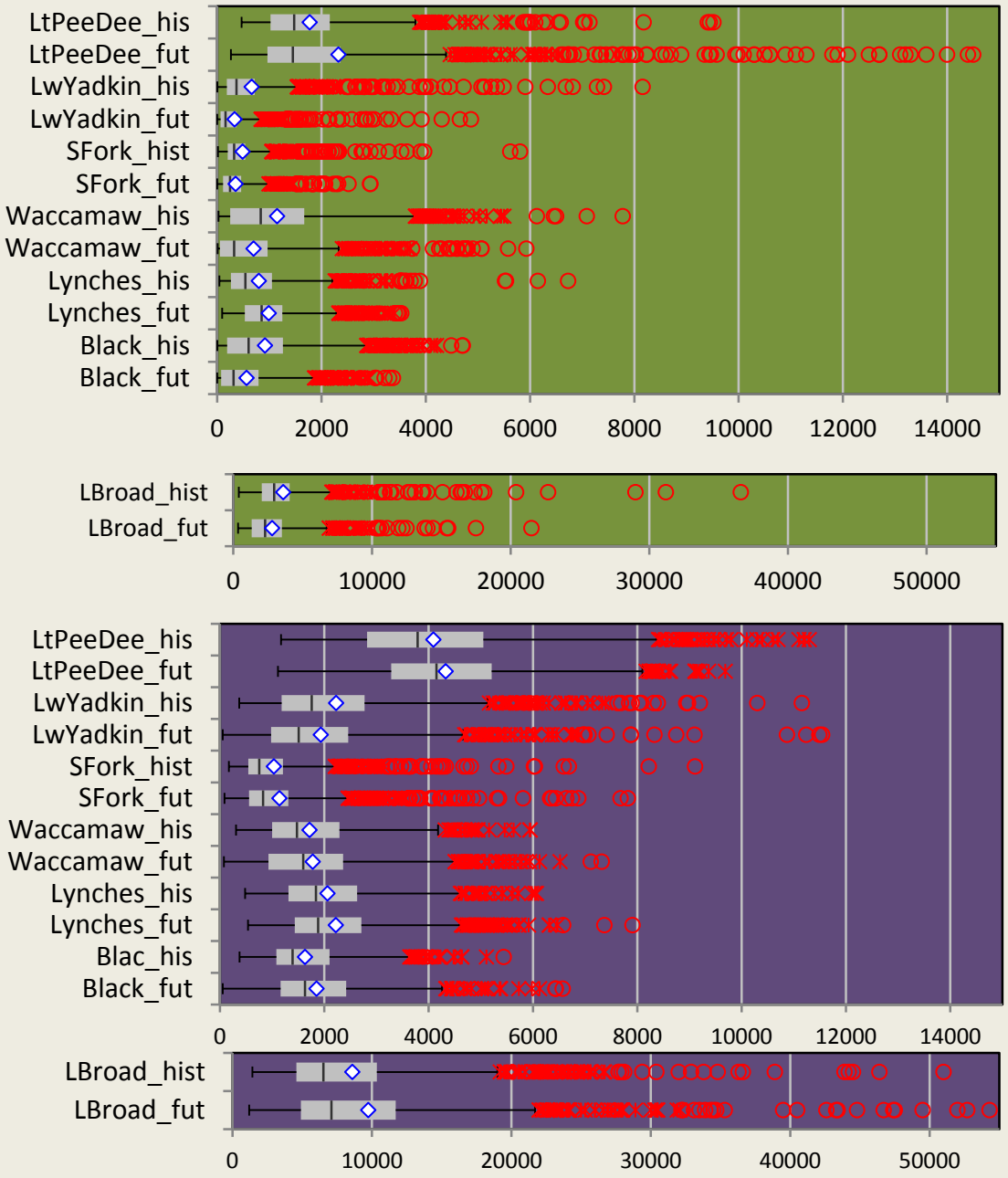
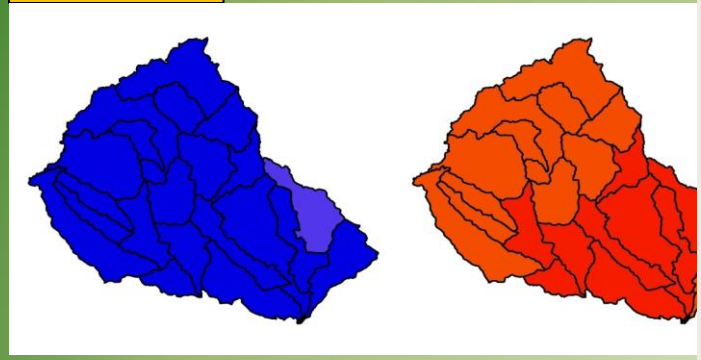


JANUARY



Daily discharge: ECHO General Circ. Model

JULY



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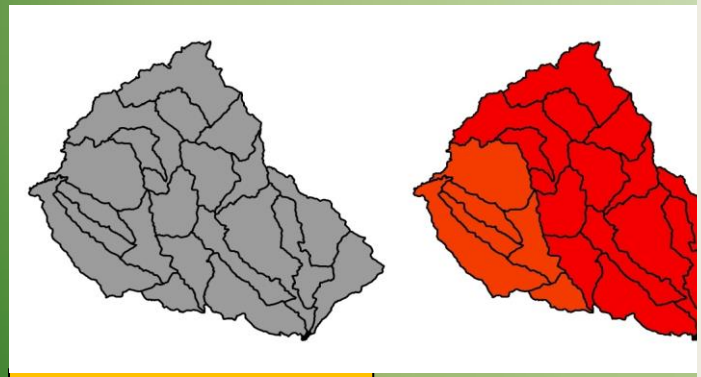

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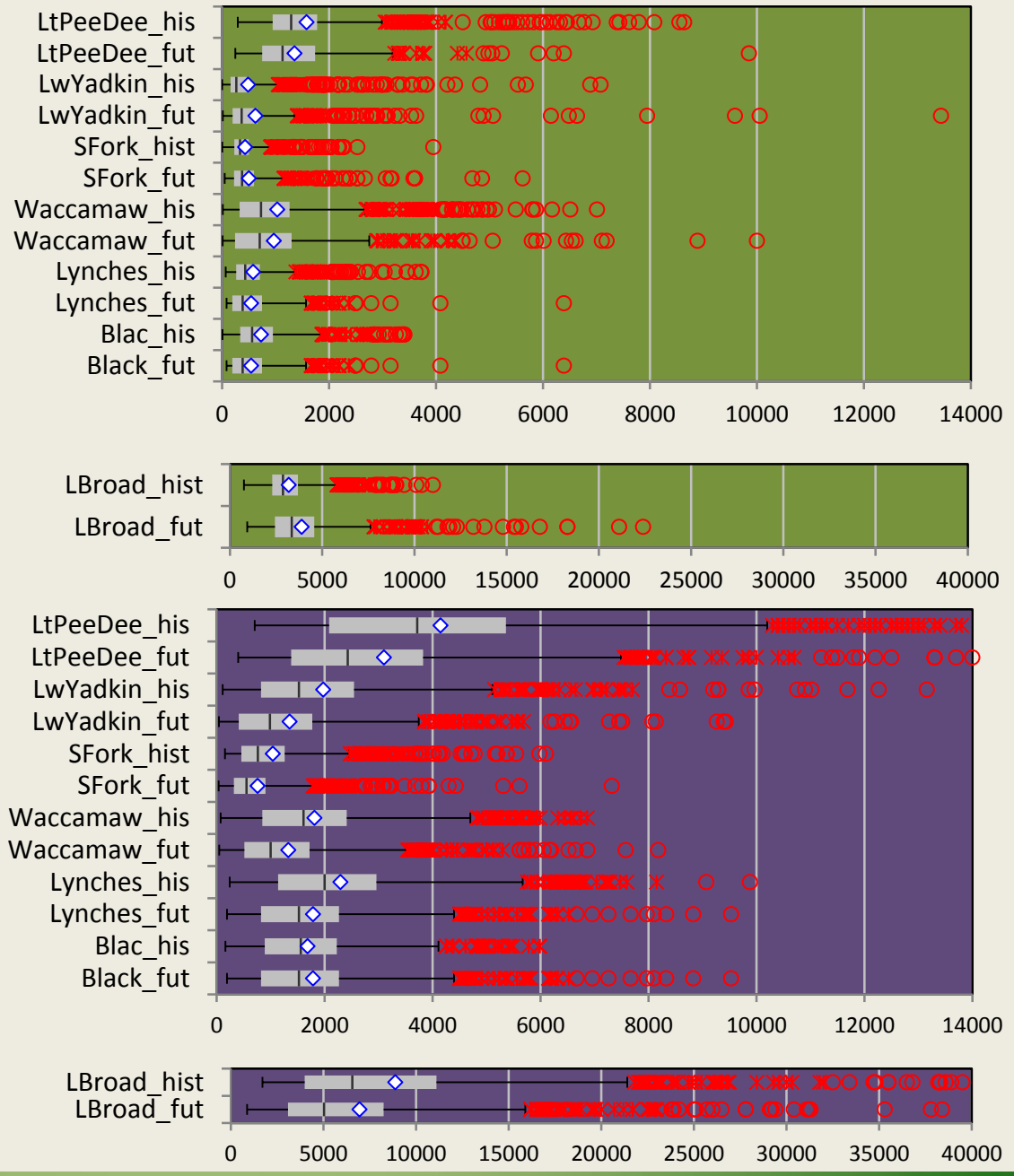


Dynamic Drought Index for Basins
In North and South Carolina

Steps

1. Select time scale
2. Select drought index
3. Select display type

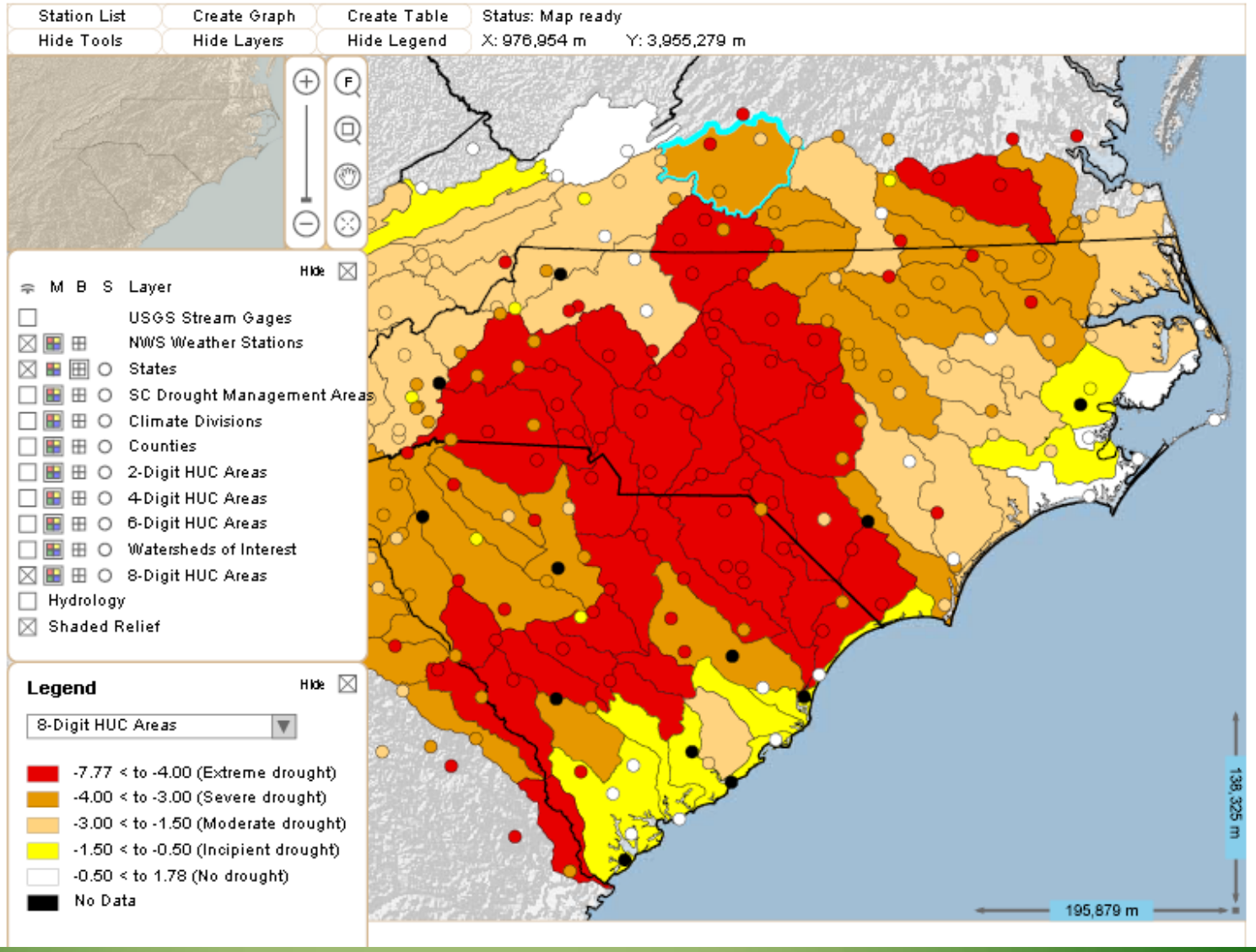
Results

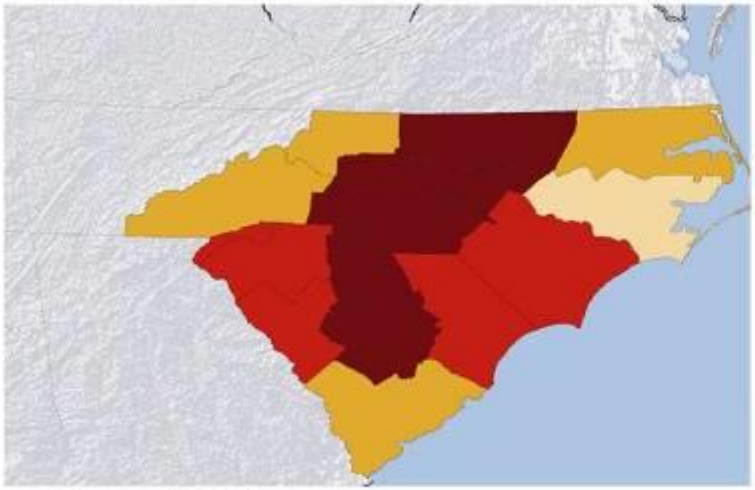
4. Map
5. Graph
6. Table

Selected variables:

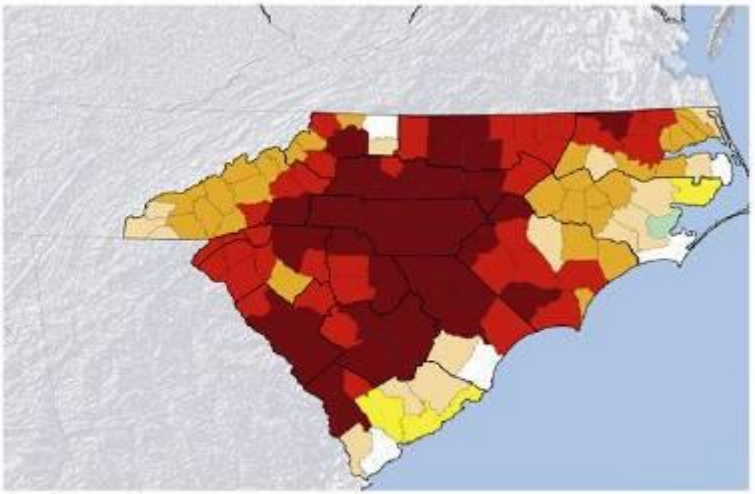
- Monthly time scale
- Raw values
> 100 % Monthly PDSI
- Map
> July 2002
> SC Drought Act for Palmer Drought Index
> 5 classes
> Same class intervals

Result 4 Map

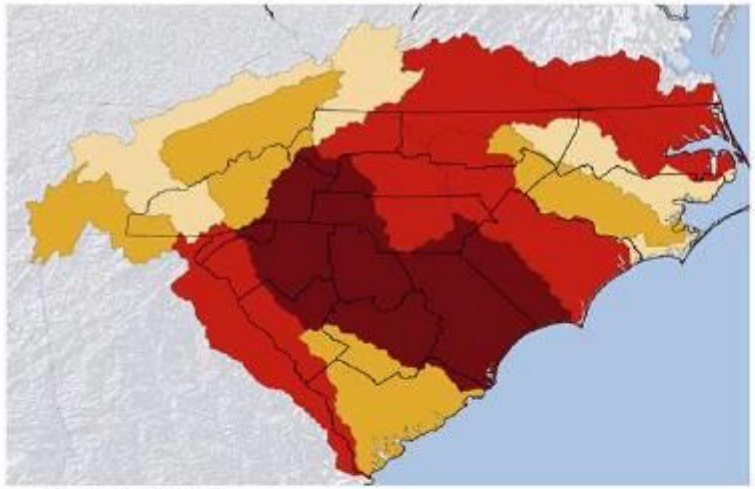




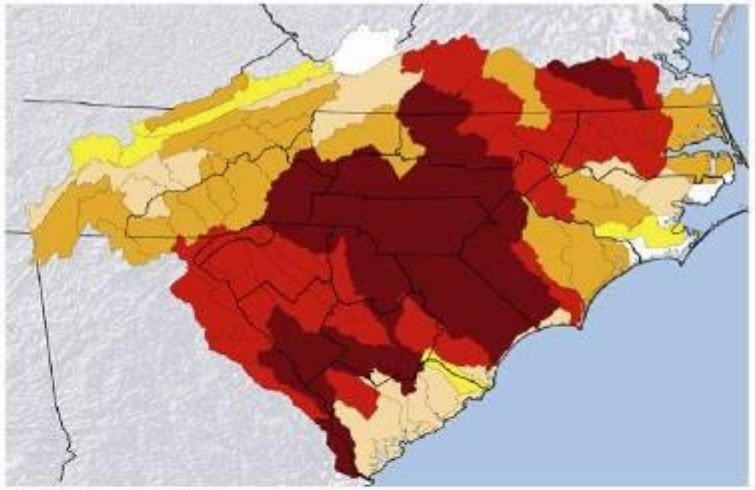
a. Climate Divisions



b. Counties



c. 6-digit HUCs

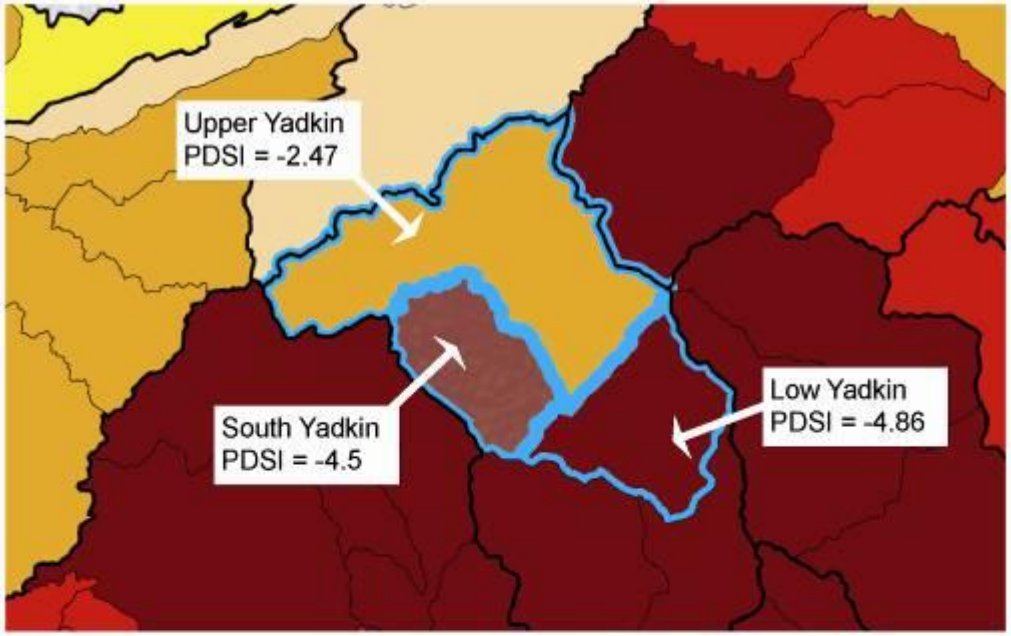


d. 8-digit HUCs

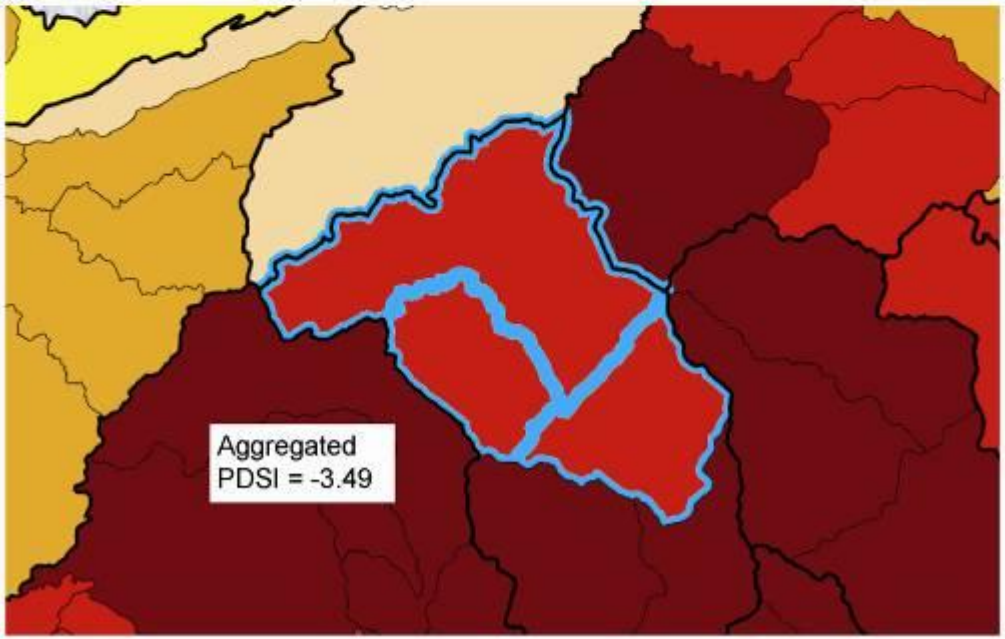
<= -4.00	(Extreme Drought)
-4.00 < to -3.00	(Severe Drought)
-3.00 < to -2.00	(Moderate Drought)
-2.00 < to -1.00	(Mild Drought)
-1.00 < to -0.50	(Incipient Drought)
-0.50 < to 0.50	(Near Normal)

0.50 < to 1.00	(Incipient Wet Spell)
1.00 < to 2.00	(Slightly Wet)
2.00 < to 3.00	(Moderately Wet)
3.00 < to 4.00	(Very Wet)
4.00 < to 5.00	(Extremely Wet)
No Data	

Aggregation



a. Individual 8-digit HUCs



b. Aggregated 8-digit HUCs

Rhee, J., G. J. Carbone, and J. Hussey. 2008. Drought index mapping at different spatial units. *Journal of Hydrometeorology* DOI: 10.1175/2008JHM983.1.

Questions / discussion