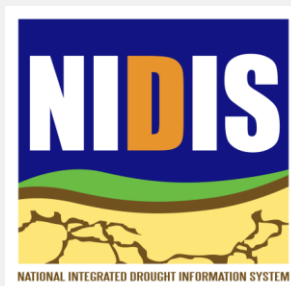


Drought and Coastal Ecosystems: An Assessment of Decision Maker Needs for Information

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Fifth Interagency Conference on Research in the Watersheds
North Charleston, SC
March 2-5, 2015



CLIMATE PROGRAM OFFICE
Advancing scientific understanding of climate, improving society's ability to plan and respond

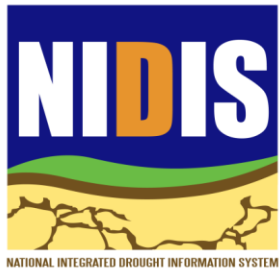
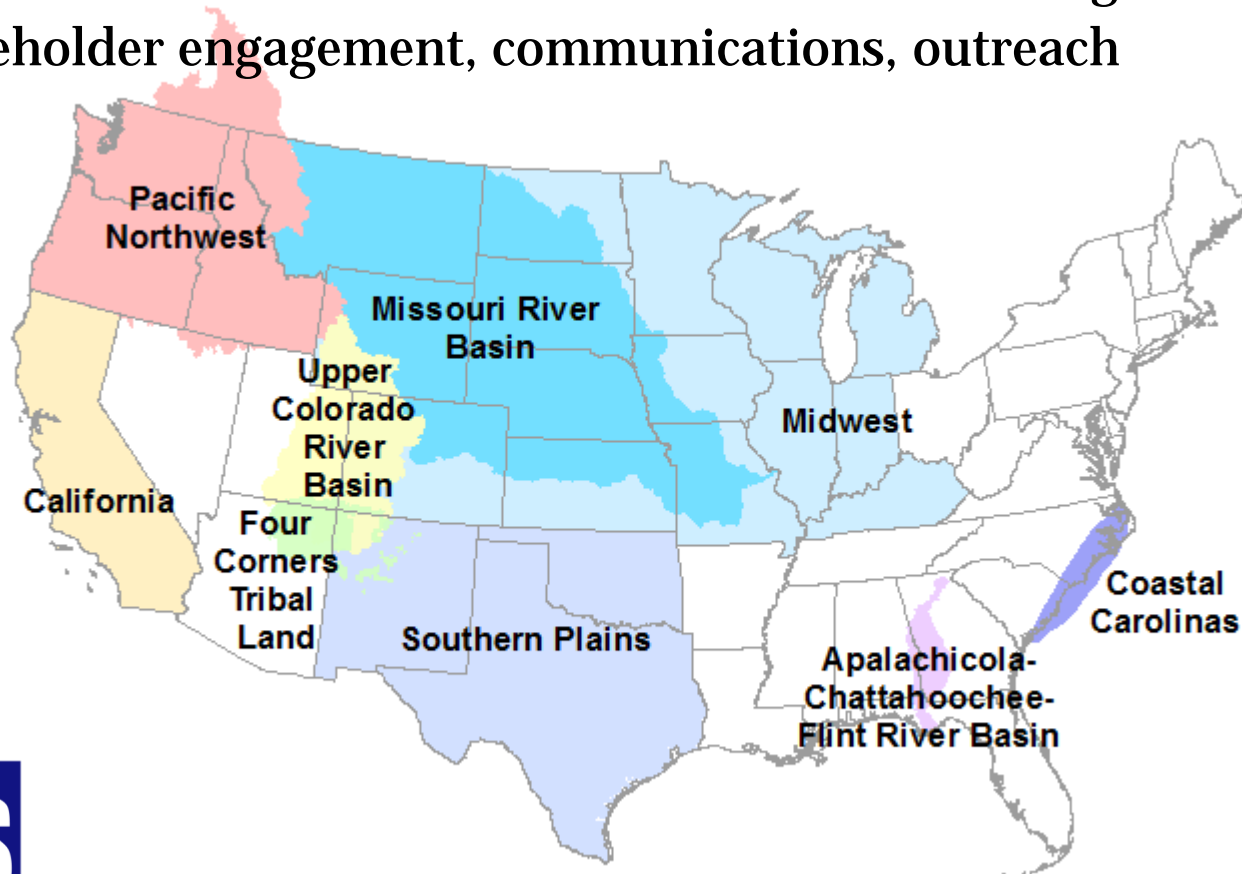
Outline

- Overview of the NIDIS-Coastal Carolinas pilot
 - What is coastal drought?
- Decision maker interviews
 - Impacts and stressors
 - Information needs
- Pilot projects

Overview of the NIDIS- Coastal Carolinas pilot

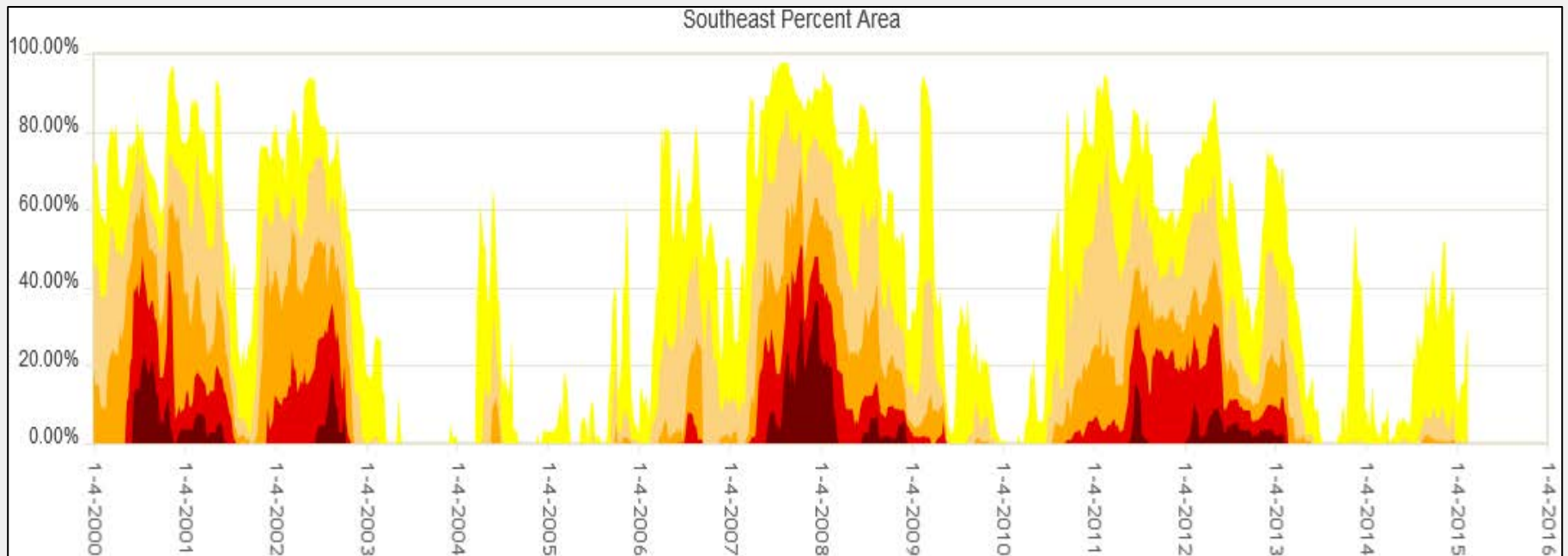
National Integrated Drought Information System

- Information and tools to monitor and forecast drought
- Stakeholder engagement, communications, outreach



Regional Drought Early Warning System Pilot Programs

Drought in the Southeast



Intensity:

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

Southeast U.S. (AL, FL, GA, NC, SC, VA)

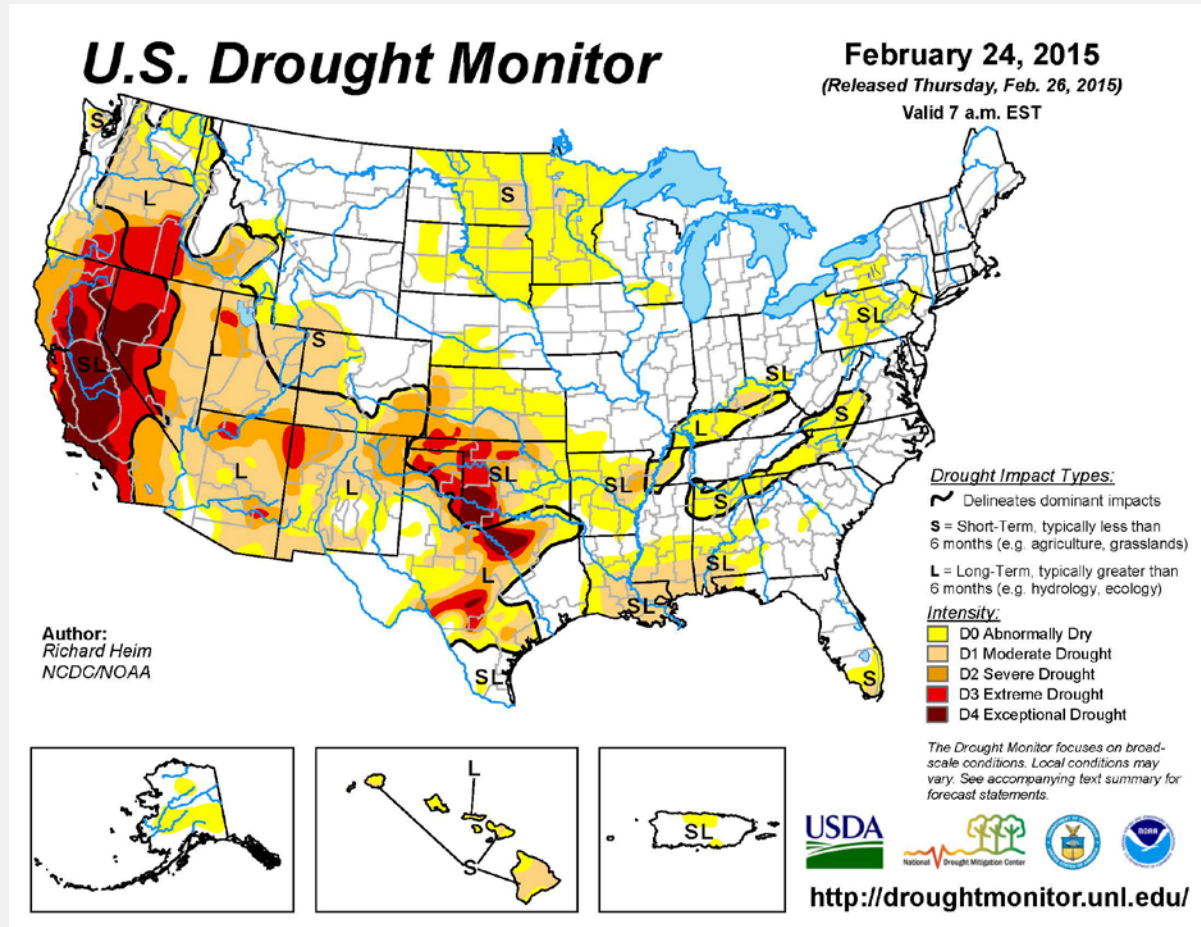
Drought Conditions, Percent Area, 2000-present

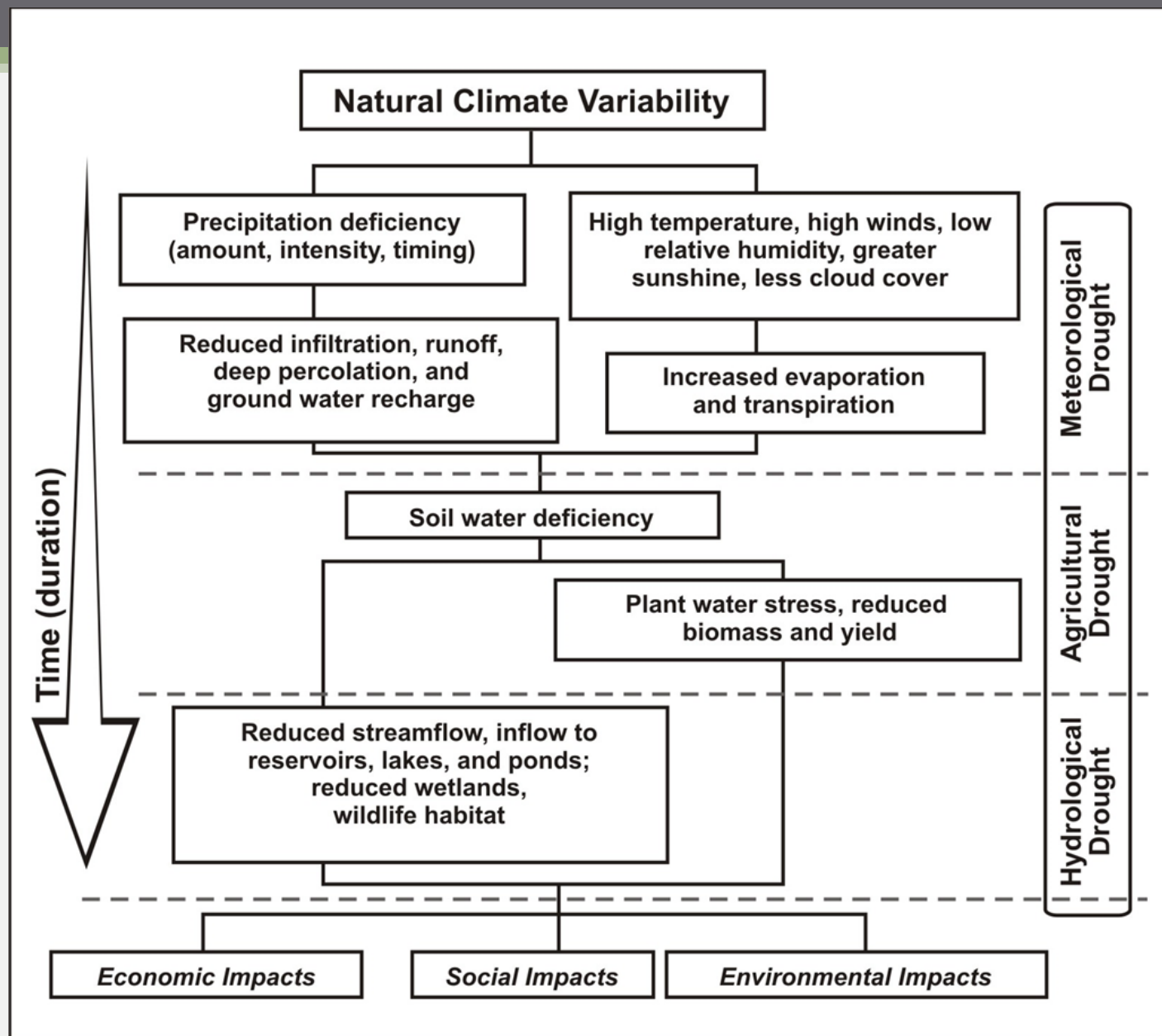
Source: <http://droughtmonitor.unl.edu/MapsAndData/WeeklyComparison.aspx>

Drought

- “less rainfall than is expected over an extended period of time, usually several months or longer”
- “a deficiency of rainfall over a period of time, resulting in a water shortage for some activity, group, or environmental sector”

<http://drought.unl.edu/DroughtBasics/Glossary.aspx>





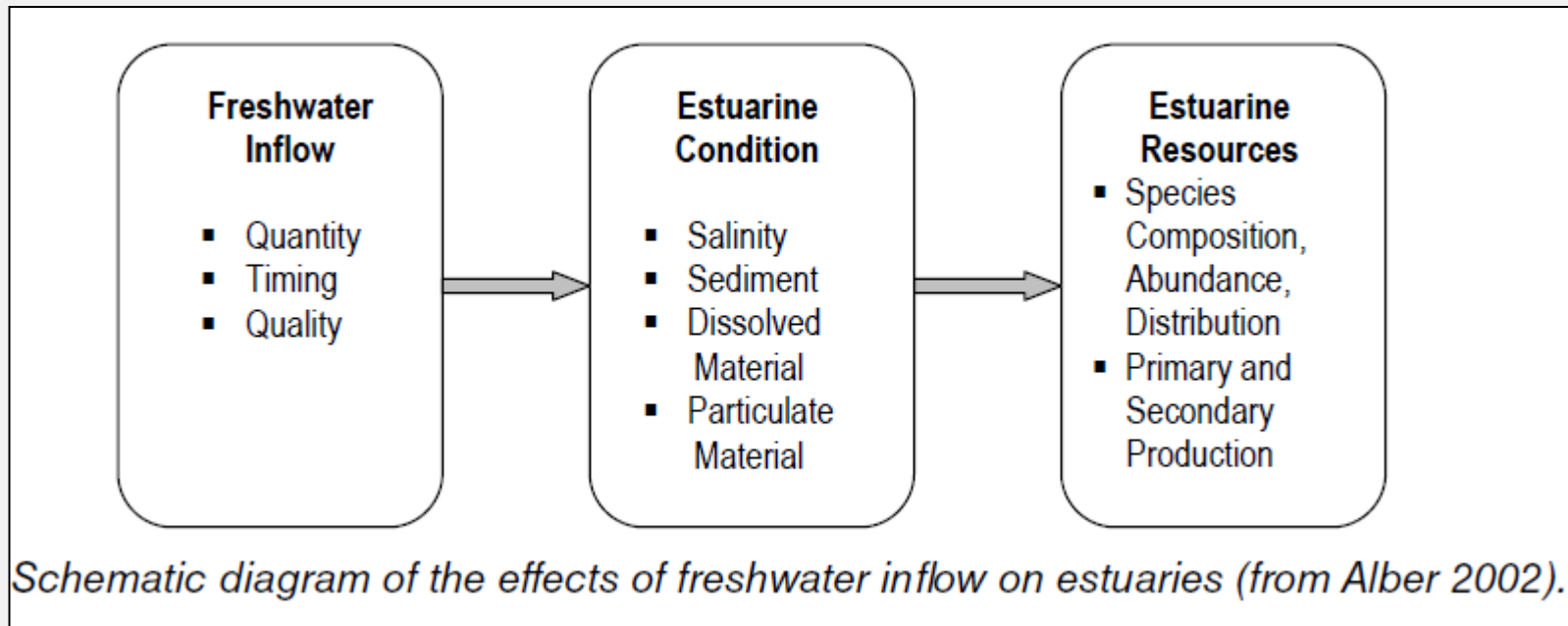
- <http://drought.unl.edu/DroughtBasics/TypesofDrought.aspx>

Why a pilot program about drought and coastal ecosystems?

- **Need to expand our understanding of drought beyond the four categories typically used:**
 - Meteorological
 - Agricultural
 - Hydrological
 - Socioeconomic
- **“Ecological drought”**
 - Water deficiency causing stress to plants, animals, ecosystems
- **Document and improve understanding of impacts**
 - Inform the development of mitigation strategies
 - Improve understanding of how and what to monitor

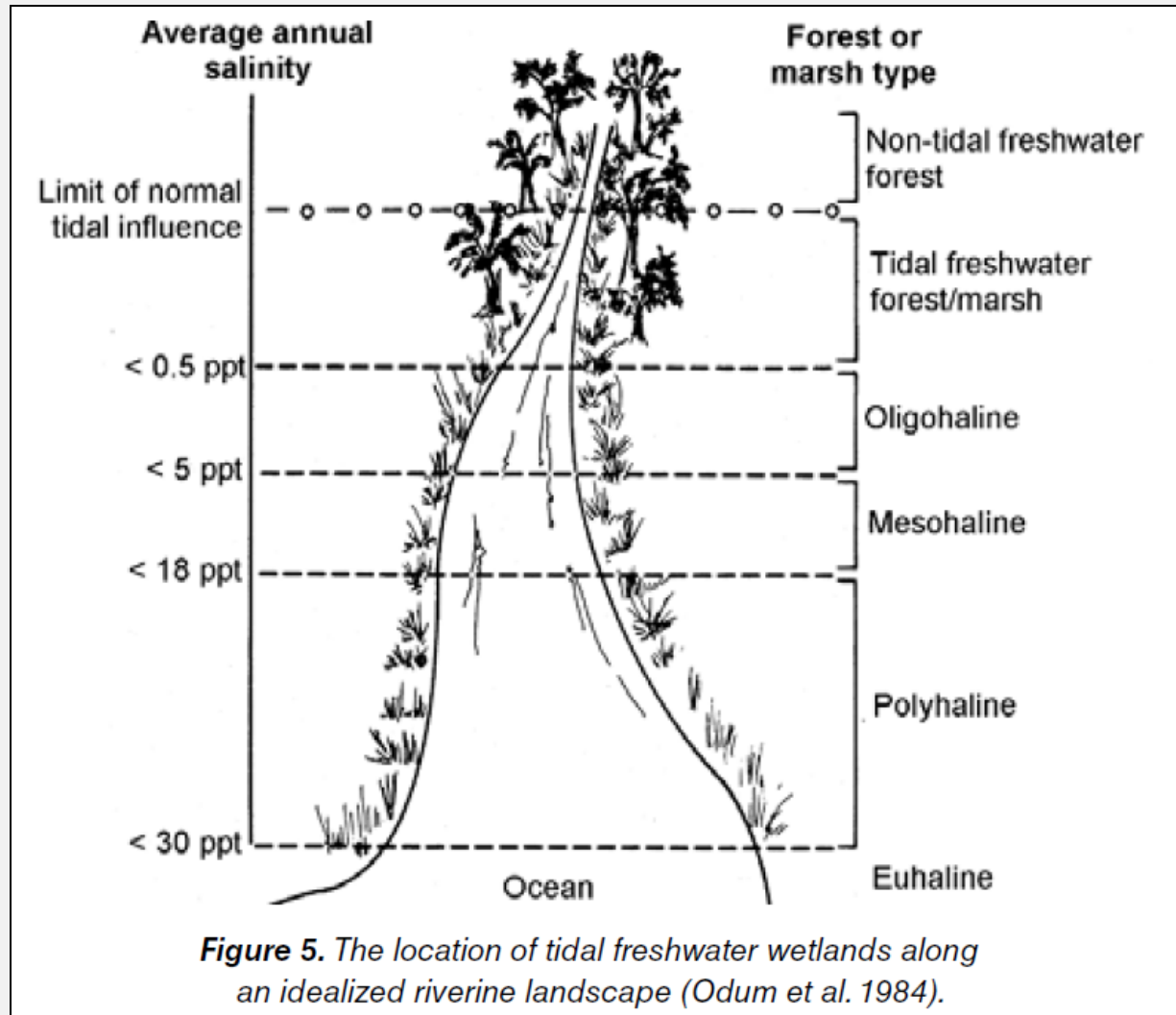
What is coastal drought?

- Lack of rainfall in the coastal region itself
- Lack of freshwater inflow from upstream
- Interactions with tidal regimes



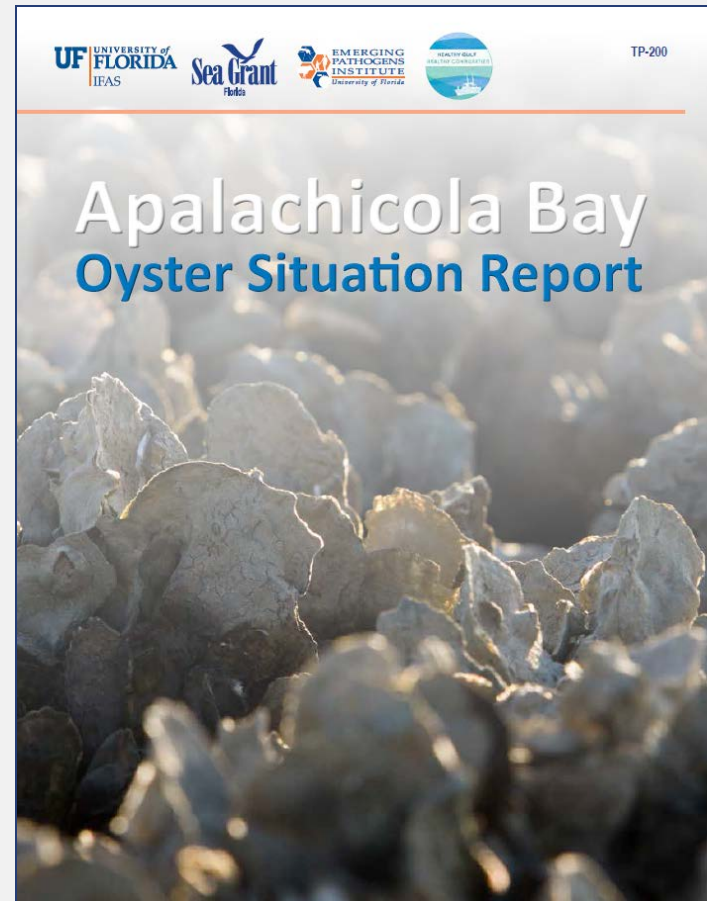
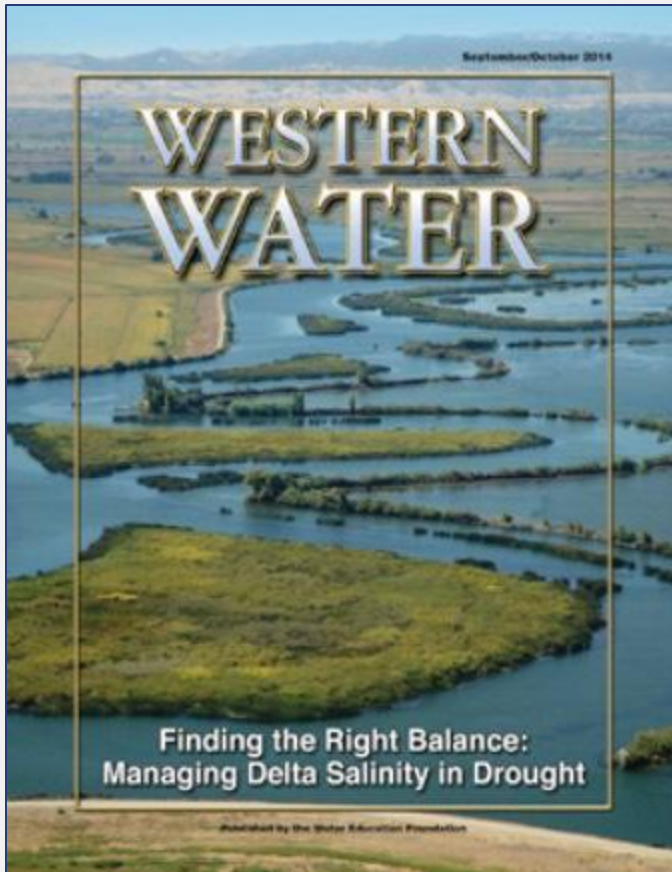
- From Gilbert et al. 2012. The Impact of Drought on Coastal Ecosystems in the Carolinas

What is coastal drought?



- From Gilbert et al. 2012. The Impact of Drought on Coastal Ecosystems in the Carolinas

What is coastal drought?



- <http://www.watereducation.org/western-water-excerpt/finding-right-balance-managing-delta-salinity-drought>
- <http://franklin.ifas.ufl.edu/uf-oyster-recovery-team/>

Why drought and coastal ecosystems?

- Drought is a significant stressor to coastal ecosystems, but ecological/drought information has not been systematically integrated into drought monitoring and response
- Available information is diverse, but not comprehensive
 - By ecosystem
 - How drought is defined and characterized
 - Temporal dimensions (seasonal v. multi-year events)
 - Episodic impacts v. broader, systemic change

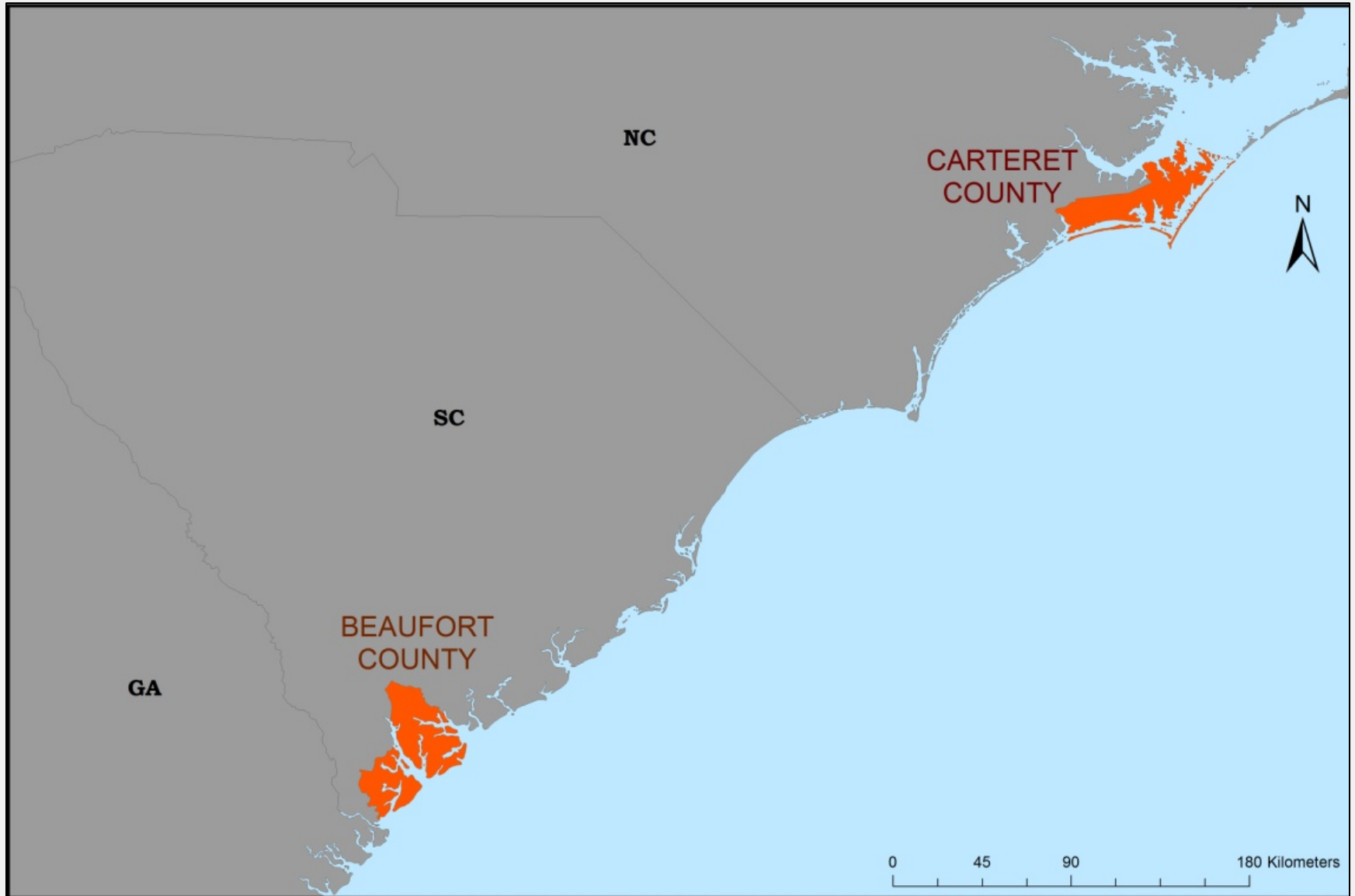
Interviews with local decision makers

Why interviews?

- **To learn first-hand about**
 - On-the-ground drought impacts in coastal regions of the Carolinas
 - Mechanisms for coping with drought impacts
 - Drought information use and needs
- **2 sets of interviews**
 - March-June 2013
Beaufort County, SC
 - Oct-Nov 2013
Carteret County, NC



Interviews



Who we interviewed

- **Commercial fisheries businesses (n=13)**
 - Shrimpers, crabbers, other commercial fishermen
 - Seafood houses
- **Recreational fishing businesses (n=6)**
 - Fishing guides, charter boats
- **Fishing – research and extension (n=6)**
- **Outdoor recreational businesses (n=6)**
 - Kayakers, ecotourism companies
- **Land/refuge managers (n=11)**
 - National Wildlife Refuges
 - Public and private parks and preserves
 - National Estuarine Research Reserves



Analysis of drought impacts: What are we looking for?

**Direct
physical
impacts**

**Indirect
impacts on
species,
ecosystems**

**Interactions
with other
climate,
biological,
and human
stressors**

**Secondary,
indirect
impacts to
individuals,
businesses,
organizations**

**Responses &
adaptations
by affected
groups**



What is coastal drought?

- **Coastal drought, as articulated by interviewees, primarily involves**
 - 1) changes to water quality conditions, particularly increasing salinity levels and fluctuations
 - 2) changes in the availability and timing of freshwater to support animals, plants, and habitats

Cascading impacts (refuge management example)

Direct impacts

Water quality conditions, salinity

Freshwater inputs, water levels

Soil conditions

Indirect (ecological) impacts

Stressed vegetation

Species composition changes and shifts

Increased fire risk

Interacting stressors

Human: water management, land use

Weather/climate: local conditions, sea level rise

Biological: invasive species

Socioeconomic impacts

More difficult to manage refuges for optimal conditions

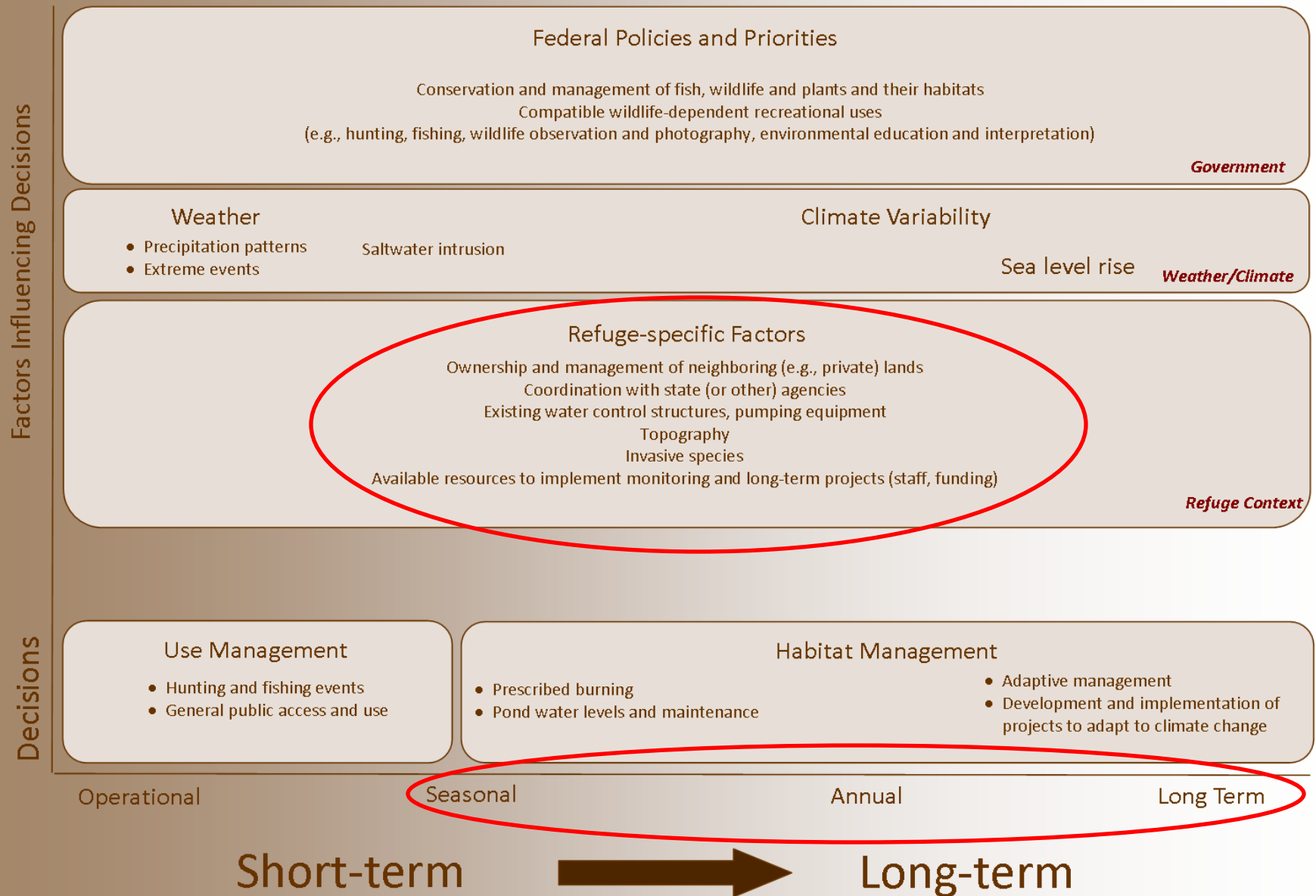
Fishing and hunting events cancelled; local businesses affected

Responses

Balance competing interests and priorities

Long-term monitoring and adaptation projects

Decision-Making Continuum for Refuge Managers



Information use and needs for a drought early warning system (all groups)

- **Drought matters**

- But, limited use of existing information and tools
- Concerns about impacts are:
 - Sector-specific
 - Context-dependent
 - local variability and diversity, “micro-climates”

- **Salinity matters**

- **Extremes matter**

- Timing, duration, seasonality of drought and other events
- Flooding and “drought busters”

Information use and needs for a drought early warning system (refuge managers)

- **Site-specific monitoring**
- **Greater use of external information**
- **Partnerships with peer groups and colleagues**
- **Needs:**
 - **Fit with decision time frames**
 - seasonal, annual, >1 year
 - **Baseline data**
 - what is “normal” (e.g. frequency of drought events, recovery periods, groundwater recharge rates)
 - **Ecological indicators**
 - link biological impacts, thresholds, and responses
 - **Early warning, seasonal forecasts might be useful**

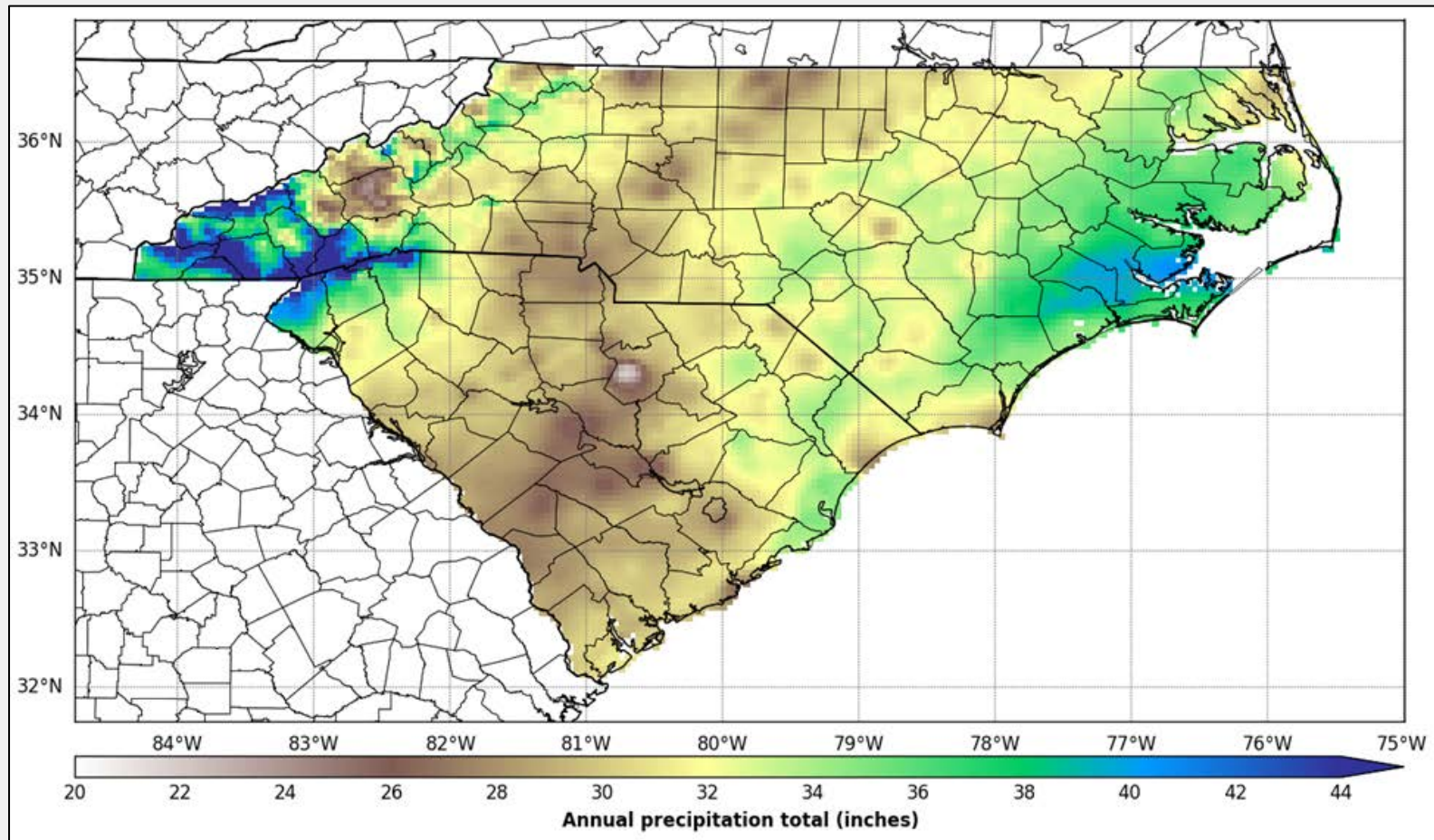
Ongoing pilot projects

NIDIS-Coastal Carolinas projects

- **Coastal drought index (CDI)**
 - Based on USGS salinity and streamflow data
 - *Paul Conrads (USGS SC Water Science Center)*
- **Indicators and indices of drought in southeastern coastal ecosystems**
 - Work with refuge managers to characterize ecological drought
 - Relate ecosystem impacts to the CDI, develop triggers and thresholds
 - *Dan Tufford (CISA), David Chalcraft (East Carolina Univ.)*
- **Assessment of drought indicators for coastal zone fire risk**
 - Which drought index is the best indicator of fire risk in coastal organic soils?
 - *Ryan Boyles (NC State Climate Office)*
- **Forecasting blue crab distributions using an individual-based population model (IBM)**
 - Links freshwater discharge data with an IBM to forecast blue crab abundance and landings
 - *Michael Childress (Clemson University)*

Atlas of Hydroclimate Extremes for the Carolinas

- **CISA team, collaborative project**
 - Annual precipitation totals during the driest year on record (1895–2013) for each 4 x 4 km pixel across the Carolinas region



For more information, visit:

<http://www.drought.gov/drought/regional-programs/coastalcarolinas/coastal-carolinas-projects>

<http://www.cisa.sc.edu/coping.html>

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