Drought Indices in Decision-making Process of Drought Management

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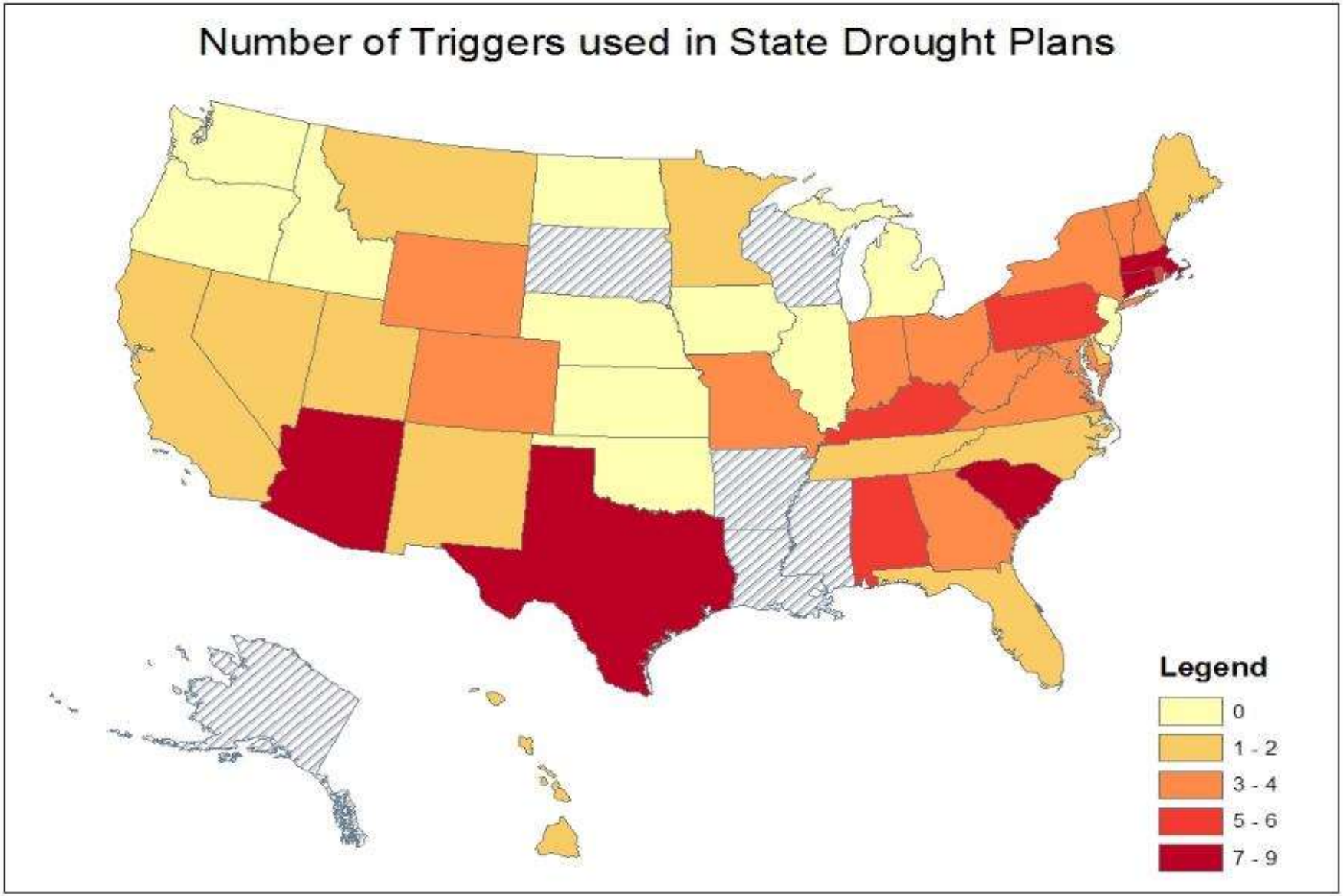
Drought and Drought Indices

- Devastating phenomenon, effects water supply and other resources.
- Hard to measure due to various temporal and spatial scales; can be measured by by rainfall deficit as well as impacts.
- Drought indicators are uses to measure and assess droughts.
- **Drought index** value is typically a single number and is **more useful than raw data** for decision-making.
- All drought indices have **+** and **–** , some sector-specific.

Proactive Drought Management

- Proactive (risk management) vs. Reactive (crisis management) approaches.
- Proactive drought management strategies can reduce and virtually eliminate drought impacts (Wilhite, 2000).
- Evaluation of drought conditions by decision-makers is important issue.
- Previous research (Mizzell, 2008) identified how decision-makers in water systems and power companies use drought indices.

This research studies use of drought indices in decision-making process by the SC's Drought Response Committee.



Svoboda, NDMC, 2011

SC Drought Policy

- SC has proactive drought monitoring and management program.
- The state was among the first to formulate drought management plan in 1982.
- The Drought Response Act (DRA) was first enacted in 1985 and amended in 2000.
- The South Carolina Department of Natural Resources (DNR) moderates work of the Drought Response Committee (DRC).
- DRC consists of statewide (state agencies) and local committee members.
- Indicators are not anticipated to be a perfect match.

South Carolina Drought Response Act 2000. *Code* of Laws of *South Carolina*, 1976, § *49-23-10* et seq., as amended.

Research Objective

- How the information from different drought indices (PDSI, PHDI, Z-Index, CMI, SPIs, KBDI, USDM) relates to DRC drought status declaration through considering measures: **onset, duration, severity and recovery***.

* Drought Response Committee (DRC) – South Carolina drought decision-making body; PDSI - Palmer Drought Severity Index; PHDI - Palmer Hydrological Drought Index; Z-Index - Palmer Z-Index; CMI - Crop Moisture Index; SPI - Standard Precipitation Index; KBDI - Keetch-Byram Drought Index; USDM - U.S. Drought Monitor.

Hypothesis

- Overarching: DRC is not consistent with any single index as measured by correspondence with onset, duration, severity and recovery.
- Sub-hypotheses:

A) DRC lags behind entering drought.

B) DRC and indices identify different duration.

C) DRC and indices have different drought severity.

D) DRC lags behind in drought recovery.

Methodology

Study Period: Jan. 2000 – Dec. 2008
on a monthly scale, includes droughts of
2000-2002 and 2007-2008.

South Carolina counties

- Charleston
- Florence
- Edgefield
- Richland
- Oconee

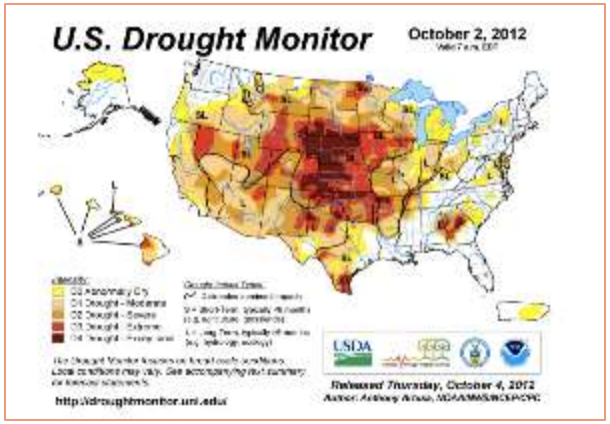
Methodology

- **Data collection**:

- SC Department of Natural Resources,

- U.S. Drought Monitor (USDM),

- Dynamic Drought Index Tool for Basins of North and South Carolina.



Database	Time Coverage	Frequency	Data Points for the Study Period
DRC Reports	Jul. 1998 – Jul. 2012	Every 4-6 week when drought	31
DDIT	Jan. 1950 – Sep. 2009	Daily, weekly and monthly: depends on the index.	Daily KBDI – 3288 Weekly CMI – 468 Monthly other – 108
DM data	May 1999 – Sep. 2012	Weekly	468

Methodology

- **Data calibration/coding**

- Weekly and daily to monthly values.
- Monthly data then into drought categories **incipient, moderate, severe and extreme.**

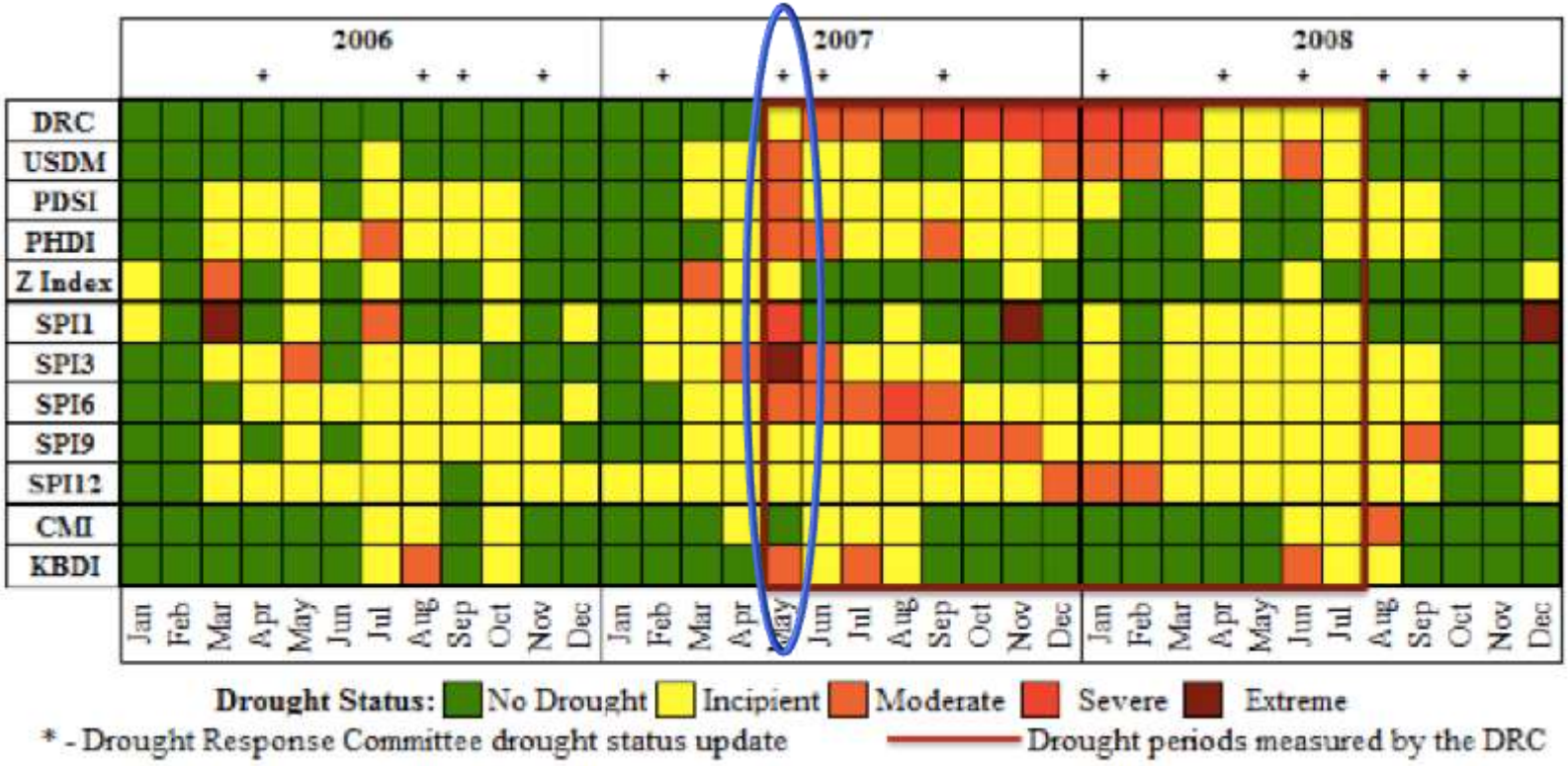
- **Data analysis**

- Visual analysis of figures and descriptive statistics.

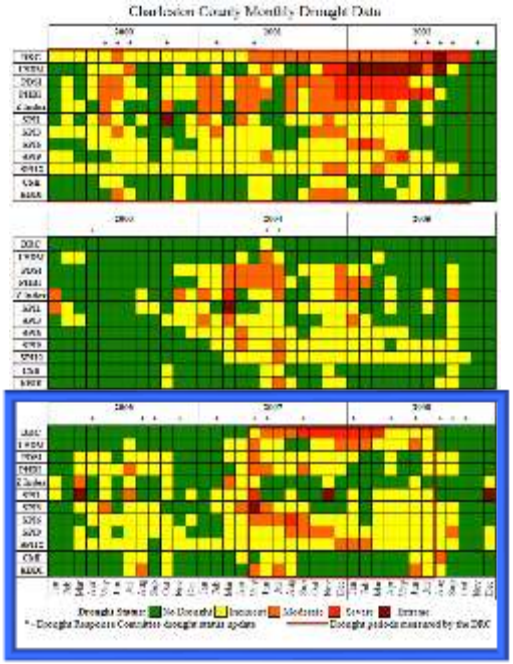
- **Limitations**

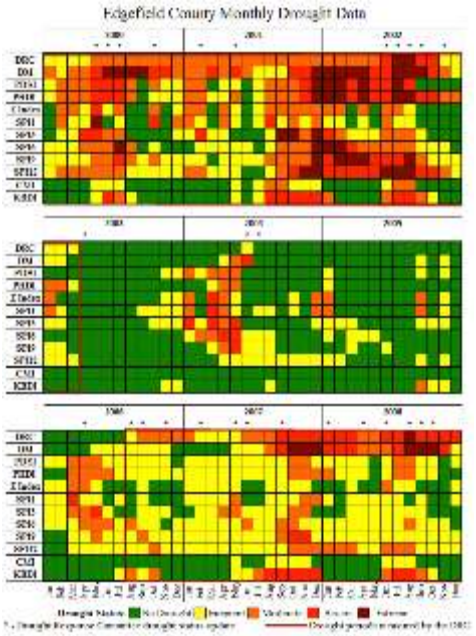
- Nine years of data, but includes two drought periods.

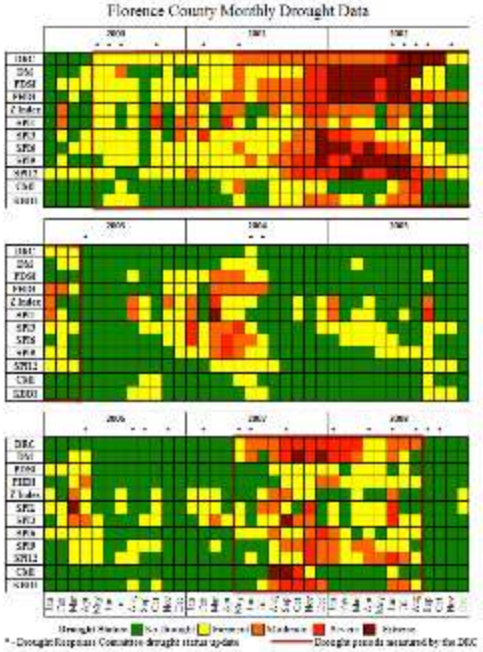
Results

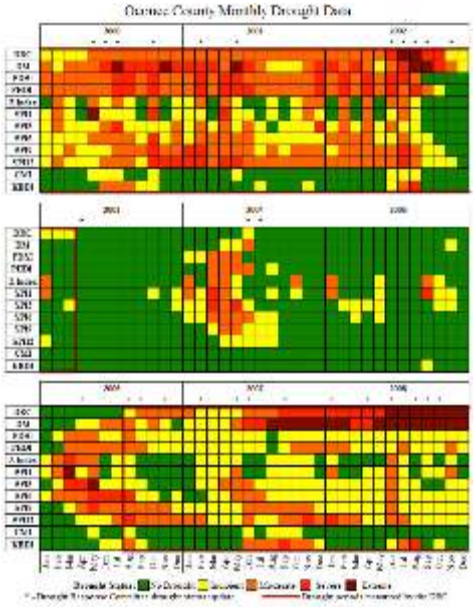

2006
2007
2008
DRC
USDM
PDSI
PHDI
Z Index
SPI1
SPI3
SPI6
SPI9
SPI12
CMI
KBDI
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Drought Status: No Drought Incipient Moderate Severe Extreme
* - Drought Response Committee drought status update
Drought periods measured by the DRC

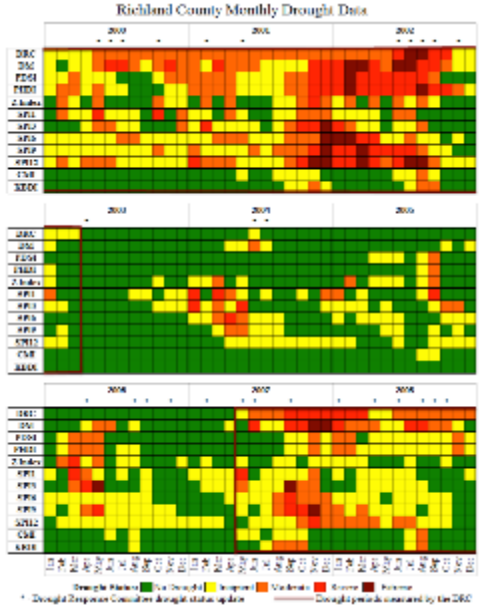
Results for Charleston, Edgefield, Florence, Oconee and Richland counties.











Key Results

As it was expected, no index measured drought onset, duration, severity and recovery the same way as the DRC.

Onset: DRC changes less frequently than indices, in most cases DRC lagged to detect drought by at least 2-3 months.

Duration: DRC values change less frequently than other indicators.

Severity: DRC tends gradually change drought severity and stays on conservative side.

Recovery: DRC consistent with indices in measuring drought recovery and lagged less than in measuring onset.

Other Results

- Charleston County experienced the least number and Edgefield County the largest number of drought months for study period.
- **USDM** demonstrated the highest drought severity among drought indices.
- **SPIs** good measure for developing drought conditions, however, in most cases, showed lower severity than USDM, PDSI and PHDI.
- **CMI** and **KBDI** measure shorter drought duration than other indices, but DRC tends to consult these indices because **direct link to agriculture and fire risk** impacts on the ground.

Conclusion: Significance

- Complexity of drought measurement and evaluation in decision-making process.
- Highlights the **need for multiple indices**, some of them **sector-specific,** link indices with **impacts on the ground.**
- South Carolina drought management program is a valuable examples of an assessment of drought indicators for policy purposes.

Ultimate Goal – Drought Resilience

http://bit.ly/1nCHJTX

Thank you for your attention.

Questions or Comments?

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