Supporting Drought Adaptation through Stakeholder Engagement

cisa carolinas integrated sciences & assessments

RISA Regional Integrated Sciences and Assessments

Introduction

Carolinas Integrated Sciences and Assessments (CISA) is part of the NOAA Regional Integrated Sciences and Assessments (RISA) program. We examine how decision makers currently use climate information to manage water and how such use could be expanded most beneficially. A strong component of CISA's work has centered on drought. This poster illustrates the ways CISA has engaged with stakeholders to conduct research and develop tools (e.g. DDIT) to help improve drought preparedness.

Dynamic Drought Index Tool (DDIT)

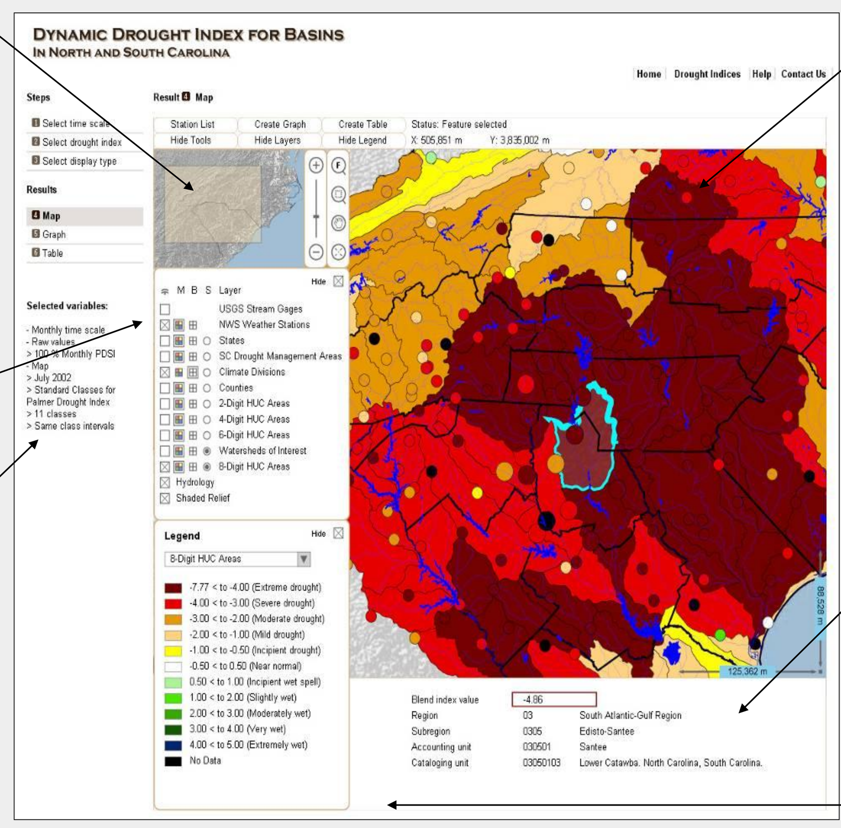
The DDIT allows users to choose raw values or percentiles, or to blend multiple drought indices. By default, indices are displayed in choropleth map form with options to manipulate the classification method. The application provides a classification scheme for each drought index and allows the same color scheme as the U.S. Drought Monitor. Users may overlay points (weather stations, stream gages), lines (e.g. streams), and polygons (e.g. states, counties, drought management areas, climate divisions, USGS HUCs), and see the contributing station data, or aggregate to their own spatial units.

The DDIT with weather stations, streams and lakes, climate division boundaries, and 8-digit HUCs.

Map navigation tools allow users to zoom in and out, to pan to a particular region, and to create a new map extent or map center.

Each layer can be shown or hidden.

Users can see their selections including time scale, raw data or percentiles, or weights for each variable for blending, classification method, the number of classes, etc.

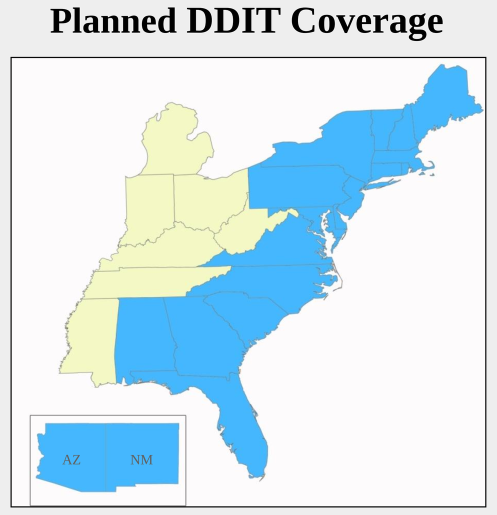


Weather stations used for the selected polygon are shown as larger circles. The list of these stations can be exported as a table.

The application provides a variety of metadata features. A roll-over feature displays the label and value for each point and polygon.

Legend for the selected classification scheme.

Planned DDIT Coverage



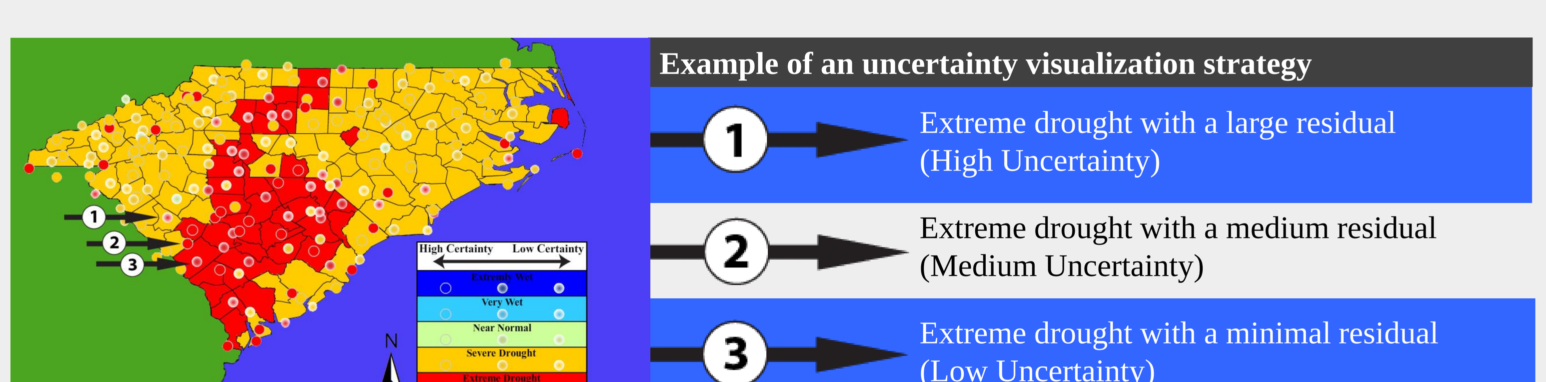
NOAA's Transition of Research Applications to Climate Services (TRACS) program is funding the expansion of the DDIT to states served by the Northeast and Southeast Regional Climate Centers.[1] This will involve integrating the tool with the Applied Climate Information System (ACIS) database, adjusting its interface and functionality to ongoing user response, and working with user groups to evaluate its effectiveness in decision making.

[1] A prototype for Arizona and New Mexico has also been developed.

Communicating Uncertainty Cartographically

Cartographic information is often assumed to be accurate. However, maps are simplified representations of reality and contain sources of error and uncertainty. It is important to inform decision-making by communicating the uncertainties inherent in maps.

CISA research tests the effectiveness of visualization strategies to display drought indices concurrently with uncertainty measures. The map below, using cross-validation to measure interpolation errors, demonstrates one approach.



Assessing Drought Triggers

The DDIT was used to compare seven drought indicators (Table 1) defined in South Carolina's Drought Response Program regulations. Indicators are used to measure drought intensity, and management plans use drought triggers in planning for response. Accurate and reliable indicators are necessary for effective decision making before, after, and during drought (Steinemann and Cavalcanti 2006).

Drought Indicator	Incipient	Moderate	Severe	Extreme
Palmer Drought Severity Index (PDSI)	-0.50 to -1.49	-1.50 to -2.99	-3.00 to –3.99	< -4.00
Standardized Precipitation Index (SPI; 3-, 6-, 9- month)	0.00 to -0.99	-1.00 to -1.49	-1.50 to –1.99	< -2.00
US Drought Monitor (USDM)	DO	D1	D2	D3+
Crop Moisture Index (CMI)	0.00 to -1.49	-1.50 to -2.99	-3.00 to -3.99	< -4.00
Keetch-Byrum Drought Index (KBDI)	300 to 399	400 to 499	500 to 699	> 700
Streamflow	Average daily stream flow for two consecutive weeks			
	111% to 120% of the 5% monthly flow	101% to 110% of the 5% monthly flow	Between 5% monthly flow and 90% of the 5% monthly flow	Less than 90% of the 5% monthly flow
Groundwater (Levels from the surface)	80% to 90%	90% to 95%	95% to 98%	98% to 100%

Table 1: SC Drought Response Program indicators.

Decision makers typically rely on multiple triggers without realizing their spatial and temporal inconsistencies. This study identified inconsistencies in the frequency of drought stages according to different indicators. For example, several indicators would place South Carolina in a drought between 40-50% of the time (Figure 1). Figure 1 also shows that CMI and streamflow vary most from the other indicators at the severe and extreme levels. Streamflow has the lowest occurrence (5.84%) of all drought levels combined. Although there are consistencies between the KBDI and groundwater indices, these are not based on similarities in calculation.

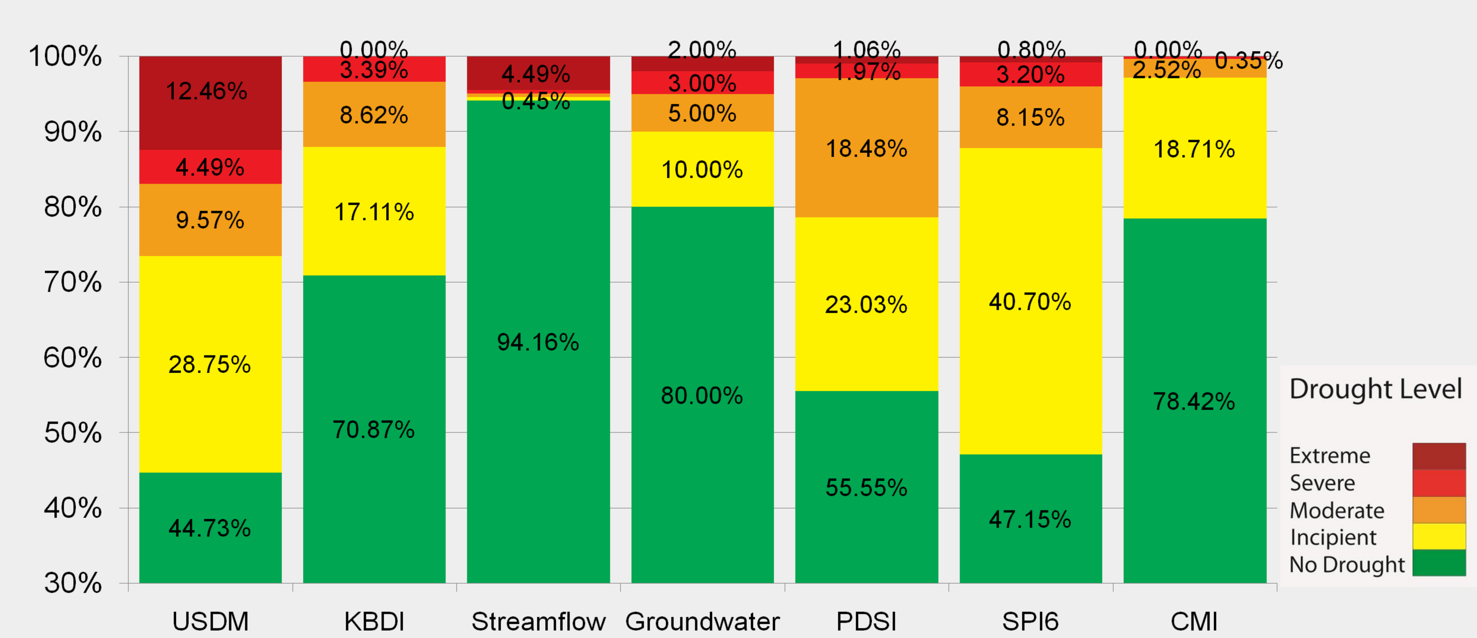


Figure 1: Frequency of drought class severity measured by different indices.

Figure 2 compares the seven South Carolina drought indicators for one station in Florence over the period from January 2000 to April 2009. This temporal mapping illustrates the difficulties in determining when a drought begins, when it changes levels, and when it can be determined to have ended. For example, in 2005-2006 streamflow indices are frequently in severe and extreme stages while other indices are at incipient or normal levels. This inconsistency has important implications for determining action in response to drought levels.

The differences among many of the indicators can primarily be attributed to the inconsistencies in the drought level ranges defined by South Carolina's drought regulations. A possible solution for using multiple and often statistically inconsistent indicators is to transform all indicators to percentiles (Steinemann and Cavalcanti 2006). The DDIT can be used to calculate percentile indicators.

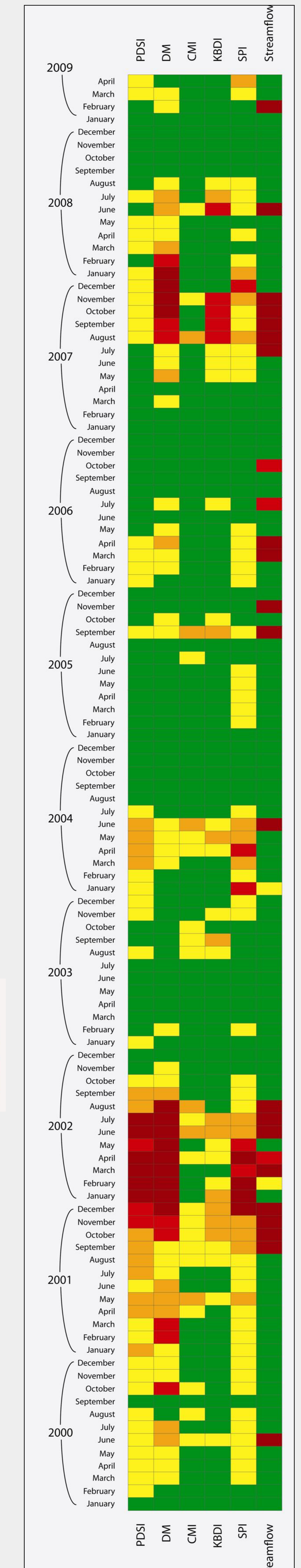


Figure 2: Monthly drought classification. Florence, SC 2000 – 2009.

Improving Understanding of Stakeholder Adaptations and Capacities

Institutions and Drought Management Adaptations in the Carolinas

This research focuses on changes in drought management in Carolinas river basins undergoing hydropower relicensing since 2003. Findings include:

- Water system adaptations frequently address local and system-specific water management stresses rather than drought directly.
- Management strategies have expanded from local, structural, and supply-oriented solutions to include: 1) non-structural methods of securing supply, 2) demand management, 3) drought planning, and 4) diverse stakeholders in decision-making.
- Successful implementation of new drought response plans will entail political acceptance and willingness to enforce water restrictions, new communication networks, and changes to water rates and rate structures.
- Multiple levels of adaptations benefit overall capacity.

A CISA stakeholder workshop in Georgetown, SC, March 2010.

Stakeholder Online Surveys and Workshops

In March 2010 CISA worked with the NC Urban Water Consortium to learn about impacts and concerns; stakeholders' use of drought data; and preferences for new tools and information. This research builds National Integrated Drought Information System (NIDIS) efforts to develop an early warning system in the Southeast. Topics discussed include:

- How the 2007-2008 drought impacted supply and demand. Each system relies on local data to manage drought events and uses its unique "drought of record" as a planning benchmark. Managers consider seasonal forecasts when supplies deviate from "normal" patterns.
- The importance of understanding processes that shape local supply availability and spatial variability of water supplies. Priorities include more monitoring gages; improved "moving-out-of-drought" indicators; weather and inflow probabilities; historical comparisons; better understanding of how land use changes influence hydrology; and models that produce a range of water supply scenarios.
- Management concerns related to implementing response plans and reduced revenues due to water restrictions. Fragmented water management jurisdictions, with different response plans, negatively effect communications.
- The need for education programs targeted towards the public and decision-makers about linkages between water supply sources and drought risks.

References

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