Drought Management and Response Discussion – Part 1

John Boyer

Agenda Item 6

Per the Planning Framework, the Specific Drought Response-related Obligations of the RBC, with Support from SCDNR, are:

1. Collecting and evaluating local hydrologic information for drought assessment.
2. Providing local drought information and recommendations to the DRC regarding drought declarations.
3. Communicating drought conditions and drought declarations to the rest of the RBC, stakeholders, and the public.
4. Advocating for a coordinated, basin-wide response by entities with drought management responsibilities.
5. Coordinating with other drought management groups in the basin as needed.

Planning Framework Outline for **Chapter 8. Drought Response**

1. Summarize **existing drought plans** and **drought advisory groups**
2. Summarize any **drought response initiatives** developed by the RBC
3. List **recommendations** on drought management or drought management strategies
4. Include a **communication plan** to inform stakeholders and the public on current drought conditions and activities regarding drought response

Drought Impacts to SC Upstate Agriculture

Greenville News

SOUTH CAROLINA

An Upstate drought ended in January. For farmers, the ramifications lasted for months.

Sarah Swetlik
Greenville News

Published 5:02 a.m. ET April 2, 2024 | Updated 1:41 p.m. ET April 3, 2024

Debbie Webster plants four pastures' worth of grass each fall to feed the horses, cows, sheep and goats that live on her farm in Oconee County. By February, her winter grasses would usually be about six to eight inches tall, the perfect size to help nourish each of her animals.

But this February, her winter grasses had barely reached two inches.

A fall drought in the Upstate forced Webster to plant her winter grasses in December last year. It's the latest she's ever planted, she said. She knew trying to grow grass out of the parched soil would be a waste of energy, money and seeds.

Livestock farmers typically sow plants animals can graze on throughout the year, referred to as cover crops, late in the fall and during the spring. But when farmers face a drought, planting times can get pushed and throw off the cycle.

A drought's impact goes far beyond short grasses. Sometimes, there isn't enough water for seeds to sprout, forcing farmers to plant again later in the season. Other times, farmers will have to supplement hay to feed their livestock. Both hurdles can cost thousands of dollars.

The 2023 drought followed a pattern of drier summers in the Upstate over the last 120 years. As the global temperature continues to increase, droughts could happen more often and become even more detrimental and more costly.

For Webster, the 2023 drought meant spending $7,000 more on hay than she did in 2022.

Take Aways from the Article:

- Farmers often see the effects of drought well before the state officially declares one.
- Warmer temperatures in the Upstate could mean more agricultural droughts and/or greater impacts.
- Some farmers are practicing "climate-smart" agriculture. They are basing decisions around weather patterns rather than traditional planting seasons.

Drought Monitoring in South Carolina

Elliot D. Wickham
Water Resource Climatologist
SC State Climatology Office

Drought Monitoring in South Carolina

South Carolina Drought Response Committee

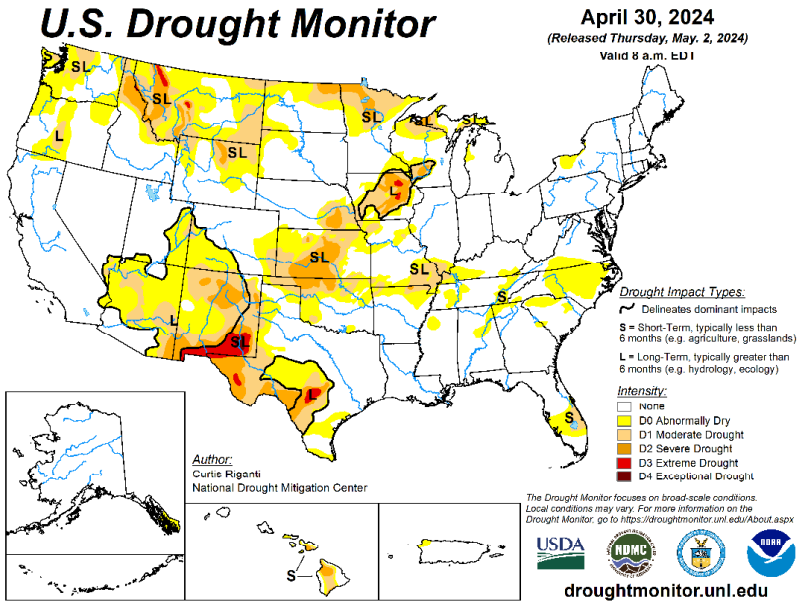
Current Status

Normal	46
Incipient	0
Moderate	0
Severe	0
Extreme	0

Number of Counties in Each Category

Latest Drought Committee Meeting: 01-11-2024

Drought Conditions >>> Find out more about current drought conditions, how drought status is determined in South Carolina, and view archived drought condition reports.

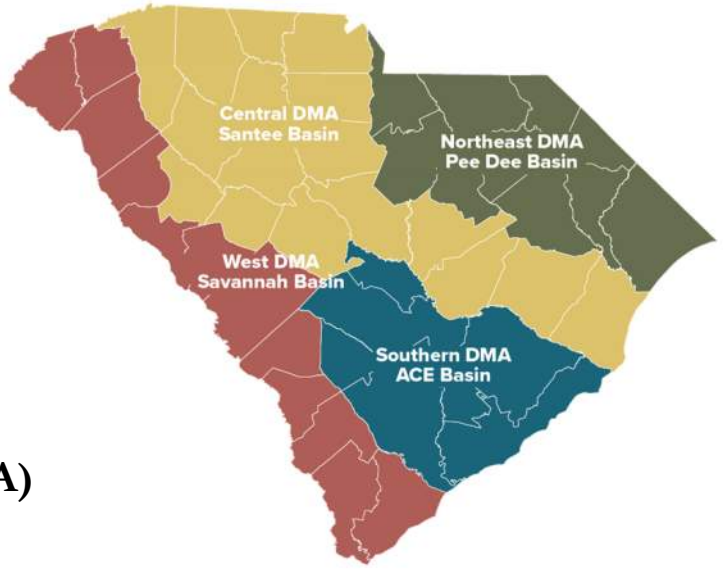


The SC Climate Office leads the drought monitoring efforts for the state

South Carolina Drought Response Committee (DRC)

Why: To carefully and closely monitor, conserve, and manage the State's water resources in the best interest of all South Carolinians.

Who: Drought Response Committee and Department of Natural Resources – State Climatology Office



Statewide members

- Forestry Commission
- Department of Agriculture
- Emergency Management Division
- Department of Health and Environmental Control
- Department of Natural Resources

Local members (12 per DMA)

- Water Utilities
- Regional Council of Governments
- Power Generation Facilities
- Soil and Water Cons. Districts
- Agriculture
- Domestic User
- Industry

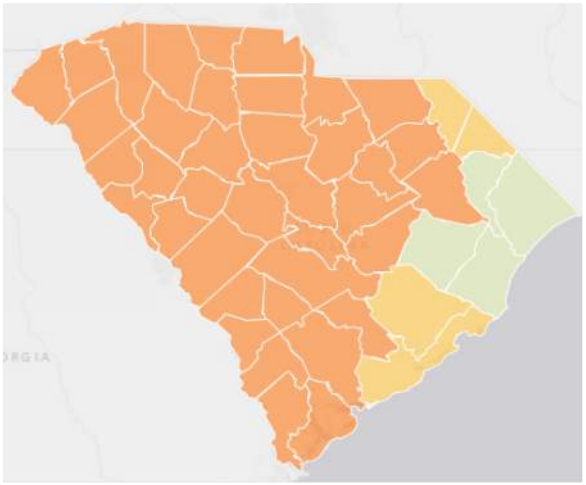
The DRC has 53 members

South Carolina Drought Response Committee (DRC)

The DRC:

1. Meets as needed
2. Makes county-level designations for drought severity
   - Normal
   - Incipient
   - Moderate
   - Severe
   - Extreme
3. At severe and extreme levels will make recommendations for non-essential water curtailment for **only** public water suppliers

SC Drought Declaration Map by County (10/17/2019)



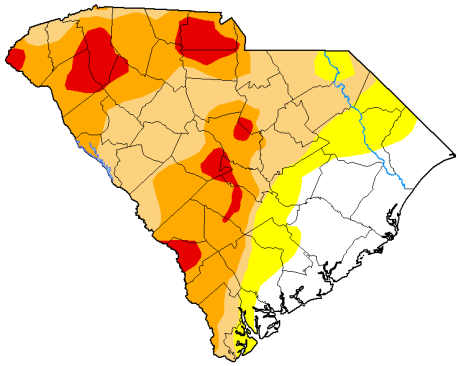
Public Water Suppliers:

1. Are required to have local drought management plans and response ordinances for water conservation and may enact their plans based on DRC county-level drought designations.

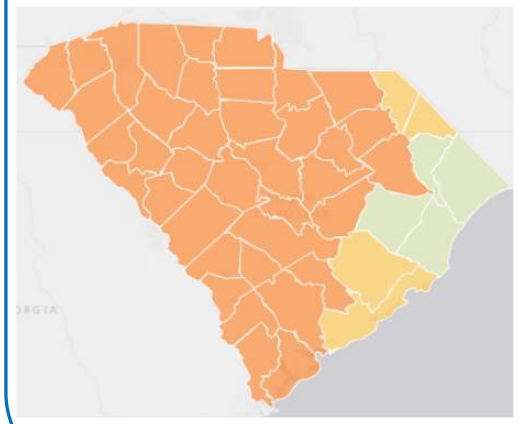
DRC Indicators

US Drought Monitor Map
10/15/2019

Intensity:
- None
- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional Drought



SC Drought Declaration Map by County (10/17/2019)



Normal | Incipient | Moderate | Severe | Extreme

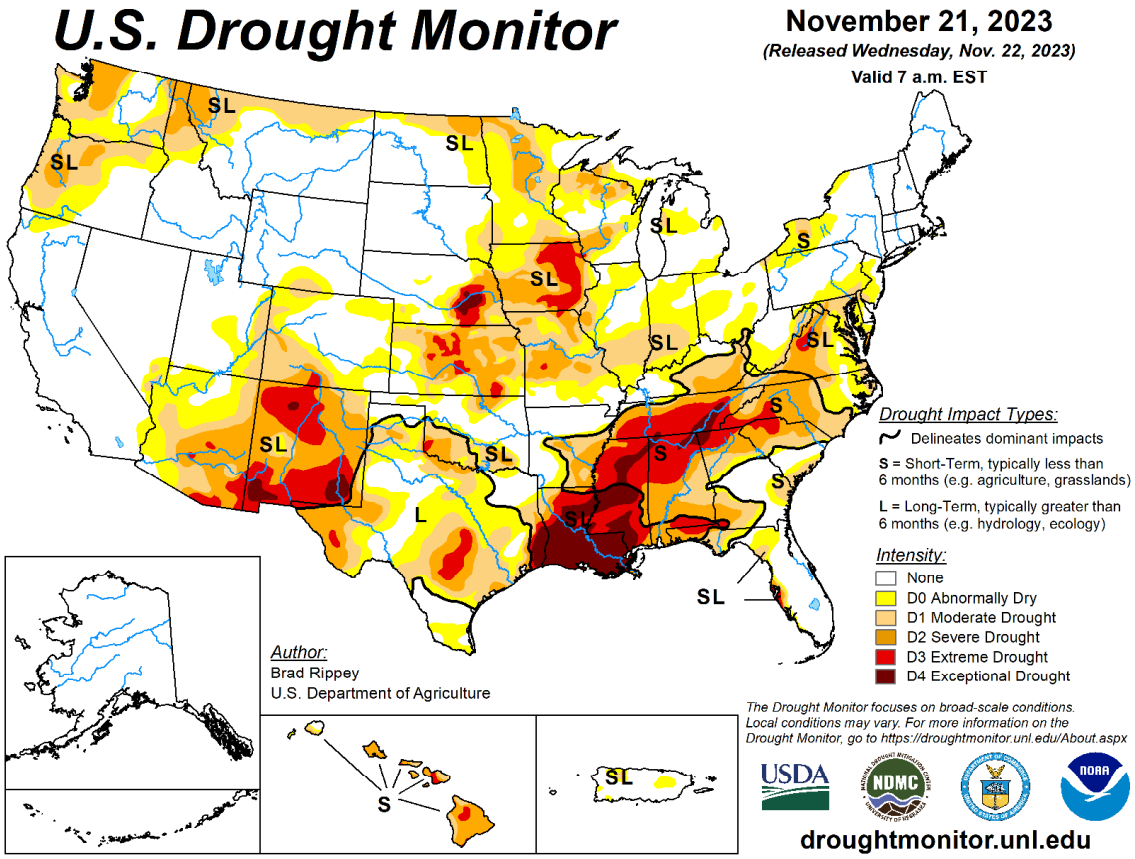
Indicators used for SC DRC

- Palmer Drought Severity Index (PDSI)
- Crop Moisture Index (CMI)
- Standard Precipitation Index (SPI)
- Keetch-Byram Drought Index (KBDI)
- Average daily streamflow
- Groundwater Levels

DRC Indicators and Severity Levels

INDICATOR	DROUGHT PHASE			
	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
CROP MOISTURE INDEX (CMI)	0.00 to -1.49	-1.50 to 2.99	-3.00 to -3.99	≤ -4.00
STANDARD PRECIPITATION INDEX (SPI)	0.00 to -0.99	-1.00 to -1.49	-3.00 to -3.99	≤ -2.00
KEETCH-BYRUM DROUGHT INDEX (KBDI)	300 to 399	400 to 499	500 to 699	≥ 700
U.S. DROUGHT MONITOR (USDM)	D0	D1	D2	≥ D3
AVERAGE DAILY STREAMFLOW	111%-120% of the minimum flow for 2 consecutive weeks (CW)	101%-110% of the minimum flow for 2 CW	Between the minimum flow and 90% of the minimum flow for 2 CW	≤ 90% of the minimum flow for 2 CW
GROUNDWATER, STATIC LEVEL IN AQUIFER	between 11-20ft above trigger level for 2 consecutive months (CM)	between 1-10ft above trigger level for 2 CM	between trigger level and 10ft below for 2 CM	≤ 10ft below the trigger level for 2 CM

The United States Drought Monitor (USDM)

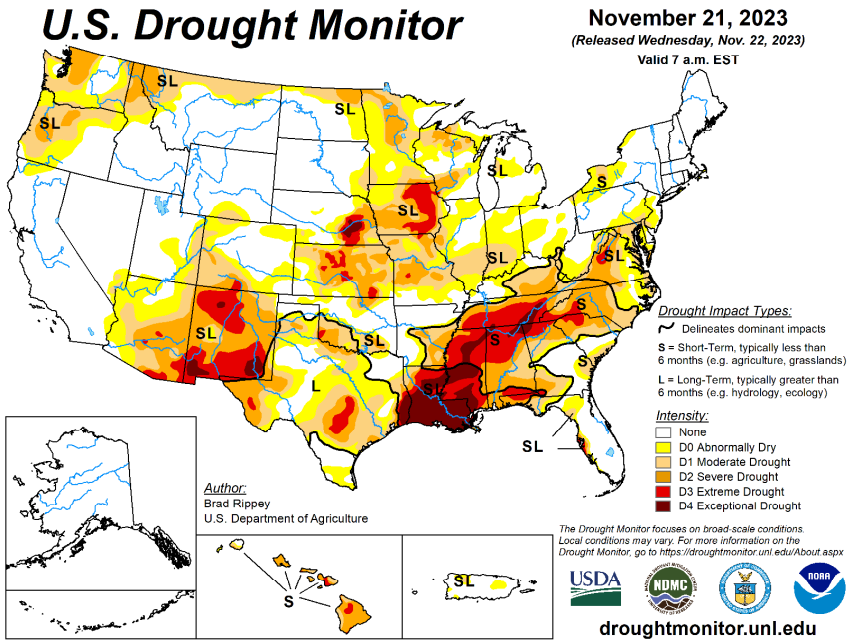


National product to map drought severity and extent

Aims to capture and depict all types of drought

Some programs use this product for agricultural aid

The USDM Process



The map is updated each week by one author

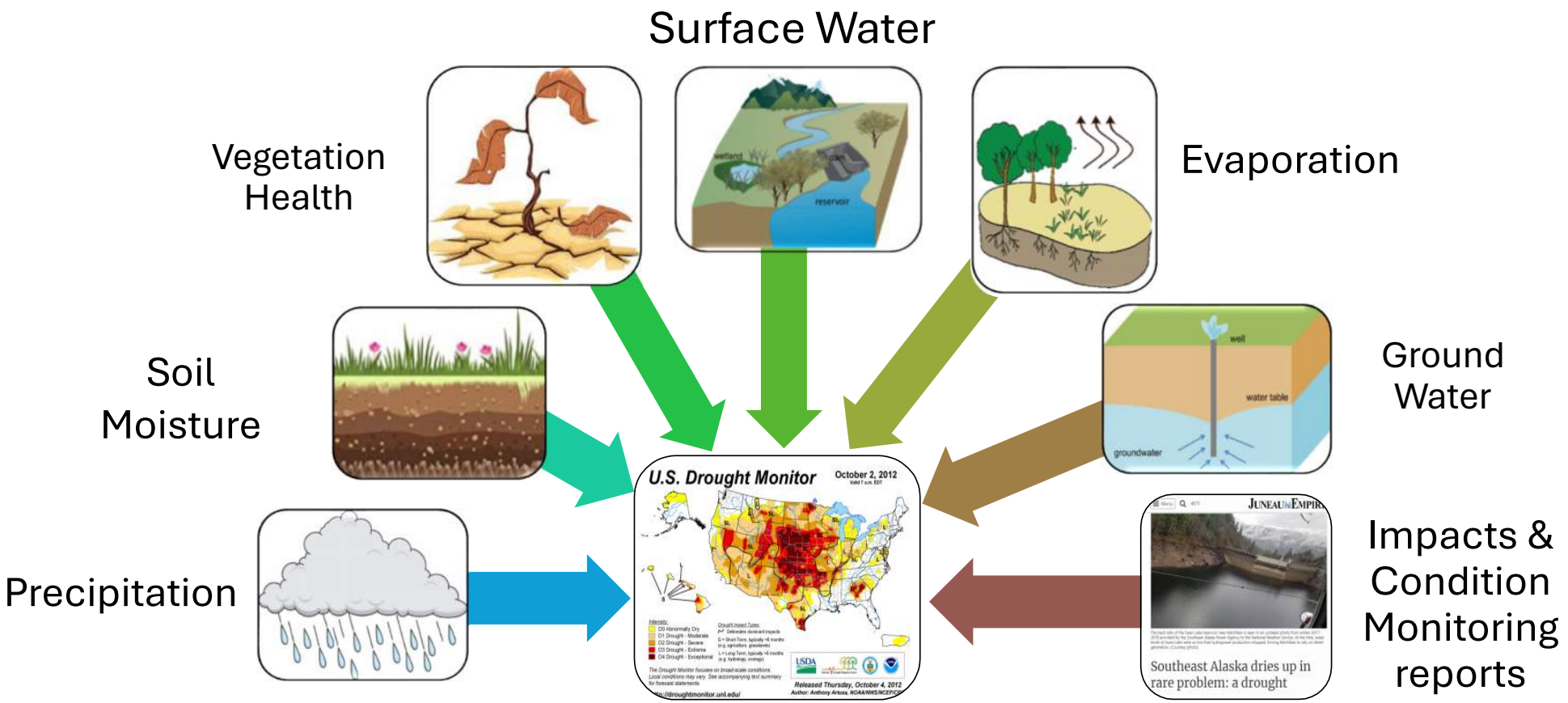
All authors are part of federal entities

USDM categories are based on convergence of evidence from multiple data points & indicators

Most states provide input to help the author accurately depict local conditions

The author gets final say on what the map depicts

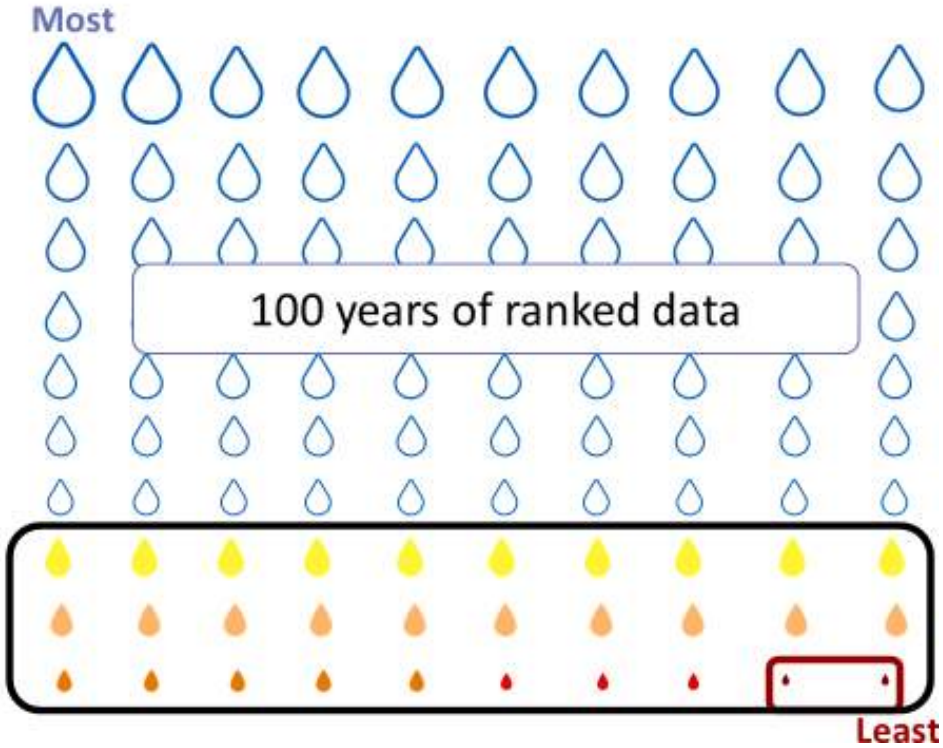
The USDM Process: Data



The USDM Process: Categories

Intensity is based on historical likelihood

		Percentile
	None	31-100
Not Drought	D0 Abnormally dry	21-30
Drought	D1 Moderate drought	11 - 20
	D2 Severe drought	6 - 10
	D3 Extreme drought	3 - 5
	D4 Exceptional drought	1 - 2



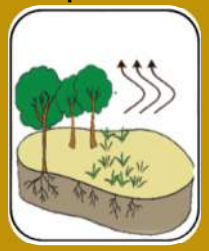
South Carolina and USDM: Weekly Data Review

Precipitation

Timesteps:
- 14 days
- 30 days
- 60 days
- 90 days
- Others as needed

Data:
- Observed
- Departure of normal
- Percent of normal
- Standard Precipitation Index (SPI)

Evaporation



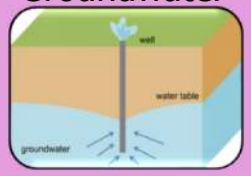
Data:
- Evaporative Demand Drought index (EDDI)
- Stand Precipitation Evaporation Index (SPEI) (see SPI)

Surface Water

Timesteps:
- Real time
- Daily average
- 7-day average
- 14-day average
- 28-day average

Data:
- Flow values (cfs)
- Percentile rankings

Groundwater



provided by SCDNR hydrology each week, reflecting values in percentiles

Soil Moisture

Depth (remote sensed)
- 10cm
- 40cm
- 100cm
- 200cm

Data:
- Volumetric
- Relative
- Percentile

Reports

- CoCoRaHS Reports
- CMOR Reports
- FSA County Reports

Vegetation Health

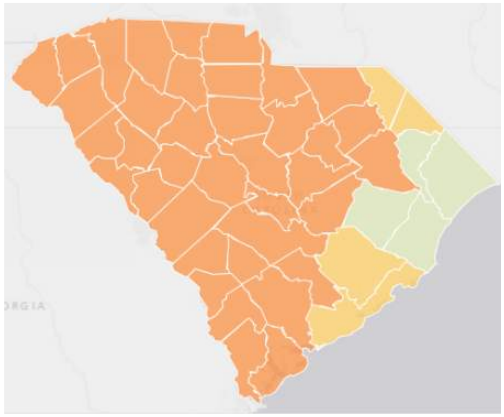
VegDRI, weekly product based on remotely sensed data

USDM vs SC DRC

	USDM	SC DRC
Agency Leads	Authors are from Federal Agencies (NDMC, NOAA, and USDA)	Five State Agencies (DNR, DHEC, SCDA, EMD, SCFC)
Participants	Federal and State Agencies, as well as universities and other entities that monitor conditions	Local stakeholders (Water suppliers, agriculture, conservation districts, power generation, local gov.)
Frequency	Weekly product	Committee convenes as needed when conditions warrant discussion.
Severity Levels	Abnormally dry, Moderate, Severe, Extreme, & Exceptional Drought	Incipient, Moderate, Severe, and Extreme Drought
Allows for	Federal disaster declarations and loans for agriculture	Used to determine non-essential water use curtailment recommendations for public water suppliers in South Carolina.

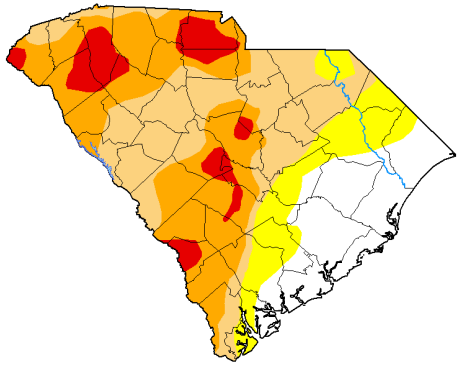
Why the Maps Look Different?

SC Drought Declaration Map by County (10/17/2019)



US Drought Monitor Map

10/15/2019



Time:

- DRC map updated as needed
- USDM updated weekly

Indicators:

- Used indicators are similar, yet different
- Spatial and temporal variations
- DRC uses indicator thresholds, USDM uses percentile rankings
- DRC designations follow county lines, USDM designations follow data "polygons"

Process Outcomes

DRC:

1. County-level drought designations that can result in local public water systems enacting their drought management plans.
2. At severe and extreme levels will make recommendations for non-essential water curtailment for **only** public water suppliers

The outcomes of DRC process relates to public water suppliers.

USDM:

1. The (USDA) may use the USDM for agricultural aid depending on severity and temporal extent for the following programs:
   - Crop Insurance
   - Conservation Reserve Program Haying and Grazing
   - Emergency Conservation Program
   - Emergency Forest Restoration Program
   - Farm Loans
   - Environmental Quality Incentives Program
   - Emergency Watershed Program
   - Livestock Forage Program

The outcomes of USDM process relate to Agriculture.

Questions?

Elliot D. Wickham

Water Resource Climatologist

Cell: **803-465-1098**

Email: **wickhame@dnr.sc.gov**

Drought Management and Response Discussion – Part 2

John Boyer

Agenda Item 7

Drought in urban water systems: Learning lessons for climate adaptive capacity

Lisa Dilling[a,*], Meaghan E. Daly[b], Douglas A. Kenney[c], Roberta Klein[d], Kathleen Miller[e], Andrea J. Ray[f], William R. Travis[g], Olga Wilhelmi[e]

[a] Environmental Studies Program and Western Water Assessment, UCB 397, University of Colorado Boulder, Boulder, CO 80309, United States
[b] Department of Environmental Studies, University of New England, 11 Hills Beach Road, Biddeford, ME 04005, United States
[c] Western Water Policy Program, UCB 401, University of Colorado Boulder, CO 80309-0401, United States
[d] Center for Science and Technology Policy Research, UCB 0488, University of Colorado Boulder, Boulder, CO 80309, United States
[e] Research Applications Laboratory, National Center for Atmospheric Research, 3090 Center Green Drive, Boulder, CO 80301, United States
[f] NOAA Earth System Research Laboratory, Physical Sciences Division, 325 Broadway, Boulder, CO 80305, United States
[g] Department of Geography and Western Water Assessment, UCB 260, University of Colorado Boulder, Boulder, CO 80309, United States

ARTICLE INFO

Keywords:
Flexibility
Conservation
Policy
Local
Fairness
Public acceptance

ABSTRACT

In this paper we examine current policies to combat drought in urban areas in the United States to illuminate lessons learned for building climate adaptive capacity. We conducted interviews with practitioners involved in drought management at urban water utilities across the U.S. to understand: 1) both short- and long-term actions taken in response to drought; 2) perceptions of what constitutes an 'effective' drought response and whether and how this was measured; and 3) limitations to drought response. We apply criteria from a theoretical framing of adaptive capacity and then 'reason by analogy' to understand how adaptive capacity may be built or constrained in the future by such responses, including how future actions may be otherwise limited by political, social, physical and other factors. We find that drought responses overall are seen as successful in reducing water demand and helping to maintain system reliability, but can also reduce flexibility and introduce other limitations. Public perception, the multi-purpose nature of water, revenue structures, expectations and other social factors play a dominant role in constraining drought response options. We also find that some urban water utilities face challenges in measuring the effectiveness of demand reduction strategies because it can be difficult to attribute water savings, especially those related to outdoor water use. The limitations in drought policies experienced by urban utilities offer important lessons for the ability of systems to innovate toward more sustainable water systems for the future.

The authors interviewed water utility managers from 19 urban areas to understand…

1. What were the short- and long-term actions taken in response to drought?

2. What constitutes an effective drought response and how was this measured?

3. What are the limitations to drought response?

Table 1
Most commonly mentioned responses to drought across the cities sampled.

	Policy Instrument	Examples
Demand Focused		
Mandatory Outdoor Use Restrictions	Watering schedules	Limited to certain days of the week
	Prohibiting certain uses	Filling ornamental fountains, pools, or washing car
	Enforcement	Ticketing, hotlines to "report" neighbors
Voluntary Outdoor Use Restrictions	Customer education, outreach	Advertising, targeted meetings, using local media
Incentives for Permanent fixture or landscaping changes	Rebates, fixture give aways,	Low flow toilets, money toward efficient appliances, money for removing turf
Rate adjustments	Tiered water rates, drought surcharges, raising water rates	
General public education on saving water	Customer education, outreach	
Planning	drought triggers, drought plan	Lake or reservoir levels, regional plan, interruptible supplies
Supply Focused		
New reservoir/increasing size of reservoir		
New long term contract		
New connection		New pumping connection, new way to alternate between sources
Diversifying water sources		Adding surface and desalination
Upgrading infrastructure		Fixing aging wells
Purchasing new water rights		Agricultural water
New ways of reusing wastewater		Pumping into lake to be retreated, use of greywater
Governance Changes	Complete reorganization of water delivery into centralized authority with obligation to provide water in return for agreed price, and environmental safeguards	
No action taken/solidarity		Sympathy program; or does not think about drought

What constitutes an effective drought response and how was this measured?

1. Reduction in per capita or overall water use
2. Ability to avoid mandatory restrictions
3. How supportive the public was in implementing response strategies
4. Ability to discontinue polices that limit use
5. Getting a positive response to communication efforts

They also gaged effectiveness of drought response in terms of…

1. **Robustness** - being less sensitive to changing conditions

2. **Flexibility** - the ability to change in response to altered circumstances

3. **Uncertainty** over how policies will work (if the measures rely on actions taken by others)

4. **Efficiency**, **Equity** and **Legitimacy**

What Are Some Lessons Learned and Limitations to Drought Response?

- Voluntary measures or community education initiatives were vastly preferred compared to mandatory restrictions.
- Public perception – neither supply side responses nor demand side responses were immune from public criticism.
- Drought surcharges were rarely utilized as they were seen to be quite unpopular.
- Being part of a regional plan provided a sense of solidarity.

What Are Some Lessons Learned and Limitations to Drought Response?

- Permanent reductions in demand allowed for a cushion between water supply and demand that could allow for banking water but made it difficult to achieve additional reductions in highly urban, low outdoor use contexts.
- Most utilities are not yet weighing the tradeoffs that may be present in dealing with drought risk in the near term and climate change in the long term.

What Are Some Lessons Learned and Limitations to Drought Response?

- Restrictions are more effective than pricing policies and tend to be more equitable across different income groups than pricing measures are, which fall more heavily on poorer households.
- A drought event itself may galvanize political will to implement policies that in normal years may not be publicly acceptable.
- Nearly every manager interviewed considered demand management an integral part of their practices: "***Our customers expect us to be in the business of encouraging efficient and environmentally sound use of resources***".

What Are Some Lessons Learned and Limitations to Drought Response?

"The issue of certainty in supply that we all grew up with no longer exists and we don't know how different it's going to be in the future, but we do know it's going to be different. *From a public policy perspective, we do well to prepare our organizations and our infrastructure to be flexible enough to deal with whatever comes at us, because we have that unequivocal obligation to meet demand. It's not only a contractual obligation. We're the people who produce the supply that puts out the fires and washes babies, so we've got to have the supply no matter what. When we fail, there's a whole lot of problems. We've got to be in a position to not fail."*

Environ Health Perspect. 2008 Apr; 116(4): A168–A171.
doi: 10.1289/ehp.116-a168
PMCID: PMC2291006
PMID: 18414616

Drought in the Southeast: Lessons for Water Management

John Manuel

Long spared the persistent droughts that have plagued the western United States this century, the Southeast suddenly finds itself the most rain-starved region of the country. In the face of this threat, policy makers and utility companies are struggling to identify sensible, sustainable options for managing the region's water. Although there currently is no immediate public health threat posed by the Southeastern drought, it does point to a very real situation in regions around the world that struggle to maintain an adequate supply of potable water.

According to the Intergovernmental Panel on Climate Change report *Climate Change 2007: The Physical Science Basis*, as global temperatures increase due to rising atmospheric concentrations of carbon dioxide, so does evaporation. That, combined with cyclical drought, could pose dire threats to water supplies. By one model, published in volume 78, issue 5 (2006) of the *Journal of Hydrometeorology*, if global warming–related precipitation changes continue apace, the percentage of the Earth's surface in severe drought could rise from the current 3% to 30% by 2100.

The Southeastern drought has already had serious economic consequences, according to the National Drought Mitigation Center at the University of Nebraska, which estimates in its Winter 2008 *DroughtScape* newsletter that 2007 losses to major field crops including corn, wheat, soybeans, cotton, and hay totaled more than $1.3 billion. Cattle farmers, nursery and landscape businesses, and recreation and tourism also have been hard hit. Low lake levels have forced power companies such as the Tennessee Valley Authority (TVA) and Duke Energy in North Carolina to reduce electricity generation from cheap, renewable hydropower and substitute more expensive and polluting fossil fuels. By the same token, if cooling reservoir levels were to fall far enough, it could force the shutdown of nuclear power plants.