

Regional Scale Drought Measures and Decision Making

APEC Climate Symposium
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Jakarta

Greg Carbone¹, Kirstin Dow¹, Kirsten Lackstrom¹,
Hope Mizzell², Jinyoung Rhee³, and Dan Tufford¹

¹University of South Carolina,

²South Carolina State Climate Office,

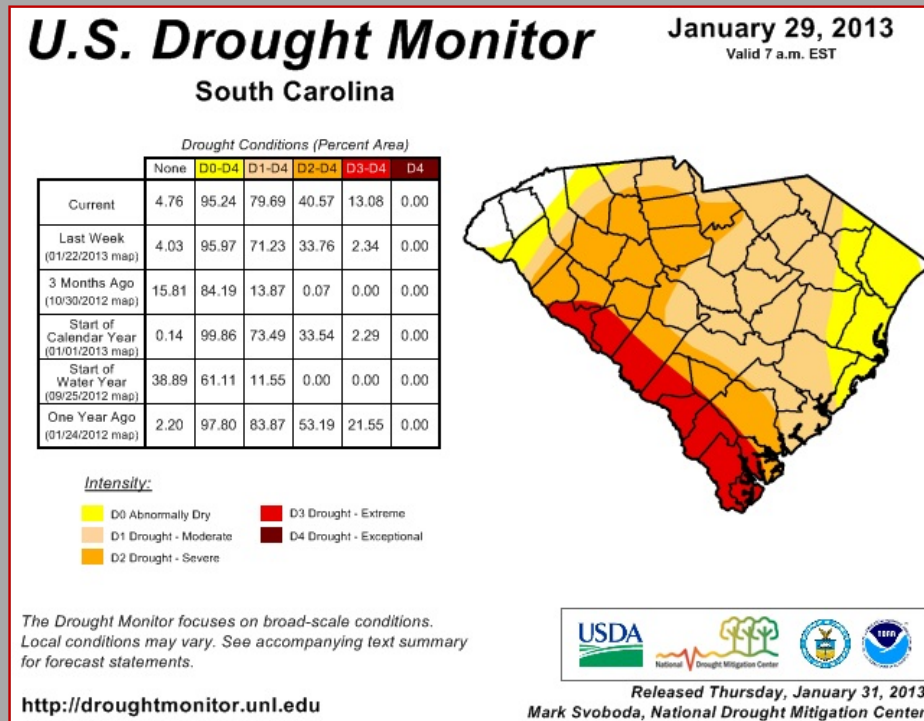
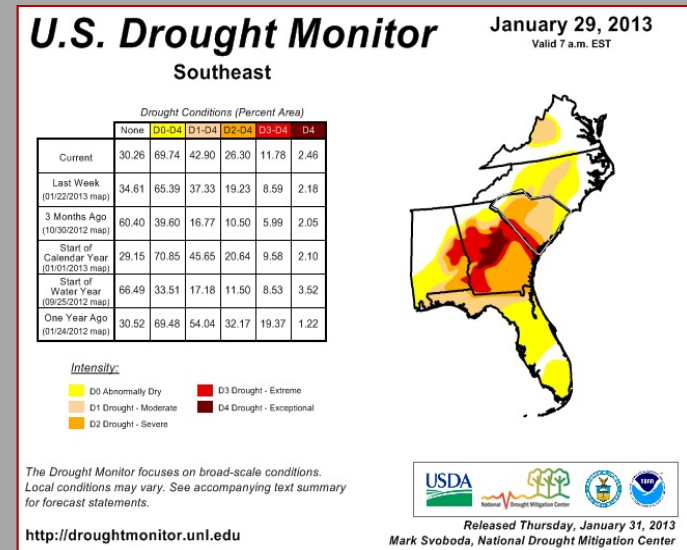
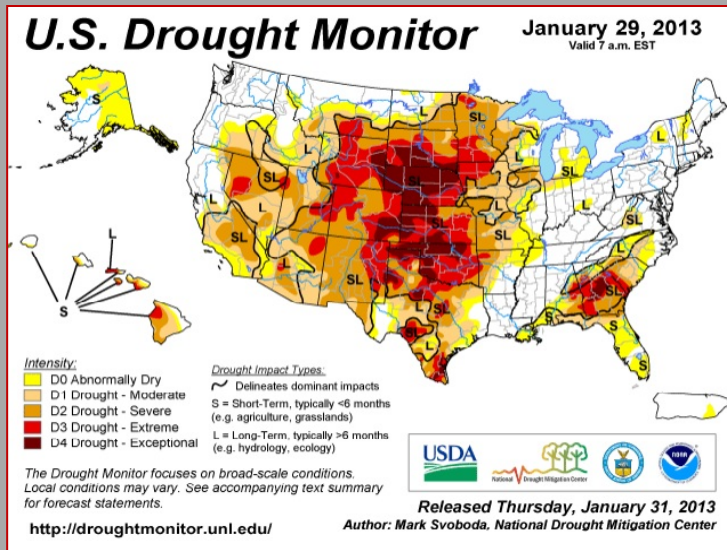
³APEC, Carolinas Integrated Sciences and Assessments



- Information transfer
- Linkages and coordination
- Beyond reactive
- Financial issues



Information Transfer



DYNAMIC DROUGHT INDEX FOR BASINS IN NORTH AND SOUTH CAROLINA

| MAP | HELP |

1. Select year and month: 1950 January

(1950, January data are available for development purpose only, which are not from a real data set.)

2. Choose weights (%) for each drought measure (must sum to 100):

• Palmer Drought Severity Index (PDSI)	<input type="text" value="0"/>
• Palmer Hydrological Drought Index (PHDI)	<input type="text" value="30"/>
• Streamflow Percentile	<input type="text" value="0"/>
• 3-month Standardized Precipitation Index (SPI3)	<input type="text" value="20"/>
• 6-month Standardized Precipitation Index (SPI6)	<input type="text" value="0"/>
• 12-month Standardized Precipitation Index (SPI12)	<input type="text" value="50"/>
• 1-month Precipitation Percentile (Precip1)	<input type="text" value="0"/>
• 3-month Precipitation Percentile (Precip3)	<input type="text" value="0"/>
<input type="button" value="Test sum"/>	<input type="text" value="100"/>

3. Select classification method: Equal Interval (Min to Max)

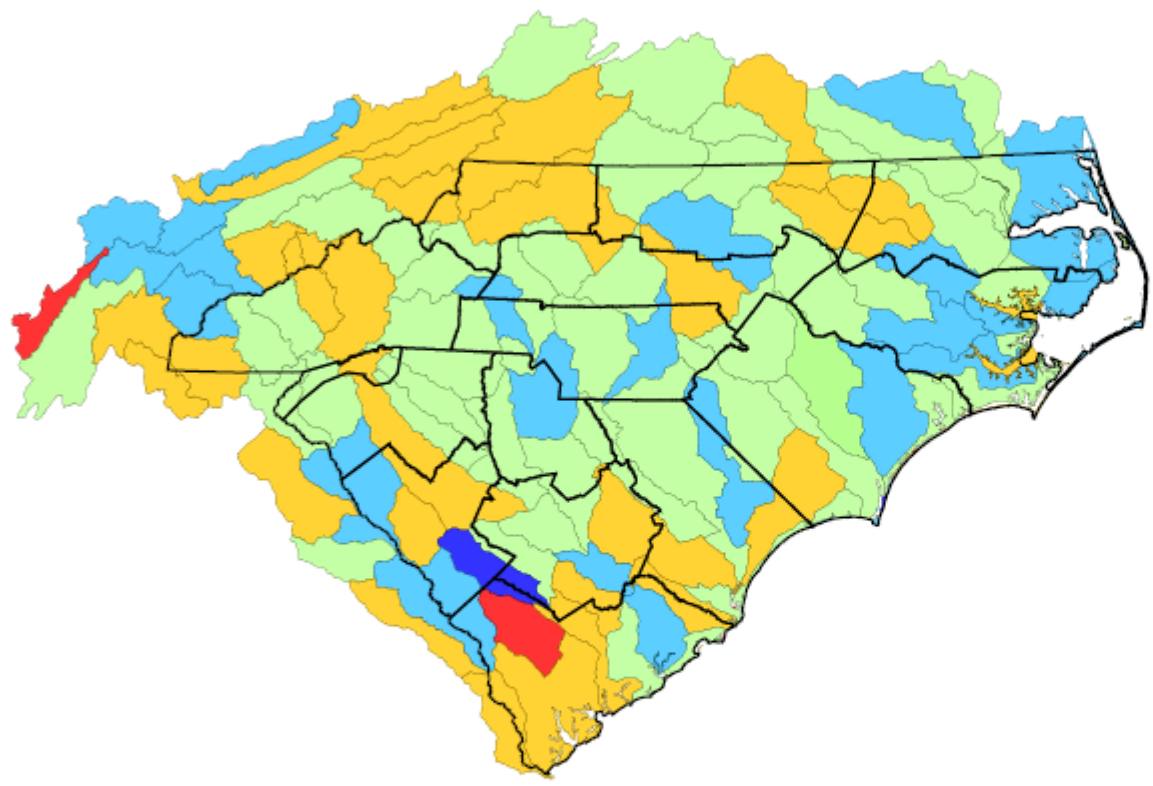
4. Number of classes: 5

5. Use same class intervals for a

- Equal Interval (0 to 100)
- Equal Interval (Min to Max)
- Quantile
- Natural Breaks (Jenks)
- 1 - Standard Deviation

Author: Jinyoung Rhee (rheej@sc.edu)

Last update: Jul. 8, 2005



691,626m

979,393m

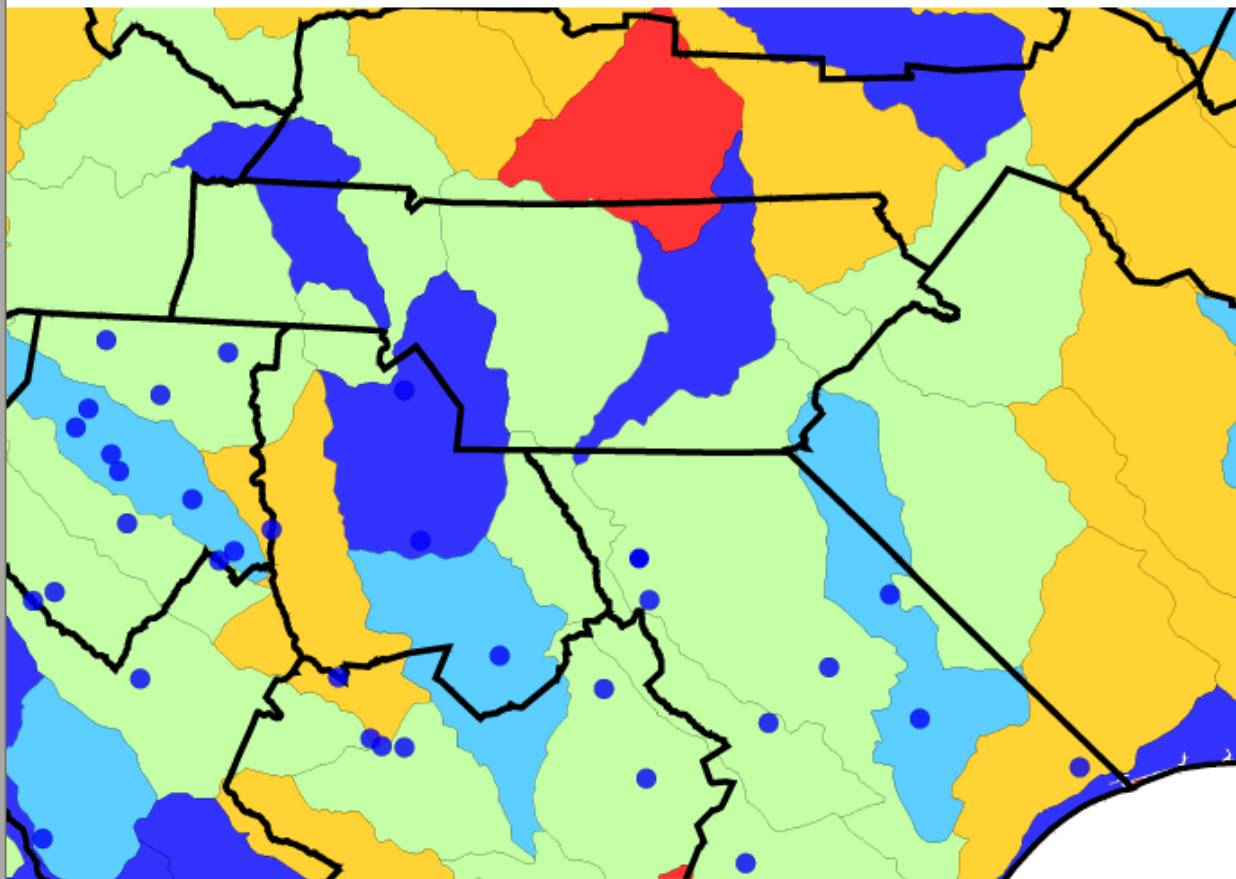


Statusbar: map ready
X: 724,495m Y: 3,873,196m

- Weather Stations
 - States
 - Drought Management Areas
 - Climate Divisions
 - Counties
 - 8-digit HUC Areas
 - Interpolation Grids
 - Hydrology
 - Shaded Relief
- Legend

Info

Blend index value		60.18
Region	03	South Atlantic-Gulf Region
Subregion	0303	Cape Fear
Accounting unit	030300	Cape Fear
Cataloging unit	03030006	Black. North Carolina.



Map navigation controls including a search icon (F), a hand icon, a zoom in (+) and zoom out (-) slider, and a shaded relief inset map of the region.

Statusbar: map ready
 X: 574,702m Y: 3,820,867m

- USGS Stream Gages
- Weather Stations
- States
- Drought Management Areas
- Climate Divisions
- Counties
- 8-digit HUC Areas
- Interpolation Grids
- Hydrology
- Shaded Relief
- Legend

381,926m

269,708m

Info

USGS Stream Gage	02130900	State	South Carolina
Gage Station Name	BLACK CREEK NEAR MCBEE, S. C.	County	Chesterfield
Latitude	34.51	Climate division	4 Northeast
Longitude	-80.18	Drought Management Area	Northeast(Pee Dee)
Cataloging unit	03040201 Lower Pee Dee. North Carolina. South Carolina.		

Daily (computed on a daily basis): total 5 indices

Daily maximum, minimum, mean temperature

Daily total precipitation

KBDI (Keetch-Byram Drought Index)

Weekly (computed on a weekly basis): total 43 indices

Weekly, biweekly, monthly average maximum, minimum, mean temperature

Weekly PDSI, PHDI, PMDI

Estimated Monthly PDSI, PHDI, PMDI

Monthly (4-weeks) PDSI, PHDI, Z-Index, PMDI *

CMI (Crop Moisture Index)

1-, 2- week, 1-, 3-, 6-, 9-, 12-, 24-month SPI

1-, 2- week, 1-, 3-, 6-, 9-, 12-, 24-, 60-month total precipitation

1-, 2- week, 1-, 3-, 6-, 12-, 24-month total streamflow

Monthly (computed on a monthly basis): total 24 indices

Monthly average maximum, minimum, mean temperature

Monthly PDSI, PHDI, Z-Index, PMDI

1-, 3-, 6-, 9-, 12-, 24-month SPI

1-, 3-, 6-, 12-, 24-, 60-month total precipitation

1-, 3-, 6-, 12-, 24-month average daily total streamflow

Challenges: defining drought impacts

- 'less obvious' impacts
- secondary and more distant impacts
- multiple stressors
- onset and recovery





In some cases the typical measures don't work well



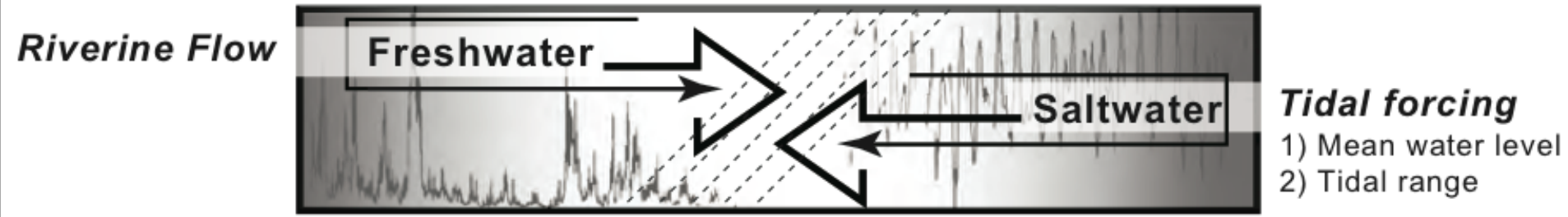
Ed Christopher

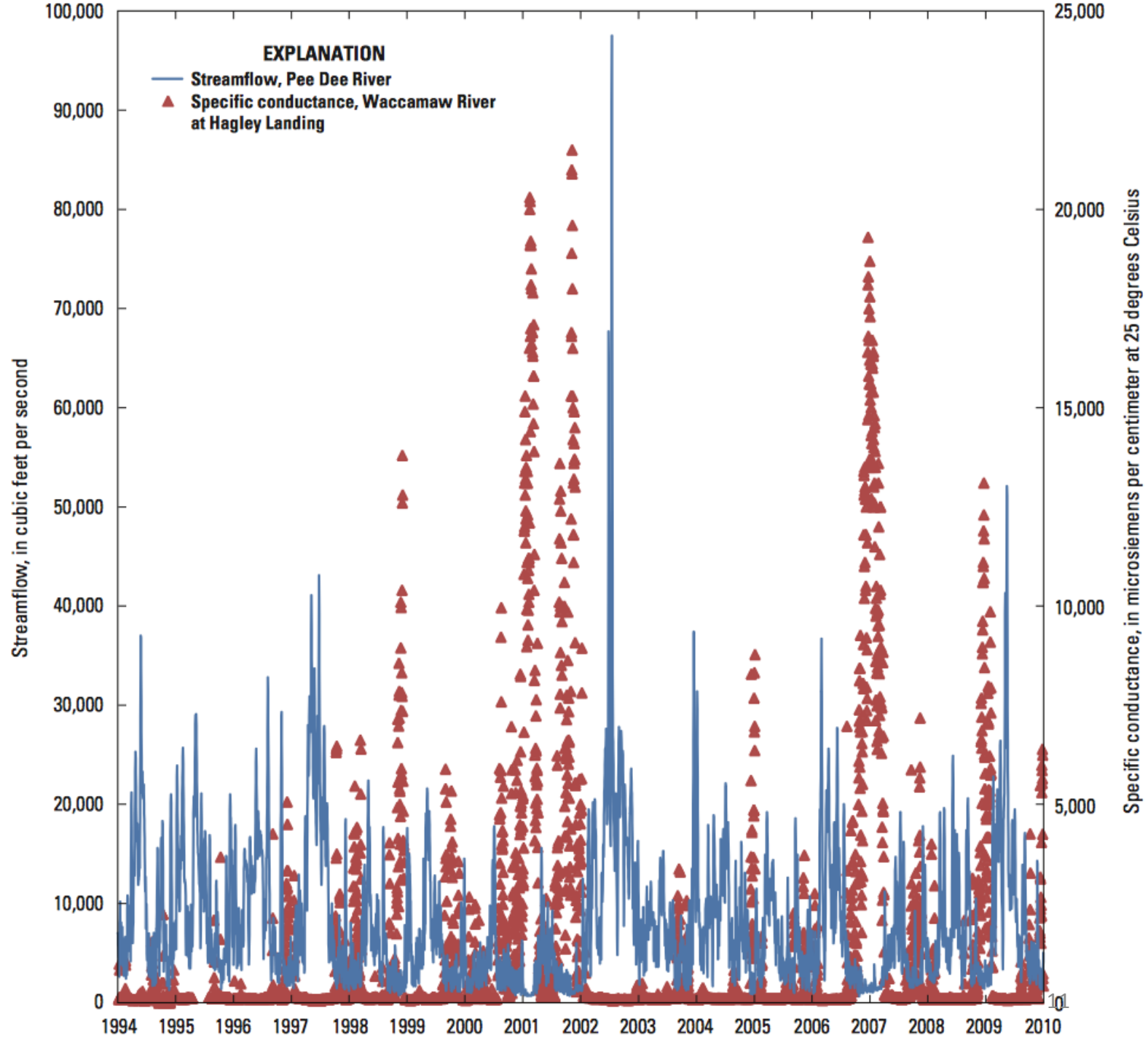


Pocosin Lakes National Wildlife Refuge, NC



Salt-water Intrusion





Simulation Tracking

Current Sim TimeStep: 1/31/1995 23:00
Simulation Start Time: 10/14/2011 14:52
Simulation Stop Time: 10/14/2011 14:53

Show User Controls

User Controls

Date/Time Controls

1 / 1 / 1995 Start Date
1 / 31 / 1995 Stop Date

Hour Time Steps
 Daily Time Steps
 Half Hour Time Steps

Simulation Input Variables Options

% Actual Q8500 100
 User Q (cfs) 20000
 Percentile Q8500 Select from List
 User Defined Hydrograph(s)

8980 WL Bias 0

Writing Output

Select to Write Output (This will open an Output Workbook)

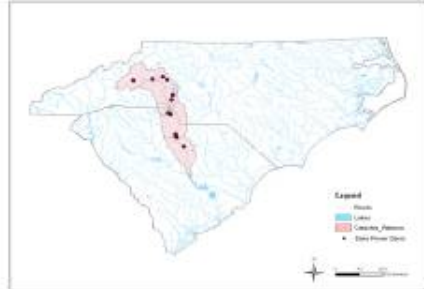
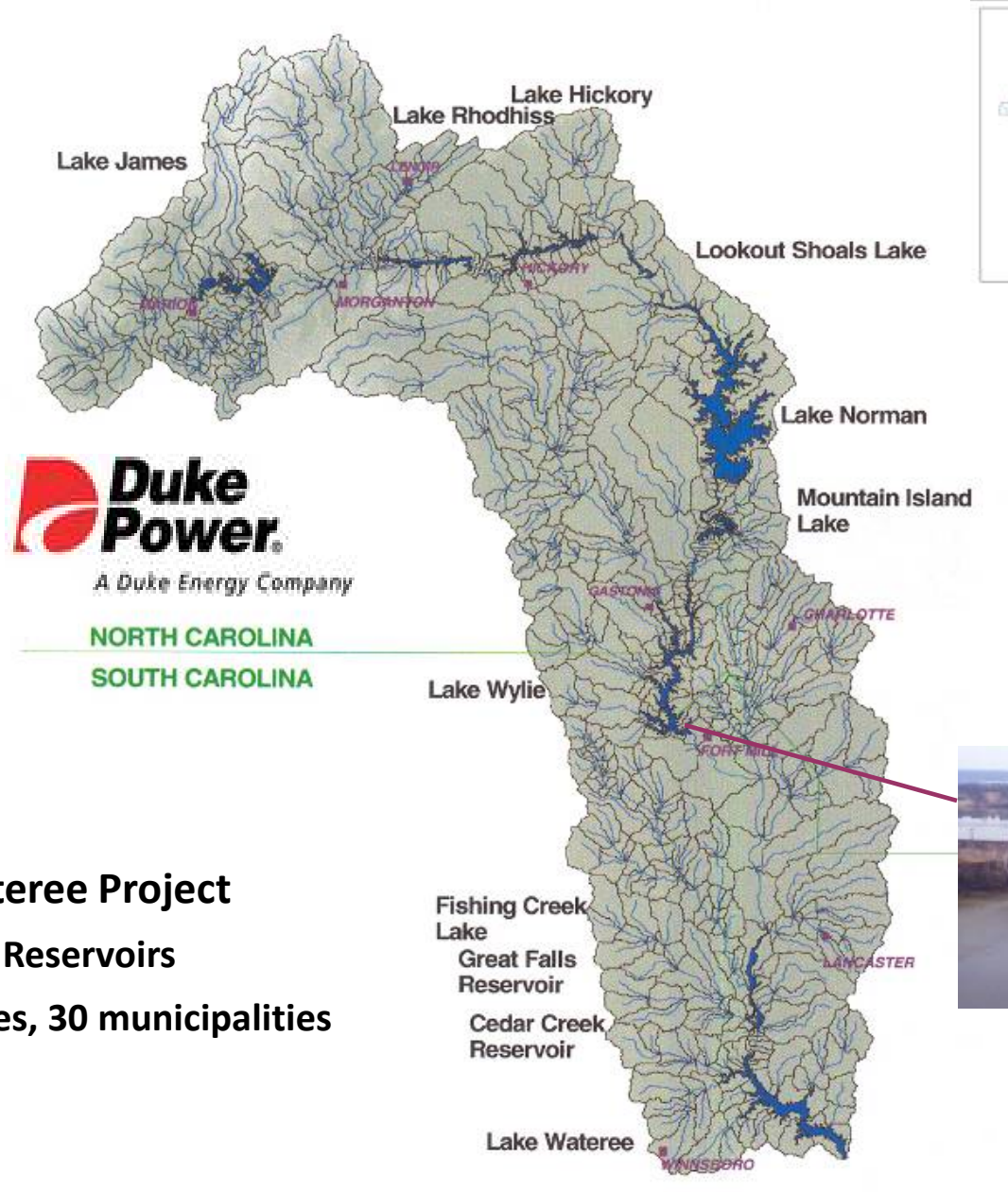
Visualization

Create Files for Visualization

Run Simulation

Linkages and coordination

Dam
Relicensing



Catawba-Wateree Project
11 **Interconnected** Reservoirs
2 states, 14 counties, 30 municipalities

South Carolina Drought Response Committee

Statewide Committee Members

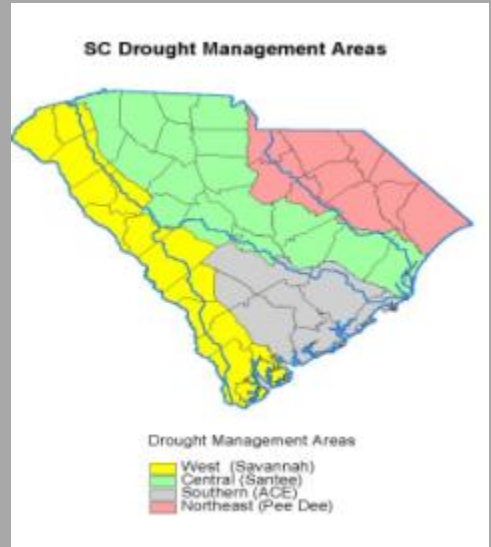
- SC Dept. of Natural Resources
- SC Emergency Management Division
- SC Dept. of Health and Environmental Control
- SC Department of Agriculture
- SC Forestry Commission

Local Committee Members

- Agriculture
- Counties
- Commissions of Public Works
- Power Generation Facilities
- Regional Councils of Government
- Soil & Water Conservation Districts
- Industry
- Municipalities
- Domestic users
- Private water suppliers
- Public service districts
- Special Purpose Districts

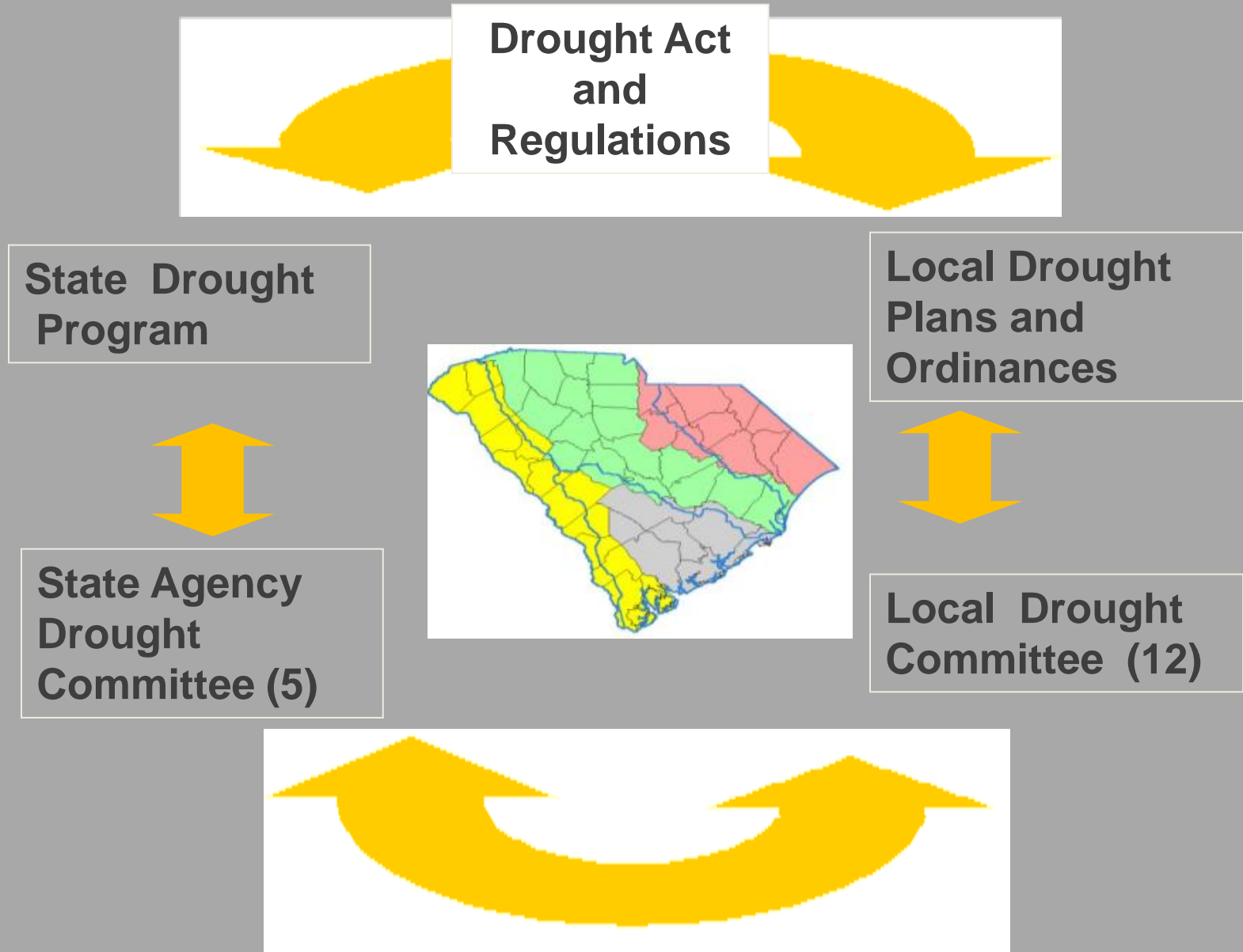
Invited Participants

- Farm Service
- United States Dept. of Agriculture
- National Weather Service
- US Geological Survey



Beyond Reactive

South Carolina's Hydro-Logical Cycle



Drought Response Plans and Ordinances

South Carolina Department of Natural Resources

Update Water Survey



5. PLEASE ENTER YOUR SURFACE WATER INFORMATION

Permitted Capacity:

Water Sources:

6. PLEASE ENTER YOUR GROUND WATER INFORMATION

Permitted Capacity:

Water Sources:

7. PLEASE UPLOAD YOUR DROUGHT ORDINANCE

Select draft if you are submitting your plan/ordinance to be reviewed by SCDNR

Select final if your are submitting the final version of your plan/ordinance that has been approved by SCDNR

Draft or Final Ordinance:



DROUGHT MANAGEMENT PLAN AND RESPONSE ORDINANCE INVENTORY - SEARCH

[Search By City](#)

Select this menu to view a list of cities having Water Systems which have submitted their Drought Management Plan and Response Ordinance information.

[Search By Water System Name](#)

Select this menu to view a list of the Water Systems which have submitted their Drought Management Plan and Response Ordinance information.

FINAL DRAFT
Chester Metropolitan District
Model Drought Management Plan
and
Response Policy

(Provided by the South Carolina Department of Natural Resources as required
by the South Carolina Drought Response Act of 2000.)

INDEX:

Section I: Declaration of Purpose and Intent

Section II: Definition of Terms

Section III: Drought Management Plan

- A. Introduction
- B. Designation of Water System Drought Response Representative
- C. Description of Water System Layout, Water Sources, Capacities and Yields
- D. Identification of Water System Specific Drought or Water Shortage Indicators
- E. Cooperative Agreements and Alternative Water Supply Sources
- F. Description of Pre-Drought Planning Efforts
- G. Description of Capital Planning and Investment for System Reliability and Demand Forecasting

The best laid plans...get complicated by reality

SC State Drought Code

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%-120% of the 5% monthly flow	101%-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% range	90% to 95% range	95% to 98% range	98% to 100% range

Community of Practice

- Co-develop ideas and processes to help integrate drought impacts info into assessment and planning
- Identify and support best practices for assessing, cataloging, and consolidating disparate information
- Leverage existing research and applications

Financial issues

Sometimes water use/availability = revenue



South Carolina Department of Natural Resources

Water Sys

South Carolina Water Systems

Water System Conservation Actions D

County

System Name

ABBEVILLE
AIKEN
ALLENDALE

South Carolina Water Conservation Actions

The SC Department of Natural Resources provides this website to assist the public in being aware of any current water restrictions or conservation efforts. SCDNR receives the information on this site from water systems. It is updated each day as systems log-on and change their status (or notify us in writing of any changes). If you do not see your water provider on this page, please contact them to find out what efforts they seek from their customers as part of their drought management plan.

Current Water Conservation Actions by County

County	System	Date	Restrictions	Additional Actions Comments
AIKEN	North Augusta, City of	11/9/2007	Voluntary	Will continue to follow drought ordinance
AIKEN	Jackson, Town of	9/1/2007	Voluntary	Will continue to follow drought ordinance
AIKEN	Monetta, Town of	8/1/2007	Voluntary	Will continue to follow drought ordinance
AIKEN	Talatha Rural Community Water District	9/6/2007	Voluntary	Will continue to follow drought ordinance
AIKEN	Wagener, Town of	12/1/2007	Voluntary	Will continue to follow drought ordinance
AIKEN	College Acres Public Works	12/31/2007	Voluntary	Will continue to follow drought ordinance
AIKEN	Aiken, City of - Dept. of Public Works	6/1/2007	Voluntary	Will continue to follow drought ordinance
AIKEN	Salley, Town of	11/14/2007	Voluntary	Will continue to follow drought ordinance
AIKEN	Valley Public Service Authority	11/15/2007	Voluntary	Will continue to follow drought ordinance
AIKEN	New Ellenton Commission of Public Works	11/12/2007	Voluntary	Will continue to follow drought ordinance
ANDERSON	Homeland Park Water & Sewer	10/21/2007	Voluntary	Surface water is provided by local utility
ANDERSON	Gilmer & Sons Mobile Homes	Always conserved	Voluntary	Surface water is provided by local utility

When money can help...

Support for a comprehensive **impact reporting** and monitoring system

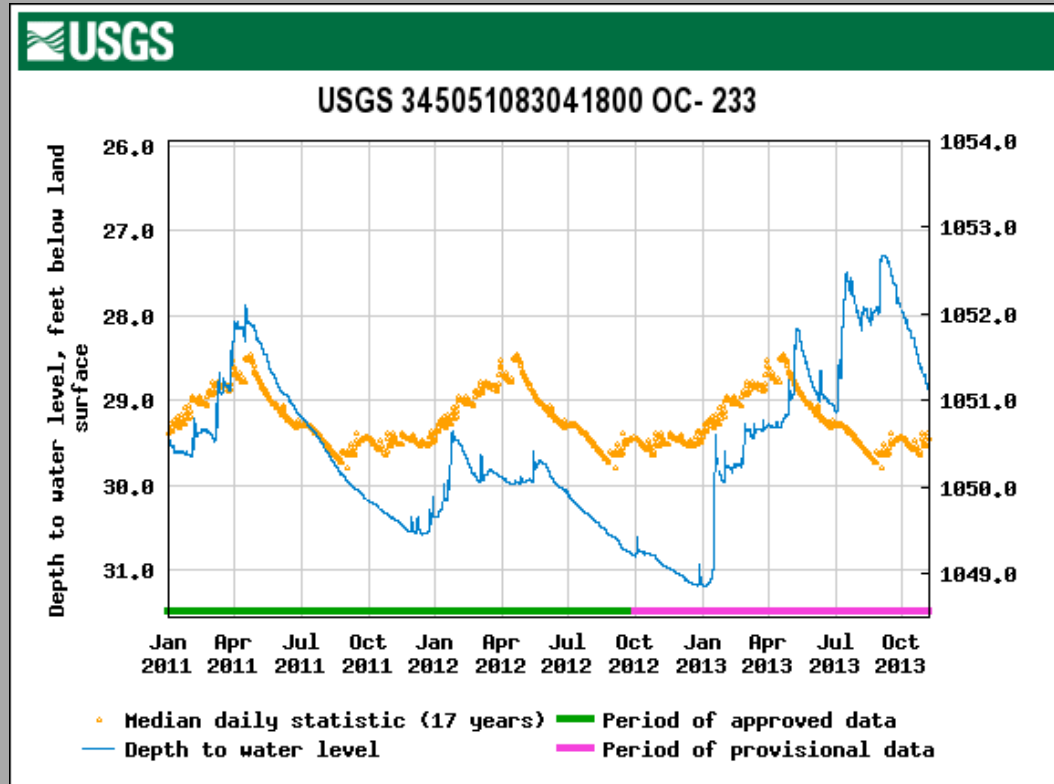
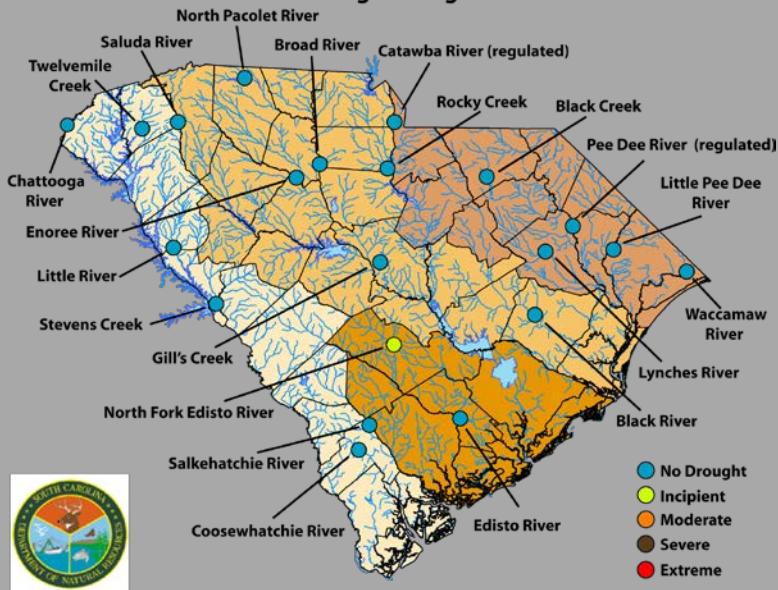
- NDMC Drought Impact Reporter (national level)

- Regional to local efforts (ad hoc)

- Agriculture (single sector)

Monitoring

14-Day Average Streamflow Ending September 25
Stream Gage Drought Status



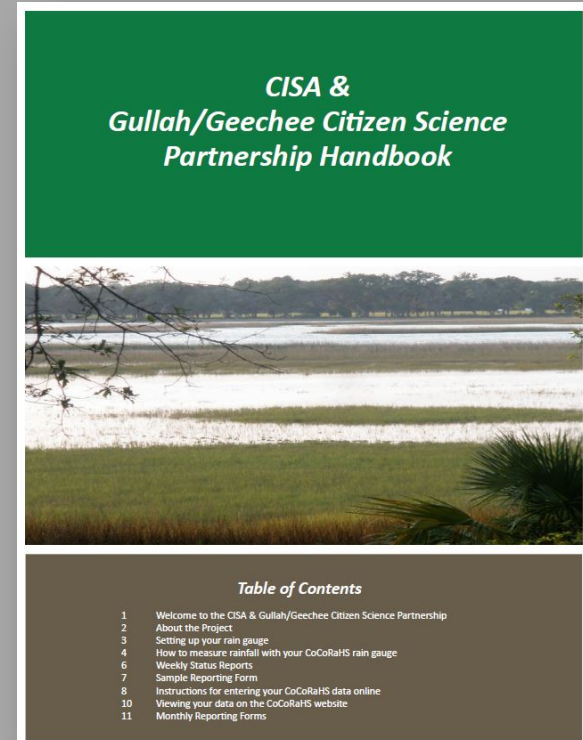
Other options: Volunteers

SC CoCoRaHS Rainfall Aug 27 – Sep 26, 2012

<u>Station Name</u>	<u>Total Precip</u>	<u>Station Name</u>	<u>Total Precip</u>	<u>Station Name</u>	<u>Total Precip</u>
Denmark 2.8 WNW	1.19	Aiken 7.8 SSE	3.49	Rock Hill 4.1 WNW	5.13
Abbeville 3.2 SSW	1.79	Pineville 0.3 SSE	3.50	Sharon 1.5 WSW	5.26
Greer 3.0 NNE	2.14	Longs 1.3 NW	3.51	Lexington 5.9 SW	5.29
Columbia 3.1 E	2.18	Hampton 0.8 SW	3.59	Greenville 5.4 WNW	5.31
Williston 4.3 NNW	2.22	Spartanburg 5.1 WSW	3.60	Lodge 3.4 SW	5.34
Lexington 2.9 NE	2.36	Bennettsville 3.8 SE	3.62	Cleveland 8.0 WSW	5.42
Reevesville 1.0 SSE	2.54	Conway 6.2 E	3.62	Yemassee 7.6 NE	5.43
Cayce 1.2 SW	2.60	Lancaster 2.0 NNW	3.62	North 0.3 W	5.67
Lyman 4.1 WNW	2.61	Gaffney 3.3 NNW	3.83	Central 2.7 NNW	5.74
Gaffney 10.6 S	2.70	Greenwood 2.8 NNW	3.90	York 4.1 NW	5.91
Sumter 1.3 SE	2.72	Manning 1.9 SSE	3.90	Loris 2.9 WSW	5.97
West Columbia 1.2 ESE	2.75	Moore 4.9 NW	4.07	Charleston 4.6 SSE	5.99
Smoaks 0.1 ESE	2.76	Blythewood 4.7 SSE	4.10	Loris 1.4 ENE	6.00
Taylors 3.0 NNW	2.91	Brunson 1.6 SSW	4.14	Pickens 6.9 W	6.09
Anderson 10.5 SE	2.94	Silverstreet 5.7 WNW	4.20	Camden 4.2 ENE	6.16
Iva 5.2 SSW	3.00	Ladson 2.7 E	4.29	Florence 5.9 W	6.17
Surfside Beach 0.4 S	3.05	Seneca 4.9 N	4.35	Allendale 1.4 S	6.27
Summerton 8.4 SE	3.14	Travelers Rest 8.9 N	4.38	NWS Charleston SC	6.30
Cameron 4.2 SE	3.22	Ridgeland 5.8 ESE	4.39	Meggett 1.8 W	6.47
Myrtle Beach 5.7 W	3.22	Gilbert 1.2 SSW	4.47	Tega Cay 1.5 ESE	6.93
Irmo 1.5 NW	3.26	Walterboro 8.1 SSW	4.49	Daufuskie Island 1.7 SW	6.98
Summerville 3.7 NW	3.27	North Charleston 2.9 WNW	4.56	Kiawah Island 3.0 N	7.26
Sans Souci 3.3 ENE	3.28	Georgetown 5.3 NNE	4.65	Kingstree 7.9 NW	7.36
Union 2.3 NNE	3.29	Huger 5.5 SE	4.65	Bluffton 2.4 NNW	7.49
Chapin 1.4 S	3.33	Moncks Corner 7.2 SW	4.75	Johns Island 9.0 SE	7.61
Murrells Inlet 1.7 N	3.35	Hartsville 2.2 W	4.78	Charleston 6.8 W	7.99
Prosperity 2.8 SE	3.35	Lake Wylie 2.3 SW	4.84	Pawleys Island 5.6 NNE	8.90
Orangeburg 3.2 NW	3.37	Seneca 3.7 NNW	5.08	Mount Pleasant 1.4 SW	249.99

Citizen Science Engagement Efforts

- Utilizing existing CoCoRaHS tools
- Developing of customized materials
- Gullah/Geechee Nation
- Low Country Institute & Master Naturalists



A child is swinging on a swing set in a wooded area. In the background, there are several tents and a table, suggesting a campsite. The scene is outdoors with trees and a clear sky.

Information transfer

sometimes new tools are needed

Linkages and coordination

making sure everyone is at the table

Beyond reactive

state-level drought plans

challenges of implementation

Financial issues

revenue matters

tools and monitoring cost money