Linking Drought Indicators and Impacts: The U.S. Perspective




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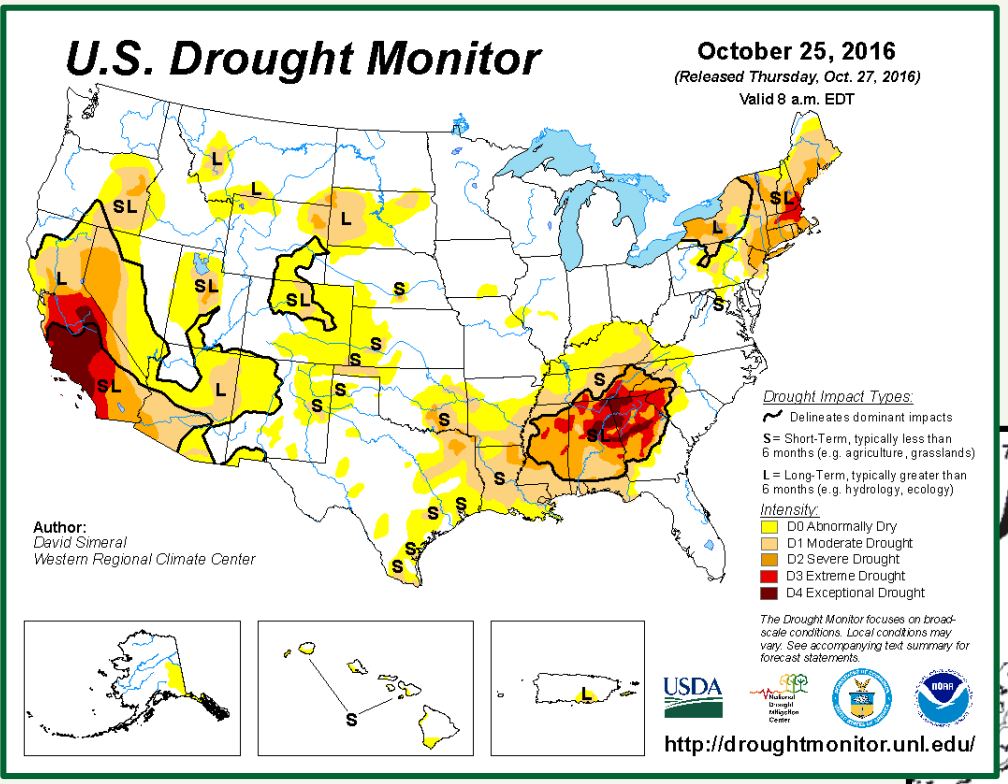
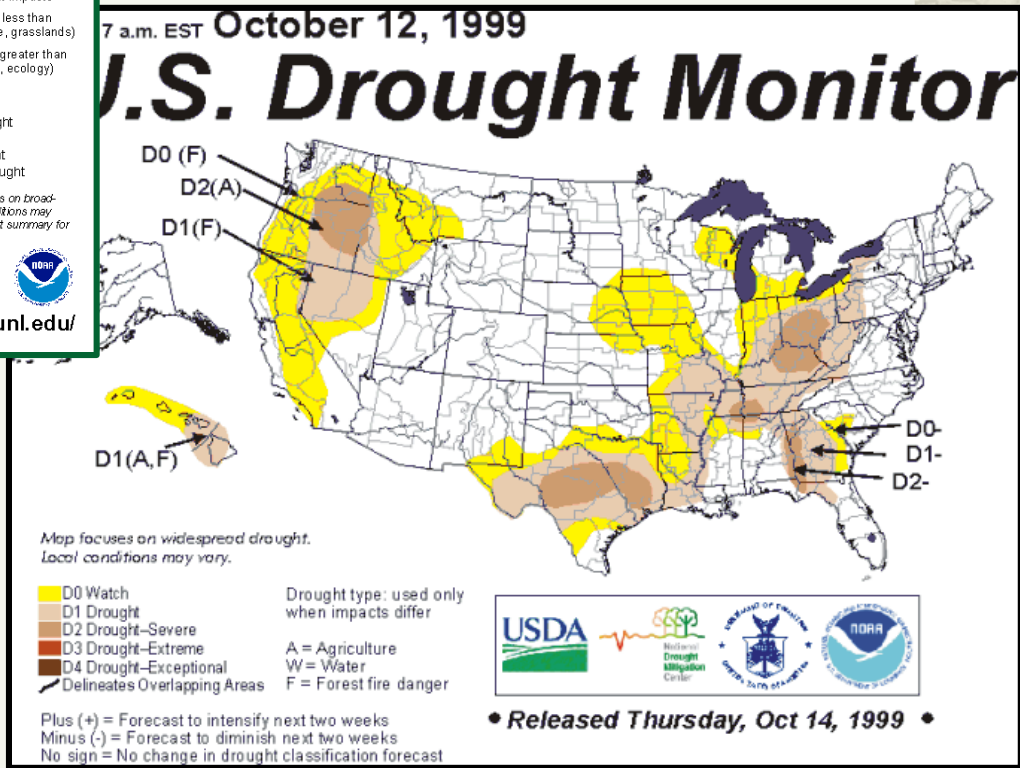
Evolution of the U.S. Drought Monitor



- "Convergence of evidence"
- A few to many indicators
- Higher resolution products



A learning process

U.S. Drought Monitor Classification Scheme

- **Potential impacts outlined but only estimates**
- **Need research to better link indicators and impacts**

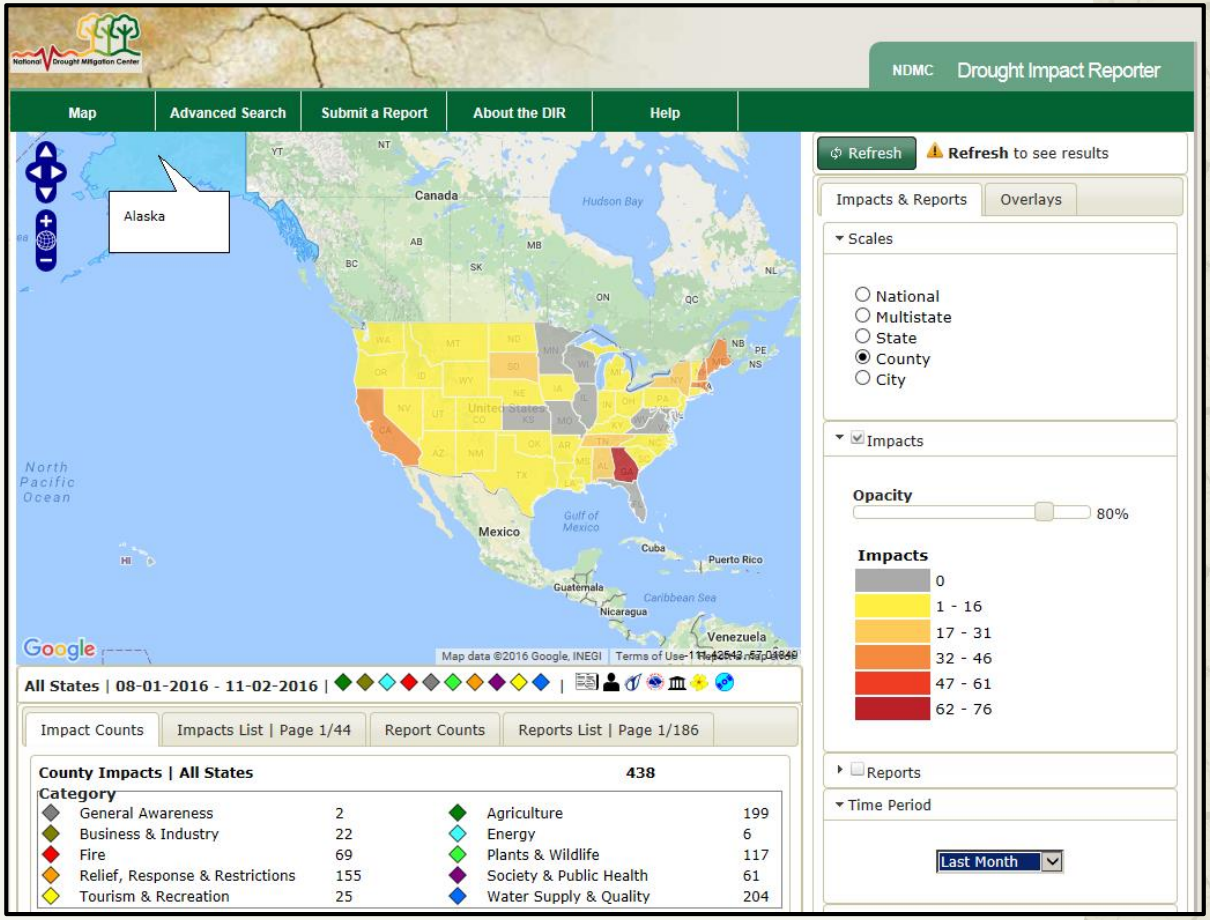
Drought Severity Classification

Category	Description	Possible Impacts	Ranges			
			Palmer Drought Severity Index (PDSI)	CPC Soil Moisture Model (Percentiles)	USGS Weekly Streamflow (Percentiles)	Standardized Precipitation Index (SPI)
D0	Abnormally Dry	Going into drought: ▪ short-term dryness slowing planting, growth of crops or pastures Coming out of drought: ▪ some lingering water deficits ▪ pastures or crops not fully recovered	-1.0 to -1.9	21 to 30	21 to 30	-0.5 to -0.7
D1	Moderate Drought	▪ Some damage to crops, pastures ▪ Streams, reservoirs, or wells low, some water shortages developing or imminent ▪ Voluntary water-use restrictions requested	-2.0 to -2.9	11 to 20	11 to 20	-0.8 to -1.2
D2	Severe Drought	▪ Crop or pasture losses likely ▪ Water shortages common ▪ Water restrictions imposed	-3.0 to -3.9	6 to 10	6 to 10	-1.3 to -1.5
D3	Extreme Drought	▪ Major crop/pasture losses ▪ Widespread water shortages or restrictions	-4.0 to -4.9	3 to 5	3 to 5	-1.6 to -1.9
D4	Exceptional Drought	▪ Exceptional and widespread crop/pasture losses ▪ Shortages of water in reservoirs, streams, and wells creating water emergencies	-5.0 or less	0 to 2	0 to 2	-2.0 or less

Drought Impact Reporter (DIR):

- ***droughtreporter.unl.edu***

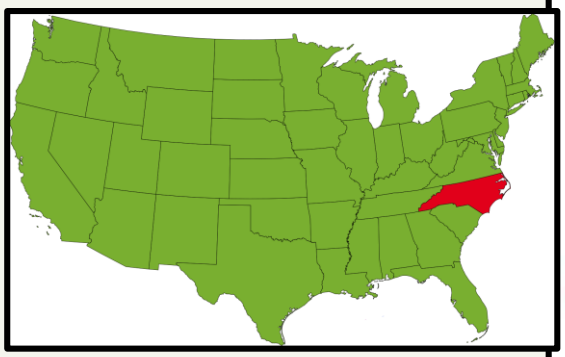
- On-line since 2005
- 21,000+ impacts in our database
- Quantitative AND qualitative
- Establishing a “baseline” of impacts due to droughts over time
- Understand impacts and ground truth indices/RS/DM

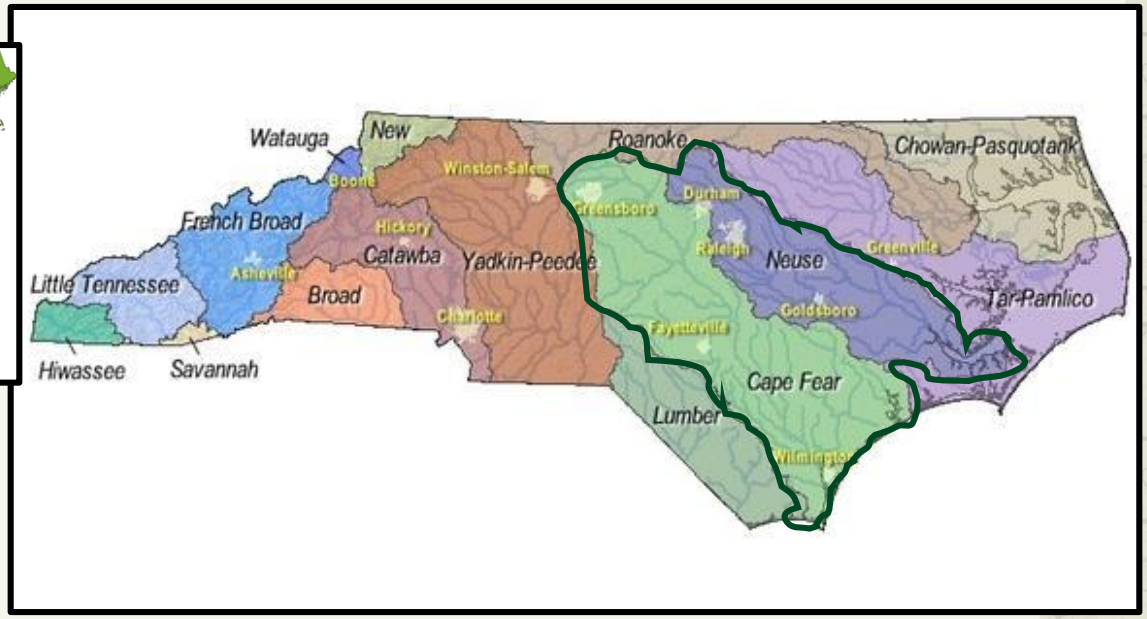


DRought Impacts: Vulnerability thresholds in monitoring and Early-warning Research

U.S Case Study

- Cape Fear and Neuse river basins in North Carolina
- investigate links between drought indicators and impacts
- Evaluate the usefulness to public water suppliers and state government





North Carolina Workshop

- 11 community water utility managers (large, medium, and small systems) in the basins
- 14 advisors from state and federal water agencies in North Carolina (e.g., Drought Management Advisory Council)

Topics:

- Project introduction
- Presentations from systems to educate the project team
- Discussions on their use of drought monitoring information, and related monitoring/management needs

North Carolina Participant Recommendations:

- Assess correlations between drought indicators/indices (e.g., U.S. Drought Monitor) and local water supply indicators and impacts for their potential use in **early warning and coordination** with the state government in declaring drought conditions

- Assess the links between local water-related drought impacts, indicators, and **management triggers** to ensure that impacts are being addressed appropriately in water suppliers' Water Shortage Response Plans

1. Assess Local Impacts vs. U.S. Drought Monitor

- Ex) observed impacts from the Drought Impact Reporter in Durham County, NC
- Help understand what impacts occur at various USDM values

Water conservation
Plants drying

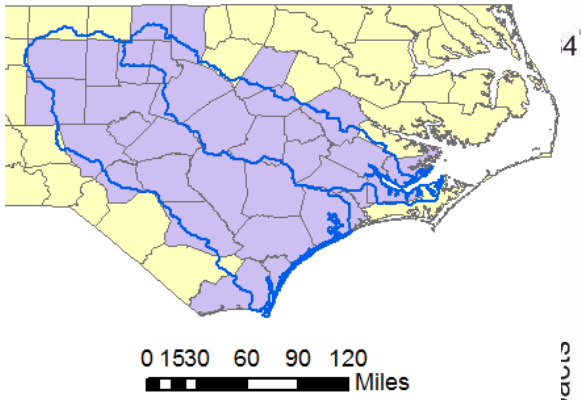
State advisories
Low reservoirs
Tree stress
Reduced sales

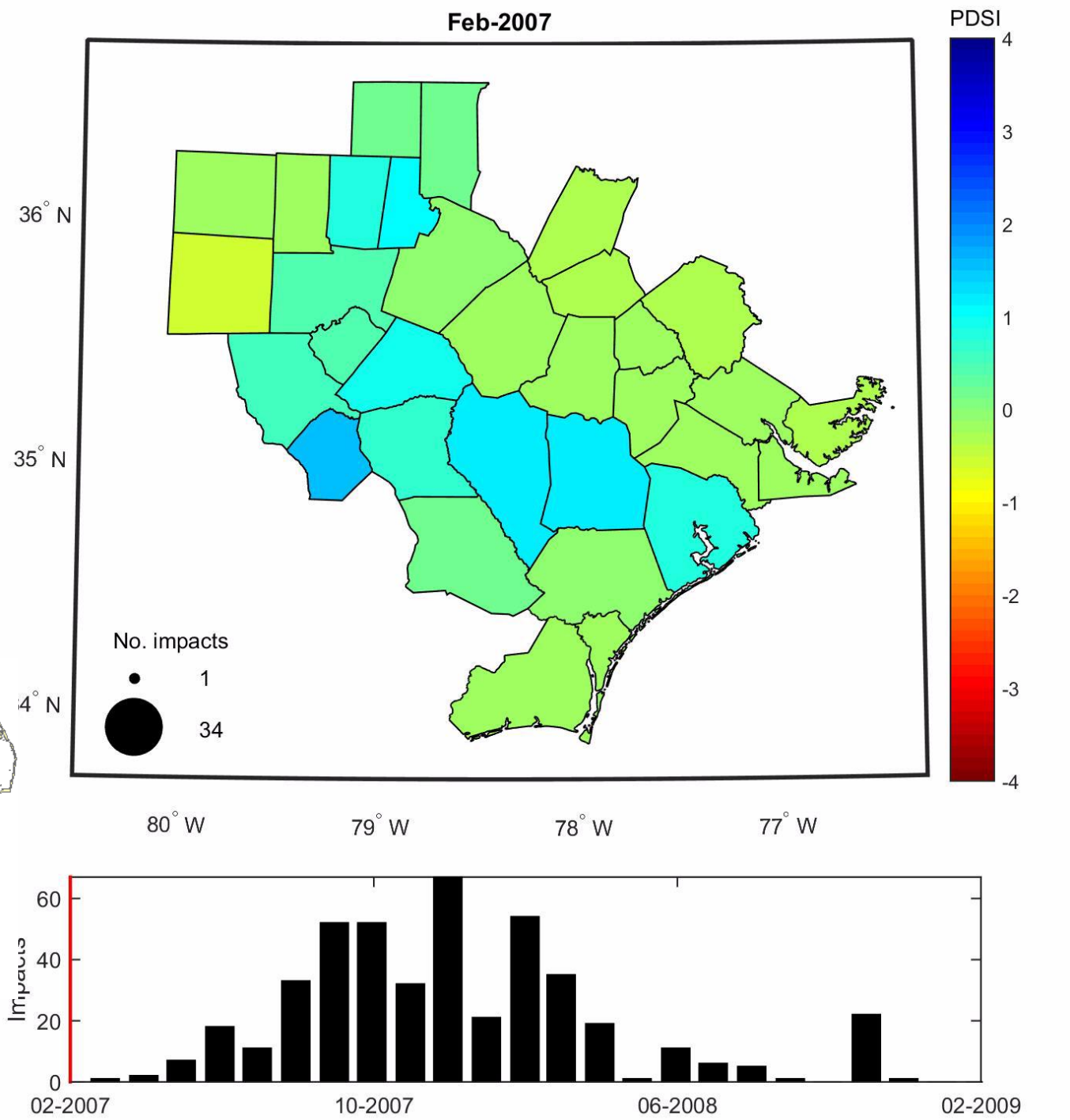
Restrictions
Buying water
Fires
Boat ramps closed

Status	Description	releaseDate	Impact ID
D0	*Conservation*		
D0	Durham residents conserved water in response to requests, restrictions	4/1/2007	23275
D0	Residents of Durham encouraged to conserve water	7/17/2011	14825
D0	*Vegetation*		
D0	Dry pasture in Laurel Creek	6/9/2008	23477
D0	Durham plants dying, yard needed watering	8/24/2015	32187
D1	*Conservation*		
D1	Durham residents asked to conserve water, reservoir low	9/30/2005	15538
D1	State panel issued moderate drought advisory for Chatham, Durham and Wake counties in N	3/6/2012	26425
D1	State urged municipalities, individuals to implement conservation measures	4/19/2012	26590
D1	*Vegetation*		
D1	Drought stressed Durham trees	8/9/2008	23946
D1	*Recreation*		
D1	Lake Mitchie closed due to drought; grass sprouting on lakebed	9/20/2005	15510
D1	Fishing gear retailer downsized due to lower sales	8/1/2007	22862
D2	*Conservation*		
D2	Durham, Chatham county enacted mandatory restrictions	11/4/2005	15910
D2	Conservation tools such as rainbarrels are top sellers at garden stores	4/19/2006	17988
D2	Annual water system maintenance bypassed in Durham to conserve water	3/10/2011	3967
D2	Large pharmaceutical company reduced water use 45%; Durham had 49 days left	8/31/2007	22407
D2	State panel urged water conservation for those in severe drought	2/3/2011	3872
	Supply Augmentation		
D2	Durham buying water from Cary	11/22/2005	16055
D2	*Vegetation/Fire*		
D2	Dry conditions, winds contribute to fire	2/19/2011	3911
D2	Drummond Village brush fire burns 4 acres	8/16/2007	21746
D2	*Recreation*		
D2	Boat ramps closed, business down	11/2/2005	15888

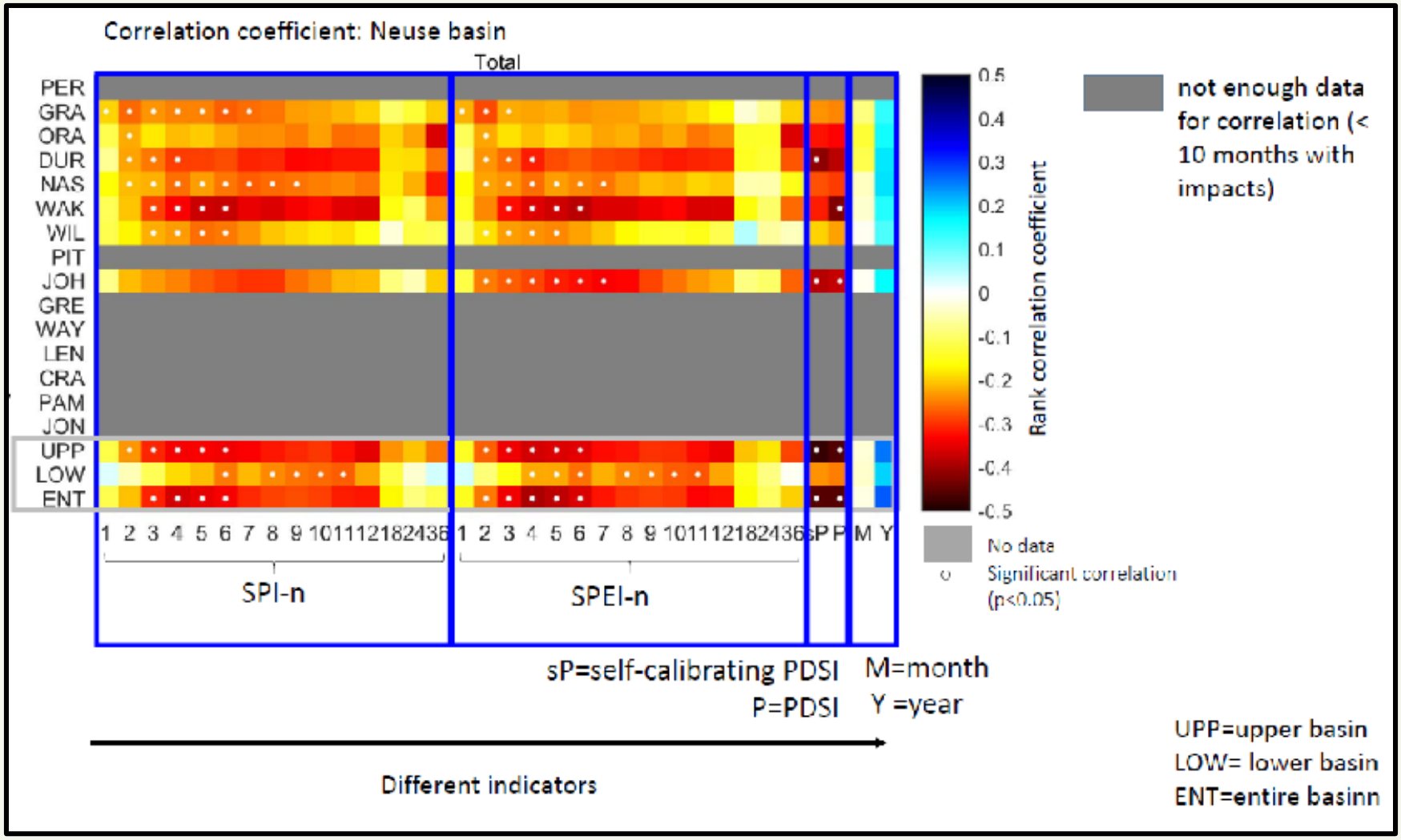
Linking drought indicators to impacts:

Progression of Palmer Drought Severity Index (PDSI) versus number of impacts per county in the Neuse and Cape Fear basin (2007/08)





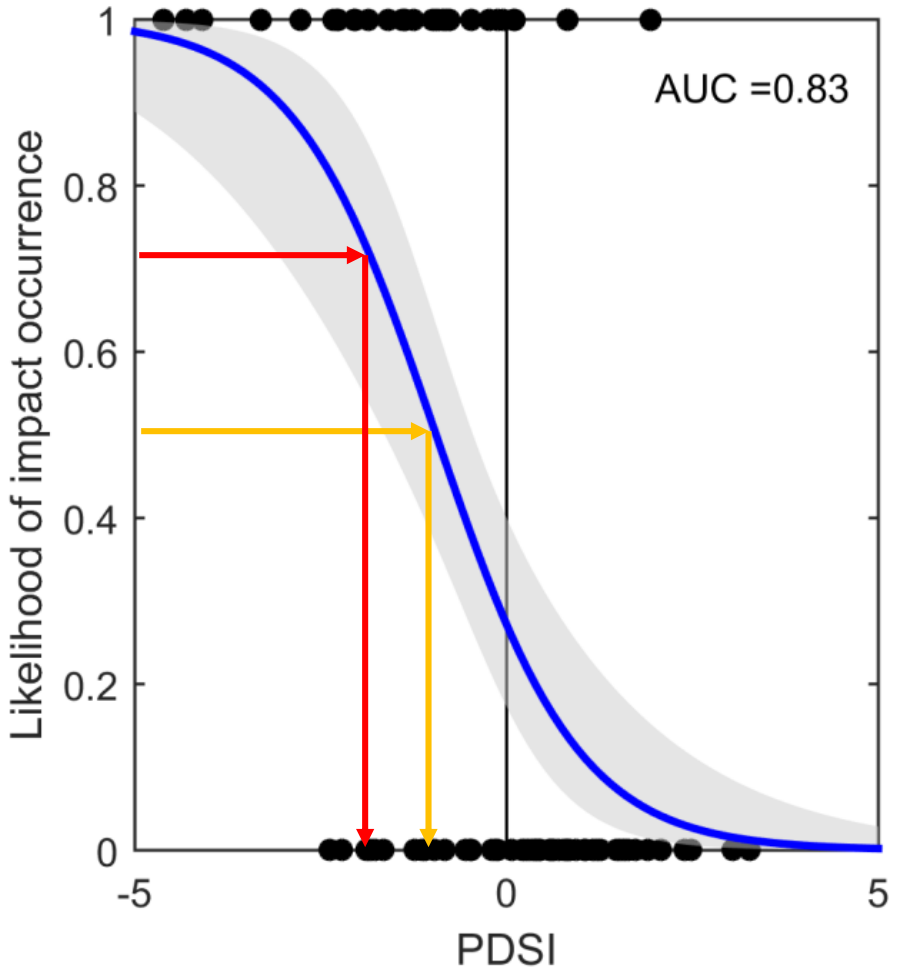
2. Quantification of Drought Impacts vs. Indicators



What indicators best correlate to impacts for a given location

Predicting the Occurrence of Drought Impacts

- Likelihood of impact occurrence for a drought indicator predicted
- Could support the design of drought triggers



Example for the upper Neuse basin: total impacts

- 50% chance of impact occurrence for PDSI of -1
- 75% chance of impact occurrence for PDSI of -2

Observed impacts (coded 0-1)

Fitted model

Confidence Interval

AUC = model performance measure

3. Scenarios: Durham, NC Water System (2007/08)

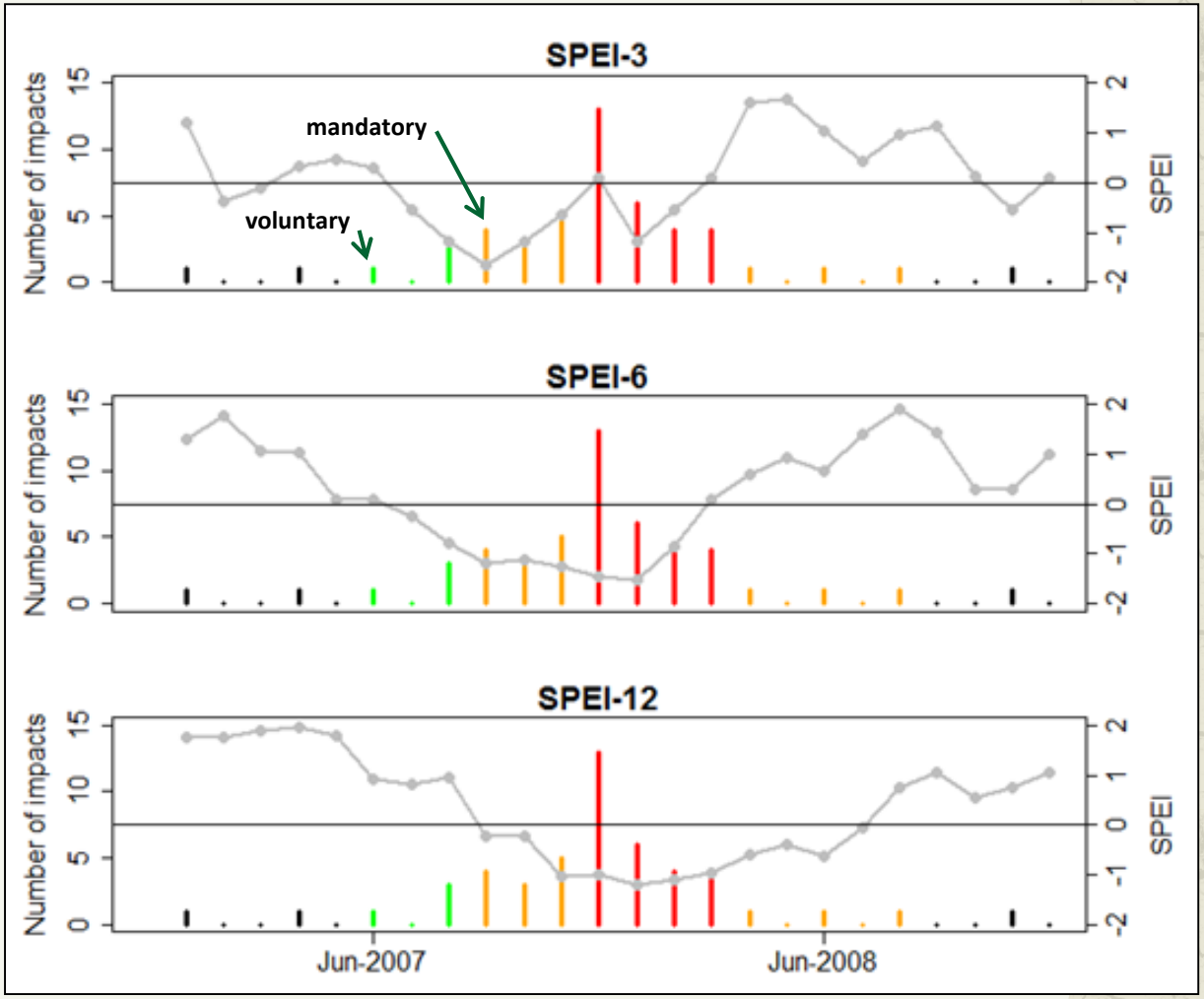
Historical Scenarios

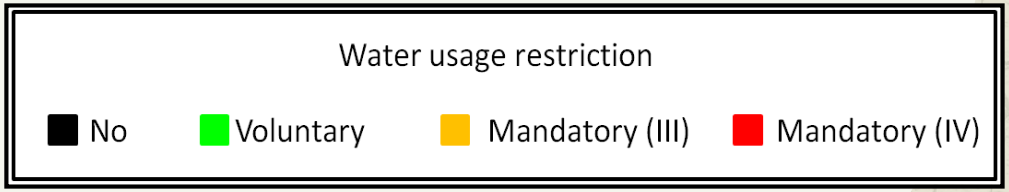
- Drought indices
- Drought impacts
- Water restrictions

Goal

- Better understand drought/impacts
- identify effective drought indicators and thresholds (triggers) for action

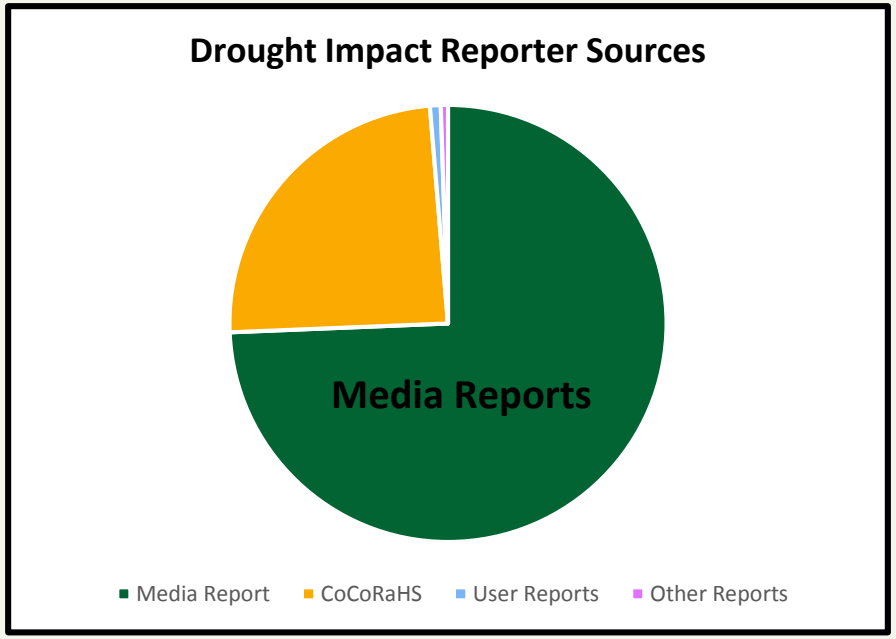
Ongoing dialogue with local water managers

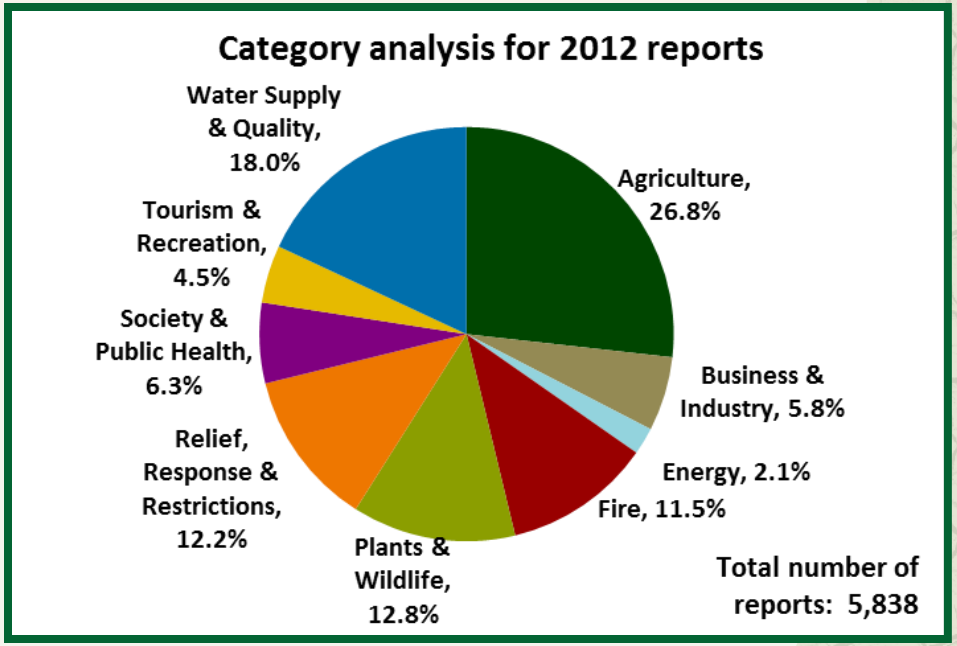




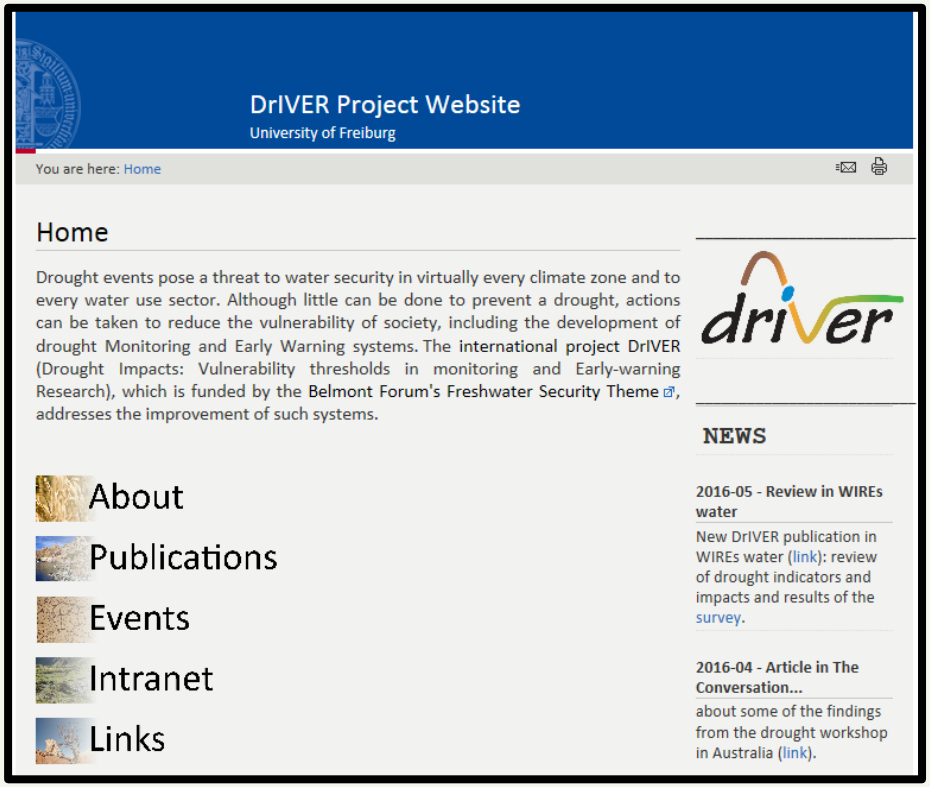
Issues:

- Need for additional impact data (reliance on the media) to decrease uncertainty
- Need for sharing impact data and management information
- More discussion needed on the best application of this information (proof of concept stage)





More Information:



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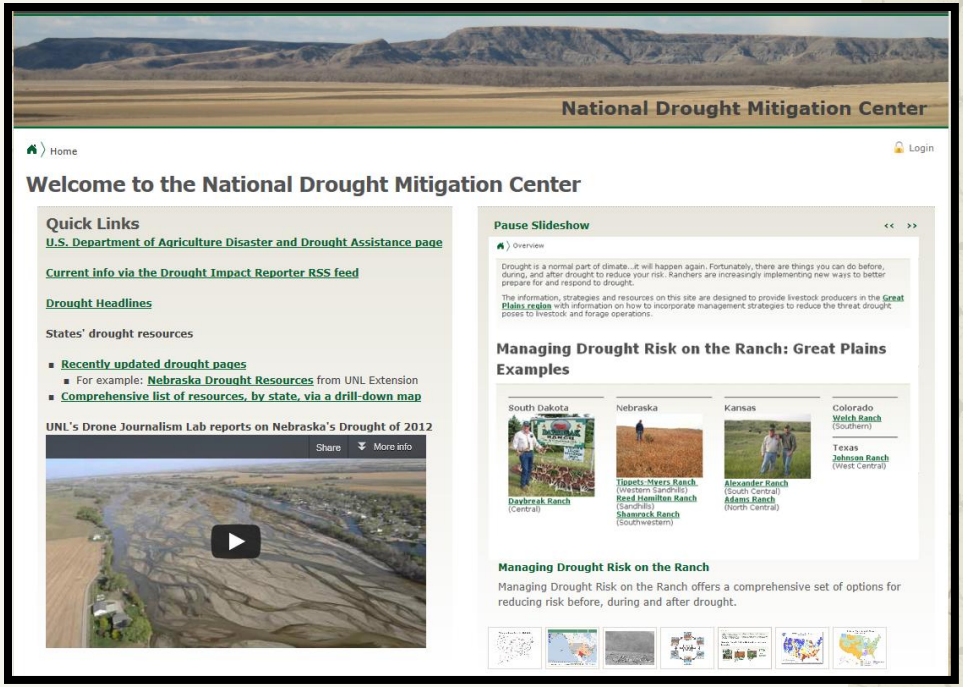

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Thank you!