National Drought Mitigation Center Drought Services: Collaborative Efforts Towards Drought Early Warning and Information Systems

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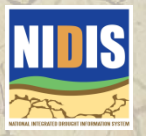
Monitoring Program Area Leader

National Drought Mitigation Center
School of Natural Resources
University of Nebraska-Lincoln

Belmont DrIVER Project Stakeholder Workshop, Wallingford, England, March 17, 2015



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National Drought Mitigation Center

National Drought Mitigation Center

- ***Founded*** **in 1995**
- ***16 Staff:*** **Diverse backgrounds**
  - **2 Program Areas (Planning/Monitoring)**
- ***Bridge and translate science*** **to policy/decision makers and the public**
- **Developing *usable* information and services**
- **Research, Applications, Operational, Education/Outreach *(End-to-End)***
- **Involve users from the *beginning…***

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NDMC Stakeholder Interactions

- ***Workshops, Listening Sessions, Forums***
- ***Webinars***
- ***Media Contacts*** (building trust) (~500+/year)
- ***Surveys***
- Evaluator Networks: USDM/VegDRI
- Drought Impact Reporter
- Drought Ready Communities Project
- Ranch Planning Project
- *Discover the Waters of Nebraska*
- Climate Change Literacy for Educators
- Climate Masters
- *NDMC Website/* ***DroughtScape***
- Nebraska's Climate Assessment and Response Committee
- Research/consultant Projects
- Invited talks

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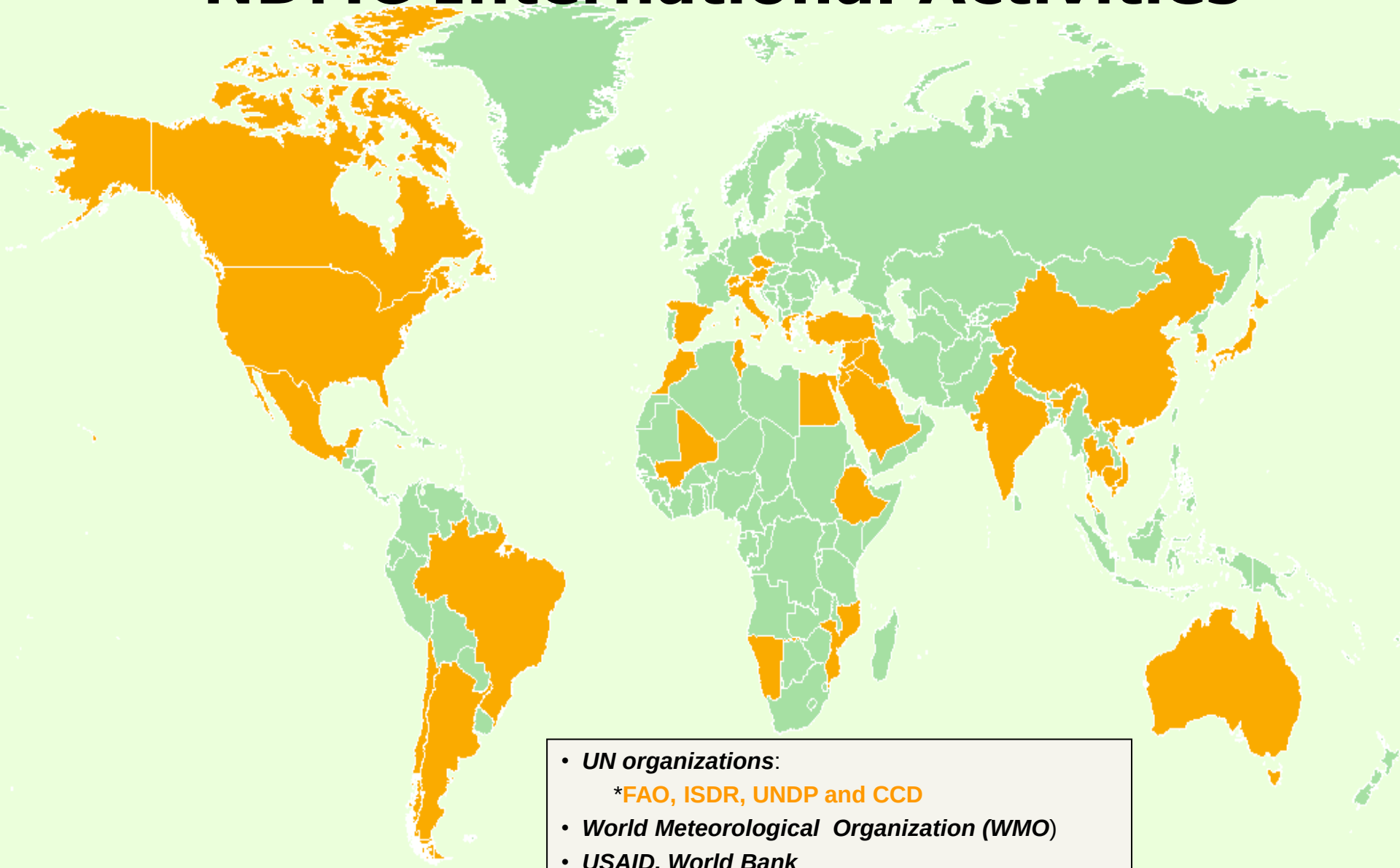
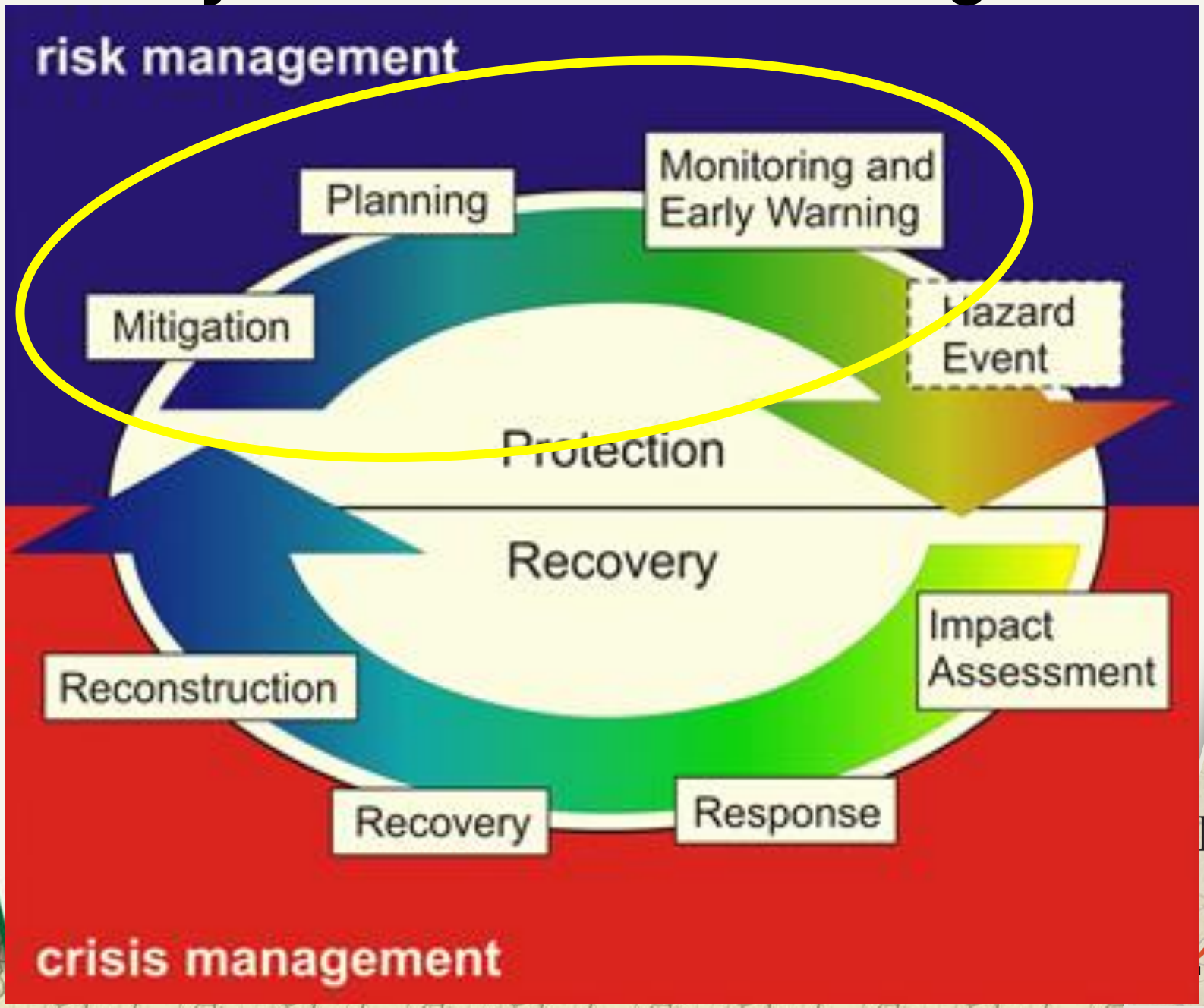
NDMC International Activities



- ***UN organizations***:
  - *FAO, ISDR, UNDP and CCD
- ***World Meteorological Organization (WMO)***
- ***USAID, World Bank***
- **Various regional and national drought centers**
- **Numerous government agencies and universities in different countries (projects, etc.)**

The Cycle of Disaster Management



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Drought Plan Components

- ***Monitoring and early warning***
  - Integrate and distill information
  - Assess, communicate, and ***trigger*** action
  - ***Foundation*** of a drought mitigation plan
- **Vulnerability assessment**
  - Who and what is at ***risk*** and why?
- **Mitigation and response actions**
  - Actions/programs that ***reduce risk and impacts*** and enhance recovery

Most processes and plans in the past have primarily focused on monitoring and response…

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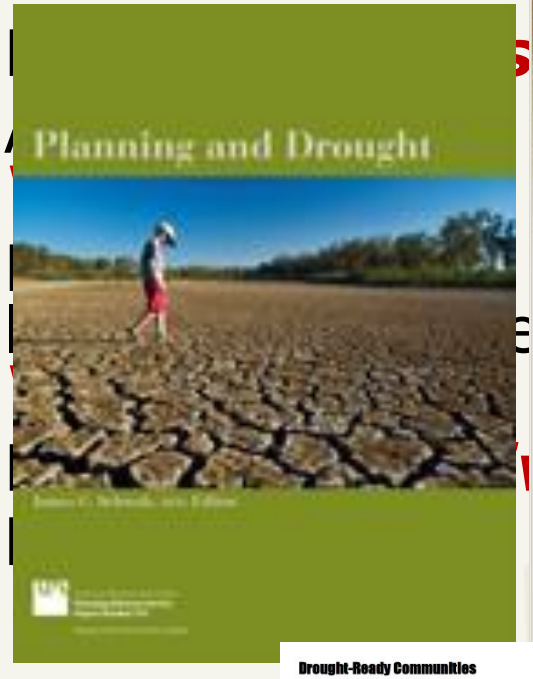
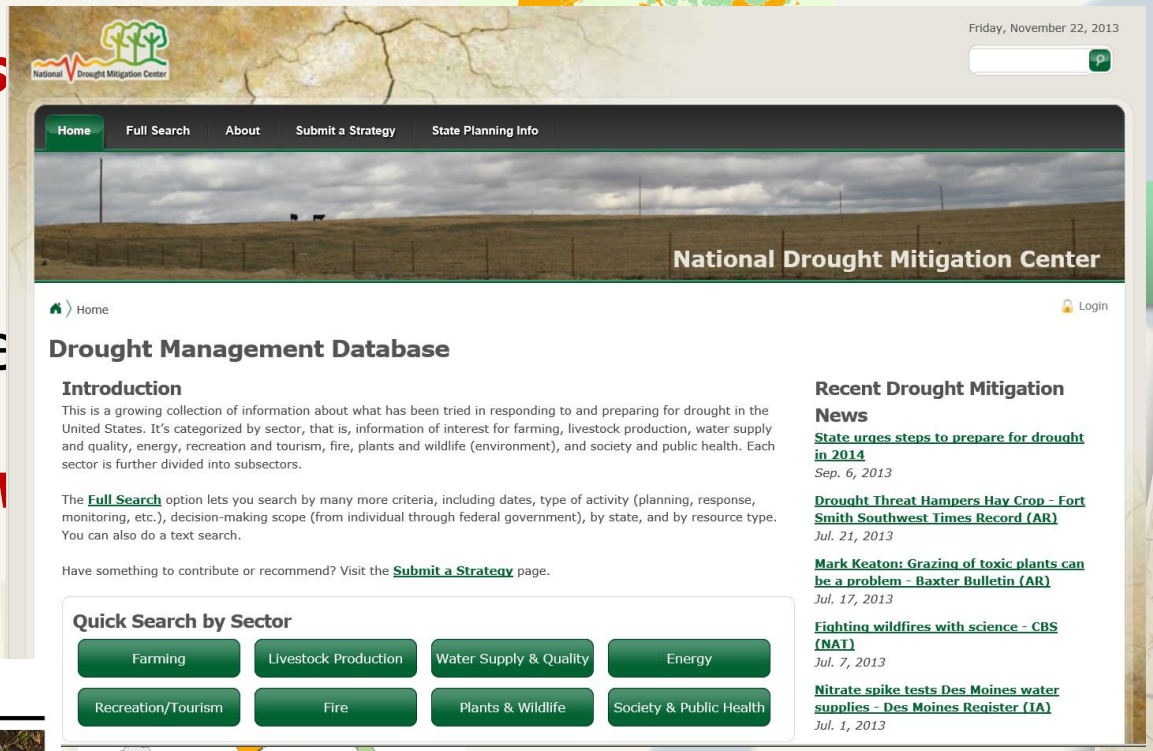
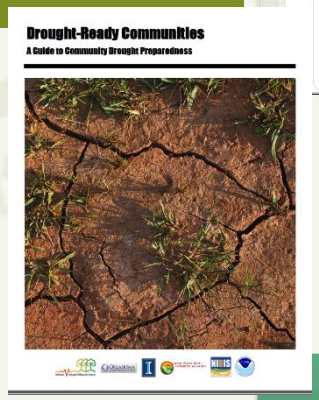
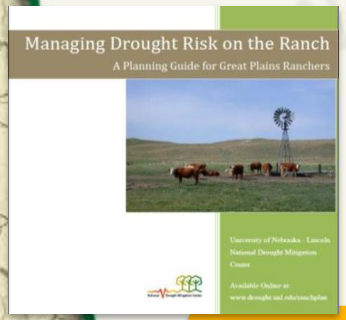
Planning Tools







State



Community

Individual

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The Importance of Drought Early Warning and Information Systems (DEWIS)

- Allows for ***early*** drought detection
- Improves response (***proactive***)
- Data and tools for ***decision support***
- ***"Triggers"*** actions within a drought plan
- A critical ***mitigation*** action
- ***Foundation*** of a drought plan

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Components of Drought Early Warning and Information Systems

- Monitoring **AND** Forecasting
- Access to **timely** data (including ***impacts***)and "value added" ***information***
- **Synthesis/analysis** of data used to "trigger" set actions within a drought plan
- **Tools** for decision makers
  - User needs assessment
- Efficient **dissemination/communication** (WWW, media, extension, etc.)
- Drought risk assessment and **planning**
- **Education** and Awareness

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NATIONAL INTEGRATED DROUGHT INFORMATION SYSTEM

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National Integrated Drought Information System (NIDIS)

A NOAA-led Federal, State, Tribal and Local Partnership

(Public Law 109-430, 2006)

Goal of NIDIS: Improve the nation's capacity to 'proactively' manage drought-related risks by **providing decision makers with the best available information and tools** to assess the impact of drought and to better prepare for and mitigate the effects of drought.

NATIONAL INTEGRATED DROUGHT INFORMATION SYSTEM

www.drought.gov

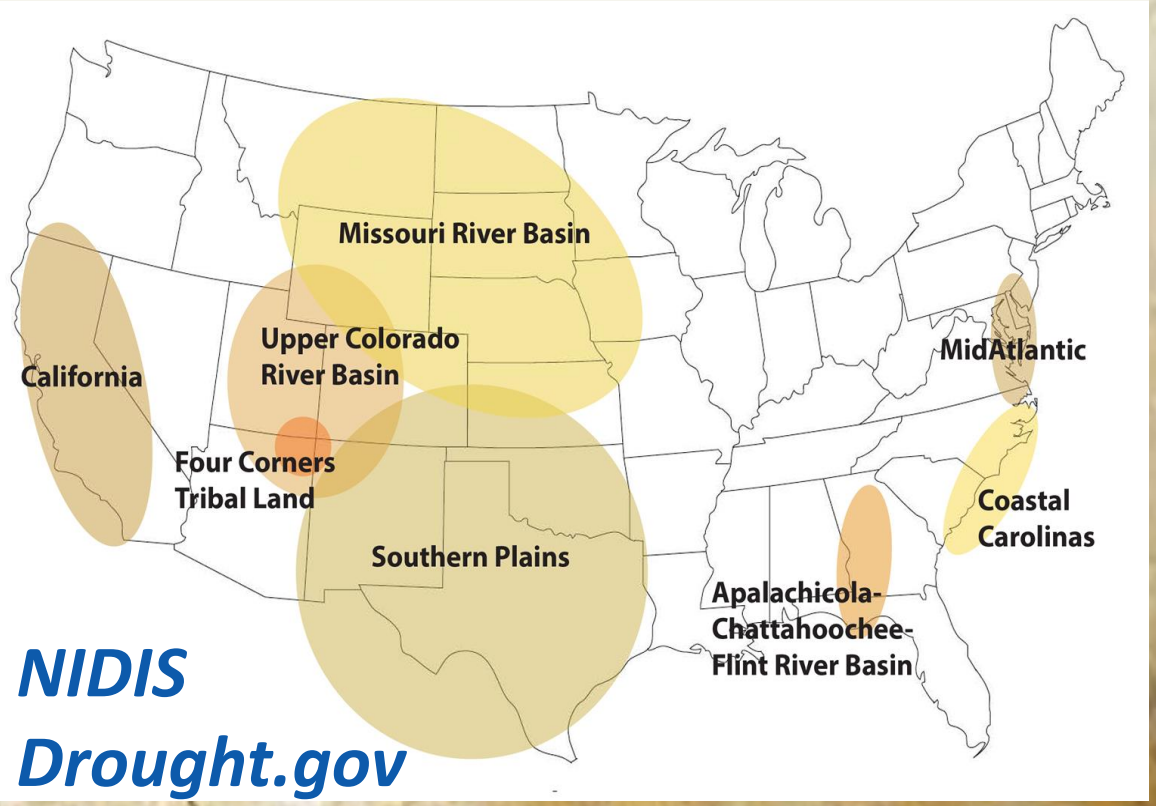
National *Integrated* Drought *Information* System (NIDIS)

NIDIS:
(TASK 1): Provide an effective *drought early warning system* that:

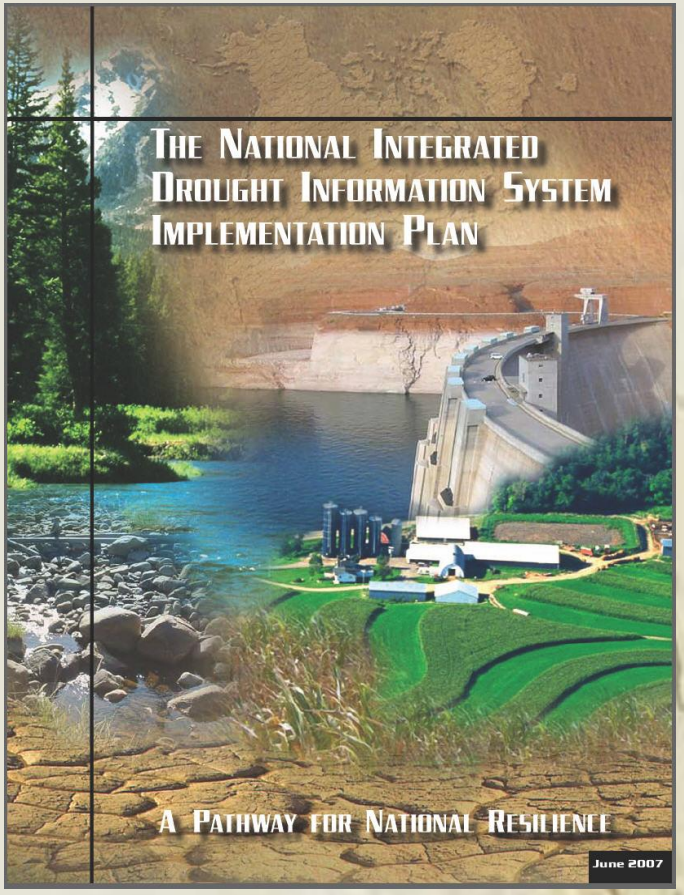
(a) *collects and integrates* information on the key indicators of drought and drought severity; and

(b) *provides timely information* that reflect state and regional differences in drought conditions

NIDIS Regional Drought Early Warning Systems



NIDIS Implementation Team Partners (to date):



www.drought.gov

Other Partners:

Western Governors Association (WGA)

National Drought Mitigation Center (NDMC)

Regional Climate Centers

American Association of State Climatologists

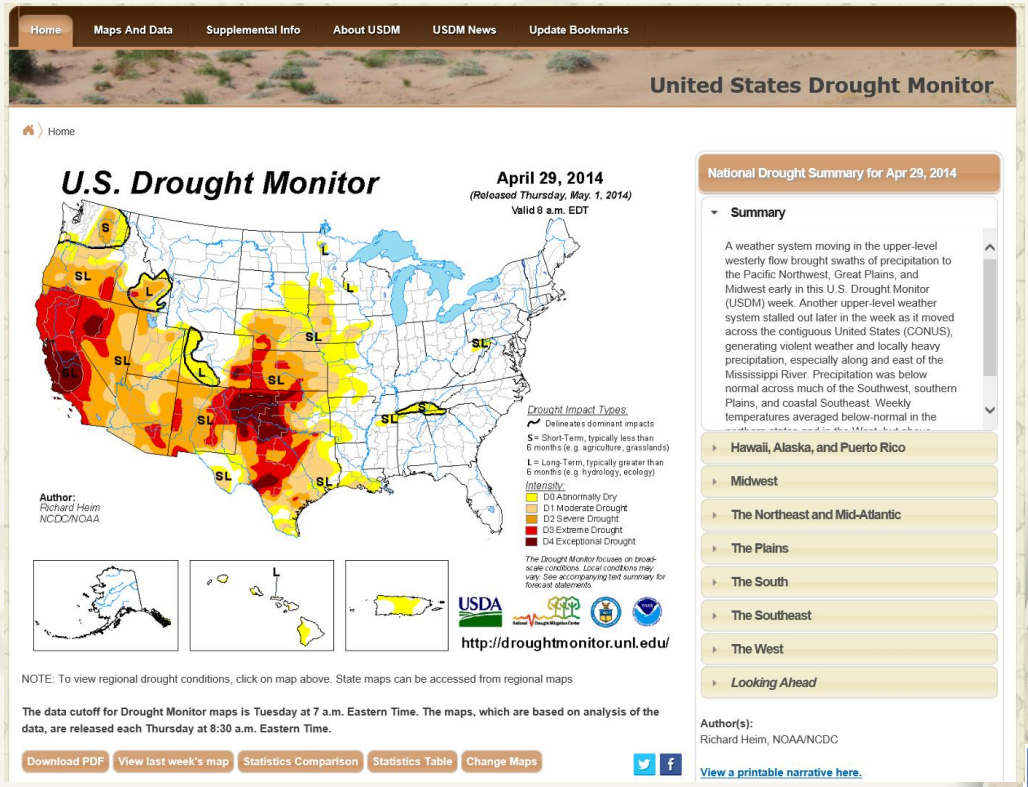
Indigenous Waters Network

Weather Channel

Numerous Universities including:
University of Oklahoma, University of South Carolina, University of Washington, South Dakota State University, and Cornell University.

U.S. Drought Monitor (USDM): droughtmonitor.unl.edu

- **State-of-the-art** drought assessment in the U.S. since 1999
  - Collaborative effort between NOAA, USDA and NDMC
- **Composite indicator** blends objective indicators and indices with field input from over **350 experts**
- **Policy implications** in Farm Bill (USDA), IRS, NOAA-NWS and several state drought plans and task forces
- **"Go to source"** for media and the public



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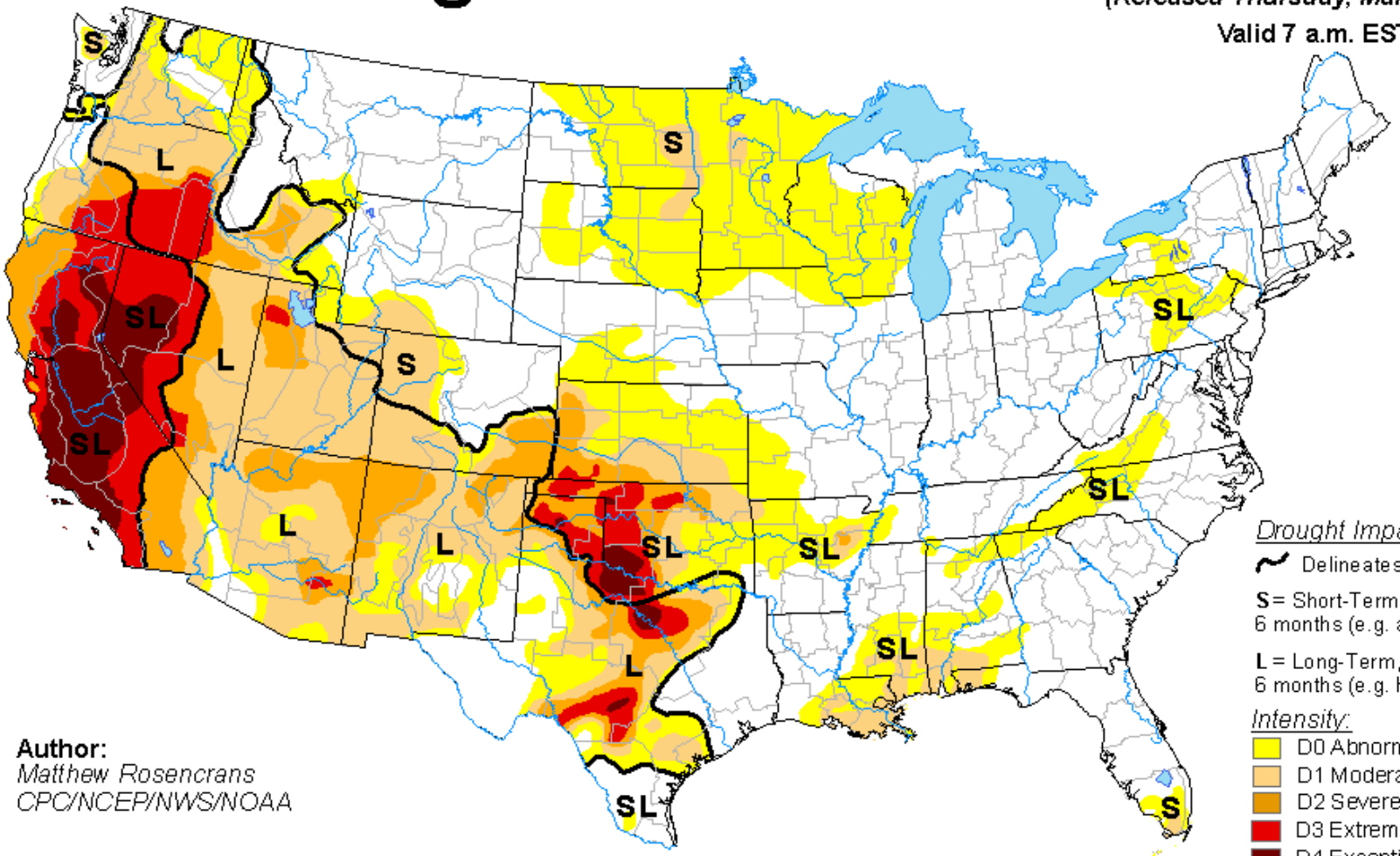
U.S. Drought Monitor

March 10, 2015

(Released Thursday, Mar. 12, 2015)

Valid 7 a.m. EST



Author:
Matthew Rosencrans
CPC/NCEP/NWS/NOAA

Drought Impact Types:

~ Delineates dominant impacts

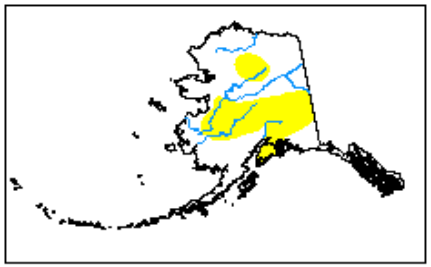
S = Short-Term, typically less than 6 months (e.g. agriculture, grasslands)

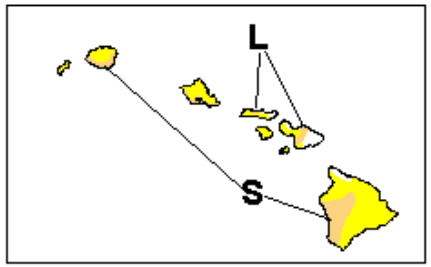
L = Long-Term, typically greater than 6 months (e.g. hydrology, ecology)

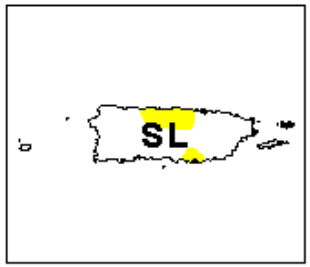
Intensity:

- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional Drought

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.





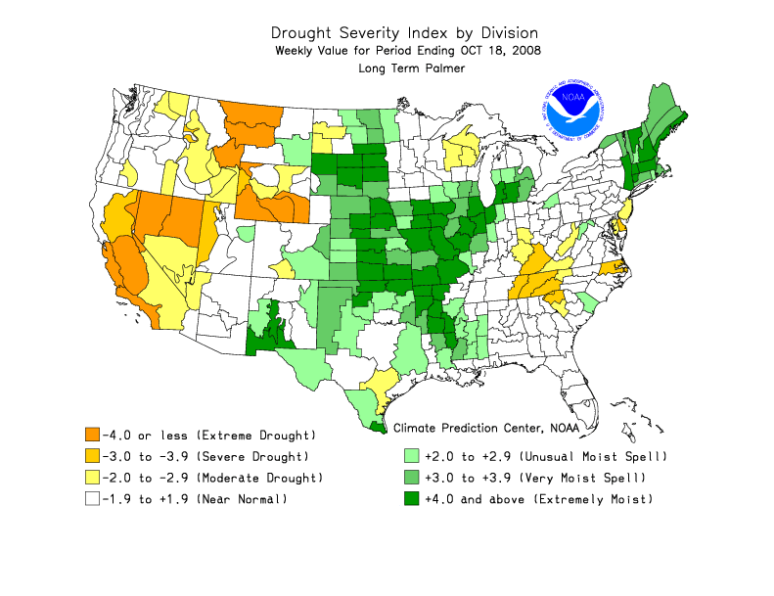


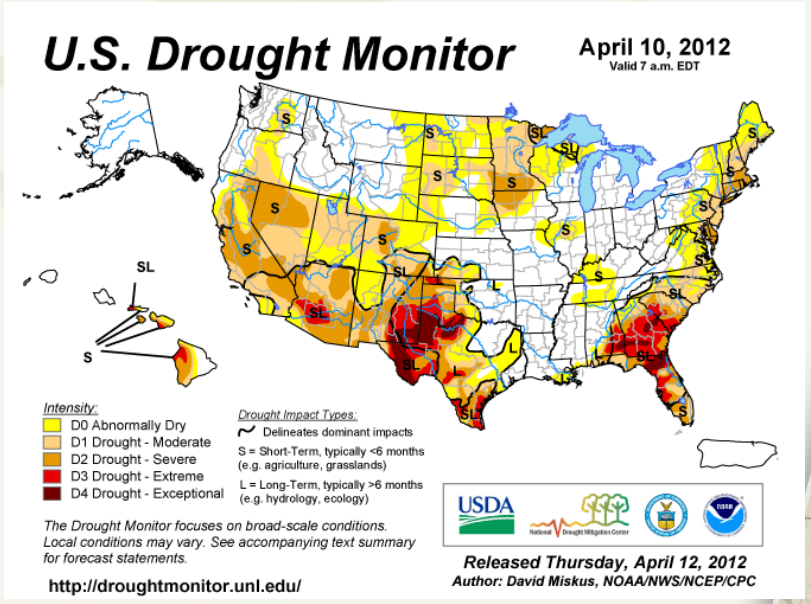
USDA National Drought Mitigation Center

http://droughtmonitor.unl.edu/

Approaches to Drought Assessment

- Single index or indicator (parameter)
- Multiple indices or indicators
- *Composite (or "hybrid") Indicator*





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U.S. Drought Monitor Approach

- **"Convergence of Evidence"**
  - Many types of drought "information" can be collectively analyzed to ***determine if the majority of information is 'converging' (telling the same story)*** about the accuracy, or inaccuracy, of the drought as depicted by the USDM
  - Need to ***look at 100% of the data, BUT don't believe in any one piece of data input 100%*** in making a decision…
  - ***Multiple indicators and types of information*** that describe different environmental parameters are needed to get a complete picture of a drought indicator's performance/applicability
  - ***Impacts are the "ground truth"***, yet aren't monitored….***you can't measure what you don't monitor!***

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Percentiles and the U.S. Drought Monitor

- **Advantages of percentiles:**
  - Can be applied to any parameter
  - Can be applied for various lengths of data record

The drought categories are associated with historical occurrence/likelihood (percentile ranking)

It is not anecdotal or subjective, like "It's really, really dry!!" ….or, "I don't remember it ever being this dry, we have to be D4!!"

- D4, Exceptional Drought: **(2)** — once per 50+ years
- D3, Extreme Drought: **(5)** — once per 20 to 50 years
- D2, Severe Drought: **(10)** — once per 10 to 20 years
- D1, Moderate Drought: **(20)** — once per 5 to 10 years
- D0, Abnormally Dry: **(30)** — once per 3 to 5 years

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Drought Risk Atlas (DRA):

Droughtatlas.unl.edu

- Launched March 2014
- ~3000 stations archived
  - 139 clusters/regions developed and analyzed
  - SPI, SPEI, PDSI, sc-PDSI and Deciles through 2012
  - Weekly gridded maps for all parameters back to early 1900s
- Created to answer questions about the characteristics of drought:
  - Frequency/return periods
  - Duration
  - Trends
  - Intensity
  - Spatial extent

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What Questions Does the Drought Risk Atlas Help Answer?

- What is my ***"drought climatology"*** ?
- How often does a drought of this magnitude happen in my area? (***frequency/return periods***)
- How does this drought ***compare historically***?
- How ***long*** do they typically last?
- ***When*** was the last time a drought like this happened? (***analogs***)
- What did the ***spatial footprint*** of the last drought look like? (areal extent/maps)

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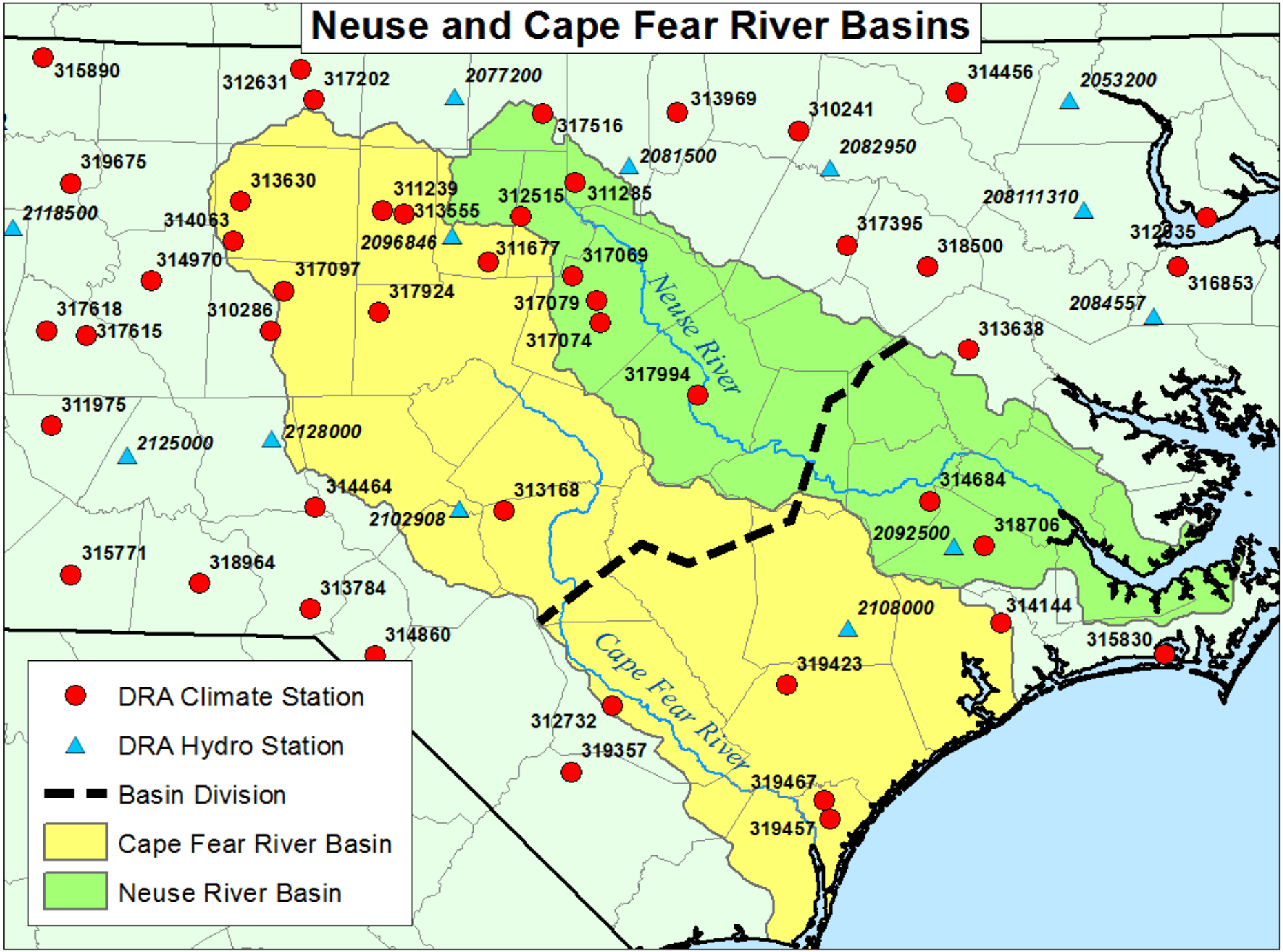

Neuse and Cape Fear River Basins
315890
312631
317202
2077200
317516
313969
310241
314456
2053200
319675
313630
311239
313555
312515
311285
2081500
2082950
2118500
314063
2096846
311677
317069
317395
208111310
312835
314970
317097
317924
317079
318500
316853
317618
310286
317615
317074
2084557
313638
317994
Neuse River
311975
2125000
2128000
314464
313168
2102908
314684
2092500
318706
315771
318964
313784
314860
2108000
314144
315830
319423
Cape Fear River
312732
319357
319467
319457
DRA Climate Station
DRA Hydro Station
Basin Division
Cape Fear River Basin
Neuse River Basin

Climate Data

Selected Atlas Station: **318706 (TRENTON)**

Select New Station

Station | Climate | Deciles | SPI | Drought Monitor | Drought Periods | Compare Indices | Frequencies

318706: TRENTON

Latitude
35.063

Longitude
-77.355

Elevation (ft)
30

State
North Carolina

County
Jones

Climate Division
7

Time Period
10/18/1955 - 12/31/2012

Years on Record
57

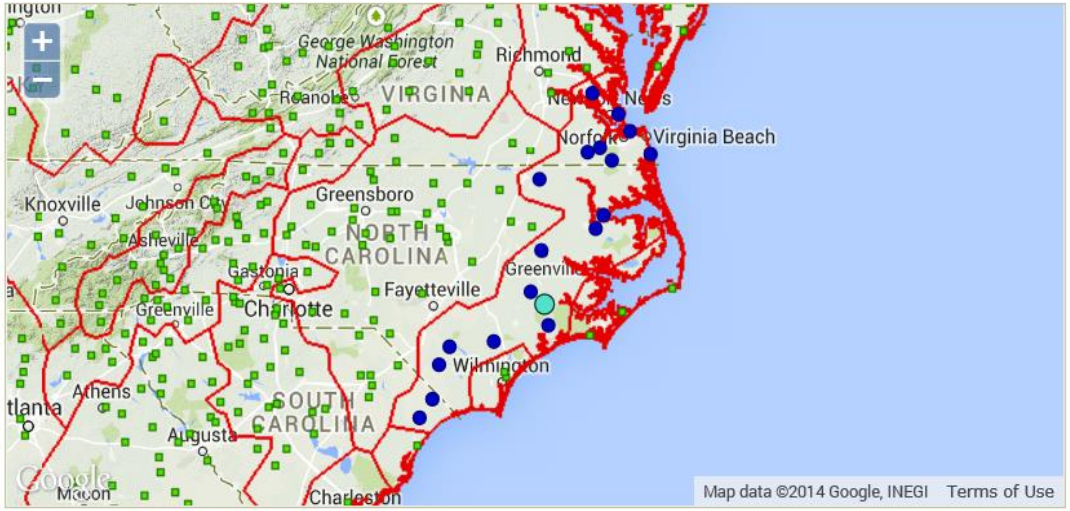
Precipitation Only
Yes

Download Metadata

The Atlas period of record can and will vary from the ACIS period of record. Stations may have had data periods that did not meet the criteria used in the Atlas. Those data periods are not included here. More information

Similar Stations

Atlas Region



Related Stations:

(Click to select)

312635: EDENTON

312732: ELIZABETHTOWN 3 SW

313638: GREENVILLE

314144: HOFMANN FOREST

314456: JACKSON

314684: KINSTON

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Climate Data

Selected Atlas Station: **318706 (TRENTON)**

Select New Station

Station | Climate | Deciles | SPI | Drought Monitor | Drought Periods | Compare Indices | Frequencies

Date

1/1/1955 to 12/31/2012

Period of Record

Station start date: 10/18/1955

Aggregate

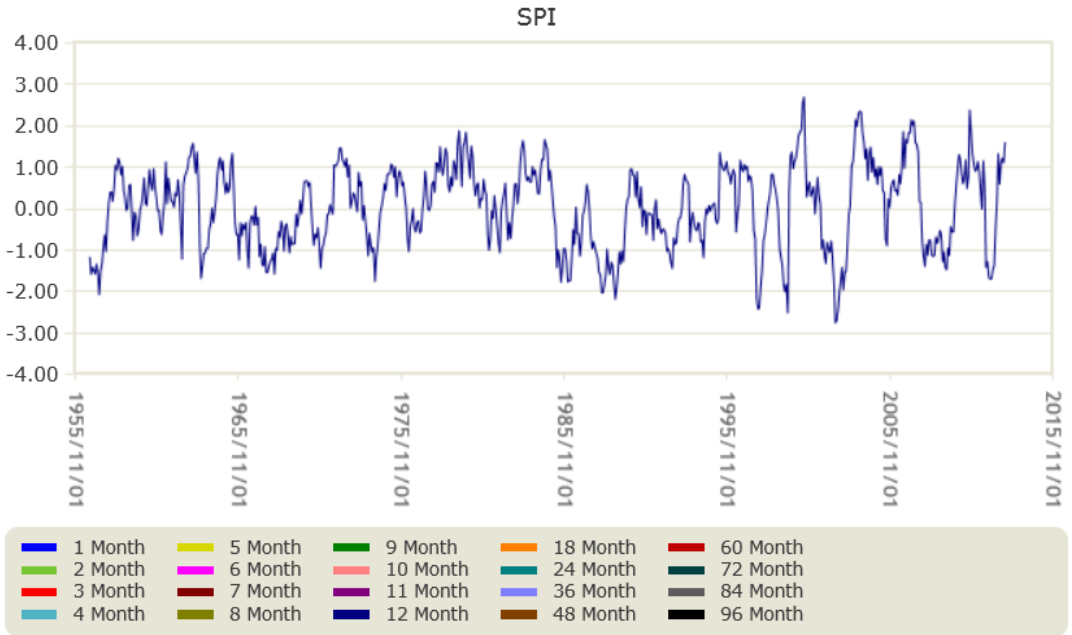
Month

Timestep

Select one or more timesteps to compare.

- 1 month
- 2 month
- 3 month
- 4 month
- 5 month
- 6 month
- 7 month
- 8 month
- 9 month
- 10 month
- 11 month
- 12 month
- 18 month
- 24 month
- 36 month
- 48 month
- 60 month

Results for **TRENTON (318706)** for the 12 Month timestep(s) between 10/18/1955 and 12/31/2012 and aggregated by month.



To zoom in on the chart, click and drag across the chart area. To return to the complete chart, double-click in the chart area.

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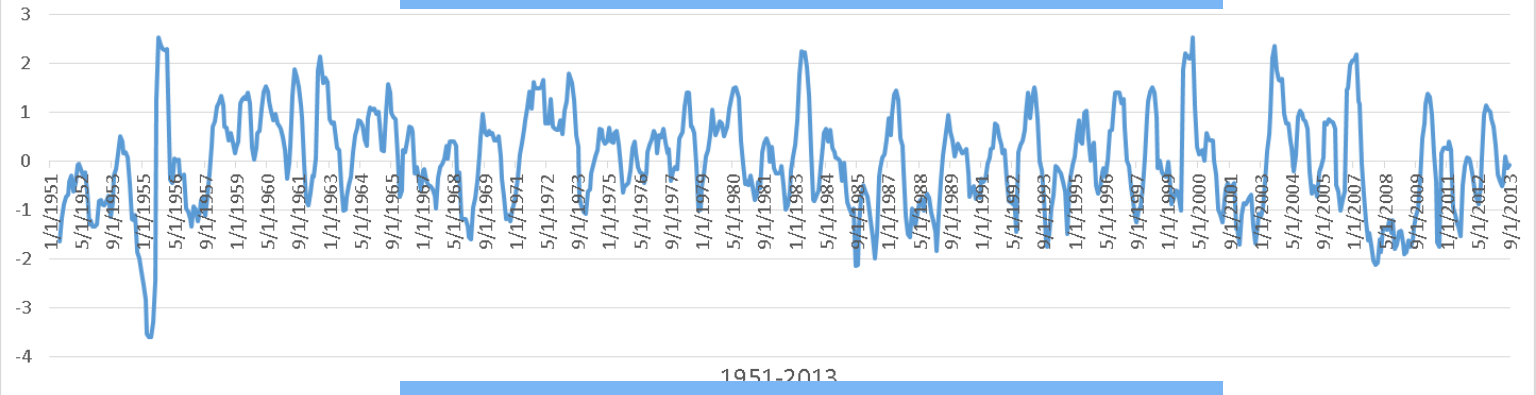
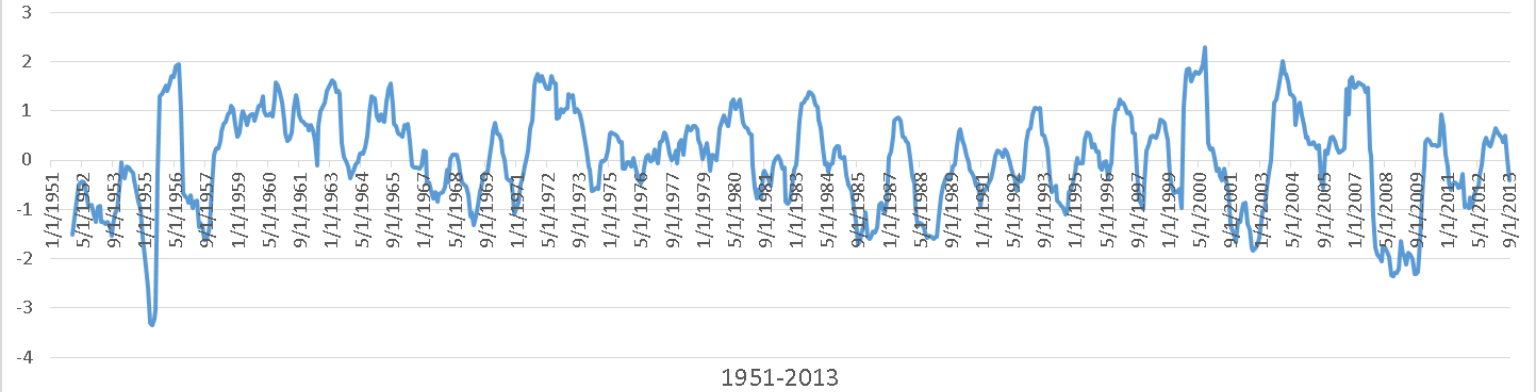
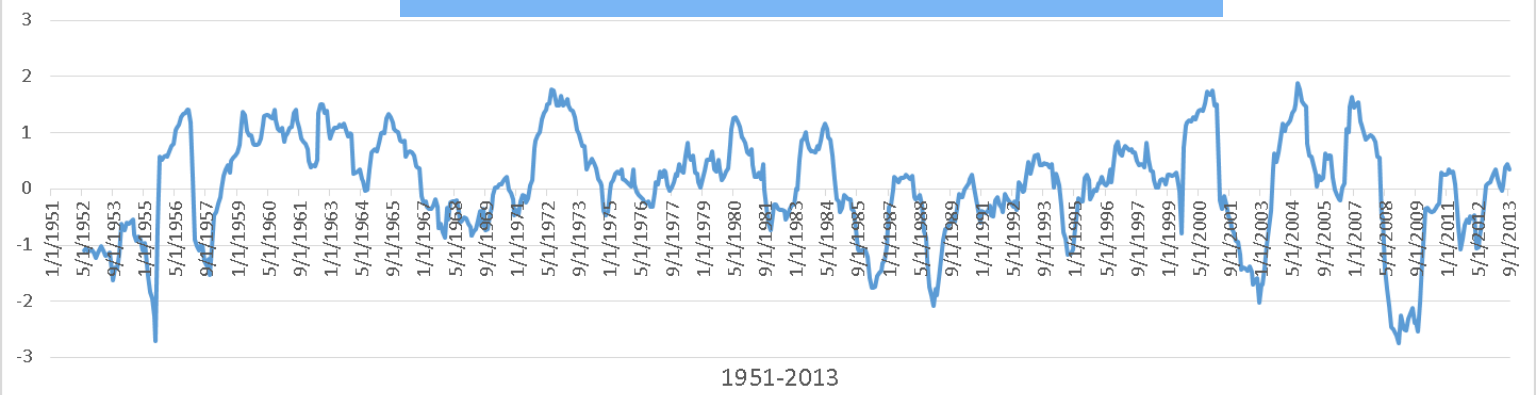
6-Month SSI Values for USGS 2092500



12-Month SSI Values for USGS 2092500



18-Month SSI Values for USGS 2092500



SSI values near Trenton, NC: #2092500 USGS

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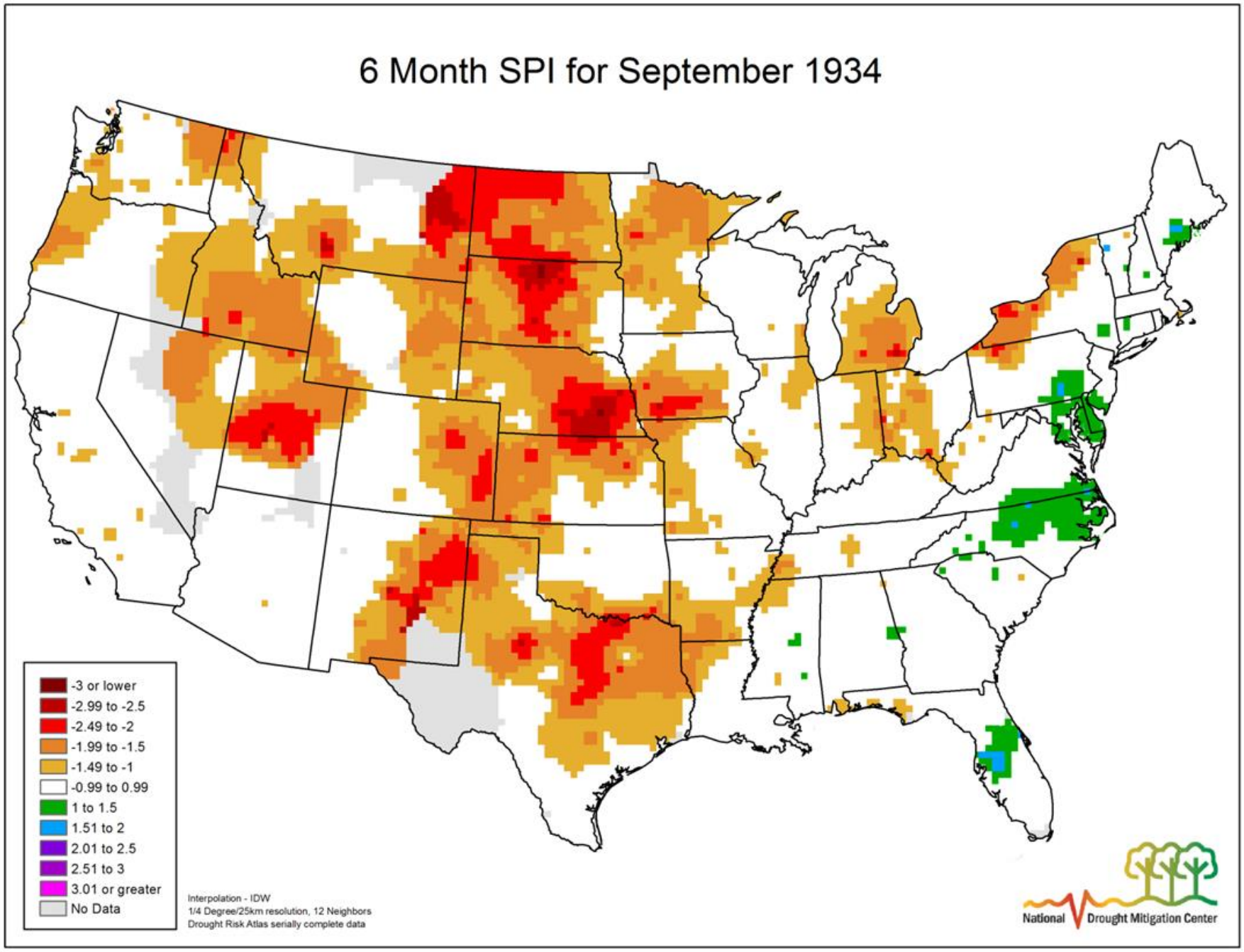
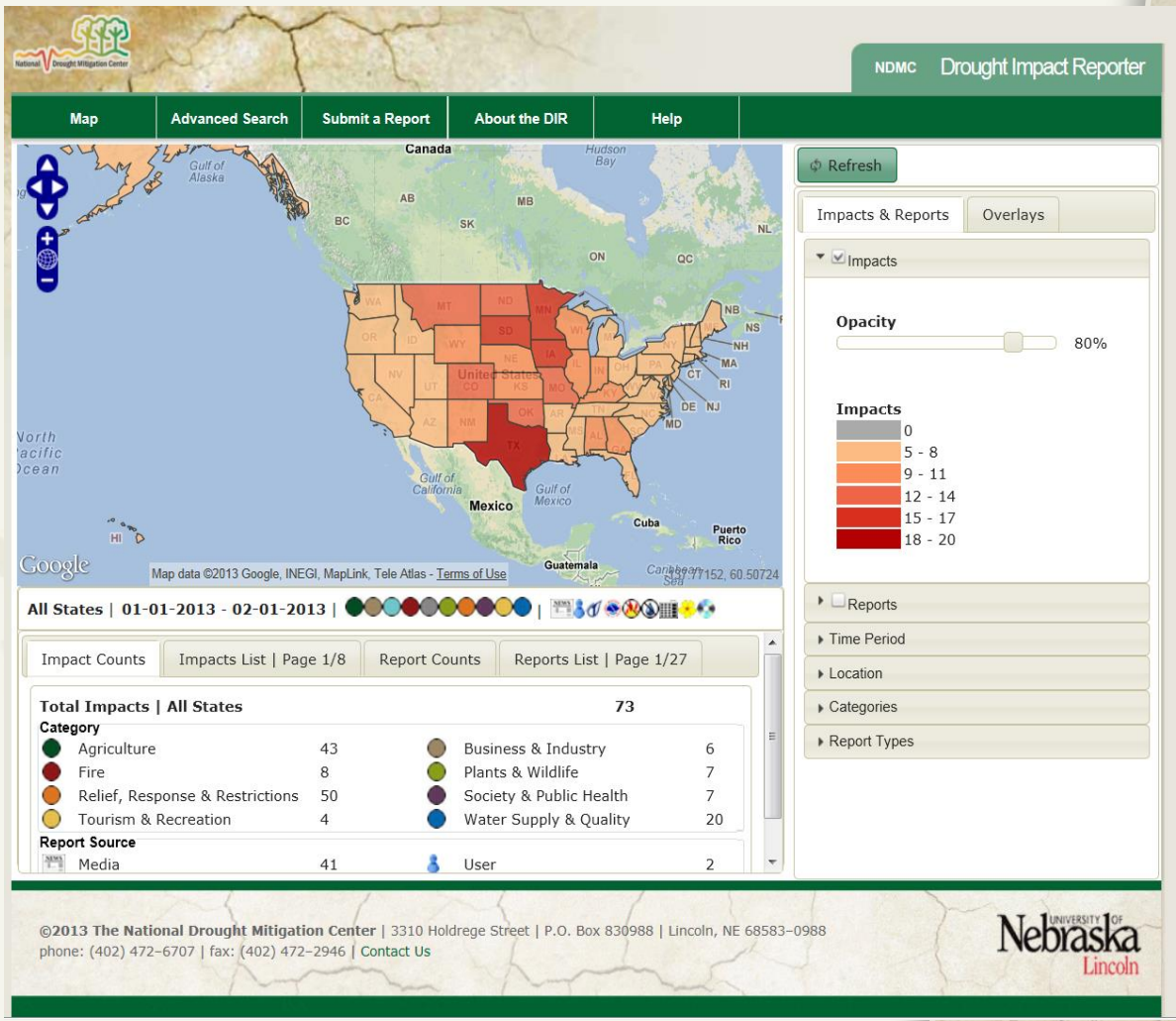

6 Month SPI for September 1934
-3 or lower
-2.99 to -2.5
-2.49 to -2
-1.99 to -1.5
-1.49 to -1
-0.99 to 0.99
1 to 1.5
1.51 to 2
2.01 to 2.5
2.51 to 3
3.01 or greater
No Data
Interpolation - IDW
1/4 Degree/25km resolution, 12 Neighbors
Drought Risk Atlas serially complete data
National Drought Mitigation Center

Drought Impact Reporter (DIR):

- On-line since 2005
- 28,000+ media reports and 18,000+ impacts in our database to date and growing
- Establishing a "baseline" of impacts due to droughts over time
  - "Face of drought"
  - Risk/vulnerability
  - Climate change
- *Ground truth* indices/RS
- Quantitative AND qualitative
- Direct AND Indirect

droughtreporter.unl.edu



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Why Track Drought Impacts?

- Establish an impacts ***baseline*** for ***monitoring***
  - Face of drought (vulnerability)
  - Climate change
- To know where to direct ***relief***
- To reduce ***risk*** in advance of the next drought
- ***"Ground truth"*** indices and models
- No single method exists for collecting and/or ***quantifying*** drought losses
- Very little in the way of ***environmental*** or ***qualitative*** collection

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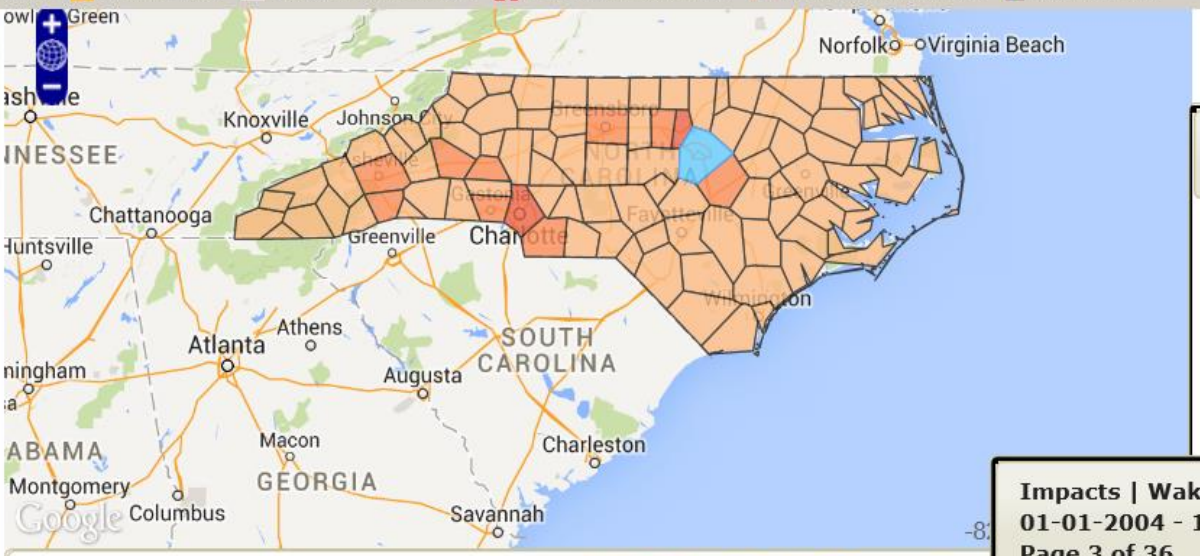


North Carolina | 01-01-2004 - 12-01-2014 |

Impact Counts | Impacts List | Page 1/106 | Report Counts | Reports List | Pa

Total Impacts | North Carolina **1059**
Statewide Impacts **214**
Category

Agriculture	204	Business & Industry	
Energy	1	Fire	
Plants & Wildlife	73	Relief, Response & Restric	
Society & Public Health	184	Tourism & Recreation	
Water Supply & Quality	457		

Impacts

Impacts | Wake County, NC
01-01-2004 - 12-01-2014

Total Impacts **358**
Statewide Impacts **214**
Category

Agriculture	84
Business & Industry	13
Fire	33
Plants & Wildlife	11

Impacts | Wake County, NC
01-01-2004 - 12-01-2014
Page 3 of 36

The number of cattle on feed fell to 10.144 million, the lowest October count since 1998
STATE |
Duration: 10-01-2013 - unknown

Rebate program in Raleigh, North Carolina connected with replacement of more than 12,000 toilets
Duration: 12-31-2009 - 01-01-2014

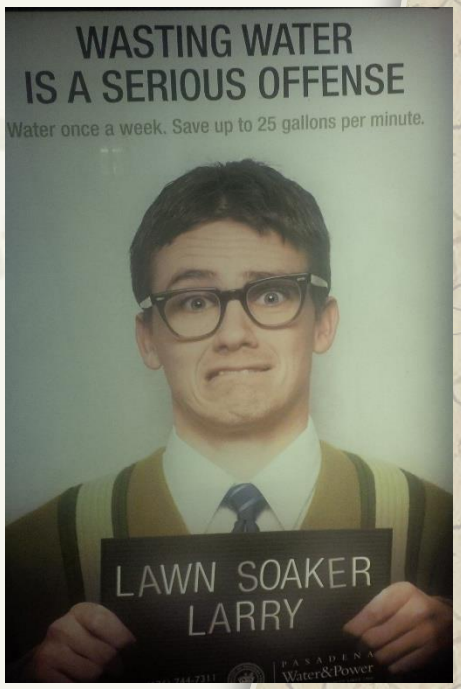
Raleigh, North Carolina residents reduced their daily water use to an average of just 98 gallons during the height of the 2007-08 drought
|
Duration: 12-01-2007 - 11-12-2013

Announcement of National Drought Resilience Partnership
STATE |
Duration: 11-14-2013 - unknown

OK

Example M&EW Impacts Logged

- Infrastructure (New and/or repair)
  - Dams/facilities/wells/augmentation-interconnection/desal
  - Water main breaks
- Water quantity and quality
  - Purchase/hauling of water
  - Purchase additional water rights
  - Salinity intrusion (higher levels of others)
  - Additional treatment costs
- Hydropower decreased
- Increased groundwater pumping
  - Subsidence/sink holes
- Good conservation leads to increased rates



Lake Folsom, California

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Lake Oroville, California

“We're not just up a creek without a paddle in California, we're losing the creek too”

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Critical Observations:

1) ***No single*** indicator/index is used solely in determining appropriate actions

2) Instead, ***different*** thresholds from ***different combinations*** of inputs is an optimal way to approach monitoring and triggers using a variety of indices and indicators

3) Decision making (or ***"triggers"***) based on ***quantitative values*** are supported favorably and are better understood

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Final Thoughts

- Monitoring is the ***foundation*** of risk management planning
  - ***Trigger to who does what and when!***
  - ***One can not manage what is not monitored!***
- ***Impact collection must be an integral part*** of any drought early warning information system
- Tool development should be an ***iterative process*** in partnership with the users
- ***Dissemination*** is needed through a variety of media and educational materials in order to reach a variety of audiences

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