

Vegetation Drought Response Index (VegDRI)

*A New Tool for Monitoring Vegetation Drought Stress
at Local to National Scales*

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*Boise, ID
July 27, 2010*



VegDRI Project Team

NDMC

- ***Brian Wardlow*** – remote sensing specialist / geographer
- ***Tsegaye Tadesse*** – climatologist / data mining
- ***Karin Callahan*** – remote sensing /GIS specialist
- ***Chris Poulsen*** – GIS specialist
- ***Eric Hunt*** – Ph.D. student (climatology and soil moisture)
- ***Sharmistha Swain*** – Ph.D. student (remote sensing)

USGS

- ***Jesslyn Brown*** – remote sensing specialist / geographer
- ***Danny Howard*** – geospatial analyst



What is VegDRI?

VegDRI is a new ‘hybrid’ drought index that integrates:

- satellite-based observations of vegetation conditions
- climate-based drought index data
- biophysical characteristics of the environment

to produce 1-km spatial resolution maps that depict

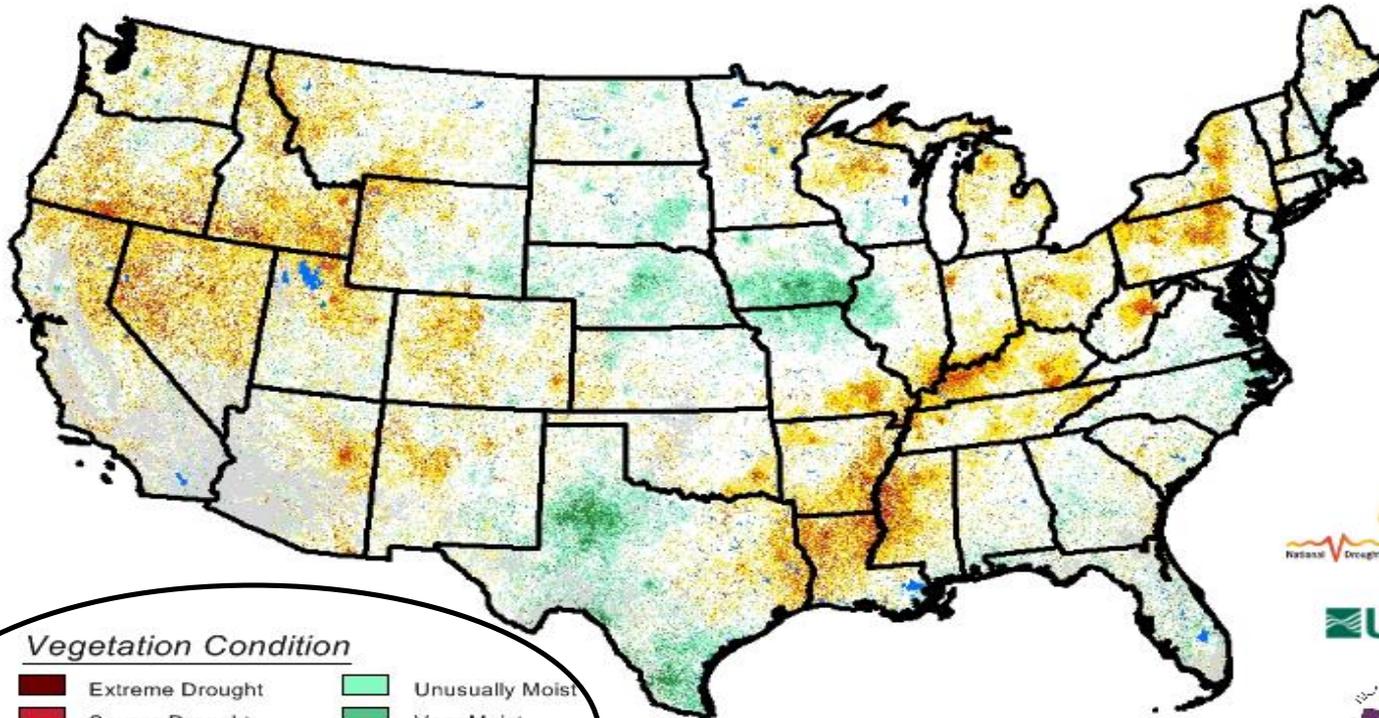
‘drought-related vegetation stress’ and are regularly updated (currently at 2-week interval) during the growing season.



What is VegDRI?

**Vegetation Drought Response Index
Complete**

July 12, 2010



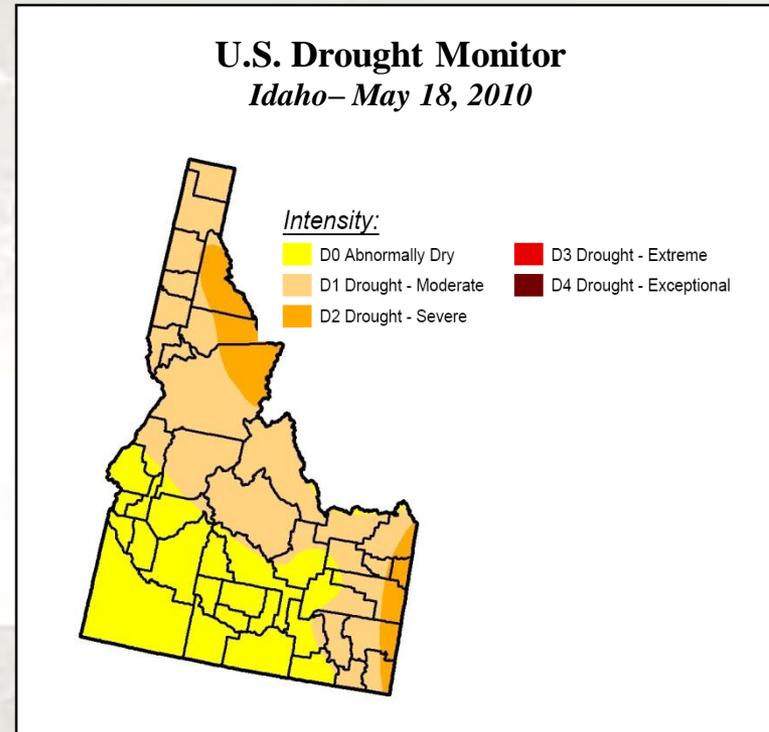
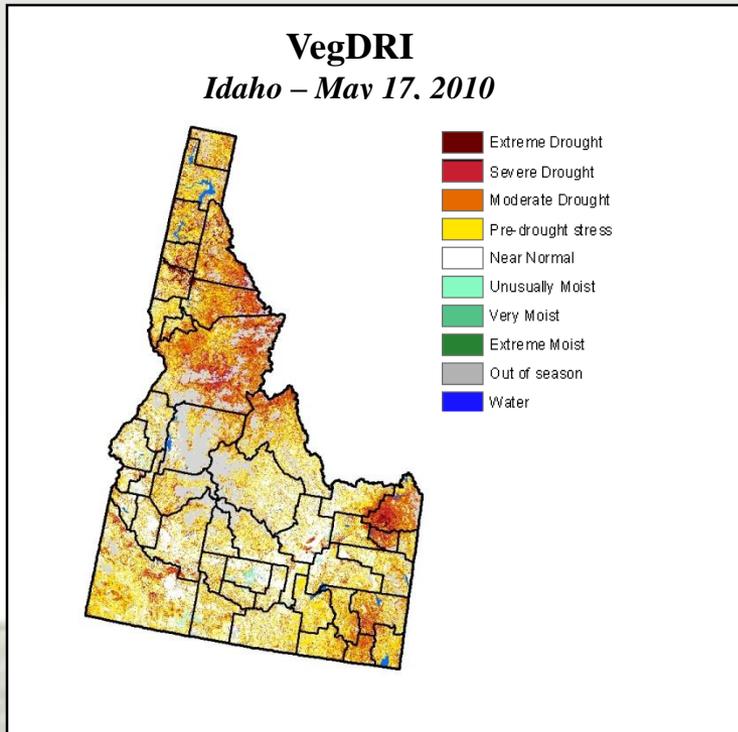
Vegetation Condition

- | | |
|------------------|-----------------|
| Extreme Drought | Unusually Moist |
| Severe Drought | Very Moist |
| Moderate Drought | Extremely Moist |
| Pre-Drought | Out of Season |
| Near Normal | Water |

Modified version of the Palmer Drought Severity Index (PDSI) classification scheme.



VegDRI vs. U.S. Drought Monitor

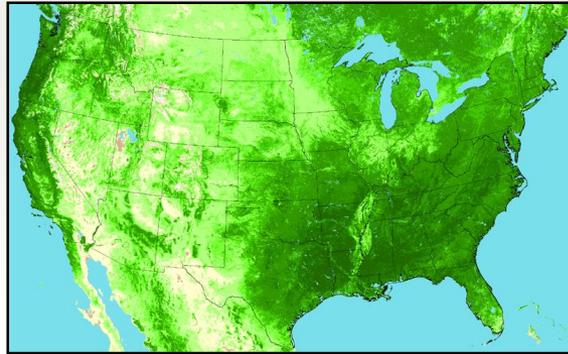


Goal of VegDRI Tool: *National-level monitoring* capabilities with *local-scale information* (i.e., county to sub-county level) regarding the level of drought stress on vegetation.



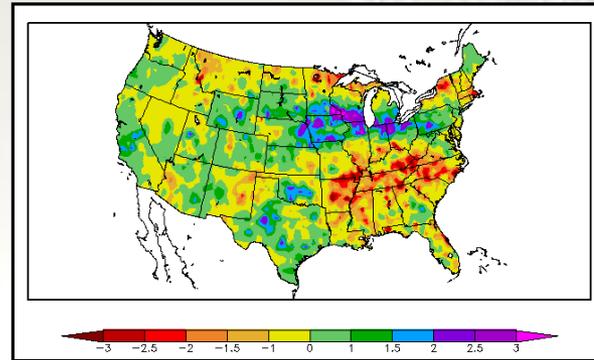
VegDRI - An Integrated Approach

Remote Sensing Component



+

Climate Component



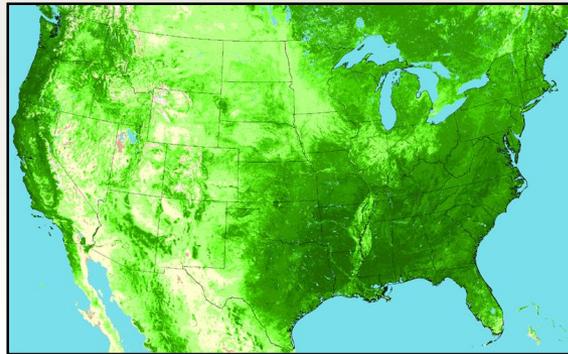
+

Biophysical Component



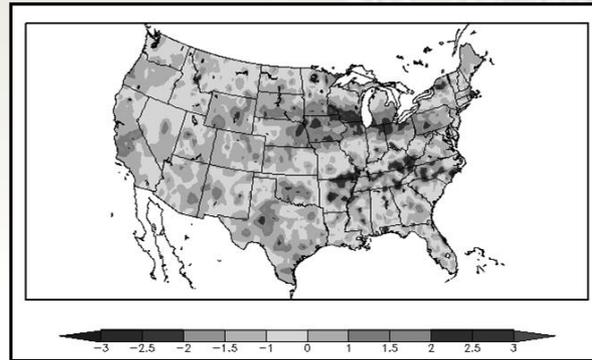
VegDRI - An Integrated Approach

Remote Sensing Component



+

Climate Component



+

Biophysical Component



Role: Satellite-based observations provide information on the *spatial distribution and general condition of vegetation*.

- (+) Spatially detailed information about vegetation across large geographic areas.
- (-) Difficult to discriminate drought impacted areas from locations under other types of environment stress (flooding, fire, hail, & pests) or experiencing land use change.

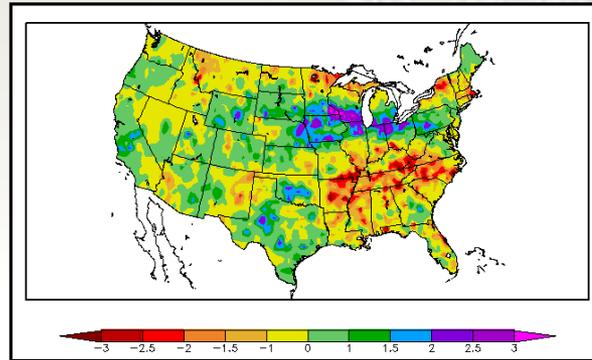
VegDRI - An Integrated Approach

Remote Sensing Component



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Climate Component



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Biophysical Component

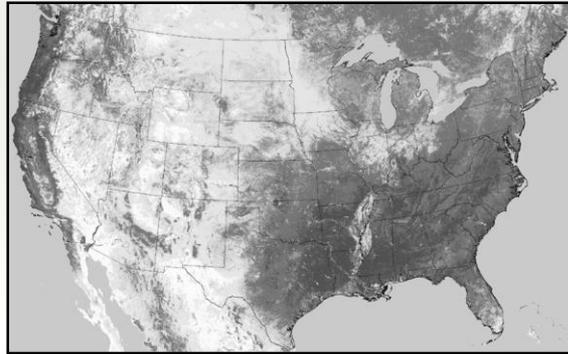


Role: Climate-based drought index maps provide a *'broad-scale' measure of dryness* that can be used for interpretation of the vegetation stress recorded in the satellite observations.

- Drought areas typified by below average vegetation conditions recorded in the satellite data and drier than normal conditions in the climate data.

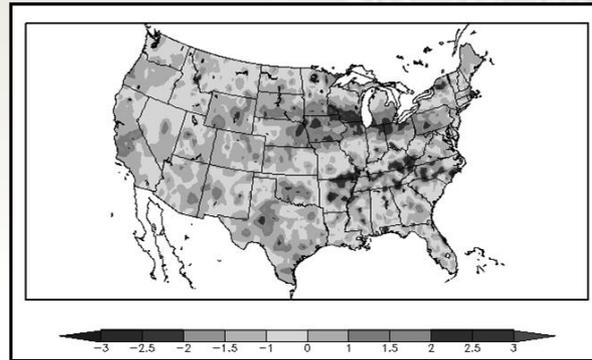
VegDRI - An Integrated Approach

Remote Sensing Component



+

Climate Component



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Biophysical Component



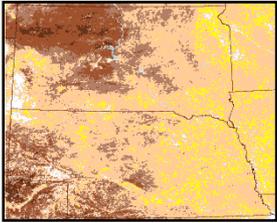
Role: Different characteristics of the environment are considered that influence climate-vegetation interactions.

- land use/land cover type
- irrigation
- soil available water capacity
- elevation
- ecological setting

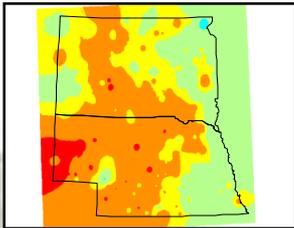
VegDRI Methodology

1. Historical Database Development

Satellite Data



Climate Data



Biophysical Data



Data Input Variables

- 1) Percent Annual Seasonal Greenness (PASG)
- 2) Start of Season Anomaly (SOSA)

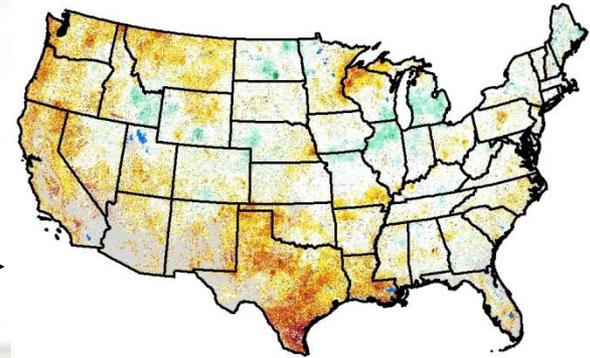
- 1) Palmer Drought Severity Index (PDSI)
- 2) Standardized Precip. Index (SPI)

- 1) land use/ cover type
- 2) soil available water capacity (STATSGO)
- 3) ecoregion type
- 4) irrigation status
- 5) elevation

2. Model Development

Regression Tree Model (*)

3. Map Generation

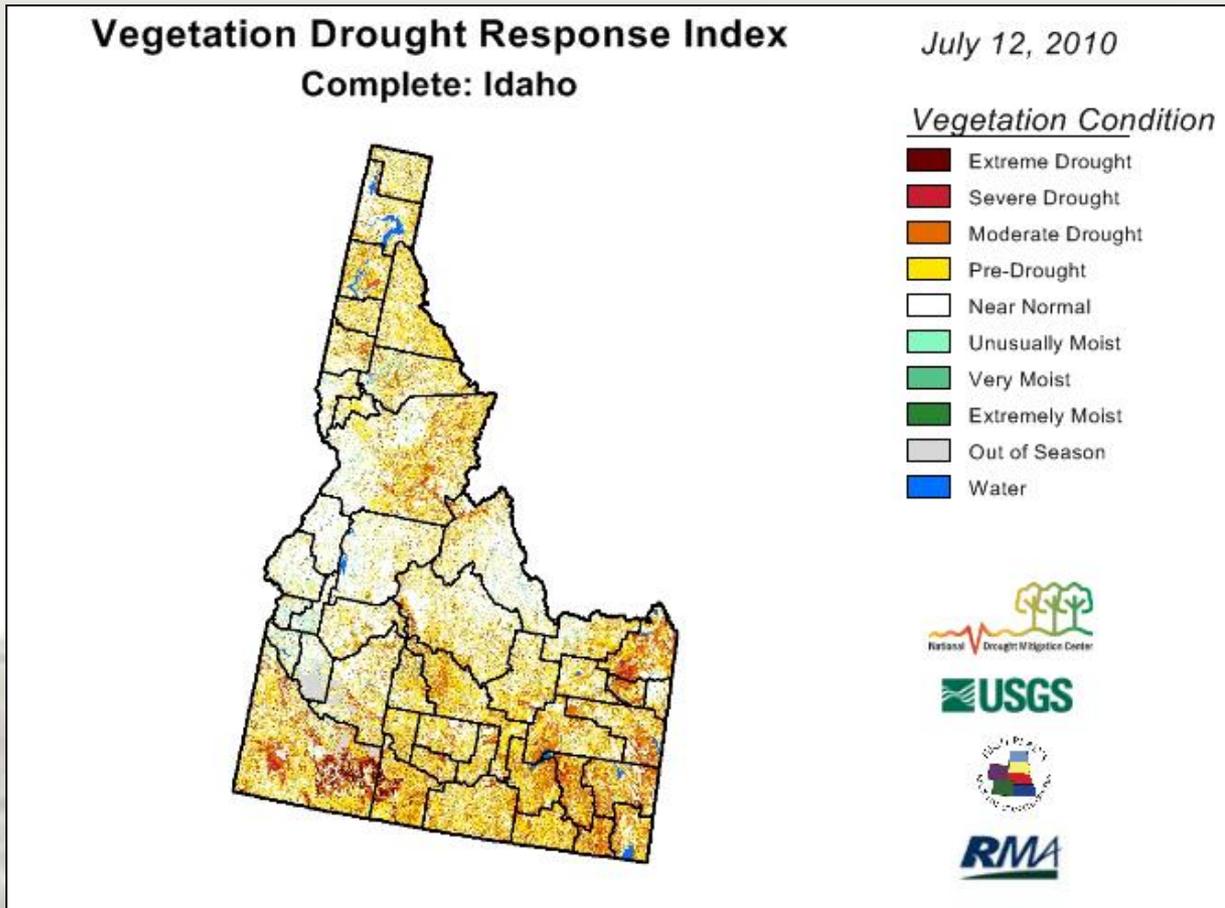


1-km VegDRI Map

(*) Models developed from a 20-year historical record (1989 – 2008) of bi-weekly climate and satellite observations at 2,200+ weather station locations.

Biophysical variables are *static* over time.

Operational VegDRI Production



(*) Bi-weekly maps currently available.

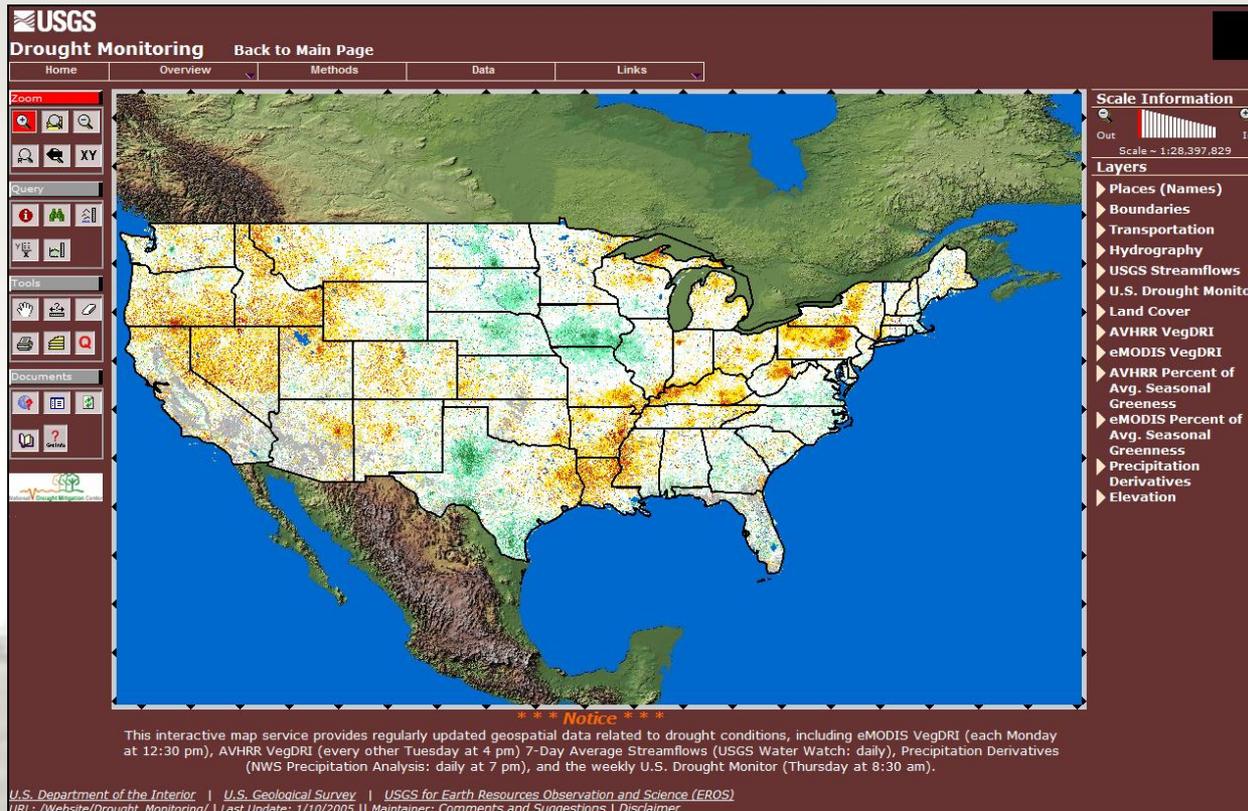
- Information currently available for North Carolina:
 - May 2009 to present
- Production of *a 20-year historical record* of VegDRI maps in progress. (1989 – 2008)
- *Weekly map updates* planned for 2010 in experimental mode.
- Future work to test the production of a *250-m resolution VegDRI* product is planned.



USGS Drought Monitoring Viewer

Interactive map viewer that enables users to customize their views of the VegDRI maps:

- 'pan' and 'zoom' options
- view VegDRI in relation to map layers of other information:
 - VegDRI
 - U.S. Drought Monitor
 - satellite-based vegetation greenness
 - precipitation
 - stream flows

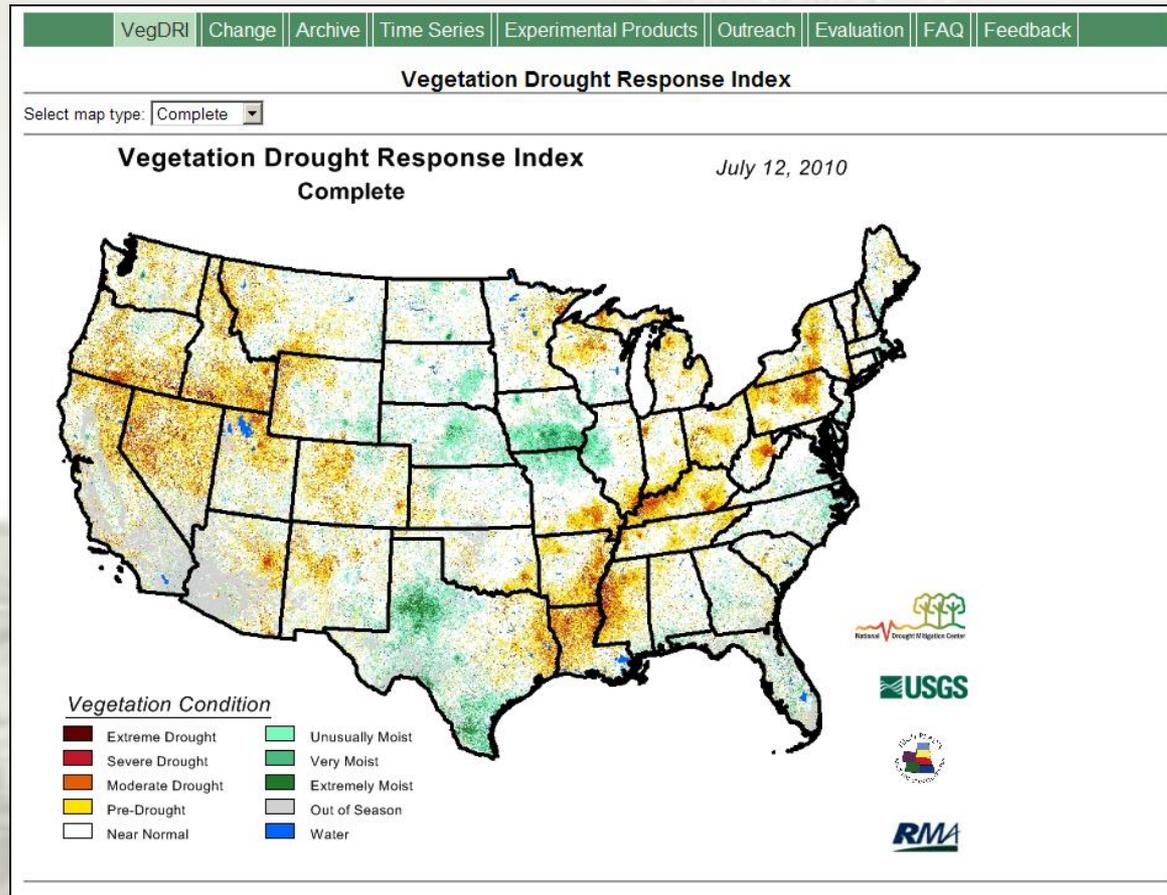


http://gisdata.usgs.net/website/Drought_Monitoring/viewer.php



VegDRI Website and Products

VegDRI products are available at the VegDRI page within the Monitoring section of the NDMC website.

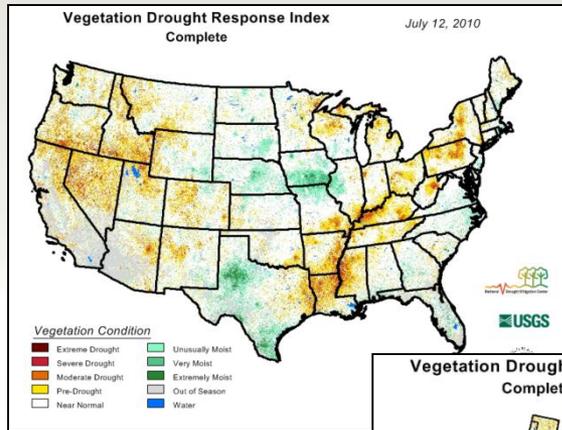


http://www.drought.unl.edu/vegdiri/VegDRI_Main.htm

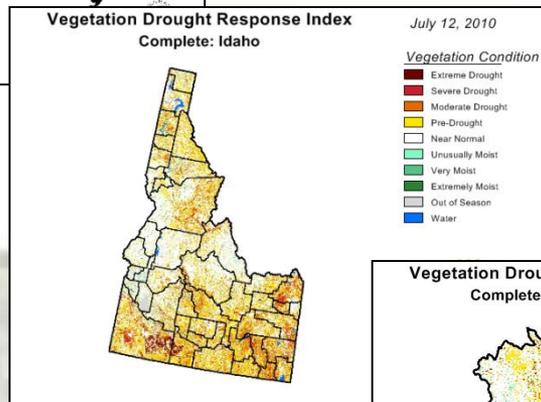


1. VegDRI Quick-View Maps

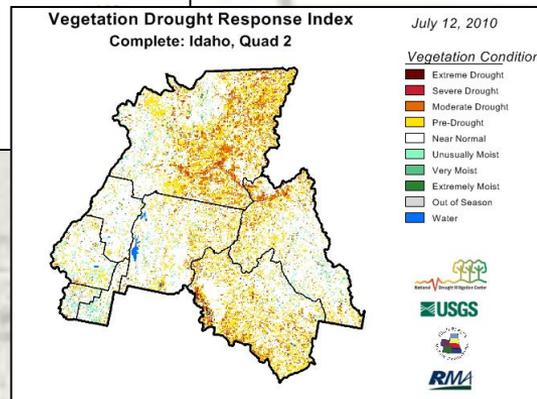
(multiple spatial scales)



National-level



State-level



Sub-state
level



1. VegDRI Quick-View Maps (cont).

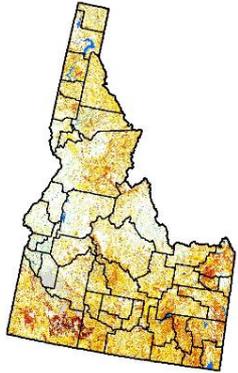
(land cover type)

Vegetation Drought Response Index
Complete: Idaho

July 12, 2010

Vegetation Condition

- Extreme Drought
- Severe Drought
- Moderate Drought
- Pre-Drought
- Near Normal
- Unusually Moist
- Very Moist
- Extremely Moist
- Out of Season
- Water



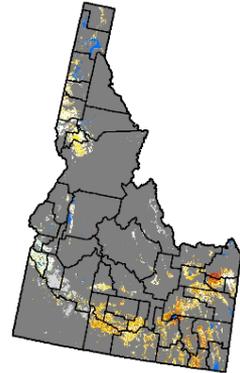
Complete view

Vegetation Drought Response Index
Croplands: Idaho

July 12, 2010

Vegetation Condition

- Extreme Drought
- Severe Drought
- Moderate Drought
- Pre-Drought
- Near Normal
- Unusually Moist
- Very Moist
- Extremely Moist
- Other landcover
- Out of Season
- Water



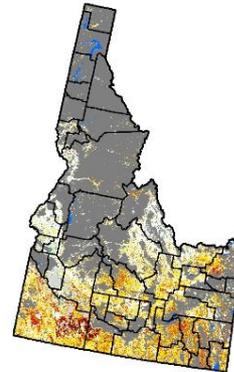
Cropland view

Vegetation Drought Response Index
Rangelands: Idaho

July 12, 2010

Vegetation Condition

- Extreme Drought
- Severe Drought
- Moderate Drought
- Pre-Drought
- Near Normal
- Unusually Moist
- Very Moist
- Extremely Moist
- Other landcover
- Out of Season
- Water



'Forest view'
option for the
eastern U.S.?

Rangeland view



2. VegDRI Area Statistics (% area) (currently available at state-level only)

Specific tables available for cropland and rangeland. A forest table option can also be added.

VegDRI Statistics for Idaho (Percent Area)

Complete Complete Rangeland Crops	Extreme Drought	Severe Drought	Moderate Drought	Pre-Drought	Near Normal	Unusually Moist	Very Moist	Extremely Moist
10/07/12	1.01	4.02	13.63	28.01	48.94	1.77	0.48	0.14
10/06/28	1.04	3.79	11.99	27.59	51.21	2.12	0.73	0.29
10/06/14	0.28	2.91	10.21	25.74	55.37	2.70	1.23	0.44
10/05/31	1.12	4.43	13.86	24.02	49.77	3.68	1.30	0.70
10/05/17	1.38	6.83	17.21	28.15	31.53	0.82	0.25	0.04
10/05/03	1.06	4.69	13.50	25.59	25.85	0.78	0.18	0.02
10/04/19	0.93	4.89	16.39	18.36	10.68	0.22	0.02	0.01
10/04/05	0.39	1.89	8.49	10.81	11.88	0.53	0.15	0.08
10/03/22	0.20	1.11	4.13	4.94	6.25	0.24	0.09	0.00
10/03/08	0.09	0.48	2.23	2.65	4.34	0.14	0.11	0.00
10/02/22	0.01	0.02	0.53	0.46	1.82	0.15	0.11	0.00
10/02/08	0.00	0.01	0.01	0.03	0.40	0.05	0.01	0.00
10/01/25	0.00	0.00	0.01	0.02	0.16	0.03	0.00	0.00
10/01/11	0.00	0.00	0.00	0.00	0.23	0.00	0.00	0.00
09/12/28	0.00	0.00	0.00	0.02	0.15	0.03	0.01	0.02
09/12/14	0.00	0.00	0.00	0.01	0.16	0.01	0.02	0.02
09/11/30	0.00	0.01	0.06	0.20	1.01	0.08	0.07	0.01
09/11/16	0.09	0.49	1.80	5.62	27.69	1.87	0.30	0.05
09/11/02	0.19	0.79	2.36	7.68	46.84	7.68	1.62	0.23

Summarize the % area of each VegDRI class for ‘current’ map and all prior dates in the growing season.



3. Map Narrative for the National VegDRI Map

VegDRI Highlights for July 12th, 2010

Western States

Little or precipitation was observed on areas from the Rockies westward resulting in continuing the drying trend in the region of southern Oregon, southern Idaho, the northernmost counties of Utah, and the western edge of Wyoming. However, central and eastern Wyoming continued to improve from drier conditions.

Great Plains

Because of moderate rainfall over southern Oklahoma and northern Texas, the Pre-drought condition has slightly improved. However, centered over Washita and Kiowa counties in Oklahoma, the drought conditions are expanding east and southward to include Blaine, Caddo, and Stephens Counties.

Moist to very moist conditions persisted over much of the Great Plains, especially Nebraska, the Dakotas, Iowa, northern Missouri and western Illinois.

Midwest

Drought conditions intensified over the Ohio valley, affecting areas of northern Kentucky, southern Indiana and southern Illinois.

Most areas Wisconsin and Michigan are improving toward near normal conditions with some exceptions of the northeastern counties of Wisconsin and northern Michigan which are in pre- to moderate drought.

Moderate drought in central West Virginia is expanding once again, primarily affecting Barbour, Lewis, Gilmer, Upshur and Randolph Counties.

Northeast

Because of recent heat and dryness, some Counties of New York including Lewis, Oneida, Chenango, Broome, Tioga, and Steuben Counties which were in moderate to severe drought conditions. Most of the northern and northeastern Counties of Pennsylvania were also under drought conditions.

Southeast

The lower Mississippi Valley is continued to be drier than normal, affecting Louisiana, Mississippi and eastern Arkansas. Most of these areas have degraded from near normal conditions to moderate drought in the past two months.



4. Change Maps

3 Types:

1) Prior period

ex. – July 13, 2009 vs. Sep 27, 2009

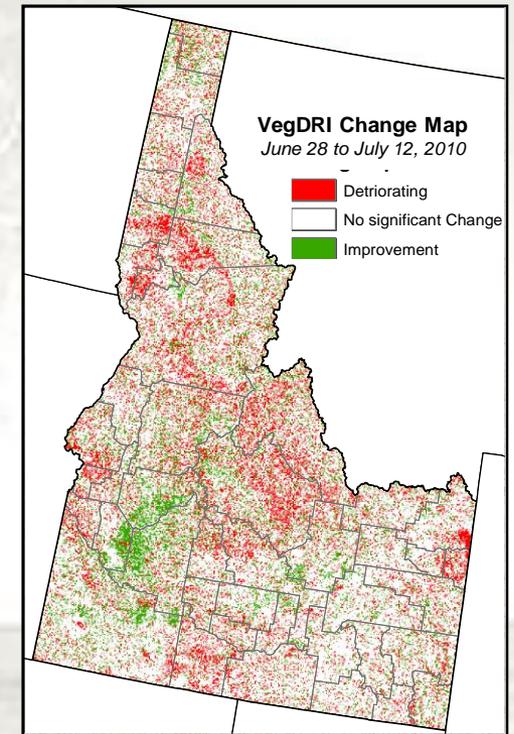
2) Same period from the prior year or a specific year in past

(* currently not available)

ex. – July 13, 2009 vs. Sep 13, 2008

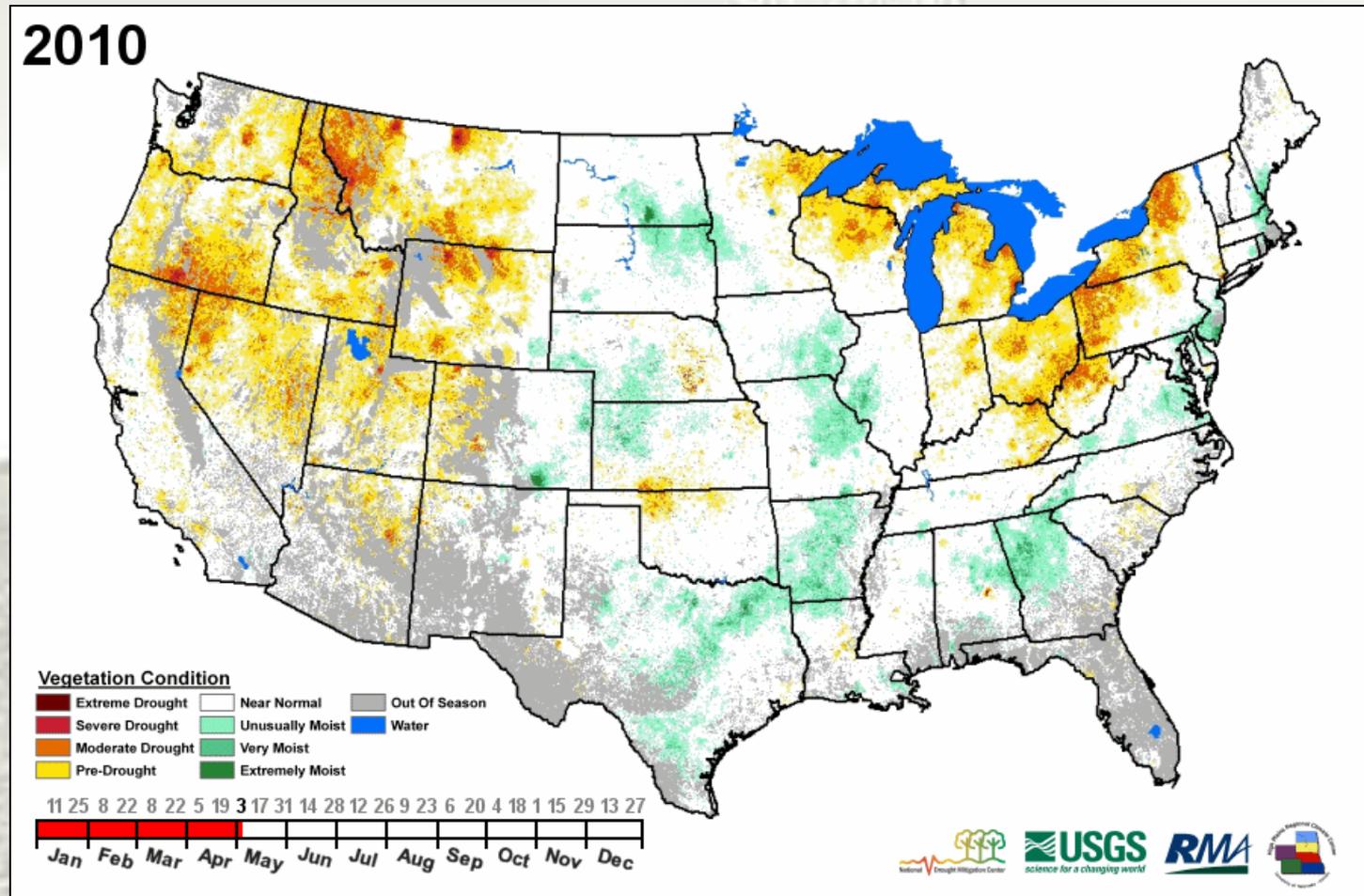
3) Historical average (* currently not available)

ex. – July 13, 2009 vs. average for July 13 (1989 through 2008)

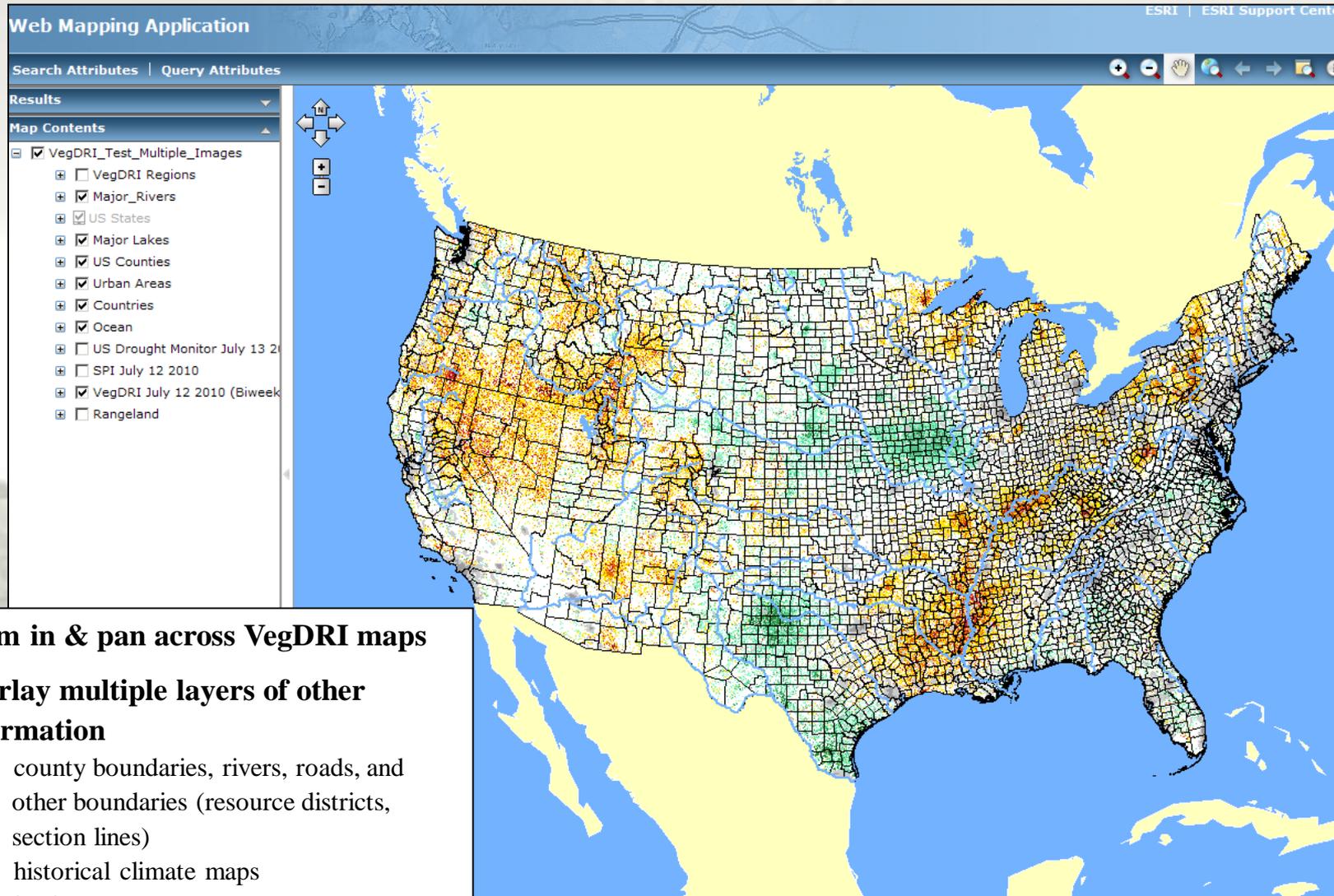


5. Animations

Goal: Visualize spatial and temporal changes in drought patterns across a specific year or multiple years.



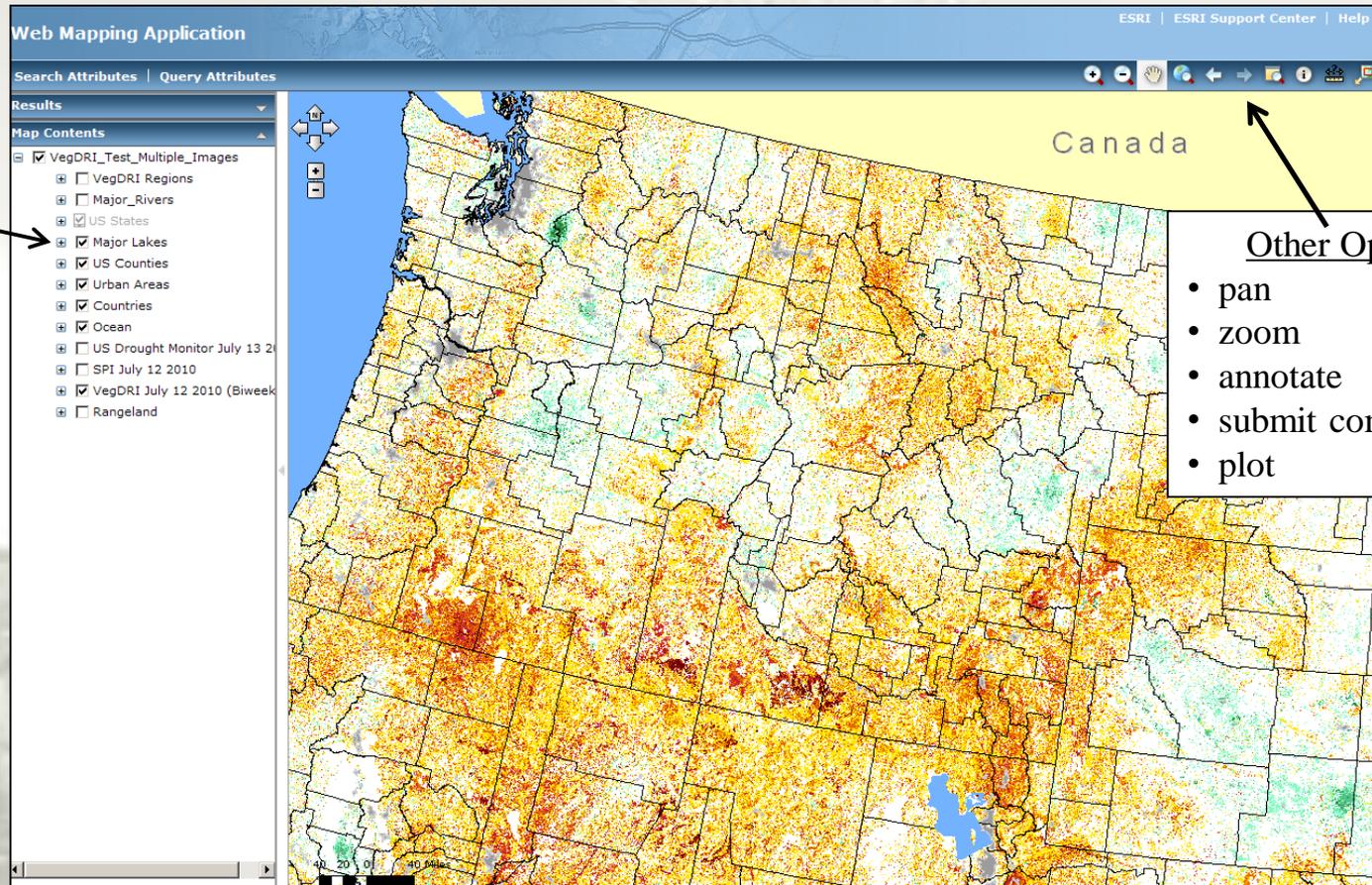
6. VegDRI Map Viewer (in development)



- **Zoom in & pan across VegDRI maps**
- **Overlay multiple layers of other information**
 - county boundaries, rivers, roads, and other boundaries (resource districts, section lines)
 - historical climate maps
 - land cover maps
 - U.S. Drought Monitor maps

6. VegDRI Map Viewer (in development)

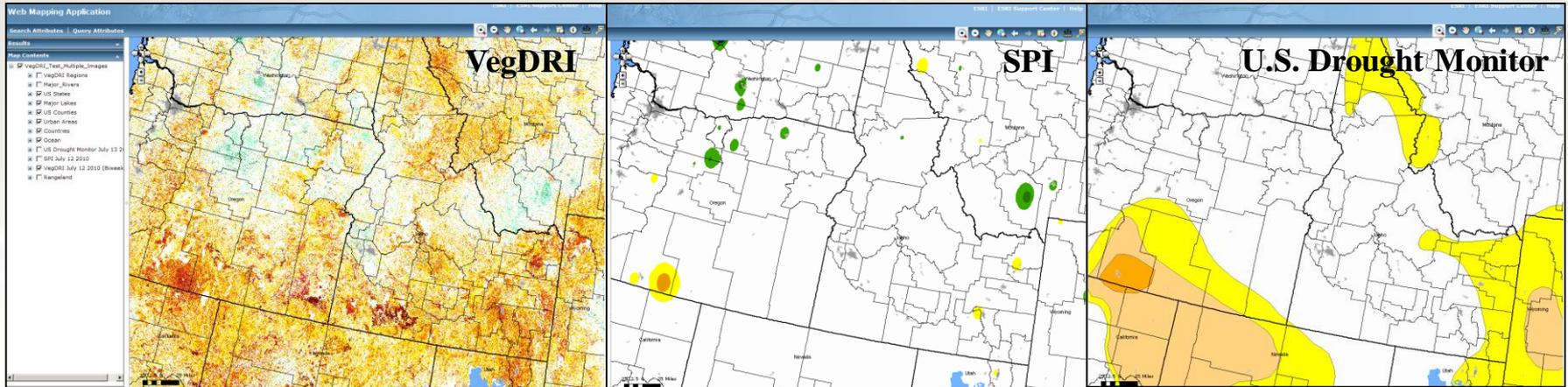
- Overlay
- county boundaries
 - rivers & lakes
 - urban areas
 - roads
 - watersheds



- Other Options
- pan
 - zoom
 - annotate
 - submit comments
 - plot

The user can customize their view of the VegDRI map and compare the VegDRI information to other historical climate information and drought impacts,.

6. VegDRI Map Viewer (in development)

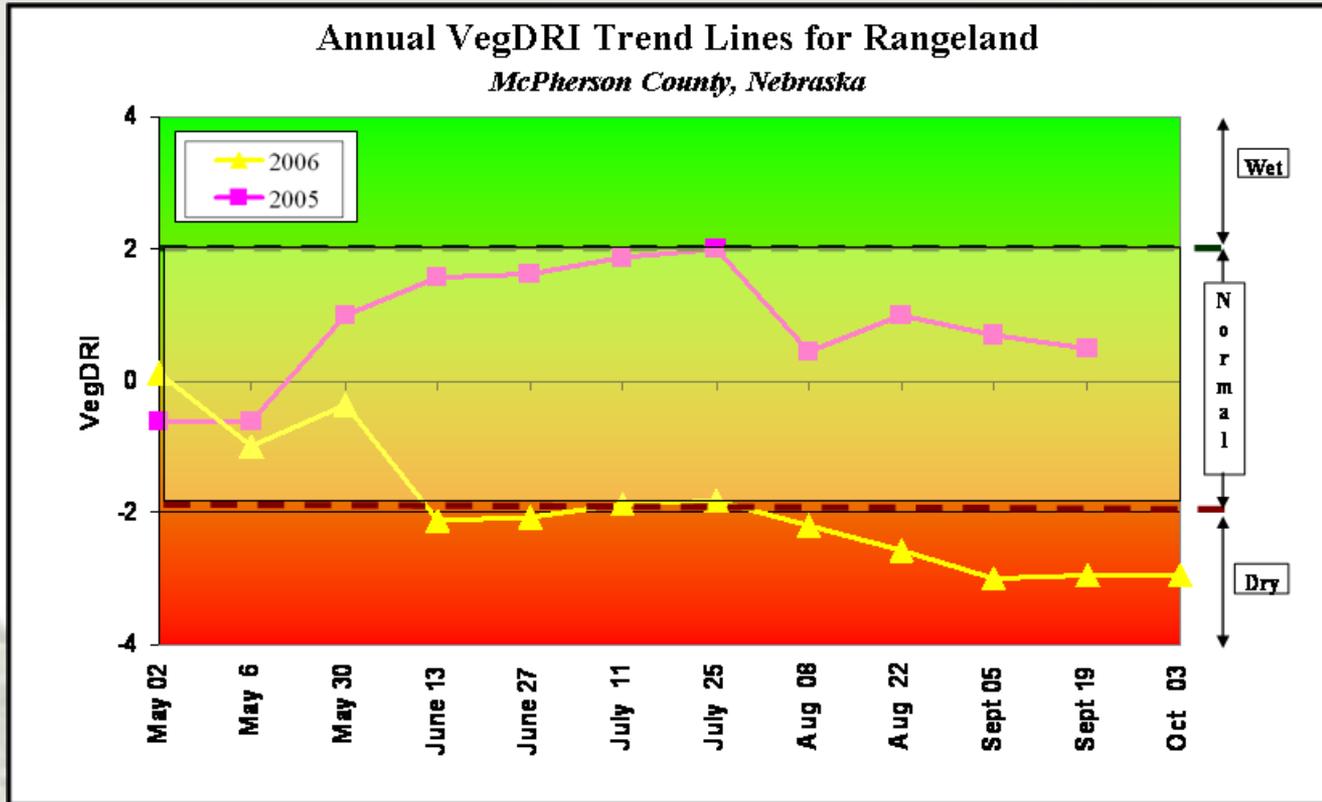


Layers of climate and drought information:

- 20+ years of historical VegDRI (1989 – present)
- Standardized Precipitation Index (SPI)
- U.S. Drought Monitor (USDM)
- Historical climate data for 3,000+ weather stations locations
- Drought impacts from Drought Impact Reporter (DIR)
- ‘Interactive’ option to view map comments or submit comments about specific VegDRI map features.



7. Trend Lines (in development)



Plots the average VegDRI values over the growing season for a specific geographic area (e.g., county) and land cover type (e.g., cropland and rangeland). Comparisons of VegDRI could be made between specific years and/or the long-term average condition.



VegDRI Evaluator Network

Purpose: Establish a volunteer network of evaluators across the U.S. that provide periodic feedback regarding the accuracy of the VegDRI maps for their 'local' area.

Goal: Collect 'baseline' information about VegDRI's performance and better understand the index's current strengths and weaknesses.

Types of feedback:

1) *qualitative:* - visual observations

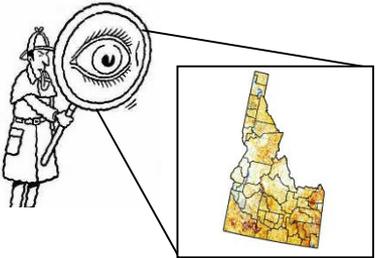
- photos

- impacts (e.g., cattle sales & feed surplus/deficits)

2) *quantitative:* - clip plot data (e.g., biomass)

- rainfall measurements & variations

- production (e.g., 'How crop yield/forage production compared to the average.')



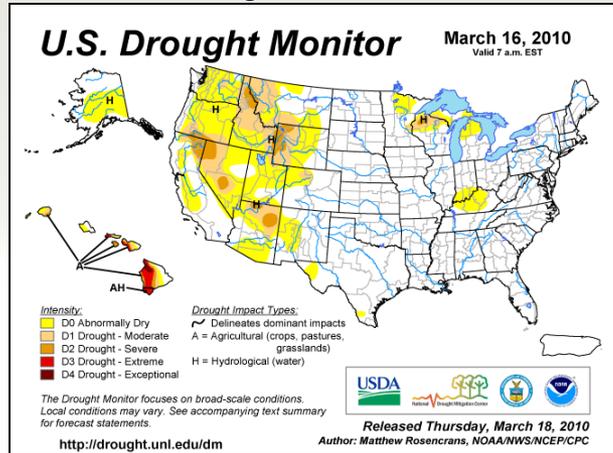
~150 Evaluators

- farmers and ranchers
- USDM authors
- state climatologists
- federal and state agencies & organizations
(Ex. USDA, NOAA, agriculture, & natural resources)
- University extension

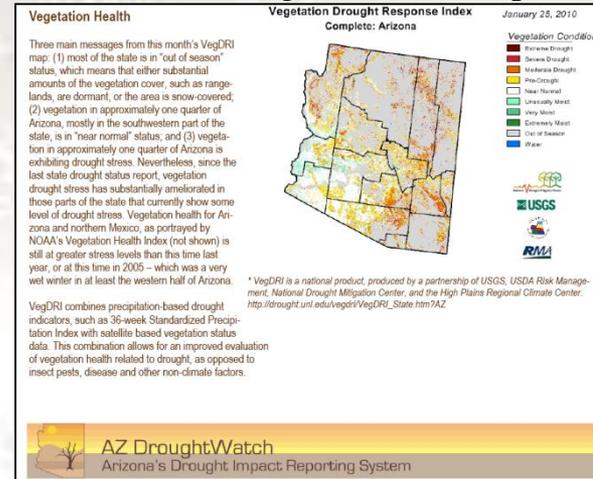
Who is Using VegDRI?

Examples...

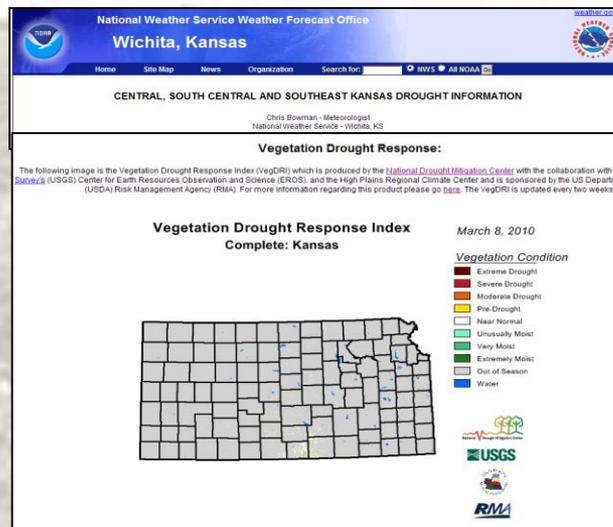
U.S. Drought Monitor authors



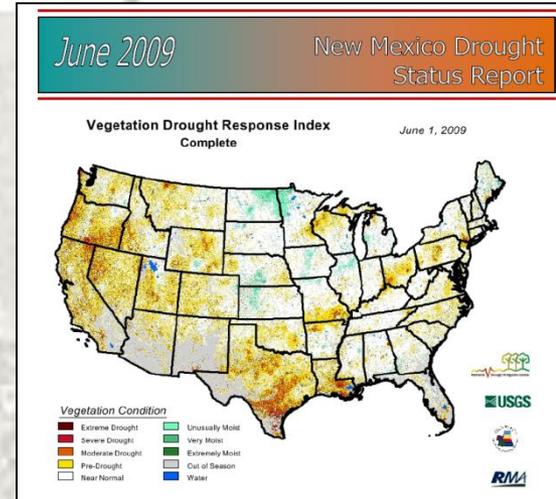
Arizona Drought Monitor Report

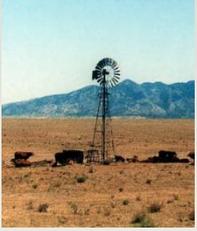


National Weather Service Drought Reports - Kansas



New Mexico Drought Status Report





Possible Uses of VegDRI Information

Agricultural Producer Perspectives



1. Justify sub-county declarations for agricultural losses (e.g., decreased crop yields and reduced forage).
2. Gauge agricultural conditions in other states to assist in operational management decisions.
3. Additional indicator of ‘fire risk’.



Thank you for your attention.

For more information about VegDRI, please visit:

http://drought.unl.edu/vegdiri/VegDRI_Main.htm

or

contact Brian Wardlow at the NDMC:

bwardlow2@unl.edu

