

# **Vegetation Drought Response Index (VegDRI)**

*A Hybrid-Based Approach for Vegetation Drought Monitoring*

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***National Drought Mitigation Center (NDMC)***

**North America Drought Monitor – International Workshop**

**Ottawa, ON, Canada**

**October 15-17, 2008**



# Presentation Outline

## 1. Overview of VegDRI

- Rationale & Goals
- Data Inputs
- Model

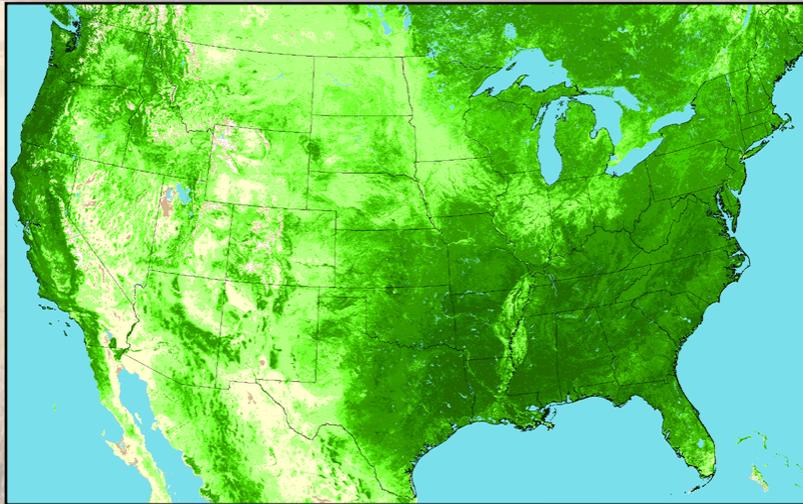
## 2. Operational VegDRI Products

- Access points to products
- Product examples
- Product development activities

## 3. Considerations for expansion to Canada and Mexico

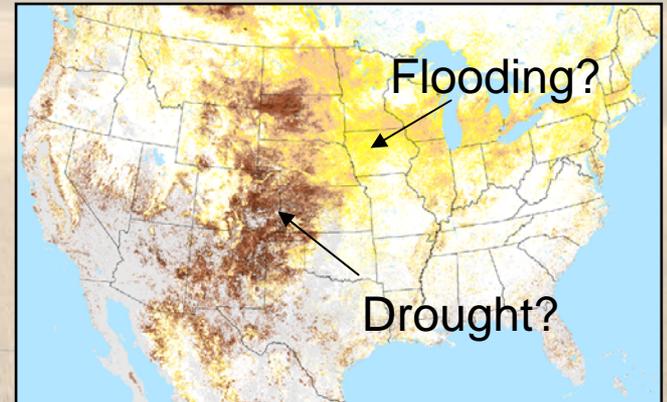
# Traditional Vegetation Drought Monitoring

- Vegetation index (VI) image data derived from satellite observations have been widely used for large-area vegetation condition monitoring.
- (+) Repetitive, spatially continuous measures of the relative state and condition of vegetation across the landscape.



# Traditional Vegetation Drought Monitoring

- Vegetation index (VI) image data derived from satellite observations have been widely used for large-area vegetation condition monitoring.
- (-) Difficult to identify the specific cause(s) of vegetation stress solely from VI data.
  - Several natural and anthropogenic events can produce anomalies similar to drought in the VI data.
    - flooding
    - hail
    - pests & disease
    - fire
    - land use/cover change



# What is VegDRI?

**VegDRI** is a new 'hybrid' drought index that integrates:

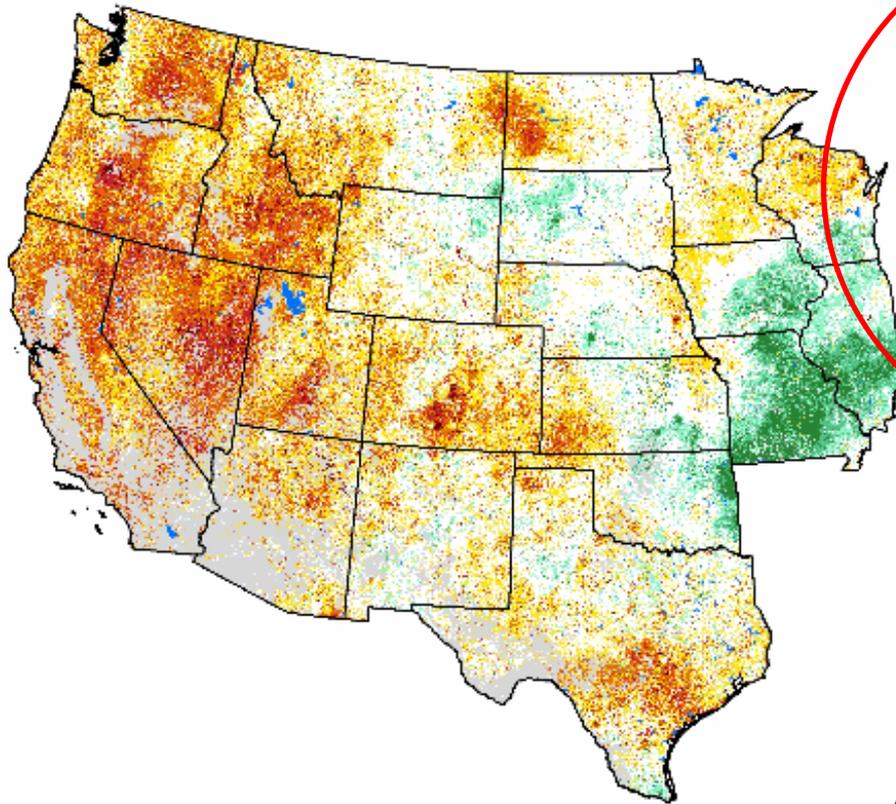
- satellite-based observations of vegetation conditions
- climate-based drought index data
- biophysical characteristics of the environment

to produce 1-km resolution maps that depict '***drought-related***'  
***vegetation stress***.



# Vegetation Drought Response Index Complete

October 6, 2008



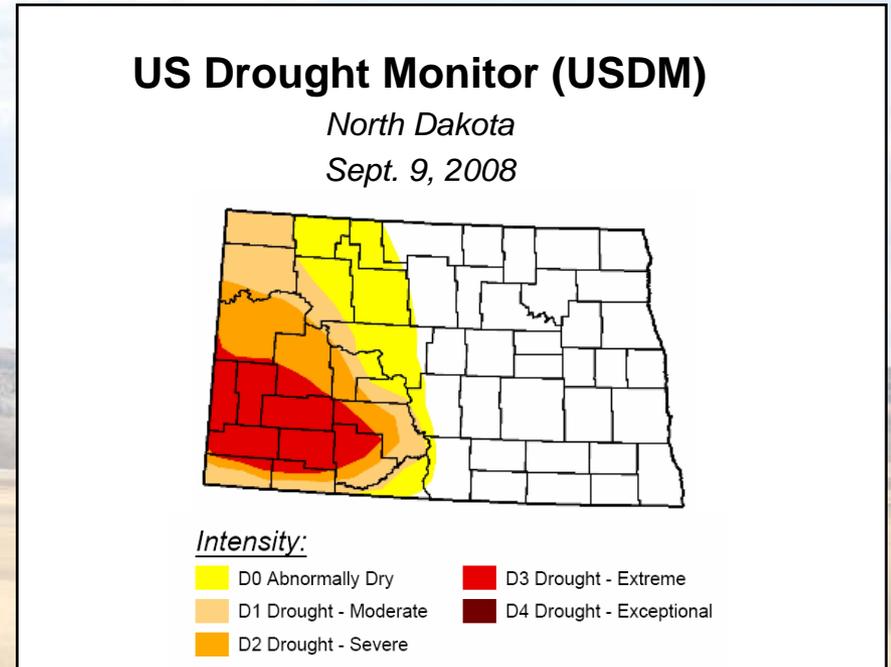
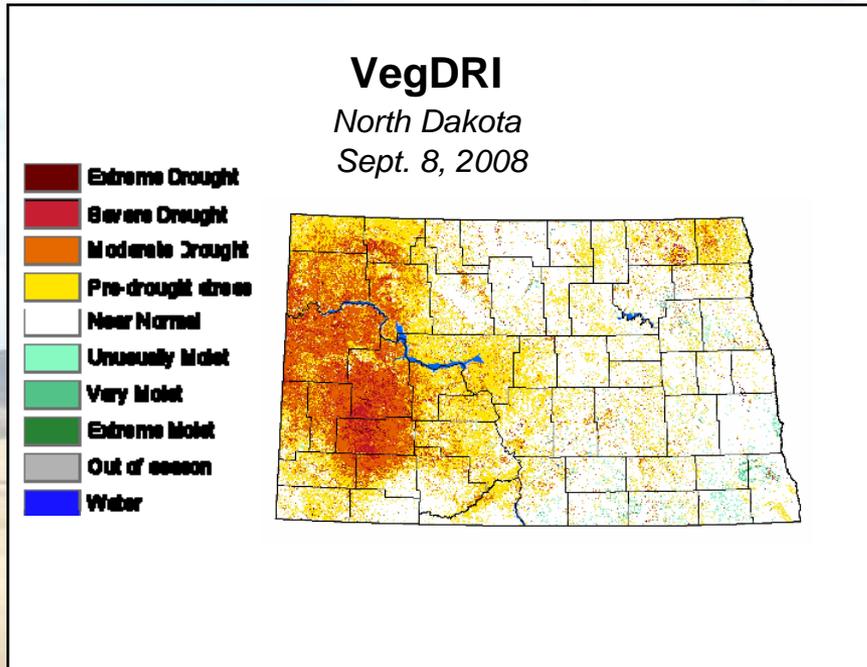
## Vegetation Condition

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



VegDRI classification scheme familiar to the drought community.  
- Similar to the Palmer Drought Severity Index (PDSI).

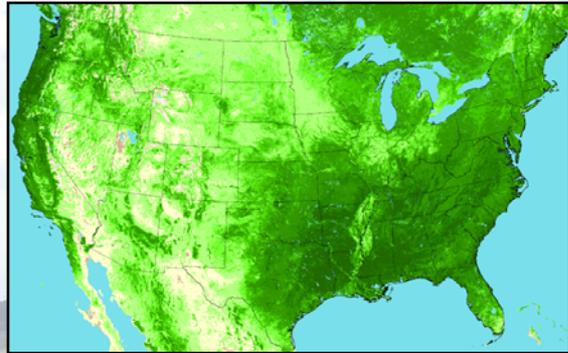
# A National View With Local-Scale Information



**Goal of VegDRI:** A tool that has *national-level monitoring* capabilities and can provide *local-scale information* (i.e., county to sub-county level) regarding the level of drought stress on vegetation in near real-time.

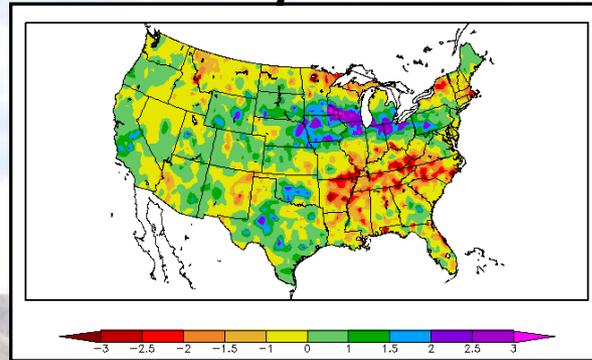
# VegDRI - An Integrated Approach

**Remote Sensing  
Component**



+

**Climate  
Component**



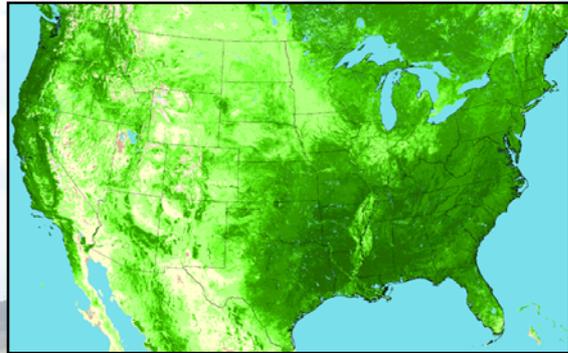
+

**Biophysical  
Component**



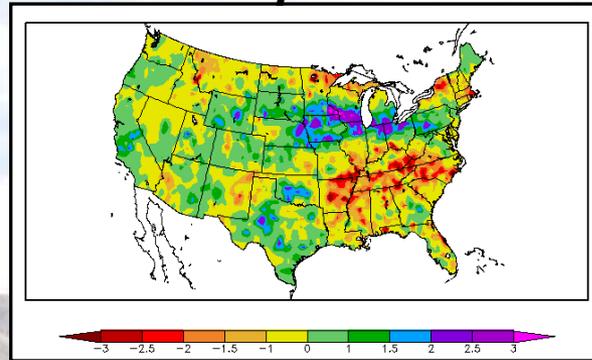
# VegDRI - An Integrated Approach

## Remote Sensing Component



+

## Climate Component



+

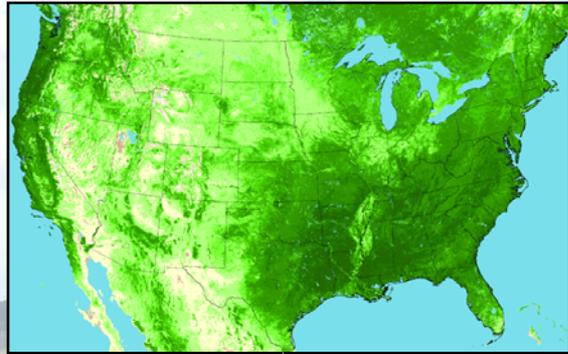
## Biophysical Component



Spatially-detailed 1-km  
*observations of vegetation  
patterns and their general  
conditions*

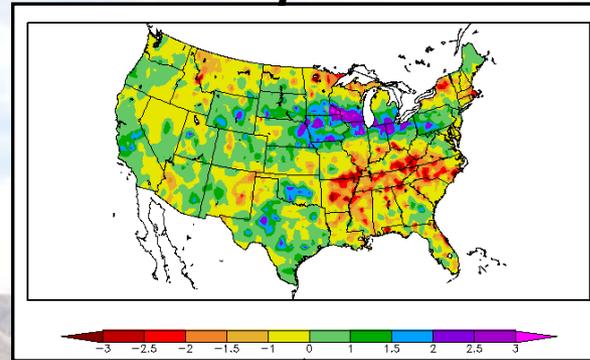
# VegDRI - An Integrated Approach

## Remote Sensing Component



Spatially-detailed 1-km *observations of vegetation patterns and their general conditions*

## Climate Component



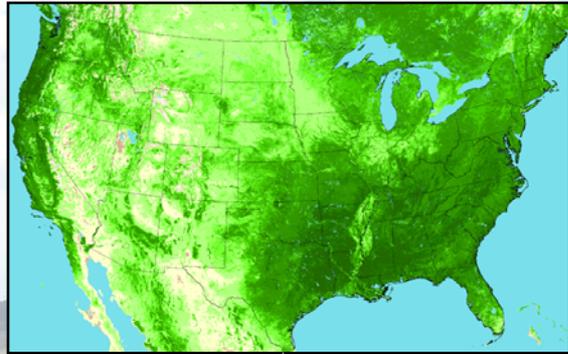
Coarse-resolution, climate-based drought index maps provide *measure of dryness.*

## Biophysical Component



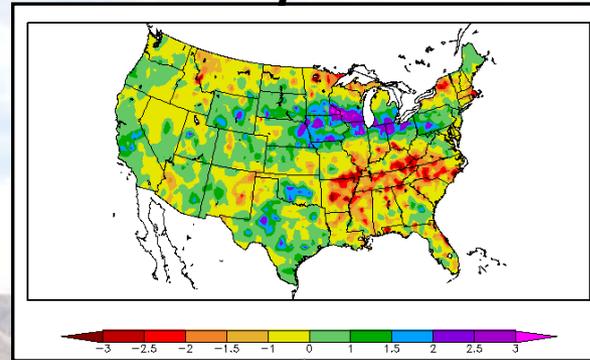
# VegDRI - An Integrated Approach

## Remote Sensing Component



Spatially-detailed 1-km *observations of vegetation patterns and their general conditions*

## Climate Component



Coarse-resolution, climate-based drought index maps provide *measure of dryness.*

## Biophysical Component



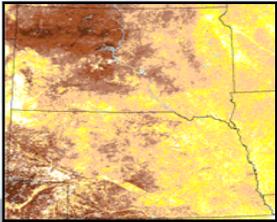
Environmental variables that can influence climate-vegetation interactions.

- land use/cover type
- soil characteristics
- elevation
- ecological setting

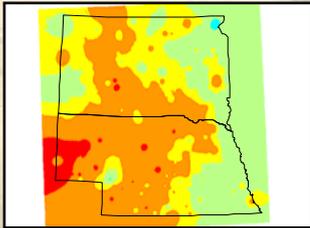
# VegDRI Methodology

## 1. Historical Database Development

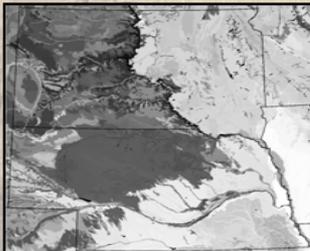
### Satellite Data



### Climate Data



### Biophysical Data



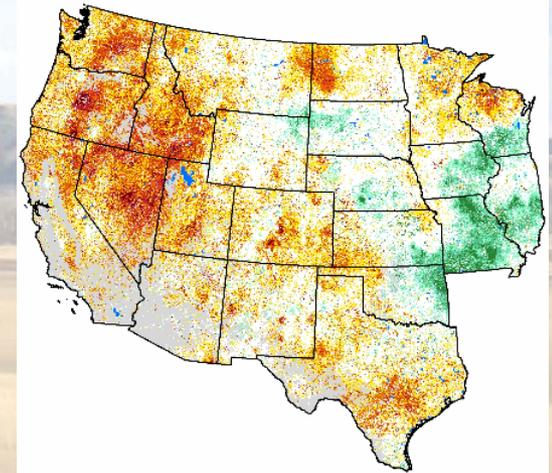
### Data Input Variables

- 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

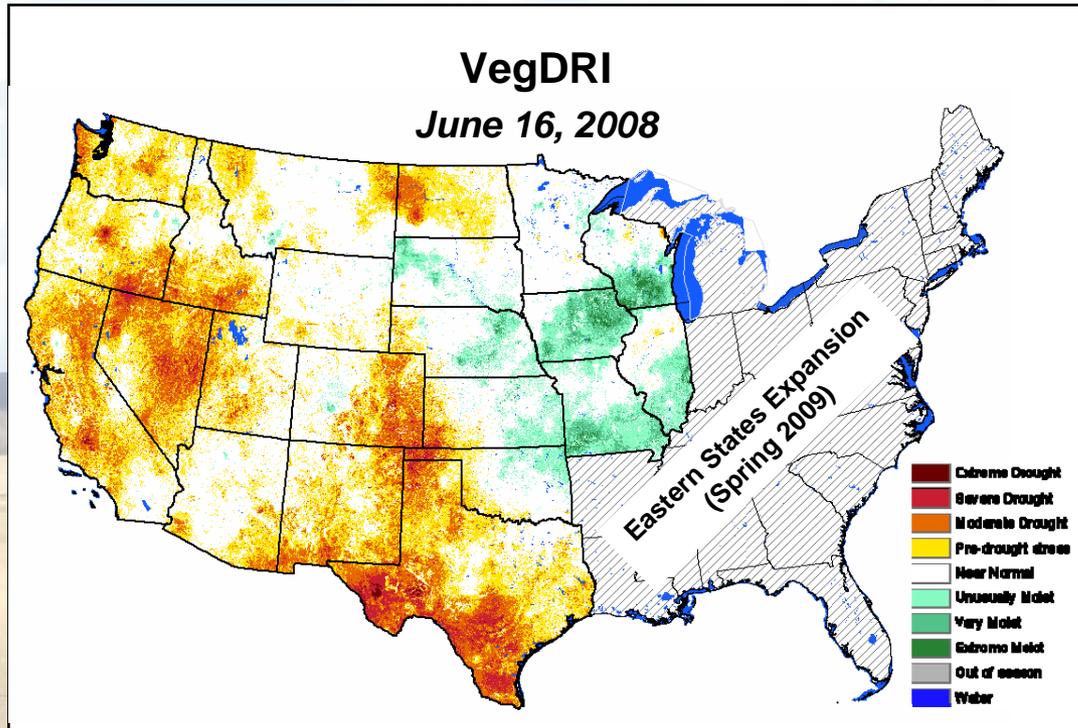


1-km VegDRI Map

(\*) Models developed from a 18-year historical record (1989 – 2006) of bi-weekly climate and satellite observations at 2,200+ weather station locations.

Biophysical variables are *static* over time.

# Operational VegDRI Coverage



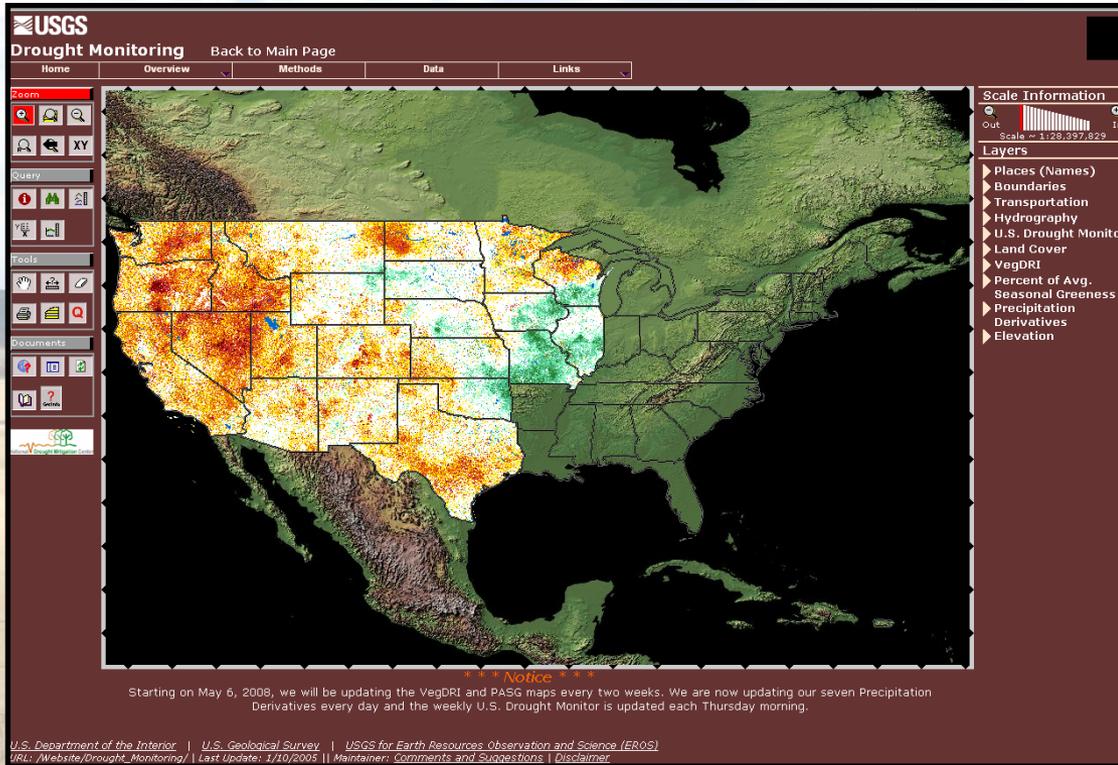
## *Scheduled Additions*

- 20-year historical record of maps (1989 – present) underway (completion scheduled for early 2009)
- Year-round production of maps started in 2008
- 'Weekly' map updates planned for Spring 2009

(\*) Bi-weekly maps currently available for 3 growing seasons (2006 – 2008) over a 22-state region.

# Access to VegDRI Information

## 1. Drought Monitoring Viewer hosted by the USGS

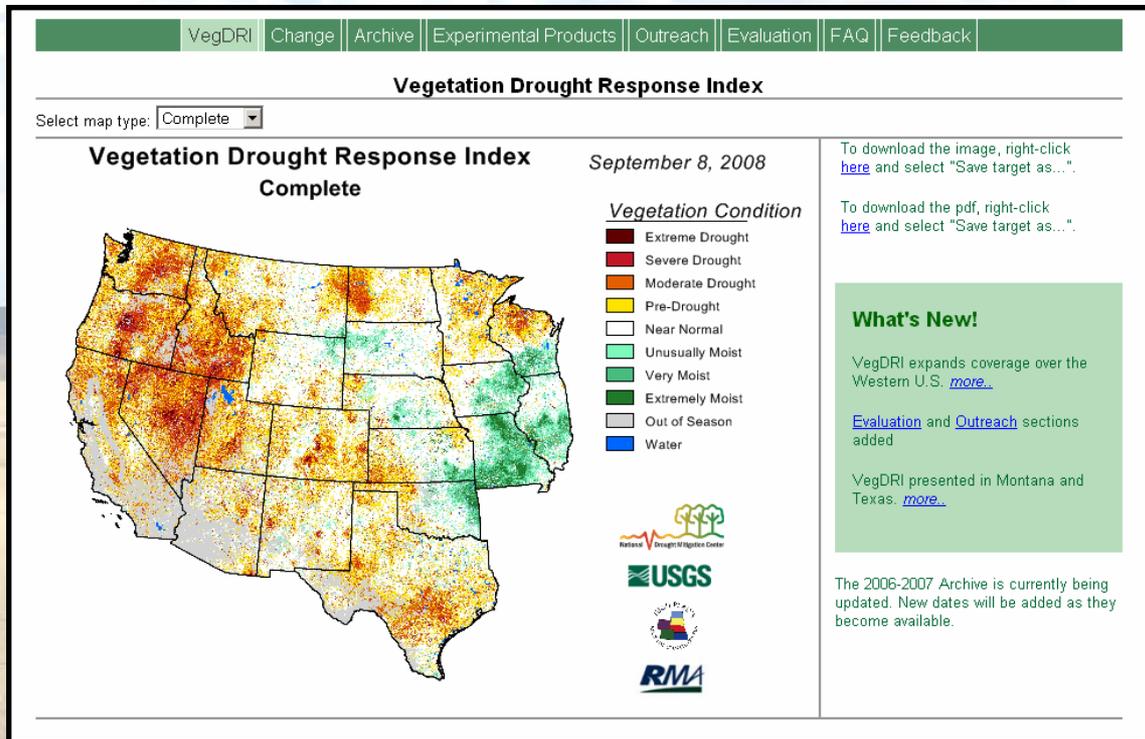


- Time series of VegDRI maps
- Zoom and pan options
- Overlay capabilities
- Multiple layers of ancillary information
  - admin. boundaries, roads, streams, etc.
  - DEM
  - land cover
  - NDVI-derived PASG
  - derivatives of the NWS precipitation analysis data

[http://gisdata.usgs.net/website/Drought\\_Monitoring/viewer.php](http://gisdata.usgs.net/website/Drought_Monitoring/viewer.php)

# Access to VegDRI Information

## 2. VegDRI Webpage hosted by the NDMC



### Features

- 'quick view' VegDRI maps
- tabular area statistics
- change maps
- historical archive
- new product releases
- research results
- FAQs about VegDRI

[http://www.drought.unl.edu/vegdiri/VegDRI\\_Main.htm](http://www.drought.unl.edu/vegdiri/VegDRI_Main.htm)

# VegDRI Products

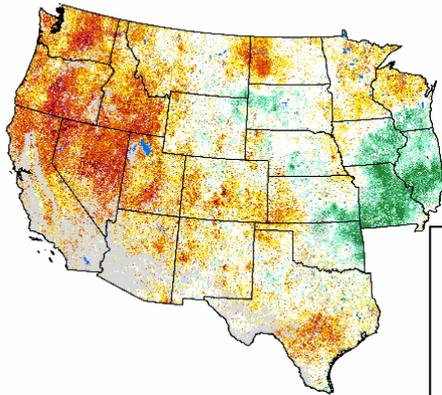
**'Quick view' maps** – multiple spatial scales

**Vegetation Drought Response Index**  
Complete

September 22, 2008

**Vegetation Condition**

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



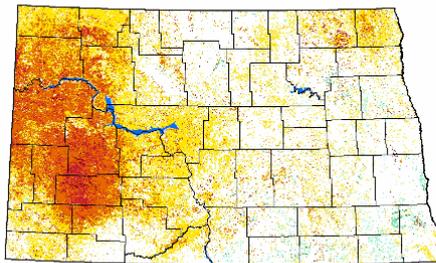
*Regional*

**Vegetation Drought Response Index**  
Complete: North Dakota

September 22, 2008

**Vegetation Condition**

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



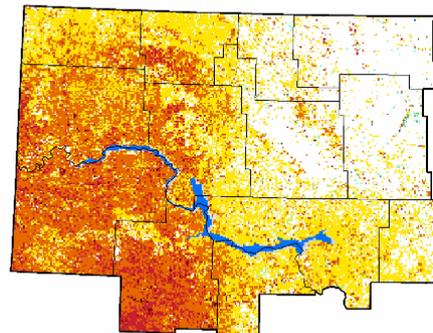
*State*

**Vegetation Drought Response Index**  
Complete: North Dakota, Quad 1

September 22, 2008

**Vegetation Condition**

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



*Sub-State*



# VegDRI Products

## 'Quick view' maps – land cover type

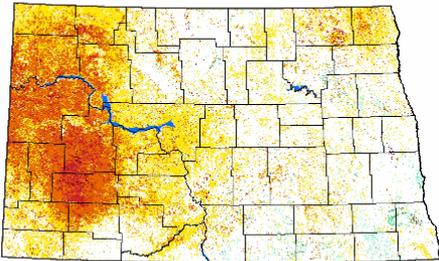
*Complete  
(all land cover types)*

**Vegetation Drought Response Index**  
Complete: North Dakota

September 22, 2008

*Vegetation Condition*

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

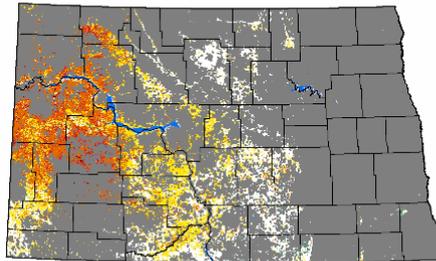


**Vegetation Drought Response Index**  
Rangelands: North Dakota

September 22, 2008

*Vegetation Condition*

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



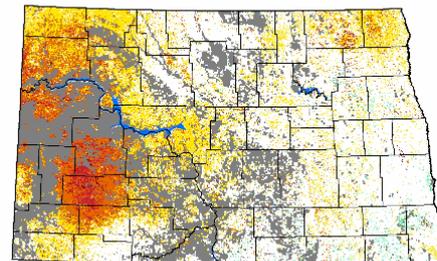
*Rangeland*

**Vegetation Drought Response Index**  
Croplands: North Dakota

September 22, 2008

*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*



# VegDRI Products

## Area statistics tables (% area)

Summarize by major land cover type.

Summarizes % area for all previous dates.

North Dakota – September 22, 2008									
Complete Complete Rangeland Crops	Extreme Drought	Severe Drought	Moderate Drought	Pre-Drought	Near Normal	Unusually Moist	Very Moist	Extremely Moist	
08/09/22	0.23	3.66	13.95	22.40	57.48	1.13	0.33	0.04	
08/09/08	0.21	3.94	14.12	22.33	57.27	0.90	0.37	0.08	
08/08/25	0.30	4.54	16.51	22.46	54.36	0.72	0.26	0.07	
08/08/11	0.22	4.08	15.74	24.02	54.18	0.55	0.34	0.08	
08/07/28	0.40	6.46	22.64	31.22	37.94	0.30	0.17	0.08	
08/07/14	0.86	8.18	20.64	37.51	31.60	0.20	0.21	0.02	
08/06/30	0.51	5.07	18.36	37.45	37.09	0.51	0.21	0.02	
08/06/16	0.34	2.76	13.23	32.55	49.15	0.90	0.26	0.03	
08/06/02	2.25	6.68	36.11	34.30	19.67	0.13	0.07	0.01	
08/05/19	2.17	8.07	38.22	30.98	17.48	0.23	0.10	0.03	
08/05/05	1.37	7.15	29.84	31.42	21.97	0.39	0.07	0.04	
07/10/08	0.02	0.31	0.58	1.71	79.52	13.13	3.37	0.54	
07/09/24	0.03	0.30	0.63	1.53	81.15	12.36	2.85	0.36	
07/09/10	0.04	0.20	0.55	1.27	76.90	15.87	3.90	0.49	
07/08/27	0.04	0.16	0.38	1.25	66.43	23.16	6.79	1.01	
07/08/13	0.01	0.15	0.23	0.94	56.64	29.05	10.35	1.84	
07/07/30	0.02	0.15	0.31	1.65	60.58	26.10	8.98	1.42	

\*\* Currently, only available at the state-level.

# VegDRI Products

## Change maps

### 3 Types:

#### 1) Prior period

ex. - June 4, 2007 vs. May 21, 2007

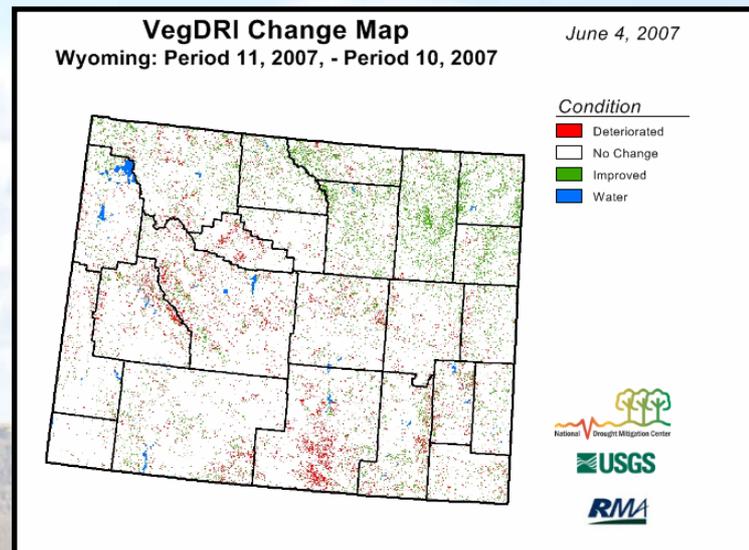
#### 2) Same period from the prior year

(\* currently not available)

ex. – June 4, 2007 vs. June 4, 2006

#### 3) Historical average (\* currently not available)

ex. – June 4, 2007 vs. average for June 4 (1989 through 2008)



# VegDRI Product Development Activities

1. **Ranking or percentile maps** – based on 20-year historical record of VegDRI.
2. **Integrate VegDRI maps with historical drought data** – from drought atlas information being developed at the NDMC.
3. **Validation** – characterize VegDRI's accuracy
  - ***Quantitative***: crop yield & soil moisture comparisons
  - ***Qualitative***: spatial pattern matching with other drought index and radar-based precipitation maps; user feedback
4. **VegDRI Evaluator Network** (200+ participants)
  - assess index's accuracy
  - guide product development
  - identify potential user communities

# Expanding VegDRI to Canada & Mexico

## *Key Considerations*

### **1. Targeted goal(s)**

- national or sub-national coverage
- update cycle (e.g., weekly, bi-weekly, or monthly)
- application(s) (e.g., N.A. Drought Monitor)

### **2. Remotely sensed time-series VI data sets availability**

- Length of historical record
- Spatial and temporal resolution of the data
- Timeliness of satellite data for near real-time map production

### **3. Historical meteorological data availability**

- Number & spatial distribution of weather stations
- Length & quality of data record

### **4. Existing environmental/biophysical data sets**

If you would like further information on VegDRI  
please contact:

Brian Wardlow  
National Drought Mitigation Center (NDMC)  
[bwardlow2@unl.edu](mailto:bwardlow2@unl.edu)

or

visit the NDMC website at:  
[http://www.drought.unl.edu/vegdiri/VegDRI\\_Main.htm](http://www.drought.unl.edu/vegdiri/VegDRI_Main.htm)

