Droughts Indicators and Triggers

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Sources / Additional Information…
• National Drought Mitigation Center (www.drought.unl.edu)
• American Meteorological Society – Applied Climatology (AMS Statement; www.ametsoc.org)
• US Drought Monitor (NOAA, USDA, NDMC, and community) (www.drought.unl.edu/dm/index.html)
"640K ought to be enough for anybody."
-- Bill Gates, 1981
Droughts are natural hazards
Droughts can affect our day to day life and the socioeconomic impacts can last for years
Drought?
Some characteristics of Drought

• Recurring temporary event, i.e. not rare, nor random (predictable?), or a permanent feature
• Characteristics and impacts vary from region to region
• Natural hazard (but human decisions could contribute to the impacts)
• Deviation from normal when the regional water budget goes in the deficit
Droughts differ in terms of:

- **Intensity**
- **Duration**
- **Spatial Extent**
So what is a ‘Drought’?

- Drought is a normal, recurrent feature of climate. It occurs almost everywhere, although its features vary from region to region.
- In the most general sense, drought originates from a deficiency of precipitation over an extended period of time, resulting in a water shortage for some activity, group, or environmental sector.
- Whatever the definition, it is clear that drought cannot be viewed solely as a physical phenomenon.
WMO Perspective

Natural Climate Variability

- Precipitation deficiency (amount, intensity, timing)
- Reduced infiltration, runoff, deep percolation, and ground water recharge
- High temp., high winds, low relative humidity, greater sunshine, less cloud cover
- Increased evaporation and transpiration

Time (duration)

Soil water deficiency

- Plant water stress, reduced biomass and yield
- Reduced streamflow, inflow to reservoirs, lakes, and ponds; reduced wetlands, wildlife habitat

Meteorological Drought

Agricultural Drought

Hydrological Drought

Economic Impacts
Social Impacts
Environmental Impacts
Recent Drought Losses in the U.S.

1988: $39.2 billion nationwide
1993: $1 billion across the Southeast
1996: $10 billion across the Southwest
1998: $6-8 billion across the South
1999: $1 billion along the East Coast
2000: $1 billion each in Nebraska, Oklahoma, Texas, and Georgia

Average annual losses: $6-8 billion (FEMA)
2002 Estimated Agricultural Drought Losses

- Colorado: $1.1 billion
- Kansas: $1.4 billion
- Missouri: $460 million
- Nebraska: $1.2 billion
- South Dakota: $1.4 billion
2002 Drought Impacts

Wildfires: 7.2 million acres, $1.26 billion

Agricultural:
    Navajo Nation: 7,000 stock ponds dry
    National wheat crop lowest since 1972
    Colorado cattle breeding stock reduced 45-50%
    1,837 counties declared “primary agricultural disaster area”
    484 additional counties eligible

Drinking Water:
    Maine: 18,000 families had private wells go dry

Environment, Recreation and Tourism, Transportation, Public Health, Energy,…
So if the Governor’s office asks.. “Should we declare drought conditions in Indiana??”, what information will you seek before making your recommendation?”

Nov 2002 – “Drought brings disaster declaration for 74 Indiana counties”

– …FORT WAYNE, Ind. -- …The declaration, approved by the U.S. Department of Agriculture, will permit farmers in 74 of the state's 92 counties to apply for low-interest emergency loans for crop and livestock losses. Farmers in 13 counties adjacent to the disaster counties can also seek help. ….
THE HYDRO-ILLOGICAL CYCLE

- Concern
- Panic
- Rain
- Drought
- Apathy

Courtesy: Mike Hayes, NDMC
US Drought Monitor

- http://www.drought.unl.edu/dm/monitor.html
The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

http://drought.unl.edu/dm
http://www.drought.unl.edu/dm/6_week.gif

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

http://drought.unl.edu/dm

Released Thursday, January 18, 2007
Author: David Miskus, JAWF/CPC/NOAA
U.S. Drought Monitor

April 12, 2005
Valid 7 a.m. EST

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

http://drought.unl.edu/dm

Released Thursday, April 14, 2005
Author: David Miskus, NOAA/CPC/JAWF
U.S. Drought Monitor

April 26, 2005
Valid 7 a.m. EST

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

http://drought.unl.edu/dm

Released Thursday, April 28, 2005
Author: Richard Tinker, NOAA/NWS/CPC/NCEP
U.S. Drought Monitor

May 10, 2005
Valid 7 a.m. EST

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

http://drought.unl.edu/dm

Author: Mark Svoboda, National Drought Mitigation Center

Released Thursday, May 12, 2005
U.S. Drought Monitor

June 21, 2005
Valid 7 a.m. EST

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

http://drought.unl.edu/dm

Released Thursday, June 23, 2005
Author: Douglas Le Comte, NOAA/NWS/CPC
The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.
The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

http://drought.unl.edu/dm

Released Thursday, February 2, 2006
Author: Richard Tinker, NOAA/NWS/CPC/NCEP
• Methods for identifying/assessing droughts
• Every year, what is the percentage of area that is typically under drought?
Percent Area of the United States in Severe and Extreme Drought

January 1895–July 2002

Based on data from the National Climatic Data Center/NOAA
• What is the typical length or duration of the impact of a drought?
Periods of Drought in Western Nebraska 5 or More Years in Duration 1200–1960

Periods of drought shown in red. Numbers in parentheses following year indicate length of drought period.

Average duration of drought: 12.8 years
16th Century Megadrought

Reconstructed Summer PDSI 1576-1585

NOAA / NESDIS / National Climatic Data Center, Paleoclimatology Branch
What Can We Do About Drought?

• 1. Monitoring
• 2. Planning
• 3. Mitigation
Drought Differs From Other Natural Hazards

- slow onset or “creeping phenomenon”
- absence of a precise, universal definition
- impacts are nonstructural and spread over large areas--makes assessment and response difficult
- impacts are complex and affect many people

Therefore, monitoring, planning, and mitigation difficult
Key Variables For Monitoring Drought

- climate data
- soil moisture
- stream flow
- ground water
- reservoir and lake levels
- snow pack
- Evapotranspiration/ effective precipitation
- short, medium, and long range forecasts
- vegetation health/stress and fire danger
- “user input” ‘ community interaction
Approaches to Drought Assessment

- Single index or parameter
- Multiple indices or parameters
- Composite index
Drought Severity Index by Division

Weekly Value for Period Ending 22 MAR 2003

Long Term Palmer

-4.0 or less (Extremely Drought)
-3.0 to -3.9 (Severe Drought)
-2.0 to -2.9 (Moderate Drought)
-1.9 to +1.9 (Near Normal)
+2.0 to +2.9 (Unusual Moist Spell)
+3.0 to +3.9 (Very Moist Spell)
+4.0 and above (Extremely Moist)
Real-Time NWS Cooperative Observer Network

www.coop.nws.noaa.gov
Automated Weather Networks
The Importance of a Drought EWS

- allows for early drought detection
- allows for proactive (mitigation) and reactive (emergency) responses
- "triggers" actions within a drought plan
- Bottom line—provides information for decision support
Components of a Drought EWS

• timely data and timely acquisition
• synthesis/analysis of data used to “trigger” set actions within a plan
• efficient dissemination or delivery system (WWW, media, extension)
An integrated climate monitoring system needs to:

• be comprehensive in scope (coupling climate, soil and water data)
• incorporate local and regional scale data
• use the best available (multiple) indices and triggering tools
• link index values or thresholds to impact sectors
• be flexible, incorporating the needs of end users
Questions addressed by monitoring

• Analyze recent events—how did we get here?
• Place current situation in a historical context—how rare is this event?
• What is the forecast and how reliable is it?
• What would it take to end the drought event?
• How can we communicate this information to decision makers to encourage positive action?
Potential Monitoring System Products and Reports

• **Historical analysis** (climatology, impacts, magnitude, frequency)

• **Operational assessment** (coop network data, SPI and other indices, automated networks, satellite and soil moisture data)

• **Predictions/Projections** (SPI and other indices, soil moisture, streamflow, seasonal forecasts, SST’s)
Importance of Drought Indices

• Simplify complex relationships and provide a good communication tool for diverse audiences

• Quantitative assessment of anomalous climatic conditions
  – Intensity
  – Duration
  – Spatial extent

• Historical reference (probability of recurrence)
  – Planning and design applications
Triggers: thresholds determining specific, timely actions by decision makers. Link impacts to index or indicator values.

Triggers need to be:

- appropriate
- consistent with impacts
- adaptable
Drought Indices

- Percent of normal
- Deciles
- Palmer Drought Severity Index (PDSI)
- Crop Moisture Index (CMI)
- Surface Water Supply Index (SWSI)
- Reclamation Drought Index (RDI)
- Standardized Precipitation Index (SPI)
Percent of Normal: Characteristics

- simple measurement
- appeals to the public as easy to understand
- calculated by dividing actual precipitation by normal precipitation (generally a 30-year mean) and multiplying x 100%
- easily misunderstood…as the mean and the median are often not the same
- data are not normalized
Percent of Normal Precipitation (in)

Generated 3/28/2003 at HPRCC
NOAA Regional Climate Centers
Percent of Normal Precipitation (in)
Decile Characteristics

- Developed in 1967 (Gibbs and Maher)
- Relatively easy to calculate
- Grouped into 5 classifications (see table)
- Distribution of occurrences divided into tenths
- Need a long period of record to be accurate

Decile Classification for Dry and Wet Periods

<table>
<thead>
<tr>
<th>Deciles 1-2</th>
<th>Lowest 20%</th>
<th>Much below normal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deciles 3-4</td>
<td>Next lowest 20%</td>
<td>Below normal</td>
</tr>
<tr>
<td>Deciles 5-6</td>
<td>Middle 20%</td>
<td>Near normal</td>
</tr>
<tr>
<td>Deciles 7-8</td>
<td>Next highest 20%</td>
<td>Above normal</td>
</tr>
<tr>
<td>Deciles 9-10</td>
<td>Highest 20%</td>
<td>Much above normal</td>
</tr>
</tbody>
</table>
Australian Rainfall Deciles
April 2001
Distribution Based on Gridded Data
Product of the National Climate Centre

© Commonwealth of Australia 2001, Bureau of Meteorology
ID code: [Unique Identifier]
Issued: 7/04/2001
Drought Indices

- Percent of Normal
- Deciles
- Palmer Drought Severity Index (PDSI)
- Crop Moisture Index (CMI)
- Surface Water Supply Index (SWSI)
- Reclamation Drought Index (RDI)
- Standardized Precipitation Index (SPI)
What is the PDSI?

- A commonly used indicator of the status of the environmental demand for precipitation with respect to what has actually been received.
- Includes
  - average temperature
  - total precipitation
  - parameterization of soil type and
  - water holding capacity of the top layers of the soil.
Description of PDSI

• normalizes the total precipitation and average temperature to a standard 30-year period.
• applies to a regional geographical area called a “Climatological Division” (CD).
• underlying data are the averages of all of the available reporting stations for each CD for the period being
Palmer Drought Severity Index (PDSI)  
(Palmer Index or Palmer Drought Index)

**Characteristics**

- Developed in 1965
- Supply and demand concept of the water balance equation
- Evapotranspiration calculated
- Soil component
- Calculated weekly or monthly
- Standardized for location and time ??
PDSI Limitations

- Complex
- All precipitation is treated as rain
- An inherent time scale (9 months)
- Inaccurate, underestimation of runoff
- Little use outside the United States
- Responds slowly to emerging drought conditions
- Percent time in severe and extreme categories—not probability based
<table>
<thead>
<tr>
<th>PDSI</th>
<th>CLASS</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.00</td>
<td>Extremely Wet</td>
</tr>
<tr>
<td>3.00 to 3.99</td>
<td>Very Wet</td>
</tr>
<tr>
<td>2.00 to 2.99</td>
<td>Moderately Wet</td>
</tr>
<tr>
<td>1.00 to 1.99</td>
<td>Slightly Wet</td>
</tr>
<tr>
<td>0.50 to 0.99</td>
<td>Incipient Wet Spell</td>
</tr>
<tr>
<td>0.49 to -0.49</td>
<td>Near Normal</td>
</tr>
<tr>
<td>-0.50 to -0.99</td>
<td>Incipient Drought</td>
</tr>
<tr>
<td>-1.00 to -1.99</td>
<td>Mild Drought</td>
</tr>
<tr>
<td>-2.00 to -2.99</td>
<td>Moderate Drought</td>
</tr>
<tr>
<td>-3.00 to -3.99</td>
<td>Severe Drought</td>
</tr>
<tr>
<td>-4.00</td>
<td>Extreme Drought</td>
</tr>
</tbody>
</table>
Weekly PDSI values for U.S.

- Based on available preliminary data
- Only the stations submitting data electronically are included
- The “normal” category is expanded to be between +1.99 and -1.99
July 4, 1998

-4.0 or less (extreme drought)
-3.0 to -3.9 (severe drought)
-2.0 to -2.9 (moderate drought)
-1.9 to +1.9 (near normal)
+2.0 to +2.9 (unusual moist spell)
+3.0 to +3.9 (very moist spell)
+4.0 and above (extremely moist spell)
Crop Moisture Index Characteristics

- Derivative of the Palmer Drought Index
- Designed to monitor short-term moisture conditions on a weekly basis
- Looks at the top 5 feet in the soil profile
- Mainly used for agricultural purposes
- Initialized to zero each spring
Crop Moisture Index by Division

Weekly Value for Period Ending 5 MAY 2001

Short Term Need vs. Available Water in 5 Ft Profile

-3.0 or less (Severely Dry)
-2.0 to -2.9 (Excessively Dry)
-1.0 to -1.9 (Abnormally Dry)
-0.9 to +0.9 (Slightly Dry/Favorably Moist)
+1.0 to +1.9 (Abnormally Moist)
+2.0 to +2.9 (Wet)
+3.0 and above (Excessively Wet)
Surface Water Supply Index Characteristics

- river basin (watershed) approach
- hydro/climo index developed for mountainous areas relying on snowpack for water supply
- takes into account precipitation, snowpack, reservoir and streamflow levels
- only computed seasonally
- data are normalized and a probability of non-exceedance is determined for each component
- limited comparison wise since the index is unique for each basin
Surface Water Supply Index (SWSI) Values

Current as of September 1, 2000

SWSI VALUES
- Extremely Dry -4.0 to -3.0
- Moderately Dry -2.9 to -2.0
- Slightly Dry -1.9 to -1.0
- Near Average -0.9 to 0.9
- Slightly Wet 1.0 to 1.9
- Moderately Wet 2.0 to 2.9
- Extremely Wet 3.0 to 4.0
- SWSI Not Applicable

Note: Data used to generate this map are PROVISIONAL and SUBJECT TO CHANGE.

http://www.mtnrcs.usda.gov

United States Department of Agriculture
Natural Resources Conservation Service

Montana
Reclamation Drought Index (RDI)

RDI = Supply Element + Demand Element

- RDI a function of supply, demand, and duration
- Flexibility
Reclamation Drought Index

Example

Precipitation Factor = 0.25
Reservoir Factor = 0.15
Streamflow Factor = 0.10

Temperature Factor = 0.50

\[\text{Precipitation Factor} = 0.25, \quad \text{Reservoir Factor} = 0.15, \quad \text{Streamflow Factor} = 0.10\]

\[\text{Temperature Factor} = 0.50\]
Characteristics of the SPI

- Developed by McKee et al. in 1993
- Simple index--precipitation is the only parameter (probability of observed precipitation transformed into an index)
- Being used in research or operational mode in over 50 countries
- Multiple time scales allow for temporal flexibility in evaluation of precipitation conditions and water supply
How it Works

• Need 30 years of continuous monthly precipitation data
• SPI time scale intervals longer than 24 months may be unreliable
• Is spatially invariant in its interpretation
• Probability based (probability of observed precipitation transformed into an index) nature is well suited to risk management
How it Works

• It is **NOT** simply the “difference of precipitation from the mean… divided by the standard deviation”
• Precipitation is normalized using a probability distribution so that values of SPI are actually seen as standard deviations from the median
• Normal distribution allows for estimating both dry and wet periods
• Accumulated values can be used to analyze drought severity
## Probability of Recurrence

<table>
<thead>
<tr>
<th>SPI</th>
<th>Category</th>
<th># of times in 100 yrs.</th>
<th>Severity of event</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to -0.99</td>
<td>Mild dryness</td>
<td>33</td>
<td>1 in 3 yrs.</td>
</tr>
<tr>
<td>-1.00 to -1.49</td>
<td>Moderate dryness</td>
<td>10</td>
<td>1 in 10 yrs.</td>
</tr>
<tr>
<td>-1.5 to -1.99</td>
<td>Severe dryness</td>
<td>5</td>
<td>1 in 20 yrs.</td>
</tr>
<tr>
<td>&lt; -2.0</td>
<td>Extreme dryness</td>
<td>2.5</td>
<td>1 in 50 yrs.</td>
</tr>
</tbody>
</table>
Correlation between the PDSI and different SPI series as a function of the time scale of the SPI
Hilo 6-Month SPI (1950-1998)
Hilo 24-Month SPI (1950-1998)
Considerations for Selecting a Specific Trigger or Index:

- Is the information readily available?
- Can an index/trigger be calculated in a timely manner? Is the information likely to remain available over time?
- Is the information likely to remain available over time?
- Can the index/trigger be meaningfully correlated to actual conditions?
Critical Observations:

1) No single parameter is used solely in determining appropriate actions

2) Instead, different thresholds from different combinations of inputs is the best way to approach monitoring and triggers

3) Decision making (or “triggers”) based on quantitative values are supported favorably and are better understood
Triggers: State of South Carolina

Incipient Drought Alert Phase:
- PDSI: -.50 to -1.49
- CMI: 0.00 to -1.49
- SPI: -1.0 to -1.49
- KBDI: 300 to 399
- Drought Monitor: D0
- ADS is 111-120% of the minimum flow for 2 consecutive weeks SWL in aquifer is between 11 to 20 ft. above trigger level for 2 consecutive months

Moderate Drought Alert Phase:
- PDSI: -1.50 to -2.99
- CMI: -1.50 to -2.99
- SPI: -1.50 to -2.00
- KBDI: 400 to 499
- Drought Monitor: D1
- ADS: 101-110%/SWL 1-10 ft above trigger level
# Colorado’s Drought Severity Triggers

<table>
<thead>
<tr>
<th>Index Trigger</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;0</td>
<td>Normal conditions</td>
</tr>
<tr>
<td>0 to -1</td>
<td>Normal conditions</td>
</tr>
<tr>
<td>-1 to -2</td>
<td>Phase 1</td>
</tr>
<tr>
<td>-2 to -3</td>
<td>Phase 2</td>
</tr>
<tr>
<td>&lt;-3</td>
<td>Phase 3</td>
</tr>
</tbody>
</table>
Triggers: Denver Water

If predicted or actual July 1 storage is below…

- 80 percent full ➔ Mild drought
- 60 percent full ➔ Moderate drought
- 40 percent full ➔ Severe drought

Declaration would be…
Trigger: Operation Curves for Cannonsville, Pepacton, and Neversink Reservoirs
Considerations for selecting a specific trigger or index:

- Is the information readily available?
- Is the information likely to remain available over time?
- Can an index/trigger be calculated in a timely manner?
- Is the information reliable?
- Can the index/trigger be meaningfully correlated to actual conditions?
Soil Moisture forecasting

- Soil moisture outlook from CPC and Anomaly from 1998-2007
- Lowest soil moisture in Dec-Jan 1999-2000 in Indiana
- http://www.cpc.ncep.noaa.gov/soilmst/img/loop_wanom.gif
SIMBAL - Soil Moisture Balance model

Designed for simulation of field tiled soils that are poorly drained with perched water tables, a common situation in Indiana. This feature is not usually found in soil moisture models. The model can also be run in well drained soil mode (no water table, no field tiles).

Initialization parameters

- corn phenology (silking date, observed or projected)
- soil profile depth (up to 10 six-inch layers)
- initial soil moisture content in each six-inch layer
- soil water characteristics (field capacity, wilting point) for soils with water table and field tiles
  - initial water table depth and field tile depth
**SIMBAL model (continued)**

Daily inputs

precipitation

evaporation (measured or modeled)
SIMBAL model (continued)

Daily Outputs

- precipitation and evaporation (from input)
- calculated corn evapotranspiration
- capillary flow from water table (poorly drained model)
- field runoff
- soil moisture content in each six-inch layer and profile total
- total soil profile moisture deficit
- percolation into water table (poorly drained model)
- water table depth (poorly drained model)
- tile drainage (poorly drained model)
- corn stress factor (0 to 1, < 0.5 indicates stressed crop)
Fig. 5. Independent comparison of modeled (SIMBAL) and measured total soil moisture ($S$) in the top 105 cm and depth ($G$) to perched water table for early planted corn on PD soil (Typic Argiaquoll) in 1970. Day ($W$) is identified from silk date = 100.
SIMBAL model (continued)

Well drained soil verification

Castana IA

Fig. 6. Independent comparison of modeled (SIMBAL) and measured plant available soil moisture, millimeters in top 150 cm for corn, for driest (1968) and wettest (1962) years of record for WD soil (Typic Udorthent) Castana, Iowa. Corn silking date \( W = 100 \) for both years was 25 July. Soil moisture measurements from Shaw et al. (1972).
Indiana Drought Region

• 3 drought regions from 9 NCDC Climate Divisions.
Developing drought indices for Indiana - Underway

- Use daily precipitation, temperature and stream flow to develop drought index in Indiana.
- Time series for temperature data is 1, 2, 3, 4 month duration between April to October only (1950-1988).
- Daily stream flow from USGS were used to calculated average monthly flow.
continue

- PHDI monthly index
  - Precipitation
  - Evapotranspiration
  - Soil water recharge
  - Runoff and water loss from soil (1931-1988)
Drought level in Indiana

• Drought watch
  > 75% level from mean value

• Drought warning
  > 90% level from mean value

• Drought emergency
  > 95% level from mean value
Drought or precipitation deficit tend to exist in northern and western part of Indiana and moving counter clockwise for seasonal trend.
Projected Precipitation in Midwest and Indiana from IPCC model

Precipitation Trends From 1900 To Present

Source: Karl et al. (1996)
Precipitation Average 100 and 50 year for Midwest
Evaporation Trend in 50 years

High in northwestern part
State of Illinois, the criteria that discriminate precipitation droughts can be defined as following:
A 3-month precipitation drought exists if the state average is \( \leq 60\% \) of the mean value.
A 6 month precipitation drought exists if the state average is \( \leq 70\% \) of the mean value.
A 12-month precipitation drought exists if the state average is \( \leq 80\% \) of the mean value.
A 24-month precipitation drought exists if the state average is \( \leq 90\% \) of the mean value.
A 30-month precipitation drought exists if the state average is \( \leq 95\% \) of the mean value.
Base Mean Map has been developed to compare with average precipitation to determine drought from precipitation deficit.
Indiana drought responses are generally short term in Indiana.
50 years average SPI index do not show / capture droughts in Indiana
(Burke et al. 2001)
Drought Mitigation

- Pre-impact, pro-active
- Addresses at-risk sectors, population groups, and regions
- Actions aimed at reducing impacts, need for government intervention
- Initial costs of mitigation may be greater than response actions
- Paradigm shift
Categories of Drought Mitigation Actions

- Drought planning
- Improved monitoring
- Water supply augmentation
- Demand reduction/water conservation
- Public awareness/education programs
- Water use conflict resolution
- Legislation/policy changes
- Technical assistance on water management
Initialization Page -

Enter Date range if you want data only for a specific period

Select County to narrow down your search for Indiana weather stations

Pulls data based on selection. If no parameter is selected, then it pulls data for all weather stations starting from 1994
Indiana Weather Stations Mapped -

Maps all Indiana weather stations which has data in the specified date range selected.

Lists all stations mapped.

Station Color Coding
Red: Hourly Stations
Blue: Cooperative Daily stations
Green: Purdue Automated Stations
Station details -

Click on a station icon (on map) or select the station from the sidebar.

Information window shows the details specific to selected weather station.

Click to get the latest weather information for selected station (as present in Purdue Climate Database).

Tabs to download data for specified date range.
Latest weather information for selected station -

On clicking “Get Latest Data” adjacent window open up to show latest information for selected station (as present in Purdue Climate Database)

Information window shows the latest weather information for selected weather station
Select Parameters to download weather information -

Select the tab corresponding to the type of data available for the station (30 Mins, Hourly, Daily)

Check parameters that you need in the dataset

Select to download data into an excel sheet or view on web page

Hit Get Data to pull data for selected parameters
Data downloaded for the selected parameters.
MEAN MONTHLY PRECIPITATION
JANUARY

(inches)
Urban Rural Analysis

Average Temperatures in May for Urban & Rural Areas

Average Temperatures in July for Urban & Rural Areas

Days (month of May)

Days (month of July)
Urban impacts on Climate

- Research is currently underway determining the effect of urban areas on storm development and regional climate.
Urban Rural Analysis

Chicago / Gary Thunderstorm Case: May 24, 2004 (UTC)

UTC 0130
Thunderstorm approaches Chicago

UTC 0203
Thunderstorm Splits in Chicago

UTC 0232
Thunderstorm re-merges outside Chicago

UTC 0300
Thunderstorm hits La Porte
Indiana Evapotranspiration Analysis

• Using data from 16 airport sites around Indiana

Average ET for the Summer Months from 1996 – 2005 for all 16 counties in Indiana

Counties from which data was taken
La Porte Anomaly

- From 1929-1964 La Porte, Indiana weather records show unusual patterns in thunderstorms, hail, and rain data.
- 30-40% more precipitation than surrounding areas
La Porte Anomaly

- Factors: Chicago, Urban area, Industry
- If the data is accurate La Porte can only be a small scale phenomenon
- The disappearance of the anomaly could be the movement or reduction of atmospheric particulates
Analysis 1 (1905-2003)

- Five-year moving averages of annual precipitation at La Porte and two other area stations, and 5-year totals of smoke-haze days at Chicago (after Changnon, 1973a)
Analysis 2 (10 year periods)

Average warm season rainfall patterns

1954-1963

1964-1973

1974-1983

1984-1993

1994-2003

Changnon 1980

Average Rainfall (cm)

- 42 - 43
- 44 - 45
- 46 - 47
- 48 - 49
- 50 - 51
- 52 - 53
- 54 - 55
- 56 - 57
- 58 - 59
- 60 - 61
- 62 - 63
- 64 - 65
- 66 - 67

- Five year moving averages of summer rainfall
Analysis 4

Isohyetal pattern based on all network storms with point amounts ≥ 2.54 cm, 1976-1978

Rainfall (cm)

Changnon, 1980
### PRODUCTS: tables

**Text files**

#### Individual stations

**West Lafayette & NW**
- **COOP ID:** 129430
- **Latitude:** 40.48 N
- **Longitude:** 87 W

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<th>MAR</th>
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#### Whole network

**PRECIPITATION [1974 - 2003]**

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#### Year: 1997

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### Combination of variables
# PRODUCTS: tables

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**Summary Statistics**

- Mean: 3712.3
- St. Dev.: 532.5472
- Range: 2145
- Minimum: 2787
- Median: 3773
- Kurtosis: -0.49245
- Maximum: 4932
- Skewness: 0.328844
- Sum: 11369
Mean monthly precipitation

Mean max & min temperatures

Total monthly snowfall
PRODUCTS: graphs

Deviation from the mean

West Lafayette 6 NW

Standardized rainfall anomalies
PRODUCTS: maps
Color maps, contour maps

PRODUCTS: maps
Seasonal maps displayed as chart maps for selected stations (the same can be done for individual months)


PRODUCTS: animations

MEAN MONTHLY PRECIPITATION

JANUARY

(inches)
PRODUCTS: maps

MEAN MONTHLY TEMPERATURE
JANUARY

°F
-< 25
25 - 28
28 - 31
31 - 34
34 - 37
37 - 40
40 - 43
43 - 46
46 - 49
49 - 52
52 - 55
55 - 58
58 - 61
61 - 64
64 - 67
67 - 70
70 - 73
73 - 76
> 76
Indiana First Frost Dates

The first frost is occurring later.
Indian Last Frost Dates


The last frost is occurring earlier.
Public Health Impacts

- Water Quality and Quantity Impacts
- Mental Health and Stress Impacts
- Dust and Windblown Agent Impacts
- Wildlife Intrusion Impacts
- Nutrition and Hygiene Impacts
Press Releases from South Dakota State University

- Drought among the factors adding stress to families
- Stress from drought issues can affect physical health
- Farming, ranching, and stress: adult depression
- Farming, ranching, and stress: recognizing and addressing your child’s fears
- Farming, ranching, and stress: just for kids—watching the news
Selected Nebraska Mitigation Actions Helpful in 2002

- Vulnerable Water Systems Identification, Assistance, and Workshops
- Hay and Farm Crisis Hotlines
- UNL Extension Drought Website
- Improved Soil Moisture Monitoring
http://drought.unl.edu/dm
• Even though droughts are infrequent in Indiana they will occur

• The solution is excellent monitoring
  - Reassess the drought plan
  - Support CoCoRaHS
  - Pursue ET mapping and hydrological budgeting
  - Set up LDAS (SIBMAL, NOAA, etc)
  - Whole technical workshops on water stresses
  - Support dedicated students to work with this group

  - Official water plan that is technically sound and defensible will emerge