Illinois Drought Update, February 9, 2006
DROUGHT RESPONSE TASK FORCE
Illinois State Water Survey, Department of Natural Resources
For more drought information please go to http://www.sws.uiuc.edu/

SUMMARY. Statewide precipitation in 4 of the 7 months since July 2005, including January 2006, has been above normal. It would be easy to conclude that the drought is over. Yet severe precipitation deficits in much of northern and central Illinois in March-June 2005 still leave their mark in January 2006 as low streamflows, depleted soil moisture, and low groundwater and reservoir levels. Typically, water stored in snow and ice cover in winter is released in spring as temperatures warm. This year there is no snow and ice cover and, hence, no water to release. Climate conditions this spring will be critical for water availability and supplies. Five key indicators point to the probability, albeit unquantified, of a dry spring and summer in northern Illinois and perhaps other regions of the state. These indicators are: i) evolution of similar drought conditions in the past, ii) persistent and strengthening drought conditions from the Mexican border northeastward to Missouri, iii) cooler than normal sea-surface temperatures in the equatorial eastern Pacific Ocean (La Niña), iv) the federal Climate Prediction Center forecast of continuation of a weak La Niña, and v) persistent warmer than normal sea-surface temperatures in the north Atlantic Ocean. Compounding the dry outlook is a tendency for above normal summer temperatures in Illinois after La Niña occurs in spring. We are not aware of any indicators that point to any increased probability of wet conditions.

1. DROUGHT STATUS. According to the U.S. Drought Monitor (Figure 1), most of northern Illinois is in a "severe" drought (category 2 in their 4-category drought classification) after being reduced from an "extreme" (category 3) drought in recent weeks. A number of drought indicators, including soil moisture and stream flow, showed some improvement this winter, especially after above normal January precipitation. Much of central Illinois remains in the categories of either "moderate" drought or "abnormally dry". Southern Illinois remains clear of drought. Drought continues to intensify in Arizona, New Mexico, Texas, Oklahoma, Arkansas, and southwestern Missouri. Examination of precipitation in Missouri over the last 90 days indicates a potential for drought conditions to extend throughout much of Missouri, thereby connecting the drought in Iowa and northern Illinois with the southwestern drought. The Drought Monitor is updated each Thursday morning at 8am EDT and can be accessed via the Internet at http://www.drought.unl.edu/dm/monitor.html.

2. PRECIPITATION. Statewide precipitation in the last 90 days (November 11, 2005, to February 8, 2006) has been 7.15 inches, 0.03 inches below normal (Figure 2). Occurring outside the growing season when little evapotranspiration takes place and lately over largely unfrozen soil, the 7.15 inches was very effective at recharging moisture storage in upper soil layers. Statewide precipitation (Figure 3) since March 1, 2005, has been 27.90 inches (9.37 inches below normal and 75 percent of normal). Precipitation deficits at individual sites were even more severe in northern and western Illinois. Since March 1, 2005, Moline received only 17.50 inches (19.31 inches below normal); Chicago, 21.19 inches (13.76 inches below); Rockford, 21.89 inches (13.71 inches below); and Quincy, 21.77 inches (14.76 inches below). At this time, there is no significant snow cover in Illinois. As a result, there is less moisture storage available for release into the soil later on into spring.

3. LAST 100 YEARS. Despite above average precipitation in January, the accumulated precipitation deficits since March 2005 continue, especially in northern Illinois. Statewide precipitation totals during the March - January period were the 6th driest such period since 1895 (Figure 4), a slight improvement from the 3rd driest period one month ago. The 26.88-inch total is just slightly less than the same period in the 1988-89 drought. Regionally, totals during the last 11 months were between the 2nd and 4th lowest ever recorded in the northwest, northeast, west, and central climate divisions (Figure 5). The west-southwest and east-southeast divisions also have been considerably short on precipitation with ranks of 7th and 8th place, respectively. In general, divisional rankings of precipitation totals since March 2005 have shown a very slight improvement.

4. SOIL MOISTURE. Improvement has been noted in the soil moisture totals in Illinois over the last month as observations at most sites indicate a recharge to near normal moisture conditions in the top 20 inches of soil. Due to the January rains, the band of overall dry soils in central and northeastern Illinois appears to be shrinking (Figure 6). Nevertheless, soil moisture in these regions remains considerably short below 40 inches, less than 50 percent of normal in a broad band across central and north-central Illinois, and as low as 20 percent of normal in the lowest layer at Peoria and DeKalb. As the growing season begins with increased surface evaporation and crop growth extracting existing moisture from the soil, timely average to above average rainfall over the next several months will be needed to not only maintain current soil moisture levels, but to recharge the total soil moisture profile in these driest regions.

5. GROUNDWATER. Shallow groundwater levels continue to be below normal across Illinois. The water levels in observation wells at the end of January averaged 2.1 feet below average. While levels this month were 1.7 feet higher than December levels, reflecting continuing recharge due to near normal precipitation in the last three months, they are still approximately 3.9 feet below January levels one year ago. Water levels at Fermi National Laboratory in DuPage County (15 feet deep) and Bondville in Champaign County (21 feet deep) have increased for the first time in 10 months. The level at both wells is 2.9 feet below normal. The wells are now above their record lowest January levels after having been reported historic lows the last several months.

The ISWS received three reports in January from homeowners who are experiencing drought-related well problems. These reports were from Christian, Kane, and Putnam Counties, and all have been using large-diameter bored wells which are particularly prone to problems during dry periods because of their shallow depth (typically 25 to 50 feet deep).

Illinois' deeper aquifers are relatively drought resistant, especially to short-term droughts (e.g., <1-2 years). These aquifers are recharged by the slow leakage of water from "source" beds (overlying water-holding formations) and as long as those source beds contain water, deep recharge is minimally affected.

These aquifers are more affected by the stress placed upon them during the high demands of hot, dry weather. A good example is the Sankoty aquifer in the Lee-Whiteside County area of northwest Illinois (Figure 7). The graph below shows how the deeper Sankoty aquifer reacts to

seasonal irrigation pumpage while the shallower Tampico aquifer responds to seasonal climate. Water levels in the Tampico have not yet recovered from last summer due to a lack of fall moisture while water levels in the Sankoty have rebounded since the end of the irrigation season late last summer. Note that water levels in the Sankoty during last summer were much deeper than previously experienced due to high irrigation demand.

6. **ILLINOIS STREAMFLOWS.** The January streamflows for much of Illinois rose noticeably during the last 4 days of the month in response to late-month rains. As shown in Figure 8, there is still a marked contrast in streamflow conditions between the western half of the Illinois, with January flows generally in the below-normal range (10^{th} to 30^{th} percentiles), and the remainder of the State that experienced January flows in the normal range (30^{th} to 70^{th} percentile). The contours and level of detail shown in Figure 7 are limited by the number of long-term stations used in creating this map. An analysis of shorter-term gaging records suggests that the band of below-normal streamflow in reality also extends into parts of northeastern Illinois, following the region of greatest precipitation deficit shown in Figure 3. The region of below normal flows extending from St. Louis to Springfield appears to be associated with a band of low precipitation that has occurred over the past 90 days (as shown in Figure 2). But the much-below normal flow (lowest 10^{th} percentile) shown for the South Fork Sangamon River near Springfield is partially artificially induced as most of the flow in the river has been pumped to augment the storage in Lake Springfield.

The unusually warm weather for January 2006 has caused streamflow conditions that are not easily compared to other years. In normal years, most of the January precipitation in northern Illinois would fall as snow, and much of this would be retained either within a snow pack or as ice trapped in the upper layers of frozen soil. The occurrence of precipitation instead of snow has probably enhanced the amount of streamflow that occurred during January, and conversely reduced the portion of the early spring runoff that would be caused by snowmelt and ground thaw.

With expected dry weather through the first half of February (see *Section 12: Outlook*), streams will continue to recede following the late January rainfall and the Illinois streamflow pattern will continue to look much like the January pattern shown in Figure 8. The spring outlook is still very uncertain; streams will rise in response to spring rains, but the magnitude of this rise will determine whether or not there is a substantial hydrologic recovery to the drought condition. The areas of northern and western Illinois that have a high accumulated precipitation deficit will likely continue to have a strong tendency for below normal streamflow, as much of the spring rainfall is expected to infiltrate to recharge groundwater and soil moisture. If below normal rainfall occurs in March and April, it is conceivable that flows in the western and northern parts of the State could return to a much below normal condition for the season.

7. WATER LEVELS AT PUBLIC WATER SUPPLY (PWS) RESERVOIRS. The Water Survey maintains monthly lake level records for 35 public water supply reservoirs in Illinois. Of these, 15 reservoirs have records that date back to the 1980s and have a relatively consistent level of water use from which the impacts of different drought periods can be compared. Seven of these 15 reservoirs, most located in either southern Illinois or the eastern half of the State, are

now at or near full pool, which is normal for this time of year. Eight reservoirs, listed in Figure 9, are still noticeably below their normal condition for this time of year.

In general, most of the reservoirs listed in Figure 9 are in a "middle ground" where they are not as low as that experienced in the previous drought periods of 1988-1990 and 1999-2000, but are noticeably lower than their normal (median) levels for this time of year. Of these eight reservoirs, only Canton Lake is located near the northwestern portion of the state where the precipitation deficits are greatest. The impacts of the current drought period on water supply reservoirs would have been significantly worse if the drought had been centered farther south in Illinois where surface waters provide the primary source of water supply.

- The water level in Lake Bloomington experienced a noticeable rebound during January, such that it now seems possible that recovery to full pool could occur this spring.
- There is still a strong likelihood that the Canton Lake water level will not fully recover this spring.
- Altamont Lake, located near Effingham, is at its lowest January level in 23 years of record. The lake is designed to provide water through a 4-year drought period. Low water levels may become a concern if there is not substantial recovery this spring.
- Paris Twin Lakes and Spring Lake (Macomb) returned to full pool (or near to full pool) in January and are no longer concerns.

8. FEDERAL RESERVOIRS. There are no water supply concerns for any of the federal reservoirs. Lake Shelbyville and Carlyle Lake are being operated to keep their pool levels near the respective target winter pools. Rend Lake has risen over a foot over the last month and is now at an elevation of 406.9 feet, which is moderately high for this time of year.

9. MISSISSIPPI AND OHIO RIVERS. The water levels in the Ohio River and the Mississippi River downstream of St. Louis have experienced normal fluctuations but with an average condition that has been very close to normal for most of January. In contrast, the Upper Mississippi River has been experiencing sustained above-normal flows.

10. **ILLINOIS RIVER**. Streamflows on the Illinois River have generally increased over the course of the January, starting the month in the below normal range, finishing the month near the long-term normal condition, and having an overall monthly flow rate in the normal range.

11. LAKE MICHIGAN. The water level for Lake Michigan rose 0.1 foot during January 2006, ending the decline of the lake's level since the summer of 2005. Lake Michigan is now 0.7 foot lower than it was one year ago, but is still 1.0 foot higher than the record low that occurred in 1964 and 0.5 foot higher than the more recent low levels that occurred during the winter of 2002-2003. The level in Lake Michigan is expected to stay fairly constant over the next month, and then begin rising in the spring as part of its normal seasonal cycle.

12. OUTLOOK. According to the National Weather Service, the weather over the next two weeks is likely to be cooler than normal over most of Illinois. Precipitation will be scarce for the next week, but chances for significant precipitation in Illinois improve after mid-month. The Climate Forecast System model of the federal Climate Prediction Center (CPC) calls for the

continuation of a weak La Niña event through the spring and summer. A La Niña is a global scale climate anomaly marked by cooler than normal sea surface temperatures in the eastern equatorial Pacific (Figure 10). This anomaly tends to shift thunderstorms westward in the equatorial Pacific, which then changes the position of jet streams and subtropical highs that affect the weather in the central U.S. Previous La Niña events have been noteworthy for their association with severe drought in the central U.S., such as during the mid-1950s, 1988-89, and 1998-2000. The CPC model predicts below normal precipitation in the central U.S. this year, with dryness potentially extending into Illinois at times during spring, and more persistently during summer. Analyses by State Climatologist Jim Angel of past La Niña events similar to the current one agrees with the model results. While spring may have alternating periods of wet and dry, the period May through August in Illinois has been well below normal in precipitation and warmer than normal in temperature during several of these past events (Figure 11).

Aside from model predictions and La Niña associations, past years with dry March through November periods have shown that they were quite likely to experience further dryness during the next growing season in Illinois. Figure 12 illustrates the course of cumulative precipitation departures in the months following a dry March through November. We have already progressed two months beyond November with a little improvement. However, five out of the six years in the diagram that did not show significant recovery during the early winter ended up continuing to receive below normal precipitation during the following spring and in three of the six years precipitation deficits increased during summer.

Finally, new research results indicate that a warm North Atlantic Ocean is associated with an increase in the probability of drought in the central U.S., including Illinois. During a past epoch of warm sea surface temperatures during 1930 to 1960, the two greatest multi-year droughts of the century occurred in the 1930s and 1950s. The current warm Atlantic epoch started in the mid-1990s, and may be tilting the climate system towards higher probabilities for drought in Illinois for some time to come.

Given the current state of depleted subsoil moisture and shallow groundwater in much of Illinois, timely and normal to above normal rains will be required for a successful growing season. Unlike last year, when the effects of drought were ameliorated by an abundance of soil moisture recharged during a wet winter, this year we enter the growing season in a far more vulnerable condition. In addition, unlike last year, the spatial extent of drought development is projected by the CPC to cover a much broader area, including most of the western Corn Belt and Southwest. While the specific probability of drought intensification in Illinois cannot be known, there are significant signals to indicate that this probability is higher than normal.

13. <u>SUMMARY OF STATE'S WATER RESOURCES</u>. Water resources in Illinois during 2005 were impacted by below average precipitation (Figure 13). Soil moisture conditions across the state showed the fastest response. Impacts on streamflow and shallow groundwater levels were slower, but longer-lasting. In general, the above average precipitation in January 2006 brought statewide water resources levels the closest to their normal values they have been since the drought began. Regardless, all water resources currently are lower than their pre-March 2005 levels. A possible repeat of drought conditions in spring 2006 would likely cause more rapid depletion of water resources than occurred in 2005.

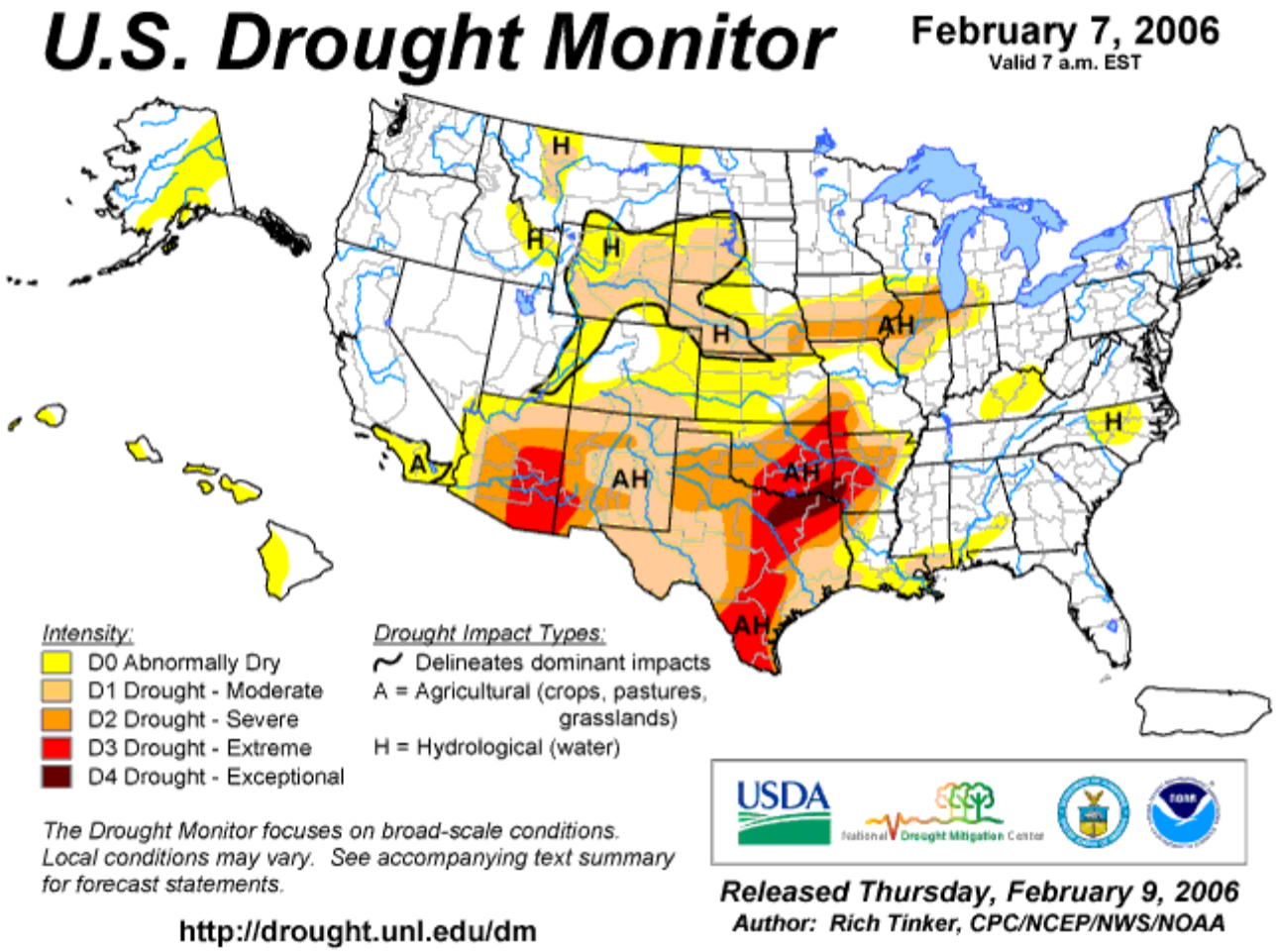


Figure 1. U.S. Drought Monitor.

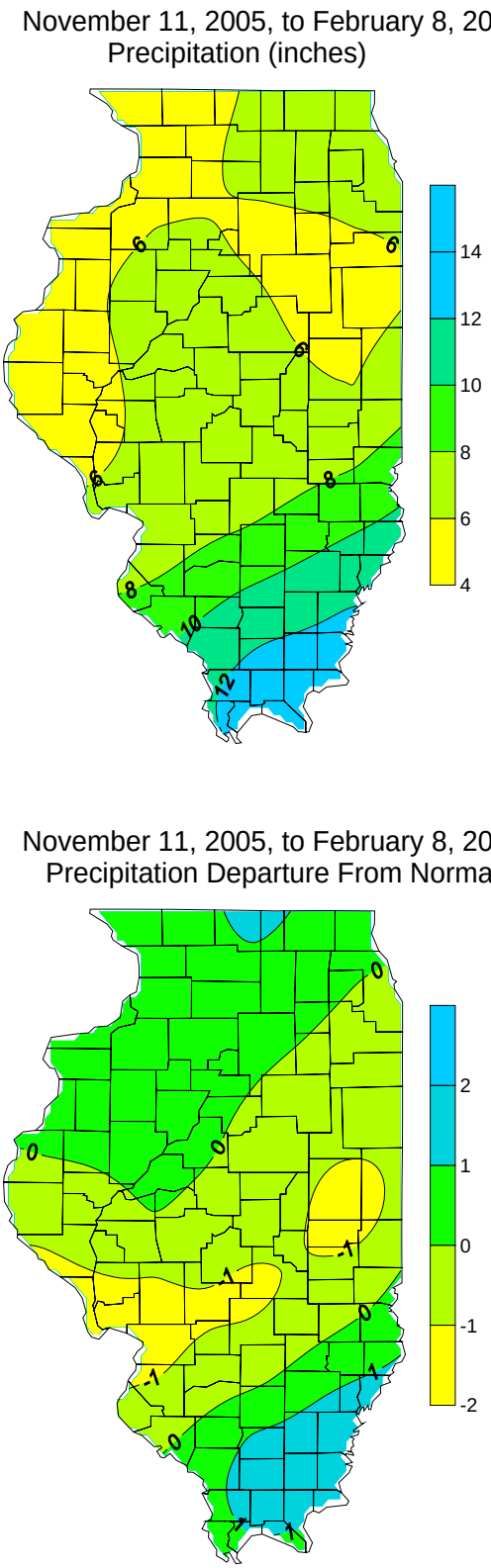


Figure 2. Precipitation since November 11, 2005 (90 days), expressed as actual amounts (top) and departure from normal (bottom). Source: Illinois State Water Survey.

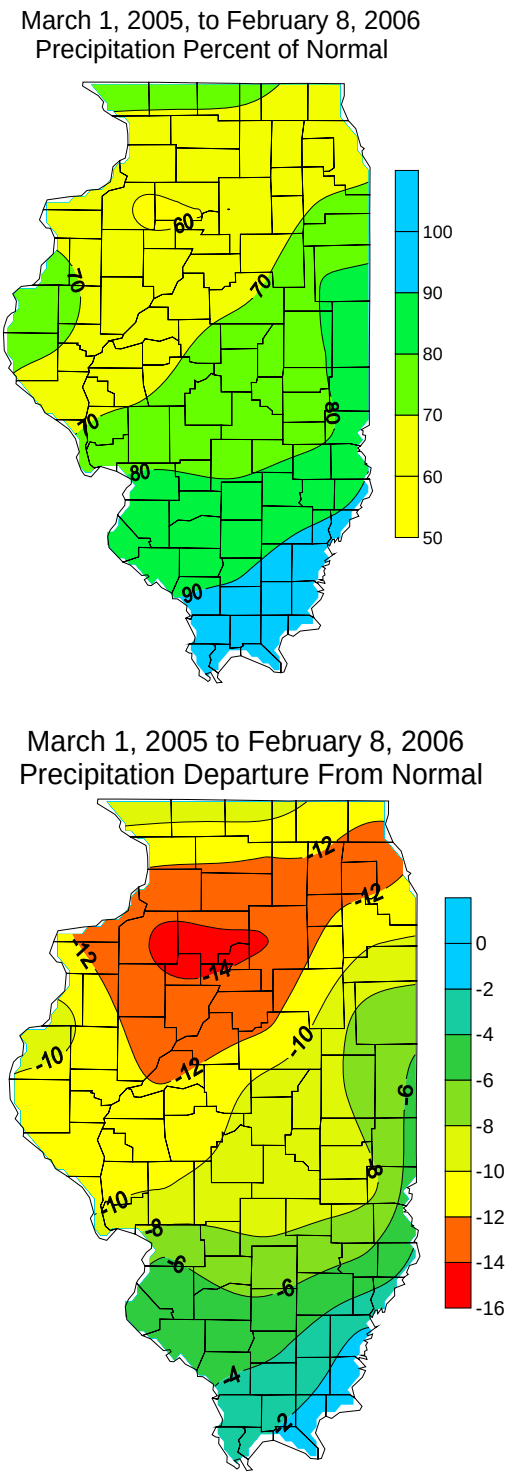


Figure 3. Precipitation since March 1, 2005 expressed as percent of normal (top) and departure from normal (bottom). Source: Illinois State Water Survey.

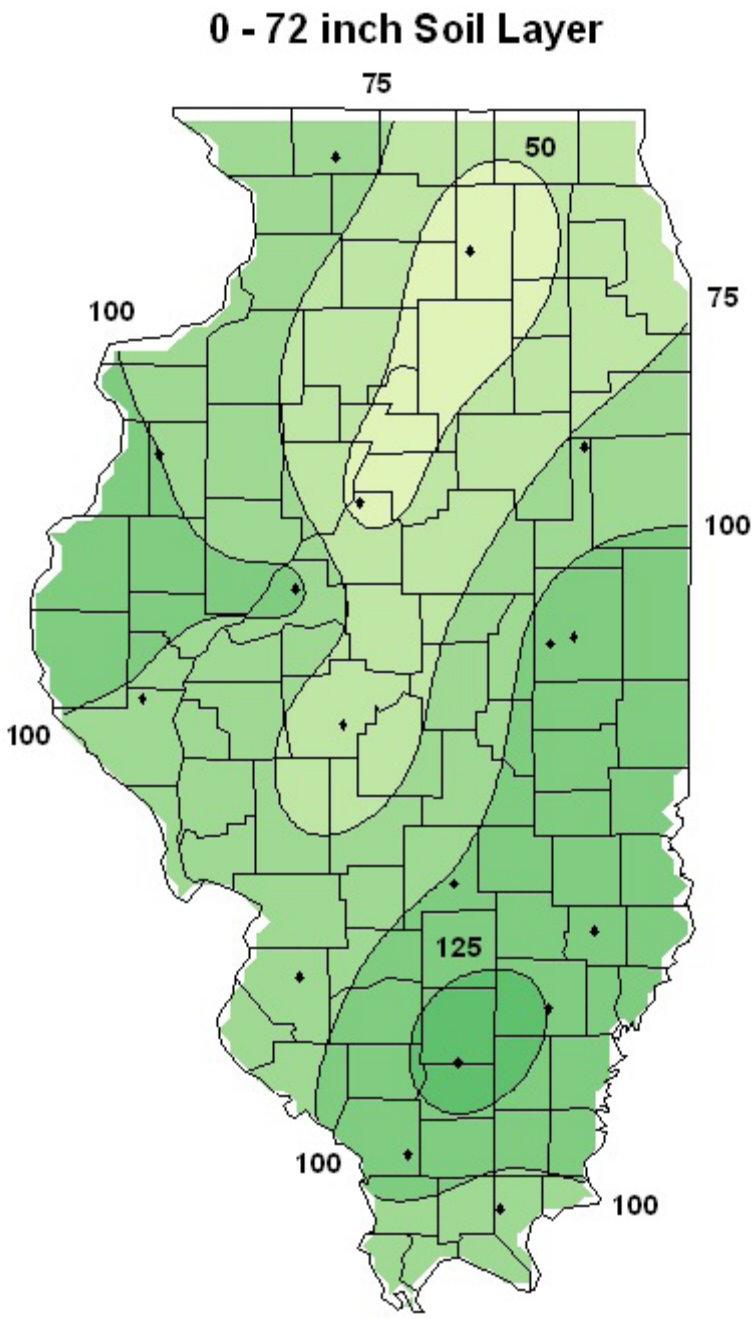
Figure 4. Ten driest March through January periods in Illinois (since 1895).

Rank	*Year*	*Precip (in)*
1	1930 31	21.74
2	1901-02	24.27
3	1953-54	26.33
4	1976-77	26.82
5	1914-15	26.85
6	**2005-06**	**26.88**
7	1988-89	27.18
8	1963-64	28.01
9	1940-41	28.73
10	1962-63	29.02

Figure 5. Rankings of driest March through January periods within Illinois climate divisions (since 1895). A map of Illinois climate divisions is located at: http://www.ncdc.noaa.gov/img/onlineprod/drought/il.gif.

Climate divisions	*2005-2006 rank*	*top 4 driest years (year drought started)*
Northwest	2	1988, **2005**, 1930, 1910
Northeast	3	1962, 1930, **2005**, 1956
West	4	1988, 1901, 1953, **2005**
Central	4	1901, 1930, 1988, **2005**
East	15	1930, 1963, 1901, 1914
West-Southwest	7	1930, 1901, 1914, 1953
East-Southeast	8	1930, 1976, 1901, 1914
Southwest	25	1930, 1901, 1953, 1976
Southeast	28	1930, 1901, 1940, 1953

Source: Illinois State Water Survey



Source: Illinois State Water Survey

Figure 6. February 1, 2006 observed percent of normal soil moisture in the top 72 inch soil layer, based on the 1985-1995 mean.

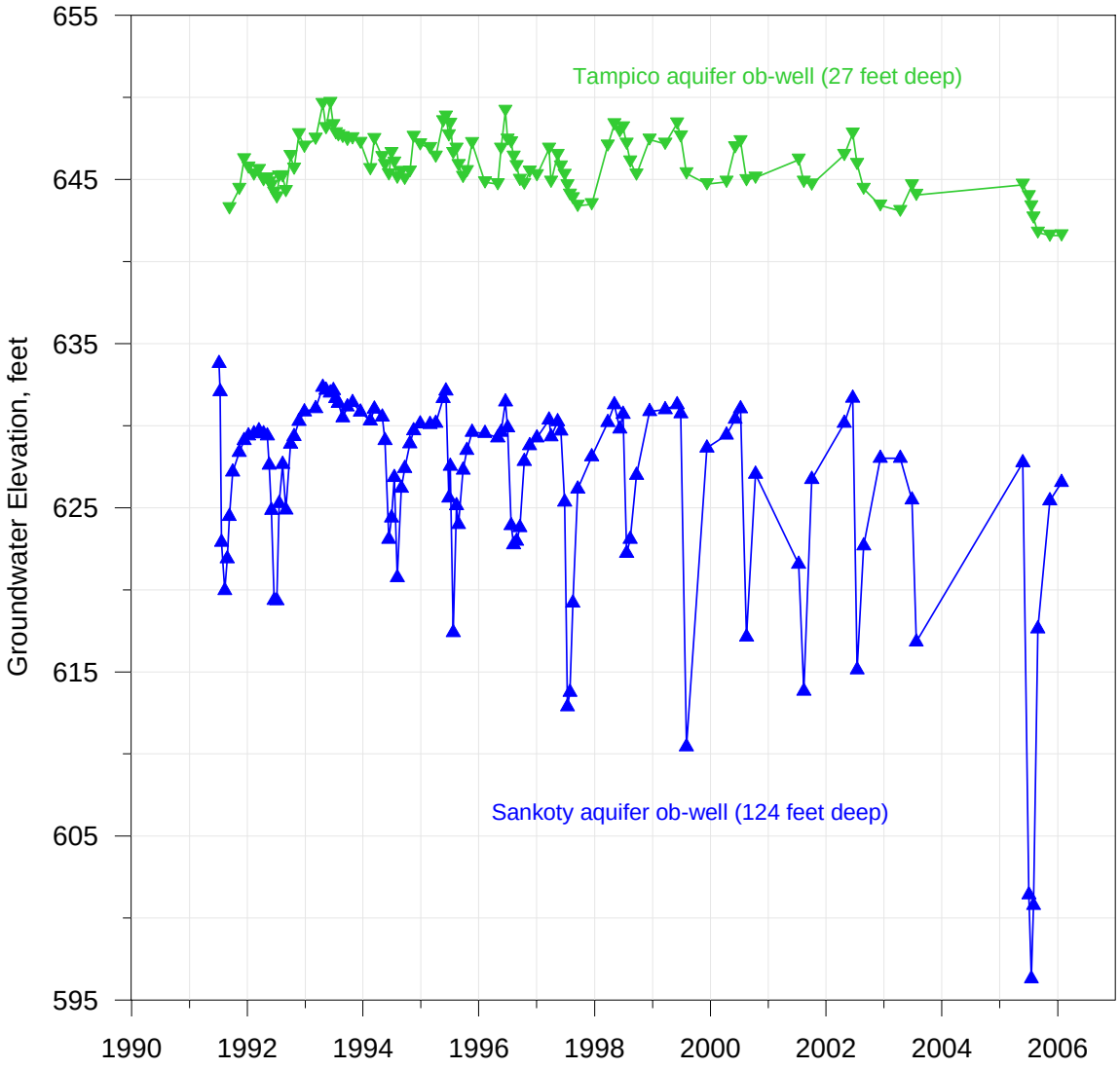


Figure 7. Groundwater levels in a shallow (Tampico) and a deep (Sankoty) aquifer in Illinois. Source: Illinois State Water Survey.

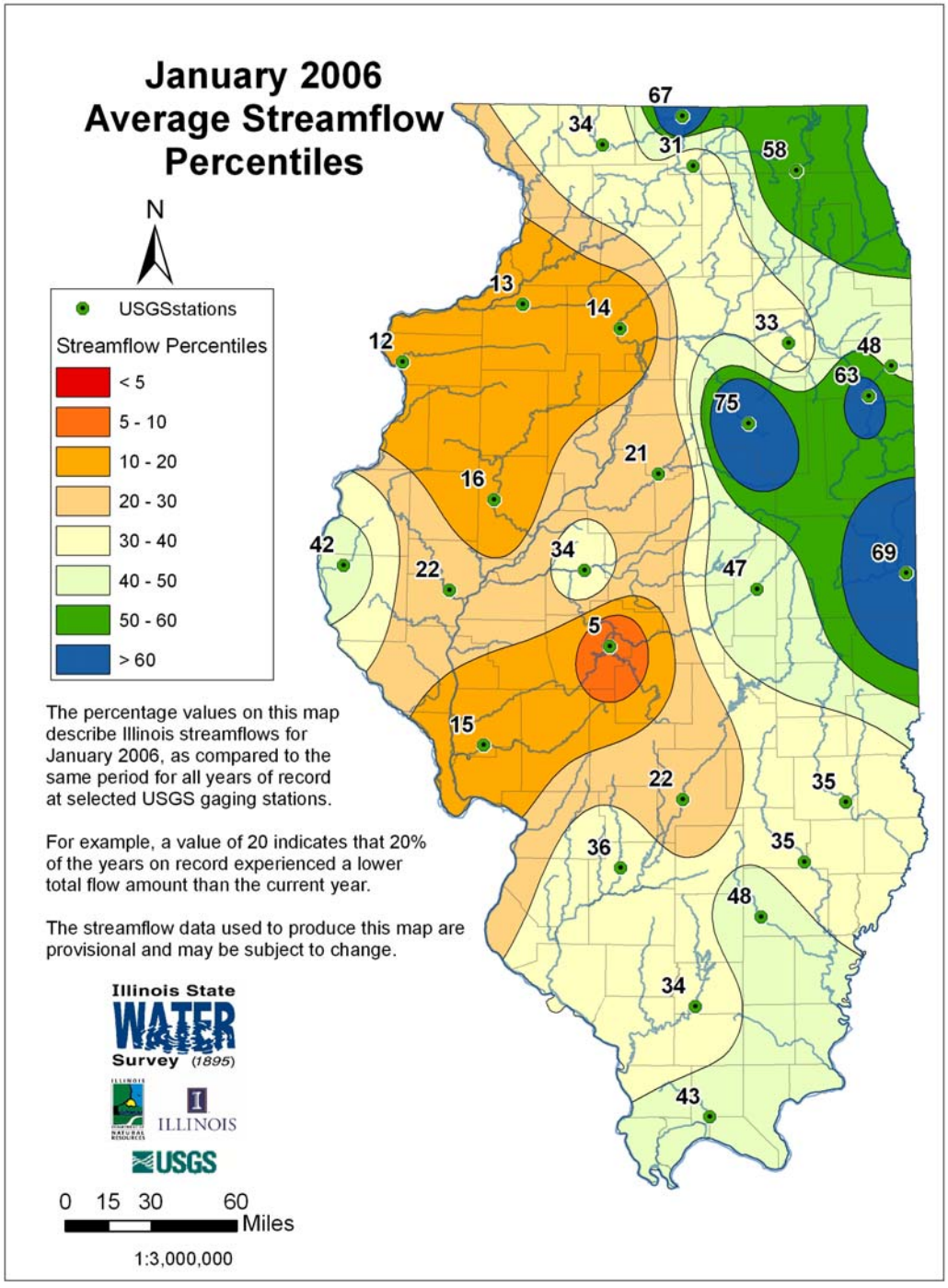


Figure 8. January 2006 average streamflow percentiles at select stations.
Source: Illinois State Water Survey.

Figure 9. January 2006 End-of-Month Water Levels at Selected PWS Reservoirs.

Reservoir	Current reservoir drawdown	Beginning of ISWS lake record (year)	This month's rank	Lowest January level on record (year)**	Median January level
Altamont Lake	-6.3 ft	1983	1	-6.3 ft (2006)	-0.2 ft
Canton Lake	-5.7 ft	1989	2	-11.3 ft (1990)	-0.0 ft
Lake Pittsfield	-2.2 ft	1988	2	-2.7 ft (2000)	-0.0 ft
Evergreen Lake*	-5.0 ft	1988	4	-14.6 ft (1989)	-2.1 ft
Lake Bloomington*	-7.2 ft	1983	6	-11.3 ft (1989)	-0.8 ft
Carlinville Lake	-1.0 ft	1983	5	-3.5 ft (2000)	-0.0 ft
Lake Pana	-3.3 ft	1983	5	-5.0 ft (2000)	-0.0 ft
Lake Springfield	-3.5 ft	1983	6	-5.6 ft (2000)	-0.8 ft

*Paired reservoirs - the amount of total reduction in reservoir storage for the combination of Lake Bloomington and Evergreen Lake is the 6th lowest for January since records began in the 1980s.

**Although some water level records are available for historical droughts such as during the 1950s drought of record, these older values are usually not directly comparable to modern records because of substantial changes over time in either water use, normal pool elevation, or in additional sources of supply.

Source: Illinois State Water Survey

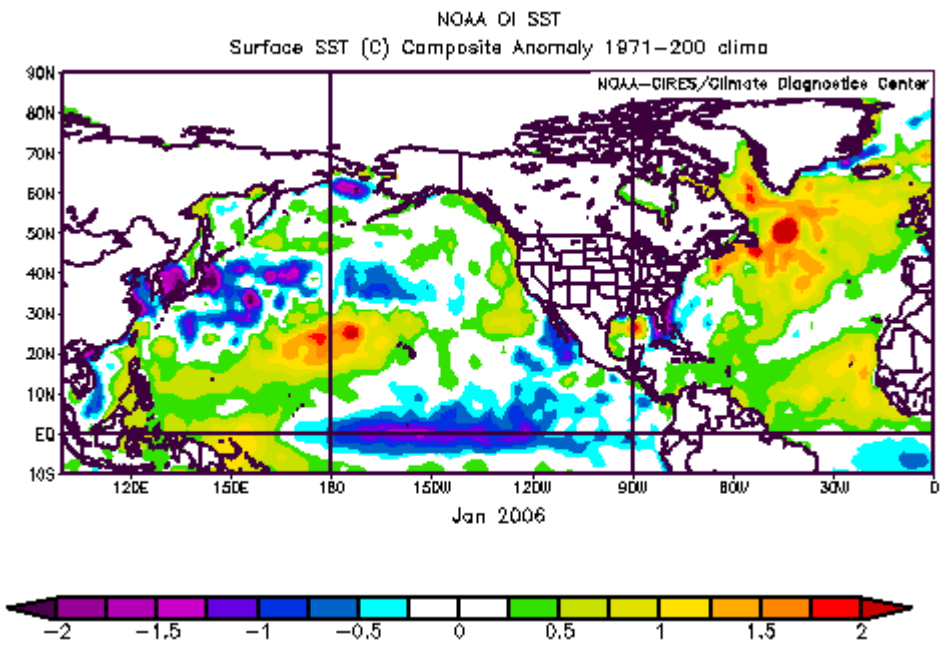
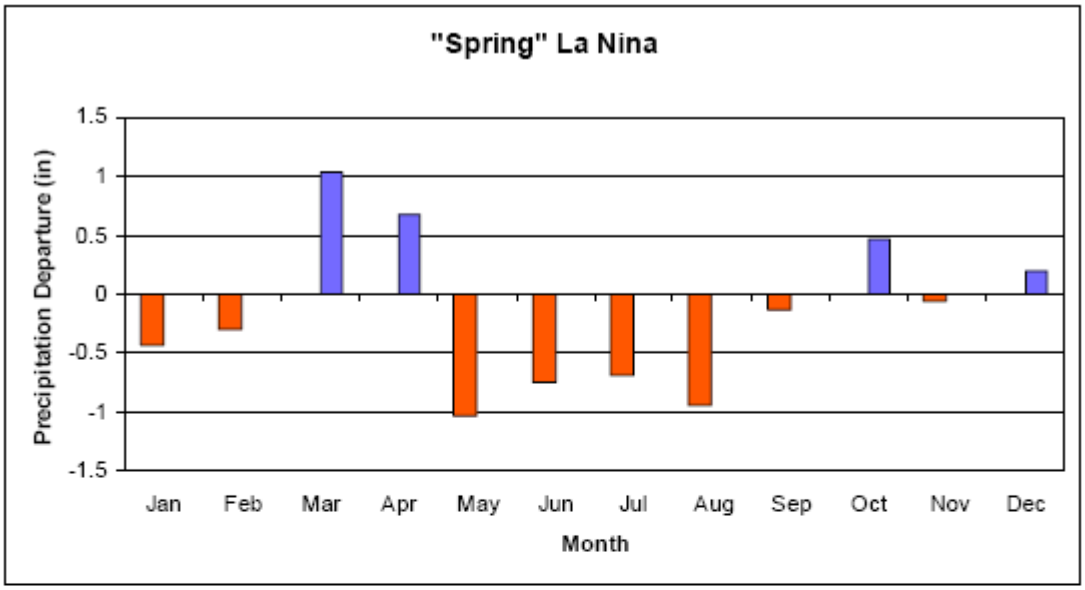
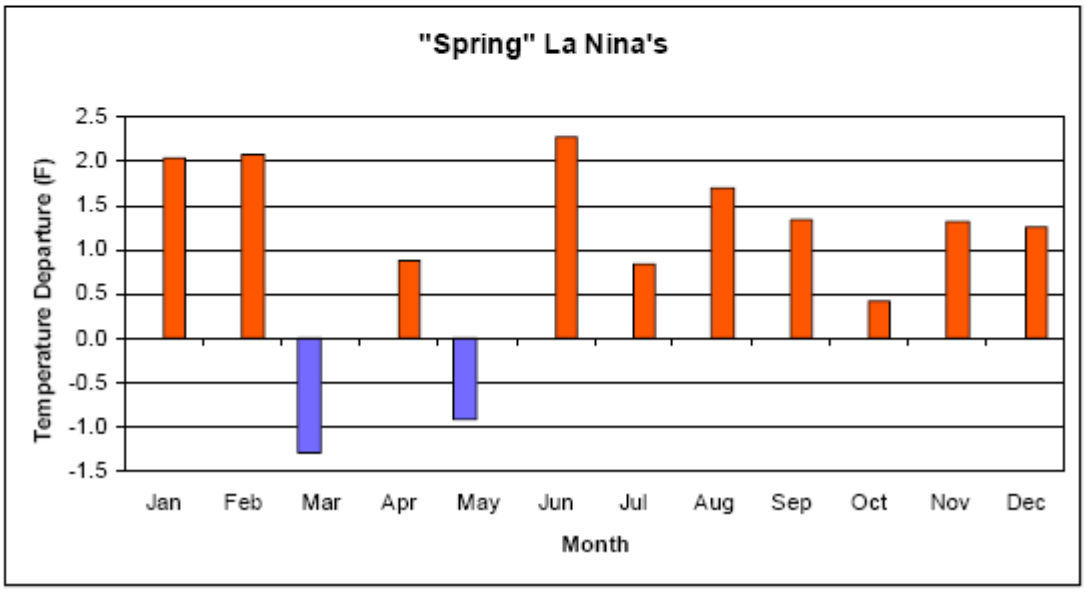


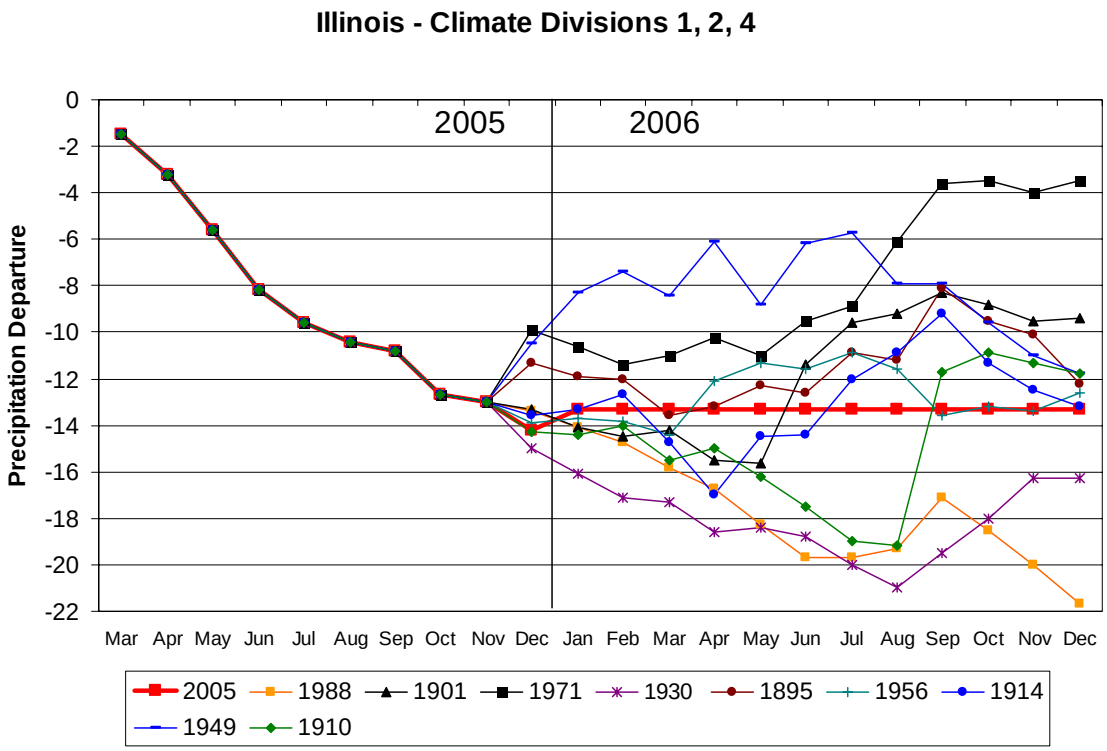
Figure 10. January 2006 sea surface temperature anomalies (°C). Note the cool anomaly in the eastern equatorial Pacific is the signature of a La Niña event. Atlantic Ocean sea surface temperatures are well above normal over a broad area.





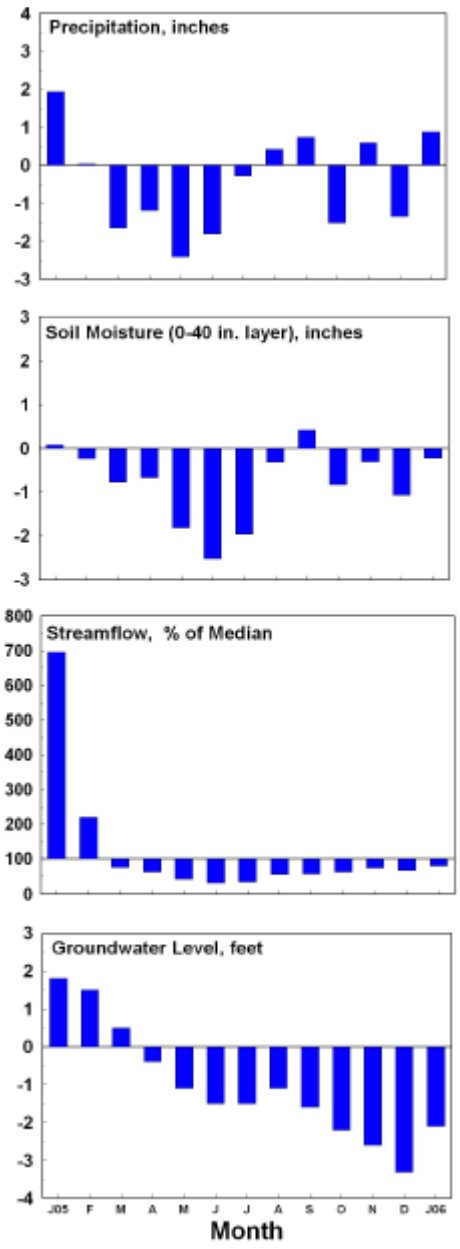
Source: Illinois State Water Survey

Figure 11. Illinois statewide precipitation and temperature averages for three La Niña events similar to the current event, sharing a late winter / early spring starting time. These similar events resulted in drier than normal conditions in the late spring and summer, and warmer than normal conditions in Illinois.



Source: Illinois State Water Survey

Figure 12. The Northern Illinois cumulative precipitation departure from normal (inches) for March 2005 through January 2006 is compared to both climatology (red boxes) and the months that followed during the other 9 driest March through November periods. The Northern Illinois average combines precipitation from the Northwest (Div 1), Northeast (Div 2), and Central (Div 4) climate divisions of Illinois. A map of Illinois climate divisions is located at: http://www.ncdc.noaa.gov/img/onlineprod/drought/il.gif.



Source: Illinois State Water Survey

Figure 13. Illinois statewide departures from normal for precipitation, soil moisture, streamflow, and groundwater level.

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