After the drought, what next?

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Historical events hint that the Midwest may be on the verge of crop weather reminiscent of the 70s and 80s. Abnormally active weather systems can bring a mix of record high yield crop years interspersed with adverse production conditions. Agriculture will remain the world's largest and most basic industry, but will become more dependent on technological advances and on effective risk management than was demanded over the past 20 years

U.S. corn yield

The U.S. corn yield has increased consistently since the Late 1930s. That is the yield per acre trend has consistently increased. Following considerable academic discussion by climatologists and agronomists it was determined that the "most meaningful" normal and trend determinations are obtained from the analysis of 30 consecutive years of record, be it crop yields or climate being evaluated (I mention this because today I am hard-pressed to identify anyone other than myself that was in attendance at those particular society meetings of the 1950s and early '60s). By the nature of "normal" distributions of anomalies in yield and in weather it would be expected that about half of all years would exceed normal and half fall below the norm. A 56-year plot of U.S. corn yield (Figure 1) shows that in the 1950s the observed yield fell below the trend for 1953-1956 (4 consecutive years) and was slightly shy of the trend through 1960. Another episode of sub-trend corn yields is noted from 1974-1977. These two depressed yield episodes corresponded with two historically strong climate events that would subsequently be termed "La Niña," (Figure 2).

The United States recently experienced 6 consecutive years of above trend corn yield (Figure 3). Then 2010 ushered in the second strongest La Niña event in the history of keeping records of this sort of weather event. The strong La Niña brought weather tending to be on the extreme side, although not all weather events during 2010 were consistent with a La Niña. The shifting impacts of this major weather anomaly added up and the impact on U.S. corn yield was three consecutive below trend corn crops and may be setting up for a fourth. At least two (mainly independent) major weather cycles are playing out at this time: 1) an apparent shift in world weather to a pattern of La Niña dominance…such patterns may persist 1 to 4 years. 2) Conditions of the North Atlantic are giving the indication of favoring severe winters in the Eastern half of the United States. Couple the trends together with the subsoil moisture not likely to fully recharge after two seasons of limited precipitation and a 4th consecutive year of below trend U.S. corn yields looks likely. It is possible that weather will be more extreme during the coming score of years than has been experienced since 1994.

Diminished U.S. corn in 2010, 2011, and 2012 accompanied a deep (hydrologic) drought that would, in Texas and Oklahoma, rival (and in isolated spots exceed) that of the 1950s episode. Long-term (or hydrological) drought results when precipitation is not sufficient to maintain soil moisture at levels where runoff and/or percolation can maintain ground water and stream flow levels. Three notable episodes of hydrological drought are depicted in Figure 4. Factors were much alike between the 1950s, 1970s, and 2010s throughout the Earth (including drought, flooding (upper Missouri river), and tornado outbreaks).

Periods of consistent and of erratic yield have been observed for crops since the mid-1800s and are indicated over at least the past 800 years by tree ring analysis. Episodes of erratic yield tend to persist for about 25 years followed by 19 years of relatively consistent yields (Figure 5). In addition to the erratic period an apparently independent cycle of harsh winters (associated with ocean currents in the Atlantic) appears to have initiated (Figure 6). Winters do have major economic impact in the Midwest but seldom have over-riding influences on the subsequent crop year (flooding because of winter moisture being the most notable exception).

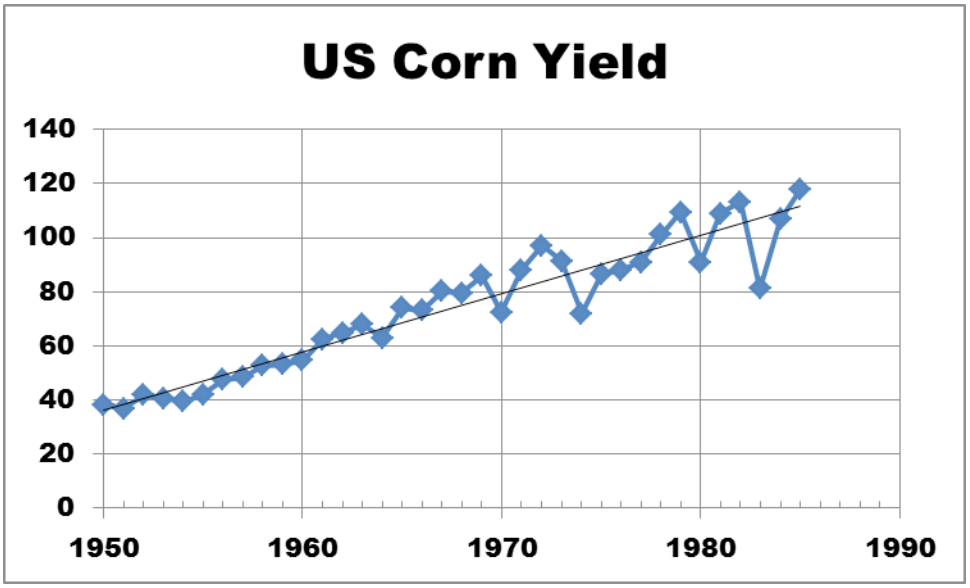


Figure 1. US corn yield from 1950-1985. A "best fit" trend line for reported corn yields in the United States for the period 1950 through 1985 depicts two episodes of consecutive years below the trend line. The deviation from trend is notable for consistency and is not considered as representing periods of great extremity for crops. The years did include extreme tornado and regional drought events, however. Source: nass.usda.gov

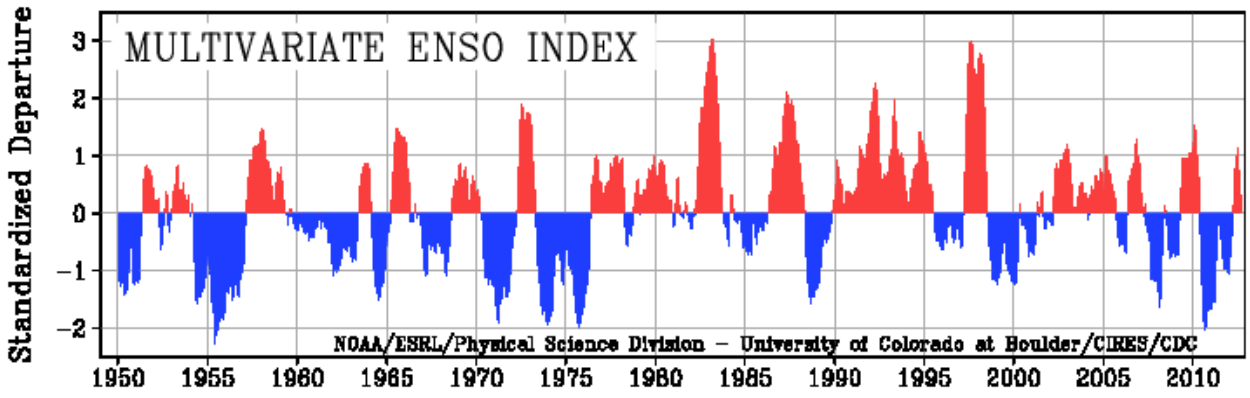


Figure 2. Historical graph of relative strength of El Niño and La Niña events computed from multiple parameters associated with the occurrence of these anomalous climatic conditions. The strongest La Niña events (negative standardized departures) are noted in the mid-'50s, the mid '70s, and the 2010-2012 period. Positive departures are indicative of El Niño conditions. Graphic produced by: http://www.esrl.noaa.gov/psd/enso/mei/

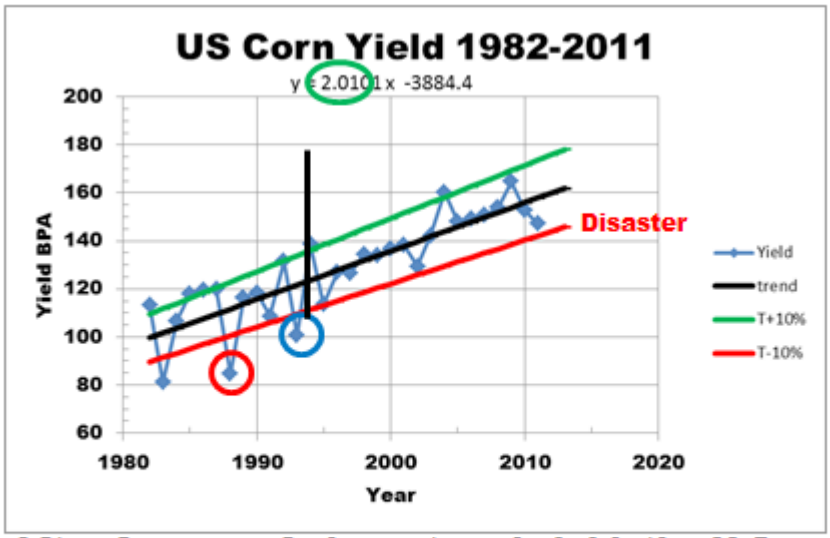


Figure 3. U.S. Corn yield from 1982-2011. The "best fit" yield trend together with 10% above and 10% below trend lines are shown. Yields are considered as exceptional when they fall outside the interval delimited by the lines. The years following 1974 tended to have yields consistently within the interval. Yields below the trend -10% line are considered as "disaster" yield levels.

1952-1957 June

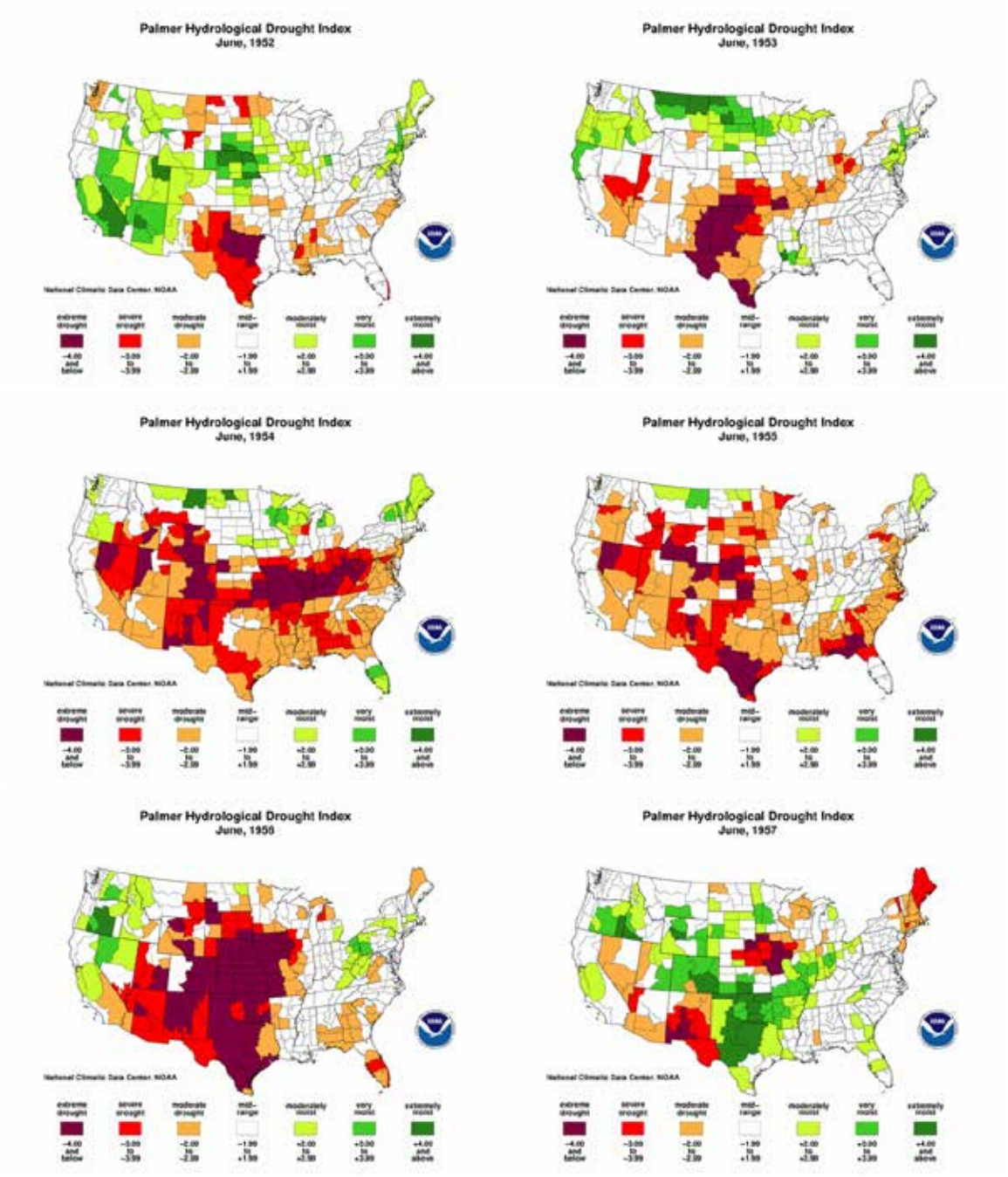
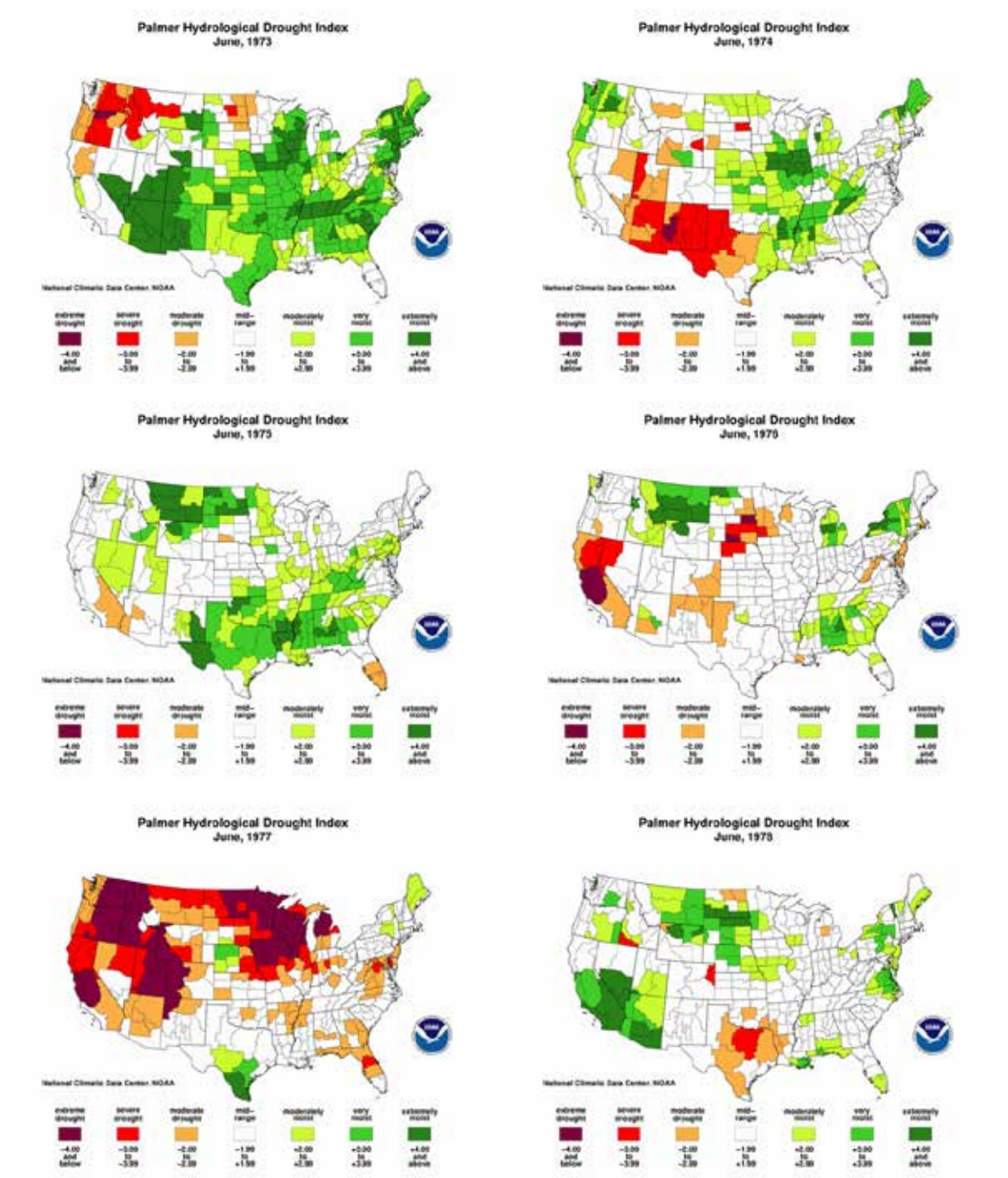


Figure 4. Hydrologic type drought as depicted by Palmer analysis. When hydrological drought begins the locality has likely been in Agricultural drought for some time. When hydrological drought ends, the Agricultural drought had ended beforehand. http://www.ncdc.noaa.gov/temp-and-precip/drought/historical-palmers.php

1973-1978 June



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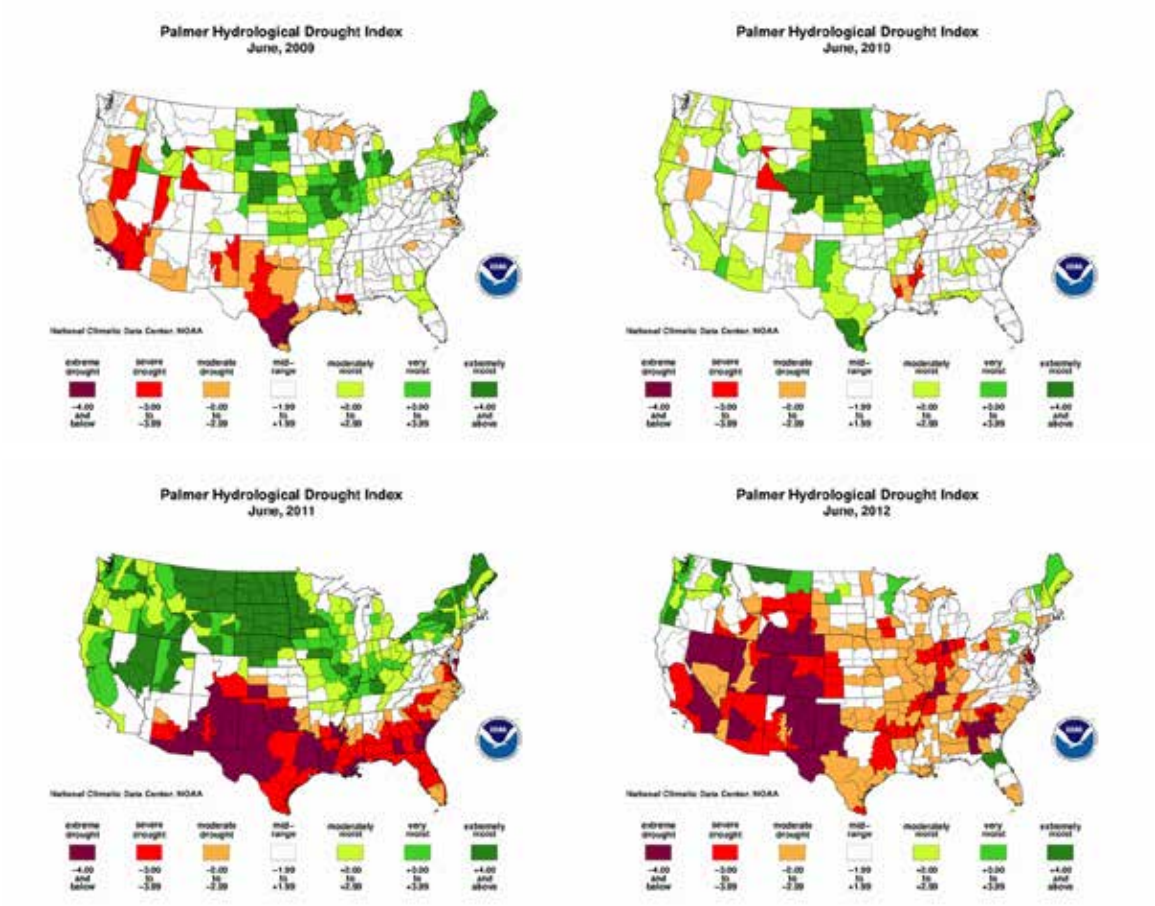
2009-2012 June



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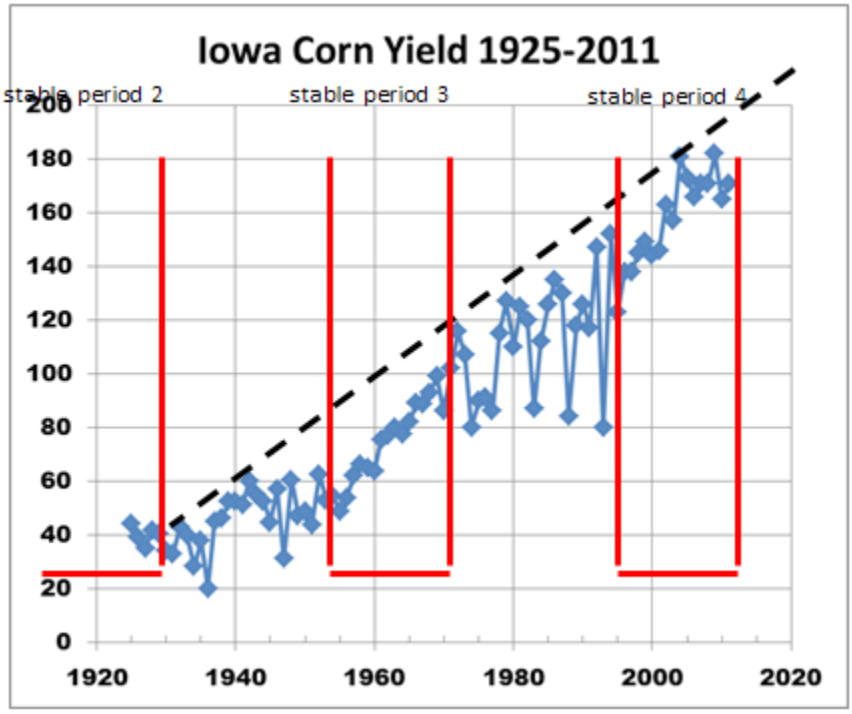

Figure 5. U.S. corn 1925 – 2011. Alternating intervals of consistent and of erratic corn yield are likely caused by a cycling of climatic conditions that are apparent in the tree-ring record since the 1300s and in the Midwest corn yield record that dates to the mid-1860s. The Midwest may be entering a period of increased yield volatility.

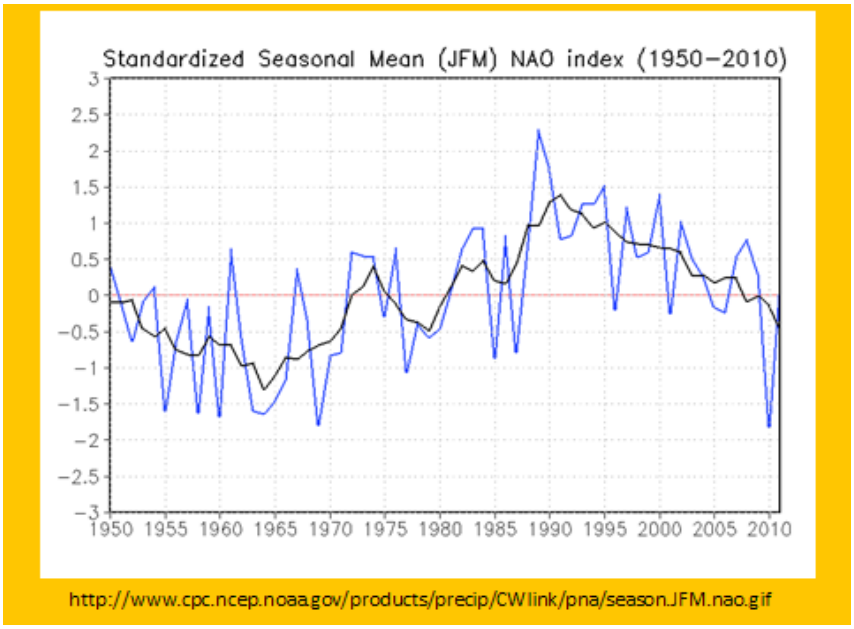

Figure 6. Winter condition of the North Atlantic Oscillation (NAO). Relative winter harshness (temperature and to a lesser extent snow accumulation) is related to the negative strength of the NAO in the central and eastern US (the effect is the opposite in Western Europe). Graphic from: www.cpc.ncep.noaa.gov/products/precip/CWlink/pna/seasonJFM.nao.gif