Reflections on a Growing Season of Extremes, Climate Trends, and Implications for Agriculture

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Outline

• Seasonal Highlights
• Historical Context, Trends
• Future Projections
• Near Future Outlook
March 2012 Summary

• Nationally, mean March temperature was 10.6°C, 4.8°C above normal.
  – Departure was 0.3°C warmer than previous all time warmest March (1910)
  – Only one month (JAN 2006) with a greater departure from normal
  – 15,292 warm temperature records broken (7,775 daytime, 7,517 nighttime)
  – Warmest March ever for 25 states

• In Michigan, mean March temperature was 6.9°C, which was 7.6°C warmer than normal and 1.8°C warmer than the previous record (1945)
  – A new all-time record for warmest temp ever in March, 32.2°C at Lapeer on the 21st.
  – Individual days where mean temp was more than 20°C above normal
Precipitation
SOUTH BEND, INDIANA

Accumulated Observed: thick line
Accumulated Normal: thin line

Daily Observed
Period Total: 34.1 inches: 866.9 mm
Deficit: 4.7 inches: 119.7 mm

Data updated through 08 DEC 2012

CLIMATE PREDICTION CENTER/NCEP
2012 Drought

- Due to prolonged dryness and much warmer than normal temperatures, drought conditions developed across large portions of the continental USA during the spring and early summer of 2012.
  - The drought was associated with a persistent upper air ridging pattern across central sections of the USA
  - As of July 16, 56.0 percent of the contiguous U.S. experienced drought conditions, the largest percentage since 1956.
  - Crop commodity prices rose rapidly to record or near record levels.
  - Preliminary damage estimates at $50 billion (on a national basis).
  - As of late August, the USDA has designated 1,297 counties across 29 states as federal disaster areas.
Upper Air Pattern Associated with 2012 Drought
The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

http://droughtmonitor.unl.edu/
SOUTH BEND, INDIANA

Daily Average and Normal Temperatures

31-Day Running Mean of Daily Temperature Departures

Green Line depicts mean departure for the period: 2.20°C

Daily Maximum (red) and Minimum (blue) Temperatures

Data updated through 08 DEC 2012

CLIMATE PREDICTION CENTER/NCEP
Accumulated ET, PET
JAN 1 – NOV 30, 2012
East Lansing, MI

Cumulative ET and PET (in)

Month

Jan
Mar
May
Jul
Sep
Nov

0
5
10
15
20
25
30
35

2012
Normal
Plant Available Soil Moisture
Top 5 Feet, Silty Clay, E. Lansing, MI
JAN 1 – OCT 31, 2012

Soil Moisture (in)
Month
Jan
Mar
May
Jul

Top 12” of Profile
Historical and Projected Monthly Lake Levels
Lakes Michigan-Huron
Historical Trends
Mean Temperatures vs. Year, Michigan
1895-2012*

* Data through NOV 2012, assumes normal temperatures during DEC 2012
# Seasonal Changes in Mean Temperature
1895-2010 (ºF/year)

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<th>Annual</th>
<th>Winter</th>
<th>Spring</th>
<th>Summer</th>
<th>Fall</th>
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<tr>
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<tr>
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<tr>
<td>Reg. Avg.</td>
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<td>0.012</td>
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Relatively greater changes in winter, spring.
Figure 10. Time series of annual averaged ice area for the Great Lakes. From Wang et al. (2010).
Great Lakes Region (32°F threshold)

Frost-Free Season (days from normal)

Year


Spring
Fall
Length

Annual Precipitation vs. Year, Michigan
1895-2012*

* Data through NOV 2012, assumes normal total during DEC 2012
Frequency of Wet Days and Wet/Wet Days

Caro, MI

1930-2010
Mean fraction of annual precipitation derived from 10 wettest days
1971-2000

Trend in sum of the top-10 wettest days in a year (%/decade)
1901-2000

(Pryor et al., 2009)
The frequency of water stress is declining and occurring earlier in the year.

(Source: Pollyea, no date)
Future Projections
Projected Temperature Changes

Hayhoe et al (2010)
Region projected to become wetter, largely as a result of increasing cold season precipitation

Source: (IPCC, 2007)
Projected Change in North American Precipitation by 2080-2099

Winter
Spring
Summer
Fall

Percent Change

Less Precipitation

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

http://droughtmonitor.unl.edu/
Figure 6. Forecasts of sea surface temperature (SST) anomalies for the Niño 3.4 region (5°N-5°S, 120°W-170°W). Figure courtesy of the International Research Institute (IRI) for Climate and Society. Figure updated 13 November 2012.
Other Winter Weather Outlooks
U.S. Seasonal Drought Outlook
Drought Tendency During the Valid Period
Valid for December 6, 2012 - February 28, 2013
Released December 6, 2012

KEY:
- Drought to persist or intensify
- Drought ongoing, some improvement
- Drought likely to improve, impacts ease
- Drought development likely

Depicts large-scale trends based on subjectively derived probabilities guided by short- and long-range statistical and dynamical forecasts. Short-term events such as individual storms cannot be accurately forecast more than a few days in advance. Use caution for applications such as crops that can be affected by such events.

“Ongoing” drought areas are approximated from the Drought Monitor (D1 to D4 intensity). For weekly drought updates, see the latest U.S. Drought Monitor. NOTE: the green improvement areas imply at least a 1-category improvement in the Drought Monitor intensity levels, but do not necessarily imply drought elimination.
Impacts of Climatic Variability

While only a small fraction of the total number of observations, extreme events are responsible for a significant portion of impacts on human and natural ecosystems.
Weather Anomaly or Climate Change?

• It is very difficult to distinguish anthropogenic signal from natural variability
• Ultimately, the physical processes and mechanisms responsible for weather and climate are the same
• Changes in the frequency of some extremes are consistent with long term trends
• Recent extremes are also generally consistent with future climate projections
• The recent weather extremes and climate change are likely not mutually exclusive: “...Although global warming is likely playing a role in this event, it probably did not play a major one. Meteorology, not climate change, is the main ingredient in the March 2012 U.S. extreme warmth”. Of climate change, he said, “... its contribution to the magnitude of current conditions (+30°F departures [from average]) is quite small (but not zero) indeed.” Marty Hoerling (NOAA ESRL)
Summary

- Extreme weather conditions during 2012 were consistent with some historical trends (e.g. warmer spring temperatures) while differing from others (summer drought).
- Overall, Michigan has become warmer and wetter during the past few decades, with warming of about 2.0ºF has occurred between 1980 and the present.
- Much of the recent warming has occurred during the cold season, leading to less ice cover on the Great Lakes and an earlier spring warm-up.
- Annual precipitation rates increased from the 1930’s through the present, due to both more wet days and more heavy precipitation events.
- Most recent GCM simulations of the Great Lakes region suggest a warmer and wetter climate in the distant future, with much of the additional precipitation coming during the cold season months.
- With warming temperatures, PET and crop water needs will likely increase with time.
Questions?