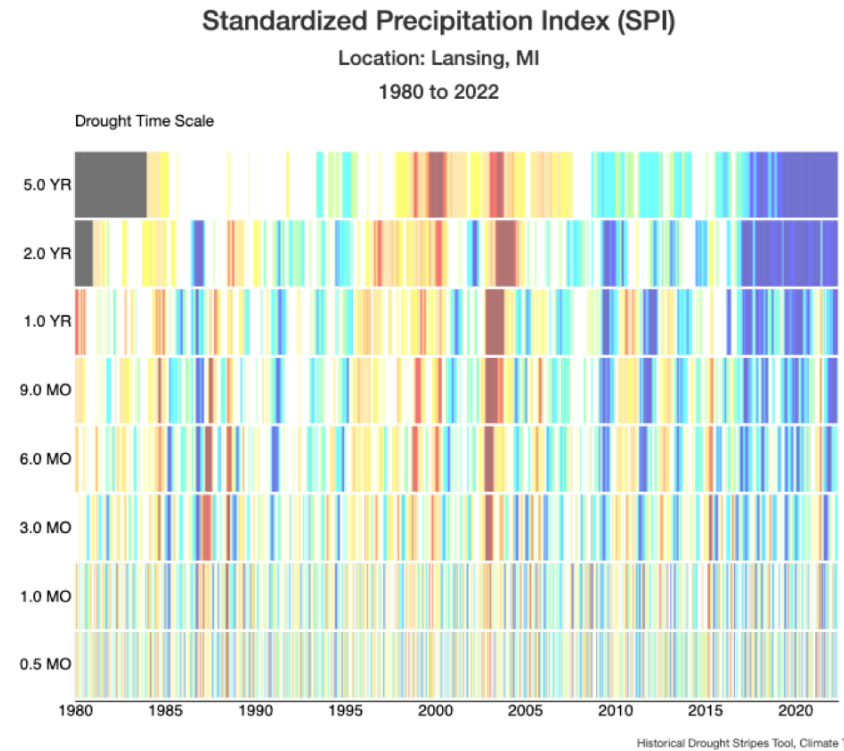
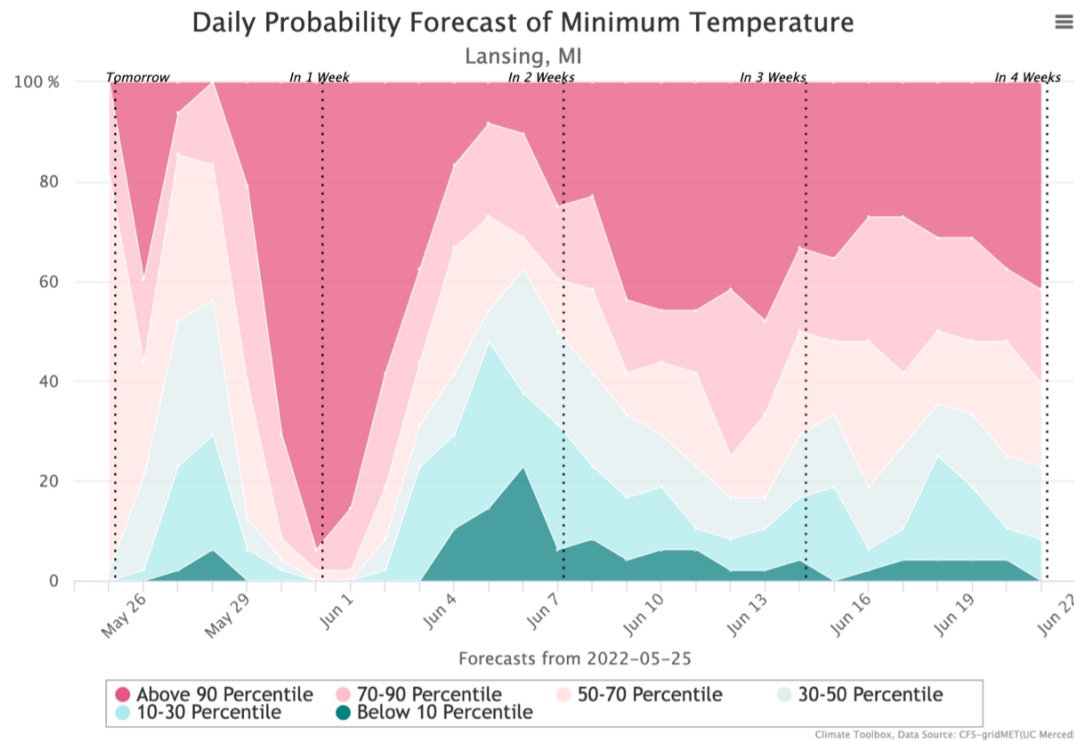


The Climate Toolbox's Subseasonal Forecast & Drought Stripes tools



Katherine Hegewisch
University of California Merced



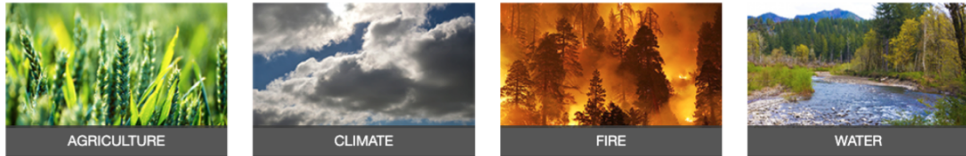
The Climate Toolbox

A collection of web tools for visualizing past and projected climate and hydrology of the contiguous United States of America.



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A collection of tools for addressing questions relating to Agriculture, Climate, Fire Conditions, and Water.



Tools

Variable Lookup
Find which tools in the Climate Toolbox have a certain variable

[Launch Tool](#)

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Maps of Future hardiness and crop suitability zones projections

[Launch Tool](#)

Future Crop Suitability
Map of future crop suitability and projections for a location

[Launch Tool](#)

The Climate Toolbox

ClimateToolbox.org

Drought Stripes Documentation Cite Tool Take Tour

Historical Drought Stripes

View past periods of short and long term drought for a location in the contiguous USA.
Location: Moscow, ID (46.7324° N, 117.0002° W)

Choose Location -

Select a point location to view data averaged over a 2.5 square mile grid cell.

[CHOOSE LOCATION](#)

Choose Data -

Drought Metric: ?

A standardized measure of the deviation of total precipitation (accumulated over a time scale) from the mean value, in units of standard deviations. SPI>0 indicates above normal precipitation (wetness/wet).

Drought Time Scale: ?

Short Term	Long Term
60.0 MONTH	61.0 YEAR
61.0 MONTH	62.0 YEAR
63.0 MONTH	65.0 YEAR
66.0 MONTH	

[MODIFY STRIPES](#)

Download Options -

Download table: [DOWNLOAD STRIPES](#)

Download chart: [DOWNLOAD CHART](#)

Download data: [DOWNLOAD DATA](#)

Choose Year Range for Stripes Figure -

Year Range: to

Choose Date for Chart -

Date:

Standardized Precipitation Index (SPI)
Location: 46.7324 N, 117.0002 W
1980 to 2021

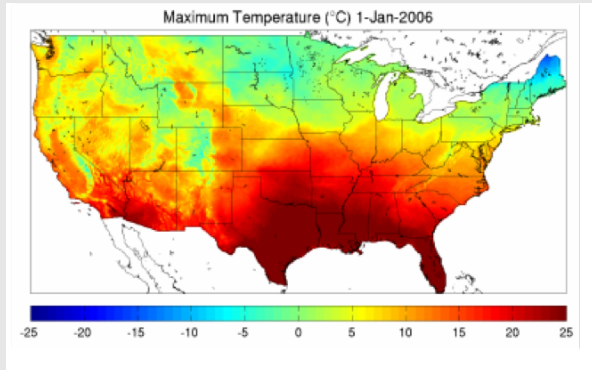
Standardized Precipitation Index (SPI)
Location: 46.7324 N, 117.0002 W
2021-10-17

Exceptional Wet
Extremes Wet
Severely Wet
Moderate Wet
Abnormal Wet
Neutral
Abnormal Dry
Moderate Drought
Severely Drought
Extreme Drought
Exceptional Drought

USDM Colors/Thresholds

Climate Toolbox - Data

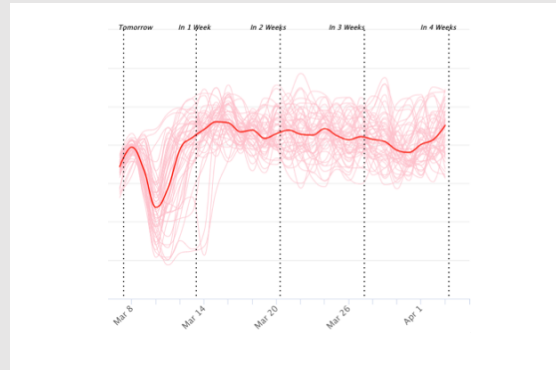
Past/Real-Time



gridMET historical data

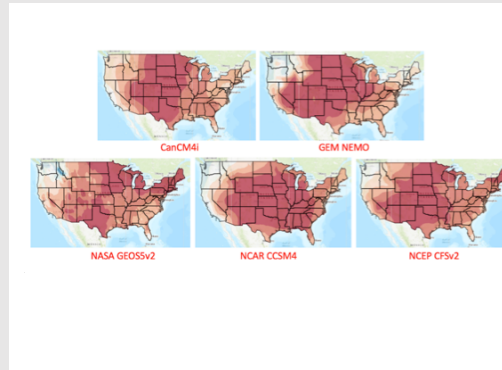
- Blend of satellite/ground station daily data from NLDAS2/PRISM
- Jan 1, 1979- Yesterday
- 2.5 mile grid cells
- Contiguous USA

Forecasts



CFSv2 - gridMET forecast data

- Daily forecasts from NOAA's CFSv2
- Forecasts for next 28 days
- 48 ensemble members



NMME - gridMET forecast data

- Monthly forecasts from NOAA's NMME
- Forecasts for next 7 months
- 5 climate models

Future Projections



CMIP5 – MACA- gridMET future projection data

- Daily projections from IPCC's CMIP5
- Projections for 2020-2100
- 20 climate models
- 2 future scenarios (RCP4.5/8.5)

All data bias corrected to gridMET (2.5 mile grid cells, contiguous USA)

Toolbox - Data

Climate Metrics



- Temperature
- Precipitation
- Humidity
- Wind
- Radiation

Agriculture/Ecology Metrics



- First Fall & Last Spring Freeze
- Growing Degree Days
- Chill hours
- Palmer Drought Severity Index

Water Metrics



- Soil moisture
- Total moisture
- Snow water equivalent
- Runoff
- Streamflow

Fire Danger Metrics



- Energy Release Component
- 100-hr Fuel Moisture
- Vapor Pressure Deficit

Drought Stripes Tool

- Time series of wet & dry periods
- Different types of drought
- Short & long term times scales
- Same thresholds/colors as USDM
- Locations within CONUS

Climate Toolbox APPLICATIONS TOOLS DATA VIDEOS CASE STUDIES TOOL SUMMARIES GUIDANCE NEWS CONTACT

Historical Drought Stripes

View past periods of short and long term drought for a location in the contiguous USA.
Location: Lansing, MI (42.7325° N, 84.5555° W)

Choose Location -
Select a point location to view data averaged over a 2.5 square mile grid cell. [CHOOSE LOCATION](#)

Download Options -
Download table: [DOWNLOAD STRIPES](#)
Download chart: [DOWNLOAD CHART](#)
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A standardized measure of the deviation of total precipitation (accumulated over a time scale) from the mean value, in units of standard deviations, where values are usually from -5 to 5. SPI>0 indicates above normal precipitation (wetness/wet). SPI<0 indicates below normal precipitation which are levels of meteorological drought.
Drought Time Scale:
Short Term: 0.5 MONTH, 1.0 MONTH, 3.0 MONTH, 6.0 MONTH
Long Term: 9.0 MONTH, 1.0 YEAR, 2.0 YEAR, 5.0 YEAR
[MODIFY STRIPES](#)

Choose Year Range for Stripes Figure -
Year Range: to

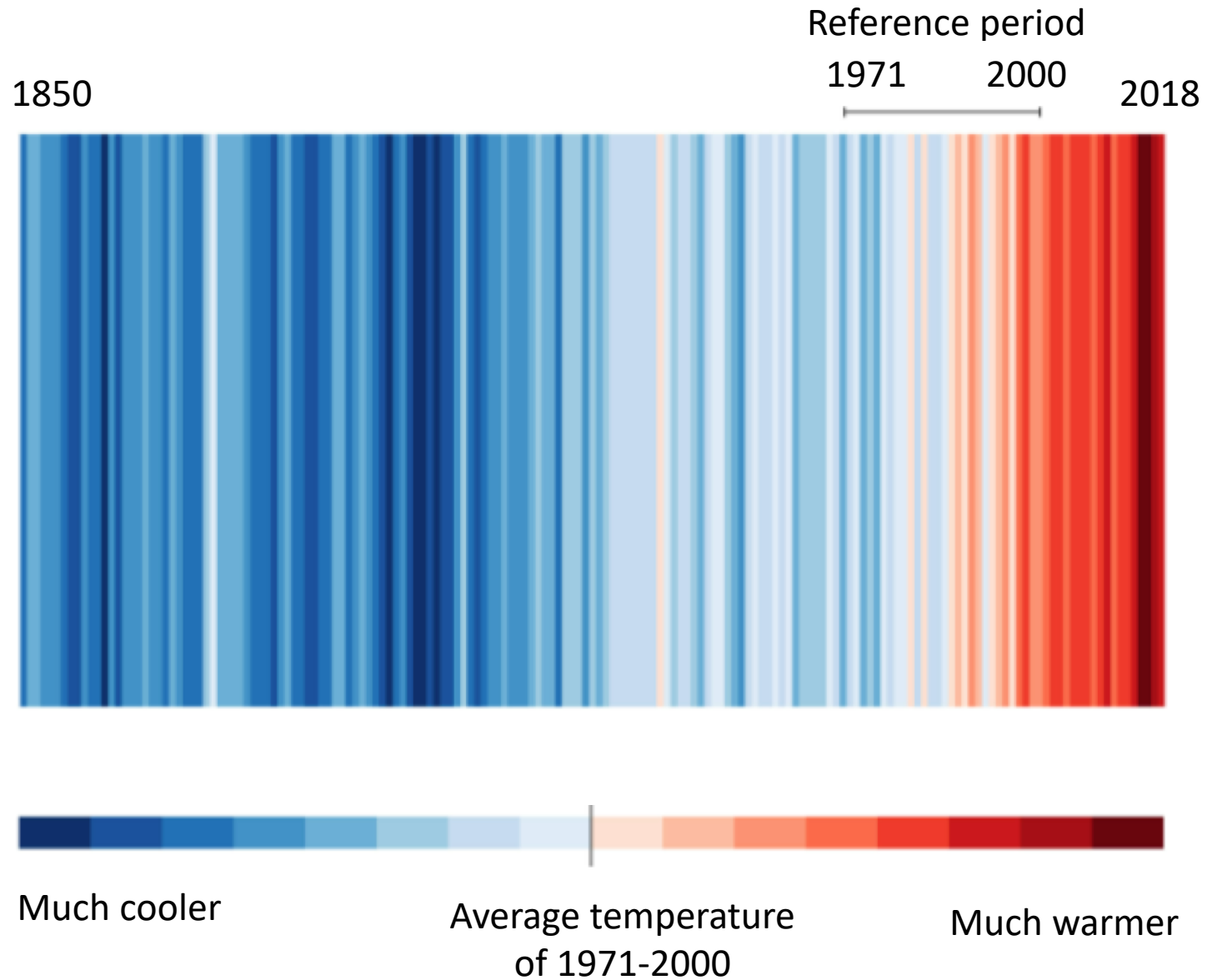
Choose Date for Chart -
Date:

Standardized Precipitation Index (SPI)
Location: Lansing, MI
1980 to 2022

Standardized Precipitation Index (SPI)
Location: Lansing, MI
2022-05-20

5.0 YR SPI: Exceptional Wet
2.0 YR SPI: Exceptional Wet
1.0 YR SPI: Exceptional Wet
9.0 MO SPI: Moderate Wet
6.0 MO SPI: Moderate Wet
3.0 MO SPI: Moderate Wet
1.0 MO SPI: Neutral
0.5 MO SPI: Neutral

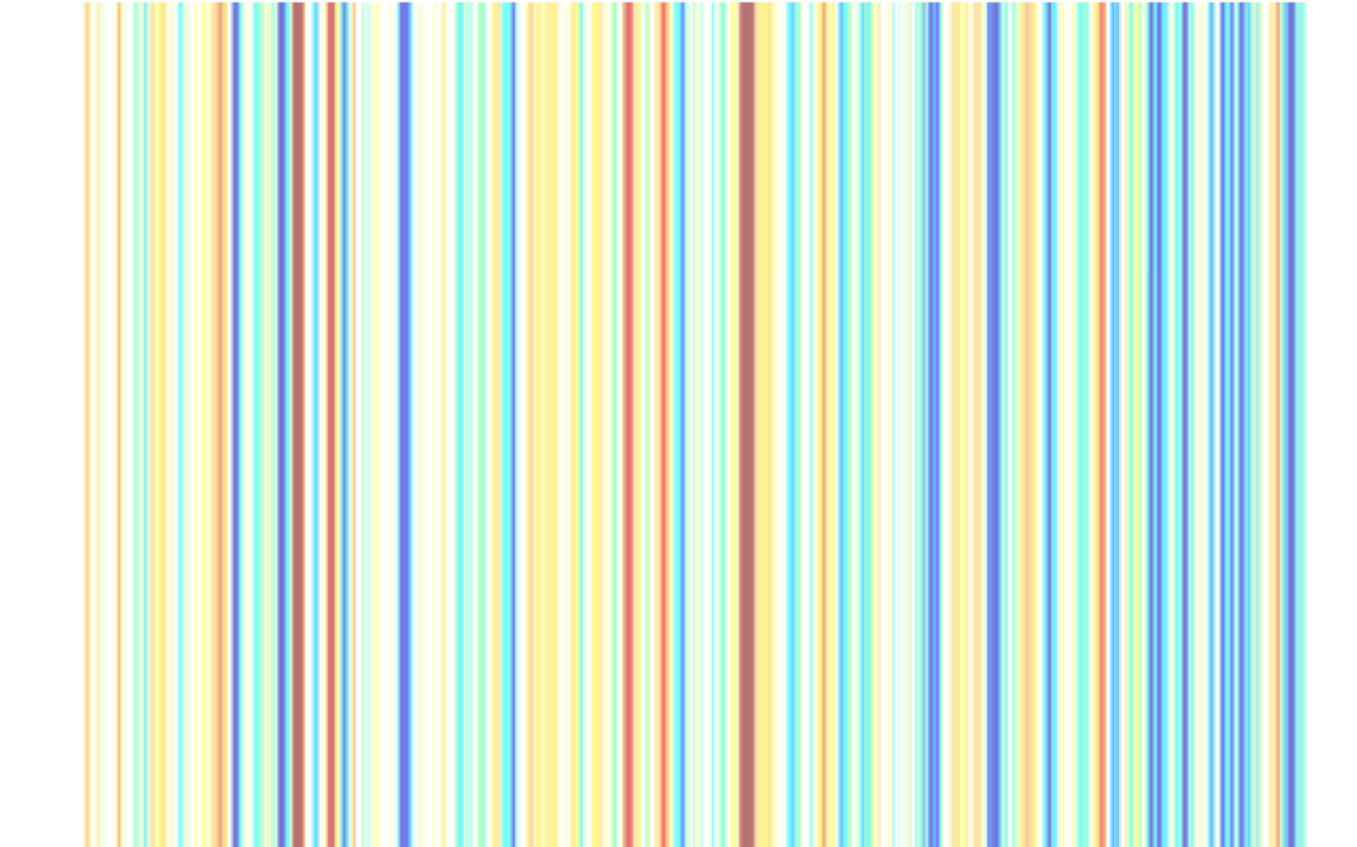
Climate Stripes by Edward Hawkins



Drought Stripes

1980

2022



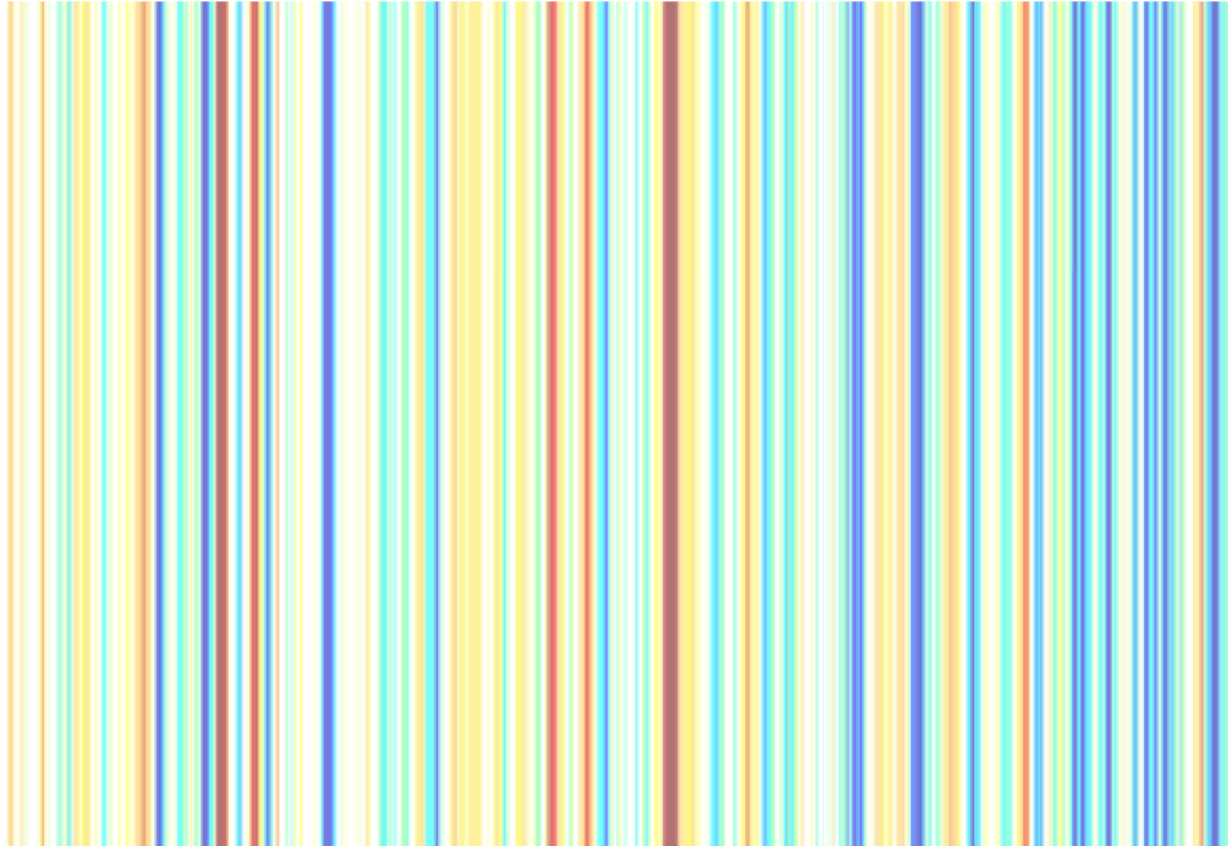
Much dryer

Average conditions
for 1980-2015

Much wetter

Drought Stripes Example

1980 2022



Much dryer

Average conditions
for 1980-2015

Much wetter

Location

Lansing, MI

Definition of Drought

Precipitation (Meteorological Drought)

Time Scale

6-month

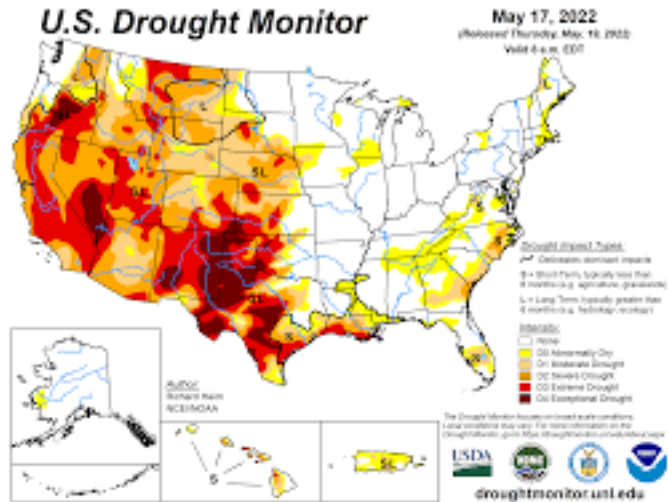
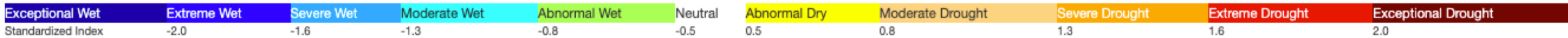
Deviations from Average

Standardized Precipitation Index (SPI)
(or 6-month SPI)

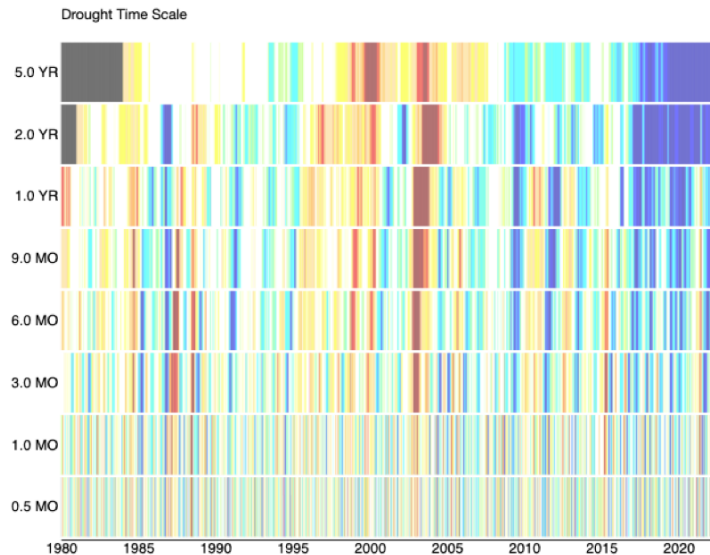
Colors

US Drought Monitor

Colors and Drought Classification



Drought Stripes



Standardized Index Z Classification

Standardized Index Z	Classification	Category
$-2.0 \leq Z$	Exceptional Drought	D4
$-1.6 \leq Z < -2.0$	Extreme Drought	D3
$-1.3 \leq Z < -1.6$	Severe Drought	D2
$-0.8 \leq Z < -1.3$	Moderate Drought	D1
$-0.5 \leq Z < -0.8$	Abnormally Dry	D0
$-0.5 \leq Z < 0.5$	Neutral	N
$0.5 \leq Z < 0.8$	Abnormally Wet	W0
$0.8 \leq Z < 1.3$	Moderate Wet	W1
$1.3 \leq Z < 1.6$	Severe Wet	W2
$1.6 \leq Z < 2.0$	Extreme Wet	W3
$2.0 \leq Z$	Exceptional Wet	W4

Drought Metrics

Drought Metrics and Timescales

Variable	Drought Index Z or percentile	Source
Precipitation (PPT)	Standardized Precipitation Index (SPI)	gridMET (Abatzoglou)
Potential Evapotranspiration (PET)	Evaporative Drought Demand Index (EDDI) (a Standardized Potential Evapotranspiration Index)	gridMET (Abatzoglou)
Climatic Water Balance (PPT-PET)	Standardized Precipitation Evapotranspiration Index (SPEI)	gridMET (Abatzoglou)
Soil Moisture	Soil Moisture Percentile	VIC-ACIS (UCLA)
Palmer Drought Severity Index	Palmer Drought Severity Index	gridMET (Abatzoglou)
Palmer Z Index	Palmer Z Index	gridMET (Abatzoglou)
Total Runoff (Coming Soon)	Standardized Runoff Index (SRI)	VIC-ACIS (UCLA)

Timescales

Short Term Drought

2- weeks
1-month

3-months
6-months

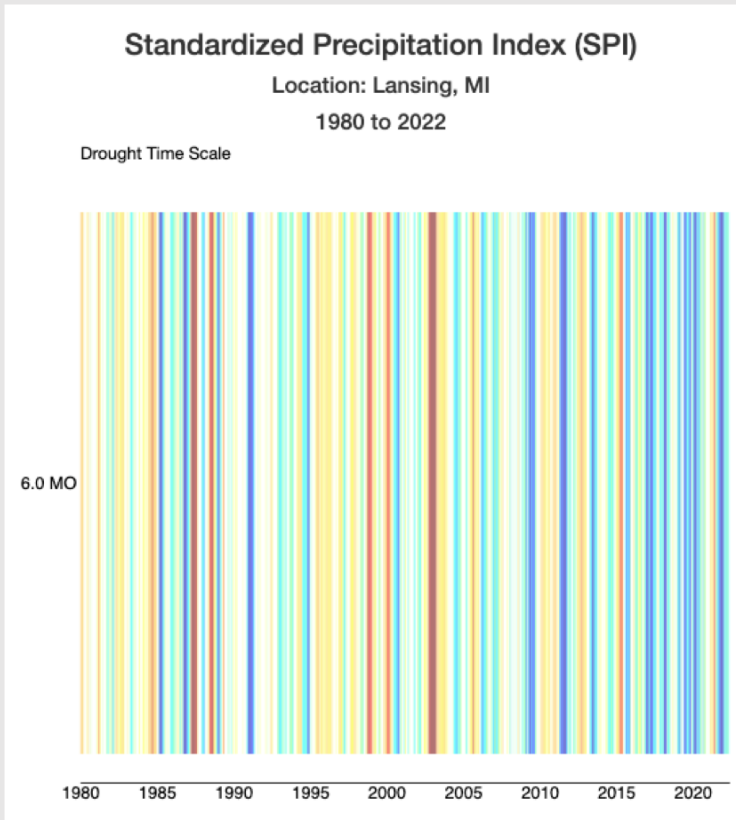
Long Term Drought

9-months
12-months

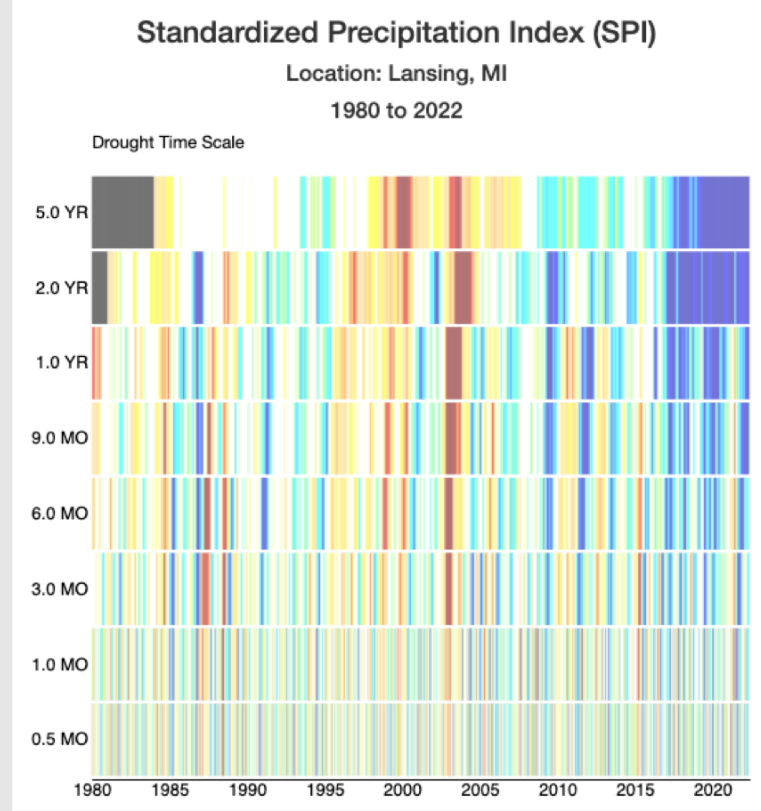
2-years
5-years

Visualizations

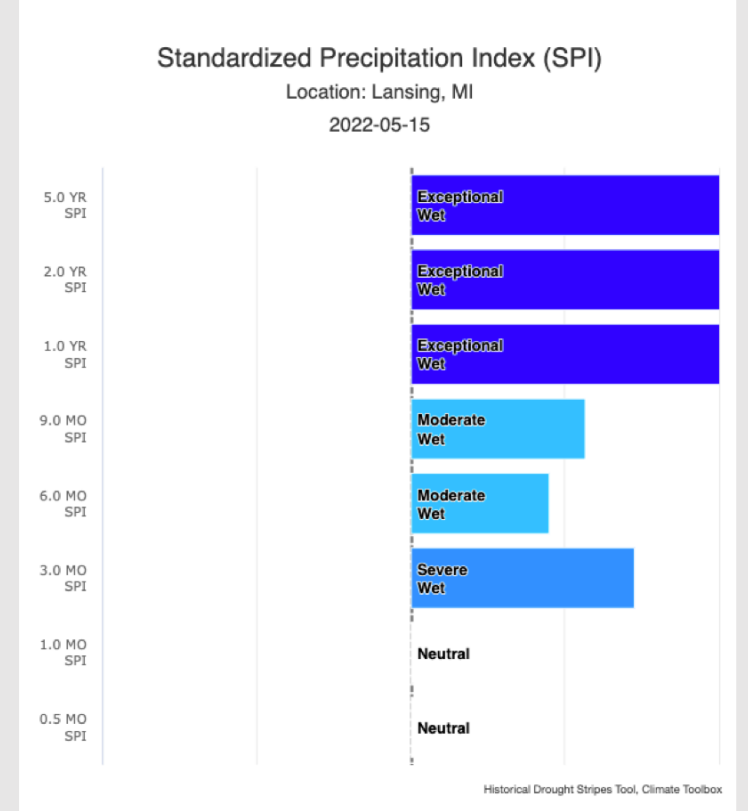
Single Stripes



Stacked Stripes



Time Slice



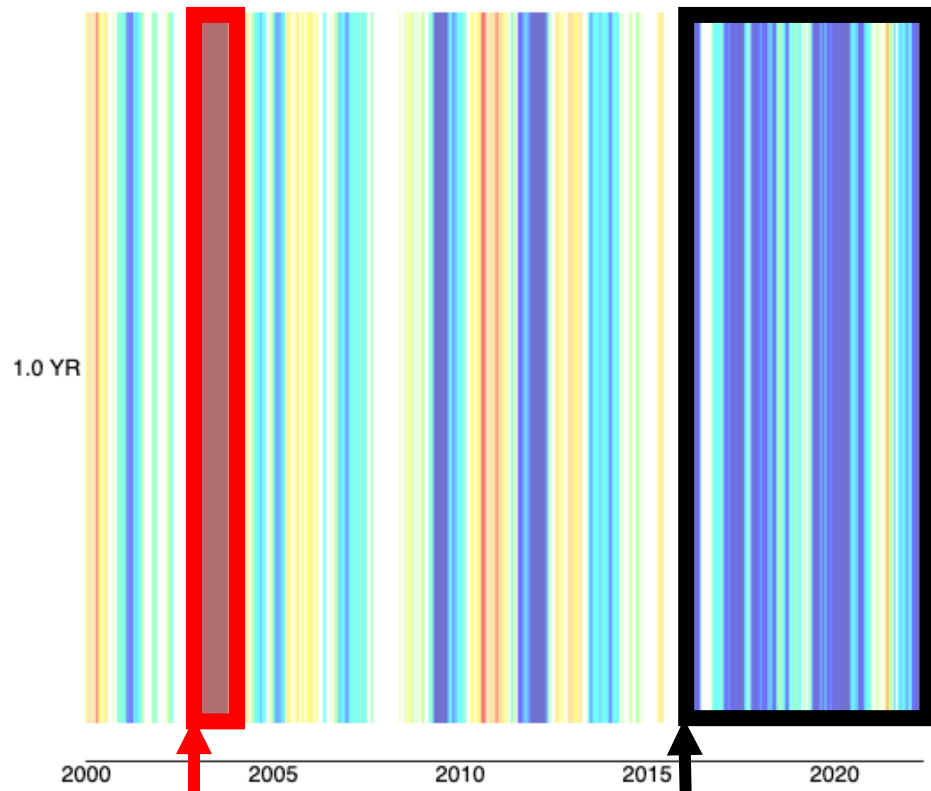
Drought (and Wet) Intensity

Standardized Precipitation Index (SPI)

Location: Lansing, MI

2000 to 2022

Drought Time Scale



2002
MidWest Drought

2016-2021
Multiple Floods

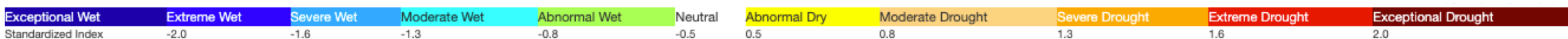
Lansing, MI

2002 Exceptional Drought

2016-2021 Exceptional Wet



Jun 2021 flooding in Michigan



Drought (and Wet) Duration

Lansing, MI

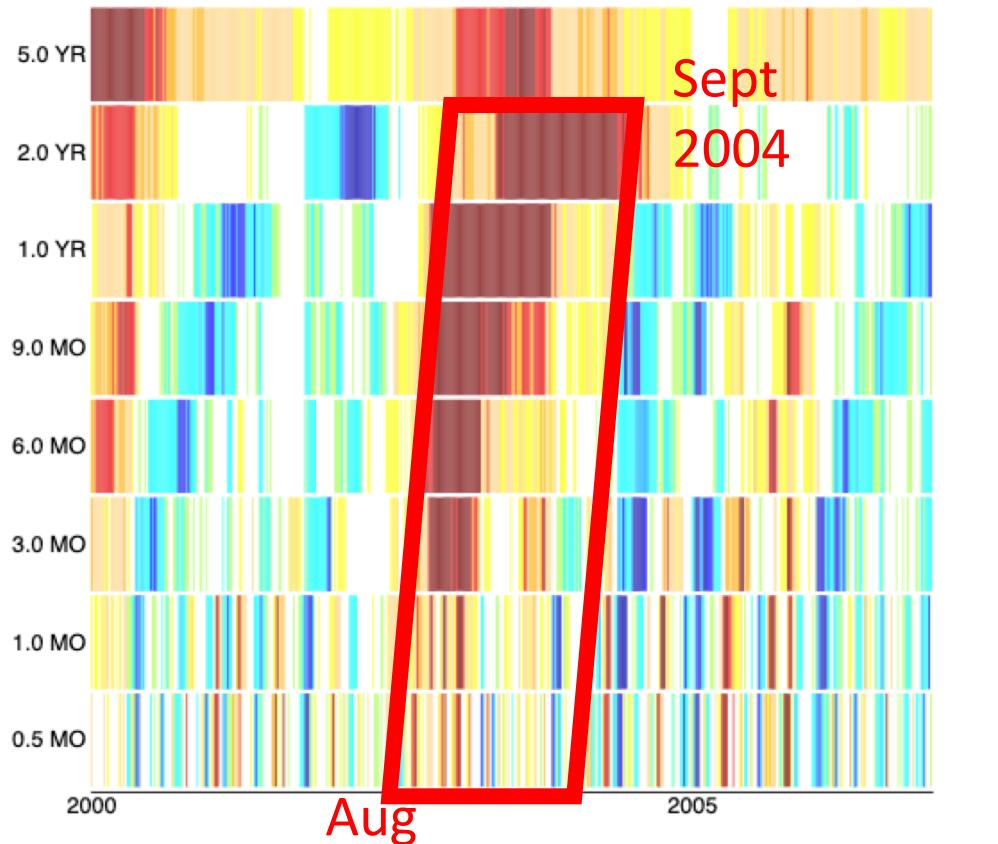
How Long have Big Droughts Lasted in Lansing, Michigan?

Standardized Precipitation Index (SPI)

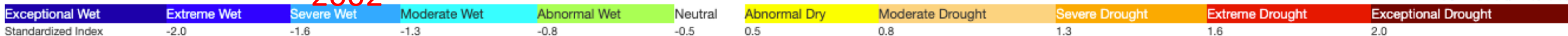
Location: Lansing, MI

2000 to 2006

Drought Time Scale



2002-2004
Exceptional Meteorological Drought
Duration = 2 years



Drought (and Wet) Frequency

Lansing, MI

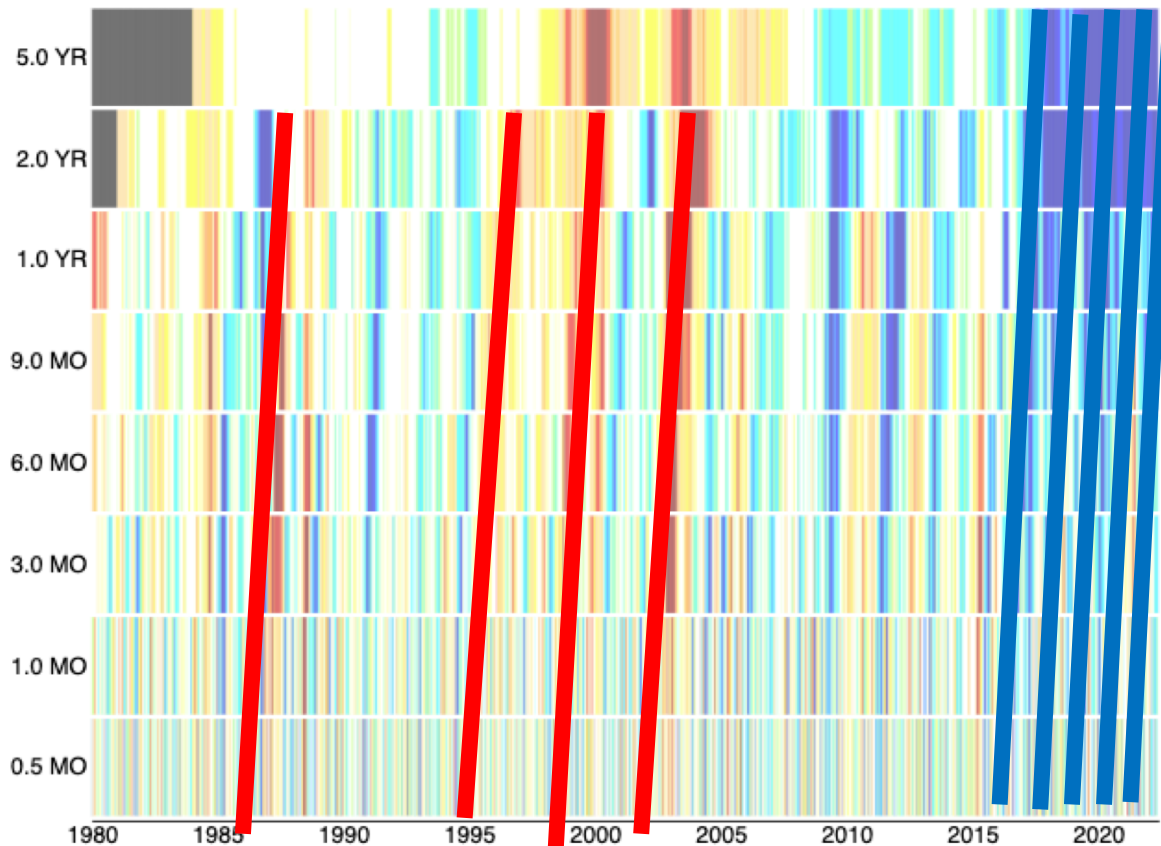
How Often Have Droughts Been Happening in Lansing, Michigan?

Standardized Precipitation Index (SPI)

Location: Lansing, MI

1980 to 2022

Drought Time Scale



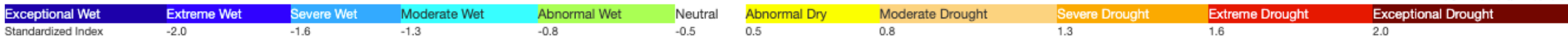
Lansing used to experience droughts more often (i.e. every 3-5 years from 1995-2005).

Currently Lansing is in a 5-year exceptional wet period.

— Extreme to Exceptional Droughts

— Extreme to Exceptional Wet

Historical Drought Stripes Tool, Climate Toolbox



Drought (and Wet) Flavors

Lansing, MI

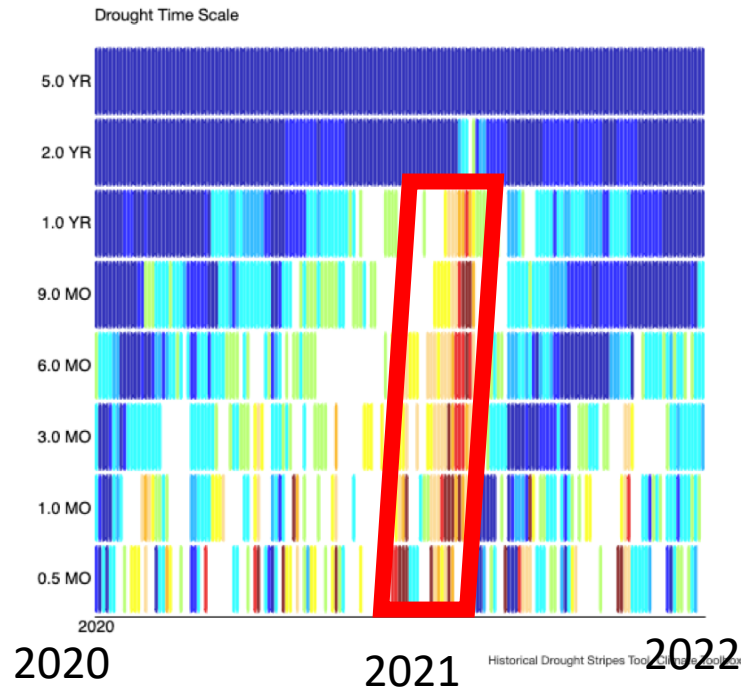
Precipitation

Potential Evaporation

Water Balance

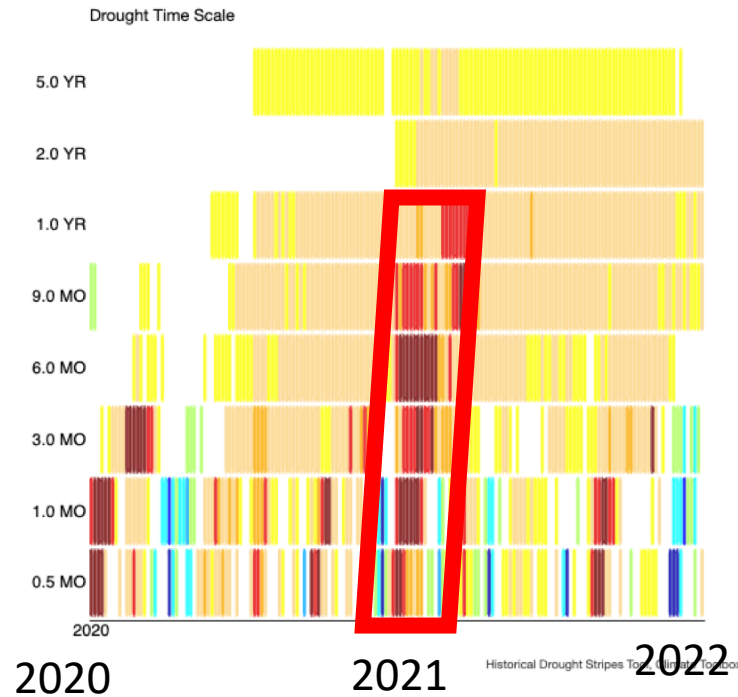
Standardized Precipitation Index (SPI)

Location: Lansing, MI
2020 to 2022



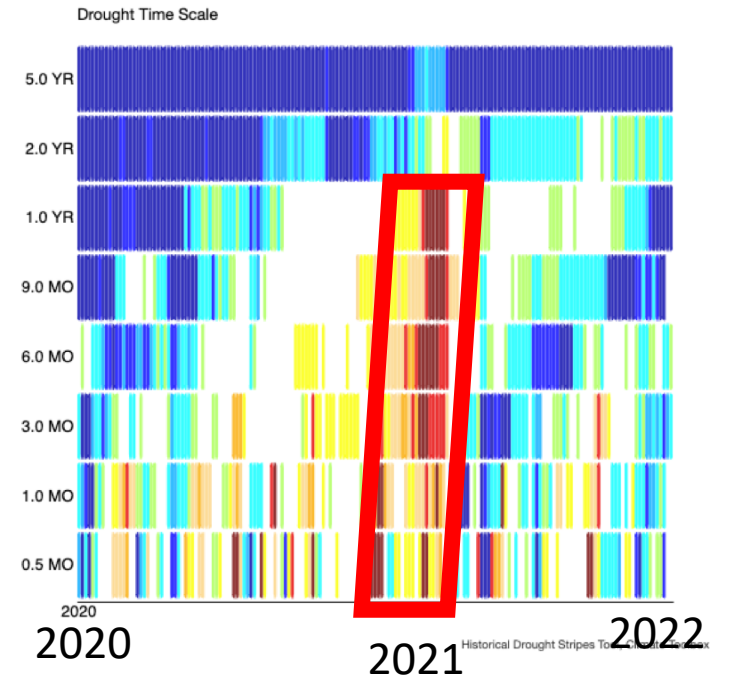
Evaporative Drought Demand Index (EDDI)

Location: Lansing, MI
2020 to 2022



Standardized Precipitation Evapotranspiration Index (SPEI)

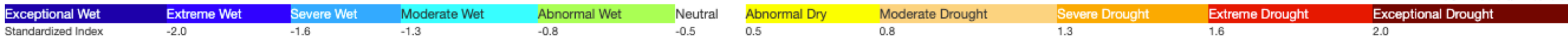
Location: Lansing, MI
2020 to 2022



2021 Low Spring Precipitation AND High Spring Temperatures



Low Water Availability for Lansing Crops (Alfalfa/Corn)



Historical Drought Stripes

View past periods of short and long term drought for a location in the contiguous USA.

Location: Lansing, MI (42.7325° N, 84.5555° W)

Choose Location-

Select a point location to view data averaged over a 2.5 square mile grid cell.

CHOOSE LOCATION

Download Options-

Download table:

DOWNLOAD STRIPES

Download chart:

DOWNLOAD CHART

Download data:

DOWNLOAD DATA

Choose Data-

Drought Metric: ?

SPI: Standardized Precipitation Index

A standardized measure of the deviation of total precipitation (accumulated over a time scale) from the mean value, in units of standard deviations, where values are usually from -5 to 5. SPI>0 indicates above normal precipitation (wetness/wet). SPI<0 indicates below normal precipitation which are levels of meteorological drought.

Drought Time Scale: ?

Short Term

0.5 MONTH

1.0 MONTH

3.0 MONTH

6.0 MONTH

Long Term

9.0 MONTH

1.0 YEAR

2.0 YEAR

5.0 YEAR

MODIFY STRIPES

Choose Year Range for Stripes Figure-

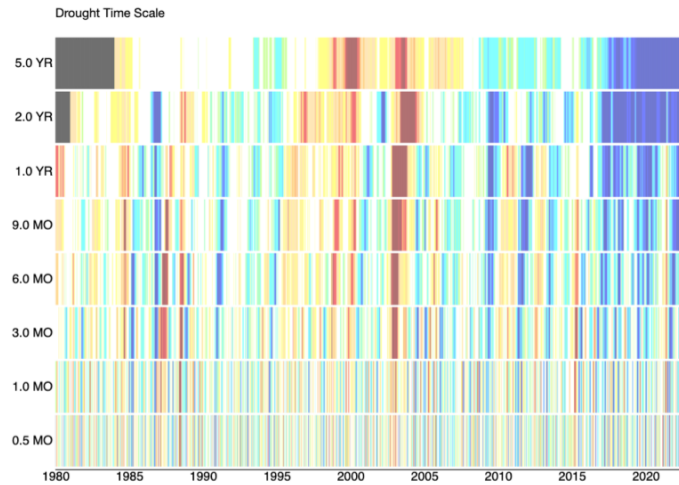
Year Range: 1980 to 2022

Choose Date for Chart-

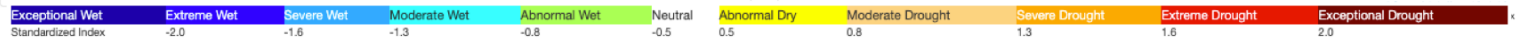
Date: 2022-05-20

Standardized Precipitation Index (SPI)

Location: Lansing, MI
1980 to 2022

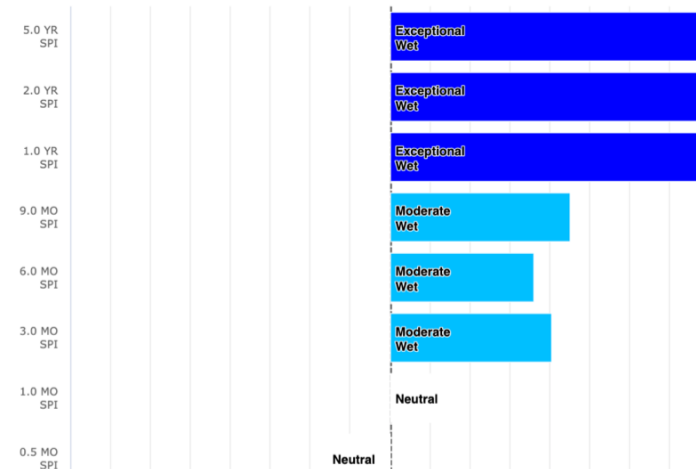


Historical Drought Stripes Tool, Climate Toolbox



Standardized Precipitation Index (SPI)

Location: Lansing, MI
2022-05-20



Summary

- The Drought Stripes tool depicts past wet and dry conditions for a location as a time series of colors.
- The Drought Stripes tool can be customized for a location, for a type of drought and for short or long term drought time scales.
- The Drought Stripes tool uses the same thresholds and colors as the US Drought Monitor.
- The Drought Stripes tool can be used to explore the past drought intensity, duration and frequency of a location.

Drought Stripes Tool at

<https://climatetoolbox.org/tool/historical-drought-stripes>

Subseasonal Forecast Tool

- 48 forecasts for next 28 days
- Variables for:
 - Temperature
 - Precipitation
 - Potential Evapotranspiration
 - Fire Danger
- Locations within CONUS

Subseasonal Forecasts

View 48 experimental climate forecasts for a location in the contiguous U.S..

Location: Lansing, MI (42.7325° N, 84.5555° W)

Choose Location -

Select a point location to view data averaged over a 2.5 square mile grid cell.

[CHOOSE LOCATION](#)

Choose Data -

Variable: Units:

Choose Analysis -

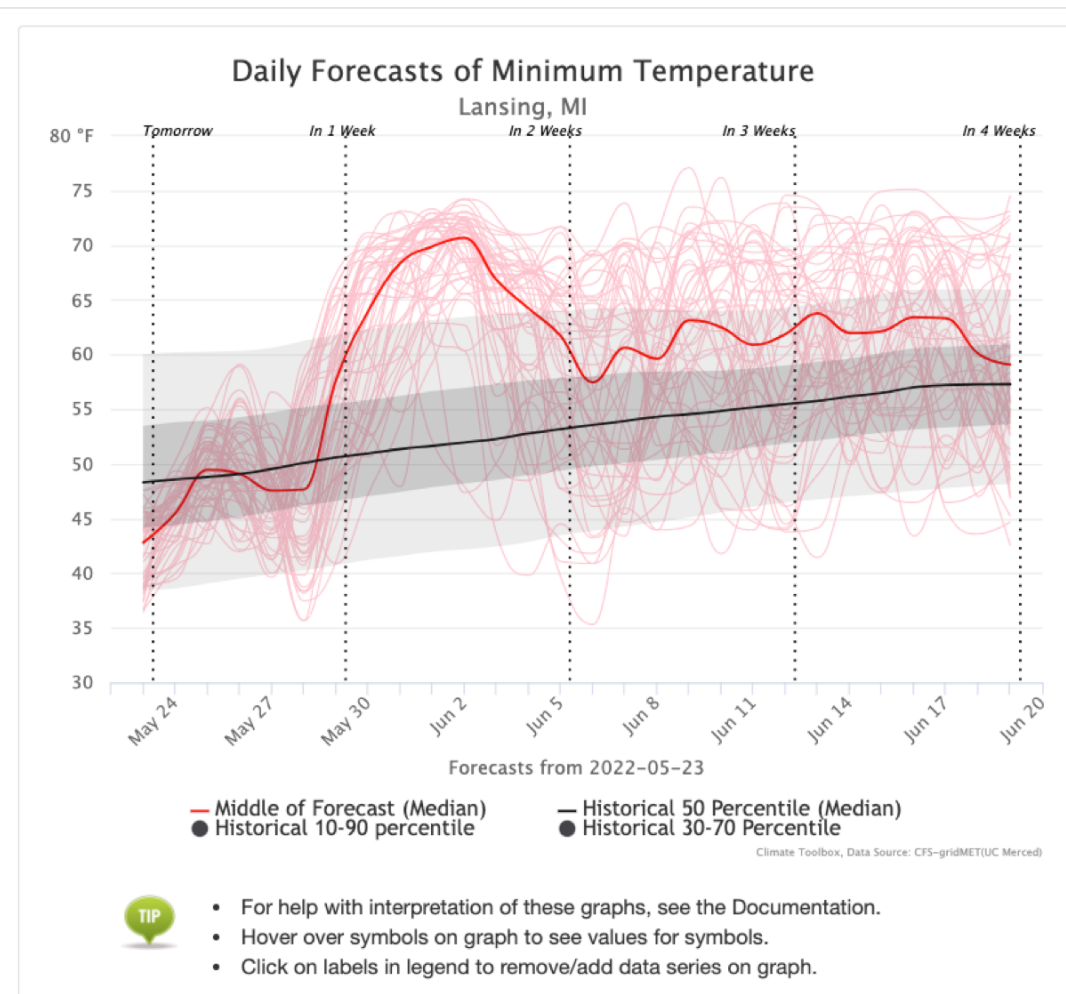
Show Graph of:

- Daily Forecasts
- Daily Categorical Forecasts
- Weekly Forecasts and Skill

Historical Percentiles: [?](#)

- 10,30,50,70,90 (Daily percentiles)

Download -



Forecast Data

Raw Data: NCEI CFSv2 Operational Forecasts (2011-Present)

- 6-hourly data at 00, 06, 12, 18UTC timeseries out 30 days
- 12 ensemble runs
- Min/max temperature, precipitation, specific humidity, wind, radiation

48 ensemble forecasts created from:

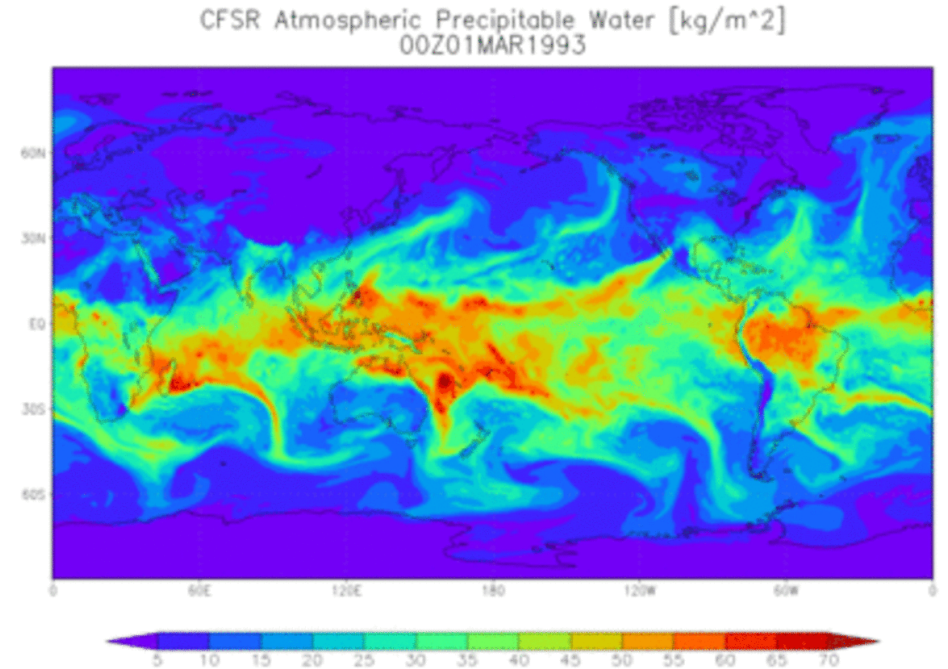
- 4 ensemble runs each hour
- 4 six-hour time series each day
- 3 last days of forecasts

Statistical downscaling

Forecasts are bias corrected and downscaled from ½-deg to 4-km resolution utilizing the gridMET historical dataset (1979-2015).

Fire Danger Modeling: National Fire Danger Rating System

Energy Release Component, Burning Index
100-hr fuel moisture



Daily Forecasts

Subseasonal Forecasts

View 48 experimental climate forecasts for a location in the contiguous U.S..

Location: [Lansing, MI \(42.7325° N, 84.5555° W\)](#)

Choose Location ▾

Select a point location to view data averaged over a 2.5 square mile grid cell.

[CHOOSE LOCATION](#)

Choose Data ▾

Variable:
Maximum Temperature ▾

Units: °F ▾

Choose Analysis ▾

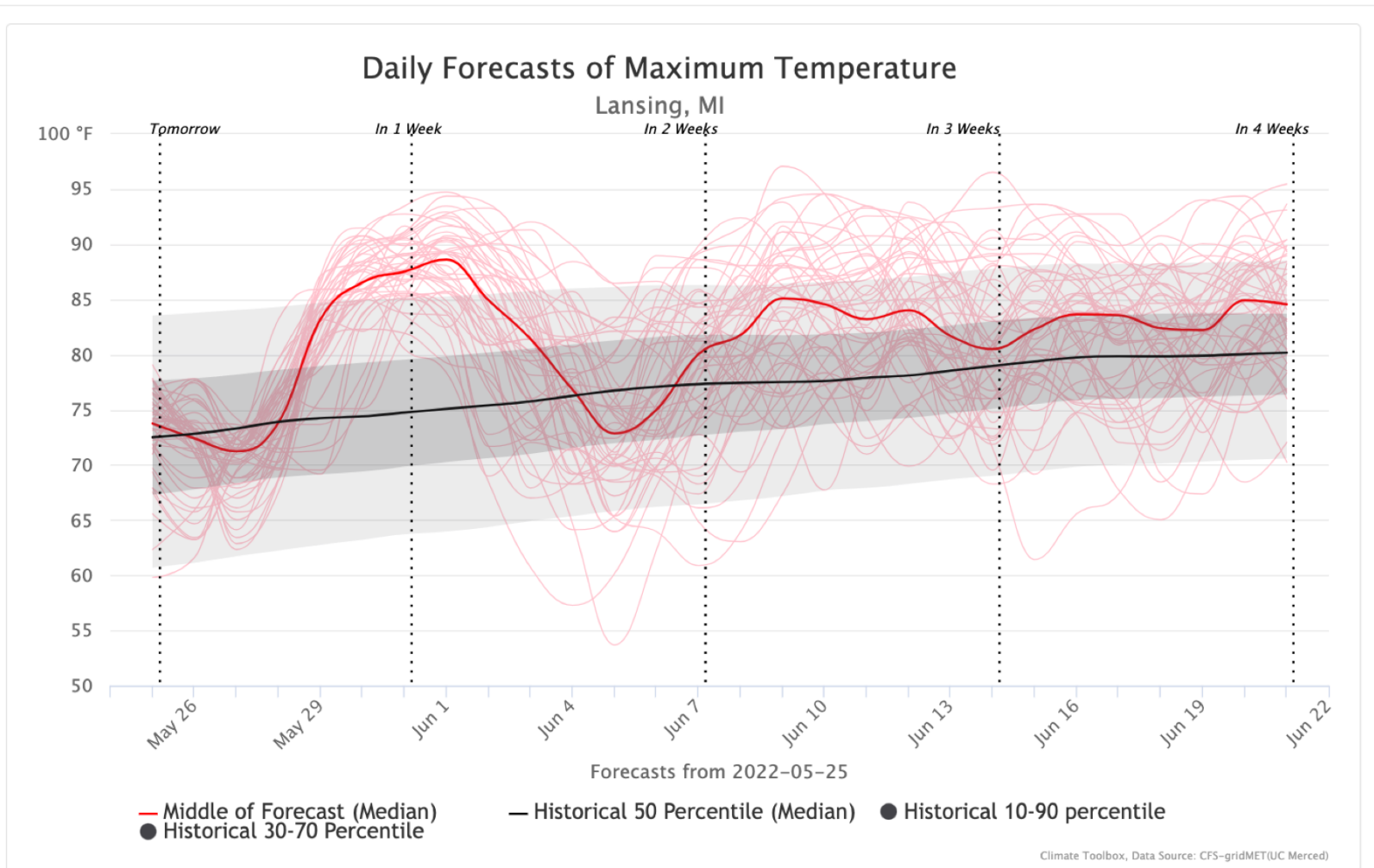
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Historical Percentiles: [?](#)

- 10,30,50,70,90 (Daily percentiles)

Download ▾



Weekly Forecast

[Documentation](#) [Cite Tool](#) [Take Tour](#)

Subseasonal Forecasts

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Location: [Lansing, MI \(42.7325° N, 84.5555° W\)](#)

Choose Location -

Select a point location to view data averaged over a 2.5 square mile grid cell.

CHOOSE LOCATION

Choose Data -

Variable:

Cumulative Precipitation (from Tomorrow) ▾

Units: inches ▾

Choose Analysis -

Show Graph of:

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- Weekly Forecasts and Skill

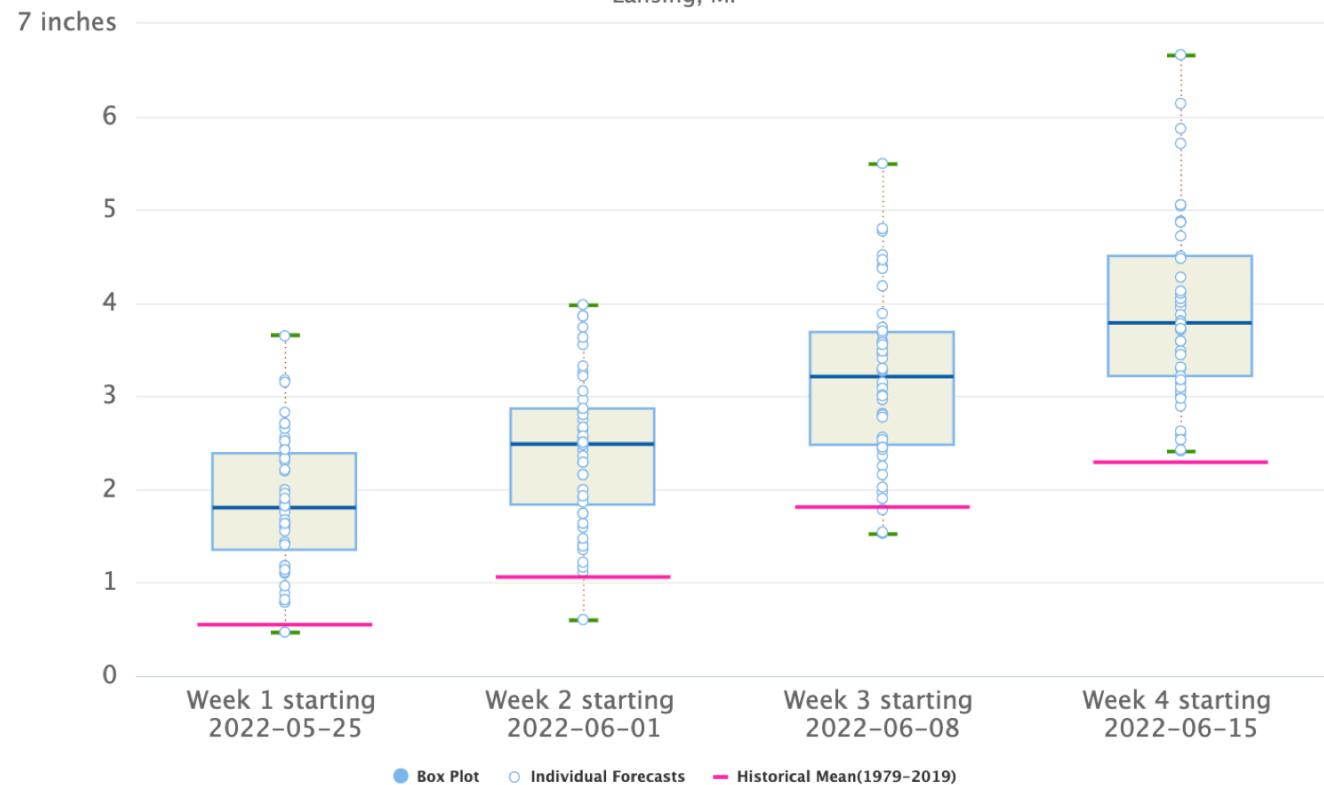
Historical Percentiles: ?

- 10,30,50,70,90 (Daily percentiles)

Download -

Weekly Forecast of Cumulative Precipitation from 2022-05-25

Lansing, MI



Climate Toolbox, Data Source: CFS-gridMET (UC Merced)

Forecast Skill ?

	Week 1	Week 2	Week 3	Week 4
Skill	Low	None	None	None
Correlation r	0.28	0.18	-0.01	0.07

Choose Location ▾

Select a point location to view data averaged over a 2.5 square mile grid cell.

CHOOSE LOCATION

Choose Data ▾

Variable:
Energy Release Component ▾

Choose Analysis ▾

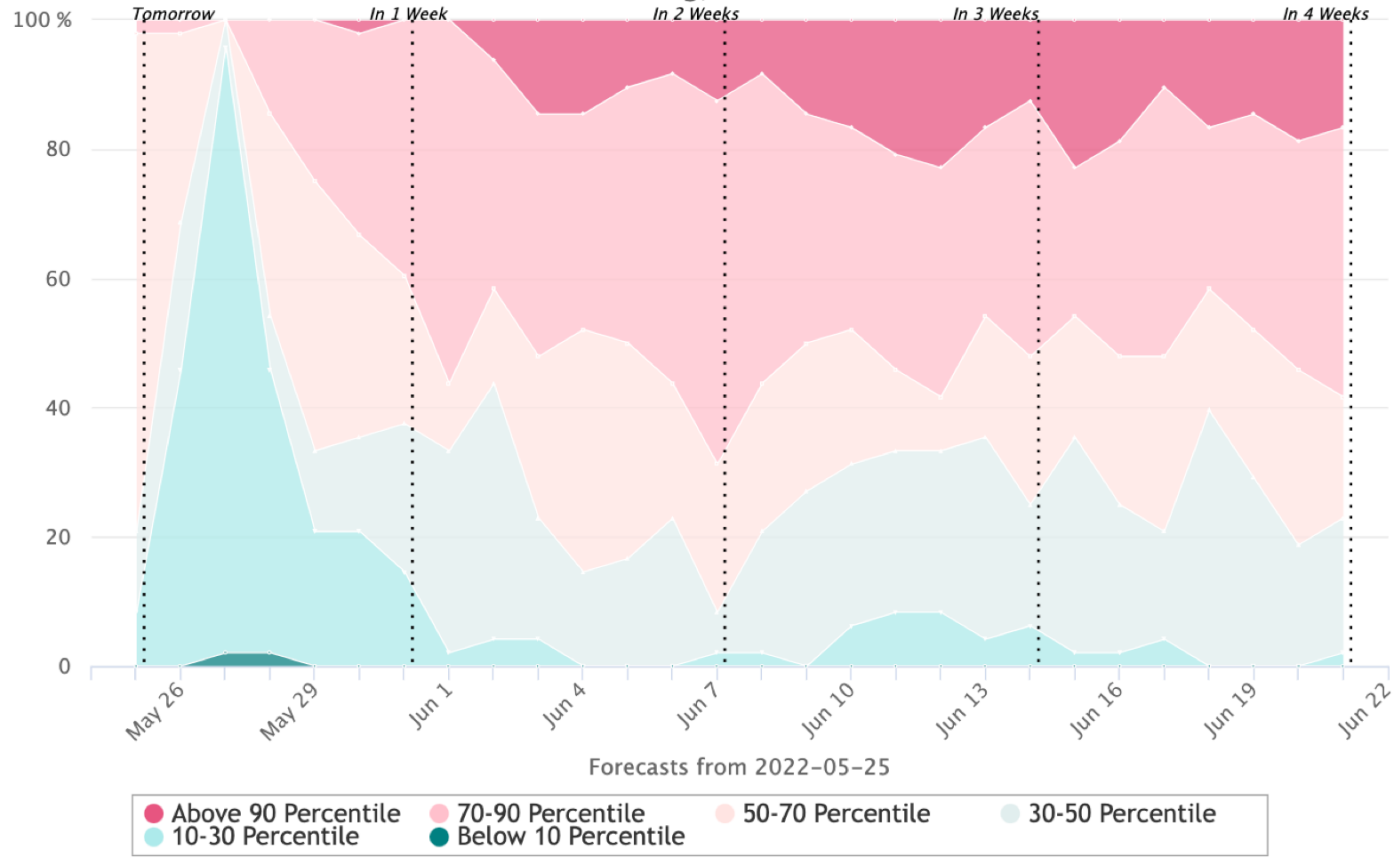
How Graph of:
 Daily Forecasts
 Daily Categorical Forecasts
 Weekly Forecasts and Skill

Historical Percentiles: [?](#)
 10,30,50,70,90 (Daily percentiles)

Download ▾

Daily Probability Forecast of Energy Release Component

Lansing, MI



Climate Toolbox, Data Source: CFS-gridMET(UC Merced)

The Climate Toolbox

A collection of web tools for visualizing past and projected climate and hydrology of the contiguous United States of America.



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A collection of tools for addressing questions relating to Agriculture, Climate, Fire Conditions, and Water.



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[Launch Tool](#)

Future Crop Suitability
Map of future crop suitability and projections for a location [i](#)

[Launch Tool](#)

The Climate Toolbox

ClimateToolbox.org

Katherine Hegewisch
 University of California Merced
khegewisch@ucmerced.edu

