

# **THE GLOBAL WIND OSCILLATION AND ITS IMPACT ON SOUTHWEST MICHIGAN SEVERE STORMS**

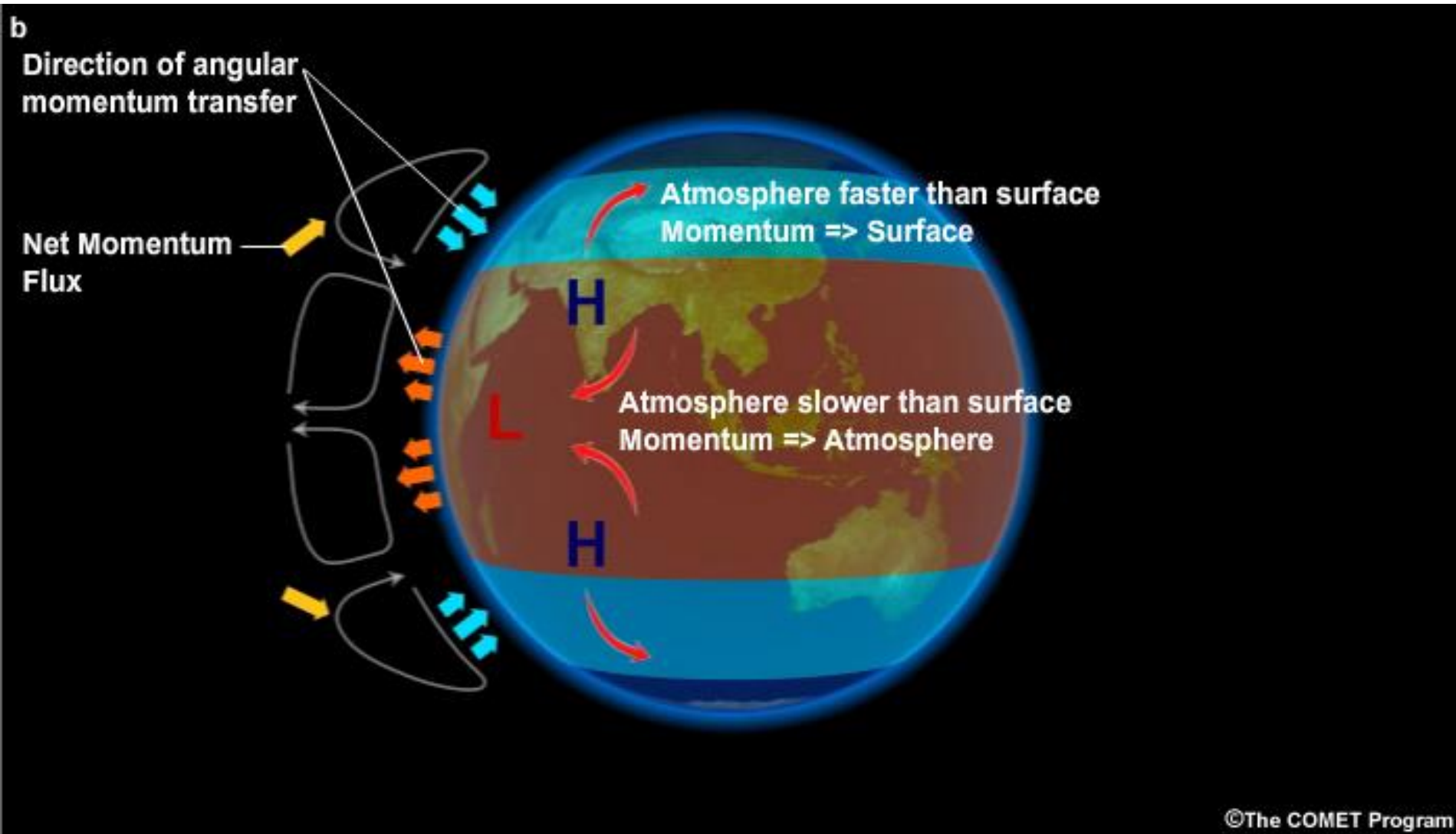
**By William Marino**

# THE GLOBAL WIND OSCILLATION AND ITS IMPACT ON SOUTHWEST MICHIGAN SEVERE STORMS

- What is the Global Wind Oscillation (GWO)
- Relating the GWO to Southwest Michigan severe storm events.
- Trends in Severe storm frequency over Southwest Lower Michigan

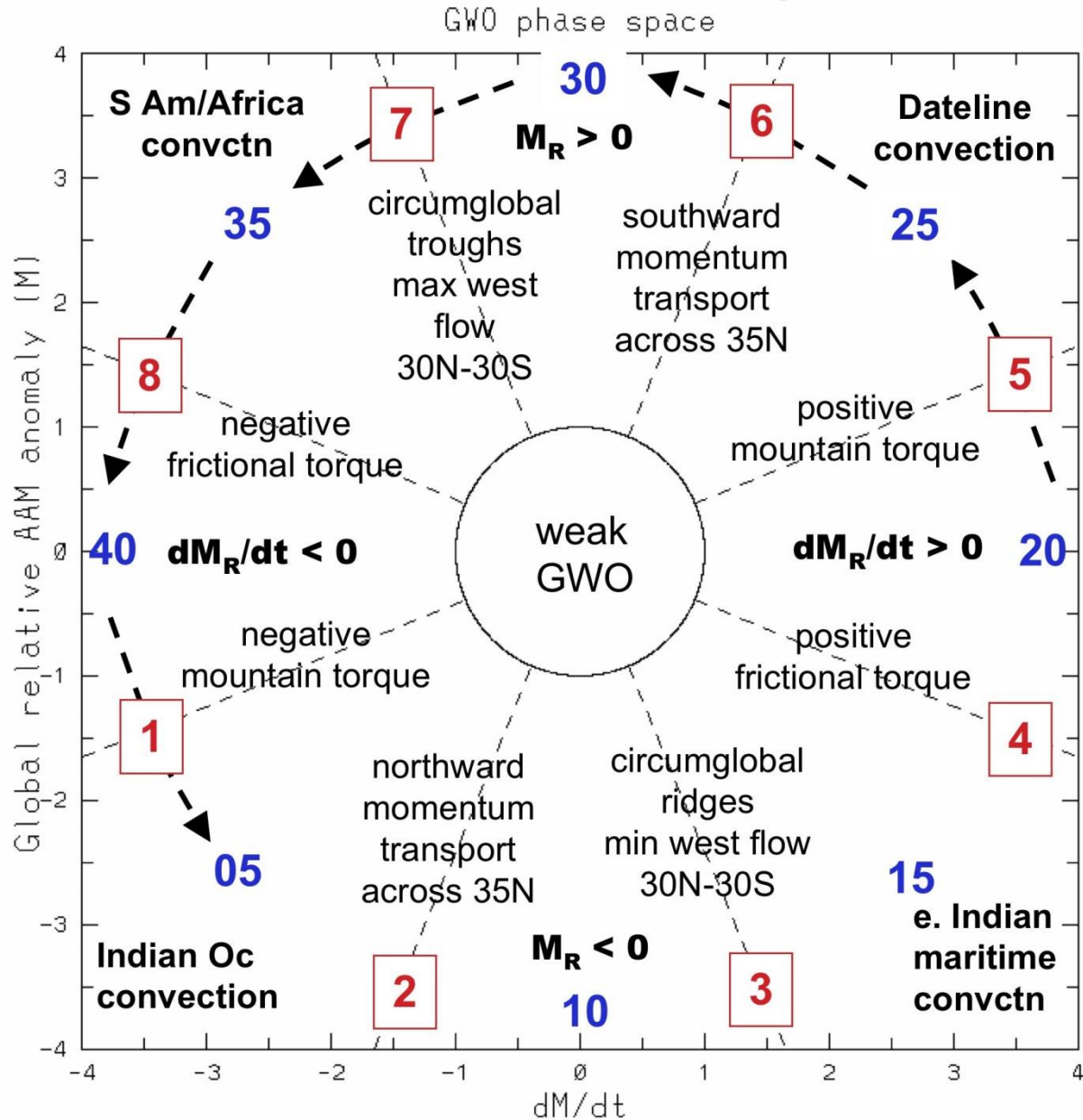
# What is the GWO?

## Atmospheric Angular Momentum (M)



# What is the GWO?

## M combined with dM/dt



# What is the GWO?

## Other Properties

- Sub-seasonal time scale
- Captures Madden-Julian Oscillation (MJO) and mid-latitude processes (e.g., troughing and ridging)
- Net easterly global wind:
  - Can occur since tropical winds are deeper and farther from rotation axis.
  - means blocking and meridional flow leading to deeper troughs and stronger jet features (typical of La Nina)
- Net westerly global wind:
  - Stronger mid-latitude flow and rapidly moving synoptic systems (typical of El Nino)

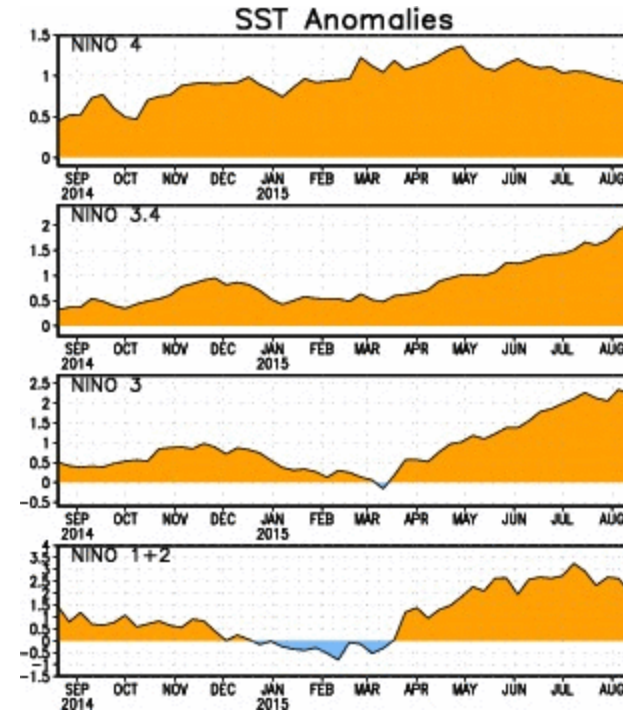
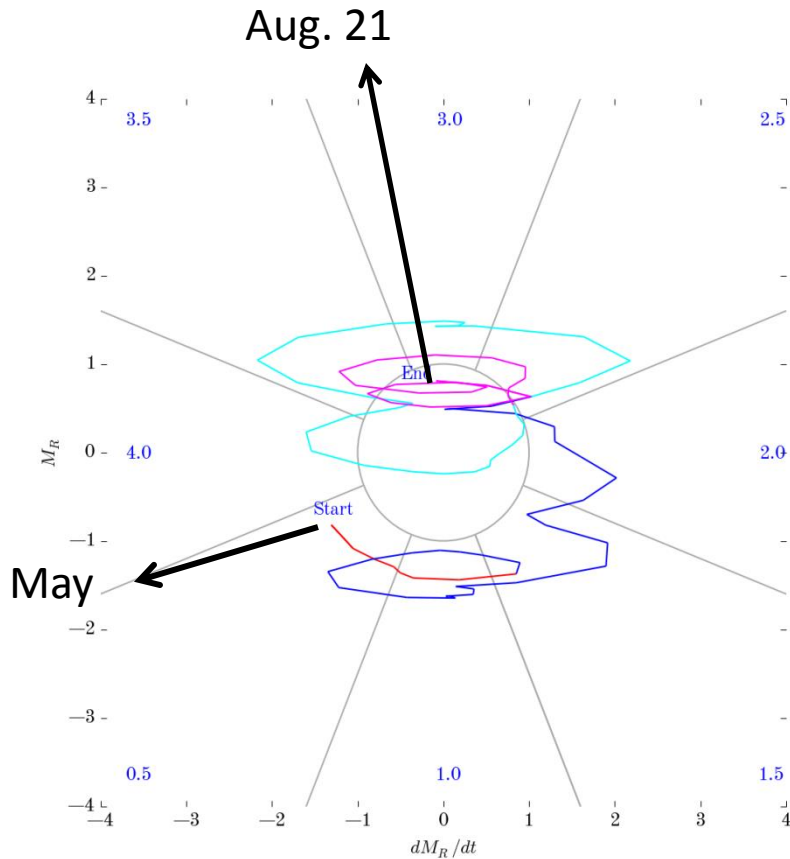


# Primary Stages of GWO

## and how this helps forecasting over CONUS

- **The four primary phases of the GWO are described below**, along with generally cold season (November-March) probable weather impacts for the USA. The GWO recurrence interval, or "time it takes to make a circuit", ranges from a broad 15-80 days. Two of the stages project strongly on El Nino and La Nina circulation states, which are also characterized by positive (Stage 3) and negative (Stage 1) global AAM anomalies, respectively. *Stages 2 and 4 are transitional.*
- Stage 1 (*La-Nina like*) – **the global relative AAM anomaly is negative**. The negative anomaly is primarily due to easterly upper level wind anomalies that extend from the *Eastern Hemisphere* tropics to the *Western Hemisphere* mid-latitudes. A retracted Pacific Ocean jet stream is a key feature in the total field. *Troughs are probable across the western USA with a ridge over the southeast. High impact weather is favored across the Plains.*
- Stage 2 – **the global relative AAM tendency is positive**. This means that negative AAM is being removed from the atmosphere by surface friction and mountains. At the same time, westerly wind anomalies are intensifying in equatorial regions of the *Western Hemisphere*. Fast Rossby wave dispersion events in both hemispheres are a coherent feature of *this stage and Stage 4*. *A cold regime is probable across the central USA.*
- Stage 3 (*El-Nino like*) – **the global relative AAM anomaly is positive**. Westerly wind anomalies move into the *Eastern Hemisphere*, broaden in latitudinal extent and link up with deep westerly flow anomalies over the mid-latitude *Western Hemisphere*. *An extended Pacific Ocean jet stream and southward shifted storm track is observed favoring high impact weather events along the USA west coast.*
- Stage 4 – **the global relative AAM tendency is negative**. Positive (westerly) AAM anomalies are being removed by surface friction in the *Western Hemisphere* mid-latitudes and through mountain torques across the Northern Hemisphere topography. The next phase of the oscillation (if there is one) is represented by easterly wind anomalies intensifying over equatorial regions of the *Western Hemisphere*. *This stage has enhanced subtropical jets and closed lows in the subtropics favoring rainfall events over the southwestern USA.*

# GWO and ENSO



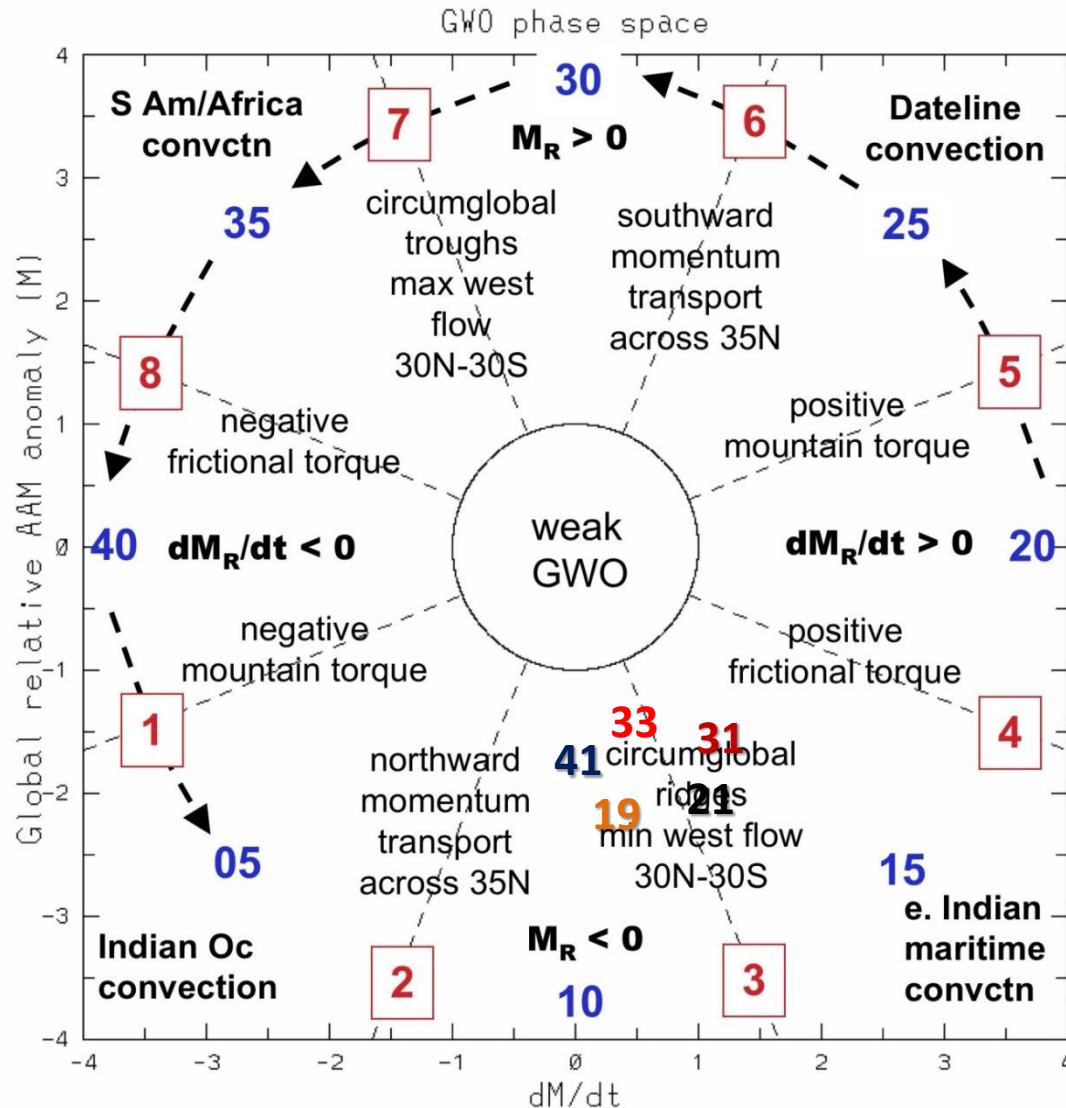
Note as our El Nino has developed over the past few months the GWO is doing as one would expect, it is becoming positive ( $M_R$ ), earlier the GWO was more La Nina like (negative  $M_R$ ). Note... El Nino = 5 consecutive months Nino 3.4  $\geq 0.5^\circ\text{C}$ , only 4 so far

# Does the GWO impact Severe Storms?

- Most of our severe events happen when the GWO is in the negative phase (deeper troughs/large ridges)
- Most severe events happen in stages  $1 > 5$
- Which is akin to a Nina type atmospheric circulation.
- The GWO has the greatest impact from March through June



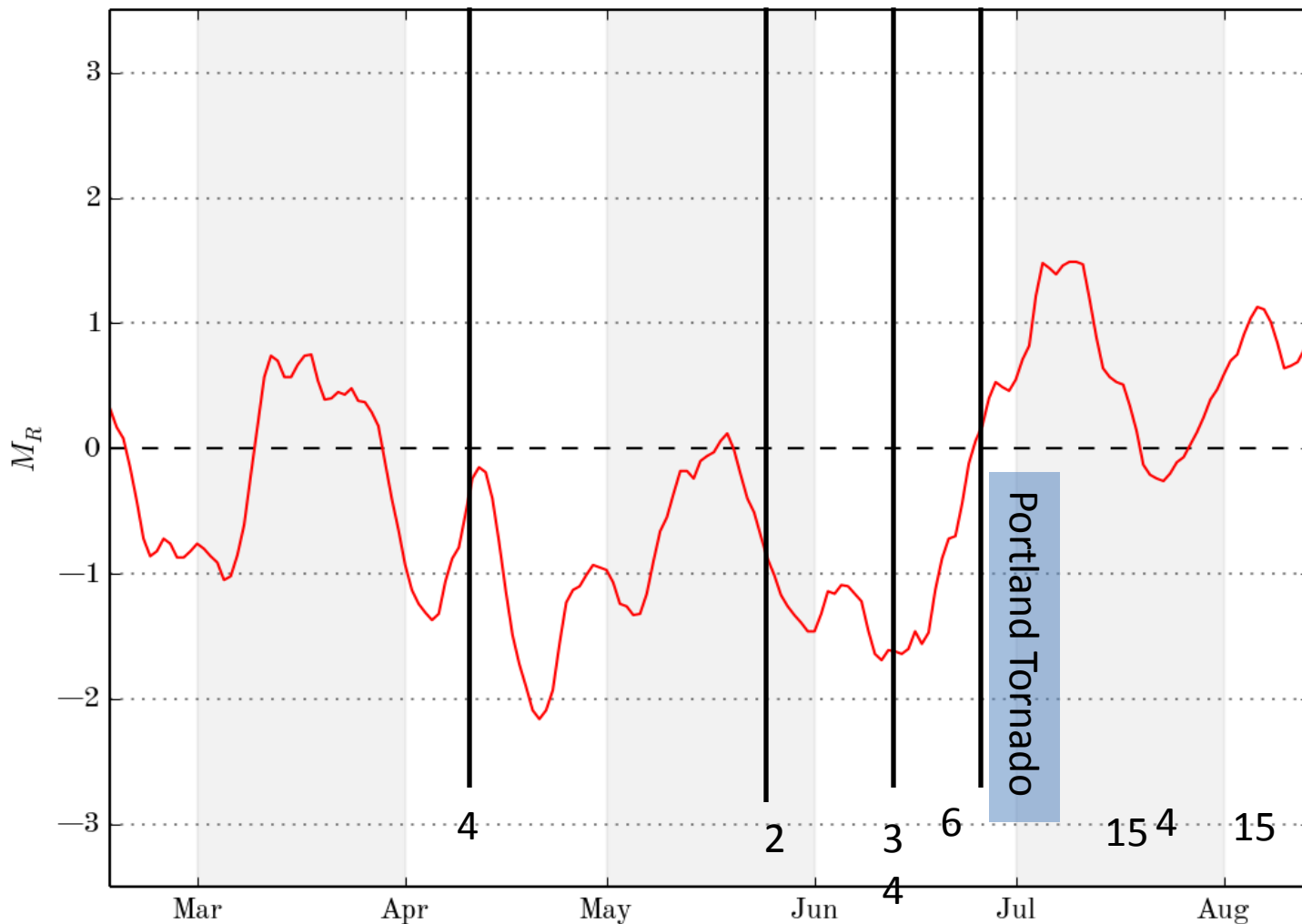
# The GWO and Southwest Michigan Severe Storms



5 Largest Events since 1985 Plotted

# Angler Momentum and Severe Events

## M anomalies / Events April – June 2015

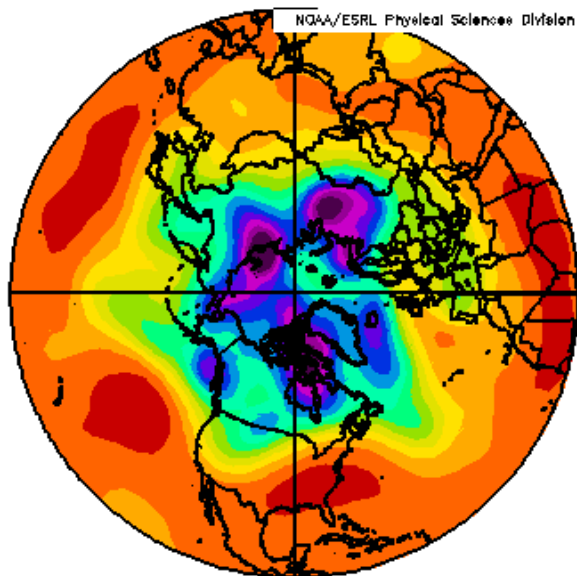


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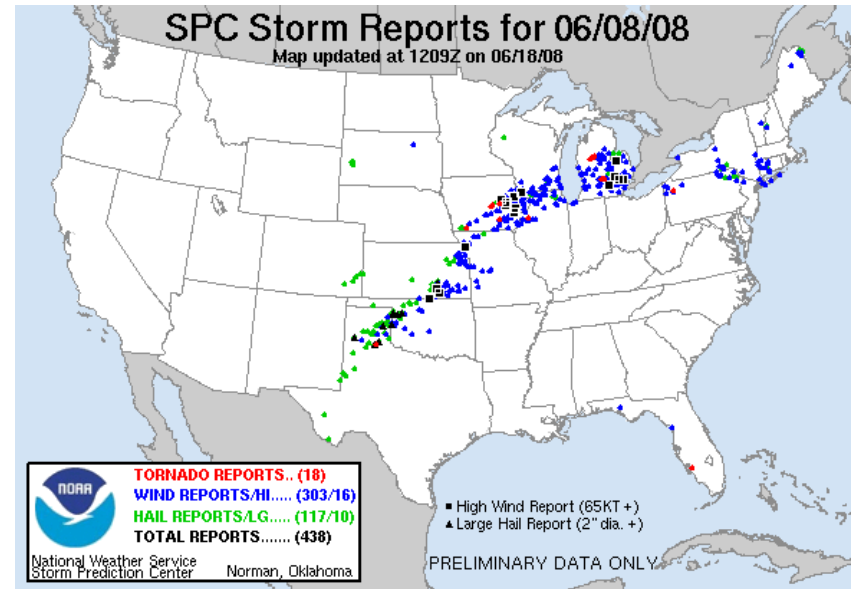
Southwest Michigan 2015 Severe Events and the "M"

# Looking at a Few Cases

June 8 2008 41 severe events **GWO = -1**



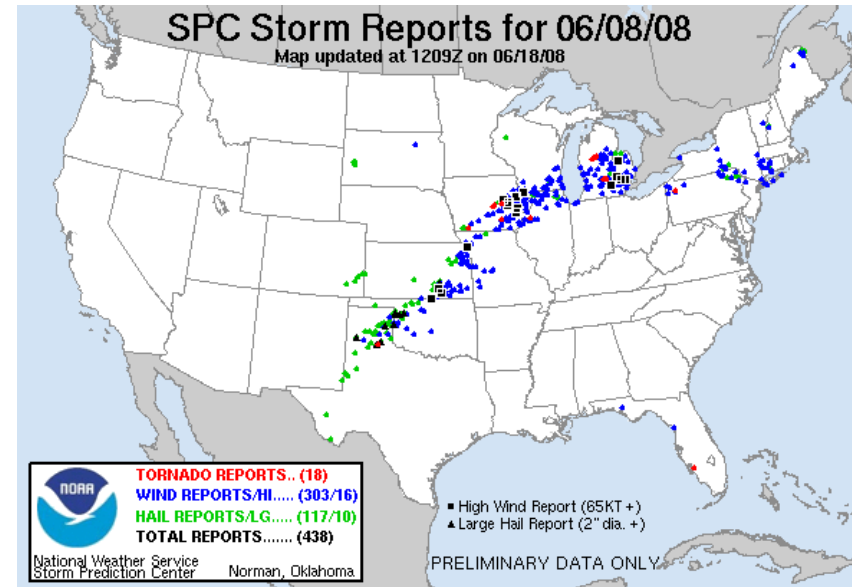
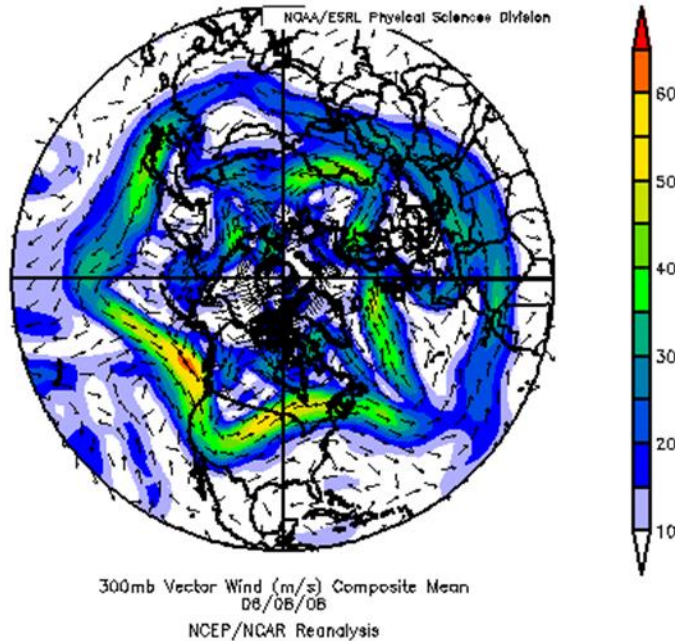
500mb Geopotential Height (m) Composite Mean  
06/08/08  
NCEP/NCAR Reanalysis



$$M = -0.98 \quad dM/dT = -0.12$$

# Looking at a Few Cases

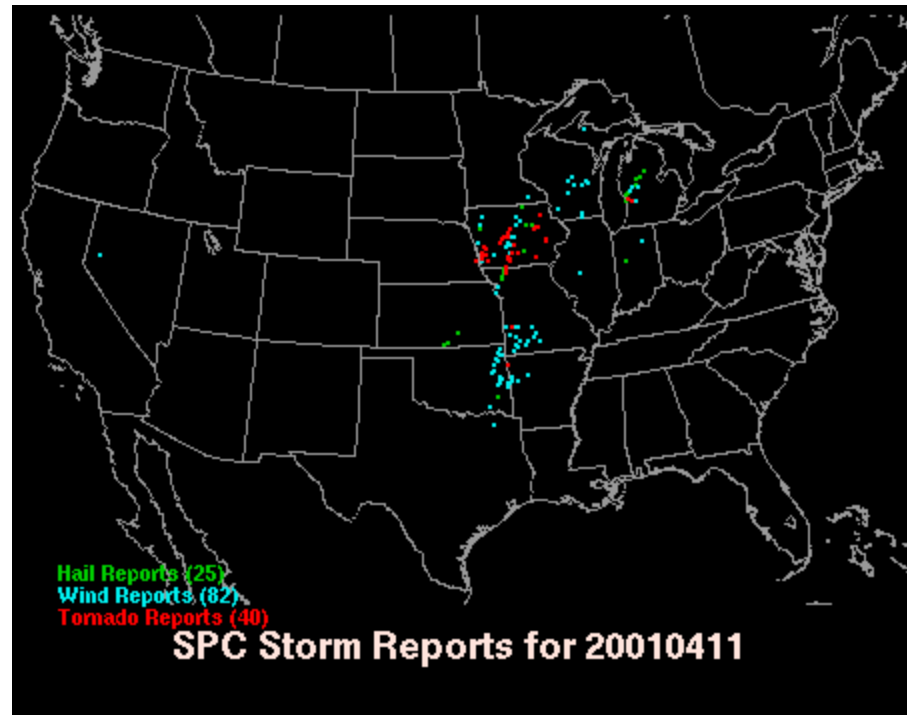
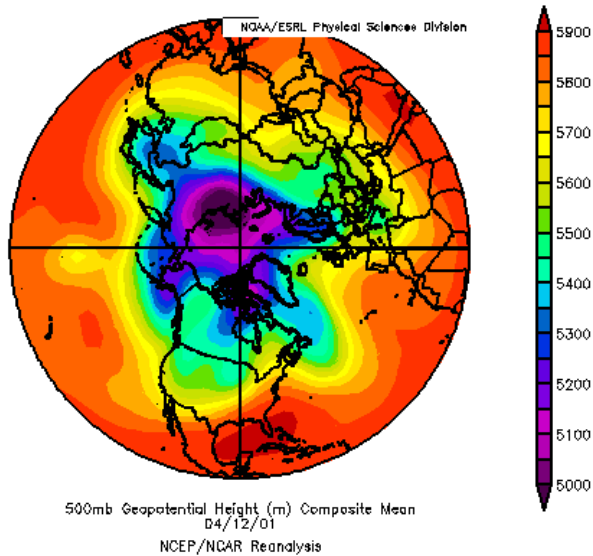
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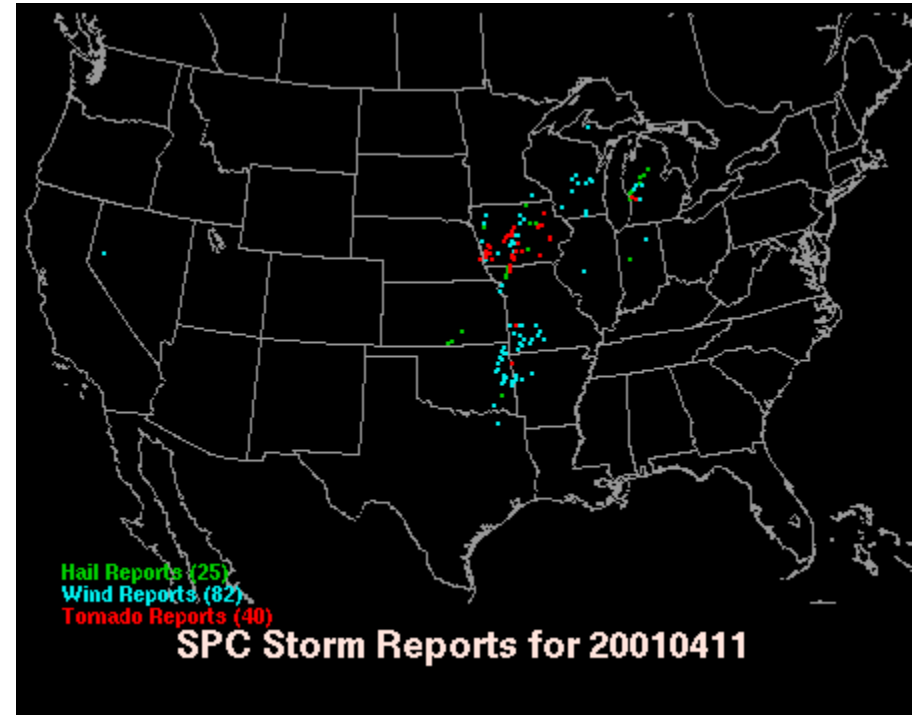
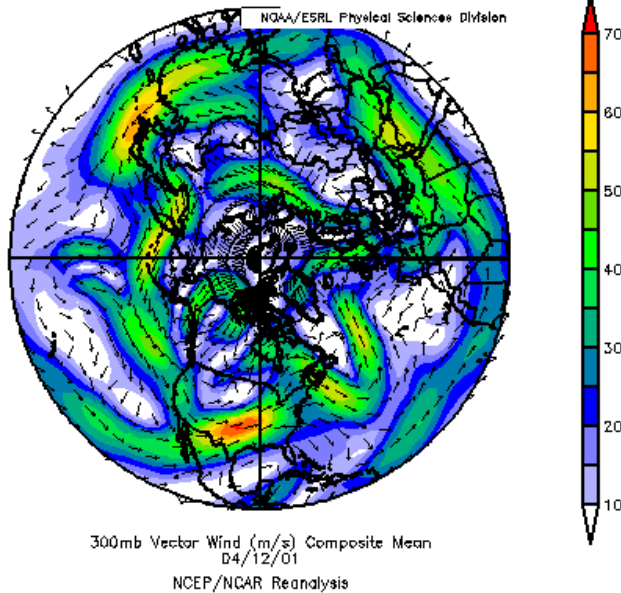
April 12 2001 8 sever events **GWO= -2.3**



$$M = -2.19 \quad dM/dT = -1.2$$

# Looking at a Few Cases

April 12 2001 8 sever events **GWO= -2.3**

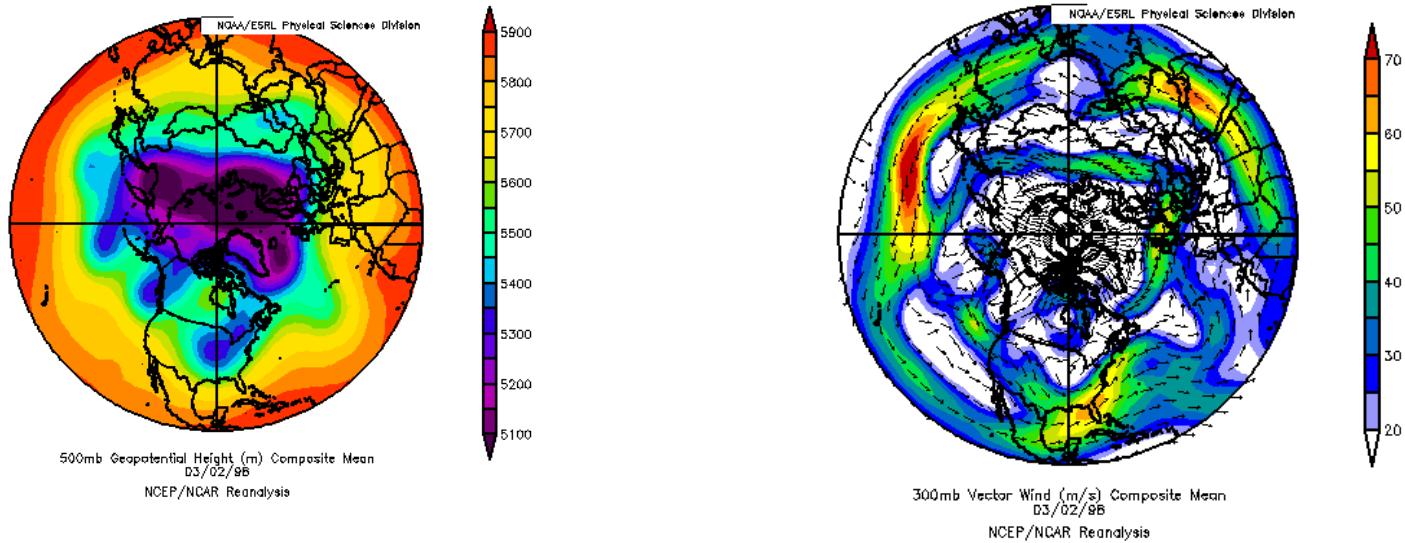


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# Looking at a Few Cases

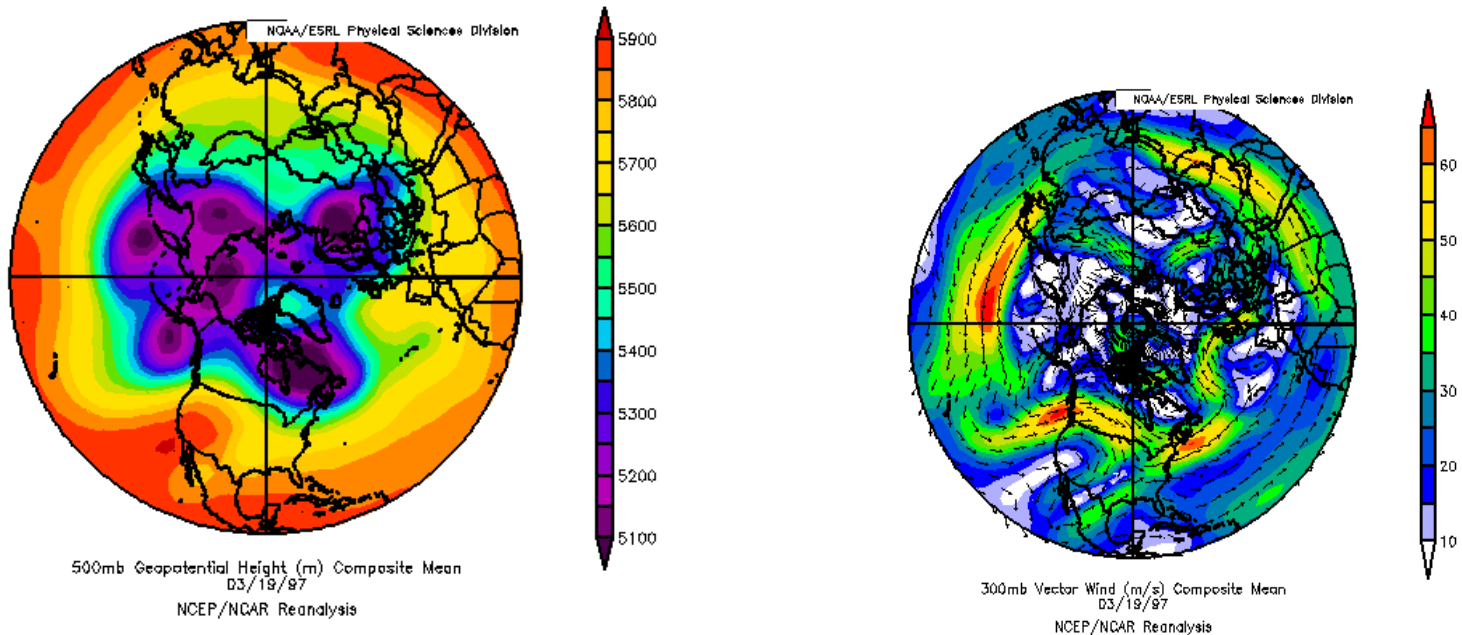
## March 2 1998 ( GWO +2 )



$$M = 2.33 \quad dM/dT = -0.2$$

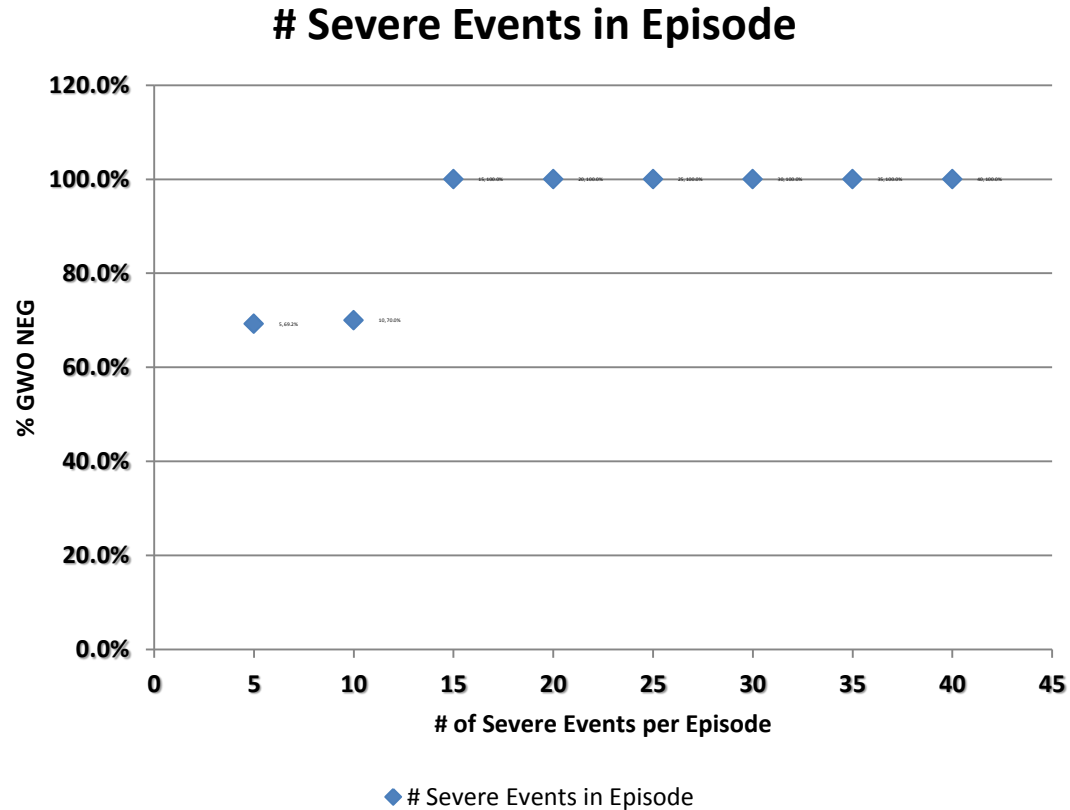
# Looking at a Few Cases

## March 19 19978 ( GWO +3 )



$$M= 3.00 \quad dM/dT= 0.1$$

# % GWO Negative / Severe Event Size



For the 8 largest severe episodes, all occurred when the GWO was negative

# Where to Find Current GWO Data

- [Definition and explanation](#)
- [Phase of the GWO for the past 90 days](#)
- [Phase of the GWO for the past 120 days](#)
- [Phase of the GWO for the past 180 days](#)
- [Global Angular Momentum Anomaly for the past 90 day](#)
- [Global Angular Momentum Anomaly for the past 120 days](#)
- [Global Angular Momentum Anomaly for the past 180 days](#)

# CONCLUSION

- **The largest events (15 or more) all occur when the GWO is negative (La Nina like planetary wind)**
- **83% of all severe episodes occur when the GWO is either negative or if positive, less than 1.0 (weak)**
- **Most of the weaker events that occur when GWO is positive happen when the GWO is less than 1.0 (weak)**