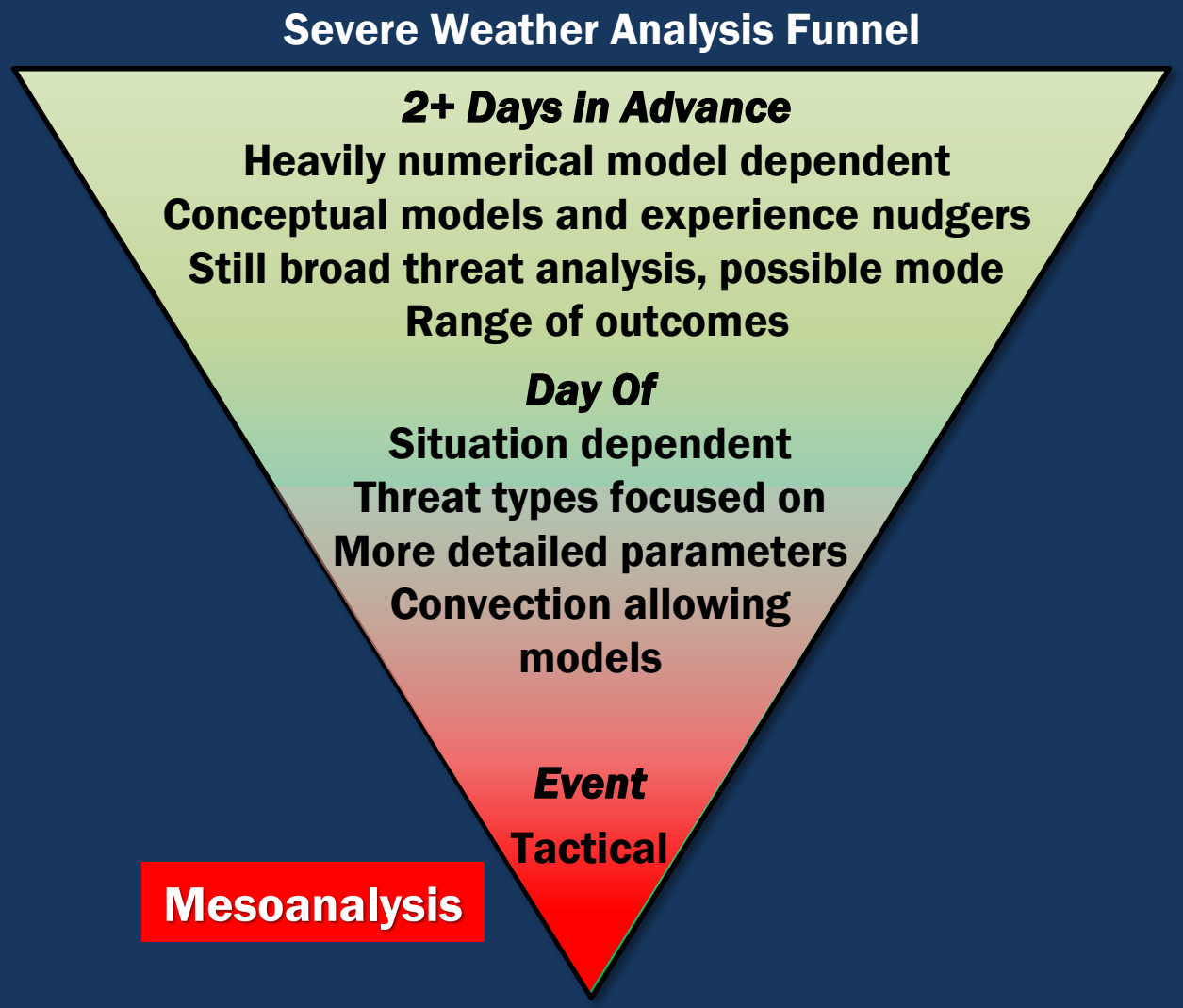
Mesoanalysis to Messaging

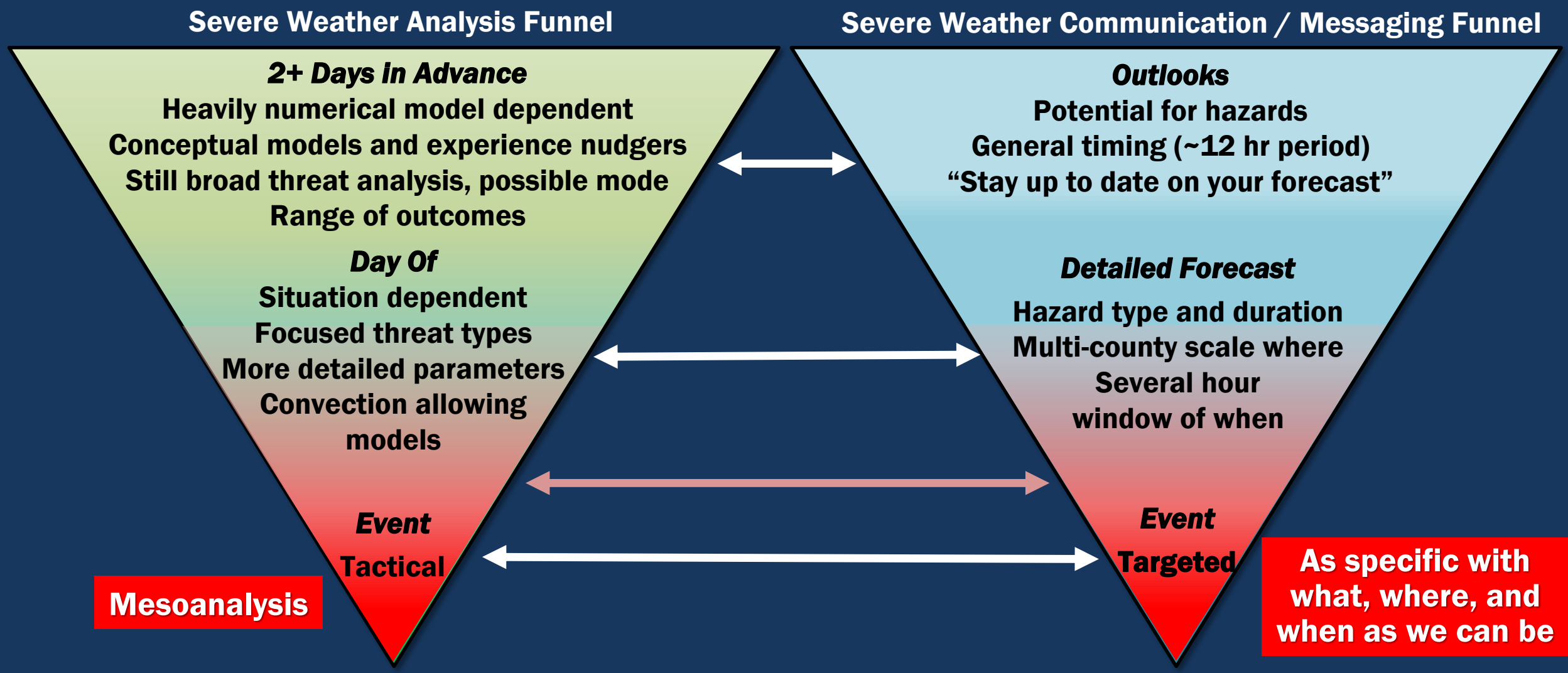
Matt Friedlein
NOAA / National Weather Service - Chicago, IL

2019 Spring Media Workshop
April 13, 2019

Forecasting to Mesoanalysis



Correlating Service



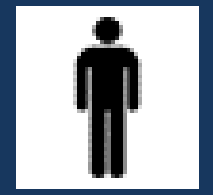
The NWS Mesoanalyst Role

- Focused on detailed environmental analysis and trends
- Data management and interrogation
- Applying pattern recognition
- Understanding mode, intensity and longevity, threats, and impacts
- Briefing other staff - radar warning teams, communicators
- Bedrock to targeted communication

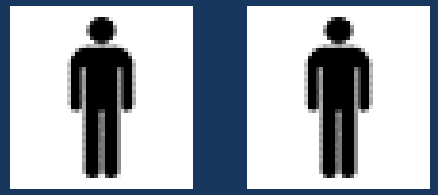
The NWS Chicago Severe Wx Operations

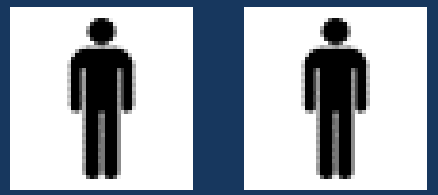
Example of a Sizeable Event

Coordinator



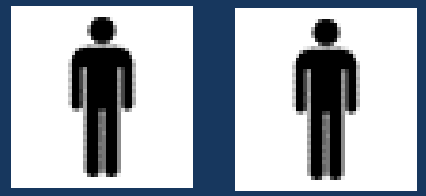
Warning Team(s)



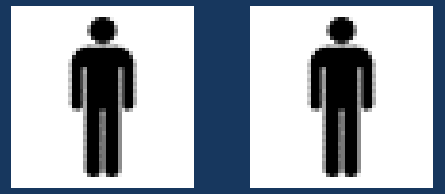


Mesoanalyst

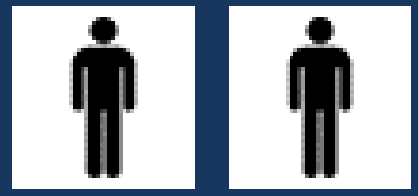
Communicator(s)

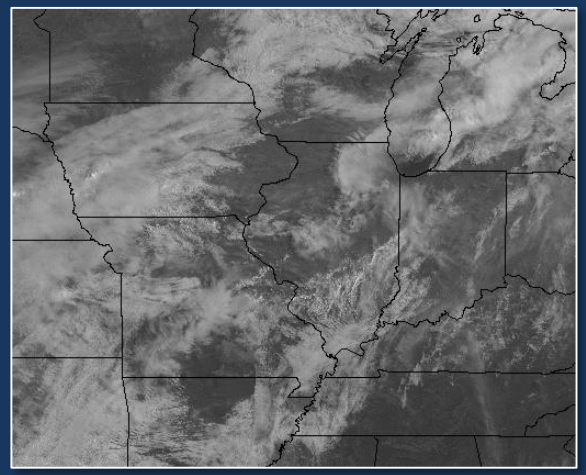


Report Data Mining



Other Forecast Services





21:36 <nwslot-todd.kluber> The ongoing cluster of storms across northeast Illinois is expected to continue to track to the east and clear the area by around 6:30pm. After a brief break, a second cluster of storms developing along the Mississippi River will track across northern Illinois over the next several hours, reaching the Chicago metro by 8pm.

21:44 <nwslot-richard.castro> We're seeing multiple localized corridors of strong winds with the scattered storms over the area, including recently passing over western Cook County . These will all be capable of producing wind gusts up to 50 to locally 60 mph.

22:09 <nwslot-richard.castro> We're monitoring for an increasing large hail threat for the warned storm in northeast Kankakee County.

22:57 <nwslot-richard.castro> The severe warned storm moving into northwest Ogle contains hail larger than half dollar size according to a spotter in far eastern Carroll County.

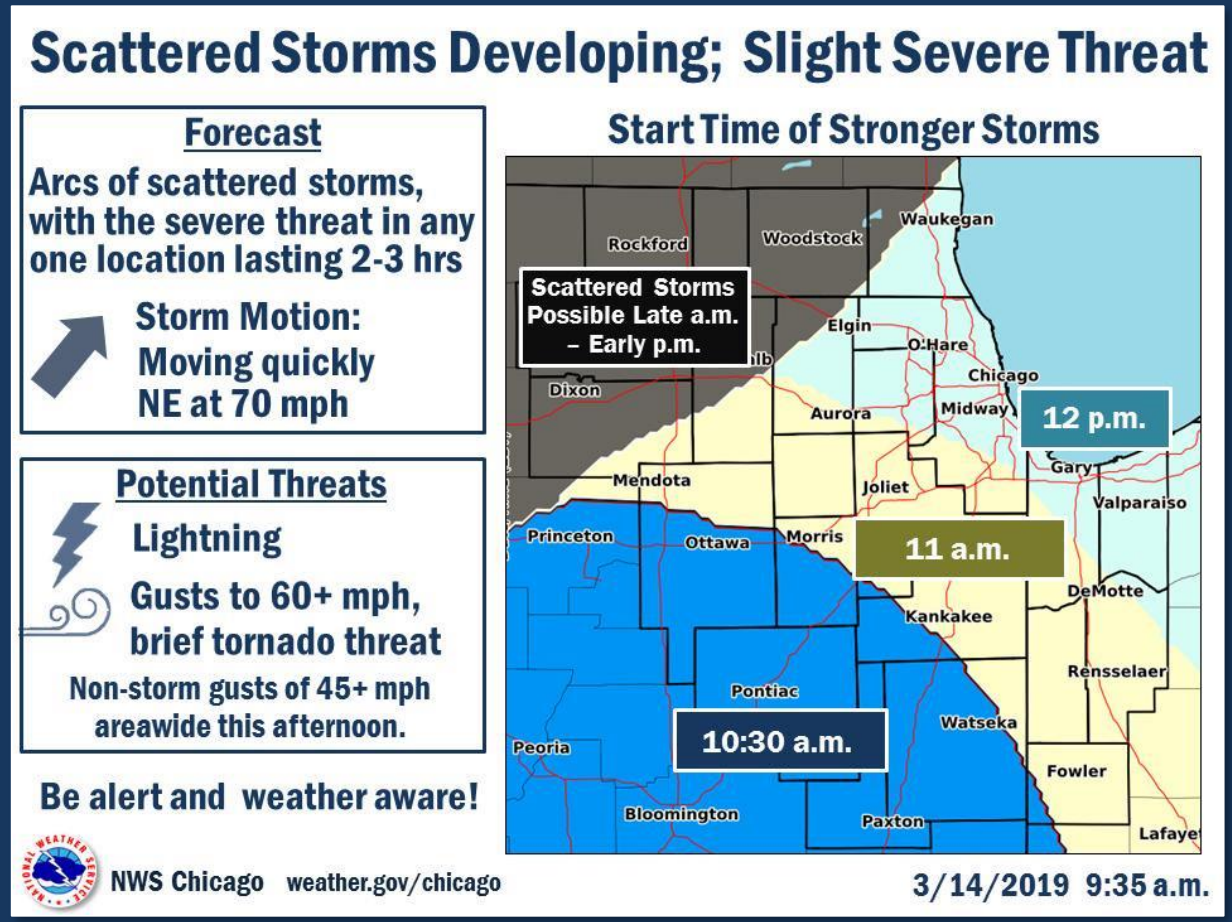
23:05 <Joey - Rockford University> dime size hail at Rockford University

23:07 <media-SVLMedia-Goddard> Relay from Lake County Sheriff Multiple trees snapped on Hadders Rd in Lowell, IN Car and trailer flipped on 41 from wind and power pole snapped on 300 block of Woodland from tree falling on wires

23:09 <media-mark.henderson> Viewer reports 1" hail on Ohio Pkwy, approx 3mi East of downtown Rockford

Mesoanalysis Starts…

- Before the event begins
- Focuses in the hours leading up to an event
- Communicating insight before convection forms
- Ripe period for continuum of information flow
- Science to Service

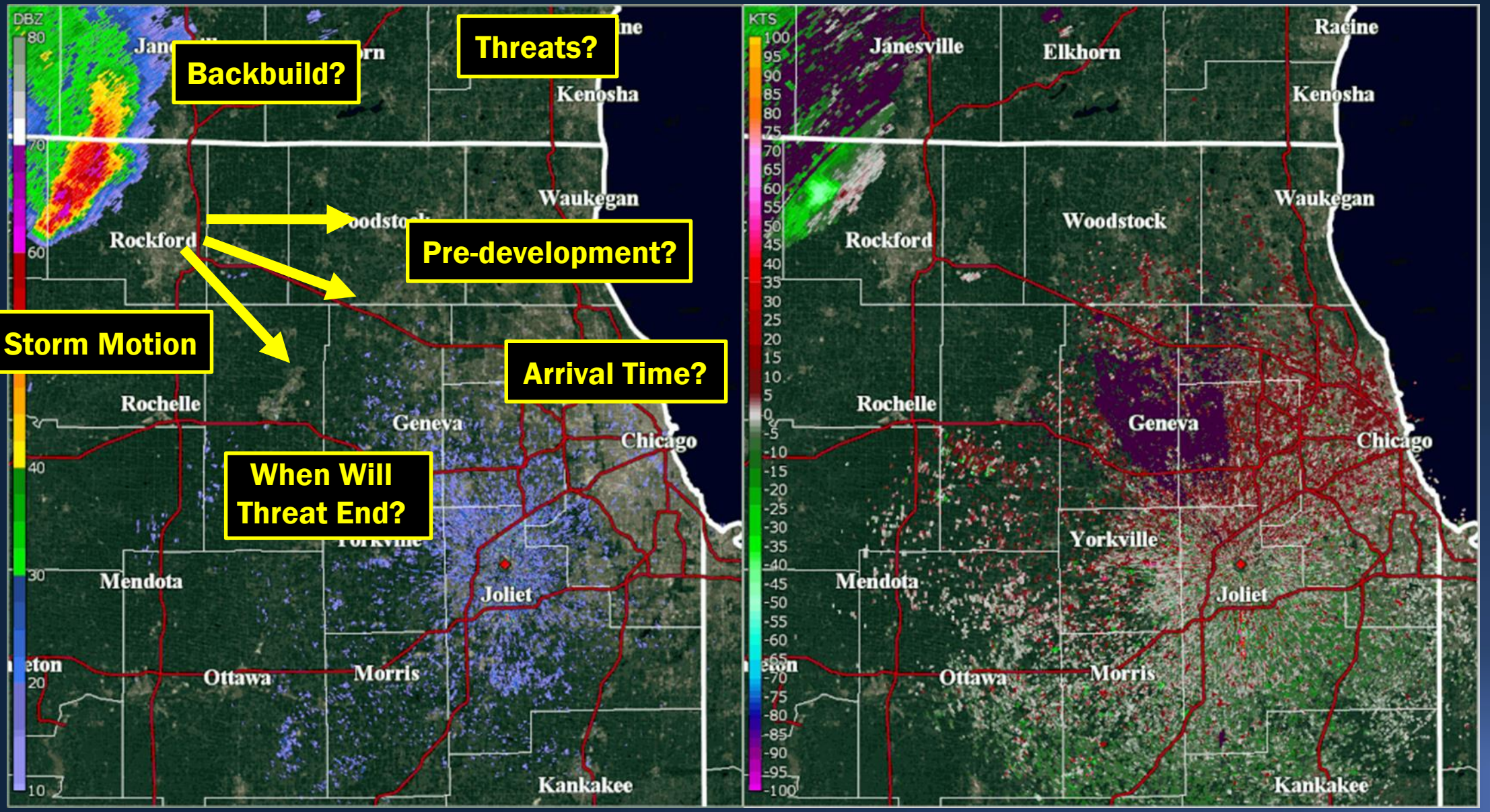


Mesoanalyst Insight

- Mode & movement → coverage and timing of arrival
- Non-uniform movement → radar can't be extrapolated
- New development → radar can't be extrapolated
- Intensity trend → lightning threat and severe potential
- Significant vs non significant severe
- Likelihood and coverage of severe
- Anticipating the spectrum of radar signatures and behavior for the day

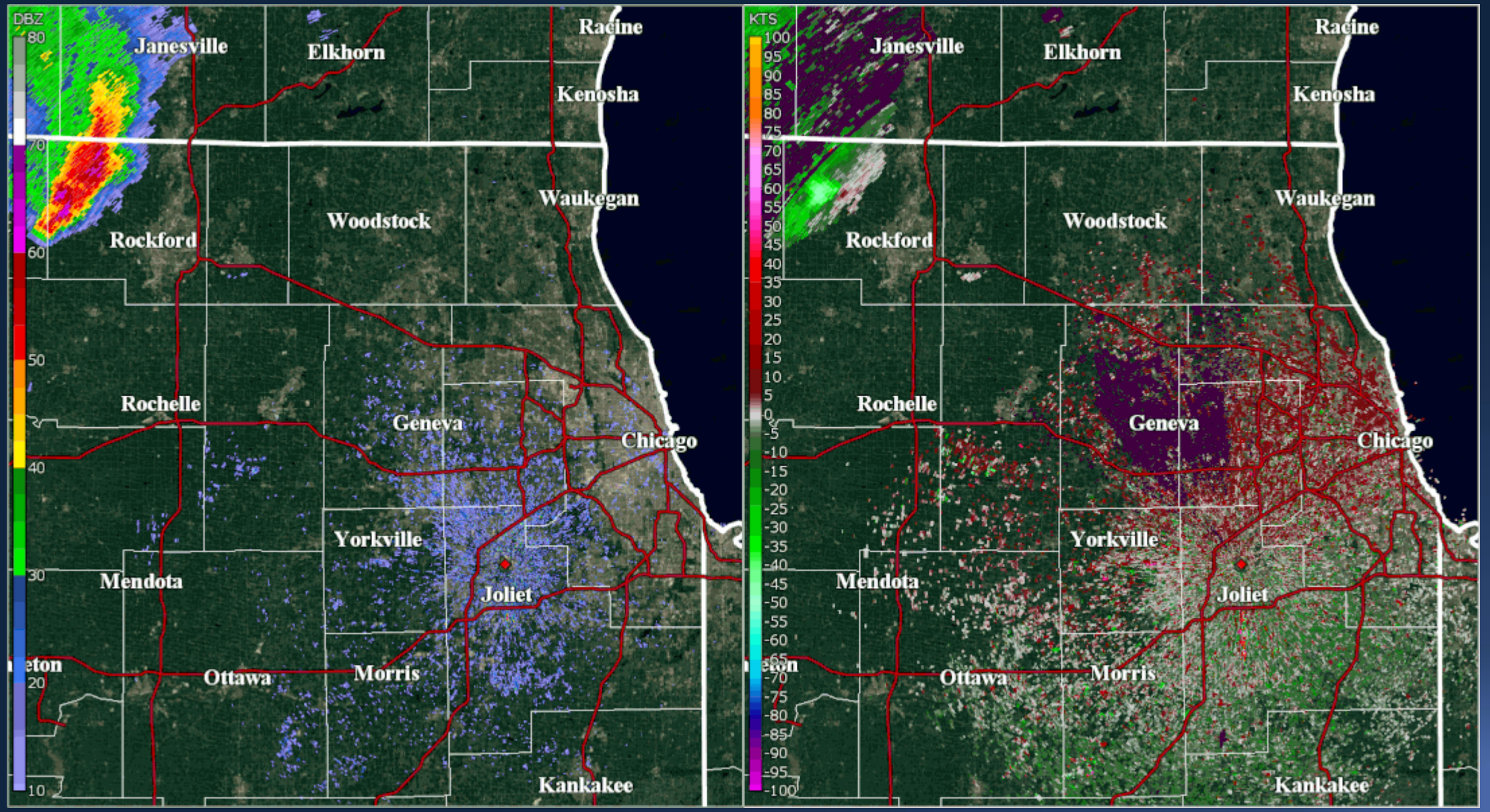
Mesoanalyst Insight

SVR Watch in effect



Mesoanalyst Insight

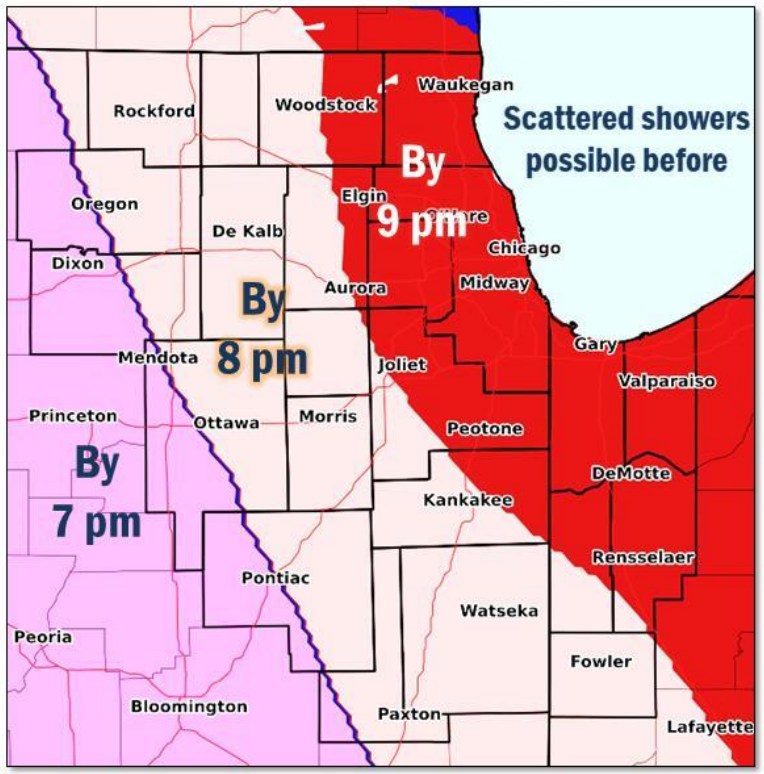
SVR Watch in effect



Rain Moving In Early This Evening

3:55 pm Radar

Forecast Steady Rain Onset Time



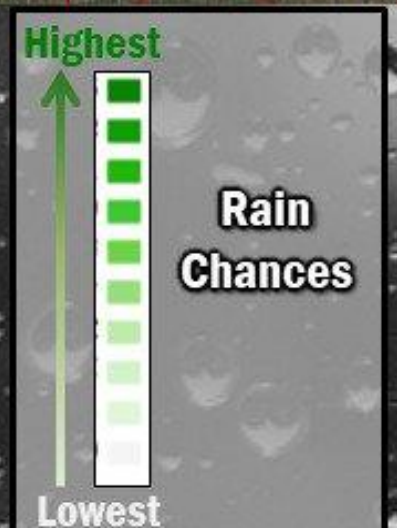
Movement: East-Northeast at 40 mph

Once starts, fairly widespread through the night

Lightning & flooding threat: Limited along/south of I-80

NWS Chicago weather.gov/chicago 3/29/2019 4:08 PM CT

Rain Chances Increase This Evening



- Mainly on and off light rain
- Higher coverage of rain overnight
- A few moderate downpours possible overnight

NWS Chicago weather.gov/Chicago

Issued: 4/3/2019 5:01 PM Central

T-Storms Moving Across Portions of Northeast Illinois

Up to penny size hail possible

Hazards

FREQUENT LIGHTNING

HAIL

Up to Penny Size

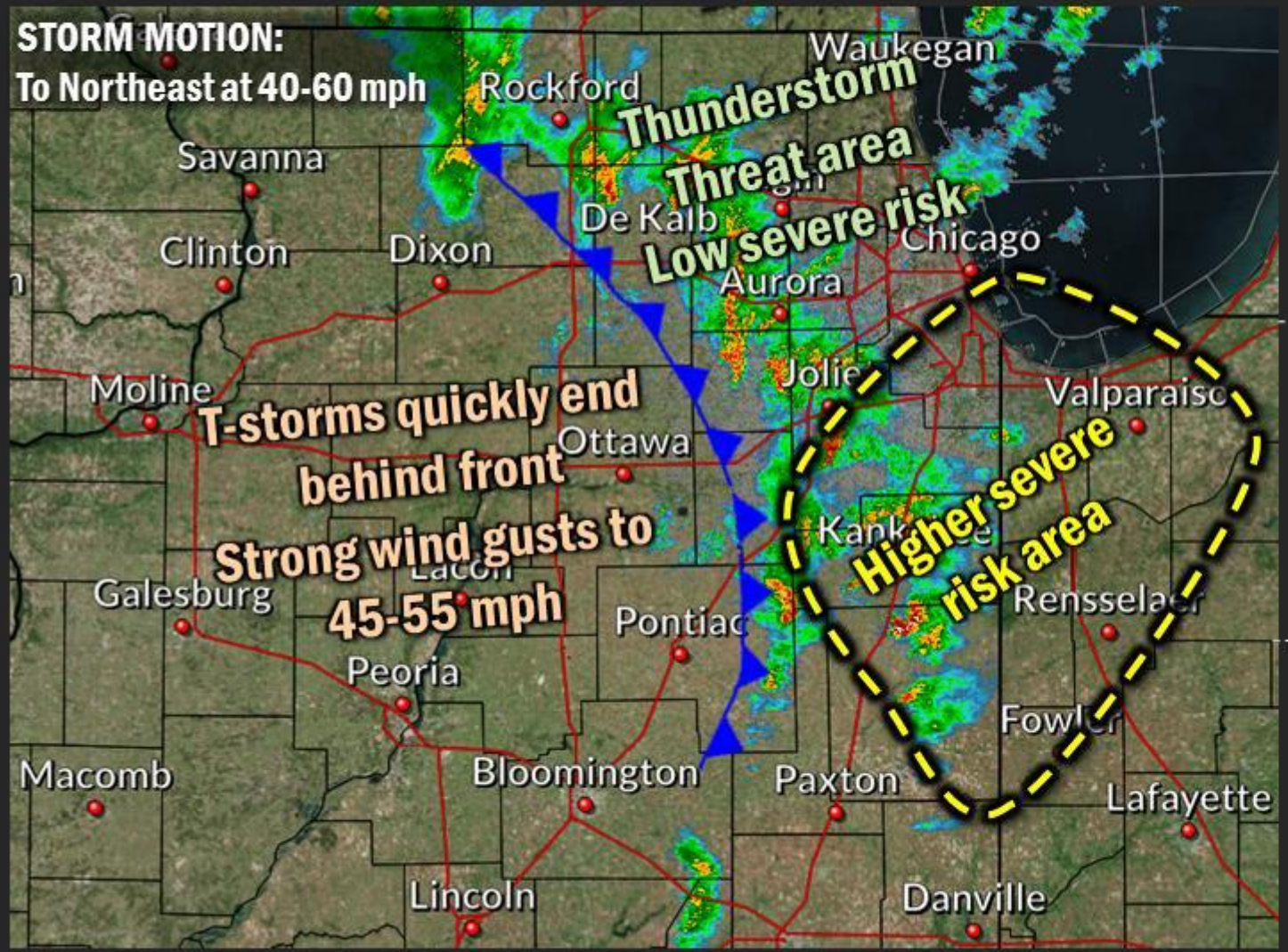
! Actions/Safety

- When Thunder Roars, Go Indoors!
- Use caution driving in heavy rain & low visibility.

NWS Chicago | weather.gov/Chicago | Issued at: 4/11/2019 8:36 AM Central

SCATTERED THUNDERSTORMS...Some Severe

Thunderstorm Threat Thru About 3pm...Higher Severe Risk Southeast of I-55



Hazards

LIGHTNING

HEAVY DOWNPOURS

May cause ponding on roads

STRONG WINDS

60+ mph gusts

Isolated tornado risk

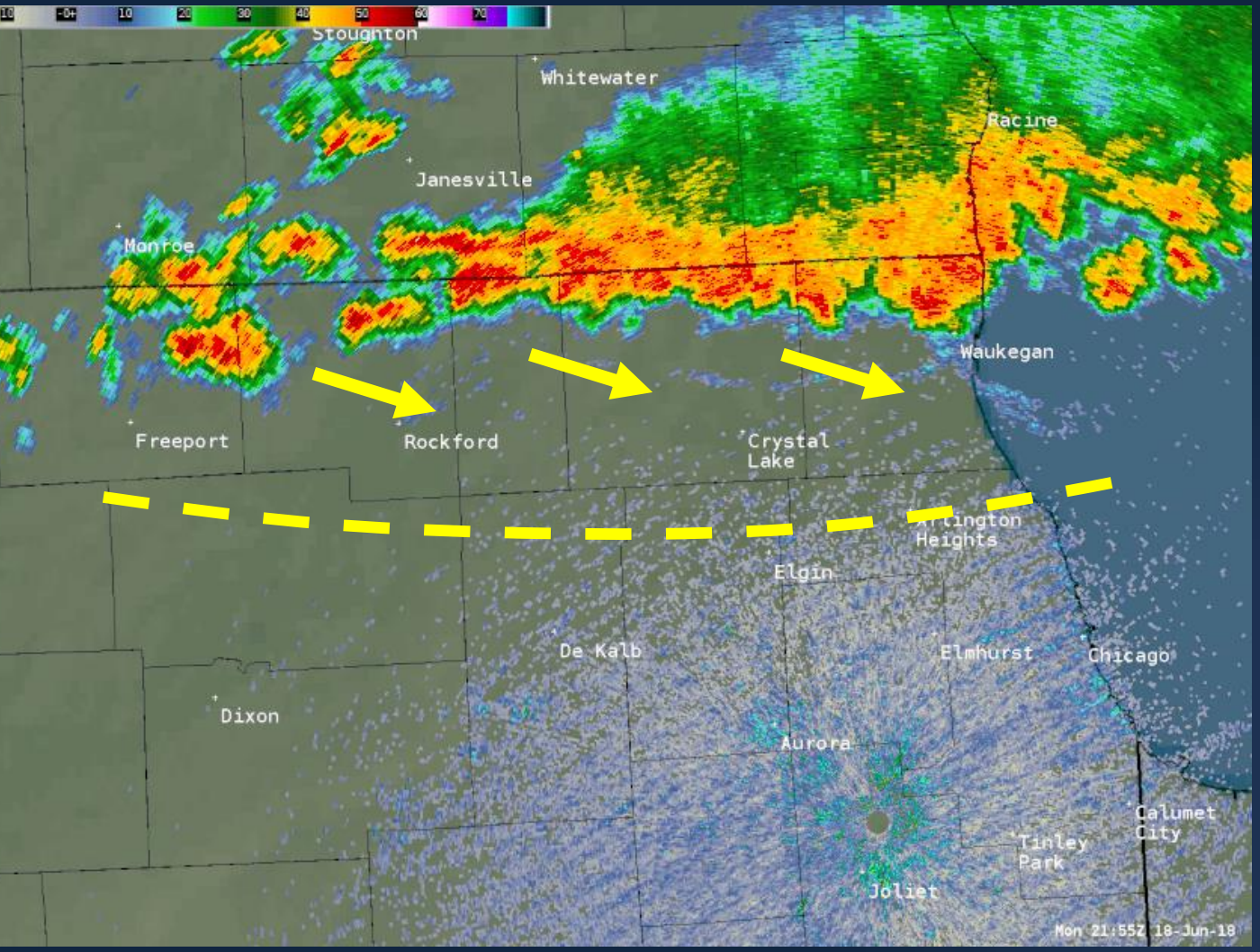
HAIL

Up to Quarter Size

! Actions/Safety

- When Thunder Roars, Go Indoors!
- Use caution driving in heavy rain & low visibility.

NWS Chicago | weather.gov/Chicago | Issued at: 3/14/2019 1:22 PM Central



Storms with Torrential Downpours and Gusty Winds

Valid Monday June 18th, 2018 at 6:54 PM CDT

Average T-storm Motion: Toward East- Southeast at 30 mph

Waukegan
Rockford
Ben
Flash Flooding Likely this evening.
Chicago
Joliet
Ottawa
Individual storms moving east, but the complex of Will gradually sag south into over IL through 8:30 PM
Rensselaer
Peoria
Bloomington
Lafayet

NWS Chicago weather.gov/chicago 6/18/2018 6:59 PM CT

Hazards

TORRENTIAL DOWNPOURS

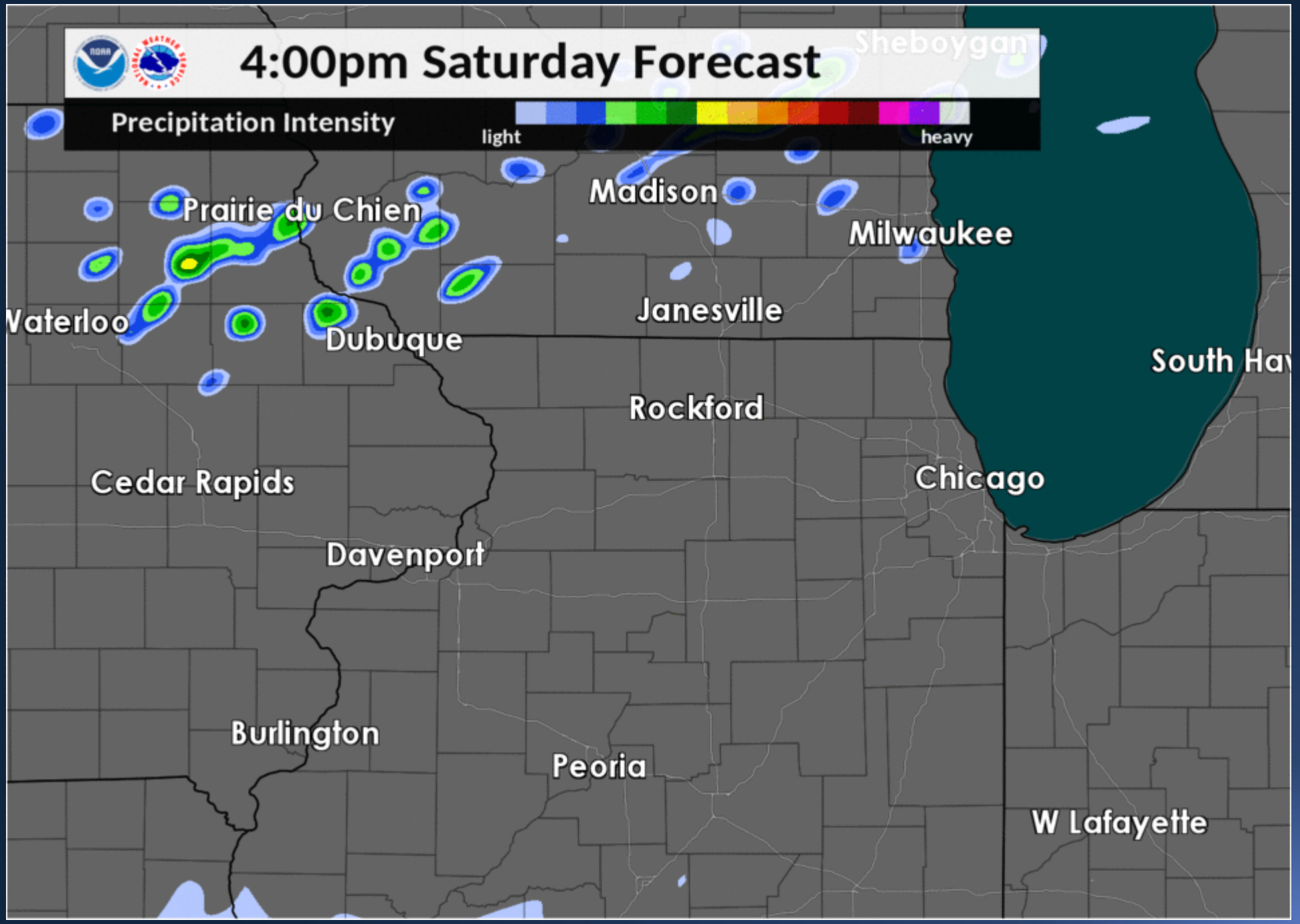
May cause areas of flash flooding, especially in Rockford.

OCCASIONAL LIGHTNING

Wind gusts to 45+ mph

! Actions/Safety

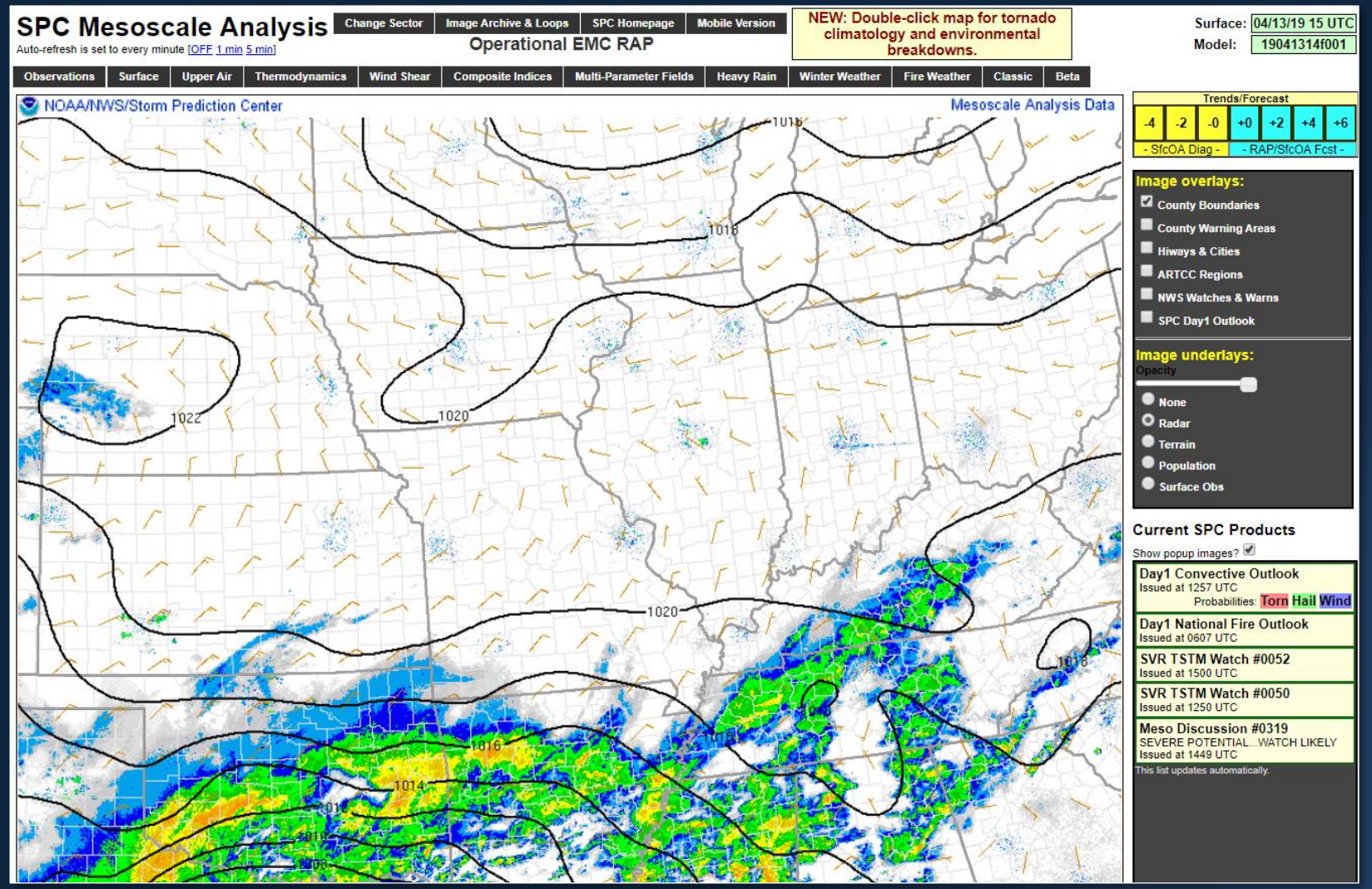
- NEVER drive or walk across flooded roads.
- Turn Around, Don't Drown!
- When Thunder roars, Go Indoors!

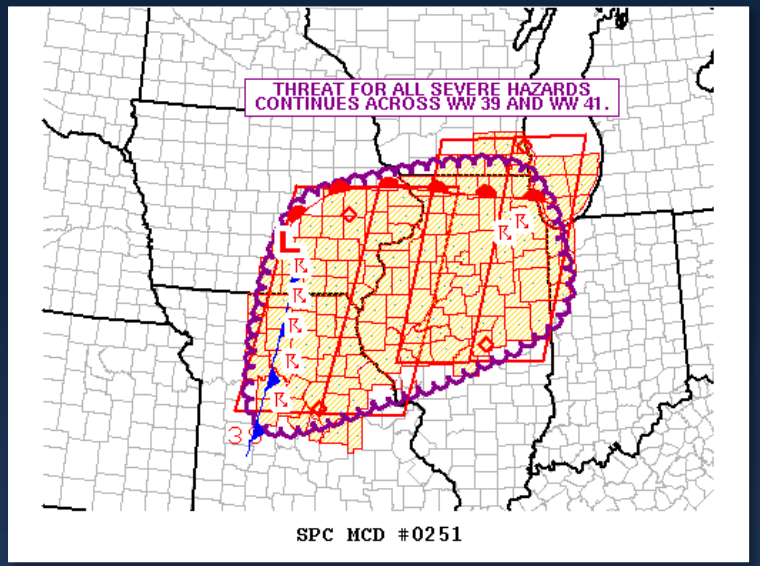

4:00pm Saturday Forecast
Precipitation Intensity
light
heavy
Sheboygan
Madison
Prairie du Chien
Milwaukee
Janesville
Waterloo
Dubuque
South Hav
Rockford
Cedar Rapids
Chicago
Davenport
Burlington
Peoria
W Lafayette

The Data Dilemma

Radar base data
Volumetric data
Radar derived data
Lightning data and trends
Suite of environmental parameters
Immediate near-storm environments
Soundings adapted for observations
Convection allowing model solutions
Broadcast media reports
Reports from all sources
Streaming video when available

SPC





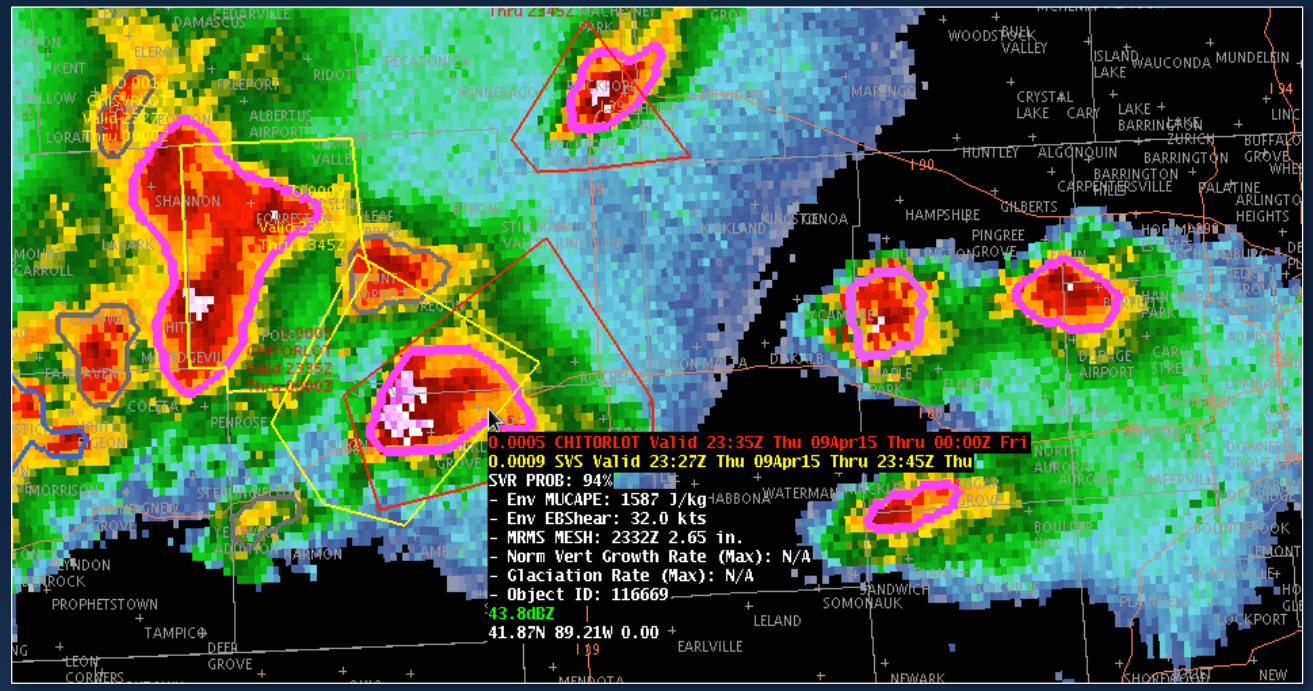
More frequent

NOAA/CIMMS ProbSevere Model

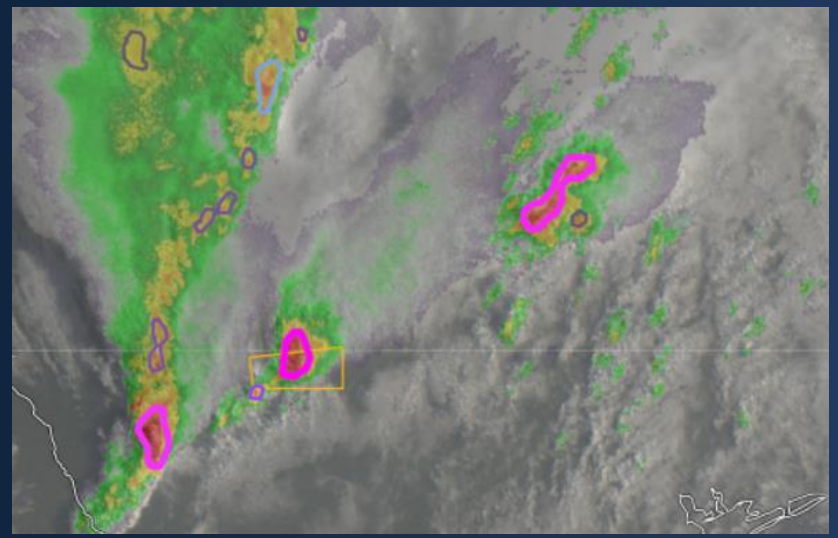
- Consolidate key observations and data into one “quick-look” product

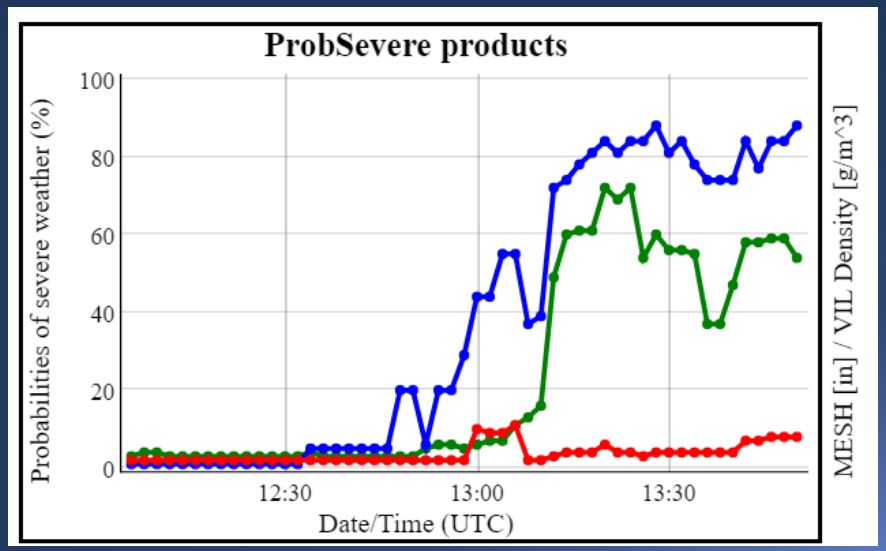
- Decision assistance – not to be used alone for a decision to warn!

- Works best with lightning potential and hail threat



https://cimss.ssec.wisc.edu/severe_conv/probsev.html (link)





Part 2: The Theory

$$\left(\nabla_p^2 + \frac{f_0^2}{\sigma}\frac{\partial^2}{\partial p^2}\right)\chi = \underbrace{-\frac{f_0^2}{\sigma}\frac{\partial}{\partial p}\left[\frac{R}{p}(-\mathbf{V}_g \cdot \nabla_p T)\right]}_{\text{differential thermal advection}} + \underbrace{f_0[-\mathbf{V}_g \cdot \nabla_p(\zeta_g + f)]}_{\text{vorticity advection}},$$

$$\frac{du}{dt} - fv - \frac{uv}{a}\tan\varphi = -\frac{1}{a\cos\varphi}\frac{\partial\Phi}{\partial\lambda} - \frac{RT}{a\cos\varphi}\frac{\partial\pi}{\partial\lambda} + \frac{g}{p_s}\frac{\partial F_u^{vdf}}{\partial\sigma} + F_\lambda^{diff}$$

$$\frac{dv}{dt} + fu + \frac{u^2}{a}\tan\varphi = -\frac{1}{a}\frac{\partial\Phi}{\partial\varphi} - \frac{RT}{a}\frac{\partial\pi}{\partial\varphi} + \frac{g}{p_s}\frac{\partial F_v^{vdf}}{\partial\sigma} + F_\varphi^{diff},$$

$$\frac{d\pi}{dt} = -\frac{1}{a\cos\varphi}\frac{\partial u}{\partial\lambda} - \frac{1}{a\cos\varphi}\frac{\partial}{\partial\varphi}(v\cos\varphi) - \frac{\partial\dot{\sigma}}{\partial\sigma},$$

$$\frac{\partial\Phi}{\partial\sigma} = -\frac{RT}{\sigma},$$

$$\frac{dq}{dt} = \frac{g}{p_s}\frac{\partial F_q^{vdf}}{\partial\sigma} + F_q^{diff} + S_q^{cond},$$

$$\frac{dT}{dt} = \frac{RT}{c_p}\left\{\frac{\partial\pi}{\partial t} + \frac{u}{a\cos\varphi}\frac{\partial\pi}{\partial\lambda} + \frac{v}{a}\frac{\partial\pi}{\partial\varphi} + \frac{\dot{\sigma}}{\sigma}\right\}$$

Hypsometric Equation

$$\Delta Z = \frac{R_d T_v}{g_0}\ln\left(\frac{P_1}{P_2}\right)$$

ΔZ = Thickness
R_d = gas constant
g_0 = gravity
T_v = Virtual temperature
P_1 = pressure at base
P_2 = pressure at top

$$\frac{\partial\vec{V}}{\partial t} = -(\vec{V}\cdot\nabla)\vec{V} - \frac{1}{\rho}\nabla p - \vec{g} - 2\vec{\Omega}\times\vec{V} + \nabla\cdot(k_\omega\nabla\vec{V}) - \vec{F}_d$$

$$\rho c_p\frac{\partial T}{\partial t} = -\rho c_p(\vec{V}\cdot\nabla)T - \nabla\cdot\vec{R} + \nabla\cdot(k_t\nabla T) + C + S$$

$$\frac{\partial\rho}{\partial t} = -(\vec{V}\cdot\nabla)\rho - \rho(\nabla\cdot\vec{V})$$

$$\frac{\partial q}{\partial t} = -(\vec{V}\cdot\nabla)q + \nabla\cdot(k_q\nabla q) + S_q + E$$

Mesoanalysis to Messaging

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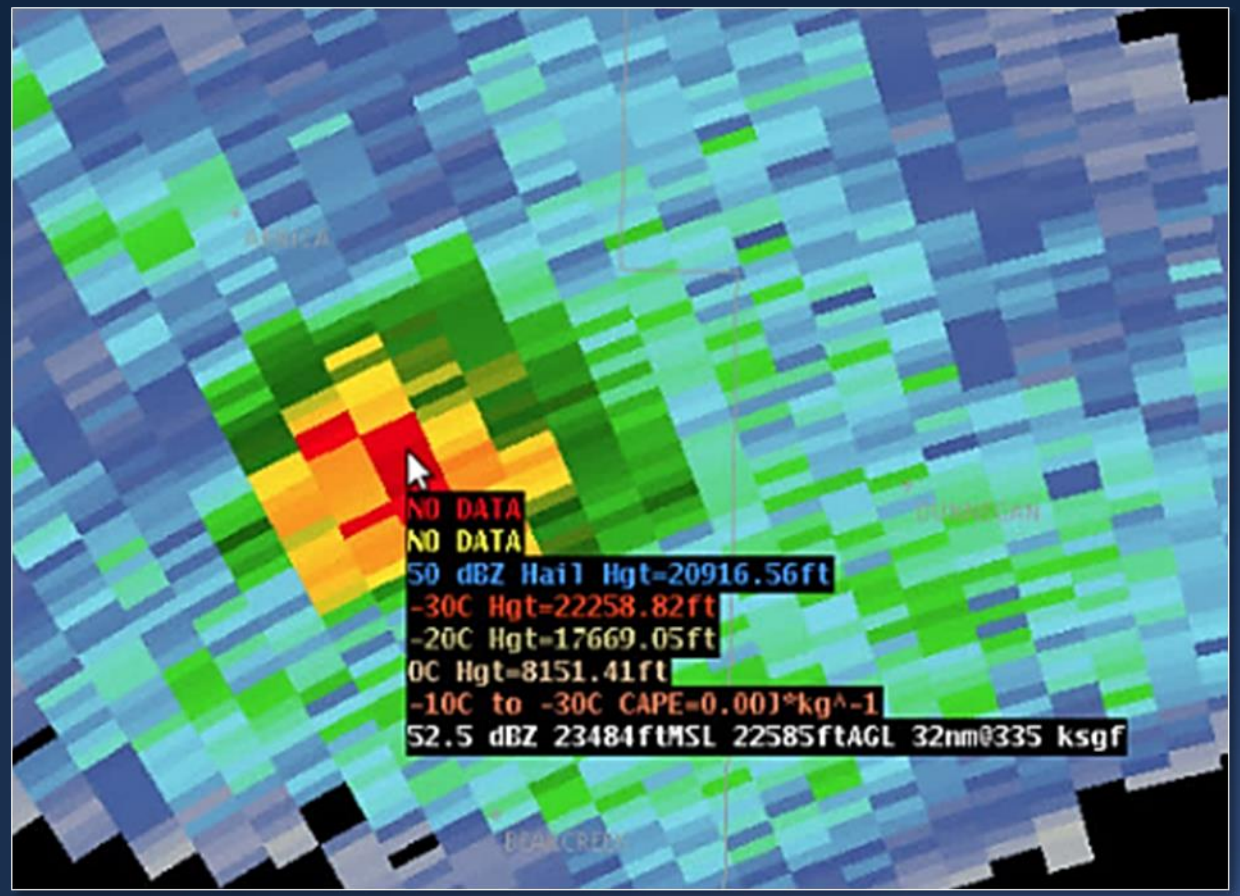
Near-Storm Environment Analysis

Combining Radar and Environment

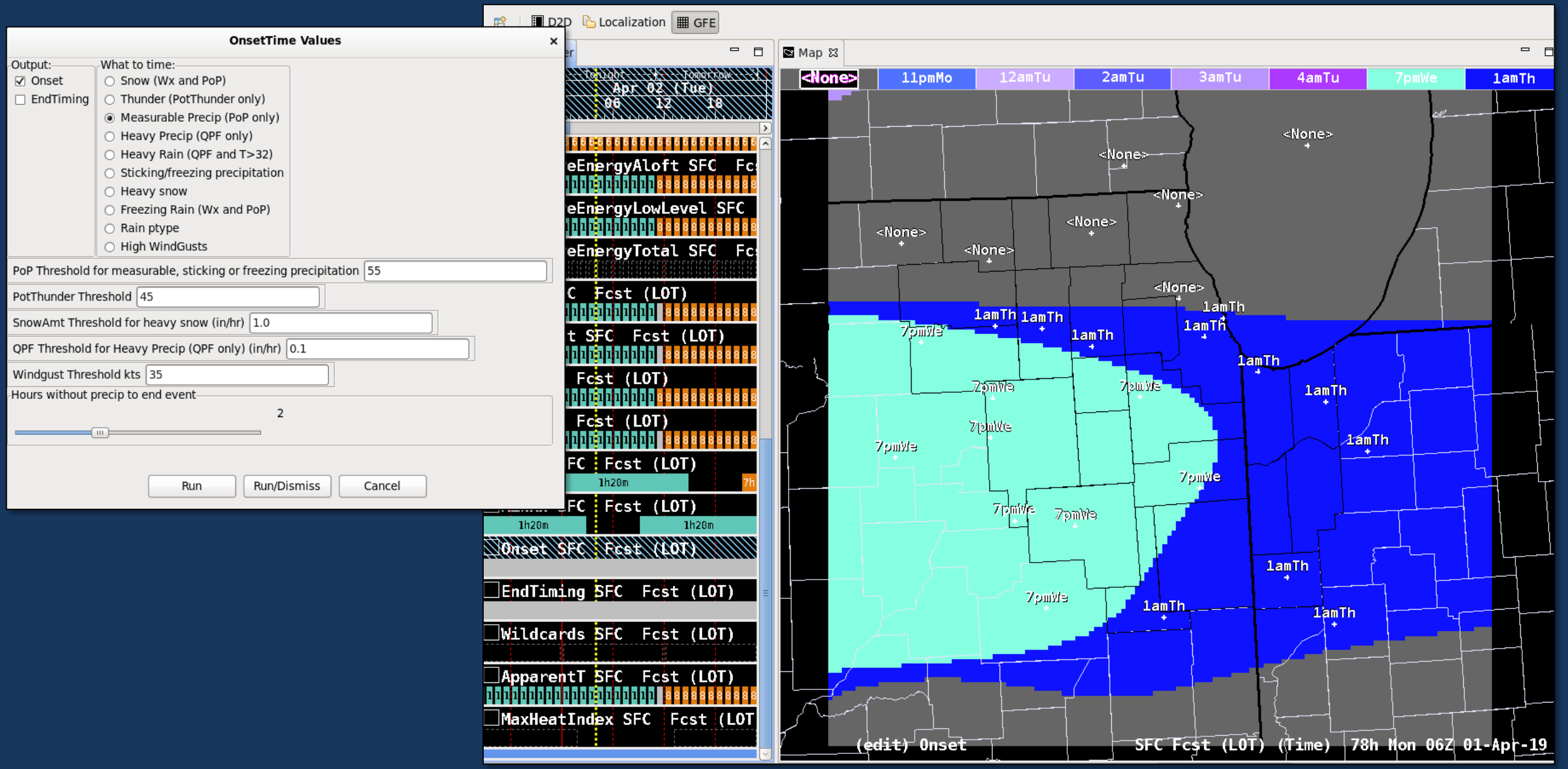
- Displays critical mesoscale parameters in conjunction with radar or satellite data



Decision-Making

- Data and information organization is essential in the discipline of warning operations, and in weather in general!
- Pre-planning data layouts and interrogation strategies
- Practicing them, learning from others, and sharing

Onset Time


OnsetTime Values
Output:
Onset
EndTiming
What to time:
Snow (Wx and PoP)
Thunder (PotThunder only)
Measurable Precip (PoP only)
Heavy Precip (QPF only)
Heavy Rain (QPF and T>32)
Sticking/freezing precipitation
Heavy snow
Freezing Rain (Wx and PoP)
Rain ptype
High WindGusts
PoP Threshold for measurable, sticking or freezing precipitation 55
PotThunder Threshold 45
SnowAmt Threshold for heavy snow (in/hr) 1.0
QPF Threshold for Heavy Precip (QPF only) (in/hr) 0.1
Windgust Threshold kts 35
Hours without precip to end event
2
Run
Run/Dismiss
Cancel
D2D
Localization
GFE
Tonight
Tomorrow
Apr 02 (Tue)
06
12
18
eEnergyAloft SFC Fc
eEnergyLowLevel SFC
eEnergyTotal SFC Fc
C Fcst (LOT)
t SFC Fcst (LOT)
Fcst (LOT)
Fcst (LOT)
FC Fcst (LOT)
1h20m
7h
FC Fcst (LOT)
1h20m
1h20m
Onset SFC Fcst (LOT)
EndTiming SFC Fcst (LOT)
Wildcards SFC Fcst (LOT)
ApparentT SFC Fcst (LOT)
MaxHeatIndex SFC Fcst (LOT
Map
<None>
11pmMo
12amTu
2amTu
3amTu
4amTu
7pmWe
1amTh
(edit) Onset
SFC Fcst (LOT) (Time) 78h Mon 06Z 01-Apr-19

OBSERVED Graphic Decision Aid

What do you want a visualization of?

MAP

- Maxs & Mins
- Current Obs
- Storm Reports
  - Severe
  - Snow
- Rainfall or Snowfall
  - Analyzed
  - Radar Estimated

RADAR

- Current
  - Loop
  - Annotated G-Now
- Past

G-Now templates will auto-update

LIST

- Current or Max & Mins

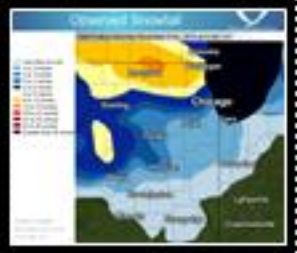
Weather & Hazards Data Viewer

Alt: GraphiDSS

CR Maps

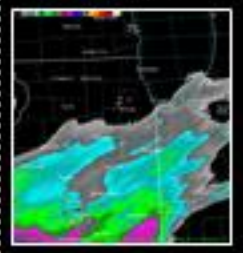
Storm Reports | Snow Reports

BIG



AWIPS

MRMS | SITE-level Procedure



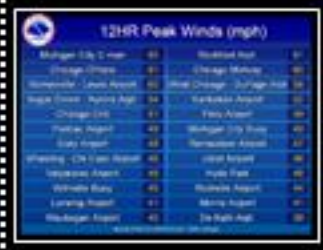
GraphiDSS

Alt: BIG

WAVE

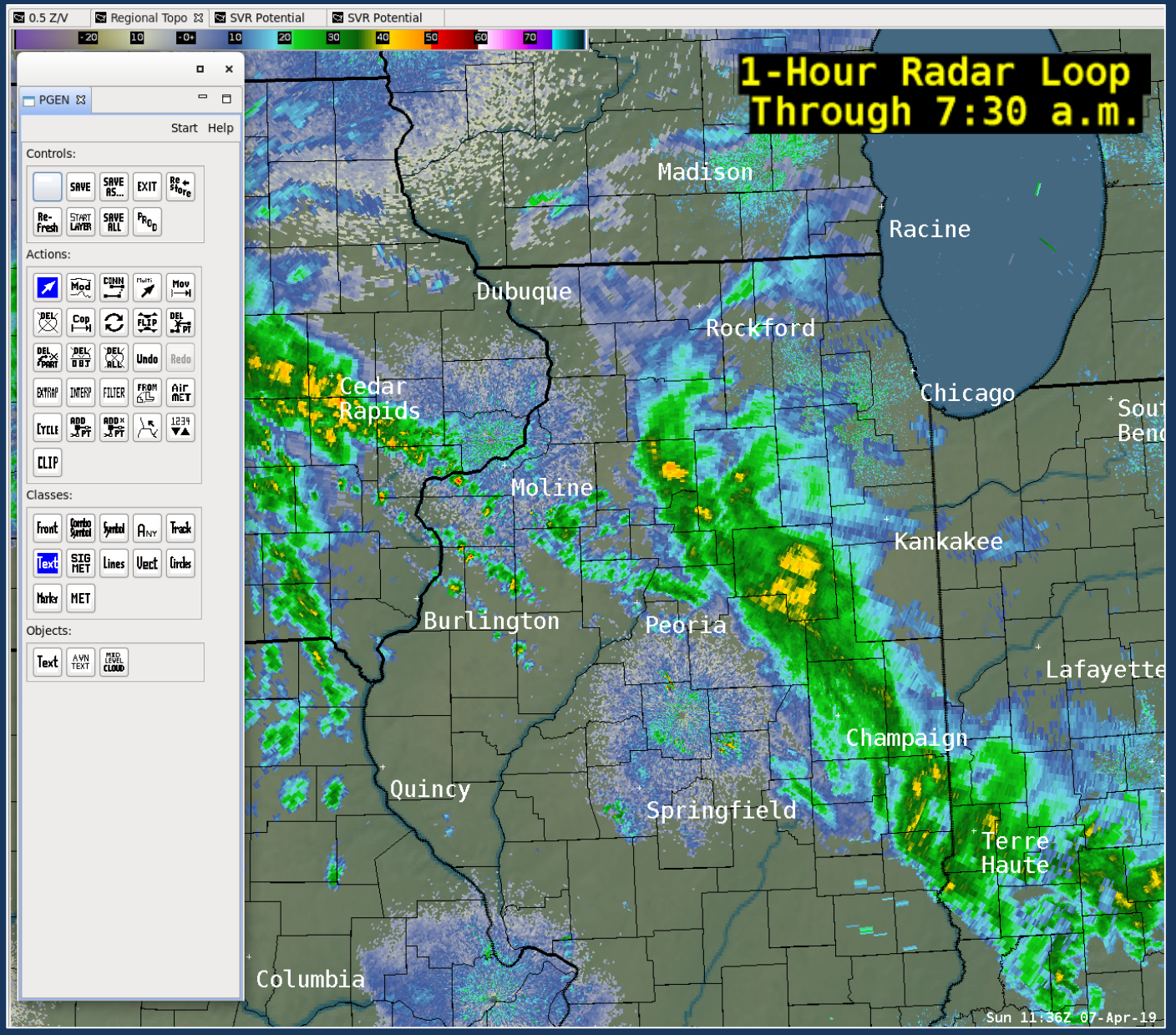
Alt: AWIPS if <24h old

IRIS



P-GEN in AWIPS

- Allows for some basic graphical interpretation
- Can be done on a loop



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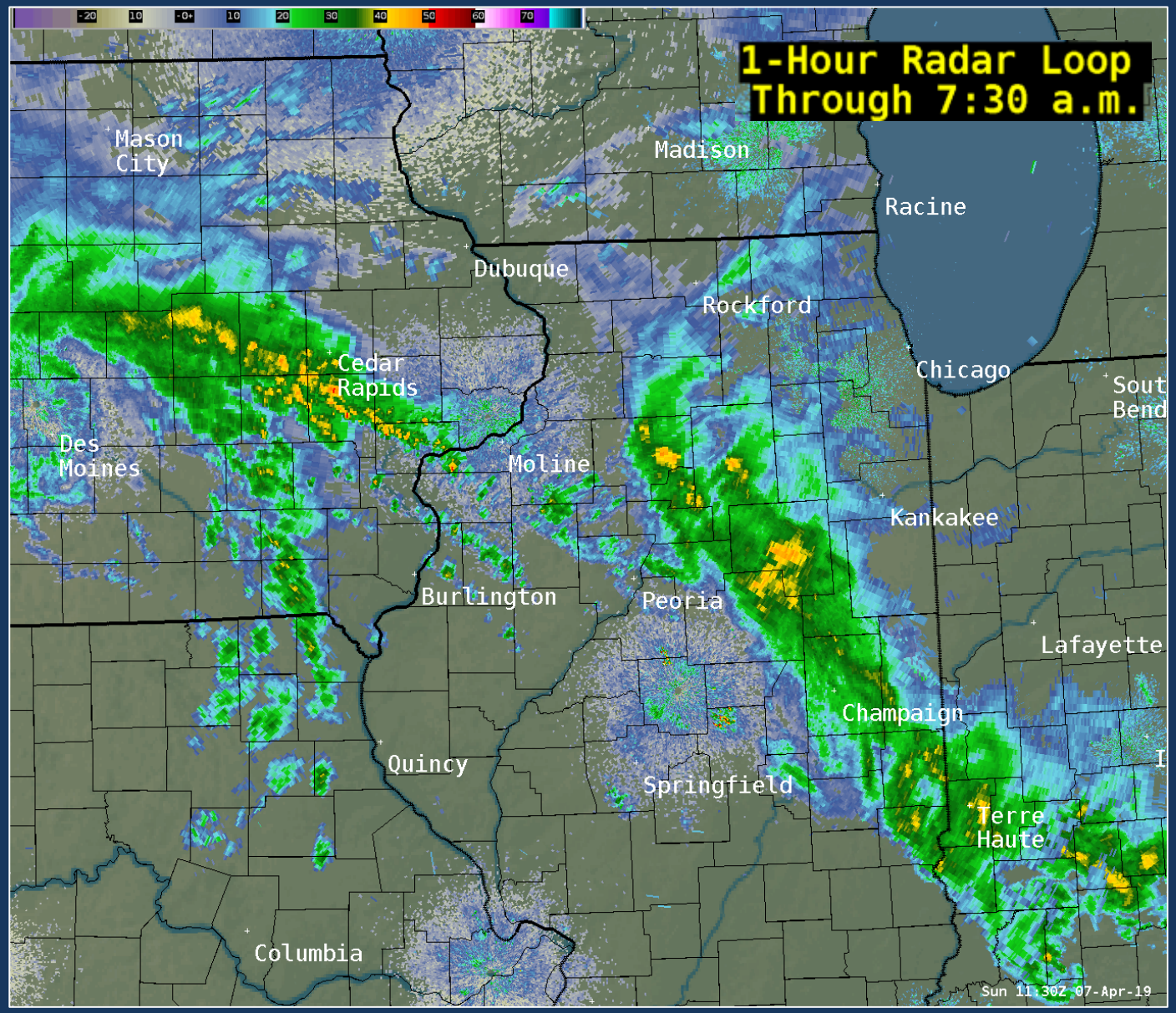

The Mesoanalyst

Core Science to Service Role

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