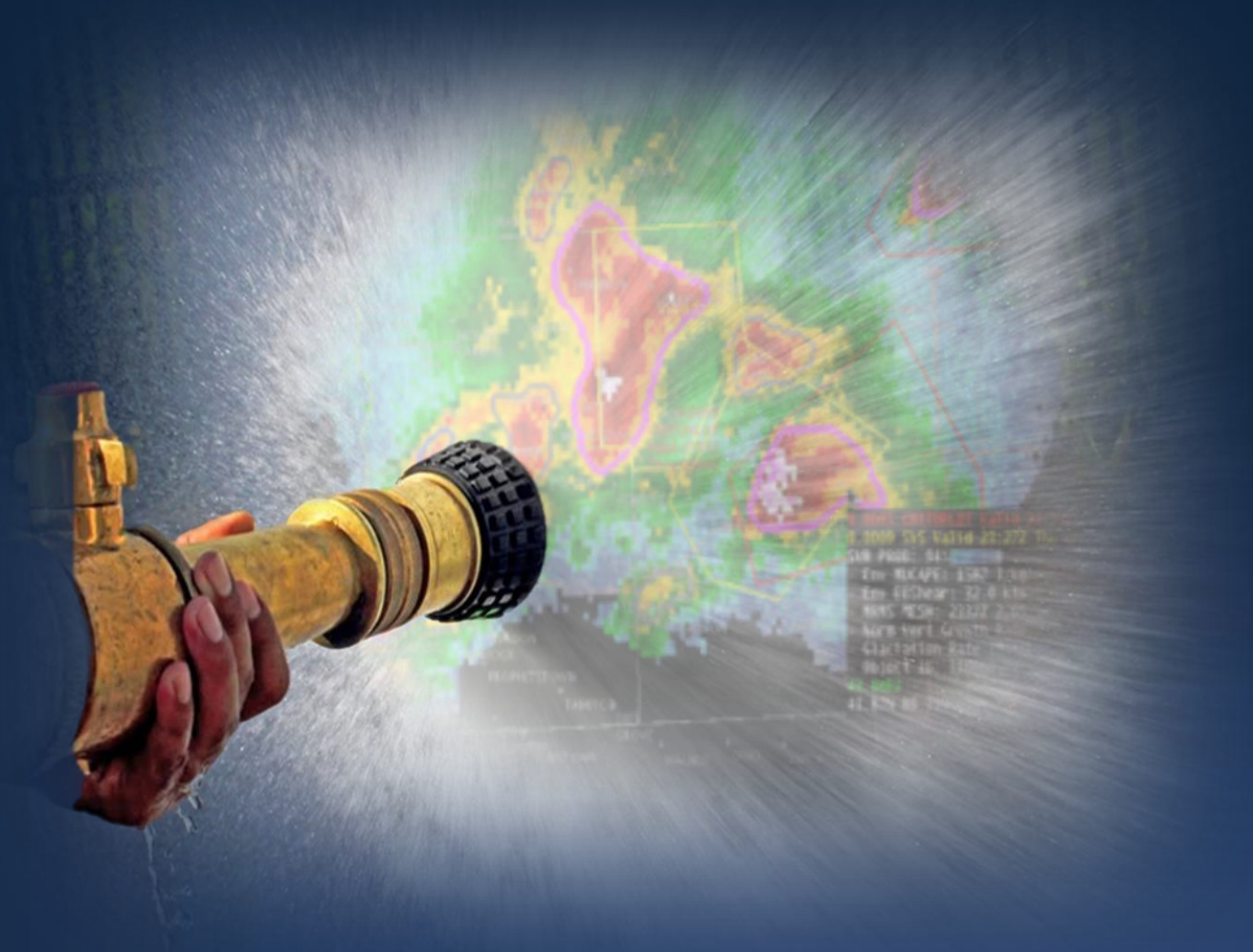
Managing and Effectively Using an Information Firehose During Severe Weather Warning Operations



Matthew Friedlein

NOAA / National Weather Service - Chicago, IL

Great Lakes Operational Meteorology Workshop

May 1-3, 2018

NWS Weather Forecast Office: Severe Ops

Severe Weather Operations Playbook Example

1
2
3
4

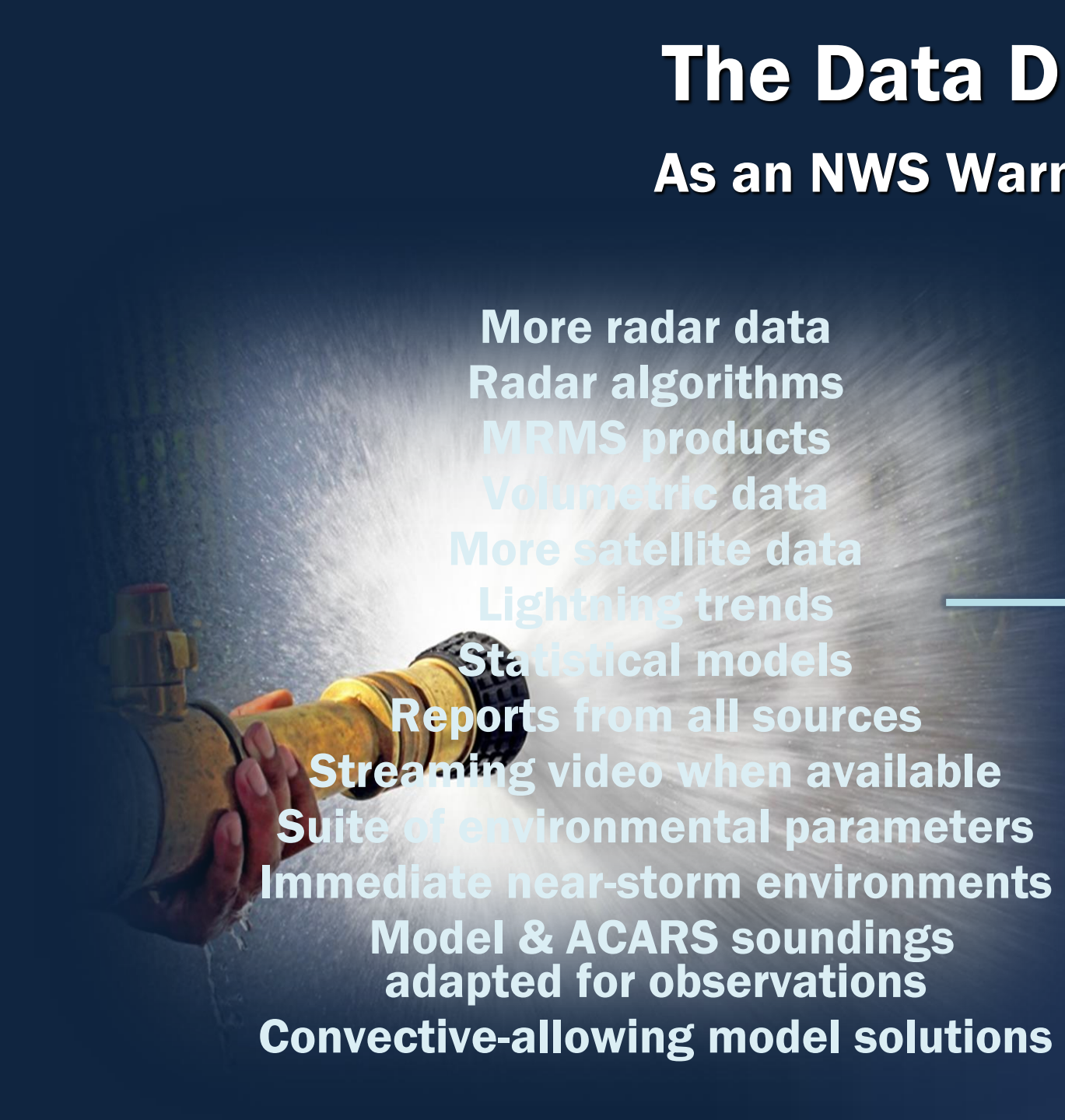
Operational Units	High Impact		Forecaster(s)	Coordination & Comms	Data Acquisition		
Roles assign as needed	Radar & Radar Asst for SVR & FFW	Mesoanalyst	Forecasters Incident Commander	PIO / Social Media Virtual DSS On-site DSS?	Verification & Social Media	Hydro & River	Obs QC & Climate
Staffing 4+ expand as needed	(or more)		(usually only 1 needed for evenings)	(3rd person for on-site DSS, if needed)	(if needed)		
Task assign as needed	- SVR - TOR - FFW - Sectorize? - Dedicated Flash Flood Analyst	- Mesoanalyst - Graphicast (coordinate w/DATAQ) - NWSchat push - SPC Colab - TDS & IBW monitoring - SPC Colab	- ESTF / Long term fcst - HWO - Aviation - Marine - Fire Wx - WCN's - Airport notifications	- DSS Events - Email & SitRep - Webinar - SA Setup - Talking Points - NAWAS - EOC Briefings - Social Media Push - Interviews - NWSchat Monitor	- Data Acquisition/QC - Monitor BMH - AHPS River Gauge QC - Phone Calls - Climate - Social Media - NWSChat Reports - Issue LSR's - Graphicast (asst mesoanalyst)		

Message foundation → **Messaging**

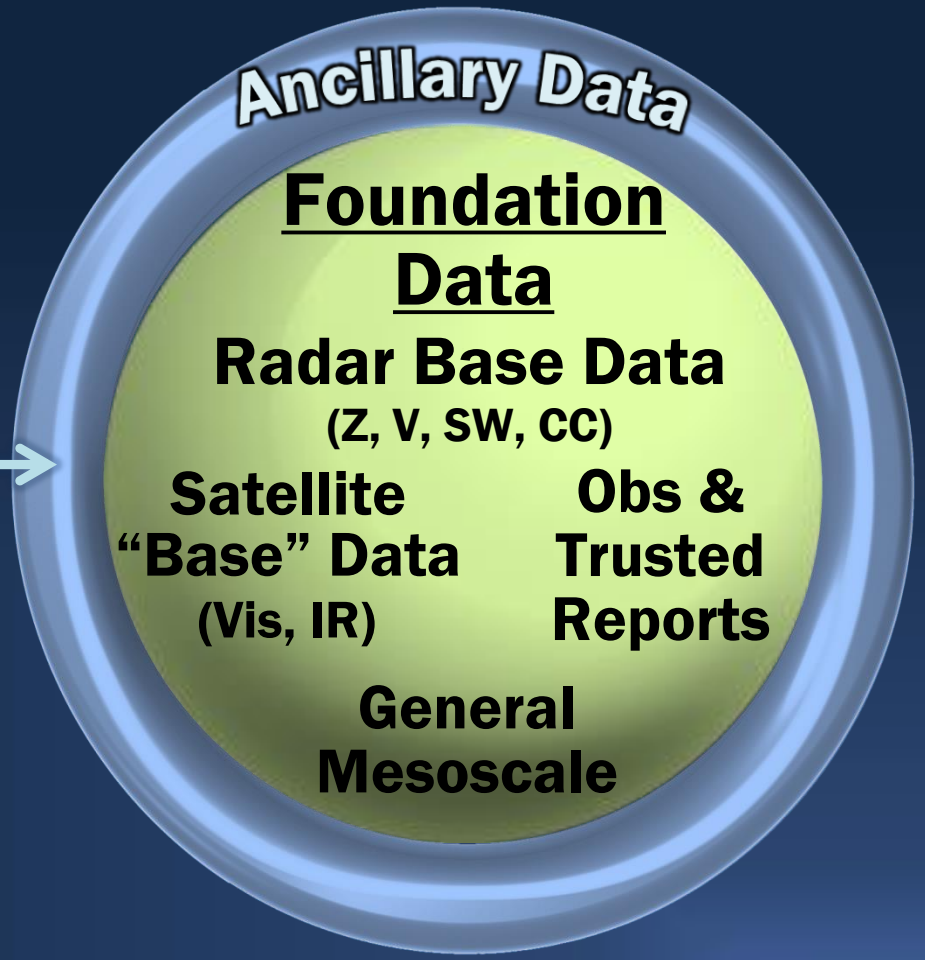
Scientific data ← ***Public data***

The Data Dilemma

As an NWS Warning Team…



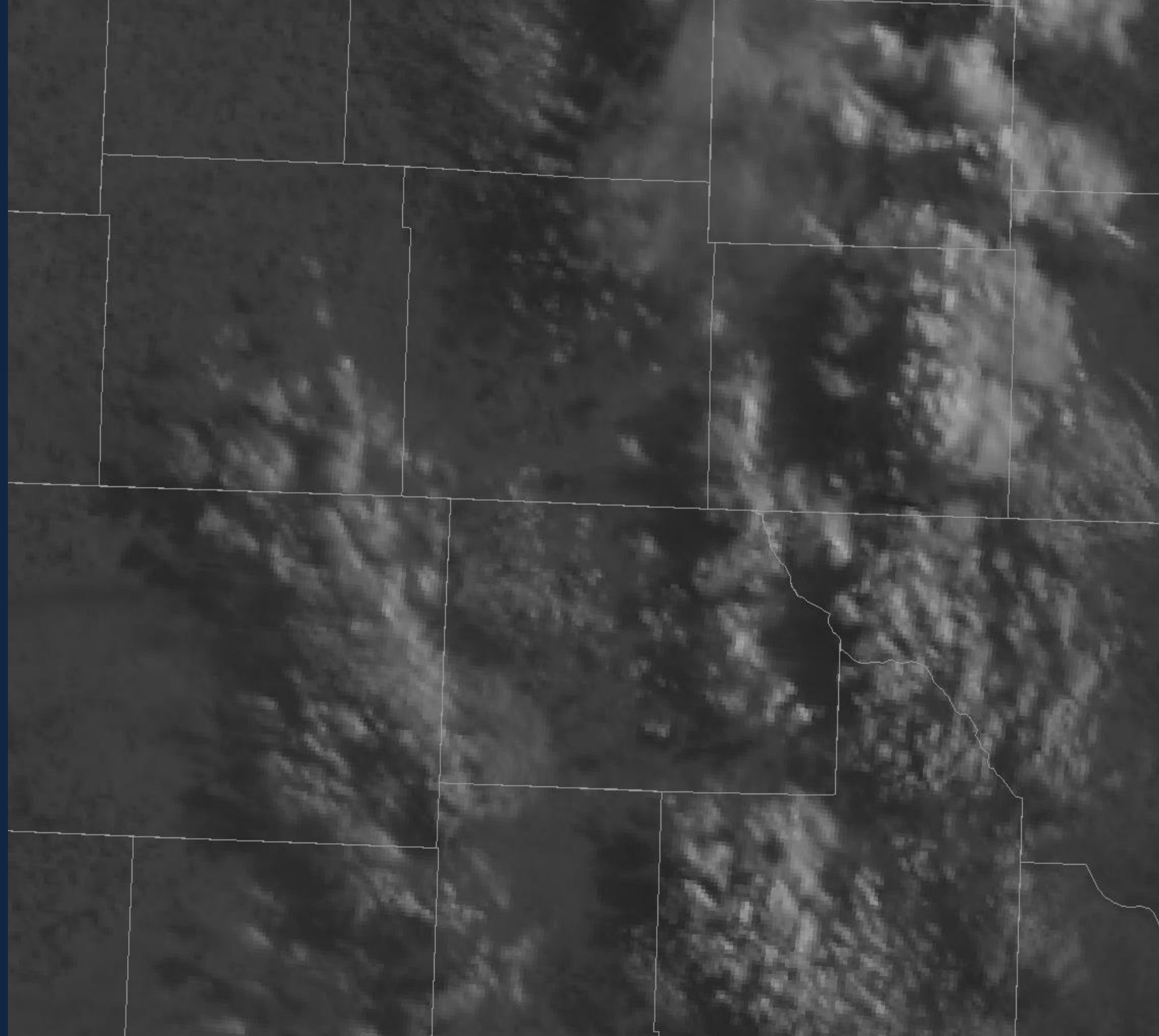
More radar data
Radar algorithms
MRMS products
Volumetric data
More satellite data
Lightning trends
Statistical models
Reports from all sources
Streaming video when available
Suite of environmental parameters
Immediate near-storm environments
Model & ACARS soundings adapted for observations
Convective-allowing model solutions



What they must look at and consider

Foundation Data Frequency

- Radar SAILS scans (supplementary 0.5° scans)
- GOES-16 meso sectors



Is it a Data Dilemma?

- **Better informed**

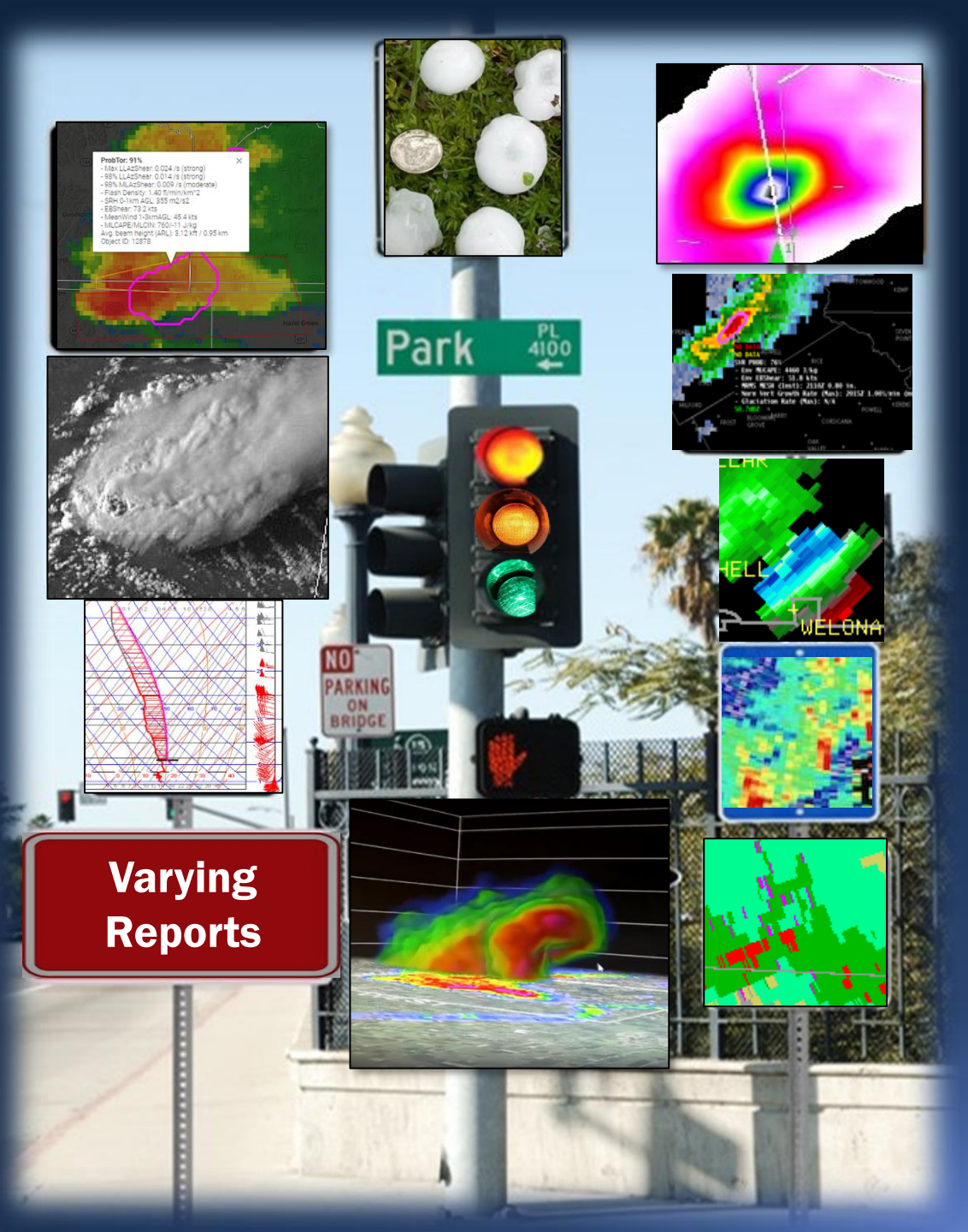
  "Information is addicting" – Psychology Today, 2012

- **More confident**

  "As data continues to grow exponentially, useful information remains elusive" – Frank & Magnone, 2011

- **More certain**

  "Base decisions on valid processes, sound radar/environmental analysis, and corroborated reliable reports" – NWS CR TWIP, 2017



The Data Dilemma

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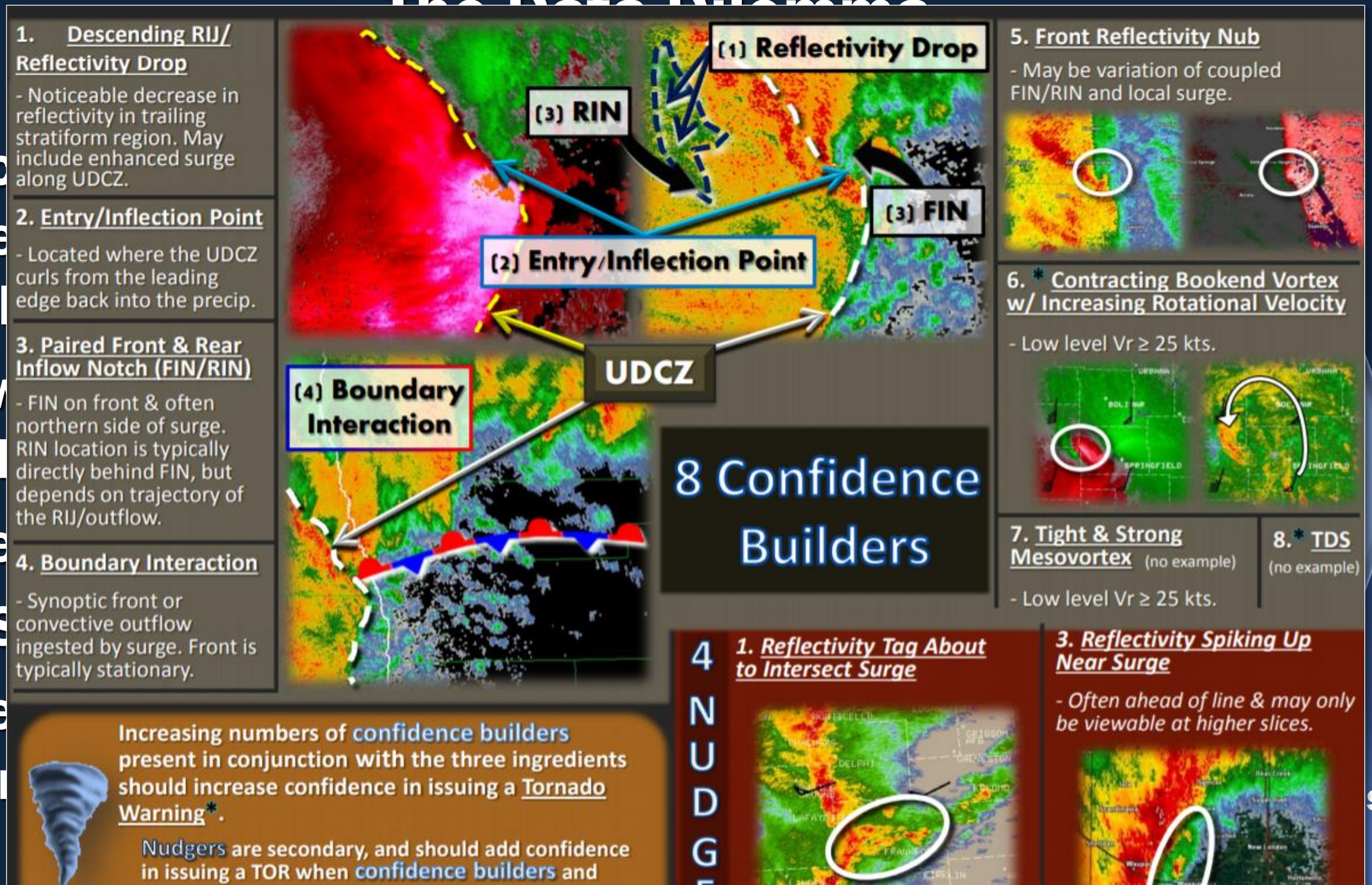
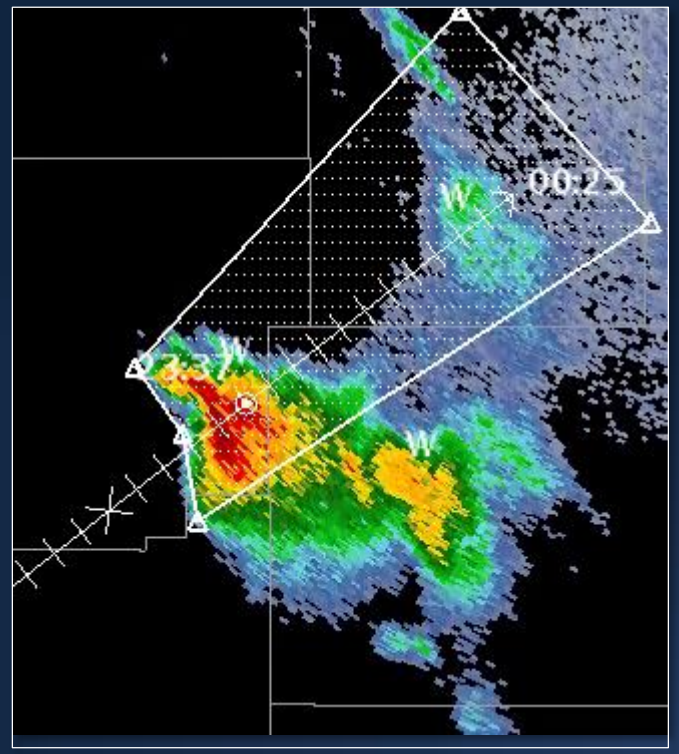
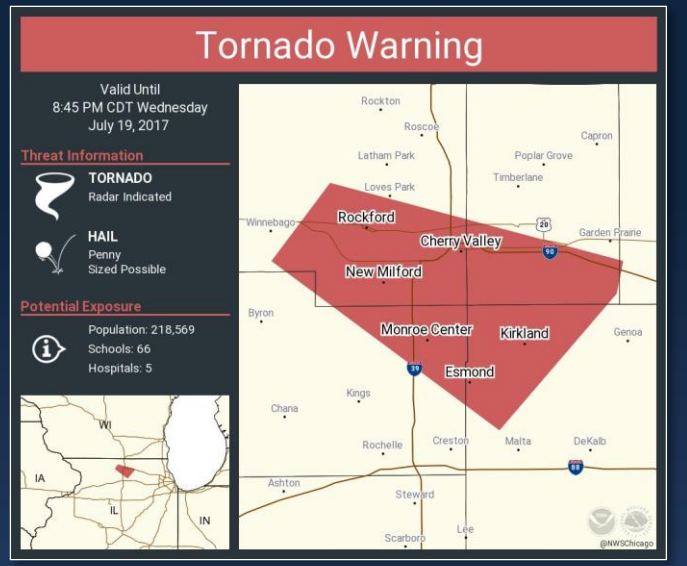


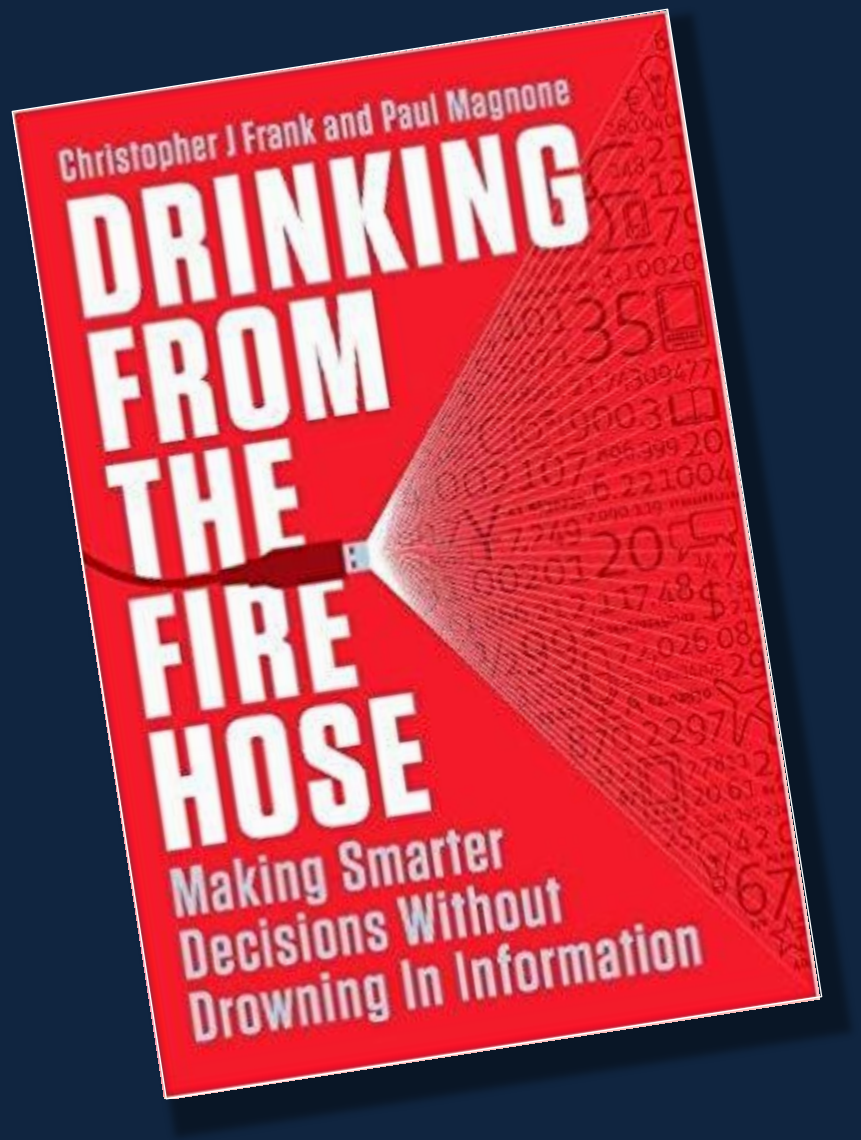
Critical Decisions Have to be Made

Channeling rivers of data into actionable insights





Managing Data



- Focus on answering the question of what is the most vital data
- Many data are relevant in active weather, only some vital to the decision that needs to be made
- Think of the question(s) as a valve, or a filter, on the data fire hose
- The answer changes though

Managing Data

Data → Information → Insights

Measurements

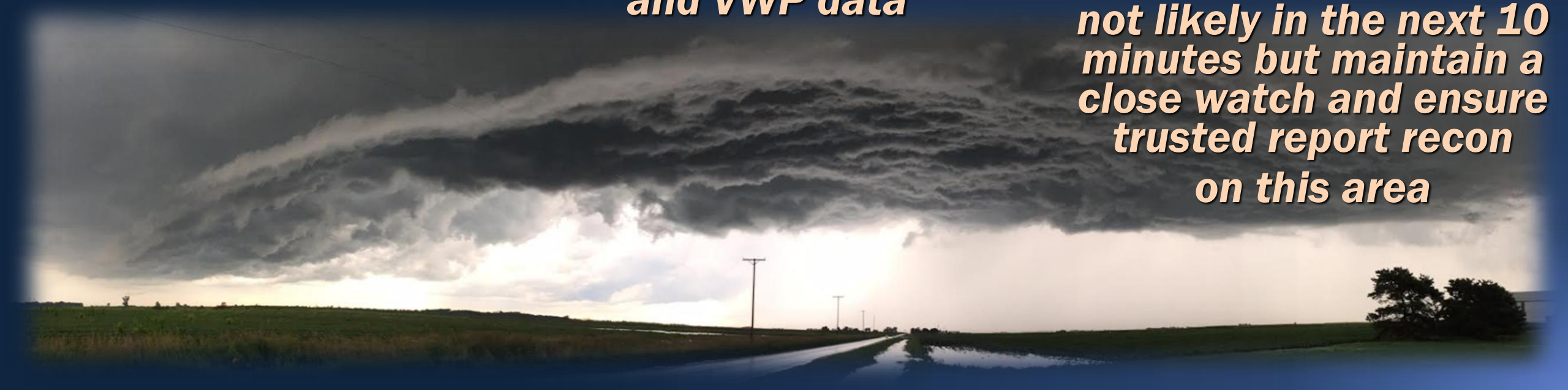
Rotational velocity of 35 kt at 4,500 ft

Analysis & Interrogation

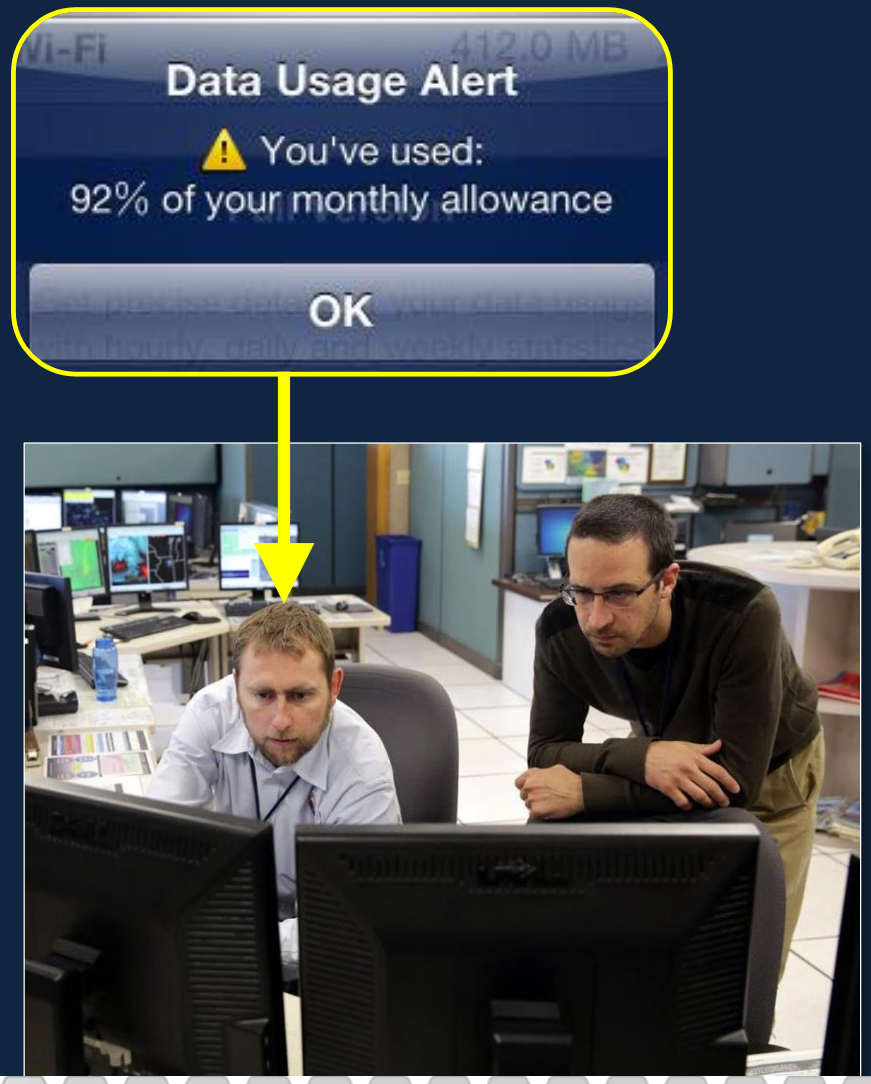
Broad, held steady for a while, 0-1 km shear of 10 kts, verified in part by nearly calm surface winds and VWP data

Actionable

While a supercell, this information and no boundary interaction with my experience indicates a tornado is not likely in the next 10 minutes but maintain a close watch and ensure trusted report recon on this area



Strategy to Managing Data



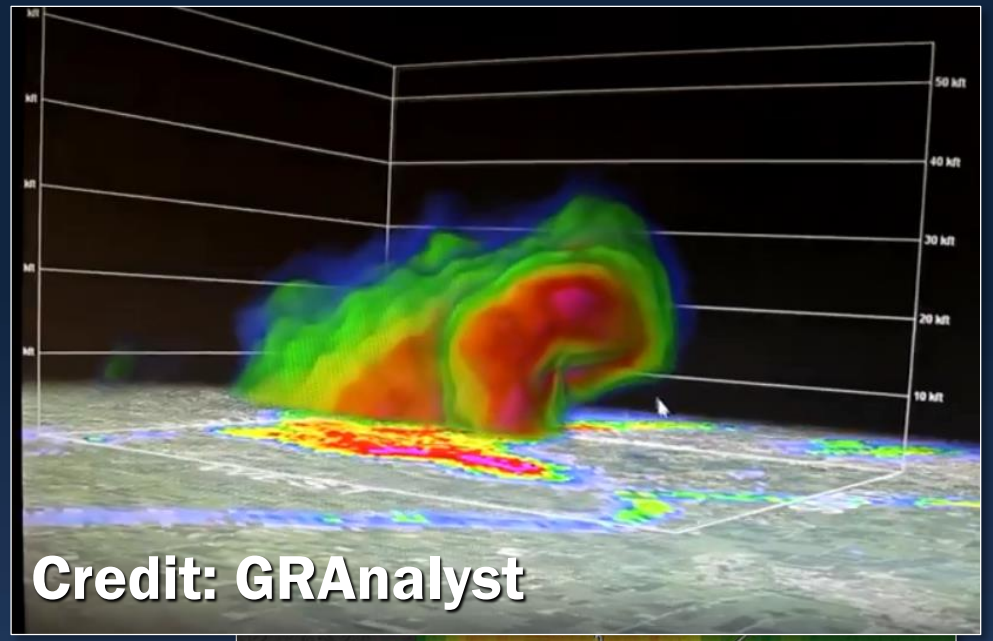
- Perceptive, selective data analysis
- Streamlined interrogation – focus on the goal
- Want it to be informative and actionable

Data That Informs

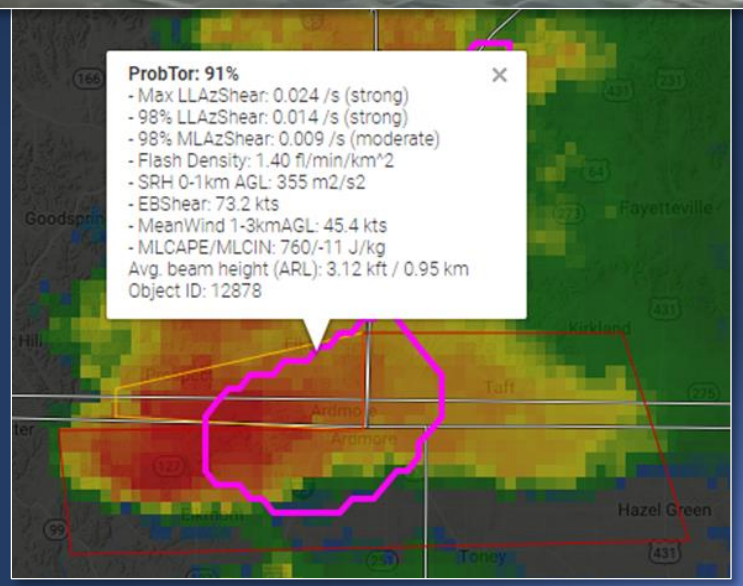
- At least some datasets are needed depending on situation

- Needed for
  - S.A. of storms and environment
  - Accurate and quality short term predictions and strong IDSS
  - Confidence in warnings & IDSS

- Strongest ancillary data: those that combine radar and environment data

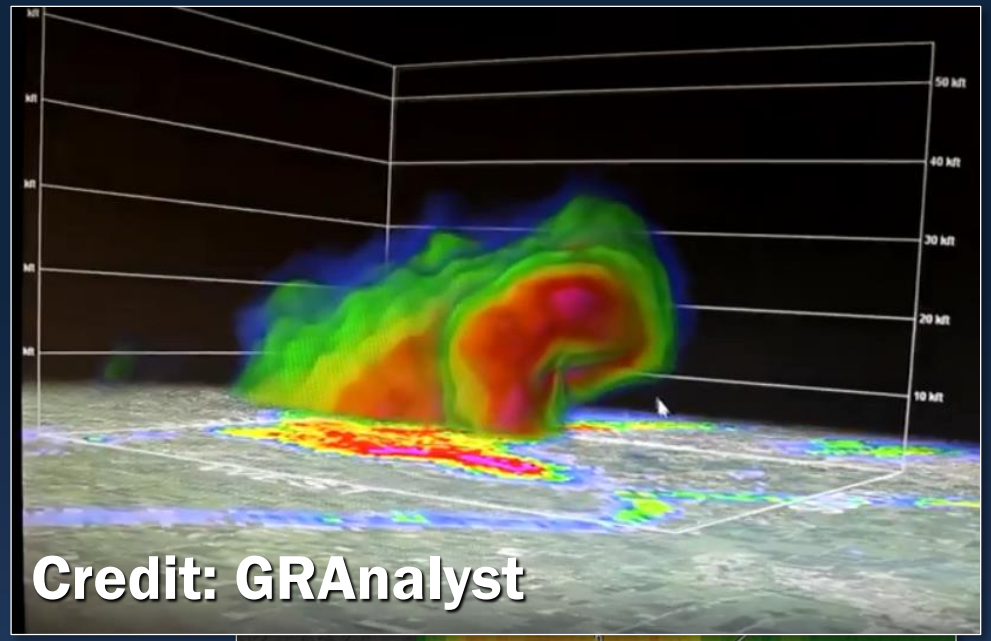


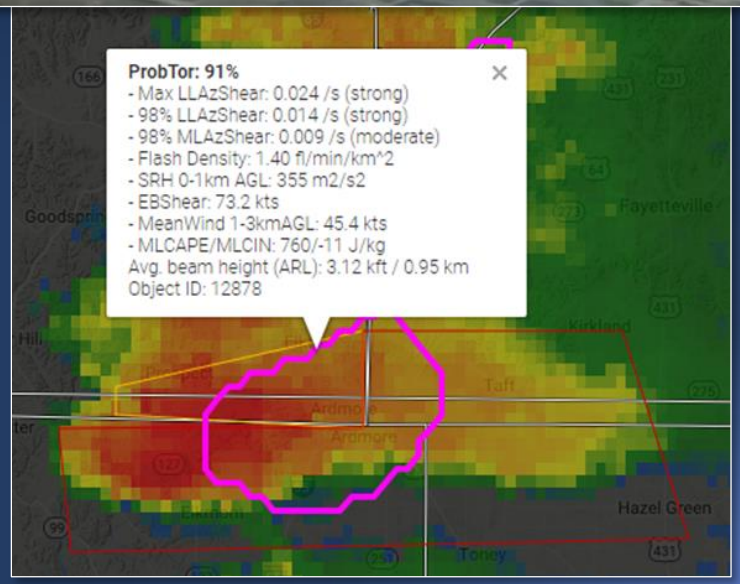
Credit: GRAnalyst



Data That Informs

- Trained statistical models (ProbSevere)
- Multi-Radar/Multi-Sensor System (MRMS)
- Volumetric data
- Near-storm environment datasets

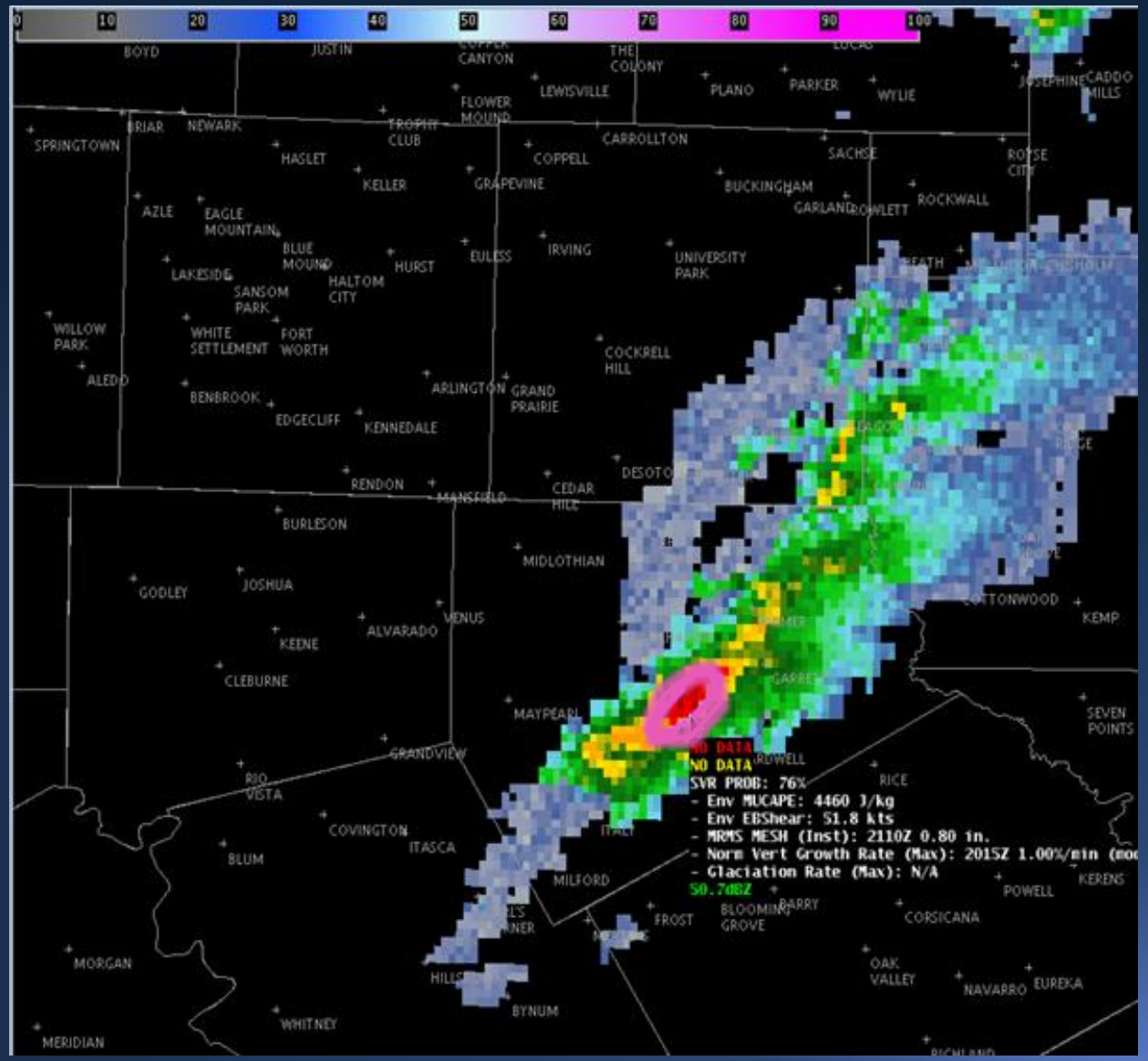




Trained Statistical Model: ProbSevere
From CIMSS

- Consolidate key observations and data into one “quick-look” product
- Accounts for some key environment fields (MUCAPE & effective bulk shear), satellite (growth & glaciation rates), radar (MRMS MESH), and lightning trends
- Model predicts probability of whether a storm will first become severe in the next 60 min using a trained dataset

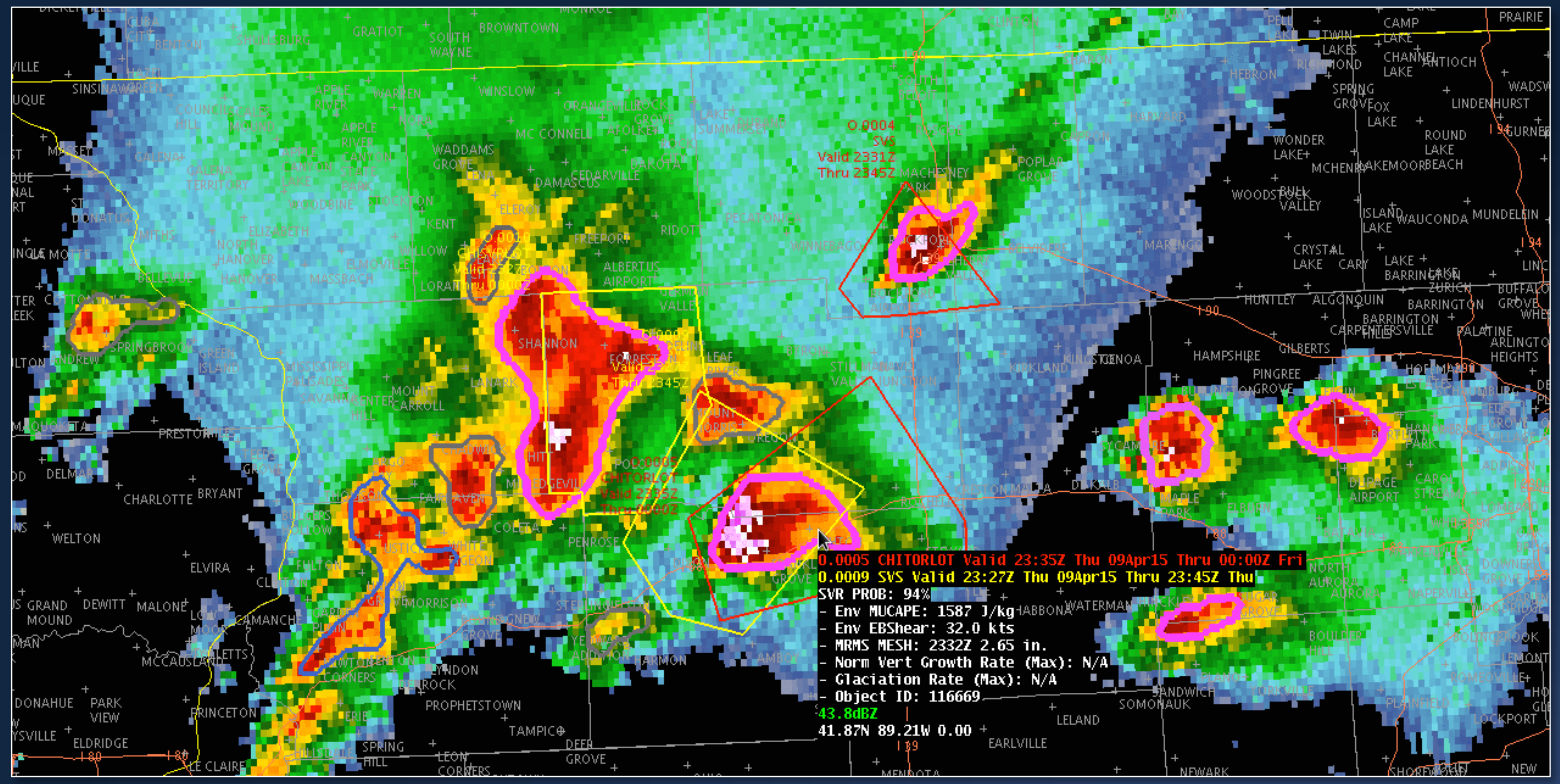
$$P(C_{severe}|\mathbf{F}) = \frac{P(C_{severe}) \prod_{i=1}^{N} P(F_i|C_{severe})}{P(\mathbf{F})}$$



Data That Informs: ProbSevere Model

- **NWS: Overlay field in AWIPS for radar or satellite**

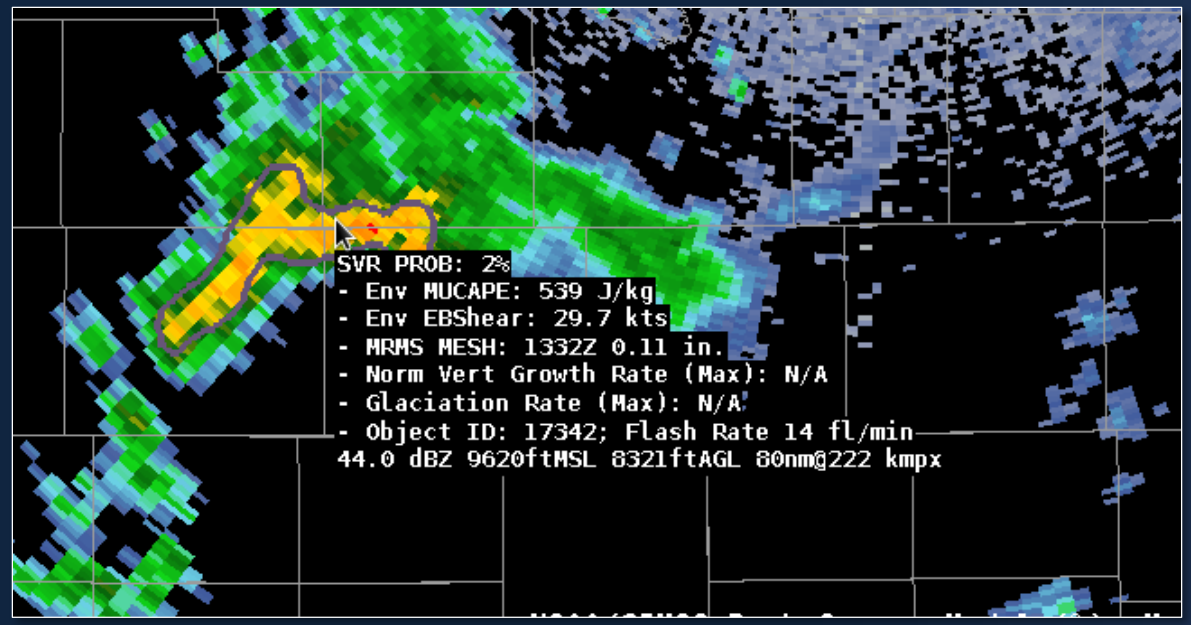
- **Radar loop overlay**
  - **Warning team: strongly encouraged at beginning of deep convection event and when numerous storms to monitor**
  - **Mesoanalyst: strongly encouraged**
  - **Encouraged also for general convection**

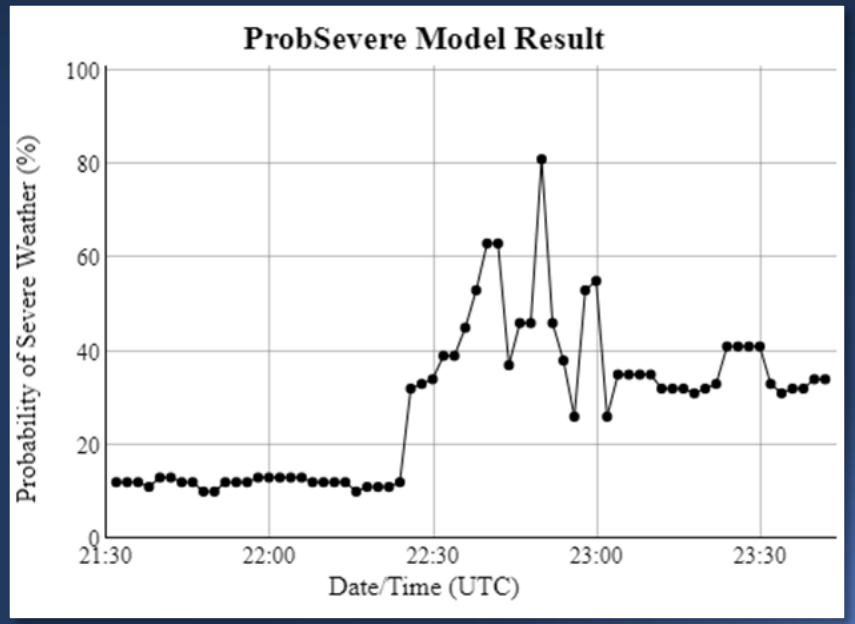


Data That Informs: ProbSevere Model

- Still evaluating; ideal for S.A. and trend monitoring
- GOES-16 data is being ingested into this
- Can view on the web as well

  cimss.ssec.wisc.edu/severe_conv/probsev.html

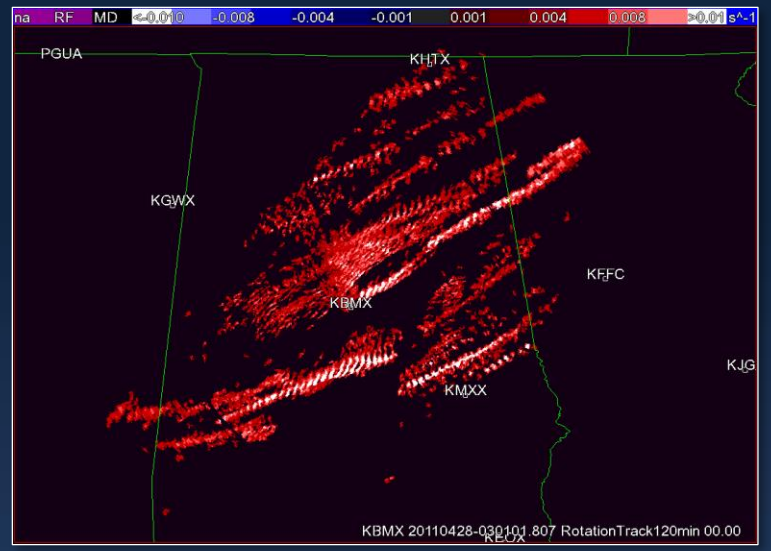


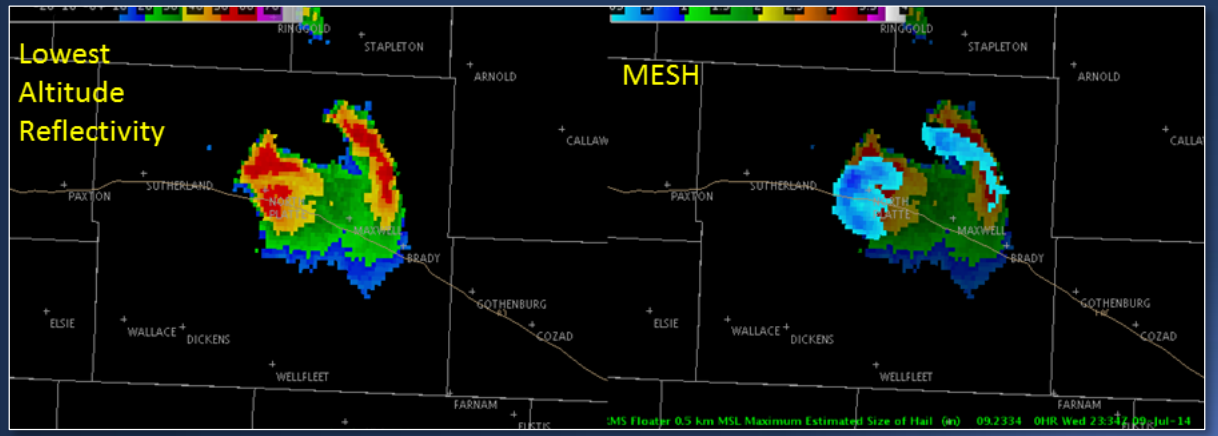


Data That Informs: Multi-Radar/Multi-Sensor System

MRMS

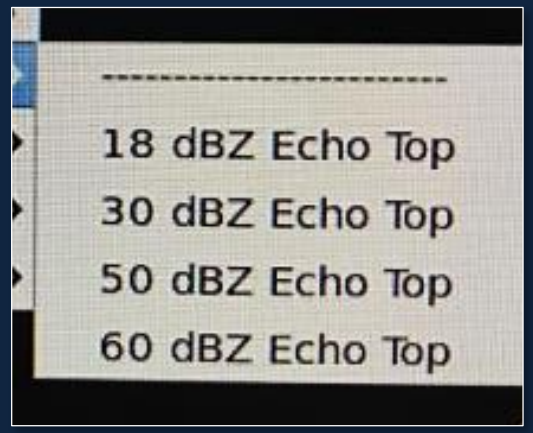
- Decision-making assistance using both radar and environment
- Mosaic derived and composite radar
- Can provide volumetric information, storm attribute trends, and “quick-look” hail threshold data

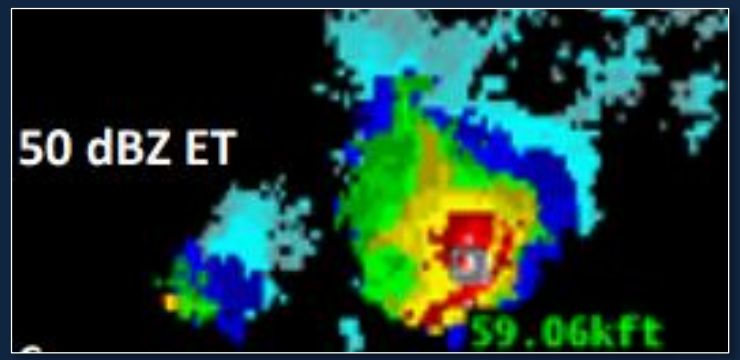




Multi-Radar/Multi-Sensor System

MRMS





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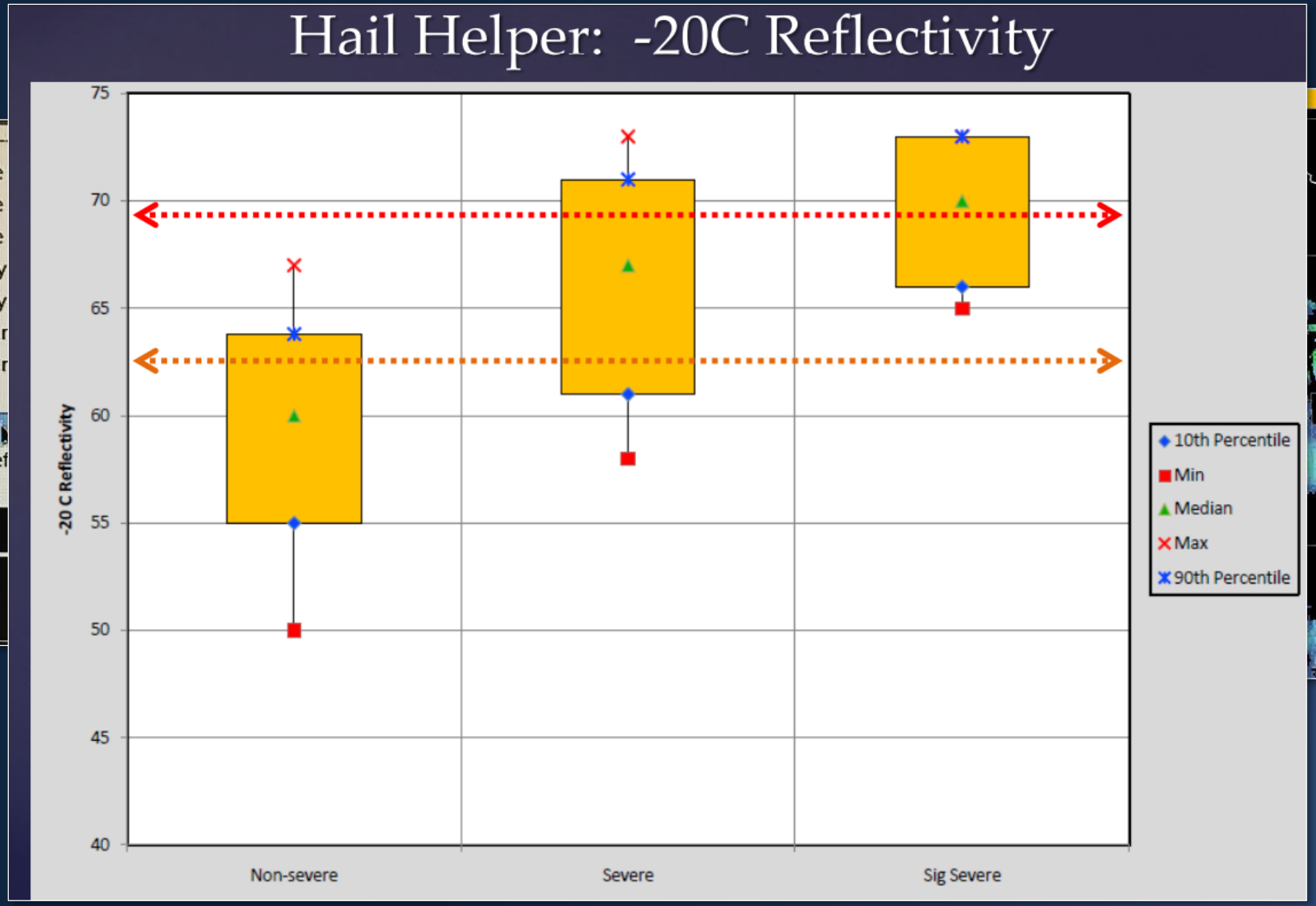
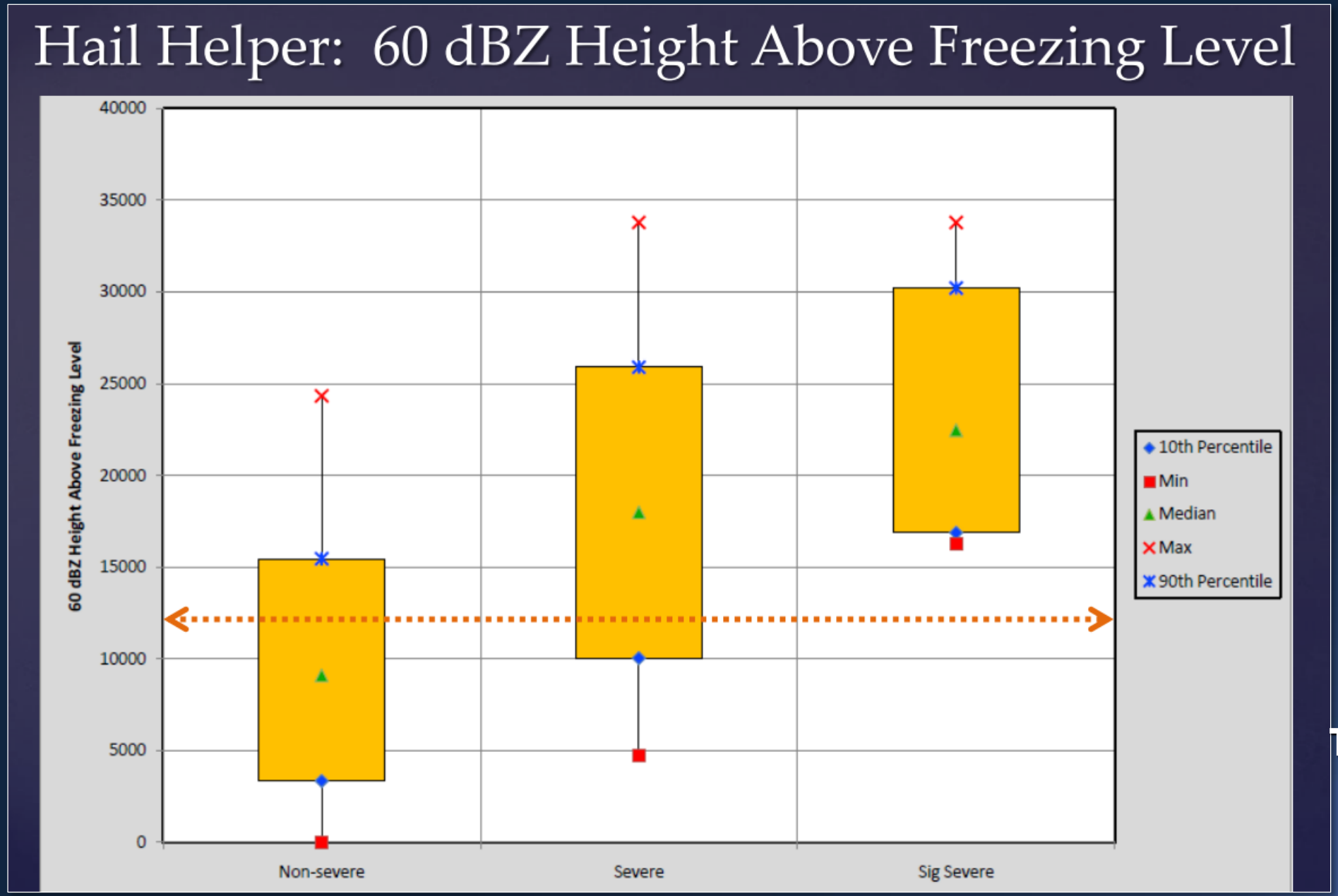
Multi-Radar/Multi-Sensor System
MRMS



Local NWS Twin Cities, MN Study

Hultquist & Hiltbrand, 2009

Multi-Radar/Multi-Sensor System



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Multi-Radar/Multi-Sensor System
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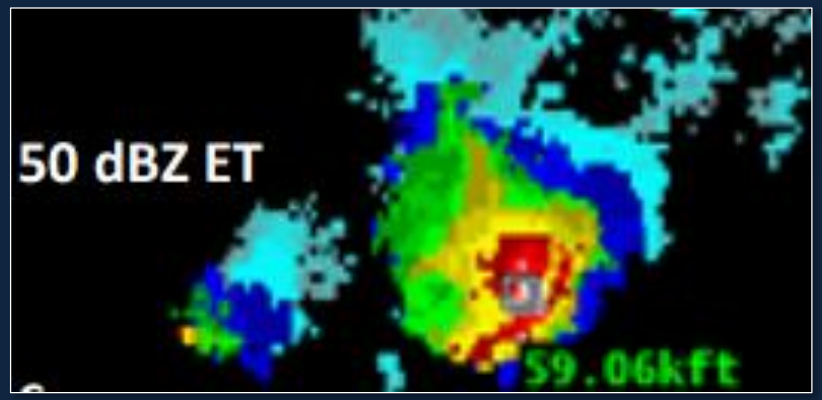
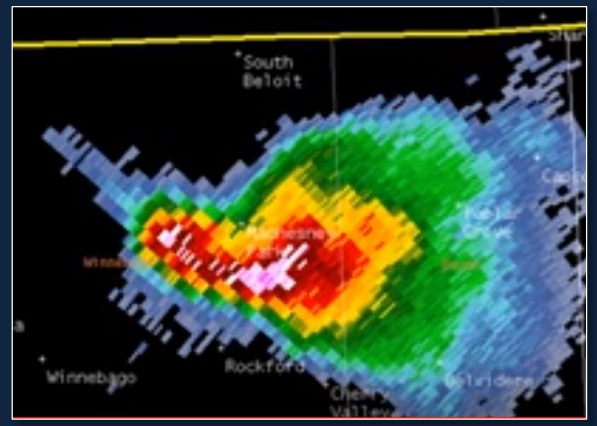




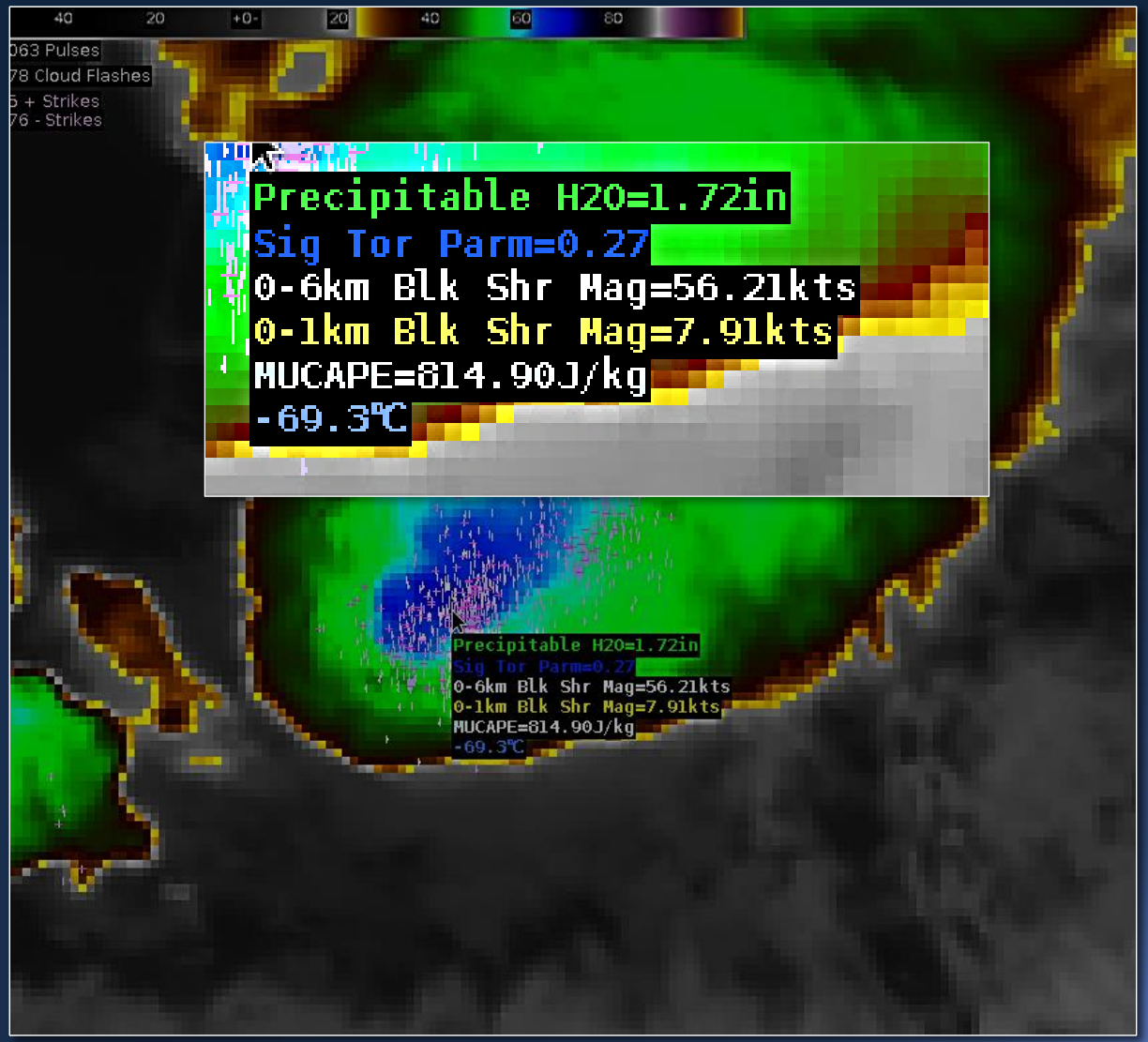
- Again strong for S.A., especially hail
- Post event operations
- Issues: Latency, and less so resolution
- Not a replacement for base data

Data That Informs: Near-Storm Environment Analysis

NSEA

- **NWS: In AWIPS, developed to facilitate increased near Storm environmental awareness by displaying critical mesoscale parameters in conjunction with radar or satellite data**

- **Cursor readout; sampling with mouse scroll**

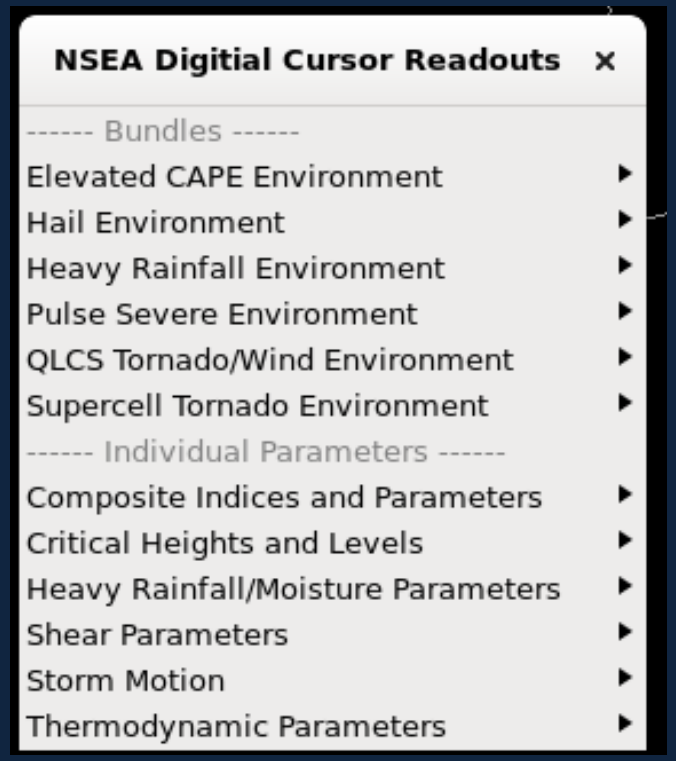


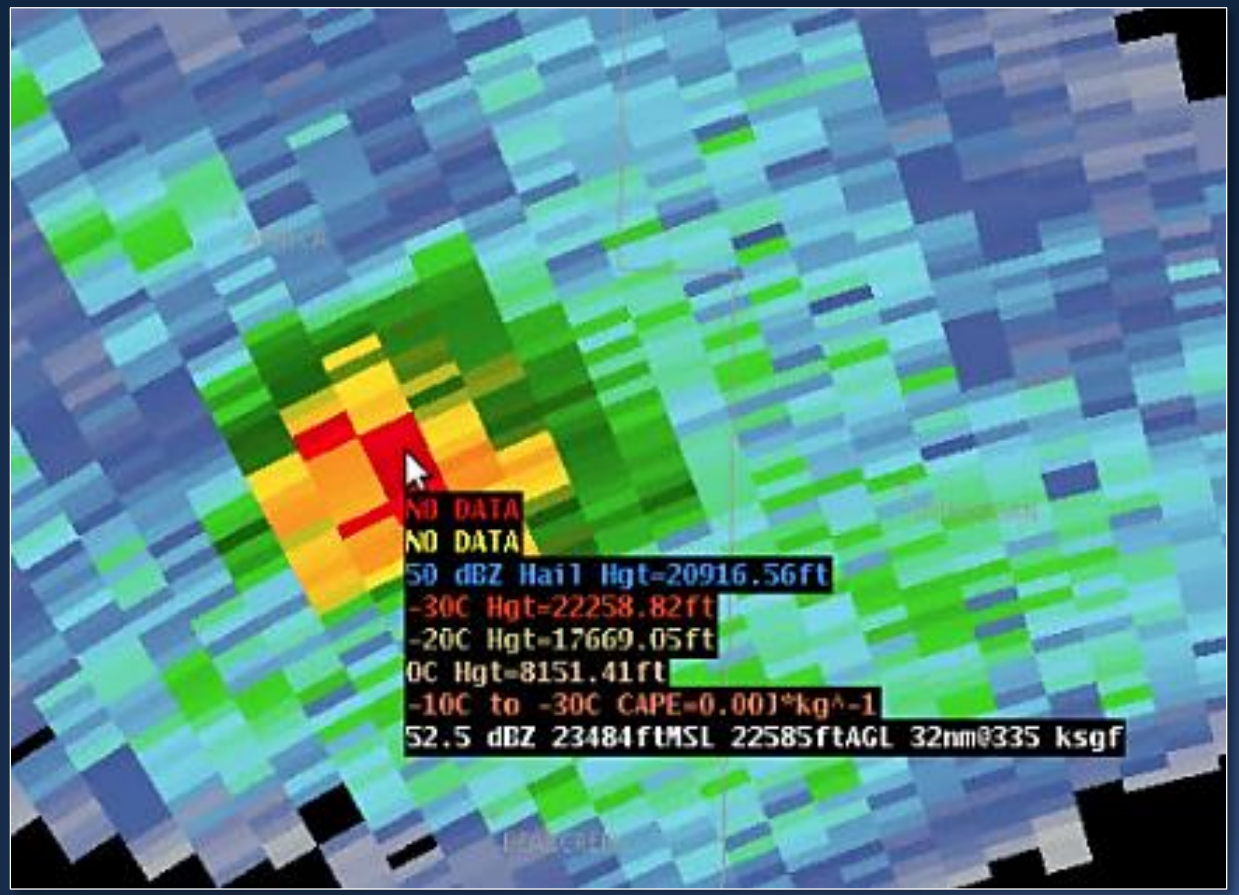
Credit: NWS CR Tornado Warning Improvement Project (TWIP)

Data That Informs: Near-Storm Environment Analysis

NSEA

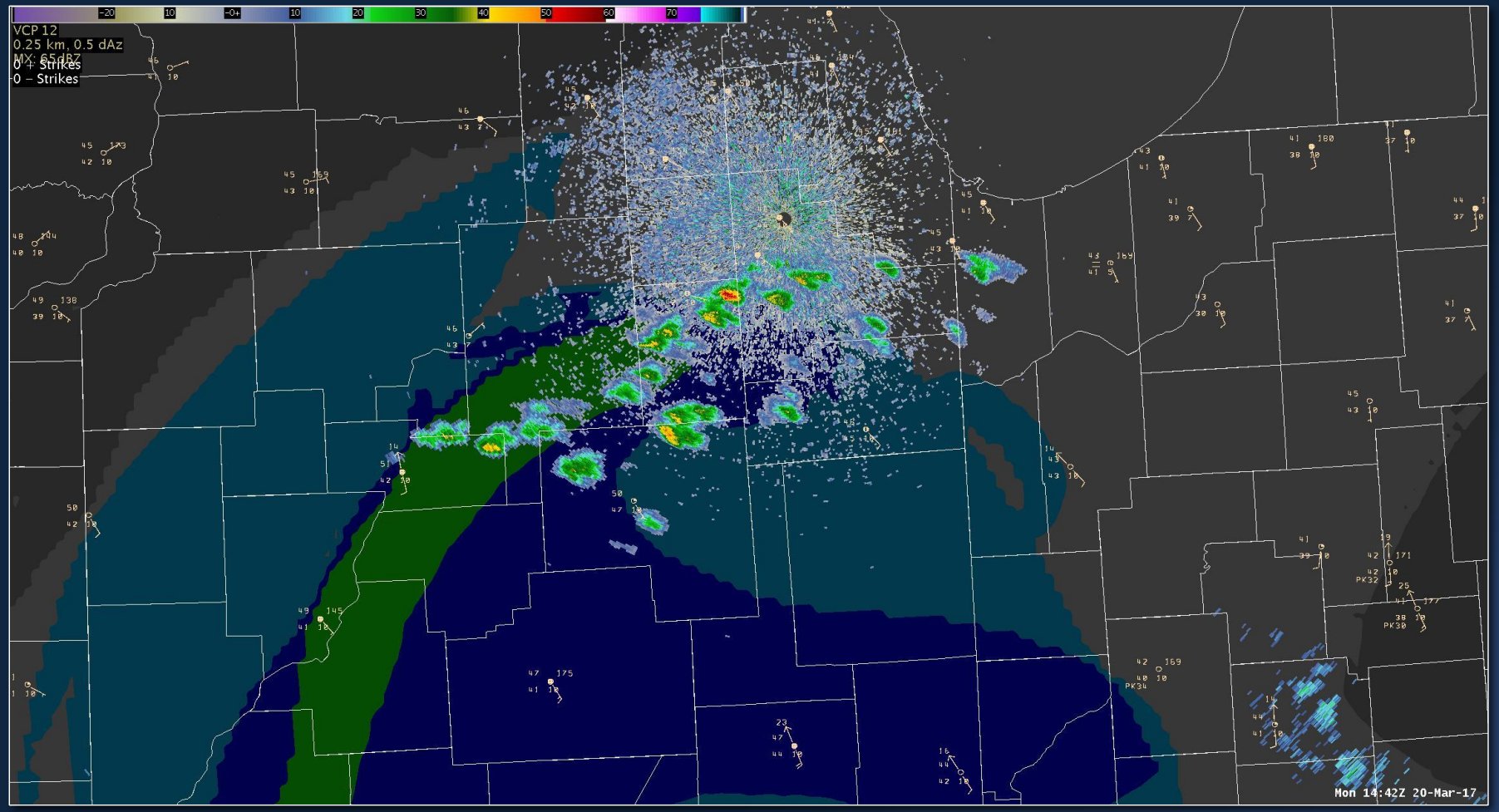
Preset data for scenarios

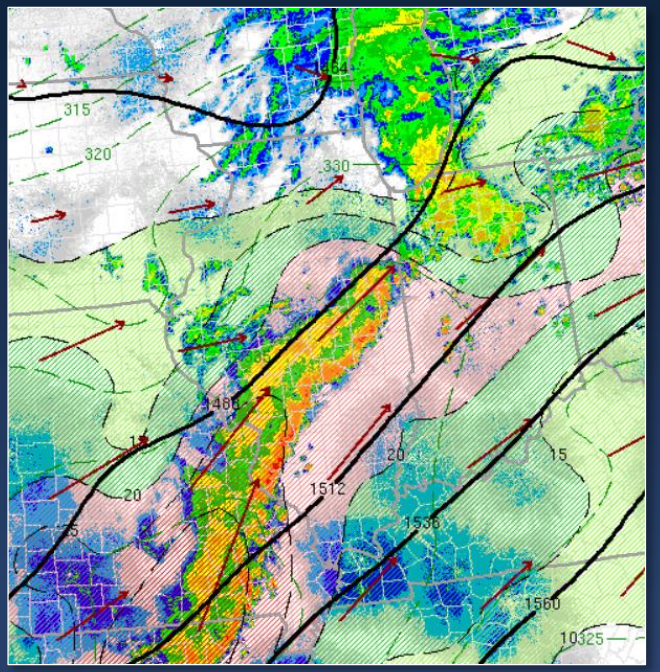




Credit: NWS CR Tornado Warning Improvement Project (TWIP)

Data That Informs: Radar with Spatial Environmental Parameters





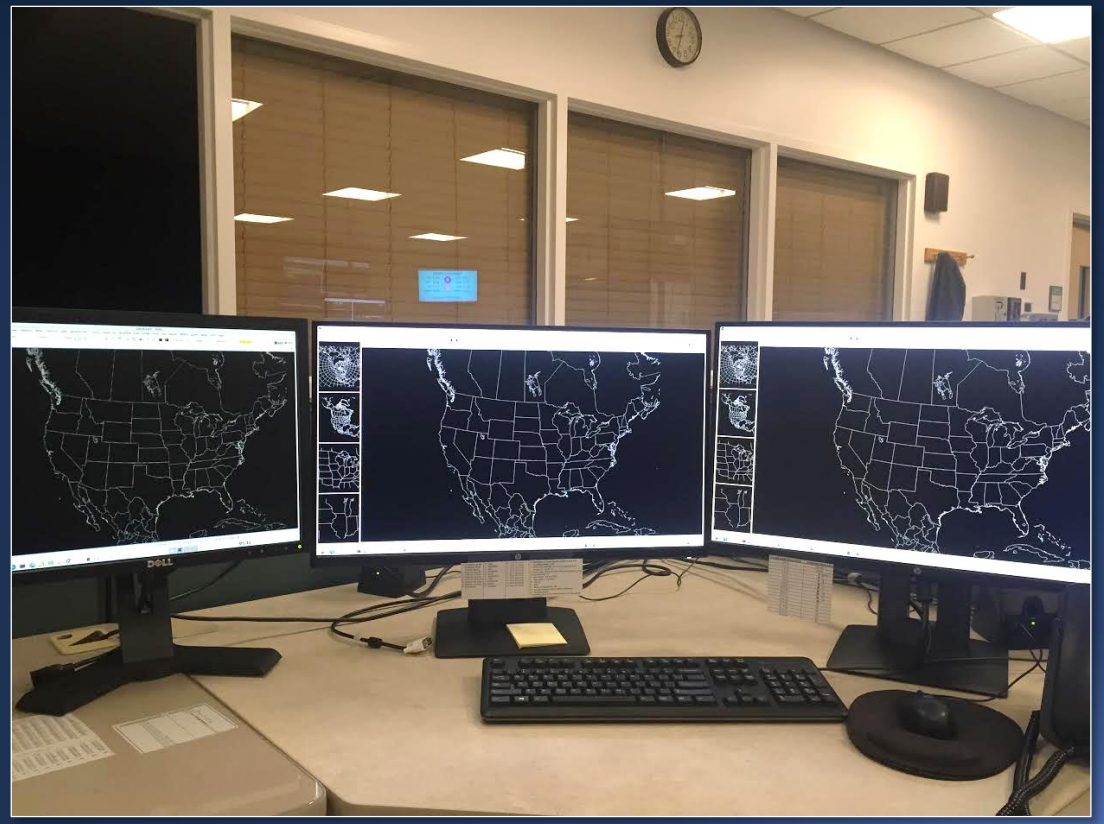
Most ideal for mesoanalyst

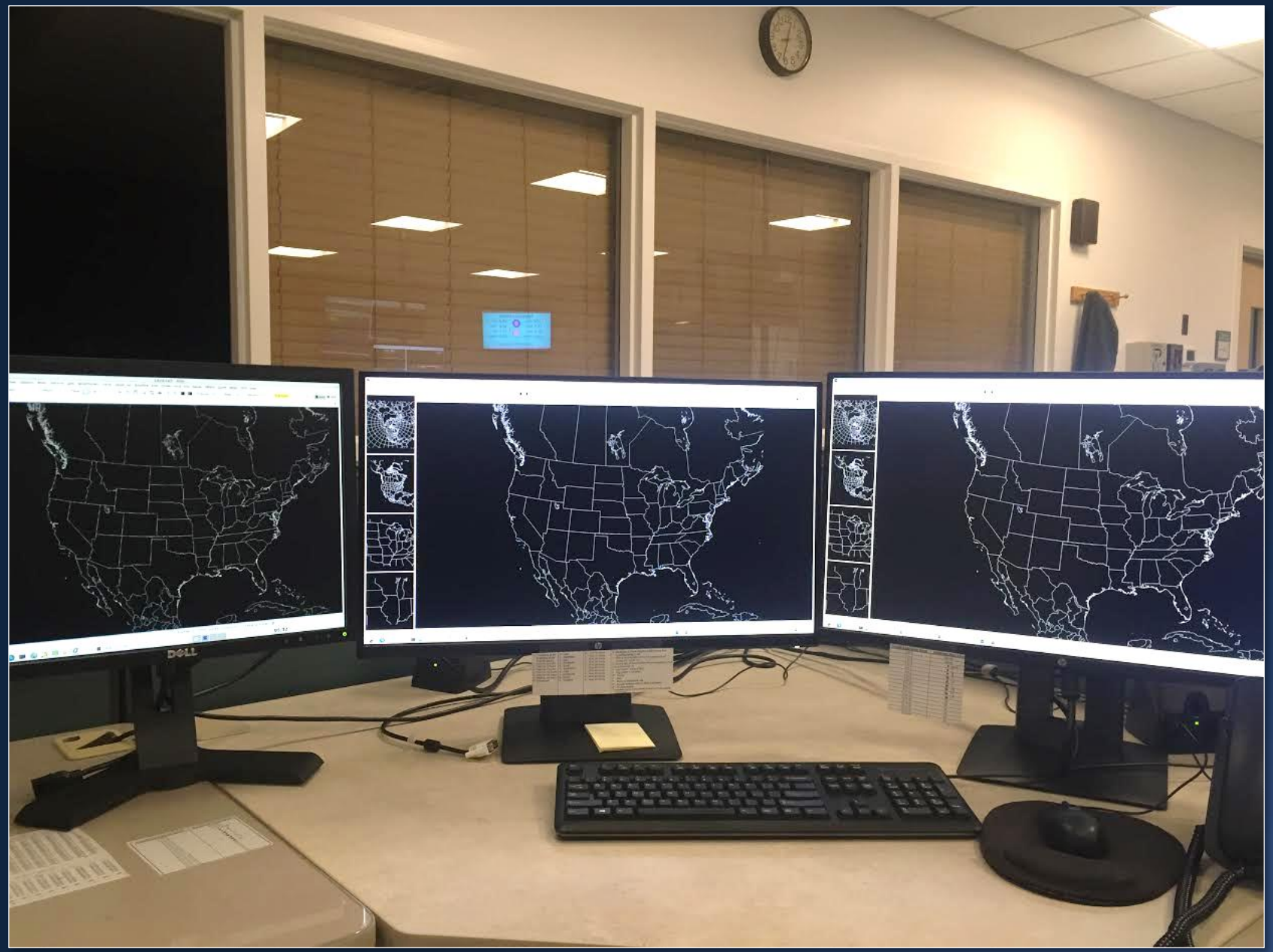
Getting to Insights / Decision-Making

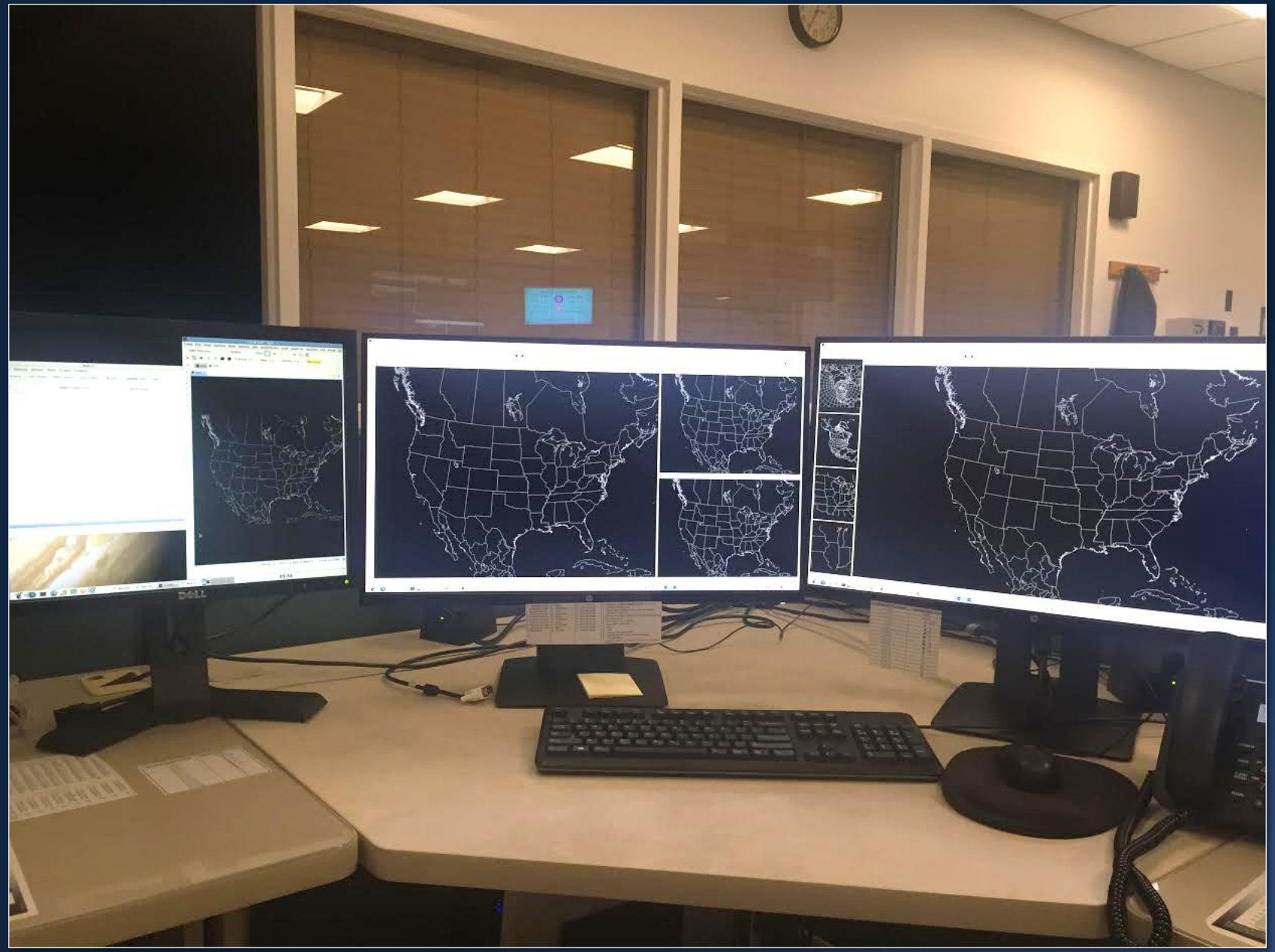
- Data and information organization is essential in the discipline of warning operations, and in weather in general!
- Pre-planning data layouts and interrogation strategies
- Practicing them, learning from others, and sharing

Getting to Insights / Decision-Making

- Traditional layout on three graphics monitors as encouraged by the NWS WDTD has been:
  - Radar interrogation
  - Situational awareness / mesoscale
  - Radar loop / issuing warnings
- Comfort with layouts must be established before an event!




DELL

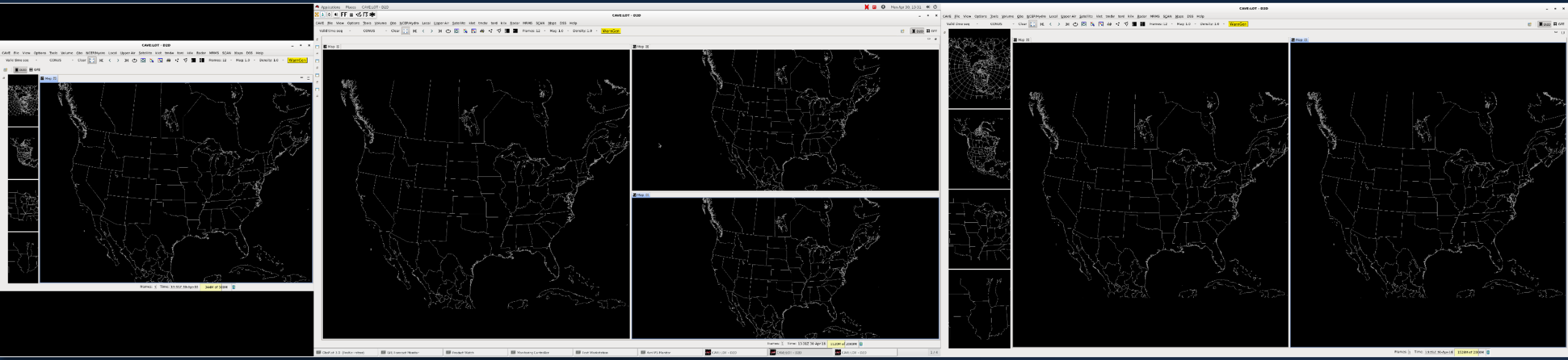


Warning Operator Needs

Storm Interrogation	Warning Issuance / Radar Loop	Situational Awareness / Mesoscale
All-Tilts (with NSEA)	0.5° reflectivity/velocity loop with ProbSevere & NSEA	Satellite (a MUST now!) and observations
Individual radar angles in 4-panels (or 6 or 9-panels)	Warning software	Environmental parameters in plan view
Dual-pol fields (TDS, hail presence, ZDR columns)		Observed / model soundings
Possibly satellite		Regional radar loop
Neighboring radars & TDWR		MRMS for storm characteristics
Rainfall intensity and amounts		FFMP

Hydroanalyst can assist | Least amount of items | Mesoanalyst assists

NWS Layout Ideas to Assist Data Management

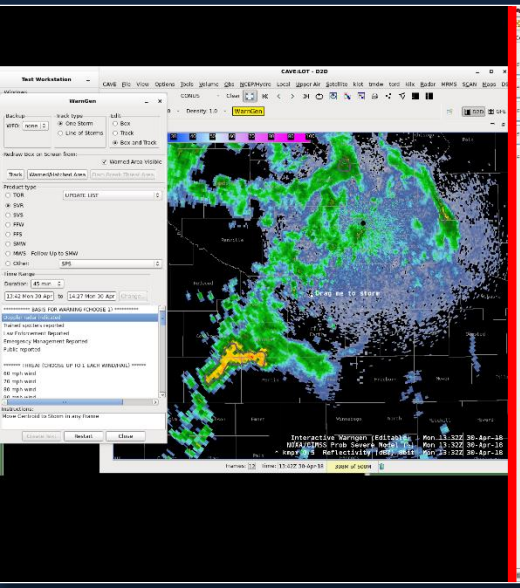


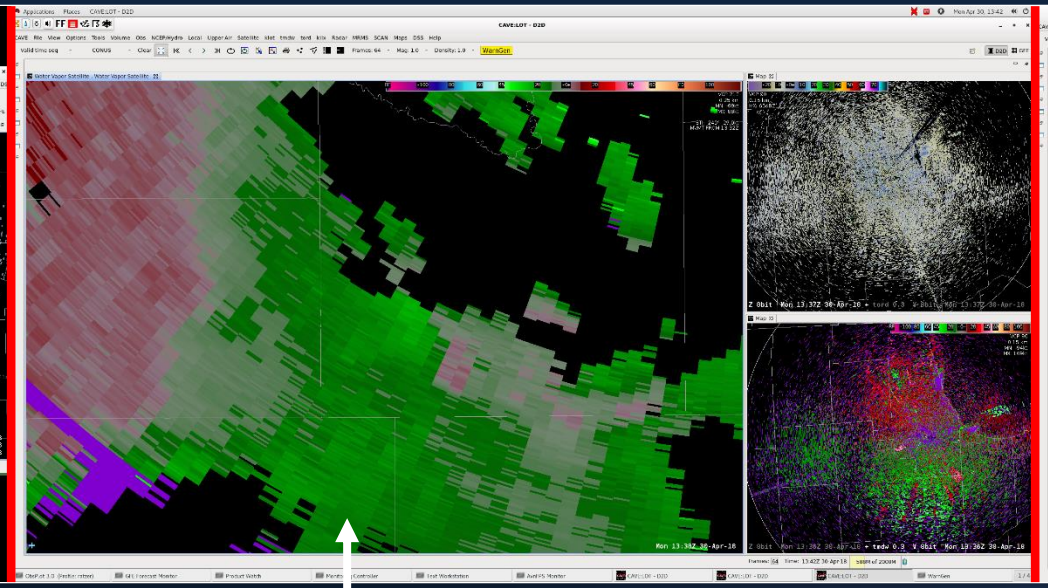
NWS Layout Ideas to Assist Data Management

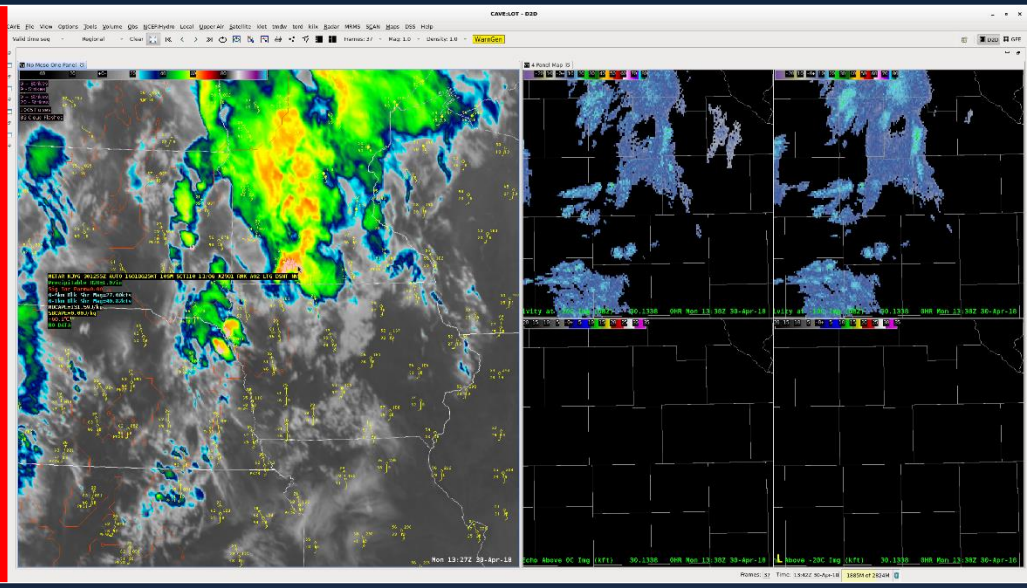
S.A. Radar / Warning Issuance

Storm Interrogation

Satellite / Environment / Mesoscale







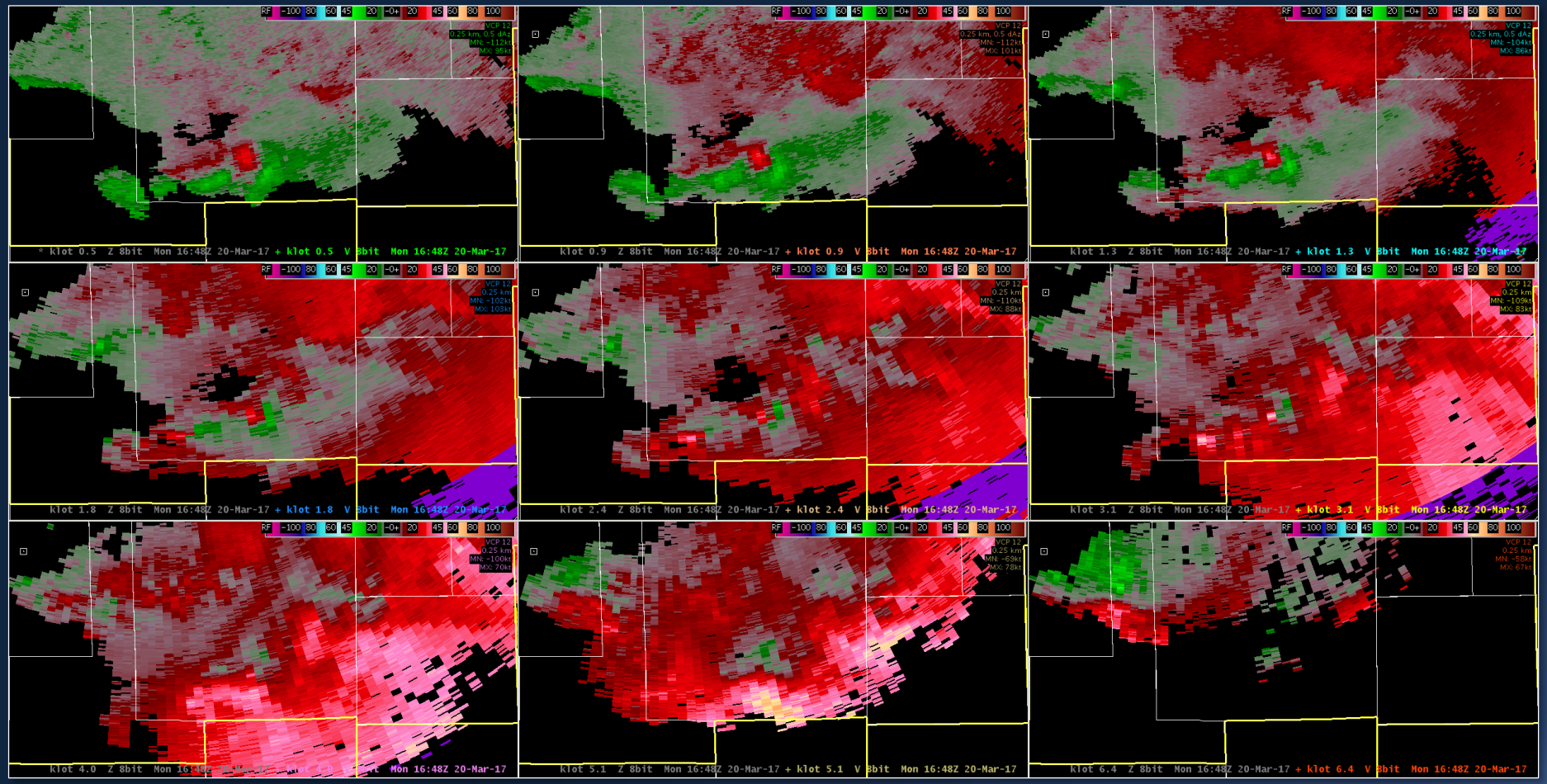
ProbSevere

NSEA

NSEA & MRMS

All-Tilts (up, down, forward, backwards)

Example of Multi-panel of Radar Angles



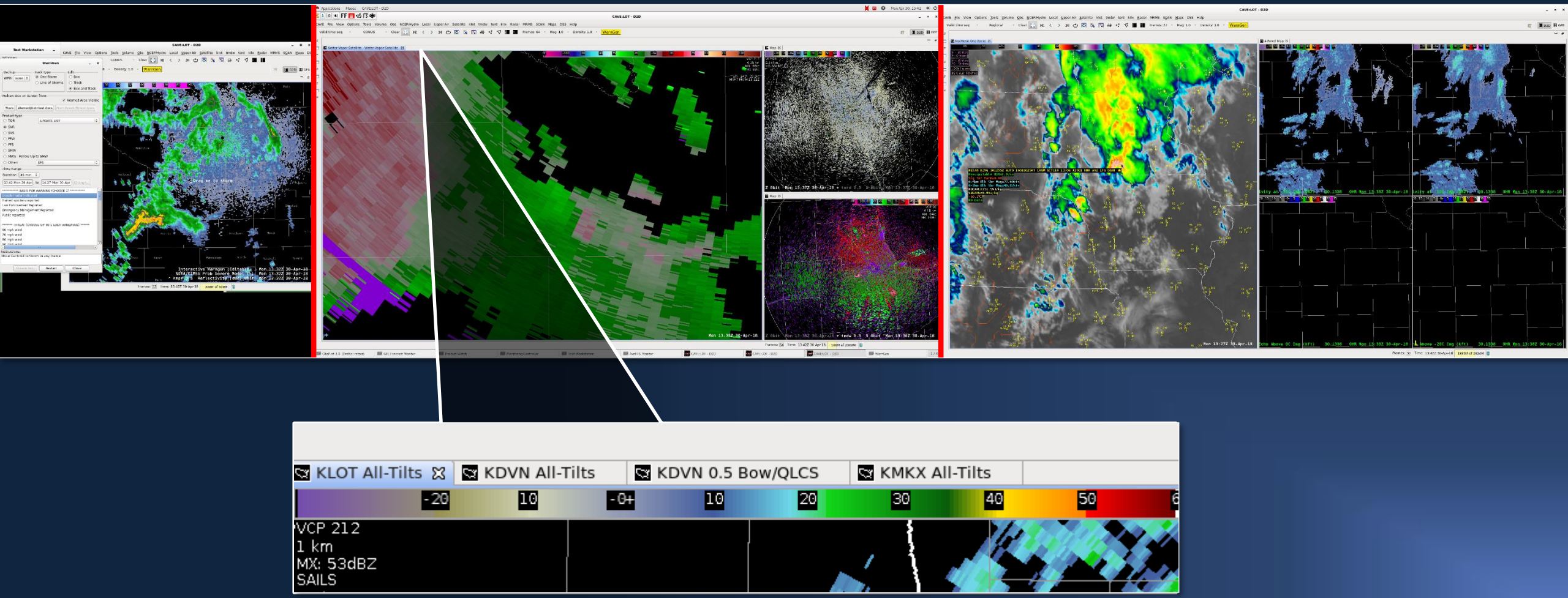
Ideal for when looking at just one storm.
For multiple storms, this can be too zoomed in.

NWS Layout Ideas to Assist Data Management

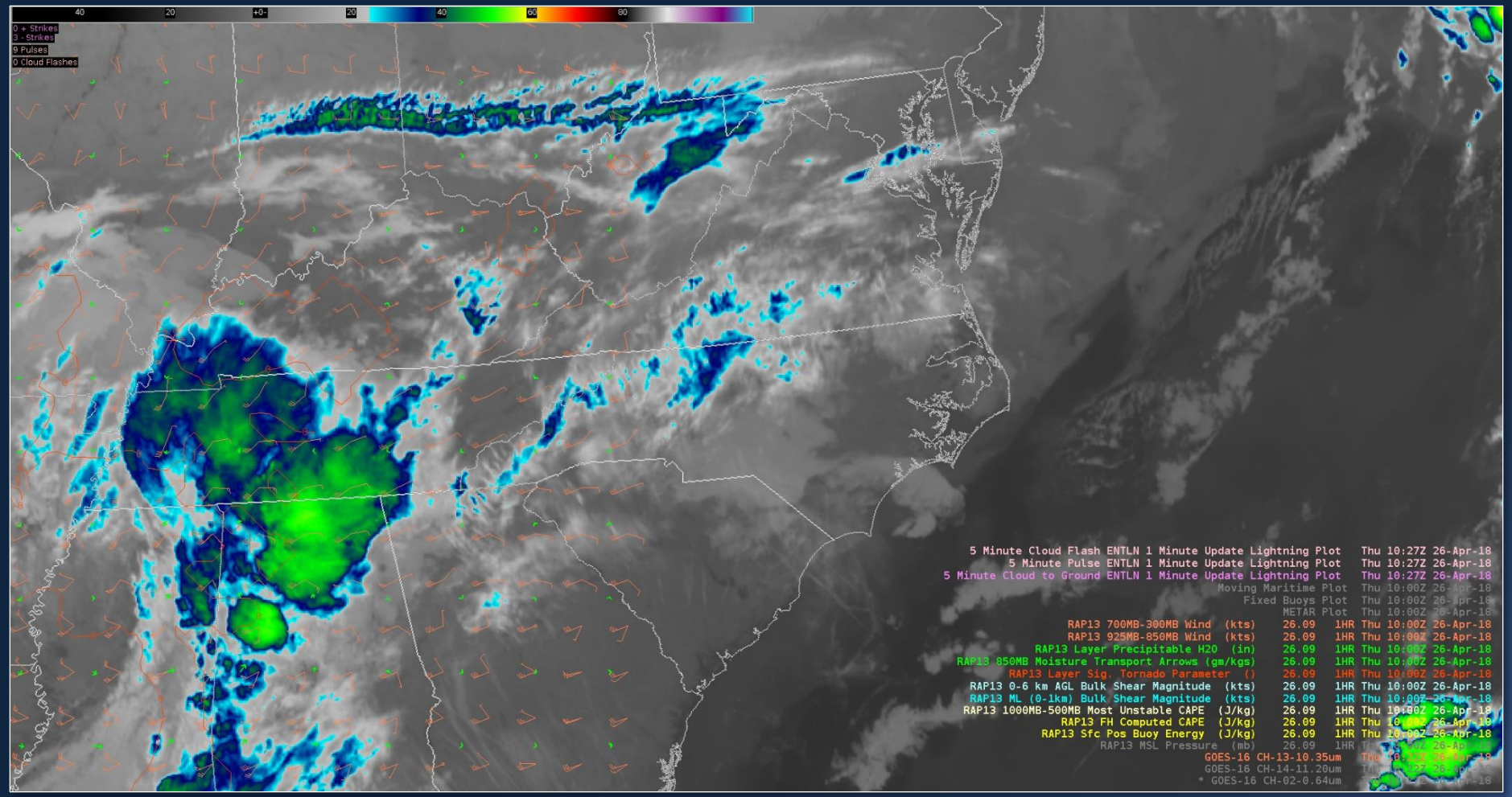
S.A. Radar / Warning Issuance

Storm Interrogation

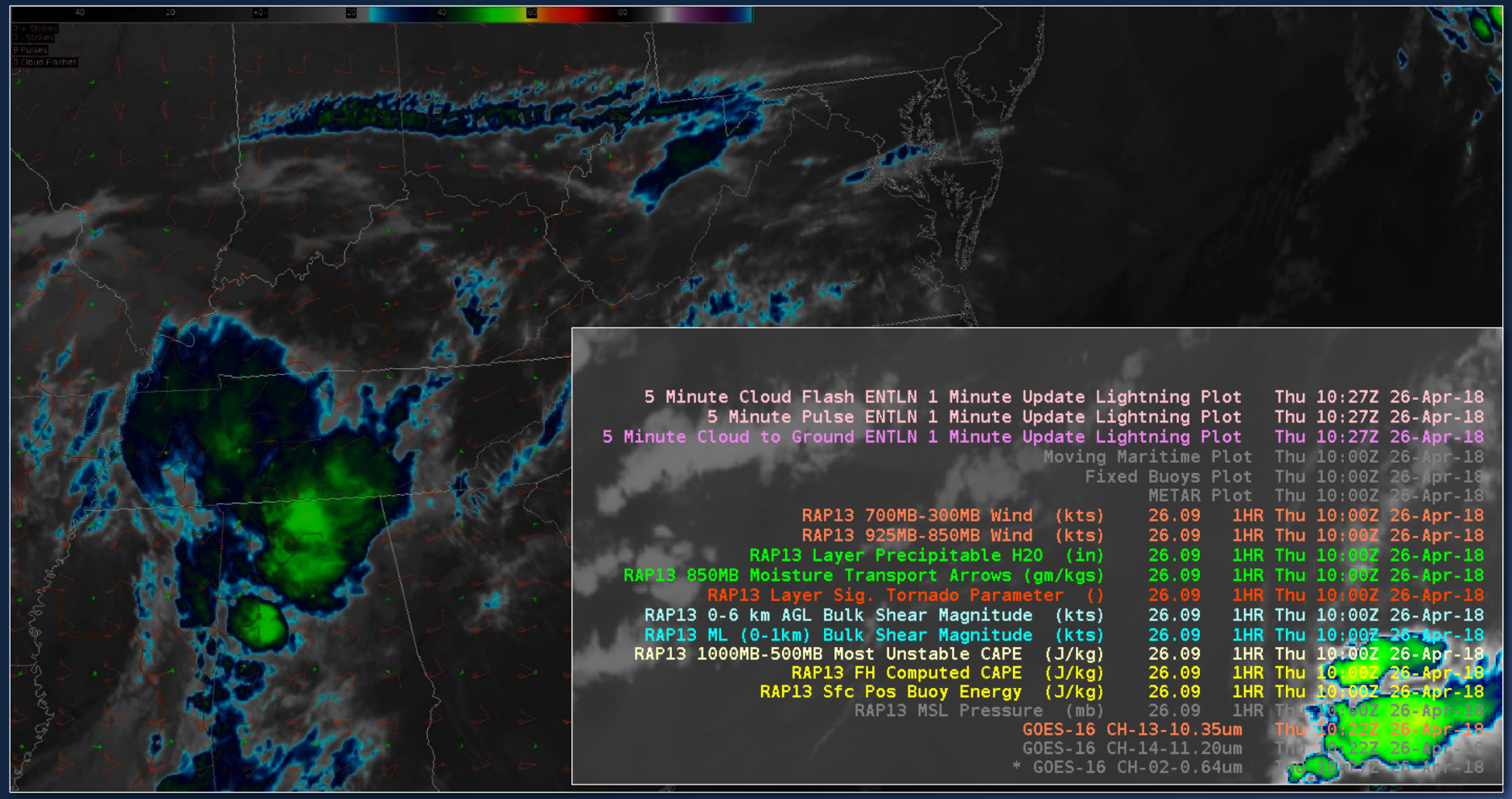
Satellite / Environment / Mesoscale



NWS Layout Ideas to Assist Data Management

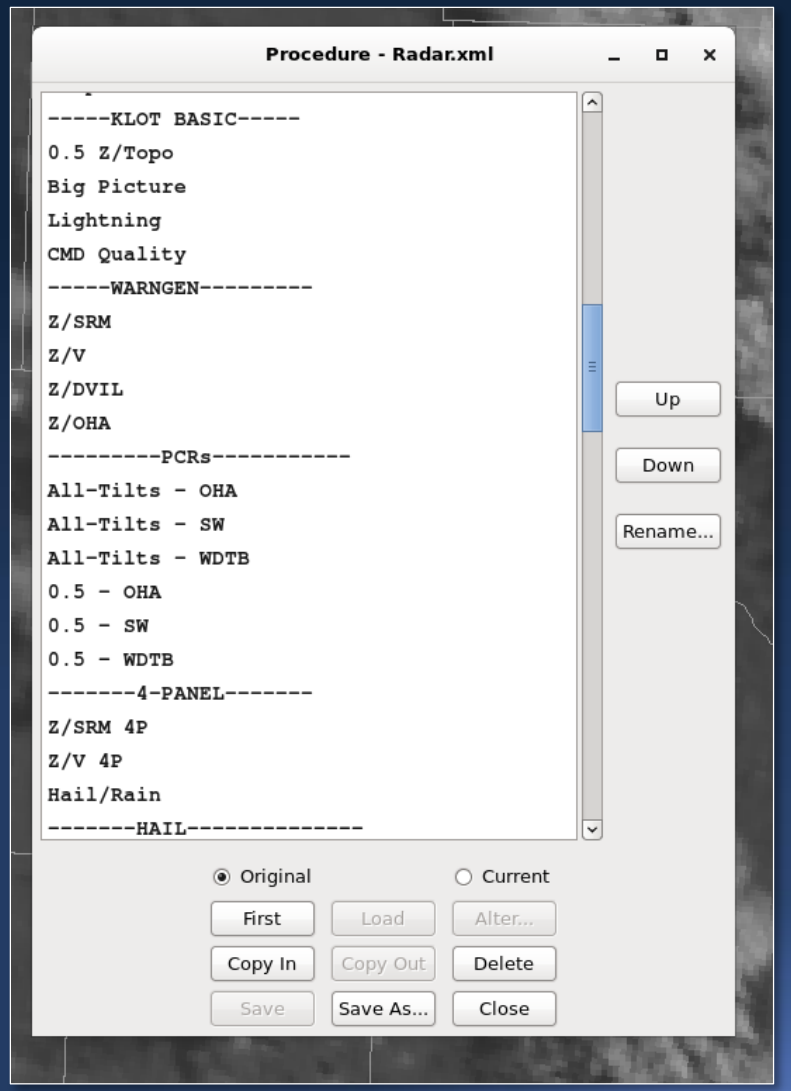


NWS Layout Ideas to Assist Data Management



NWS AWIPS: Procedure and Perspective Sharing

- Some consistency in layout/setup from forecaster to forecaster is a must
- Want to be able to harvest the newest tools, yet not be data inundated
- Still look at the basics toward conceptual storm models
- Save, refine, share, build onto



Takeaways

- We love data and the weather enterprise has and will advance for more
- However, our data firehose is impossible to drink from completely to make decisions
- Scenario recognition and partner understanding → answer the question of vital data

Managing Data

Data → **Information** → **Insights**

Measurements **Analysis & Interrogation** **Actionable**

Takeaways

- Merged datasets in a way that you understand can be effectively used to address the firehose
- Pre-planning and strategizing
- Strategizing for handling data can apply farther than the NWS and with more than just severe weather

Credits

- Frank, Christopher and Paul Magnone: Drinking from the Fire Hose: Making Smarter Decisions Without Drowning in Information, 2011.

- Friedman, Ron Ph.D.: "Why Too Much Data Disables Your Decision Making". *Psychology Today*, 2012 (online).

Thanks to:

- Ray Wolf (NWS Quad Cities)
- Jim Ladue (NWS WDTD)
- Eric Lenning (NWS Chicago)
- Ben Deubelbeiss (NWS Chicago)

Thank You!

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