Lessons Learned from the 2023 HWT Satellite Convective Applications Experiment

Kevin Thiel
OU CIWRO, NWS SPC

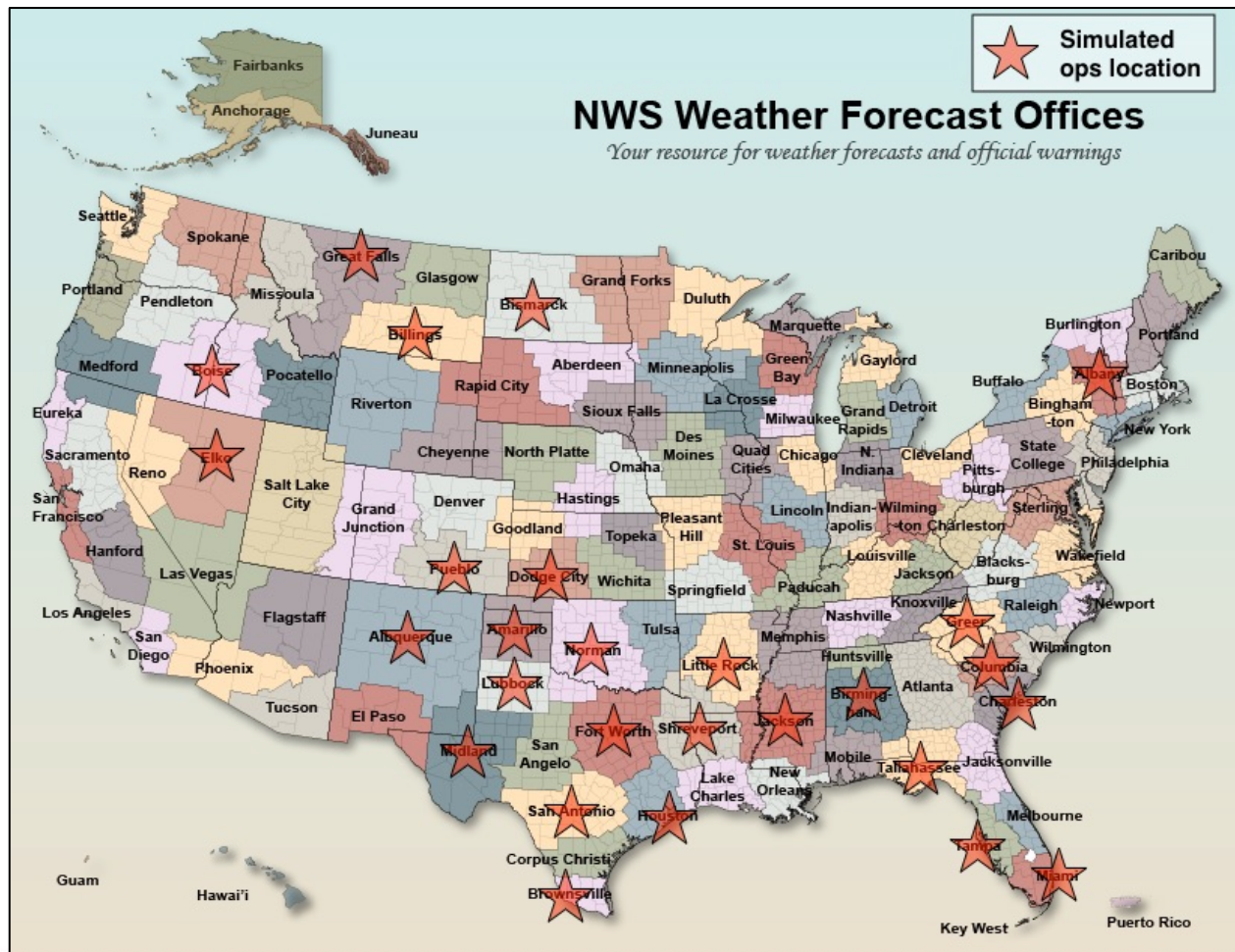# Satellite Experiment Fast Facts

- 3 weeks of demonstrations
  - <u>1 in-person</u>, 2 virtual
- 22 NWS Forecasters
- Live weather in simulated operations
  - Mesoanalysis
  - Severe thunderstorm/tornado warnings
  - Decision support
  - Graphics for public/partners
- Data collection:
  - Discussions
  - Surveys
  - Blog posts (Examples)

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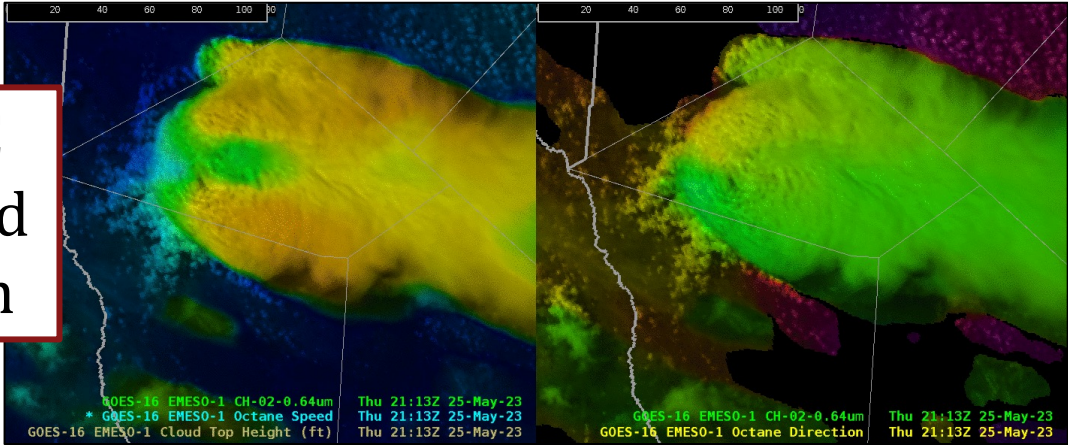 - Discussions
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What kinds of products did we test?

ProbSevere LightningCast
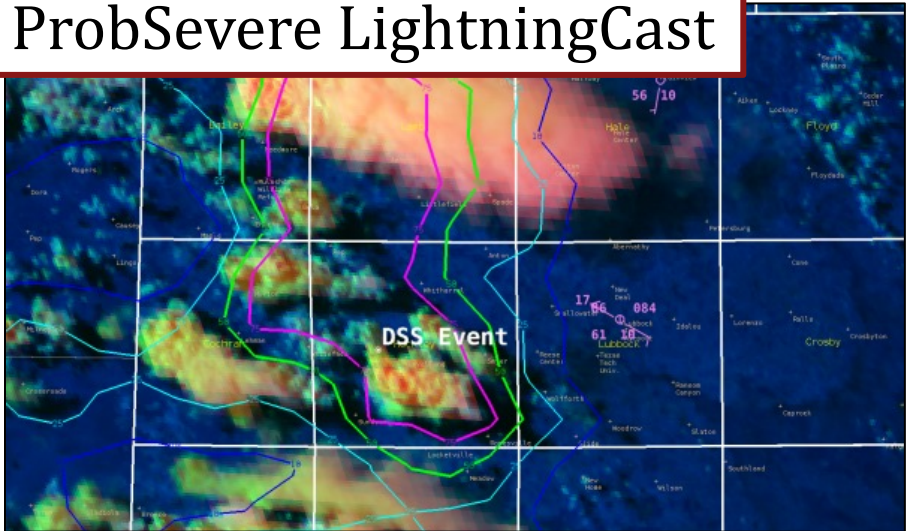
Gridded NUCAPS and NUCAPS-Forecast
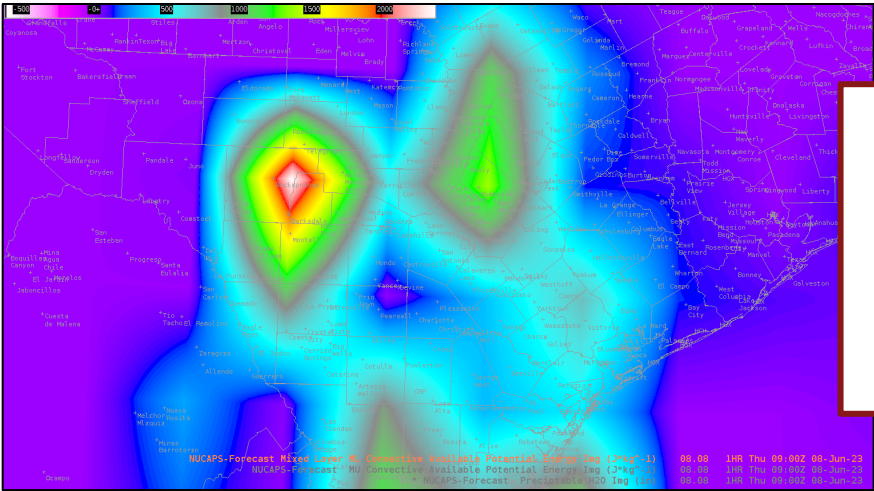
ProbSevere v3
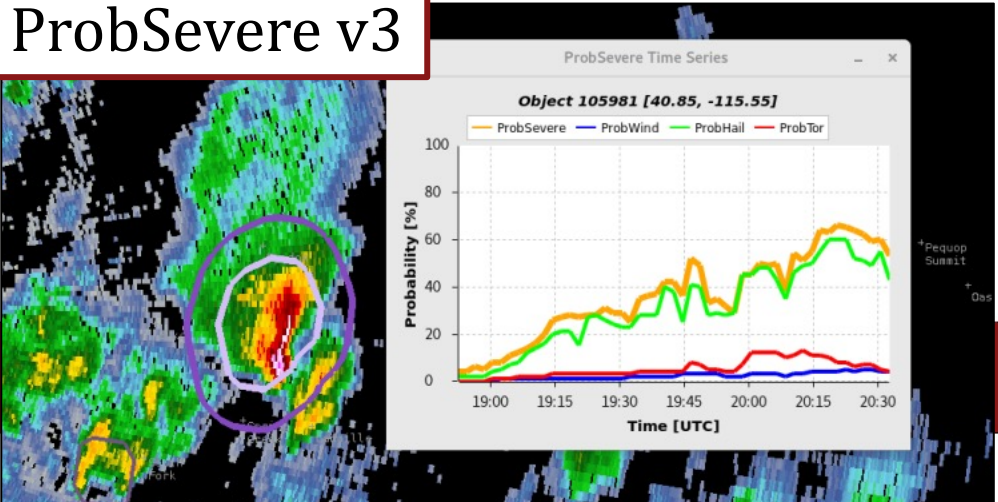
PHS Model
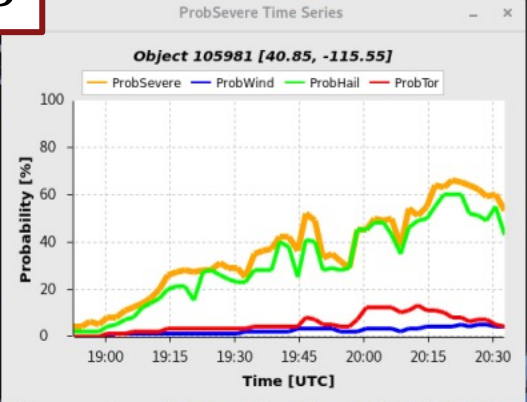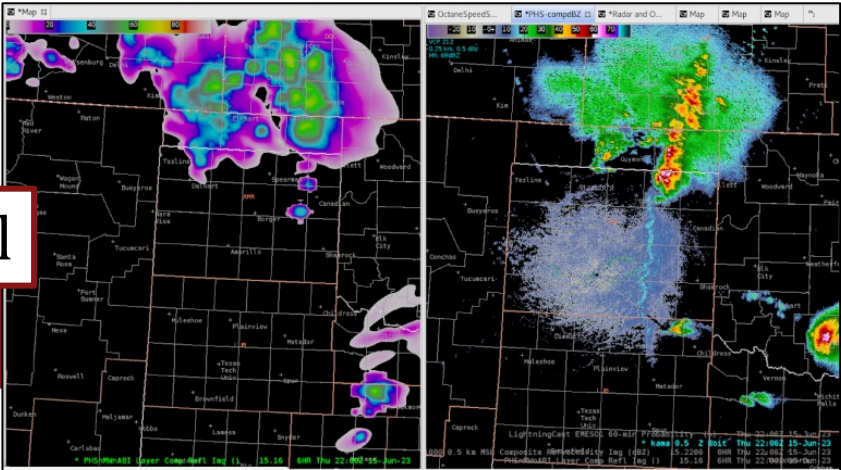
Mesoanalysis with NUCAPS-Forecast and PHS

- Comparisons with SPC mesoanalysis and NWP
  - Lapse rates, CAPE, PWAT, and simulated reflectivity

- Data duration/frequency
  - Hourly out to 12 hours
  - Half-hourly out to 6 hours

- Model assessment
  - CI timing/location and evolution
  - Where does the model add value

NUCAPS-Forecast 850-700mb Lapse Rates

SPC MesoA 0-3km Lapse Rates

PHS Composite Refl.

KAMA Base Refl.
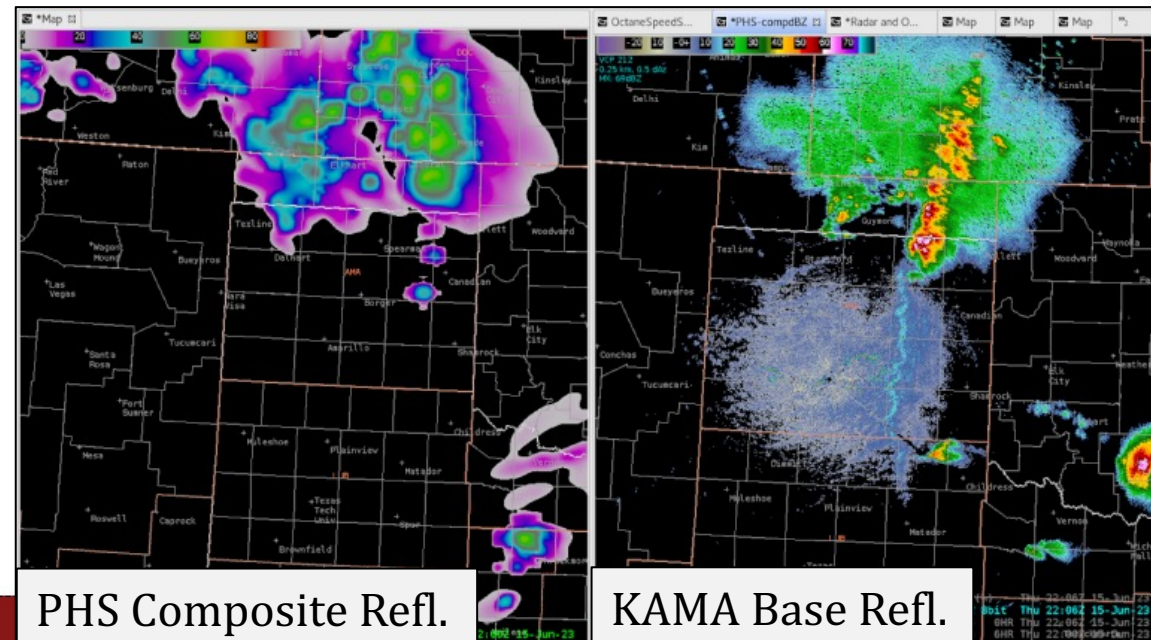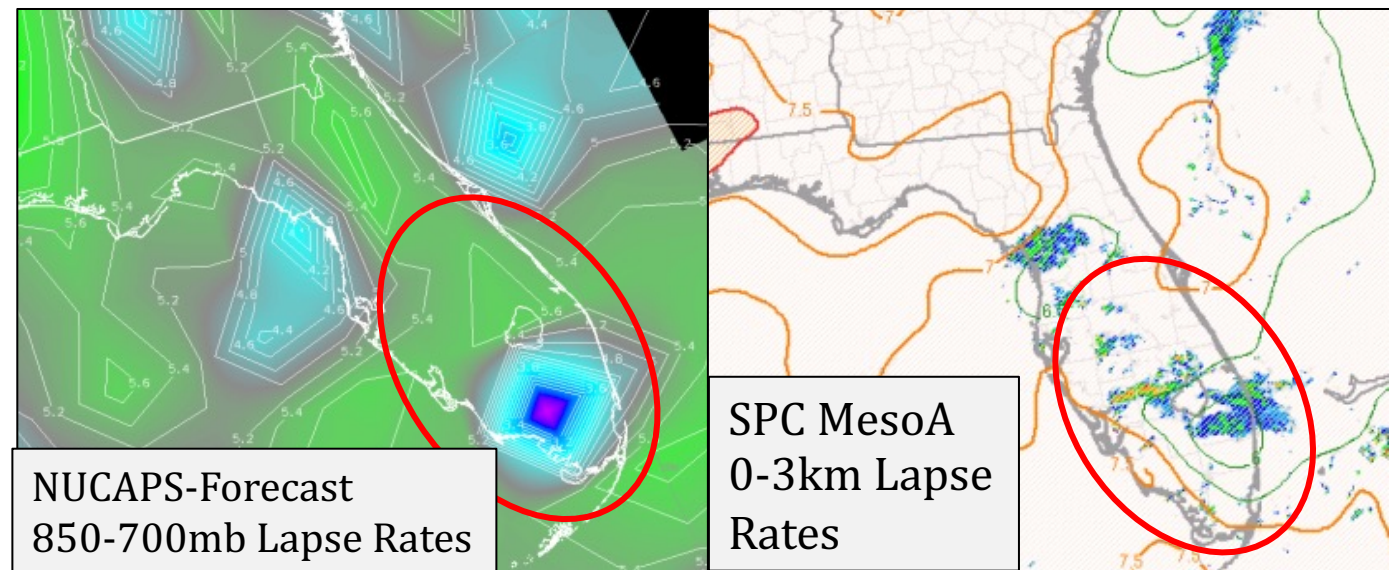
Initiating Convection with OCTANE and LightningCast

- Thermodynamic and kinematic signals of CI
- Timing relative to radar

LightningCast overlaid on Day Cloud Phase RGB

LightningCast overlaid on OCTANE
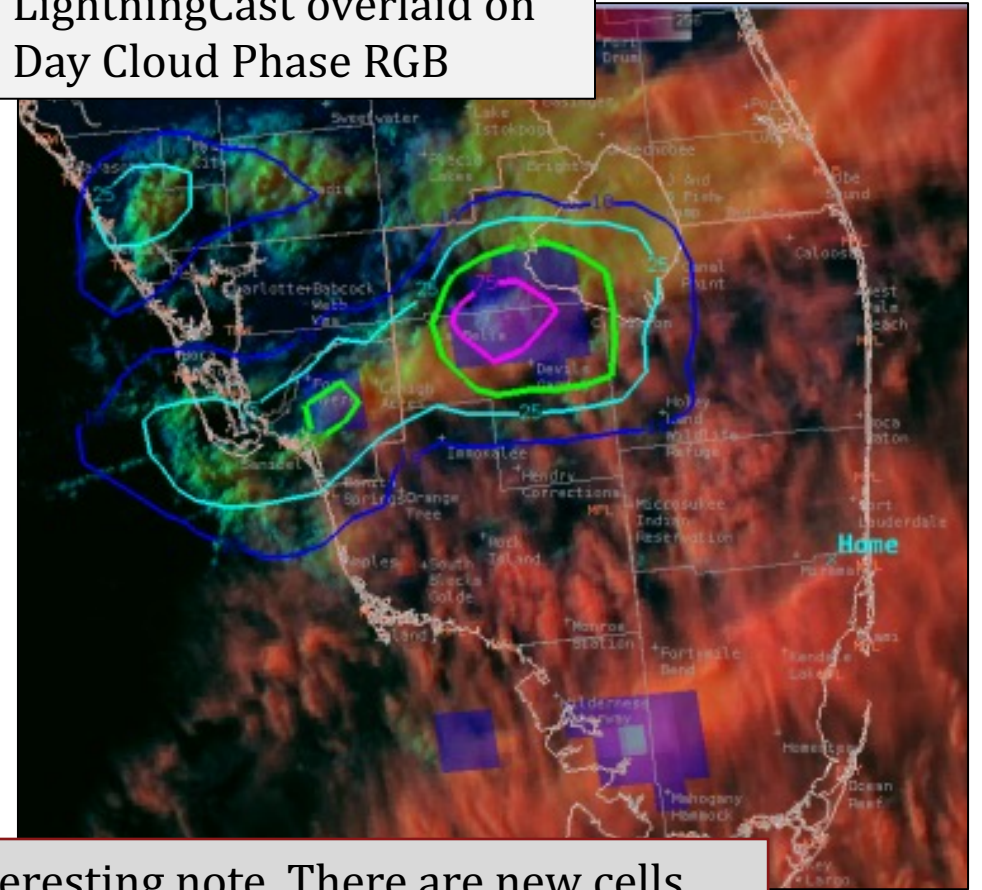
'One interesting note. There are new cells developing in far SW FL with lightning noted on GLM, however **the cirrus canopy there is too thick** to allow LightningCast to detect this convection.'
6 June 2023, Blog Post: *Monitoring Convection for the South Miami Open*

OCTANE Speed (GOES DMW overlaid)

+DIV

+DIV
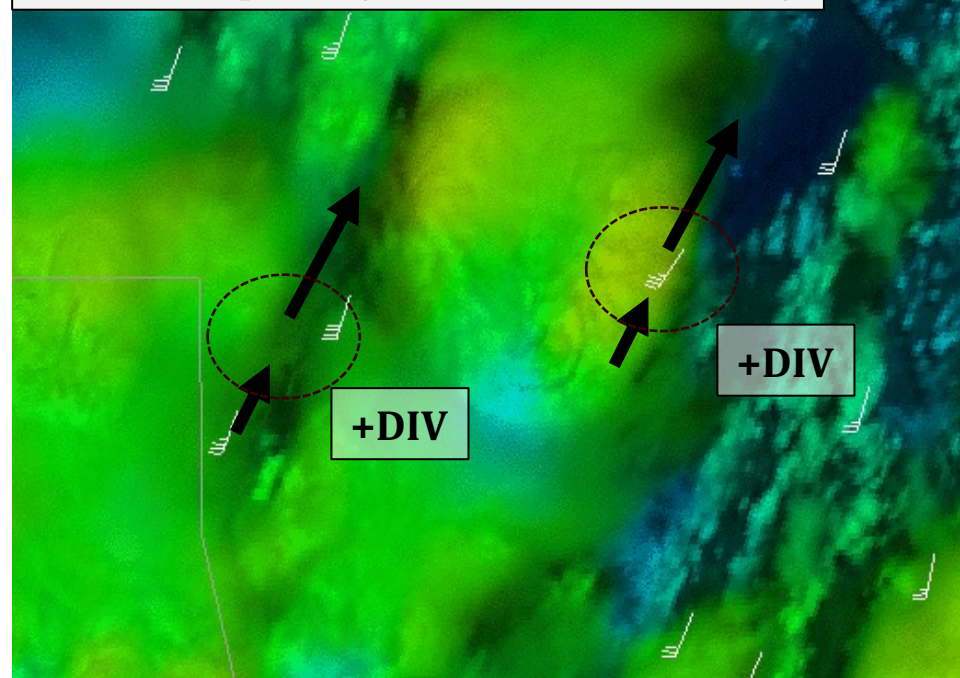
Monitoring Convection with OCTANE and ProbSevere v3

OCTANE

- Monitoring divergence signals
- Comparing with radar and GOES DMW
- Display techniques

ProbSevere v3

- Triaging storms using trends
- 'Data dropout' cases

ProbSevere v3
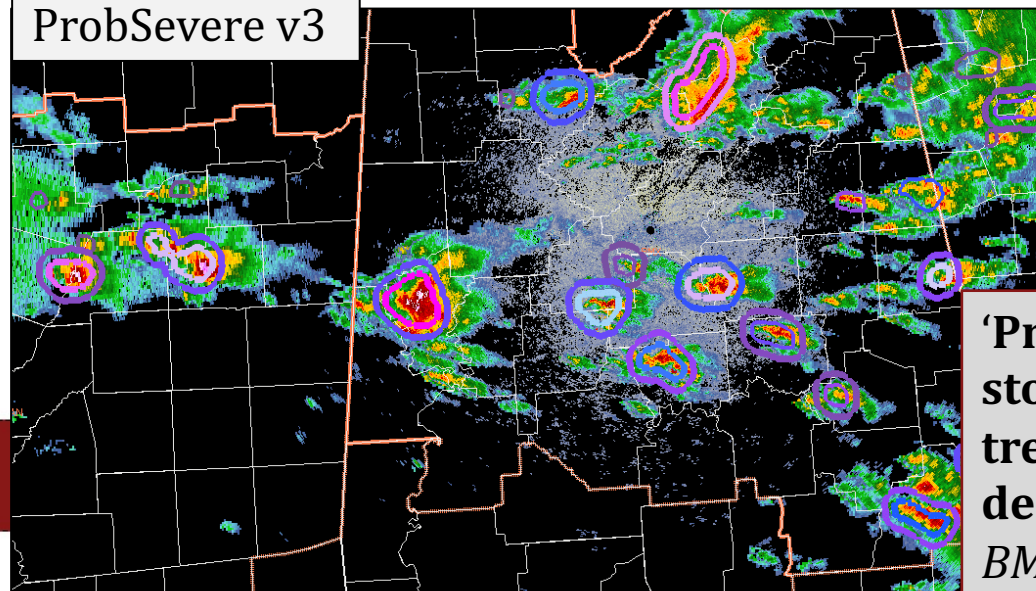
'ProbSevere helped considerably in triaging which storms deserved attention, and which storms were trending in such a way that warranted a warning decision and/or adjustment.'
BMX Warning Met West Sector on June 14 2023

CIWRO
COOPERATIVE INSTITUTE FOR SEVERE AND HIGH-IMPACT WEATHER RESEARCH AND OPERATIONS

DSS Messaging with LightningCast

- Initiation and advection
- Communicating probabilities
- Finding useful thresholds..
  - Initiation: 10% and 25% (lower)
  - Advection: 50% and 75% (greater)
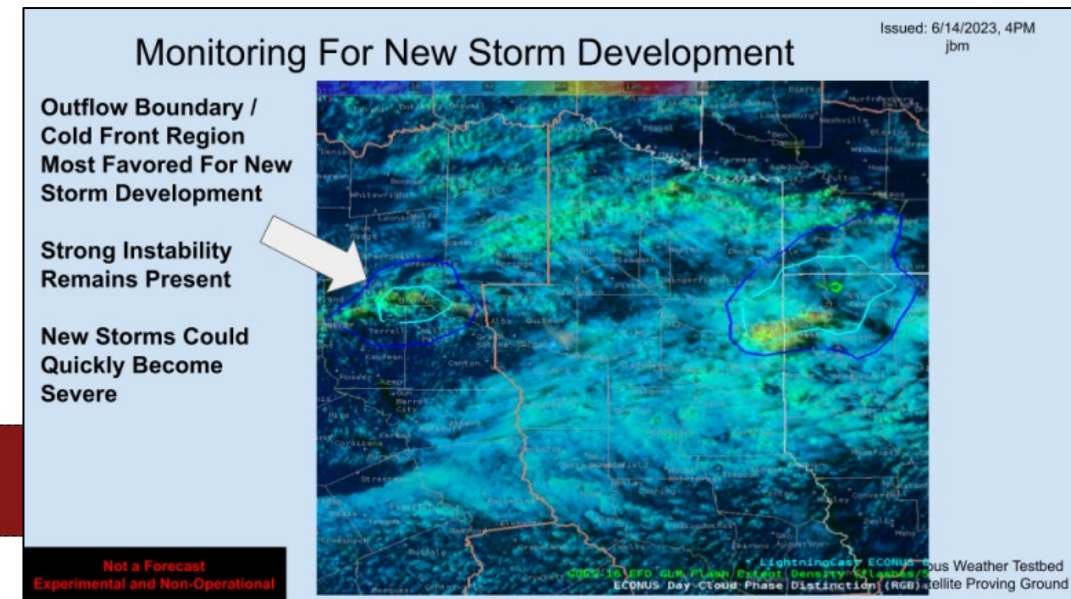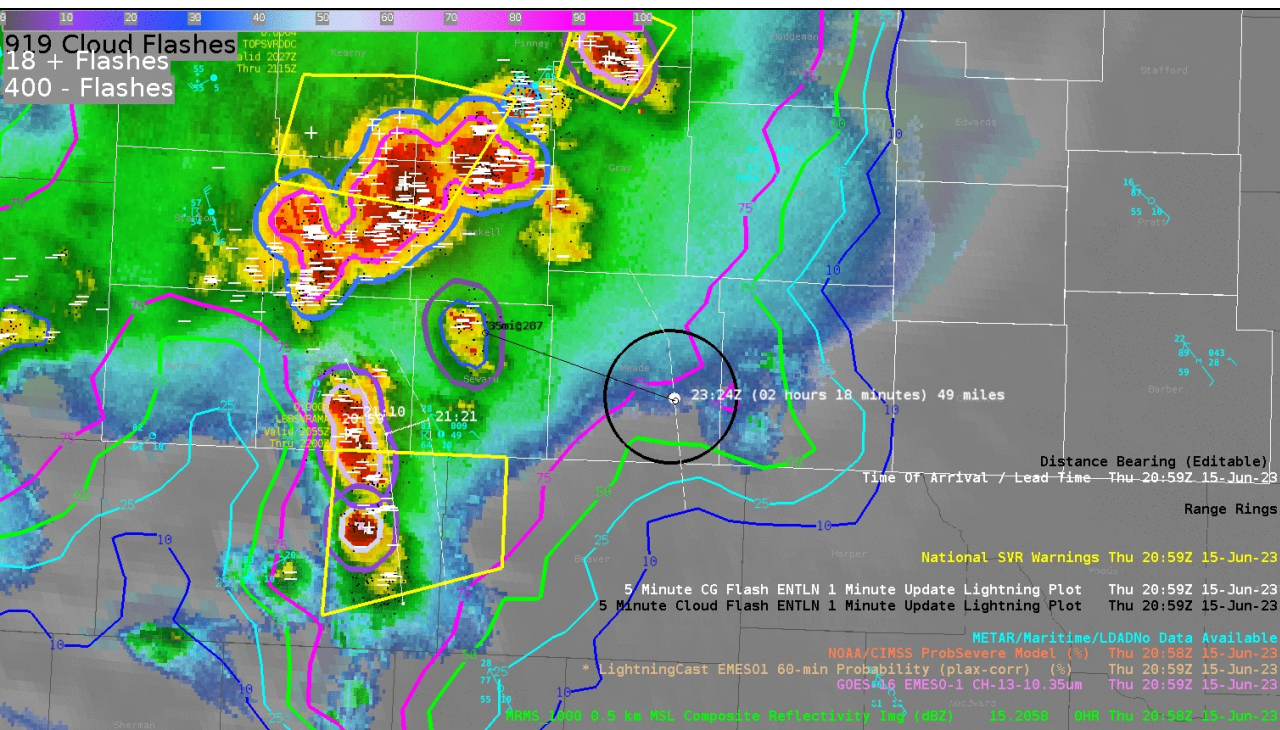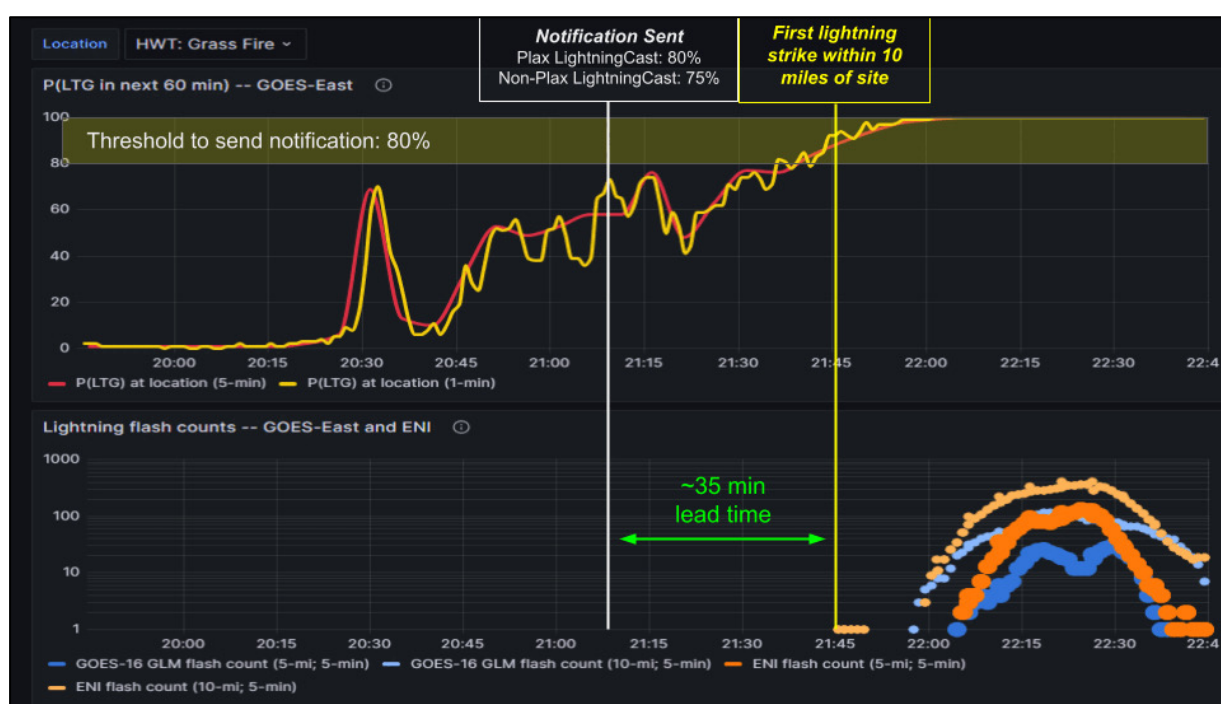
In-Person vs Virtual Experiments

- Time in operations
  - Event duration
  - Discussions with forecasters
  - Depth of evaluation
- Flexibility in schedule
- Testing, breaking, and creating
- WDTD 'Tales from the Testbed' webinar

'I think the in-person format is vital. It's difficult to have multiple simultaneous conversations with the virtual format. Furthermore, rapport and trust with the forecasters is built with in-person interactions. I believe they're more willing to engage during and after the testbed because of the relationship built'
Developer – *End of Testbed Survey*
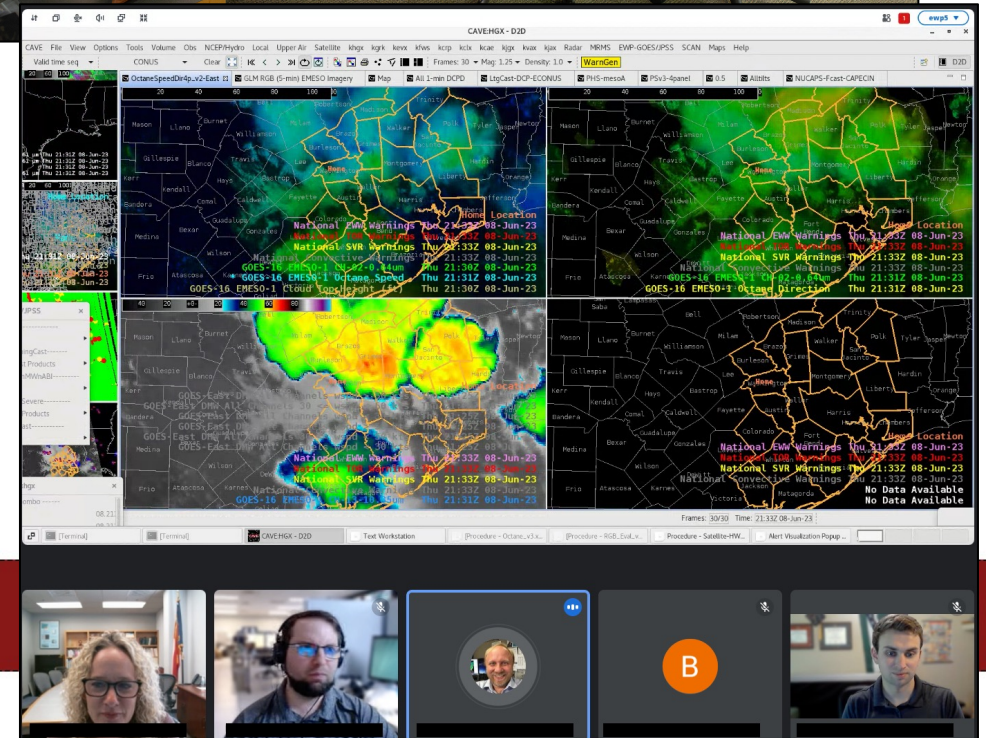
Lessons Learned from the 2023 Experiment

- **NUCAPS-Forecast:** A NUCAPS-Forecast product with half-hourly output out to six hours be evaluated in future testbeds.

- **OCTANE:** Divergence signals are useful for thunderstorm interrogation. Training on the physical basis for high resolution cloud top winds in context with radar, lightning, and satellite imagery.

- **PHS Model:** Show how the data assimilation technique employed by the PHS model adds value when compared to a control or similar model run.

- **LightningCast:** Training incorporate model limitations such as lower probabilities in dense cirrus fields. The web-based time series output is a powerful DSS tool.

- **ProbSevere v3:** The AWIPS time series tool can be used for quickly diagnosing trends in multiple storms and making warning decisions.

- **The Experiment:** Continue to hold in-person demonstrations and look to expand when able.

Want to learn more?

- Final Report
  - Example applications/limitations
  - Qualitative and quantitate analysis
  - <u>Forecaster-led</u> recommendations

GOES-R and JPSS Proving Ground Dem the Hazardous Weather Testbed 2023 Spri Final Evaluation

Project Title: GOES-R and JPSS Proving Ground Demonstrat Experiment – Experimental Warning Program (EWP)

Organization: NOAA Hazardous Weather Testbed (HWT)

Evaluators: National Weather Service (NWS) Forecasters, St (SPC), National Severe Storms Laboratory (NSSL), Universit Cooperative Institute for Severe and High-Impact Weather Re (CIWRO)

Duration of Evaluation: 22 May 2023 – 16 June 2023

Prepared By: Kevin Thiel (OU/CIWRO and NOAA/SPC)

Submitted Date: 12 October 2023

Table of Contents:

'The data readout of the parallax corrected LightningCast offered within AWIPS (not shown) was favored over the non-parallax corrected time series [Figure 18], giving higher confidence in the true probability of occurrence used within the DSS message. This gave around a 35 minute lead time before the first strike was detected miles of the DSS site. Had we used the non-parallax corrected readout val would have been much shorter, around 10 minutes using 1-minute imager 10 minutes using 5-minute imagery. This clearly demonstrates the value o corrected data compared to non-parallax corrected data when performing
15 June 2023, Blog Post: *Utility of Parallax Corrected LightningCast Ver Corrected Within DDC*
https://inside.nssl.noaa.gov/ewp/2023/06/15/utility-of-parallax-corrected-l versus-non-corrected-within-ddc/

Figure 18: A ProbSevere LightningCast meteogram for the GOES-East CONUS sectors (top) and the local flash counts (bottom) on15 June 2023.

Through its frequent use within the testbed, a few limitations of the ProbSevere model were noted by the forecasters. When dense altostratus and cirrus were pre pointed out that the LightningCast model often produced probabilities that w initiating convection, as the model struggled to observe the relevant features within included after lightning activity within a thunderstorm had already started a suggestions by the forecasters to incorporate radar information into the mod expected probabilities were also noted by participants to where flash initiated t through stratiform convection, convective systems.

When asked in the daily surveys, seemed well calibrated, with the

13 June 2023, Blog Post: *OCTANE's Ability to Assess Areas of Lift in S Environments*
https://inside.nssl.noaa.gov/ewp/2023/06/13/octanes-ability-to-assess-an strongly-sheared-environments/

Figure 9: OCTANE Speed (top) and ABI Day Cloud Phase Distinction RC northeast Texas at 2037 Z on 13 June 2023. The black dotted line was drawn by identify a region of mesoscale ascent.

Intercomparisons with the GOES atmospheric motion vectors (AMVs) proc investigate the quality of OCTANE speed and direction data, and in grou forecasters often cited small differences between the two motion calculations. V the operational AMVs, a strong majority of participants noted the added value o within the daily and weekly surveys due to their increased temporal and sp Additionally, forecasters stated in group discussions they did not routine convective scenarios at their home office, which made the use of cloud top wind

Figure 4: MU-CAPE values from NUCAPS-Forecast (left) when compared from the RAP model (right) at 0200 Z on 8 June 2023.

Overall, forecasters used NUCAPS-Forecast more frequently in operatio NUCAPS. In the daily surveys 56% (42/75) of forecasters stated they used NU their severe weather analysis compared to 35% (25/72) using Gridded NUCAPS well features from NUCAPS-Forecast were complimentary to other data so responded 'Moderate' and 'High' most often for 'Spatial Patterns' (33/45, 75% 75%), and 'Gradients' (31/43, 72%). The 'Magnitudes' option was deemed le with a majority of forecasters responding 'Low' and 'Moderate'.

Forecasters were also asked to subjectively rate the value of NUCAPS-Forecast location of convection initiation and storm mode. The 'Location' option favorable responses, with 43% (18/42) selecting 'Moderate' and 24% (10/42) se comparison, 30% (11/37) of forecasters selected 'Moderate' and 35% (13/37) se the 'Storm Mode' option. The parameters most frequently used from NUCAPS lapse rates, and PWAT) provided information regarding the initiation of co kinematic fields were often used to further determine storm mode. The lack of in the Gridded NUCAPS and NUCAPS-Forecast data was noted by the for discussions, however the idea of including modeled winds in an observationa with mixed support among the participants.

'There was a noticeable instability gradient across the MAF CWA today Forecast showed better low level moisture (via LCLs) and instability in portions of the CWA. This coincided with a higher SPC risk for severe

Figure 13: SPC Mesoanalysis (left) and PHS (right) MUCAPE from 2100 Z on 7 June 2023.

'PHS captured the initial convection just east of AMA well, even though the convection started an hour earlier than PHS indicated… Toward the end of the exercise, the storm coverage was well captured by the PHS 16z run. Should have taken this into account for my public graphics when describing the storm evolution.'
15 June 2023, Blog Post: *6/15 Feedback for AMA*
https://inside.nssl.noaa.gov/ewp/2023/06/15/6-15-feedback-for-ama/

NOAA Institutional Repository
doi.org/10.25923/fwnq-kf73

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- Observers and visiting scientists

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