NUCAPS Results from HWT 2016 GOES-R/JPSS Spring Experiment

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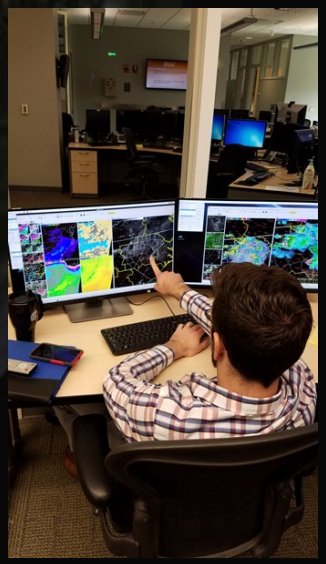
GOES-R and JPSS in the Hazardous Weather Testbed

HWT in Norman, OK

- Product developers observe their recently developed GOES-R and JPSS algorithms being used alongside standard observational and forecast products in a simulated operational forecast and warning environment (Research to Operations, **R2O**)
- Feedback received from participants leads to the continued modification and development of GOES-R and JPSS algorithms (Operations to Research, **O2R**)
- Education and training received by participants helps to enhance **readiness** for the use of GOES-R and JPSS data

HWT 2016 GOES-R/JPSS Spring Experiment

- 4 weeks (18 April, 25 April, 2 May, 9 May)
  - 3 NWS forecasters, 1 broadcast meteorologist per week
  - Mon-Thurs, 8 hr forecast shifts. Friday half day debreif
- Real-time, simulated nowcast/warning environment using AWIPS-II.
  - Can operate anywhere in CONUS; begin prior to CI
  - "mesoscale forecast updates" (via live blog posts)
  - experimental severe t-storm and tornado warnings (via WarnGen).
- Evaluating: GOES-R and JPSS Baseline, Future Capabilities, and Experimental Products
- Training: 2 hours of Articulates
- Feedback: Daily and weekly debriefs, daily and weekly surveys, **blog posts**, discussions, Webinar
- We want forecasters to think about how they are using the experimental products in nowcast and warning decision making.



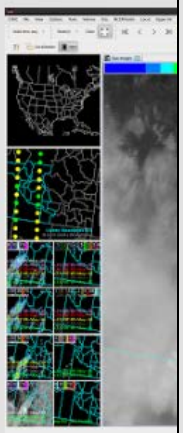
GOES-R/JPSS HWT Blog

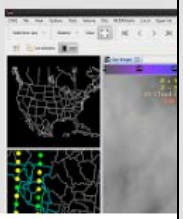
http://goesrhwt.blogspot.com/search/label/NUCAPS

- Mesoscale forecast updates
- Reasoning behind warning decisions
- Updates to previous warnings/forecasts
- Best practices
- Ideas for improvement
- Any thoughts/feedback, good/bad, about the experimental products

CI gives a lead time of 45 minutes!

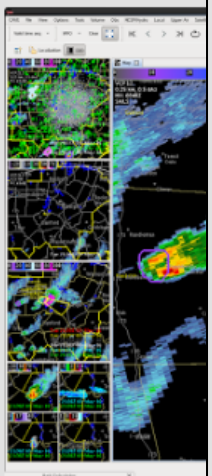
The highest CI of the day matched up with the highest ProbSevere Probability...so far! The CI algorithm showed a 61% probability at 2030Z. Then...as convection formed and moved northwest towards that specific area where the CI was...th
at 50% (without any satel





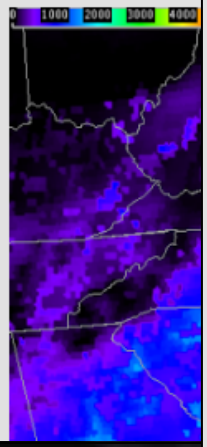
Chatham And Wake County Severe Thunderstorm Warning - Prob Severe and Lightning Jump Helpful!

Here is the Severe Thunders
UTC. The storm that was in th
issued. However, the Prob S
the time of the warning issua
issuance. These factors, con
me more confidence to issue
Several other reports of 1.00
pong ball size hail in Kerly (
later on). JJW



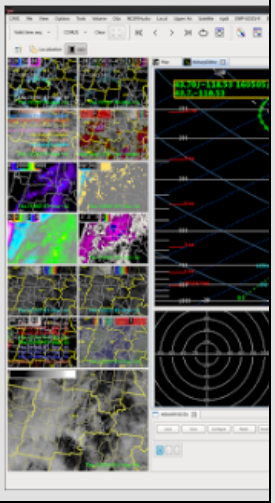
Raleigh Pre-Storm Analysis

In terms of moisture and instability, the Raleigh CWA appears to be primed for convection this afternoon.
Surface dewpoints are well
range on the latest LAP an
CAPE field which are depe
largely less than 1000 j/kg,
what the GFS is showing, p
mesoanalysis, so this lead
skies over the area should



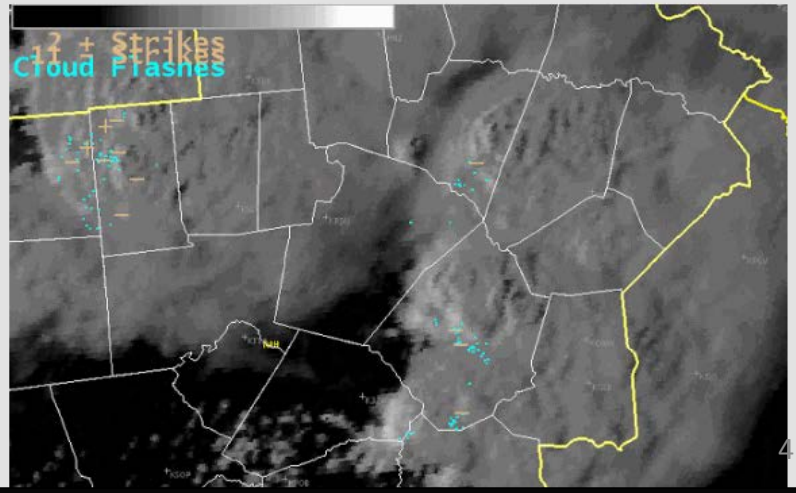
NUCAPS Sounding Showing Increasing MUCAPE And Lower 0C/-20C Levels!

The adjusted NUCAPS sounding, ta
MUCAPE values over 1200 J/kg at 2
earlier (off of the 1200 UTC BOI sou



Rapid Storm Intensification Evident On Super Rapid Scan

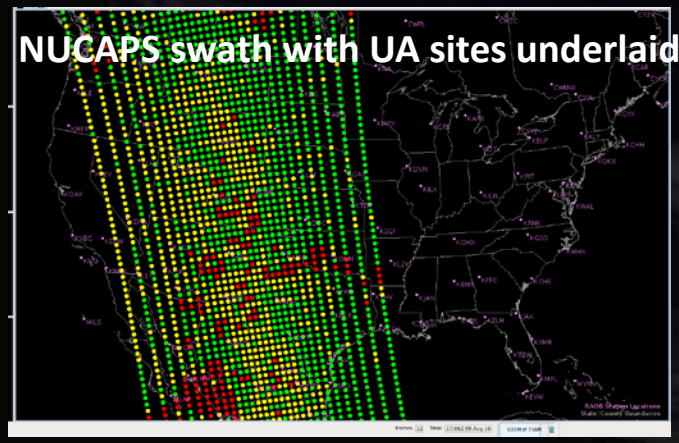
The super-rapid scan visible imagery clearly showed a rapid intensification of a few storms across the CWA. This intensification corresponded with intensification in radar parameters. Within 15 minutes of this feature on the satellite imagery, ProbSevere had jumped to 97% and there were several 2-3 sigma lightning jumps. A significant TBSS was also evident in the half hour after this satellite feature.

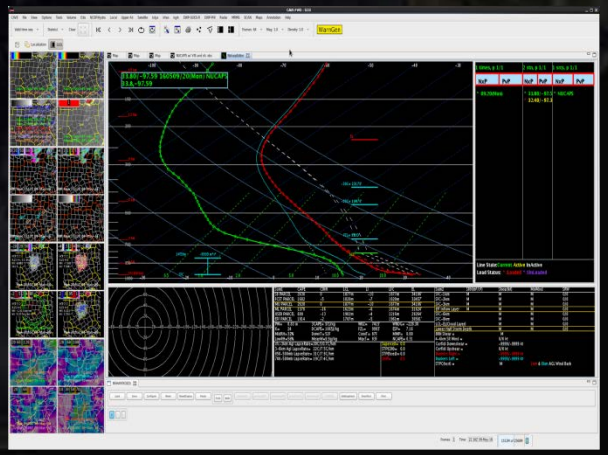


>400 blog posts so far this year

NOAA Unique Combined Atmospheric Processing System (NUCAPS)

- NUCAPS combines both statistical and physical retrieval methods to generate temperature and moisture profiles using information from the CrIS and ATMS instruments aboard Suomi-NPP.
- NUCAPS in AWIPS-II currently:
  - Suomi-NPP only
    - NUCAPS Profile Availability (Time/Location) with quality control flags
    - NUCAPS Vertical Temperature and Moisture Profiles
- Early afternoon timing of Suomi NUCAPS gives it exceptional potential value for convective forecasting.
  - Usually just prior to convective initiation
  - Temporally: Available between morning 1200 UTC and evening 0000 UTC radiosondes
  - Spatially: High density - fills gaps between radiosonde sites





Why NUCAPS in HWT?

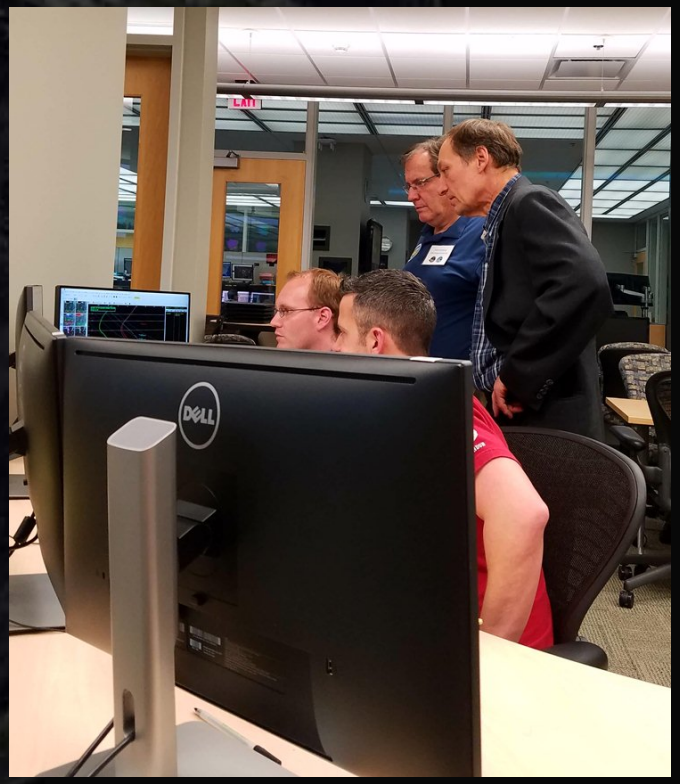
- Does NUCAPS provide useful and unique information, particularly for convective forecasting?
- What can be done to make NUCAPS more useful?

- HWT allows for the testing of NUCAPS by operational forecasters in real-time operational test environment

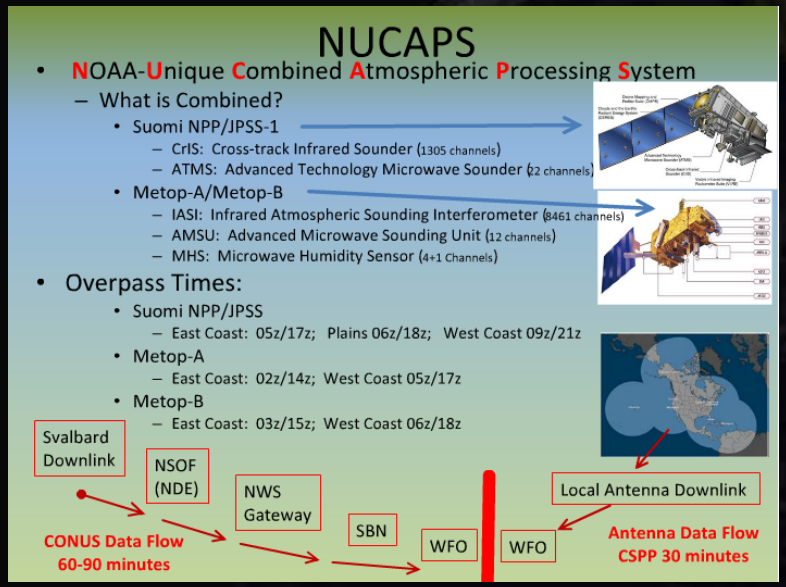
NUCAPS Evaluations in HWT

- 2015 NUCAPS Evaluation in HWT
  - First evaluation of NUCAPS
    - Only the temperature and moisture profiles and the profile availability
  - Final Report

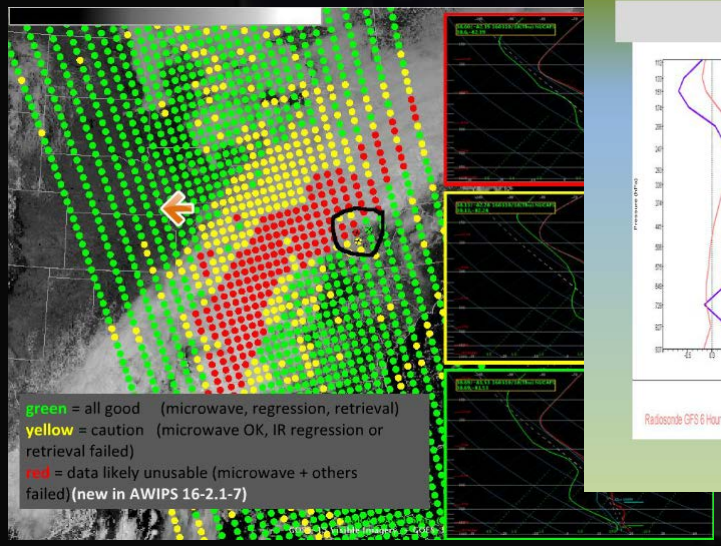
- New for 2016 Evaluation in HWT
  - QC Flags
  - MetOp A/B (Week 4 only)
  - Plan View Display
  - Cross Sections (Week 4 only)
  - Updated Training

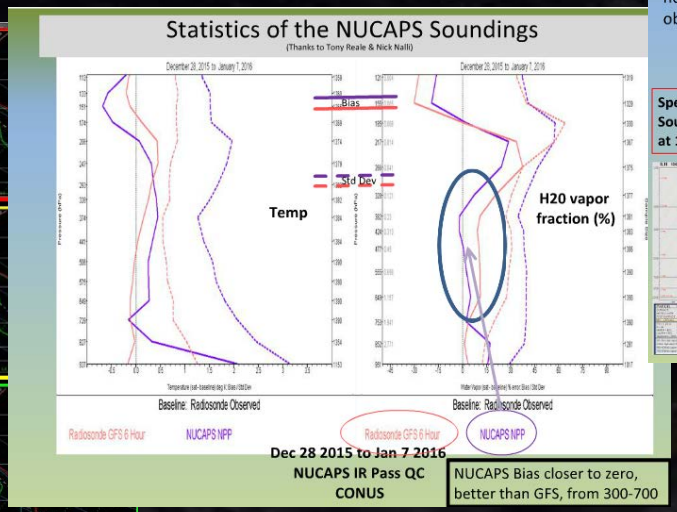


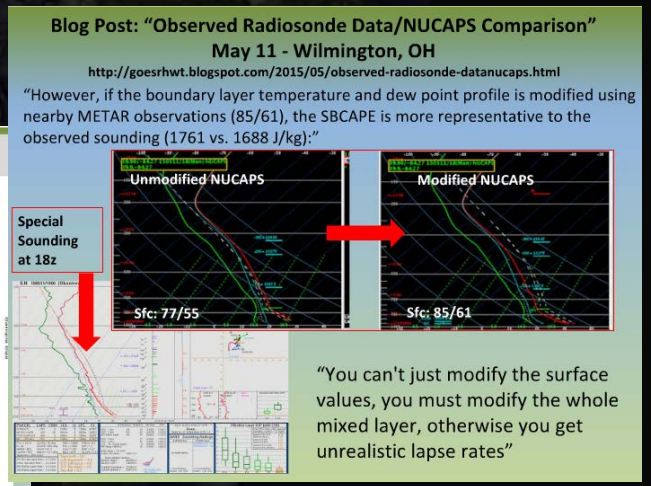
NUCAPS Training



- 15.5 min Articulate PowerPoint
  - Completed prior to arrival in Norman
  - Updates for 2016 Training
    - QC Flags
    - MetOp A/B
    - Verification Statistics
    - Operational use examples (from HWT 2015)
    - Method of surface modification
    - Other minor updates

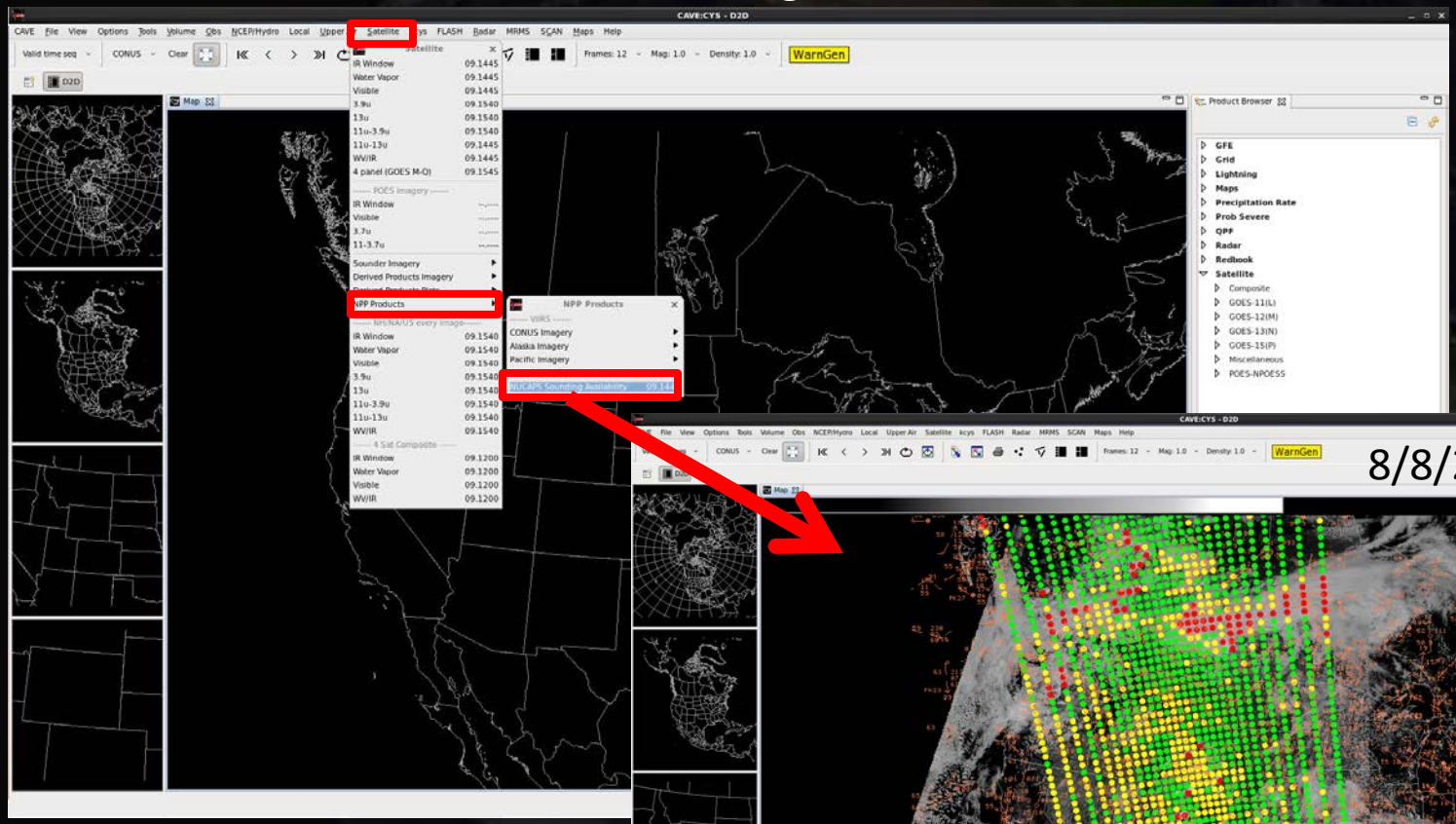


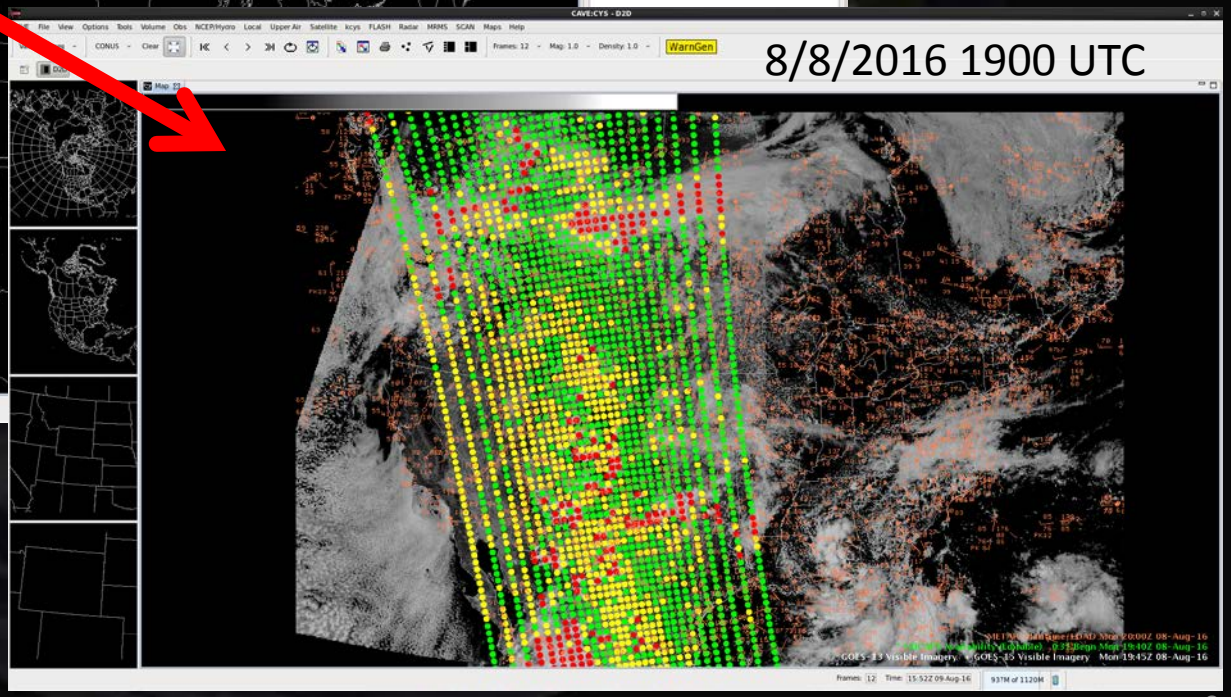




Using NUCAPS in AWIPS-II

Loading NUCAPS



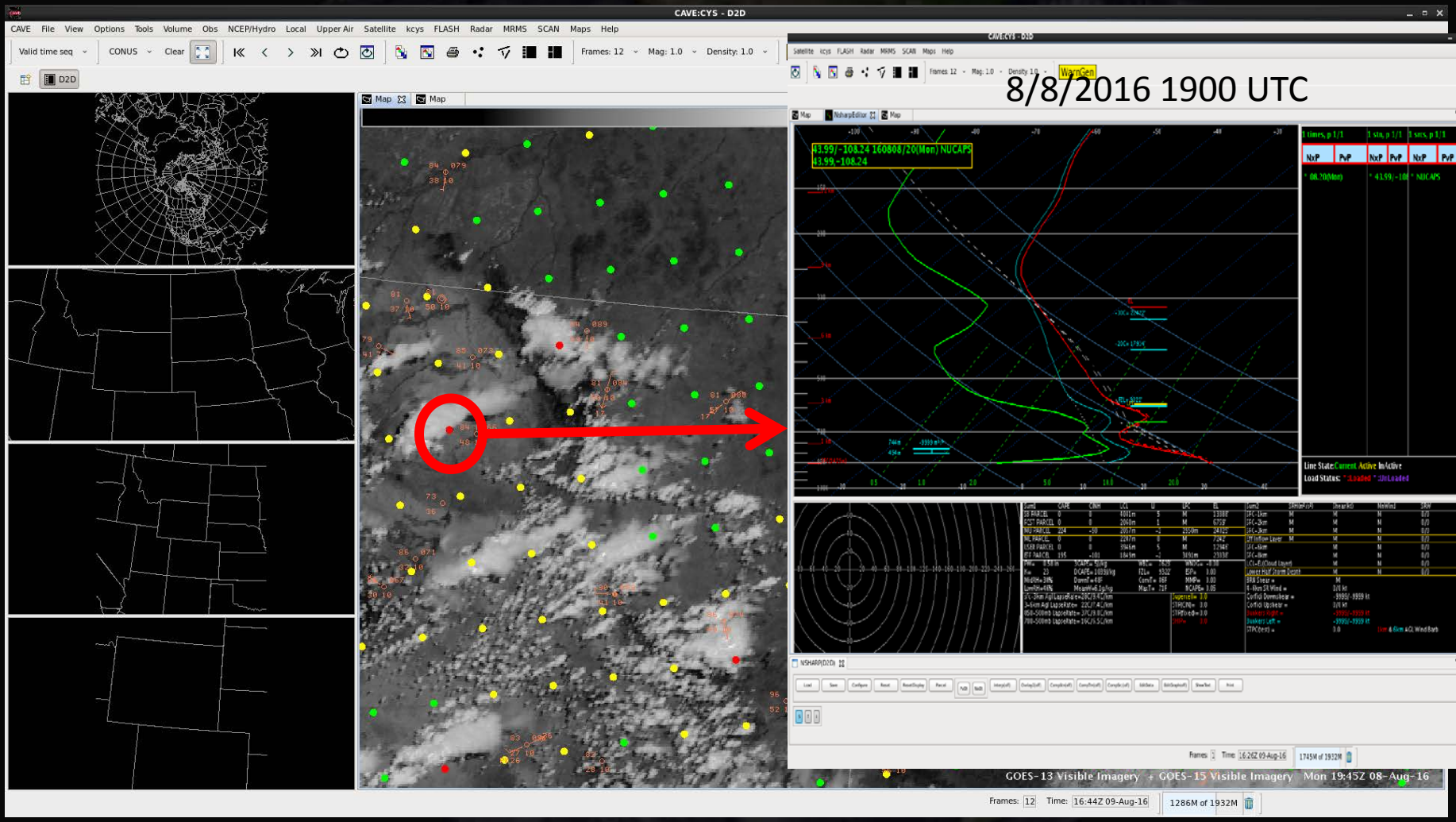


8/8/2016 1900 UTC

8/8/2016 in NE Wyoming and W South Dakota. SPC Marginal Risk for Severe Weather.

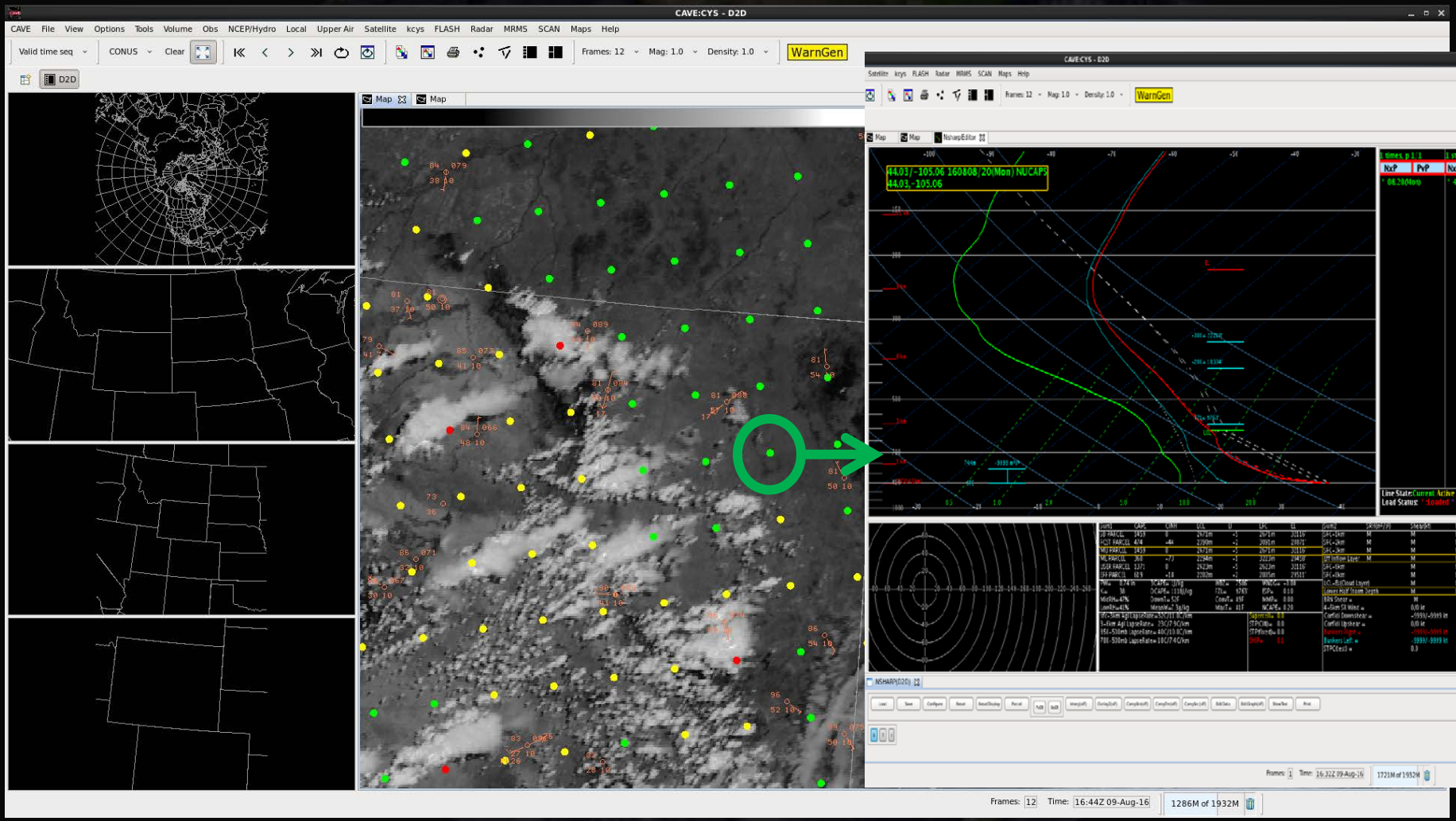
Using NUCAPS in AWIPS-II

Selecting a NUCAPS Profile: Red – Failed QC



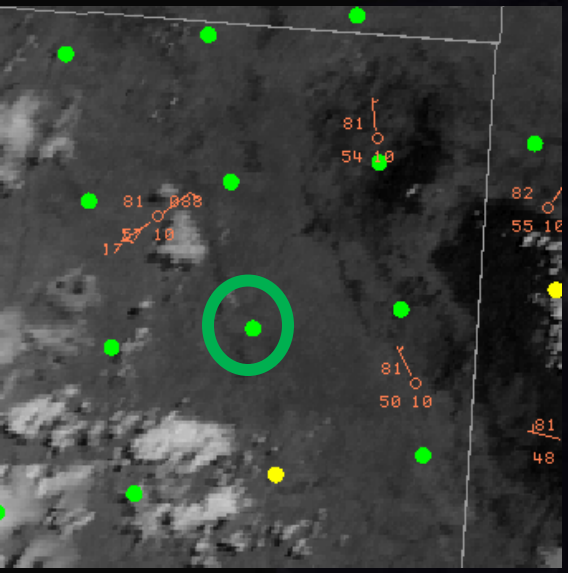
Using NUCAPS in AWIPS-II

Selecting a NUCAPS Profile: Red – Passed QC



Using NUCAPS in AWIPS-II

Modifying NUCAPS Profile - Temp

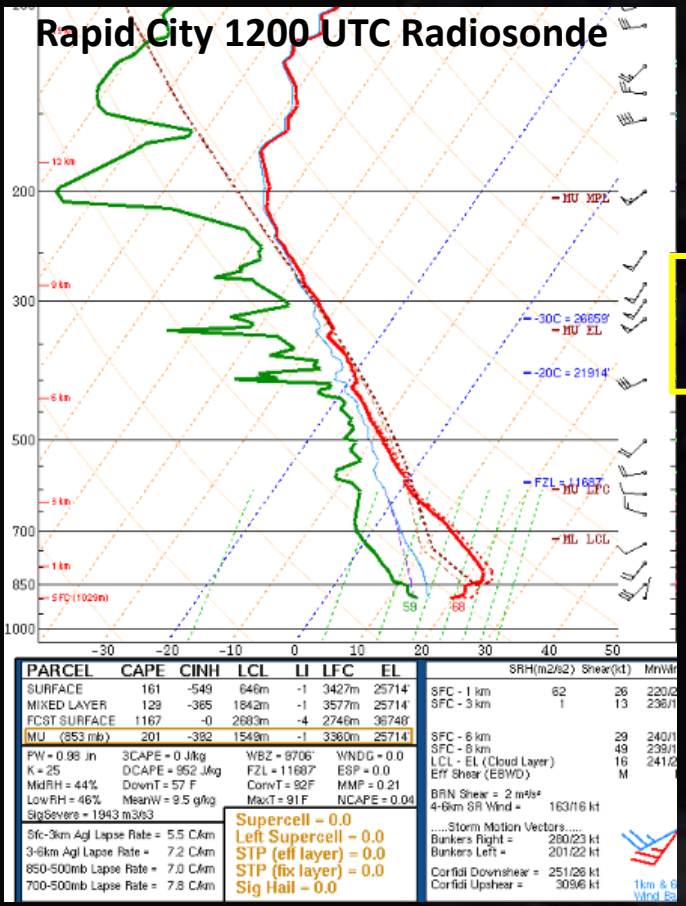


NUCAPS surface temp: 89
METAR surface temp: 81

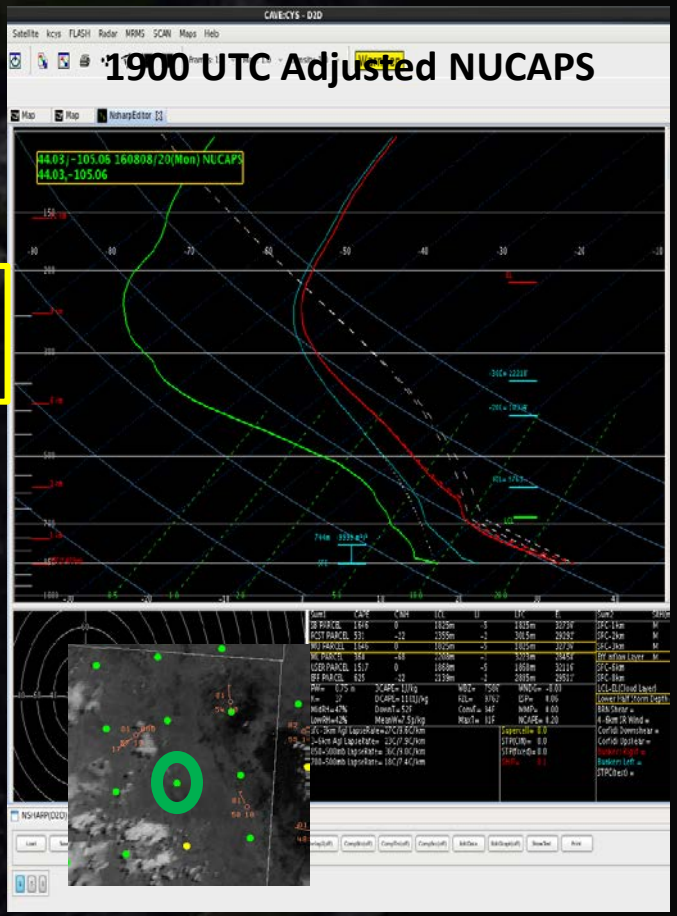
NUCAPS surface dew point: 47
METAR surface dew point: ~53

Using NUCAPS in AWIPS-II

Final adjusted NUCAPS 1900 UTC Profile



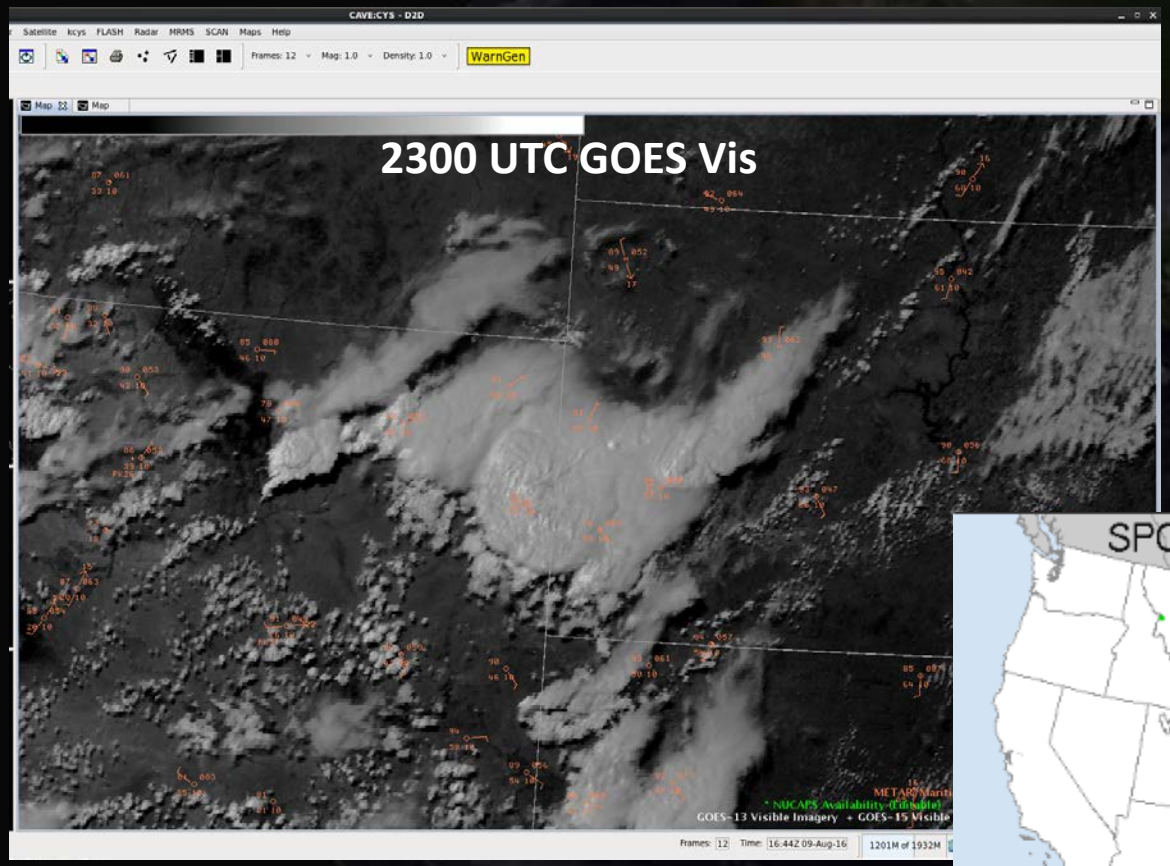
Drying/cooling aloft
Heating surface

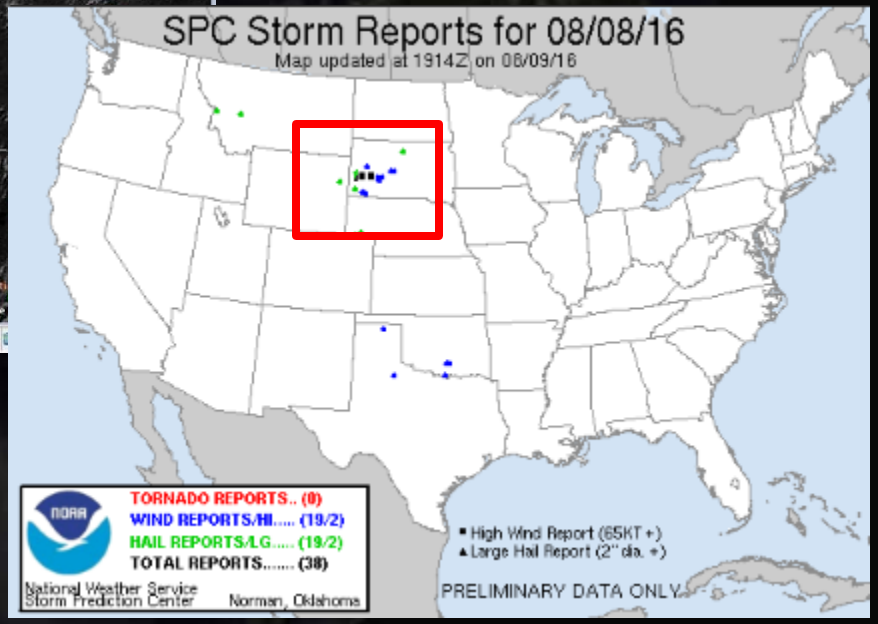


SBCAPE: 161 j/kg
3-6 km LR: 7.2 C/km
FL: 11,700 ft
-20C: 22,000 ft

SBCAPE: 1650 j/kg
3-6 km LR: 7.9 C/km
FL: 9,800 ft
-20C: 19,000 ft

Using NUCAPS in AWIPS-II



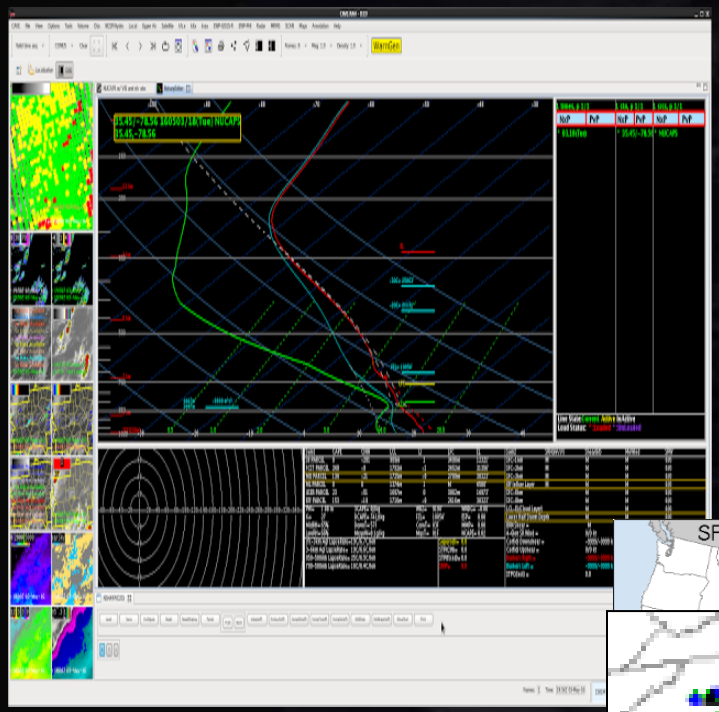


How was NUCAPS used in the HWT?

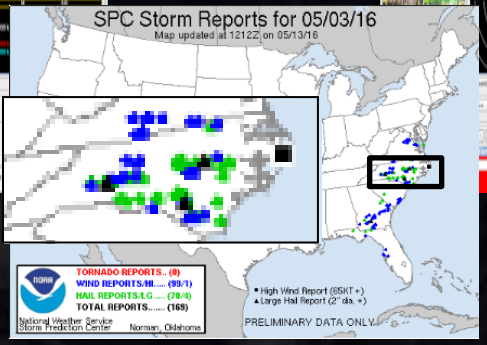
- Assessing the thermodynamic environment…
  - … prior to convective initiation (pre-convective environment)
  - … in the vicinity of ongoing convection
  - … near boundaries
- Comparing with other datasets
  - Water Vapor Imagery
  - Radiosondes
  - NWP

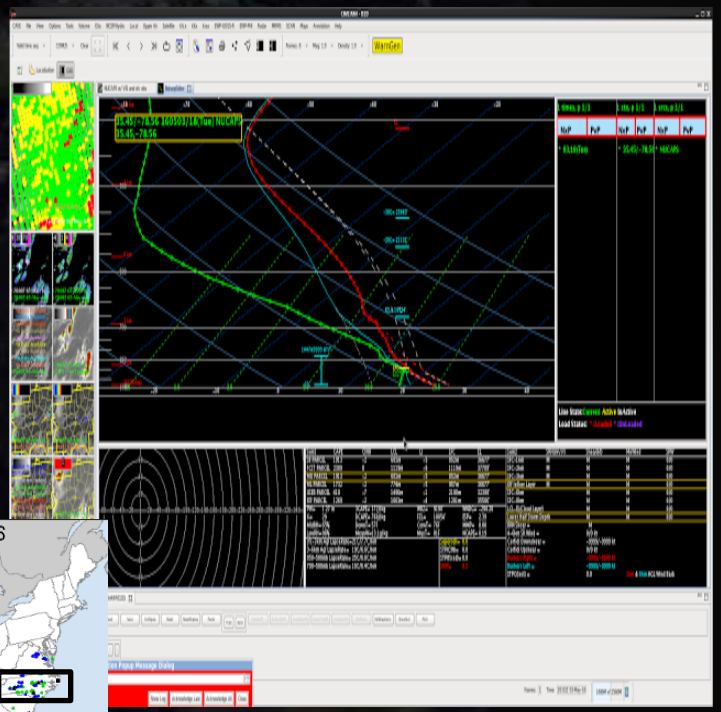
NUCAPS Modification and Severe in North Carolina

- HWT Blog Post: **NUCAPS Sounding Near KJNX Observation 1800 UTC - Adjusting It Is Best For Use By Mesoscale Analyst In Severe Ops.**
- 03 May 2016 – Raleigh, NC



Temp/DP: 70/55
SBCAPE: 0 j/kg



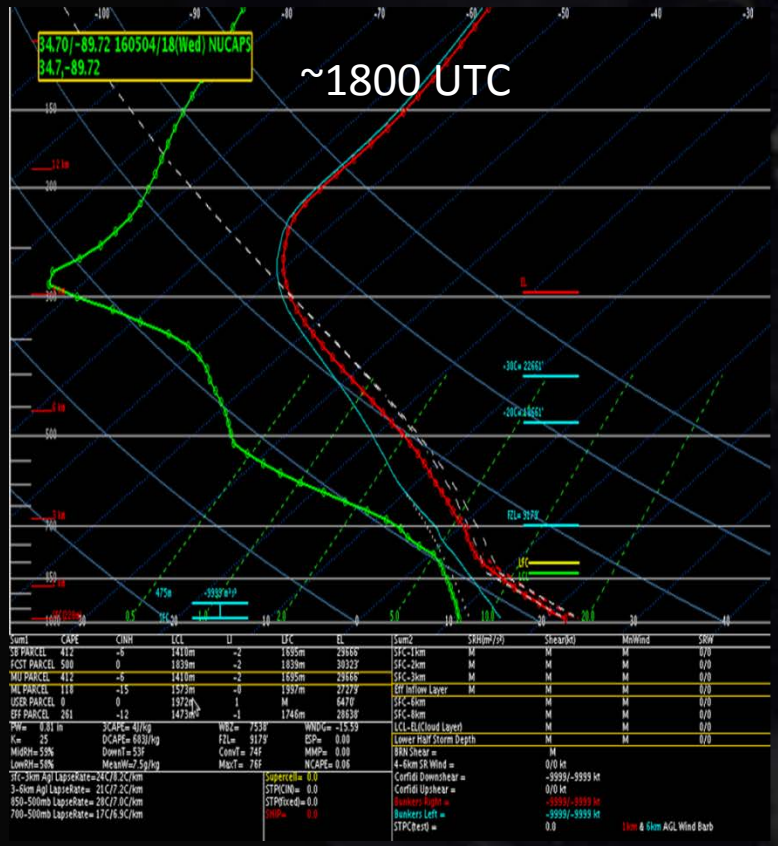


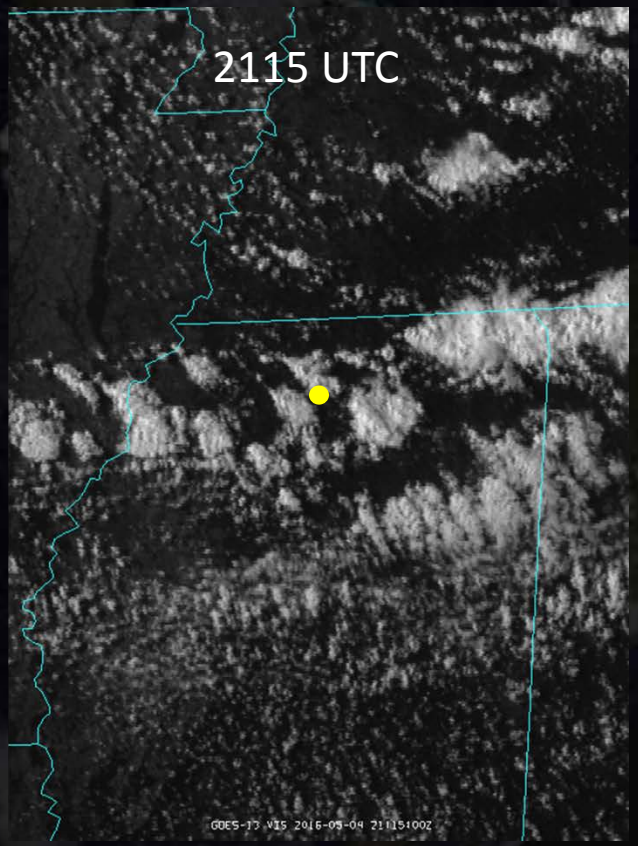
Temp/DP: 75/66
SBCAPE: 1900 j/kg

"It seems that having to adjust the low levels of the NUCAPS sounding would be best handled by the mesoscale forecaster, NOT the warning forecaster. Once you get the hang of adjusting these NUCAPS profiles, they can be useful for near storm environmental monitoring."

Sub-severe in N MS

- HWT Blog Post: **Adjusted NUCAPS Sounding for far north central MS at 1800 UTC - Helpful with estimating CAPE!**
- 05 May 2016 – N MS

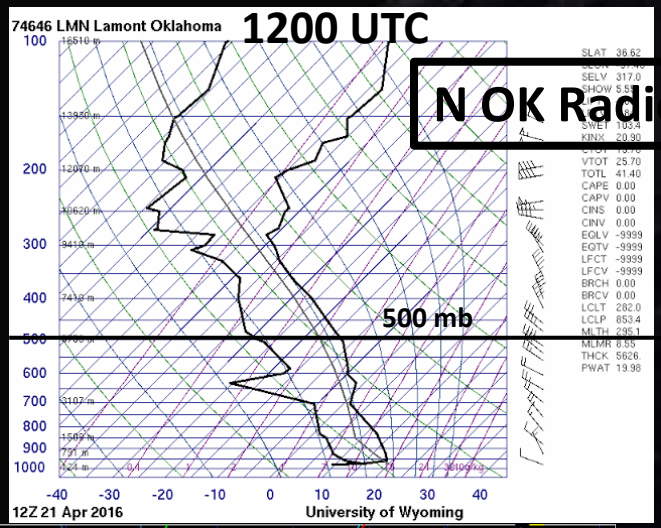


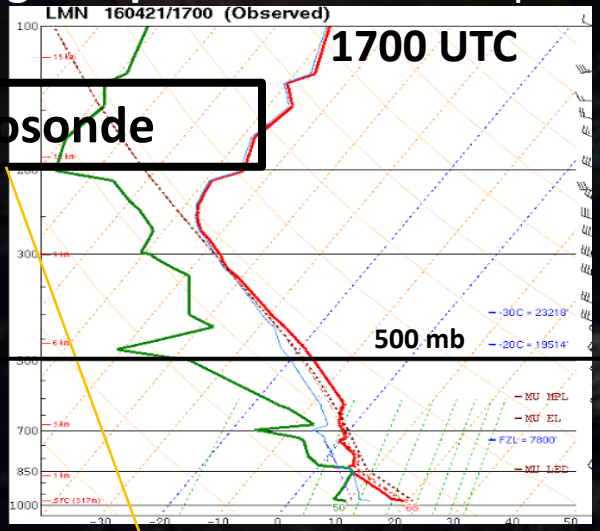


"This would suggest that there is potential for further convective development in this area over the next few hours."

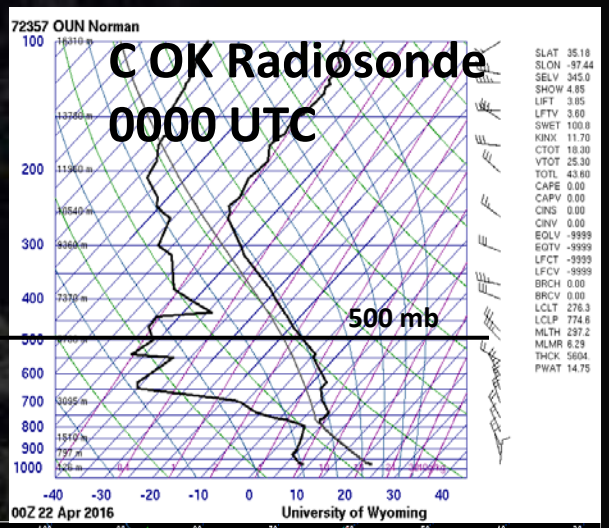
NUCAPS and RAP in Mid-Level Drying

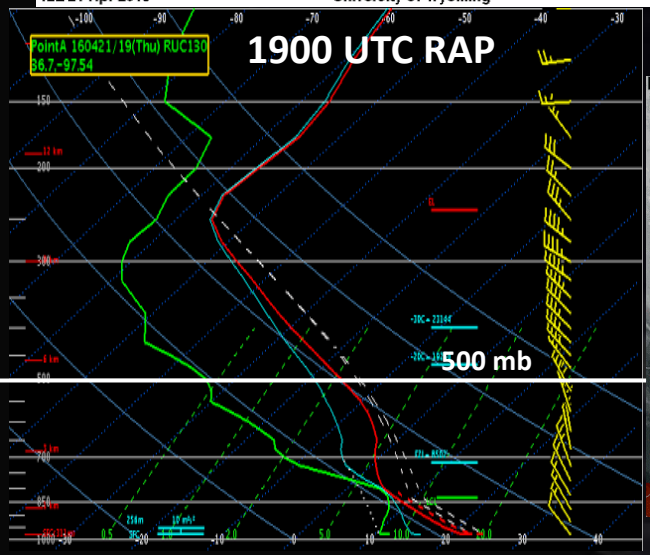
HWT Blog Post: **NUCAPS Sounding Comparison** 21 April 2016 – N OK

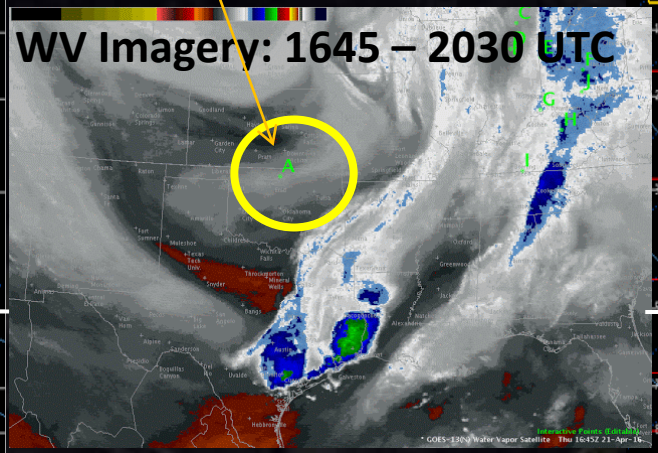


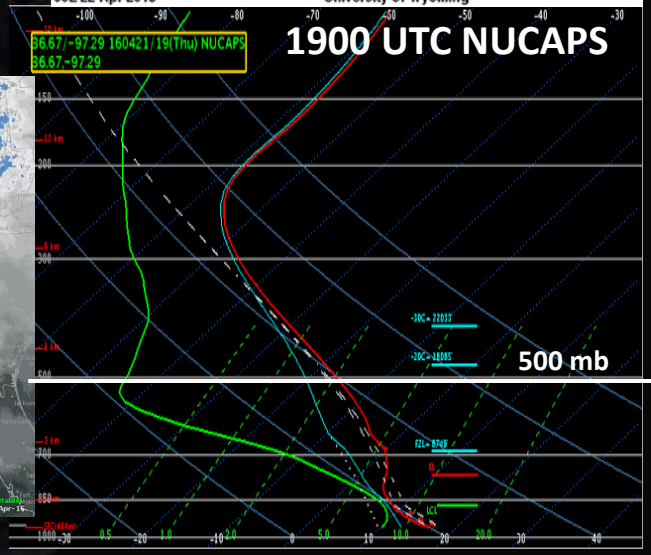


N OK Radiosonde





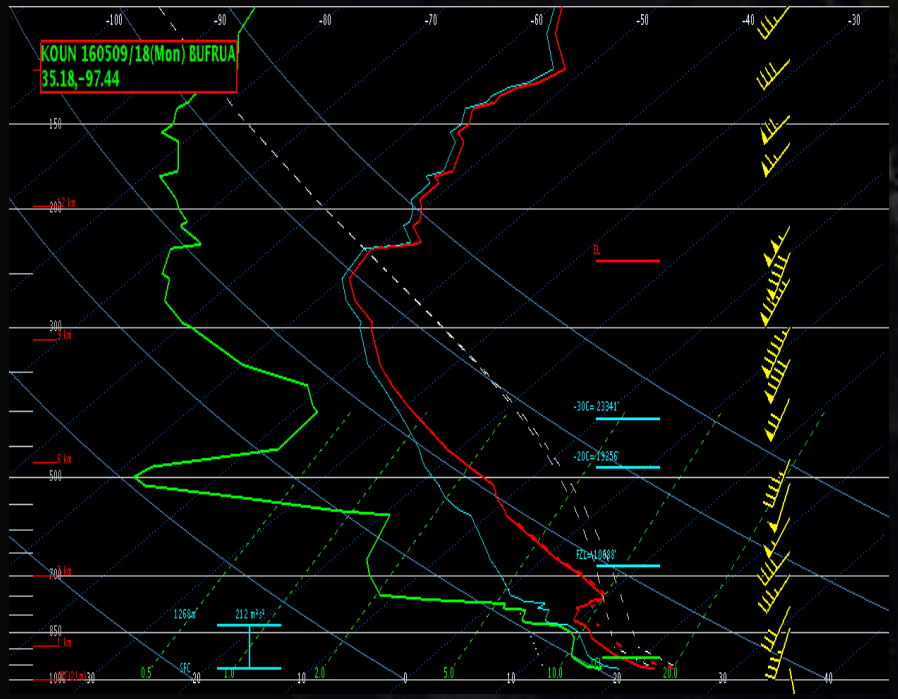


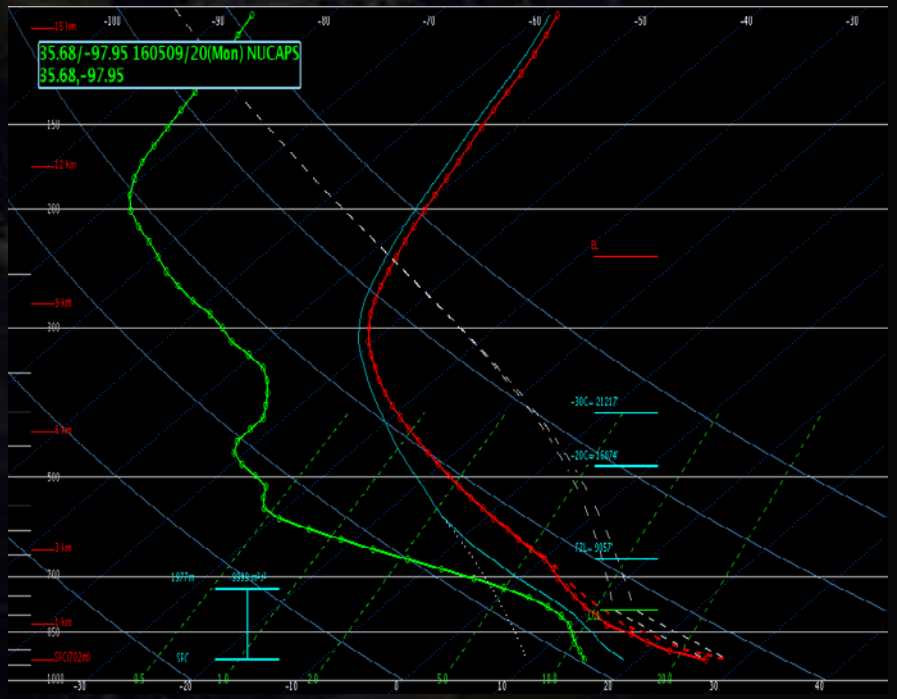


"You can see in the two images that the RAP shows the trend but may not be pronounced enough with the mid-upper dry layer."

NUCAPS Missing Cap

- HWT Blog Post: **NUCAPS Comparison with KOUN Sounding**
- 09 May 2016 – Norman, OK

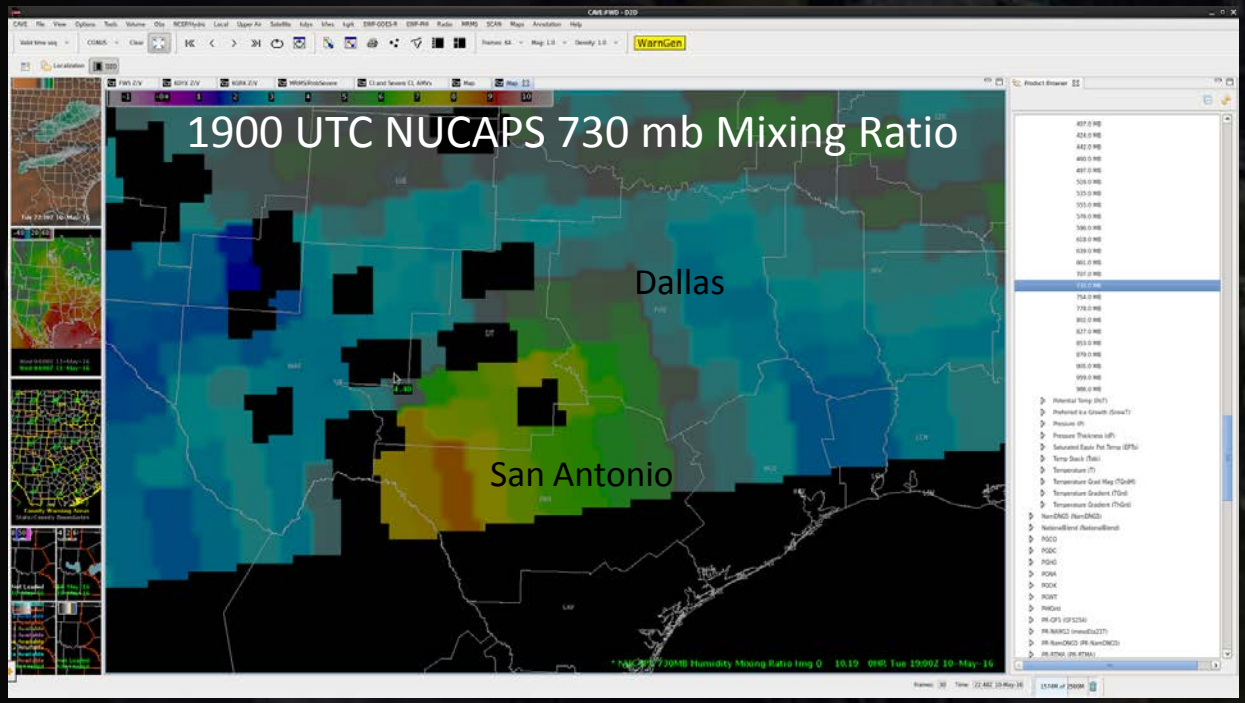




"The smoothed nature of the soundings limits the potential usefulness of the soundings. The inability to see capping inversions and saturated layers is a real drawback."

NUCAPS Plan View - Moisture

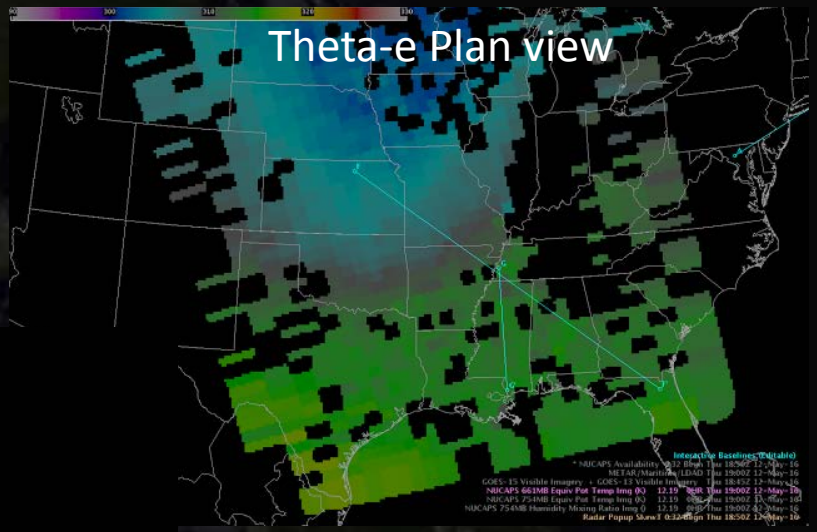
- HWT Blog Post: **NUCAPS Mixing Ratio Plan View**
- 10 May 2016: C Texas

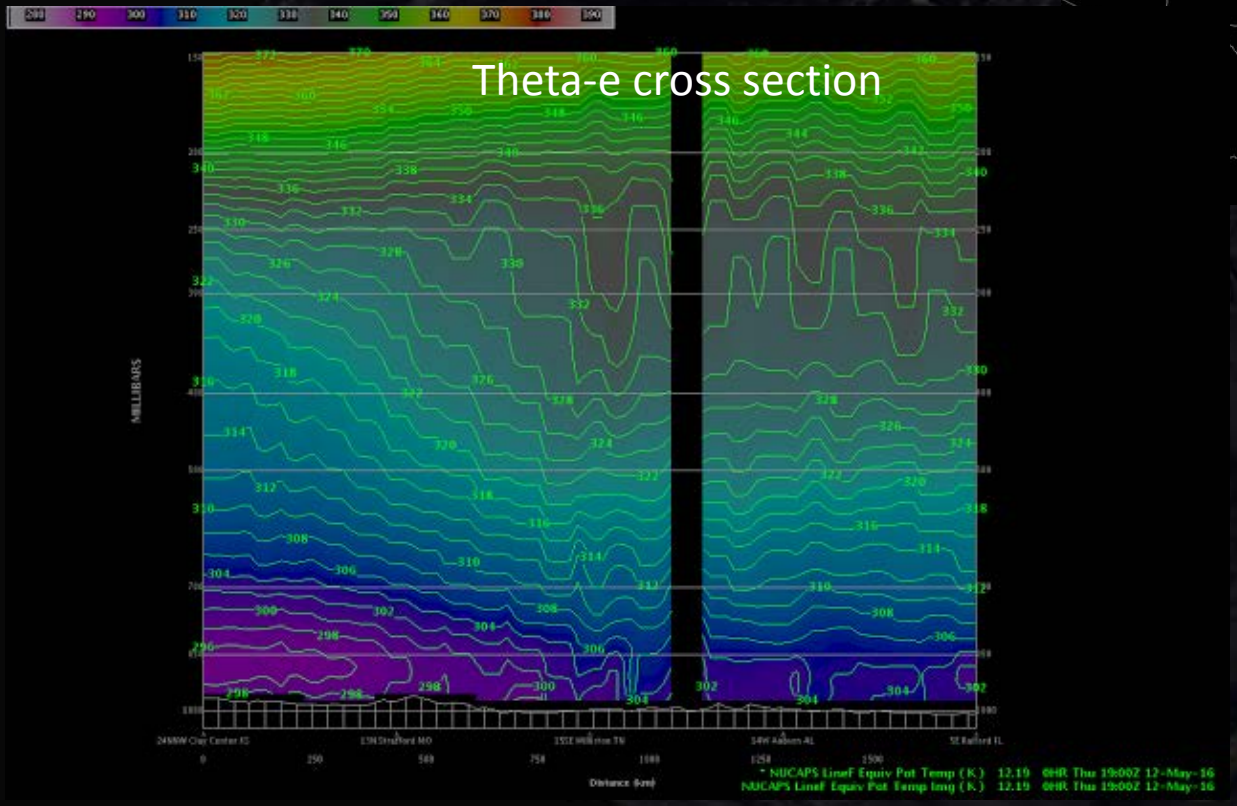


"Storms formed on the border of the FWD and SJT forecast areas but seemed to die out quickly once entering the FWD area. A shot of mixing ratio helps show that **mixing ratios were much better to the southwest**. Travelling further southwest into the EWX area, mixing ratios approached 9 g/kg and just over the Mexican border there was the **longest lived storm of the day** that persisted for a long time... At first I was not convinced at the utility of NUCAPS but these fields show much more promise to me as a forecaster."

Cross Section

- HWT Blog Post: **NUCAPS theta-e Cross Section**
- 12 May 2016 – Southeast US



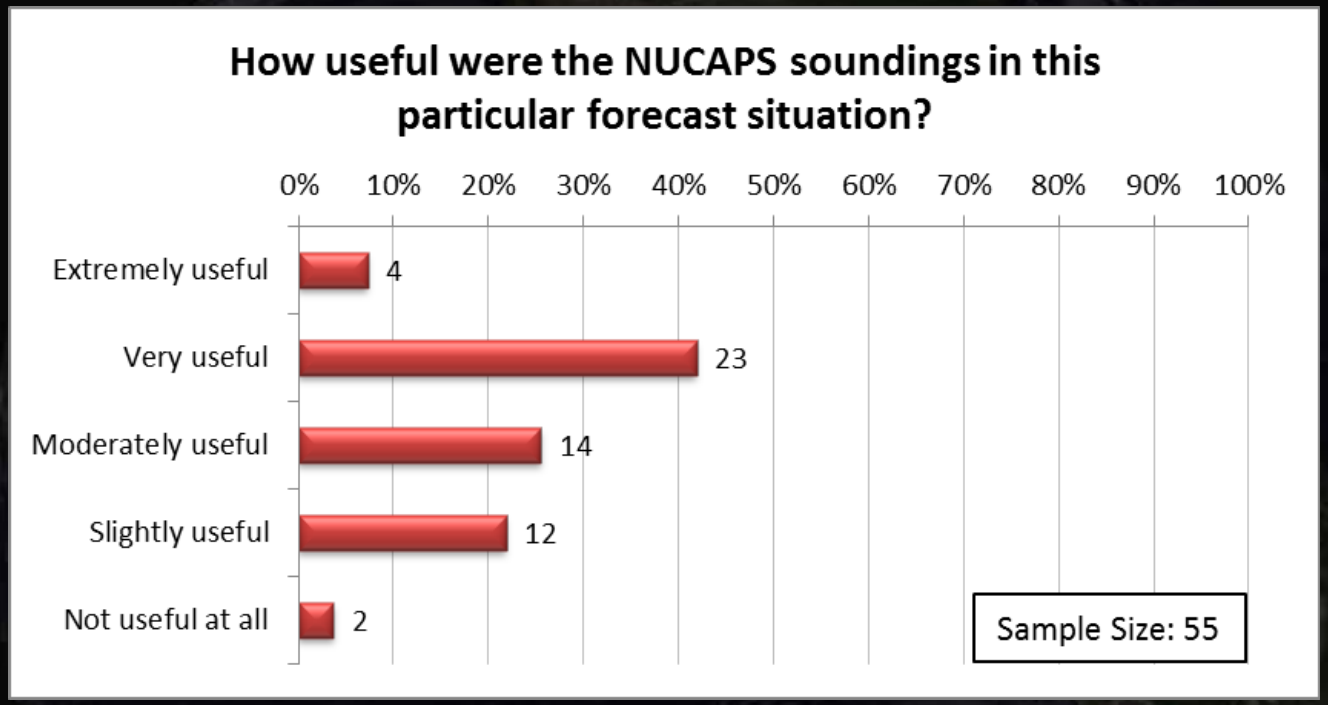


"We used a cross-sectional view of Theta-E in the afternoon to determine the location of our cold front."

Forecaster General Impressions

- While the upper levels of the profile appear accurate, the surface and low-levels usually contained errors,
  - making manual low-level modifications necessary.
    - Best be made by a mesoscale analyst. Warning forecaster does not have time
  - Upon such modifications, when compared to a radiosonde,
    - although NUCAPS profiles lack the vertical detail of a radiosonde, the general shape of the profile is typically similar, and
    - thermodynamic fields derived from the NUCAPS profile are also typically similar.
      - CAPE, lapse rates, height of freezing level and -20C level, TPW, layer moisture trends
- Based on their use of the data, majority of forecasters felt that NUCAPS provided them with unique/useful information for use in convective forecasting.
  - However, widespread acceptance in the field likely depends on some key improvements (future slide)

End of Day Survey



Did the NUCAPS soundings provide an effective update on the current state of the thermodynamic environment?

Answered: 54 Skipped: 9

Answer Choices	Responses	
Yes	90.74%	49
No	9.26%	5
Total		54

End-of-Week Survey

Q23 Will you use the NUCAPS soundings at your home office?

Answered: 16 Skipped: 0

Answer Choices	Responses	
Yes, I willstart using NUCAPS as is.	75.00%	12
Yes, but only if/when the surface/low-level modification process is automated.	18.75%	3
I likely will never view NUCAPS in my home office.	6.25%	1
Total		16

- "We already use NUCAPS. The main use so far has been to identify mid-level moisture and the potential for elevated convection."
- "I will start using it now to get a sense of the environment but I will find it much more reliable when the low-level modification is automated."

Feedback on New Additions

- All new additions for 2016 evaluation went over well with participants!
  - QC Flags
    - Makes profile selection more efficient
    - Were accurate in most situations
  - MetOp NUCAPS
    - Provides more continuity from 1200 UTC radiosonde to afternoon JPSS NUCAPS.
    - Should be processed, available in AWIPS operationally
    - Would welcome application to other satellites for improved continuity
  - Plan view displays
    - Provides quick look at a NUCAPS swath at a given level
      - Temperature, moisture, and variables derived from them
    - Would like to see layer fields added (CAPE, LI, TPW, LPW, LR's, etc.)
    - Cross Sections were used for deeper analysis of synoptic scale features such as frontal boundaries
  - Training
    - Received positive reviews
    - Verification statistics comparing NUCAPS with RAP model
    - Use of Pop-up Skew-T should be included

Key Suggestions

- Improve low levels of NUCAPS soundings
  1. While keeping NUCAPS primarily observational (ideal)
  2. Blend with NWP (RAP)
     - "By introducing model data to the process you could make it look better but you are introducing a second possible source of error into the product."
- Reduce latency into AWIPS
- Improve availability in cloudy sky regions
  - Make microwave only soundings available in AWIPS
- Verification statistics – NUCAPS vs RAP
- AWIPS capabilities
  - Overlay NUCAPS with other soundings in NSHARP
  - Plot nearby observed winds (sfc obs, satellite) in NSHARP

Summary

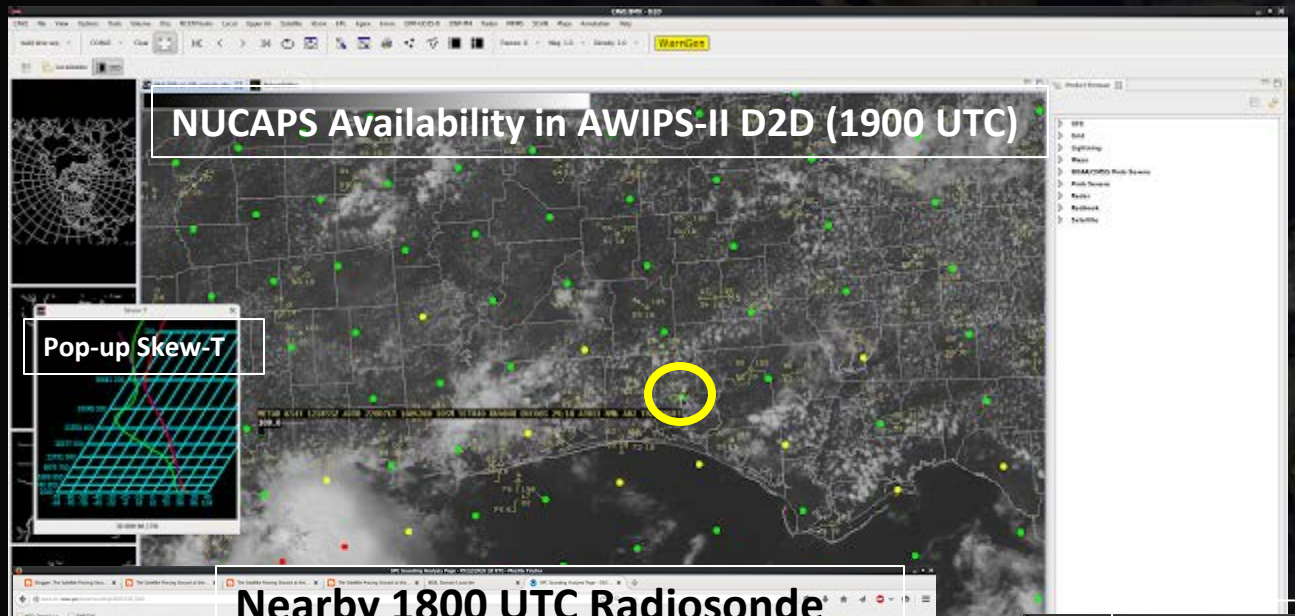
- Generally similar feedback as last year.
  - NUCAPS effective/unique update on thermodynamic environment, however,
    - modifications are time-consuming
    - lack of detail in vertical (primarily inversions) is big negative
  - Would prefer to keep it observationally-driven
- QC Flags were appreciated
- Morning NUCAPS (from MetOp) was useful
- Plan View and Cross-section are great
- **HWT Blog: http://goesrhwt.blogspot.com/search/label/NUCAPS**
- **Final Report Coming**

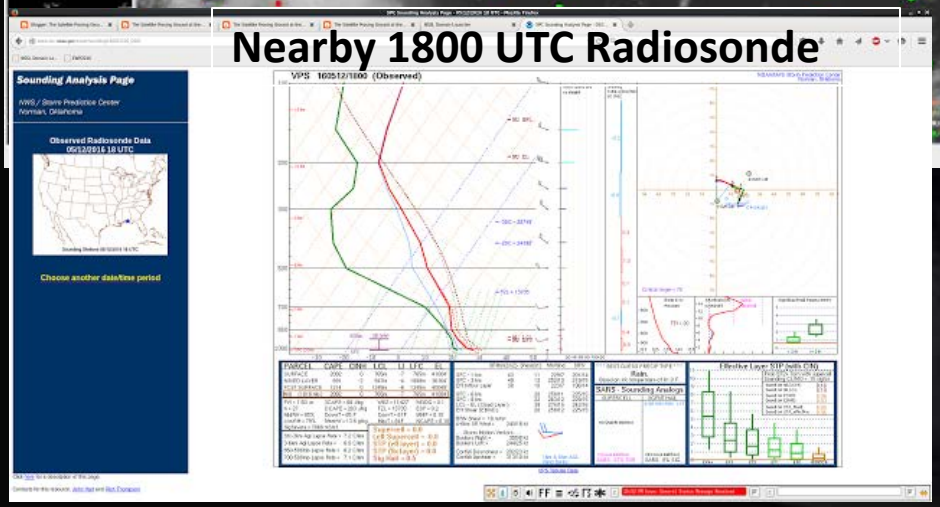
- New job as meteorologist with NOAA/NWS in Pueblo, CO starting in October. I plan to maintain involvement with satellite community

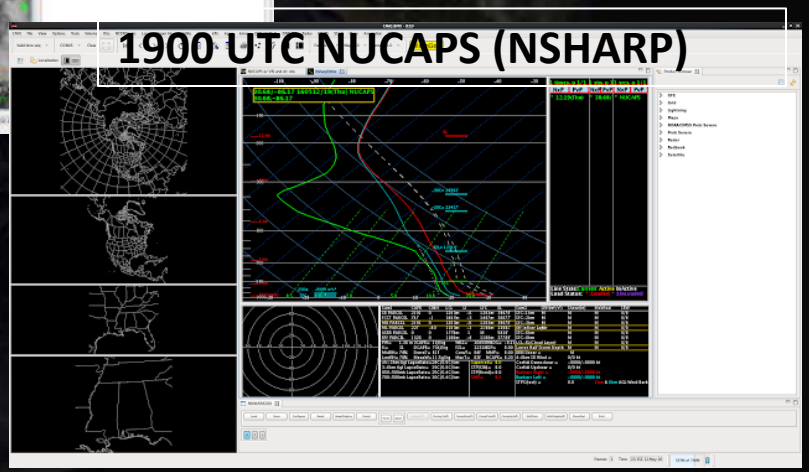
bill.line@noaa.gov

NUCAPS and Pop-up Skew-T

- HWT Blog Post: **Pop-up skew-T for AWIPS**
- 12 May 2016 – NW FL





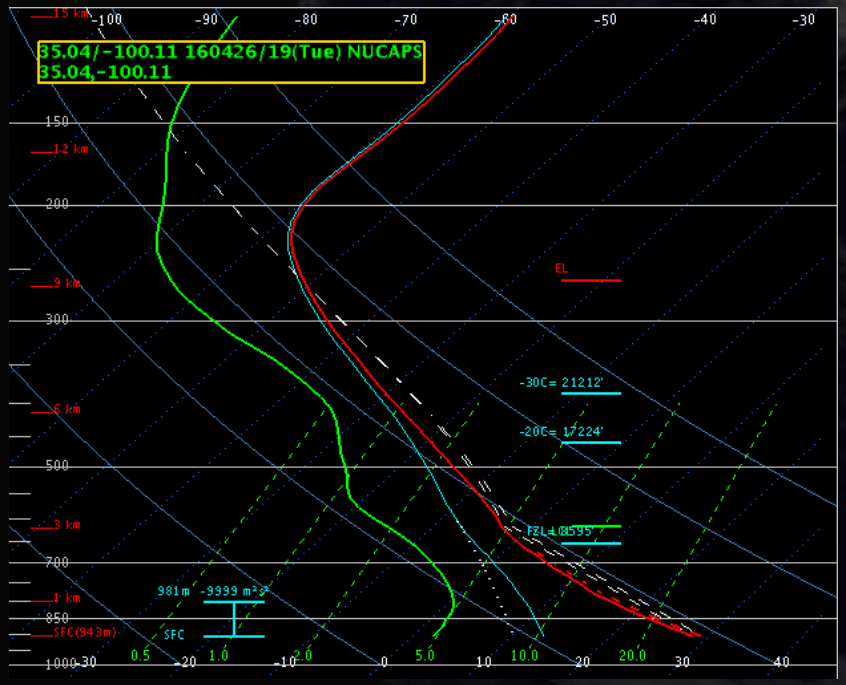


The AWIPS "Pop-up Skew-T" tool allows forecasters to gain a quick/simple look of the NUCAPS profiles prior to selecting and loading a given profile for interrogation.

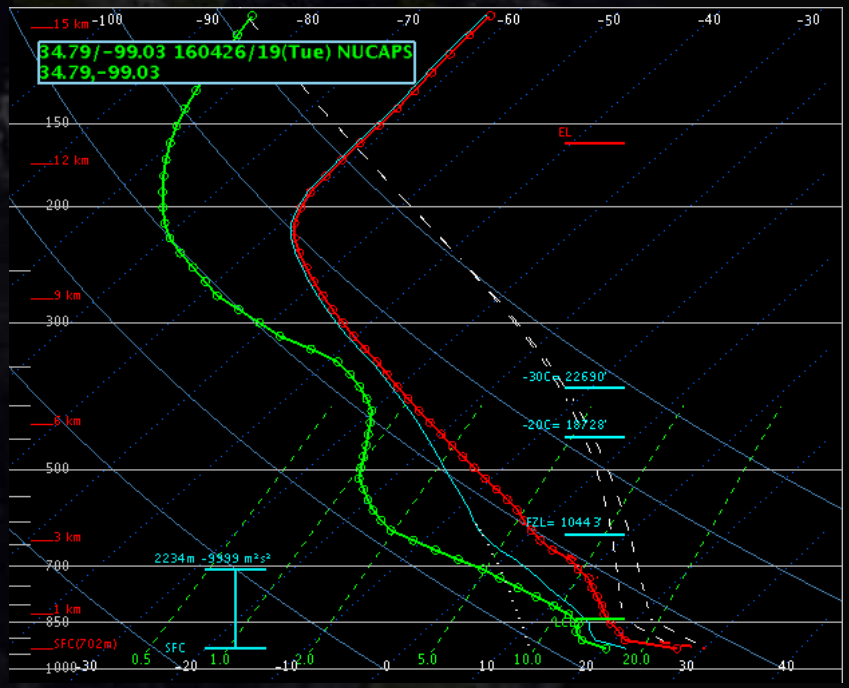
NUCAPS around Dryline

- HWT Blog Post: **NUCAPS Around The Dryline**
- 26 April 2016 – SW OK

Behind Dryline



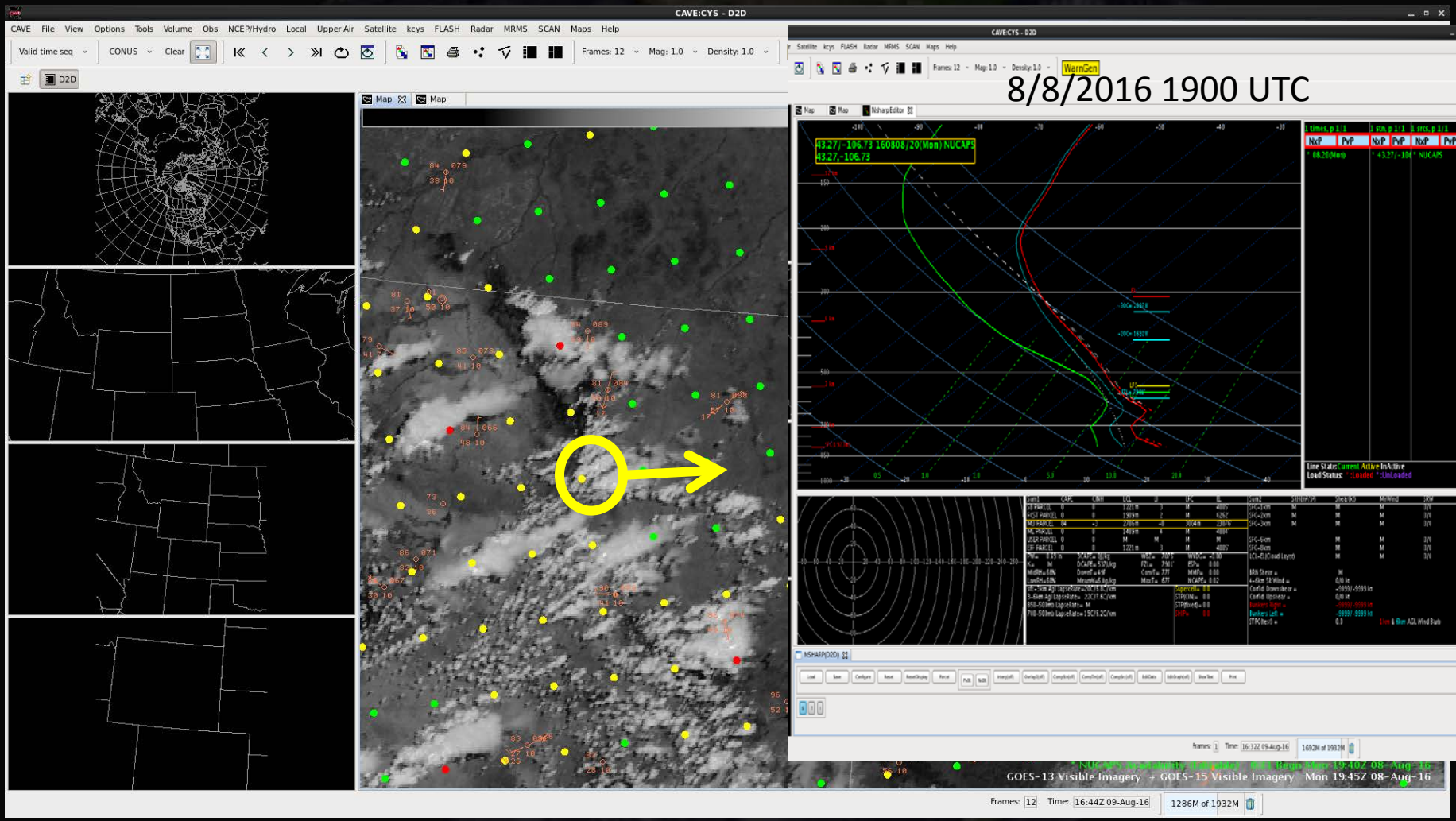
Ahead of Dryline



"The NUCAPS profiles did a good job resloving the dryline in southwestern OK…. Also of note was the moist layer evident on both soundings around 400mb. This matches a moist layer found on 12z and 18z soundings around the area."

Using NUCAPS in AWIPS-II

Selecting a NUCAPS Profile: Yellow – Failed QC



End of Day Survey

How did you use NUCAPS?

In the morning as a check on how unstable the airmass was. We also used a cross-sectional view of Theta-E in the afternoon to determine the location of our cold front.

I used the soundings to verify some of the environmental characteristics I was seeing in RAP sounding such as the amount of instability, lapse rates, and the freezing level.

To look at instability in a fairly data sparse region in the Pueblo CWA. We also looked at a plan view of mixing ratio, which showed a couple of areas of higher moisture. This is where the bulk of convection occurred.

We used it to compare to the Del Rio 1800 UTC sounding, and it matched nicely with the pre-convective environment for the Dallas-Fort Worth area.

Ialso used them to see how the 0C and -20C levels were changing over the afternoon (they decreased in height a few thousand feet each). This was key for warning operations.

There were two soundings in close proximity to each other (within KLWX) only 1 hour apart. These soundings showed the warming and moistening of the lower layers as well as the increase in instability.

End of Week Survey Results

This was the product of the week that provided the most work for the forecaster to get out what they wanted/needed. Having to modify a sounding or make a cross section and then seeing the amount of suspect data will make forecasters very skeptical at first. I suspect that if I trained my staff on it as is, maybe 1 out of 10 forecasters would use it as is. That being said if it can be delivered in a format that is easy to put into a procedure and that they don't have to modify I think buy in will be a lot higher. There can be extreme value in this product, especially if it is kept entirely observational…. I would like to say that having the IASI soundings were very helpful and getting them 4 times per day would be great. N

NUCAPS is a tool I wasn't aware of before this week but am now looking forward to using it in operations (and sharing it with co-workers). The only downfall is the temporal resolution and the luck of the draw with the cloud cover.

NUCAPS has strength in tracking mid-upper level moisture trends as shown in my one blog example, but even then I prefer to not look at a single point but rather use 6.7u/WV loop to see spatial/temporal characteristics of moistening/drying trends aloft.

The inability to see capping inversions and saturated layers is a real drawback.

End of Week Survey Results

I still firmly believe anything that prevents a forecaster from having to manually adjust the sounding is beneficial. If this does not occur, I think it would be a tough sell as forecasters would simply look to other model-derived datasets to make their forecast. Manually adjusting the sounding is labor intensive and potentially confusing as many do not modify soundings on a regular basis.

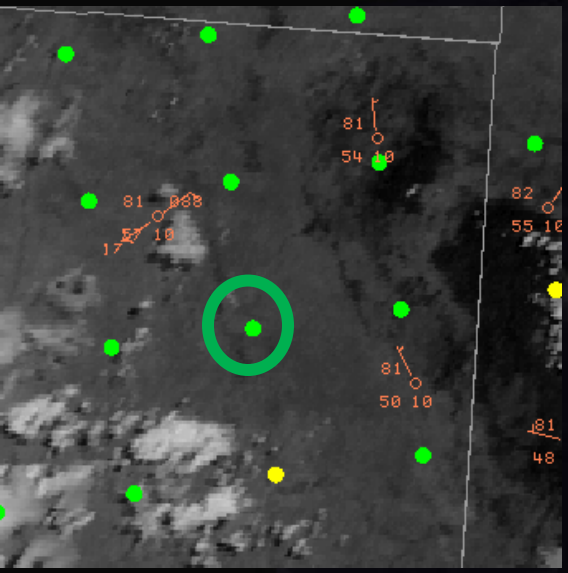
It was nice to have this data going into severe weather events, although changing the values to match the state of the atmosphere better was a little tedious, the information about the freezing level, and -20C level for hail was helpful right before going into a severe weather event.

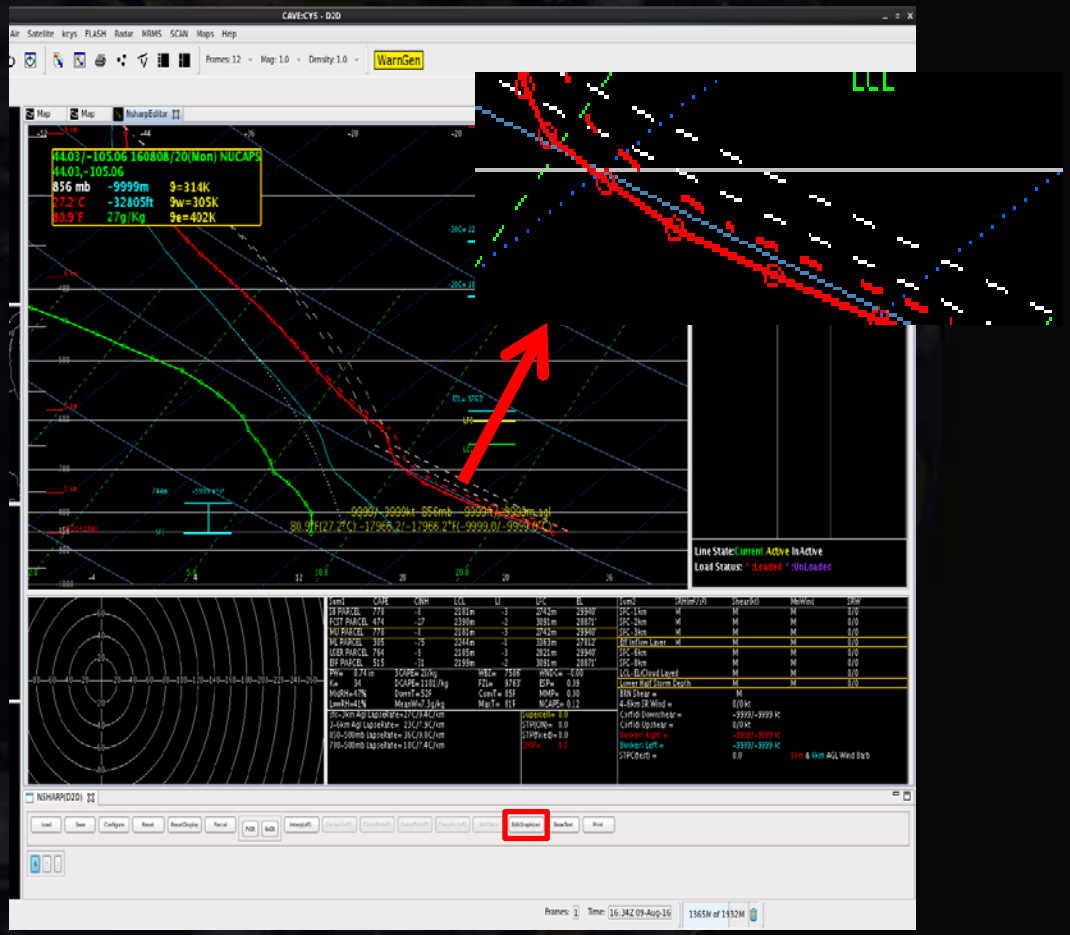
This data could be highly useful, if there was more confidence in the actual profiles. Taking the time to modify a significant portion of the sounding to more accurately match things like RAP analyses, is not necessarily practicle.

We can use this data set to account for when model runs fail to reach AWIPS2 and also for added sampling over higher terrain/sparse data fields over mexico. Our Texas office also has a RAOB gap that can be utilized for some low level moisture return events.

Using NUCAPS in AWIPS-II

Modifying NUCAPS Profile - Temp



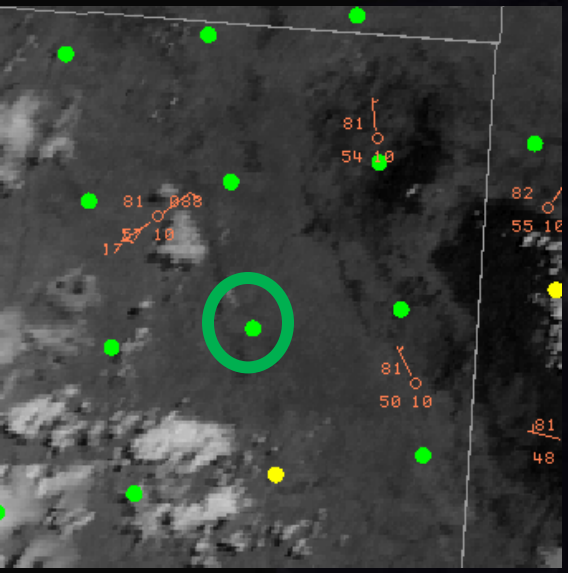


NUCAPS surface temp: 89

METAR surface temp: 81

Using NUCAPS in AWIPS-II

Modifying NUCAPS Profile – Dew Point

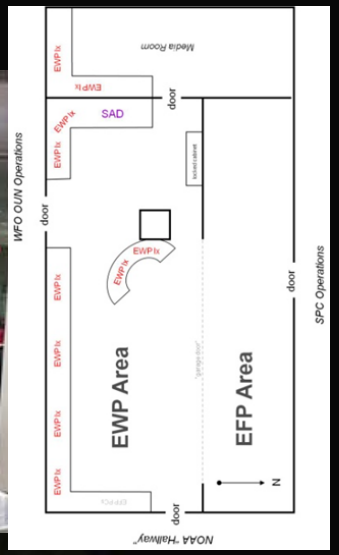


NUCAPS surface dew point temp: 47

METAR surface dew point temp: ~53

Hazardous Weather Testbed

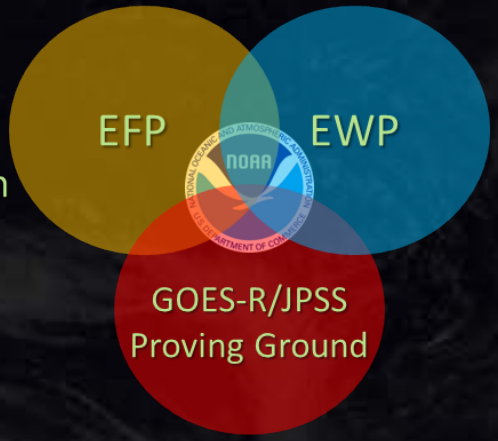
Not just a facility…



… but an organization as well

Experimental **F**orecast **P**rogram

*Prediction of hazardous weather events from **a few hours to a week in advance***



Experimental **W**arning **P**rogram

*Detection and prediction of hazardous weather events **up to several hours in advance***