

Operational Transition of Gridded NUCAPS to NOAA NWS and Emerging Applications

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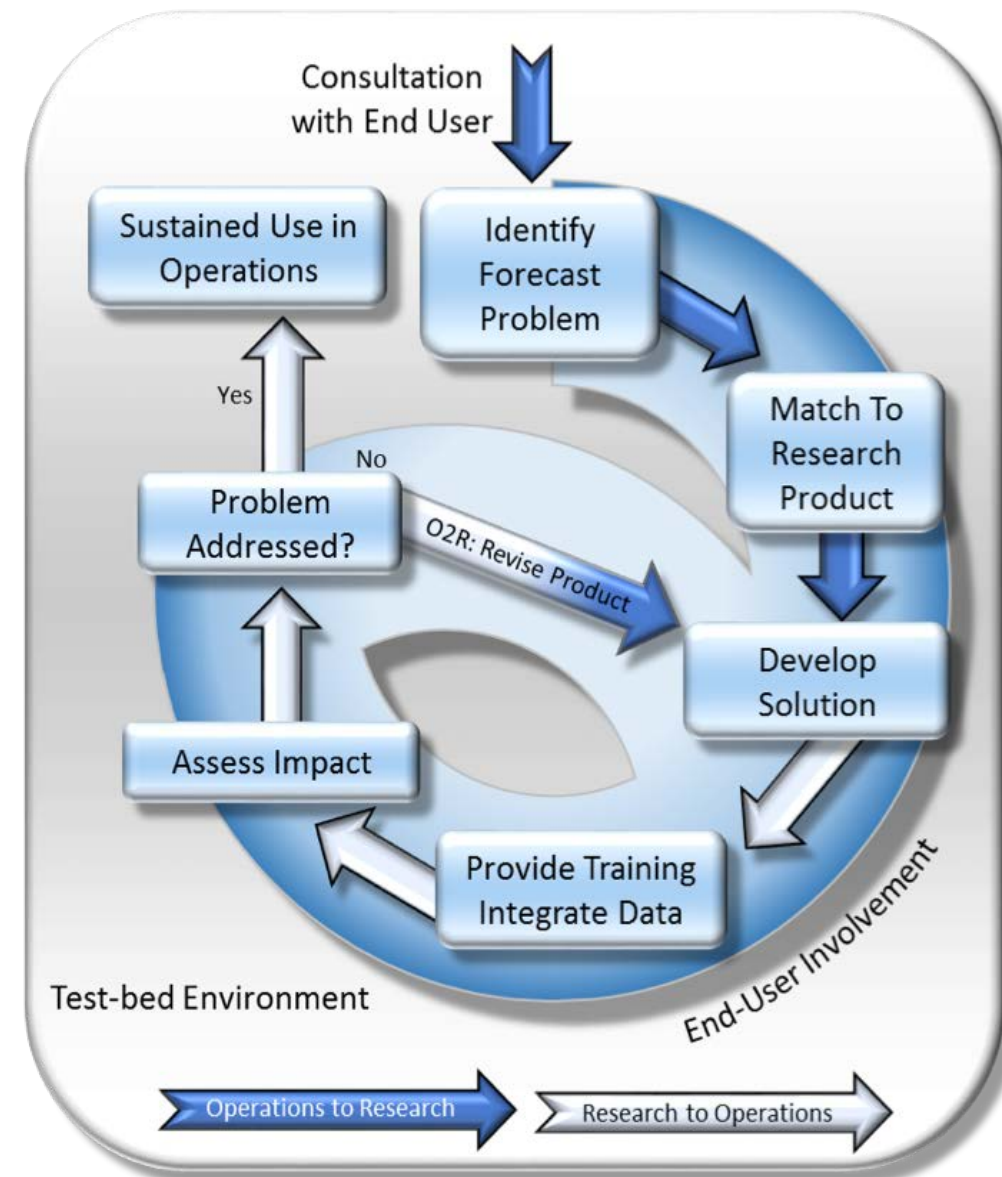
- The Short-term Prediction Research and Transition Center was established in 2002 for transitioning unique satellite observations and research capabilities to end users to improve short term forecasting and decision support
- Introduce experimental products to end users through a Research to Operations / Operations to Research Paradigm
- Concept has been used to successfully transition a variety of satellite datasets to operational users for 15+ years

<https://weather.msfc.nasa.gov/sport/>

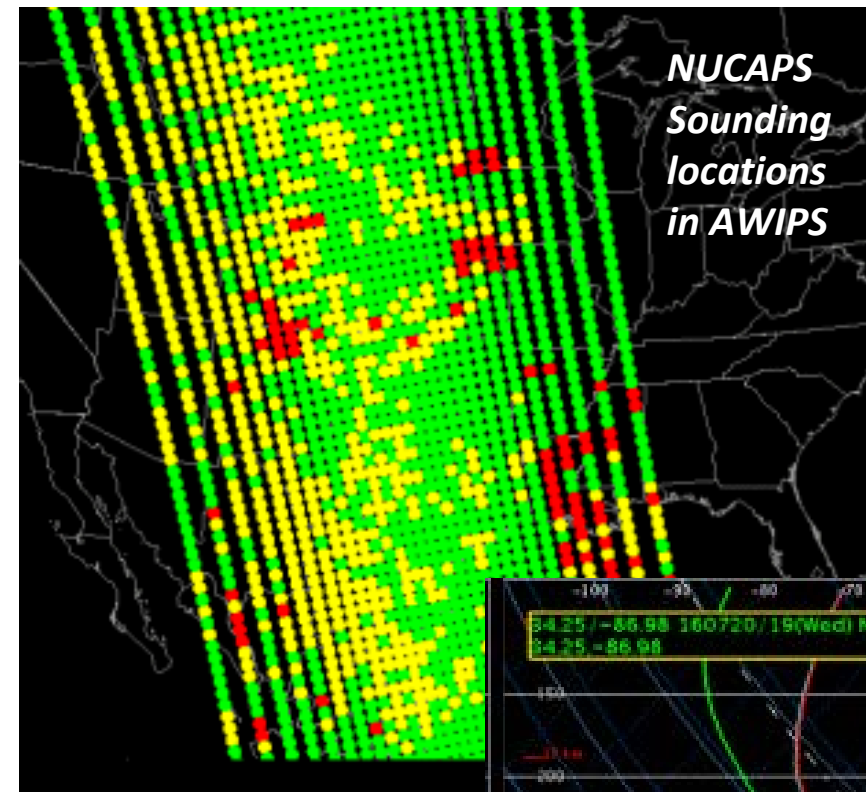
<https://nasasport.wordpress.com>

Twitter @NASA_SPoRT

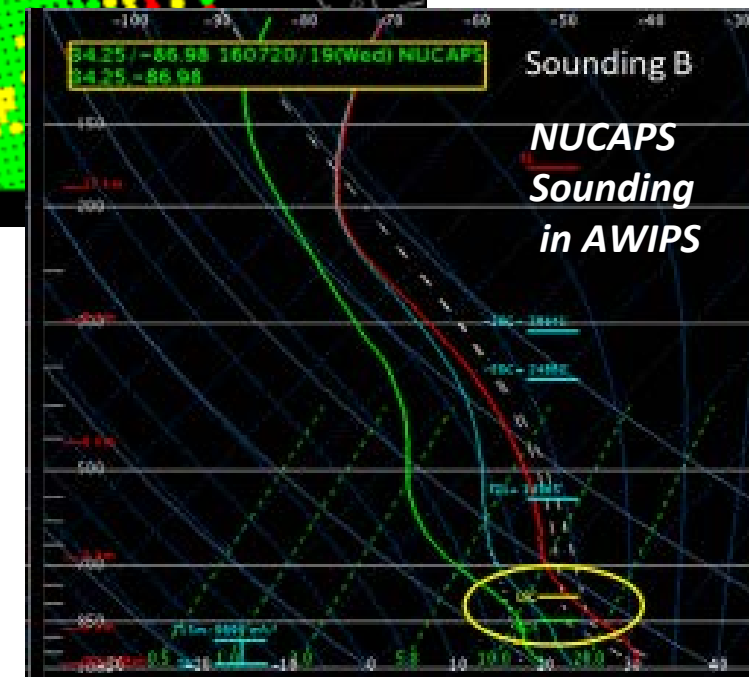
Facebook NASA SPoRT Center



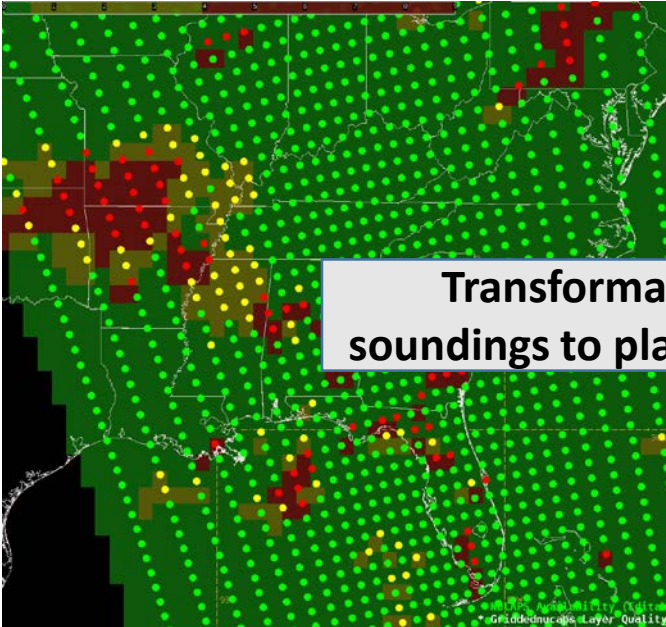
- Since 2014 S-NPP CrIS/ATMS NUCAPS Soundings have been operationally available to all National Weather Service forecasters through the Advanced Weather Interactive Processing System (AWIPS) as Skew-T plots
- NUCAPS Soundings have been valuable:
 - Where conventional observations lack
 - Between radiosonde launches
- Have been demonstrated as valuable for:
 - Assessing the pre-convective environment
 - Cold Air Aloft aviation hazard
- The JPSS Sounding Initiative collaborated to develop the capability to visualize the data in plan view or cross section to maximize the benefits of NUCAPS data in AWIPS



Images by Kris
White (NWS
HUN/SPoRT)



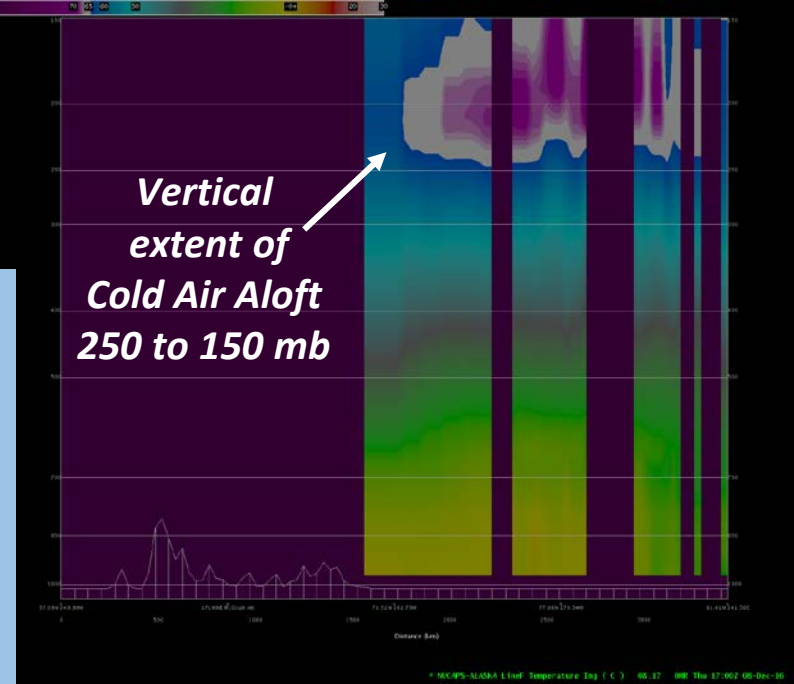
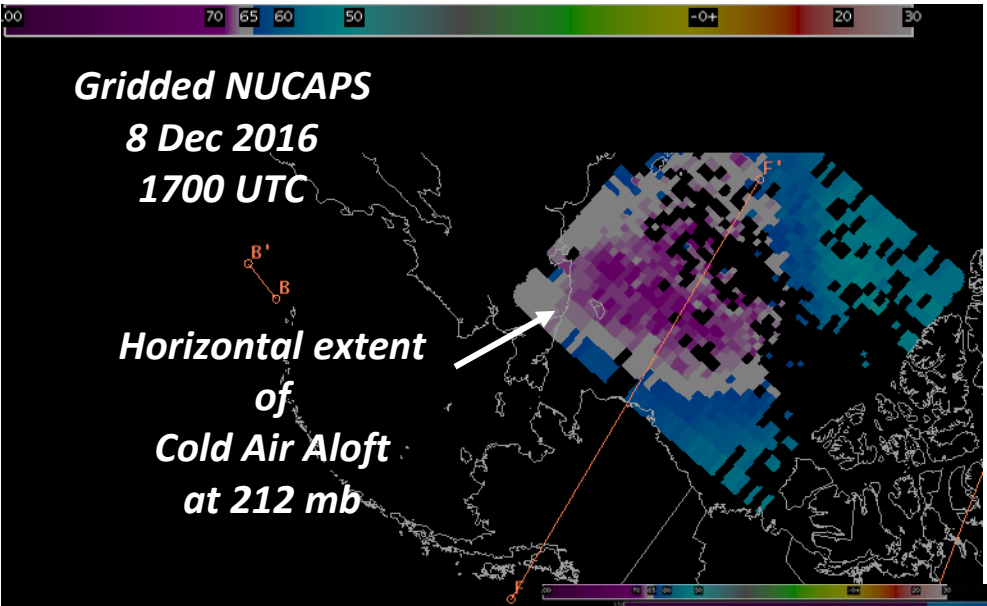
- An experimental gridding process was developed in 2015/2016 and introduced to NWS forecasters in a testbed environment
- The JPSS Sounding Initiative part develop the gridding capability w
- Operational NWS-wide release w
- Minimal interpolation in the grid
- Temperature, moisture, and deriv



Gridded NUCAPS	
----- Level/Layer Products -----	
Temperature	
Dewpoint Temperature	
Dewpoint Depression	
Relative Humidity	
Lapse Rate	
Theta-E	
Theta-E Lapse Rate	
Precipitable Water	
----- Single Level Products -----	
Temperature 2m	01.1632
Relative Humidity 2m	01.1632
Ozone Anomaly	01.1632
Total Ozone	01.1632
Tropopause Level	01.1632
Haines Index	01.1632
Quality Control	01.1632

Pressure Levels	
1000 MB	01.1632
925 MB	01.1632
850 MB	01.1632
700 MB	01.1632
500 MB	01.1632
300 MB	01.1632
250 MB	01.1632
200 MB	01.1632
100 MB	01.1632

- Gridded NUCAPS was initially developed to address Cold Air Aloft
- Cold Air Aloft ($\leq -65^{\circ}\text{C}$) events can freeze airliner fuel and regularly occur at flight levels in the arctic
- The Anchorage Center Weather Service Unit (CWSU) provides Meteorological Impact Statements (MIS) to Air Traffic Controllers to direct flights around the 3D air features
- In data sparse Alaska, forecasters have relied on analysis and model fields and limited radiosonde observations to guess the 3D extent of the Cold Air Aloft



NUCAPS Soundings and Gridded products have been operationally adopted into the Anchorage CWSU operations
Weaver et al. (2019)



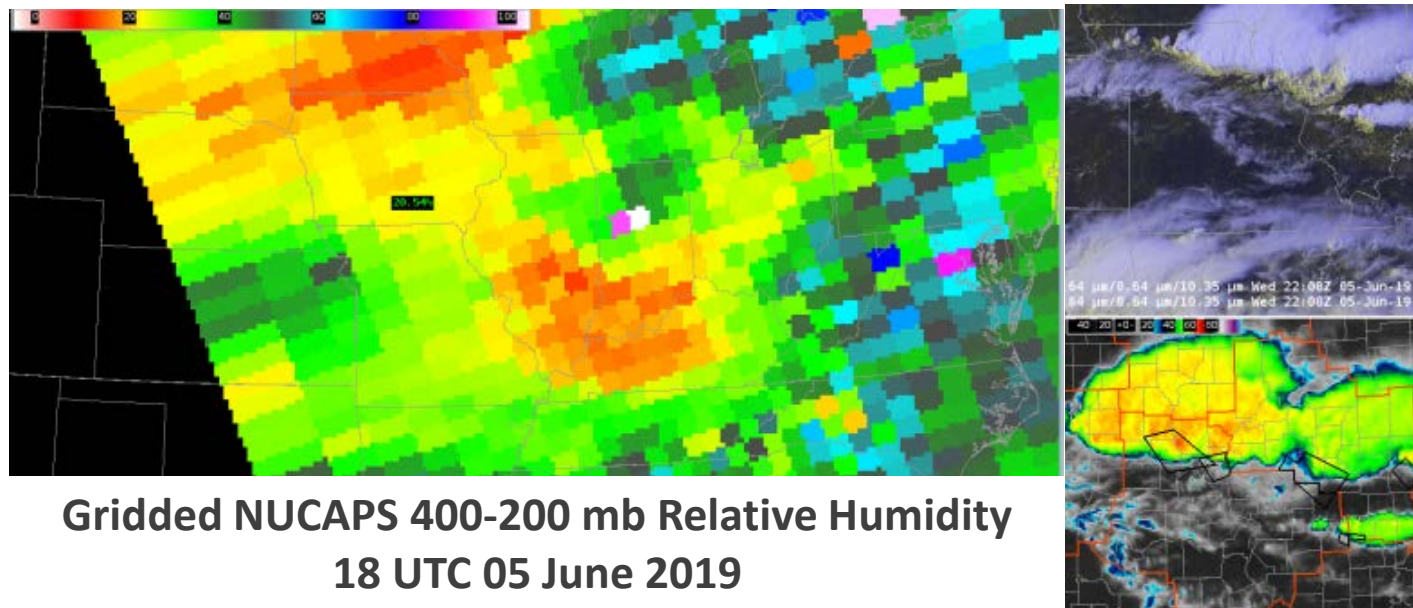
- Since 2015 NUCAPS has been assessed by NWS forecasters at the Hazardous Weather Testbed Spring Experiment
- This has led to incremental product development and ideas for new areas of applied research
 - Boundary layer modification
 - Plan-view/cross-section displays
 - Improved latency
 - Data Fusion

Examples on the HWT blog

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

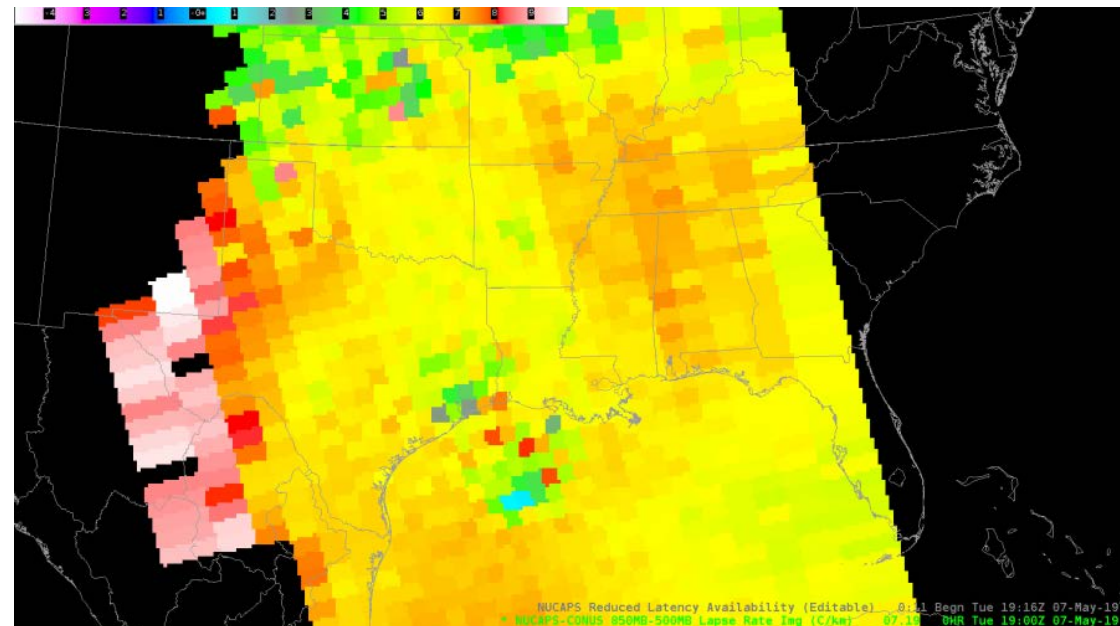
<https://blog.nssl.noaa.gov/ewp/tag/nucaps/>

- Gridded NUCAPS was first demonstrated at the Hazardous Weather Testbed in 2016
- The goal was to test the utility of Gridded NUCAPS for analyzing the pre-convective environment
- Testing at HWT solidified the value of Gridded NUCAPS:
 - To assess thermodynamic spatial gradients/patterns
 - As another observation tool to increase situational awareness

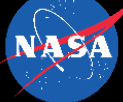


IR and RGB imagery showing outflow coming out of the storms in the eastern LSX area not firing up additional storms. NUCAPS 400-200 mb RH product shows quite a bit of drier air that the line is pushing into. More moisture is west of the MO/IL line, so that part of the line may have a better chance to maintain themselves/develop new cores ahead of the line along that outflow. ~ **HWT Forecaster 2019**

- Forecaster feedback led to product improvements and best practices
 - View the data on standard pressure levels
 - Leverage AWIPS derived parameters
 - The value of spatial gradients in mid-level fields
 - AWIPS procedures and recommended fields to analyze
 - Easy to access menu
 - Best practices to address data quality and gaps

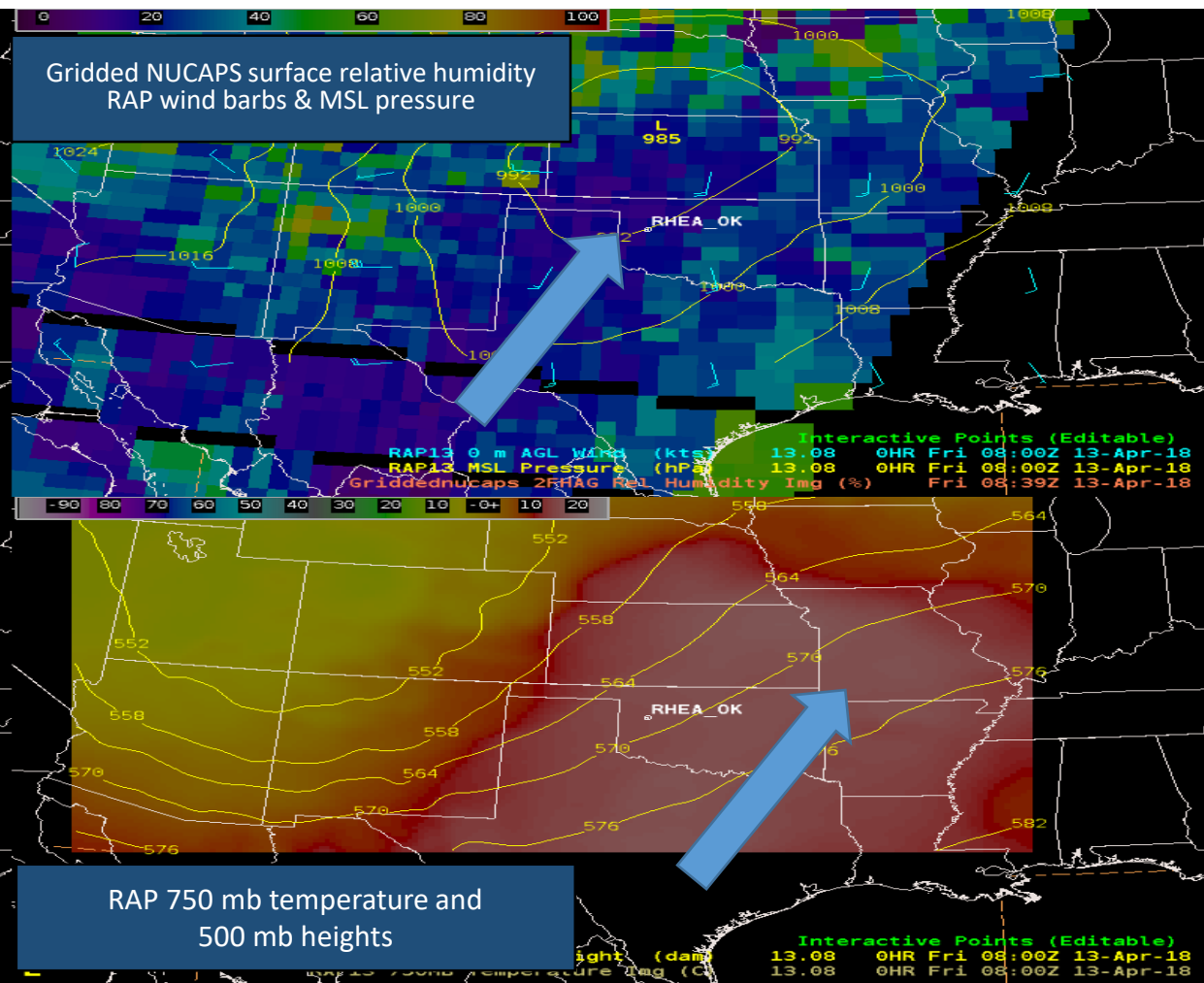
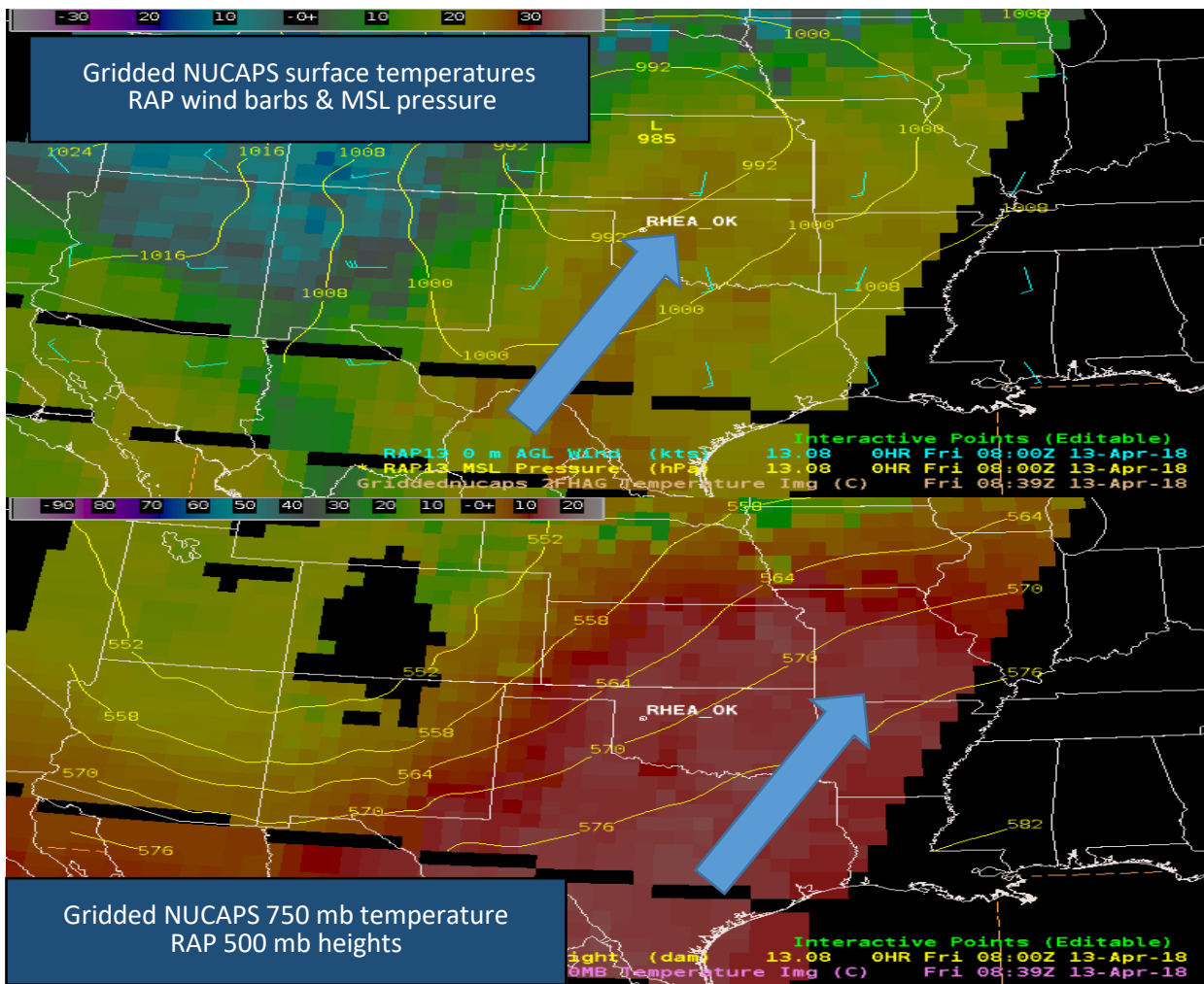


As an operational forecaster, I like to compare model output, real-time obs, and any additional derived data. ***This image from the NUCAPES H85-H5 Lapse Rate can potentially help boost one's confidence in particular synoptic situations.*** For example, suppose you were expecting a dryline to emerge east across W Texas, but guidance indicated otherwise and sfc METARS were unavailable, ***using the NUCAPS Lapse Rate products can help determine the location of the dryline (for this particular setup).*** In this image, values reflect the drier air advancing east leading to steeper lapse rates. ~ HWT Forecaster 2019

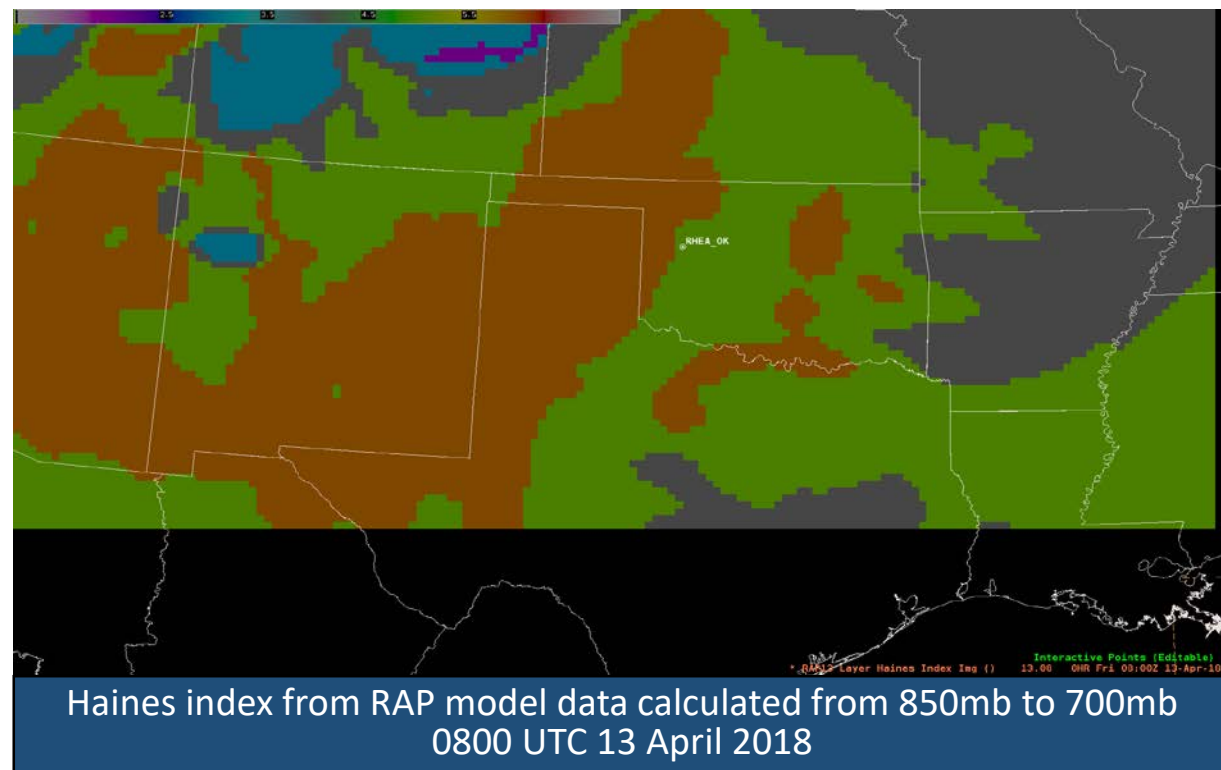
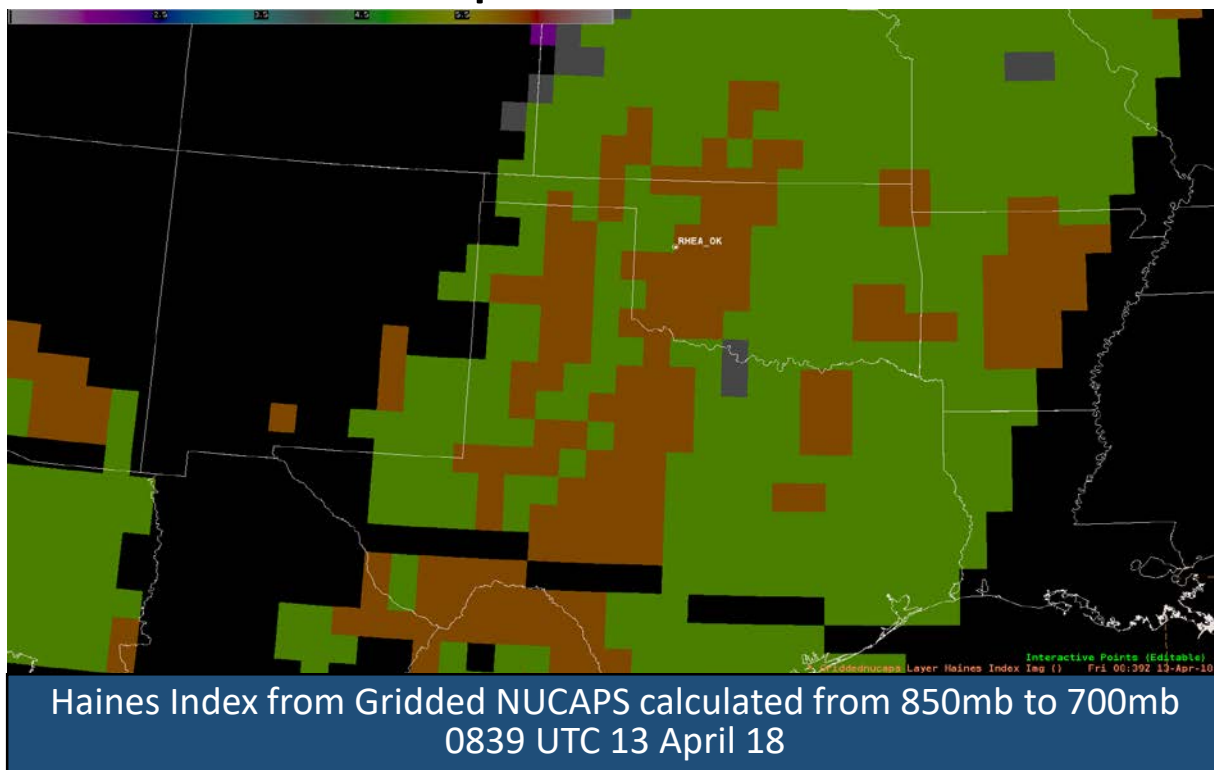


Fire Weather

- Rhea, OK fire started on April 12, 2018 which burned approximately 400,000 acres
- Combined with model data, NUCAPS can be used to diagnose warm, dry conditions
- Identification of a Low Level Thermal Trough

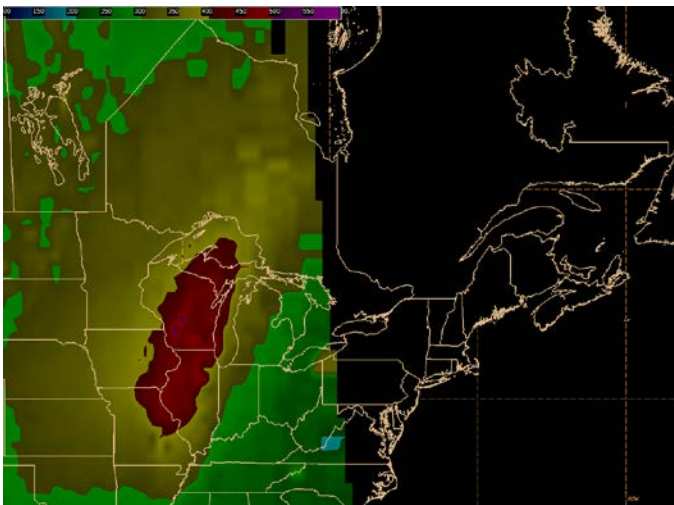


- Haines Index can be calculated in AWIPS
- The levels used to calculate the parameter can be adjusted
- NUCAPS region of high potential fire growth (orange) shifted to the east compared to RAP

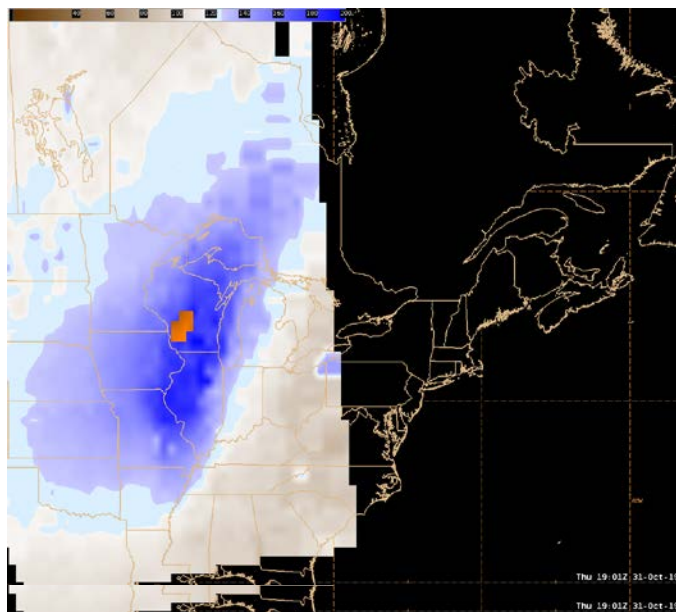


NUCAPS is model-independent observational data set that can be used to diagnose the potential for fire growth between model runs and to identify gradients not captured in the model

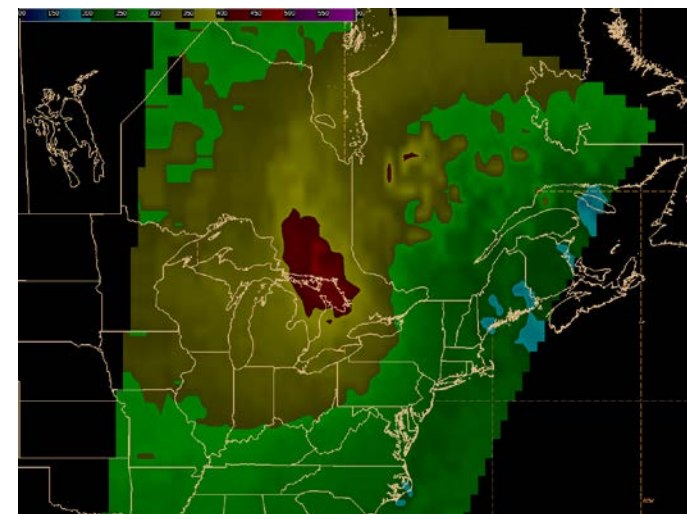
- Ozone-derived fields have been demonstrated in Ocean Prediction Center operations
- Now available in the operational Gridded NUCAPS in AWIPS
- Ozone is a tracer for stratospheric air to assess the potential for tropopause folding



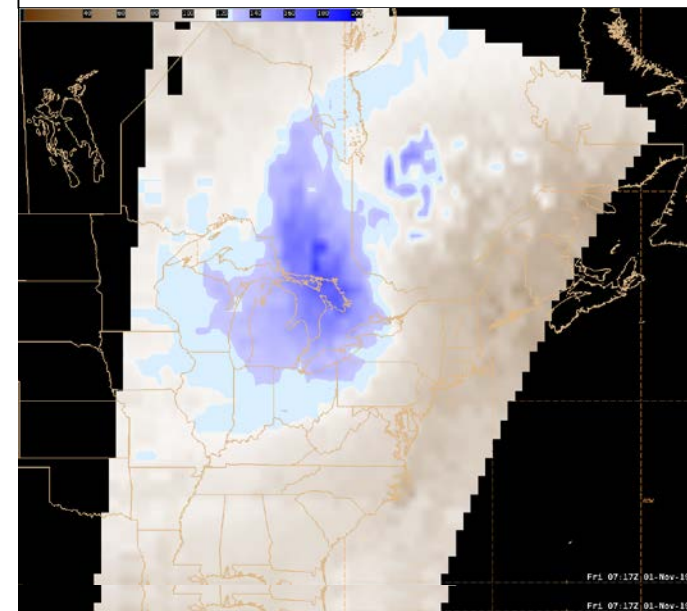
Total Ozone 31 October 2019 1901 UTC



Ozone Anomaly 31 October 2019 1901 UTC



Total Ozone 1 Nov 2019 0717 UTC



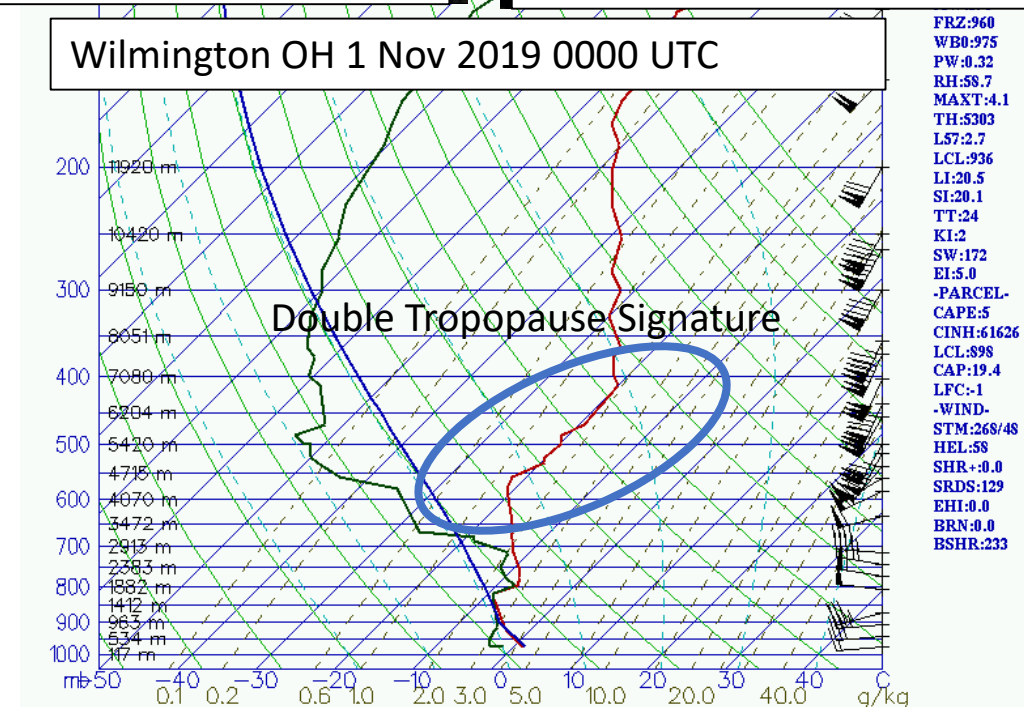
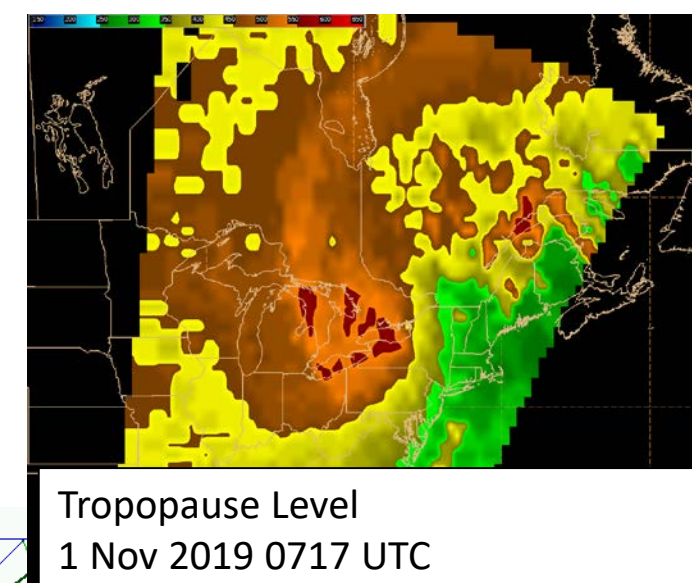
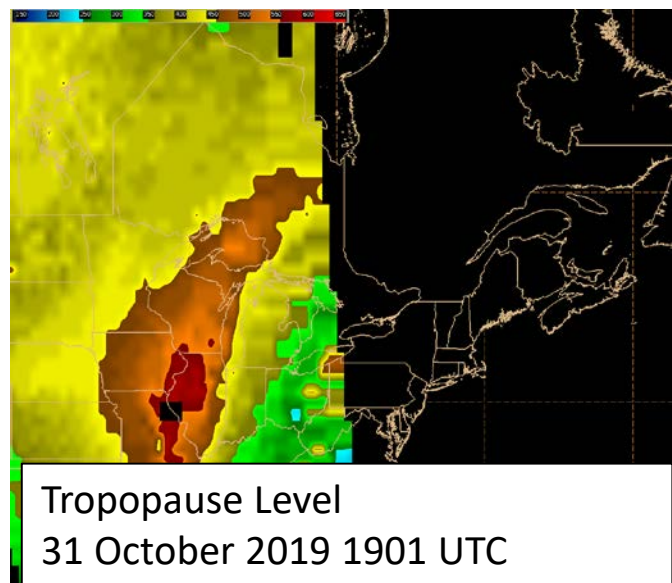
Ozone Anomaly 1 Nov 2019 0717 UTC



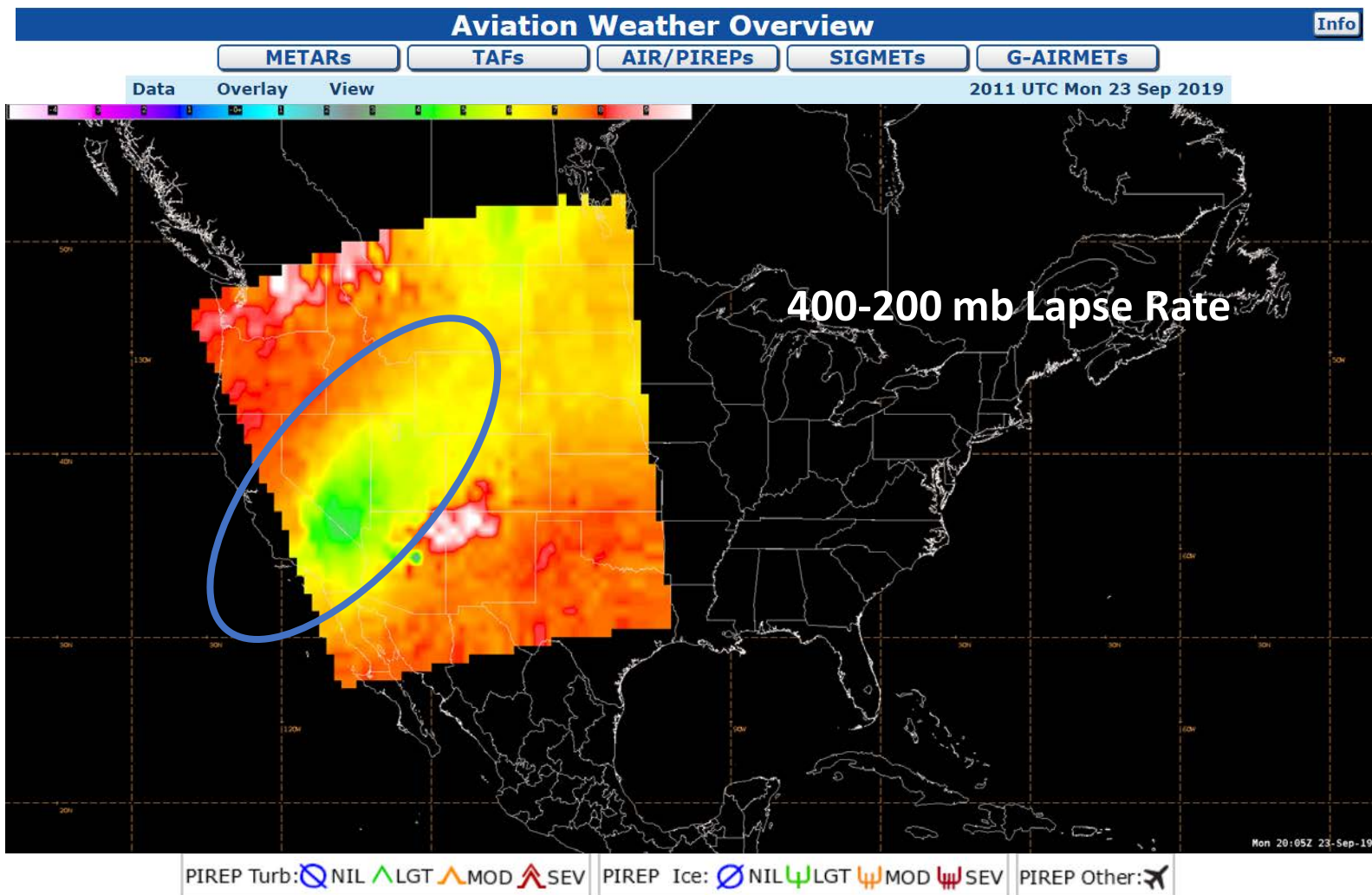
Tropopause Folding



- Gridded NUCAPS can calculate tropopause level based on ozone and a database of ozone values at the dynamic tropopause
- Double tropopause signature in 0000 UTC radiosonde
- Gridded NUCAPS tropopause level product shows 450-500 mb tropopause height



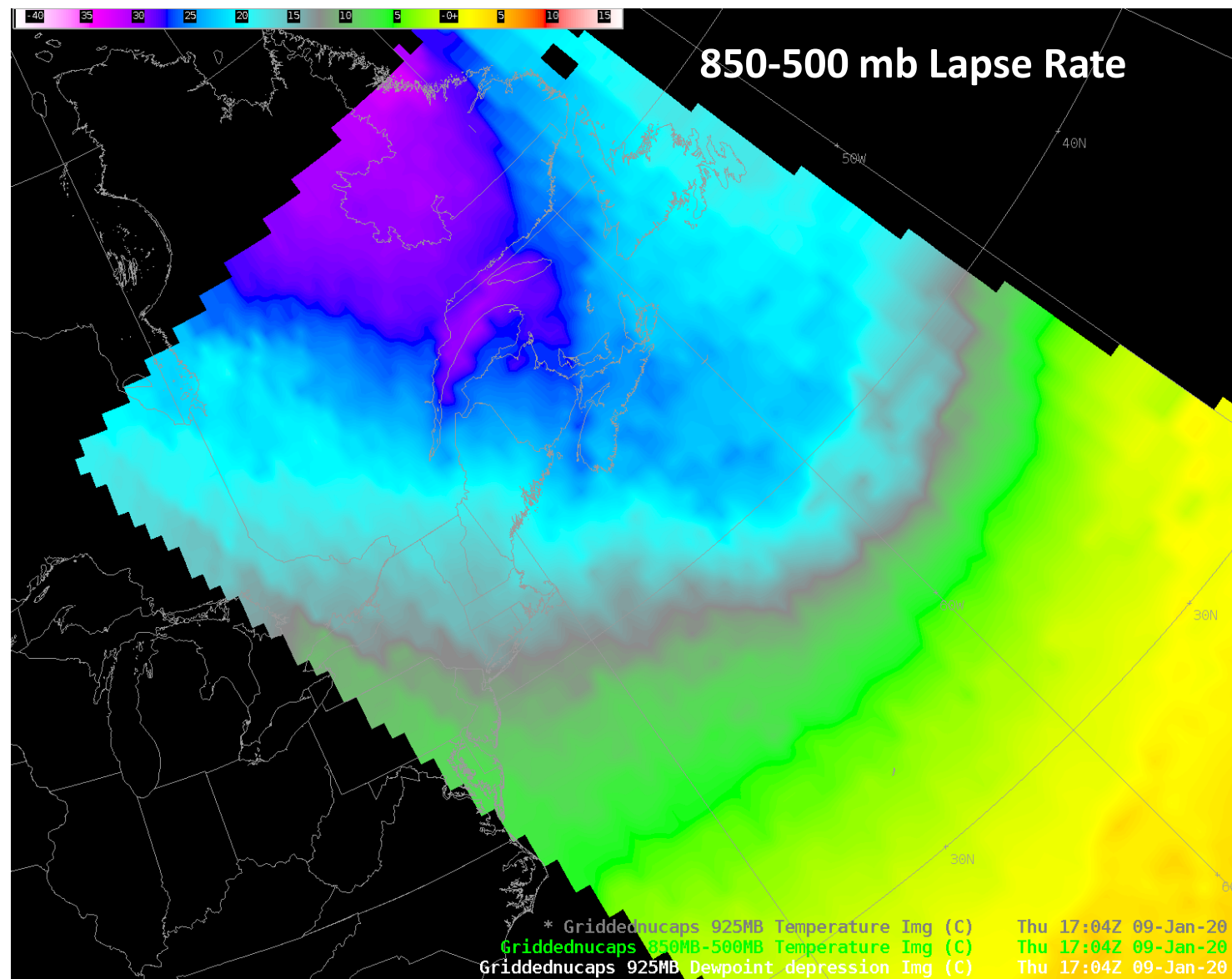
- Can soundings and new gridded fields assist in increased situational awareness?
- Gridded NUCAPS indicated
 - lower tropopause level east of the area of expected turbulence
 - Lower level lapse rates indicate a gradient from stable to unstable east of the expected turbulence
 - Upper level lapse rates indicate unstable lapse rates in the region of turbulence with lower lapse rates (stable) to the east
- Combine with model fields to diagnose turbulence potential



- Can Gridded NUCAPS thermal and moisture field assess changes in precipitation type?
- If strong vertical motion is forecast, the lapse rate and/or the dewpoint depressions fields can help you anticipate how much cooling might occur.

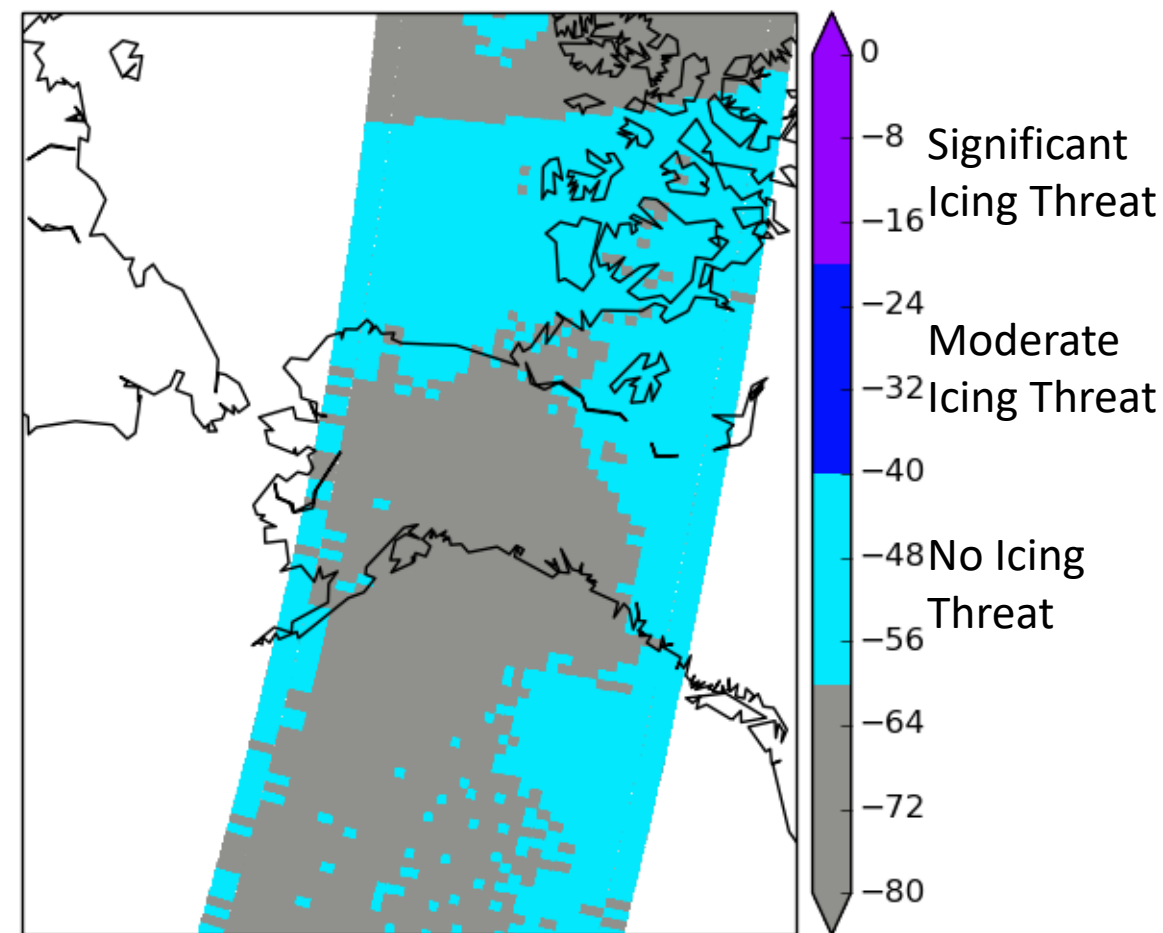
See more at:

<https://cimss.ssec.wisc.edu/satellite-blog/archives/35383>



- Icing typically occurs in cloudy regions
- The combine IR+MW retrievals fail in regions of thick clouds and/or precipitation
- Can NUCAPS microwave-only soundings provide valuable information?
- Is there value in replacing failed IR retrieval with microwave-only retrievals?
- More examples need to be assessed to determine the value

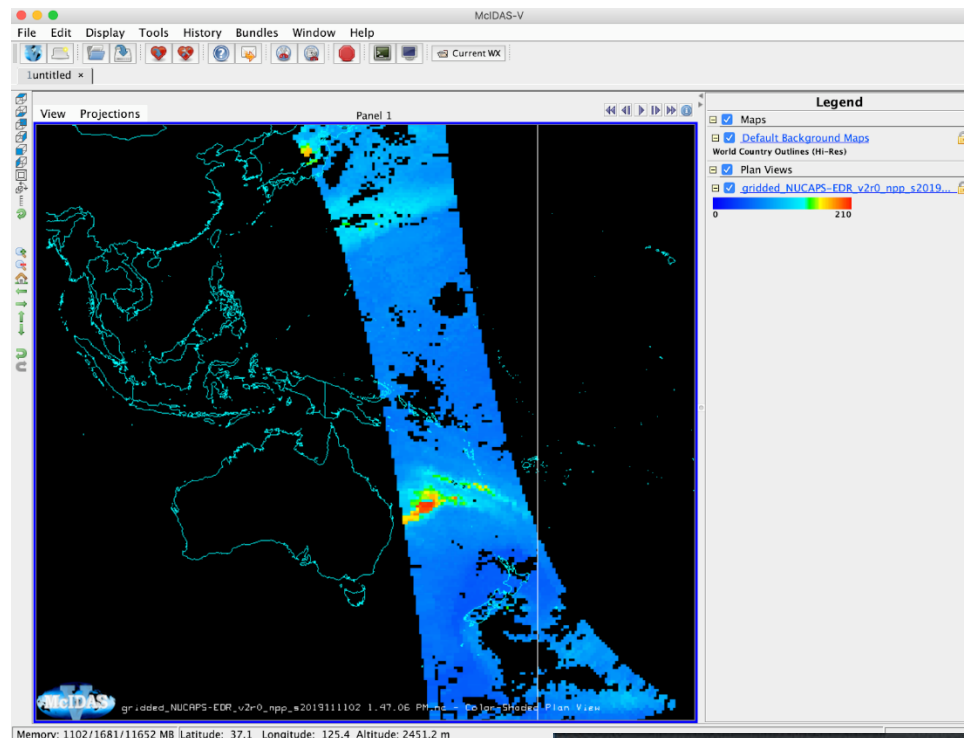
IR+MW and MW Only where IR Retrievals Failed





Alternative Visualizations

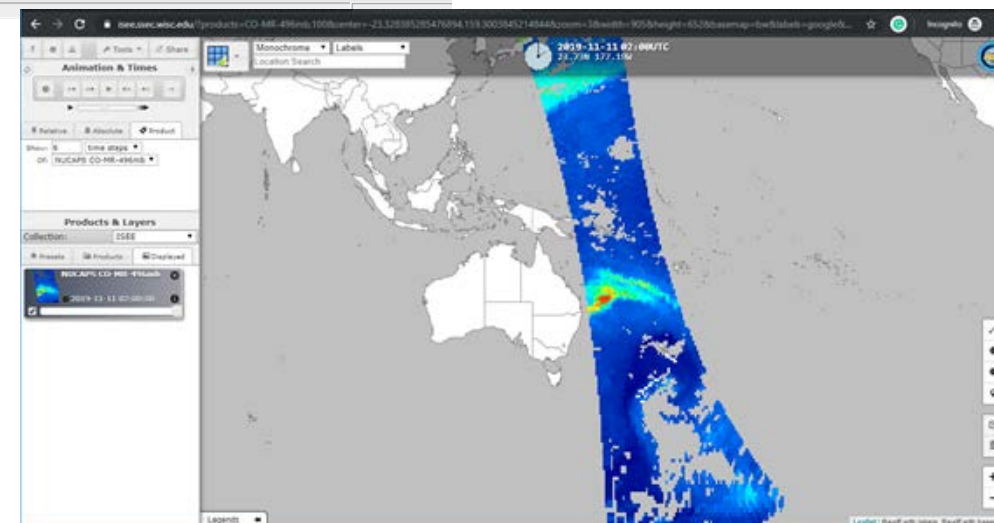
- User have requested
 - non-AWIPS visualizations
 - Access to trace gas fields
- Prototype development for processing and display of gridded fields in alternate display systems
- Enable data access for new user communities
 - NWS IMETS
 - Caribbean forecast agencies
 - International communities



Gridded NUCAPS 496 mb
CO displayed in
McIDAS-V.

More examples on the
[SSEC SDOC blog](#)

Gridded
NUCAPS 496 mb
CO displayed in
SSEC RealEarth



- NUCAPS Soundings were operationally transitioned to NWS operations in 2014
- Through the Hazardous Weather Testbed Spring Experiment the JPSS Sounding Initiative has had the opportunity to introduce Hyperspectral Infrared Sounder Retrievals (S-NPP, NOAA-20, MetOp-A/B) to NWS forecasters
- Products have been tailored to meet the needs of the operational environment
- As a result of consistent user interaction and feedback, Gridded NUCAPS has been transitioned to operations
- New applications include fire weather, cyclogenesis, turbulence, icing, rain/snow line
- Opportunities exist to experimentally exploit the value of microwave-only soundings in cloudy regions
- New visualization tools are being developed to expand NUCAPS capabilities to new users

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