

Adapting Satellite Soundings for Operational Forecasting within the Hazardous Weather Testbed



Rebekah Esmaili, Nadia Smith, Chris Barnett

Science and Technology Corporation, Columbia, Maryland USA

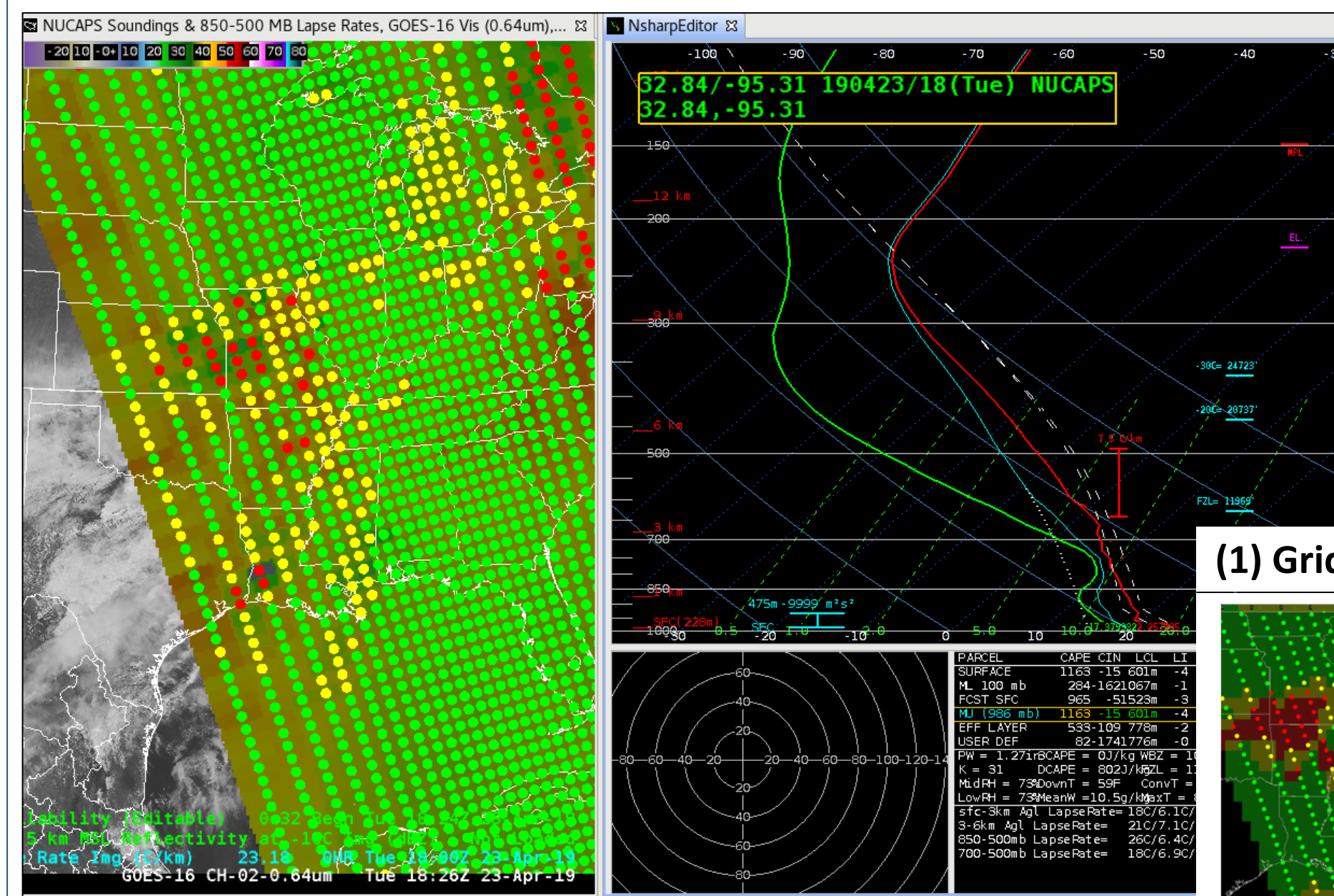


NUCAPS soundings

- Supplement radiosondes with wide swaths of soundings from JPSS satellites
- Retrieve vertical temperature, moisture, and trace gases
- Calculate stability indices
- Are available multiple times during the day
- Are model-independent
- Available in real-time through direct broadcast

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

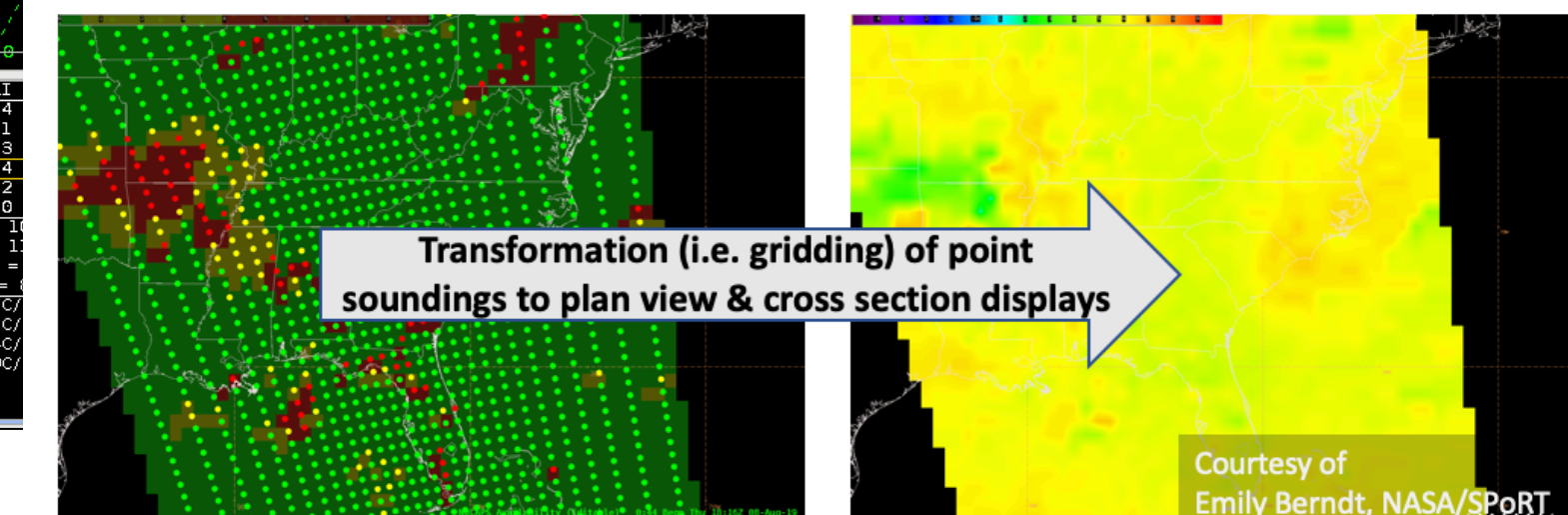
NUCAPS evaluated by NWS forecasters in the Hazardous Weather Testbed (HWT) since 2015



HWT Goals

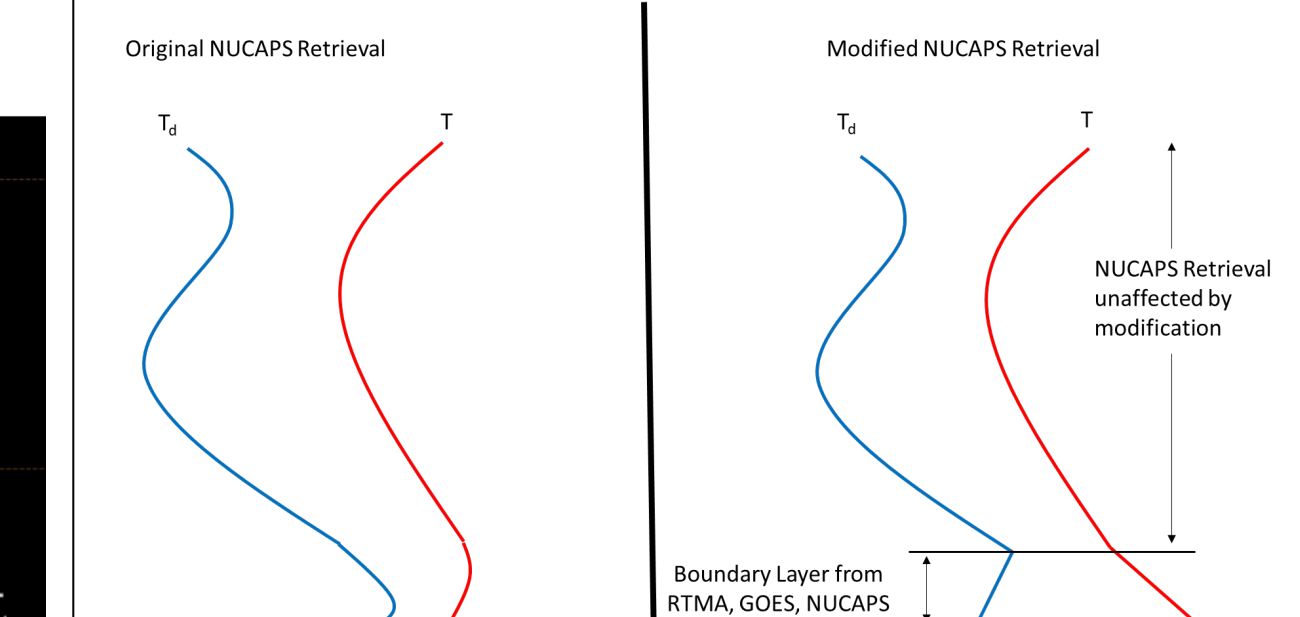
- Train forecasters in new products/technology
- Evaluate new products ahead of their release in operations
- Left: NUCAPS in AWIPS, soundings available in NSHARP display
- Incremental product development from forecasters feedback:

(1) Gridded NUCAPS: Plan-view/cross-section displays



Courtesy of E. Berndt

(2) Modified NUCAPS w/Boundary layer modification w/surface observations and GOES

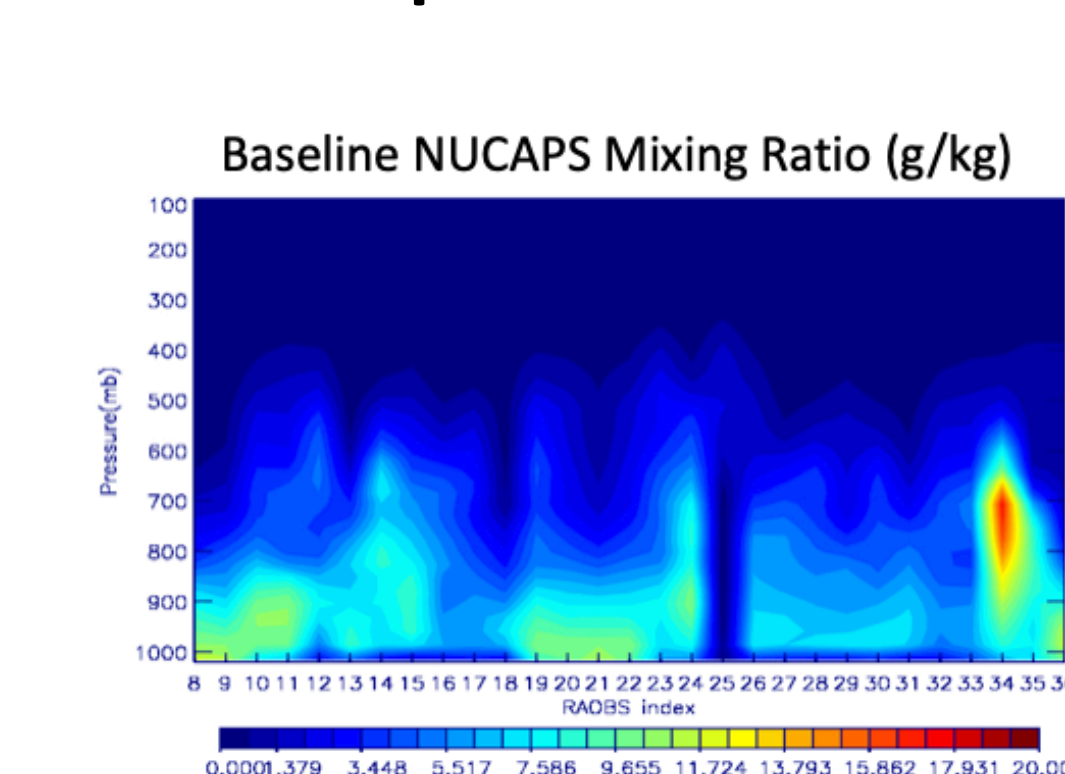


Courtesy of J. Dostalek

Recommendations to Product Developers for Research to Operations:

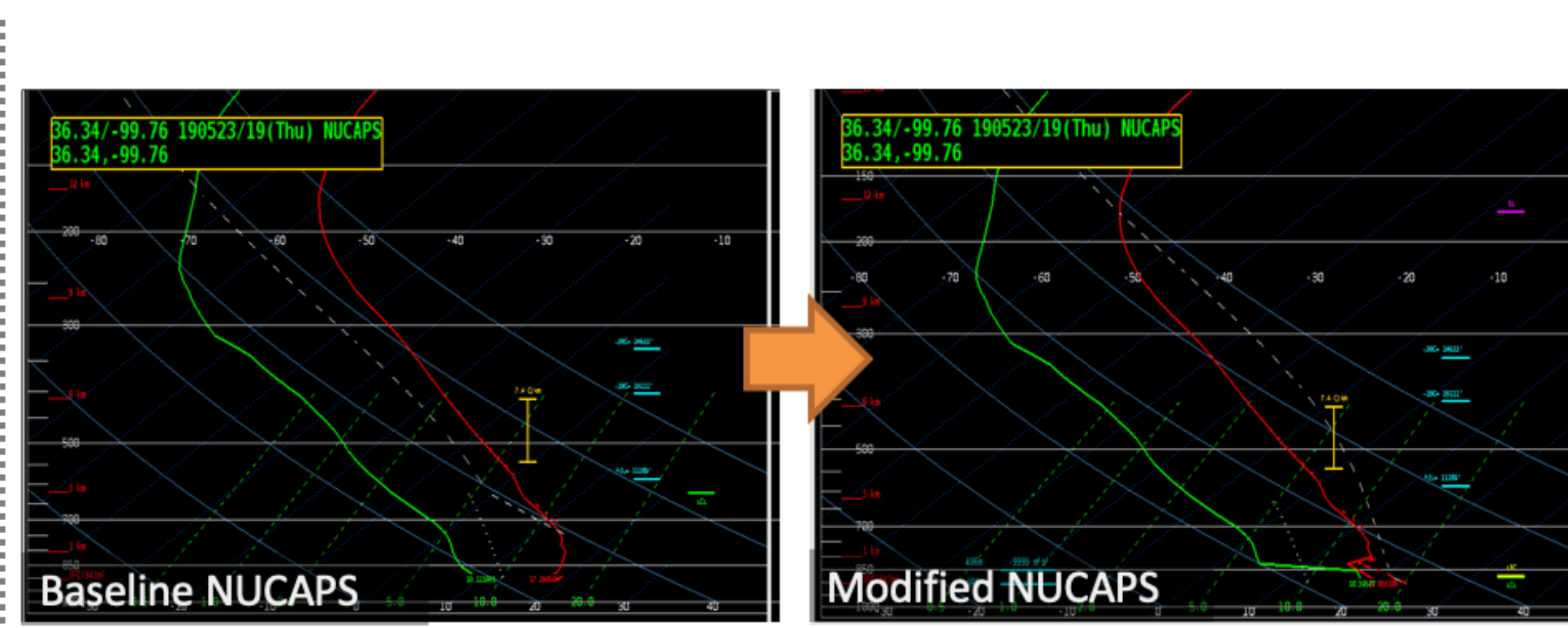
Have a clear understanding of user needs

Developer needs



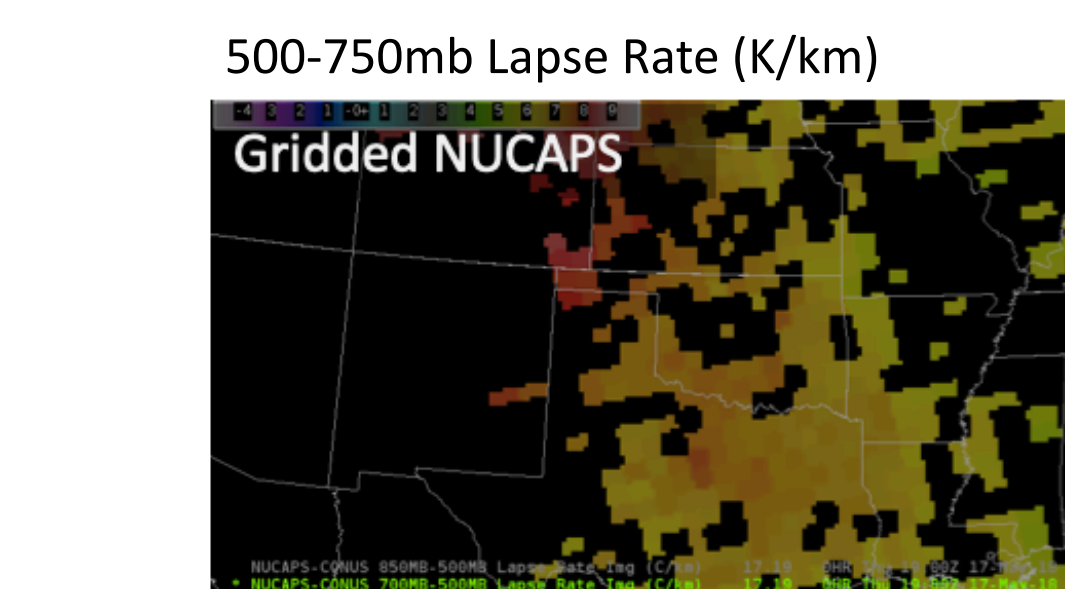
How a product developer wants to see a cross-section

User needs

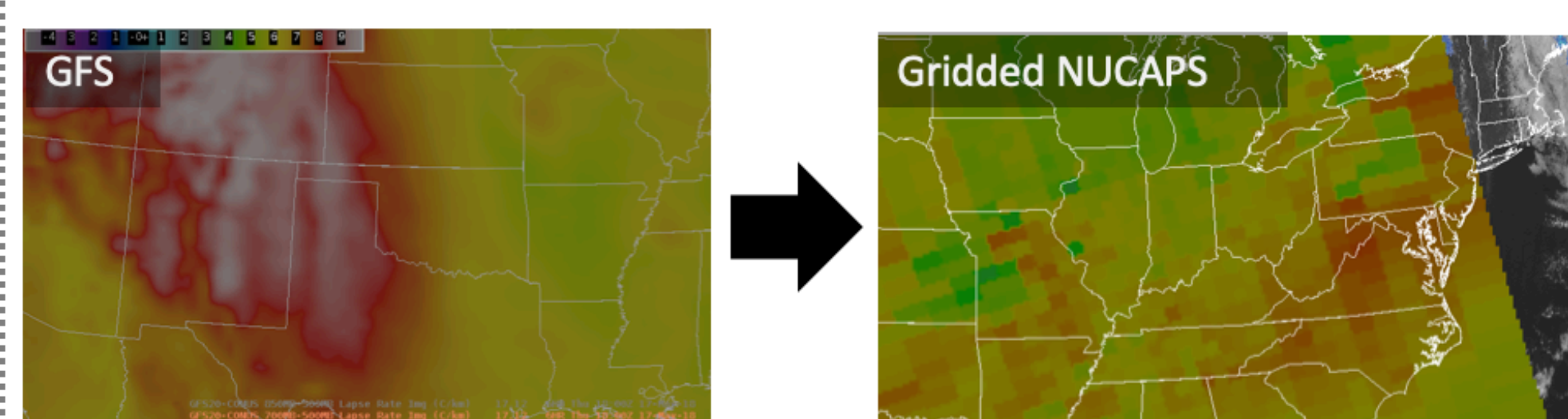


How a forecaster wants to see a cross-section

Adjusting NUCAPS automatically following forecaster feedback



Developers like looking at QC'd data to ensure they "meet requirements"



But forecasters prefer to see data filled in, even if the observations have errors.

Development of gridded NUCAPS following forecaster feedback.

Surveys should contain a mixture of quantitative and qualitative questions

How often would you use NUCAPS in the future?

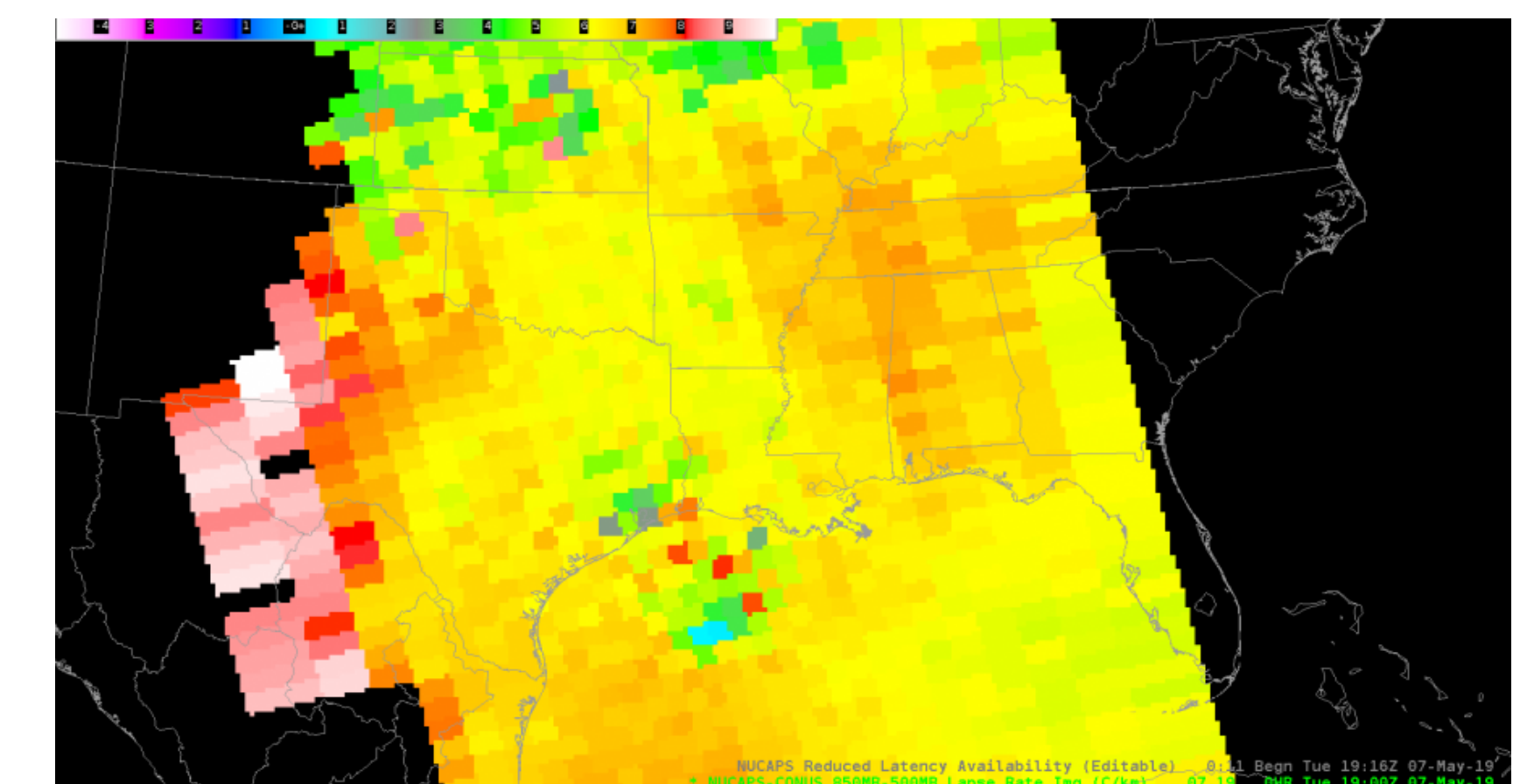
60% of HWT 2019 responses: "sometimes", "usually", or "always"

How can NUCAPS products be more useful in the future?

50% of respondents indicated more satellite overpasses would be helpful

Ranked as important/very important:

1. Better boundary layer representation (and by extension, CAPE values)
2. More observations (e.g. having two satellites available in AWIPS)



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

Encourage data combination, sophisticated analysis to identify future work

Successes

Phenomena

- Freezing levels
- Supercell development along cold fronts
- CAPE gradient head of MCS tracks
- Captured low level caps
- Dryline convection

Situational Awareness

- Quickly got orientation at the beginning of shift
- Modified soundings and gridded fields provided insight into gradients.

Future Work

Not enough data

- Useful for evaluating mid-level environments but a single LEO satellite availability is too sparse

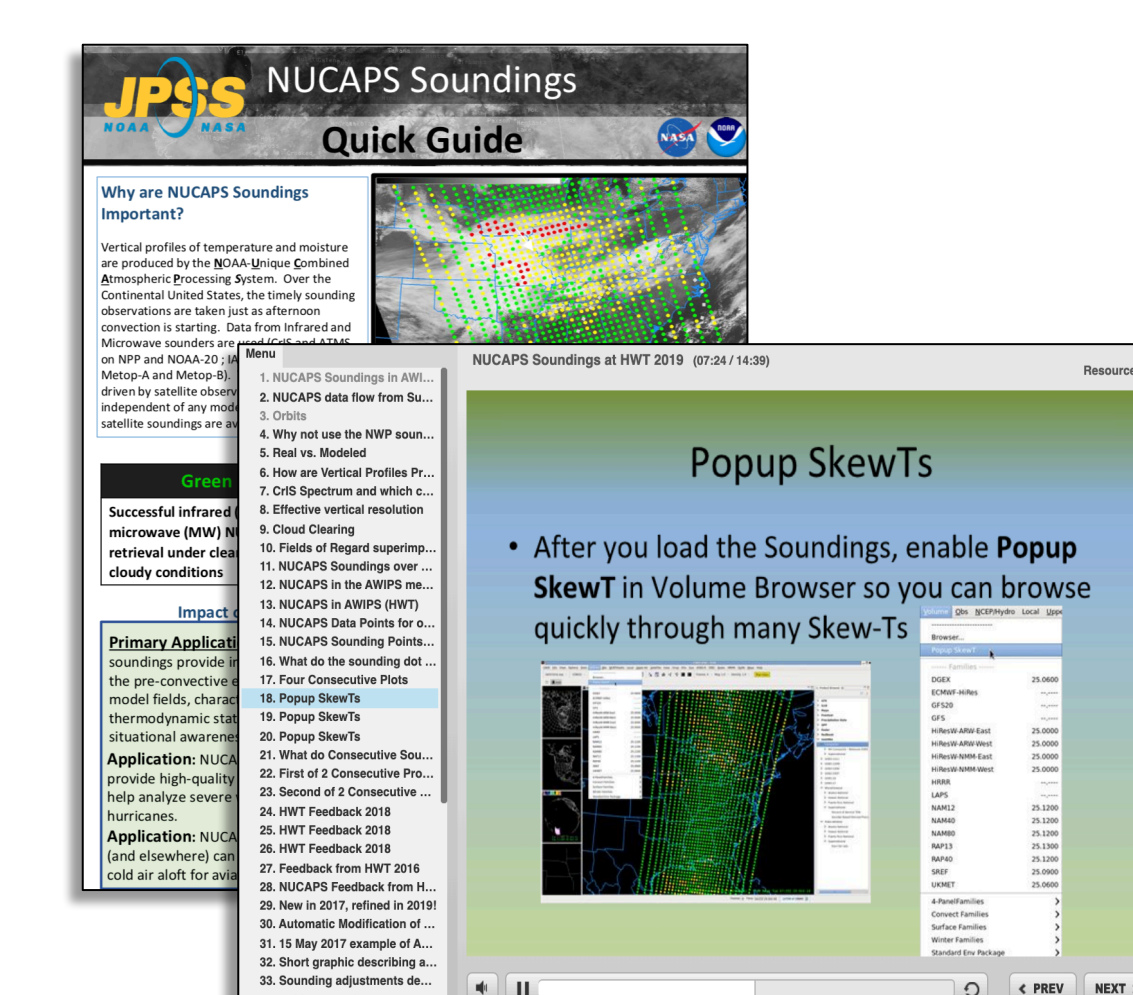
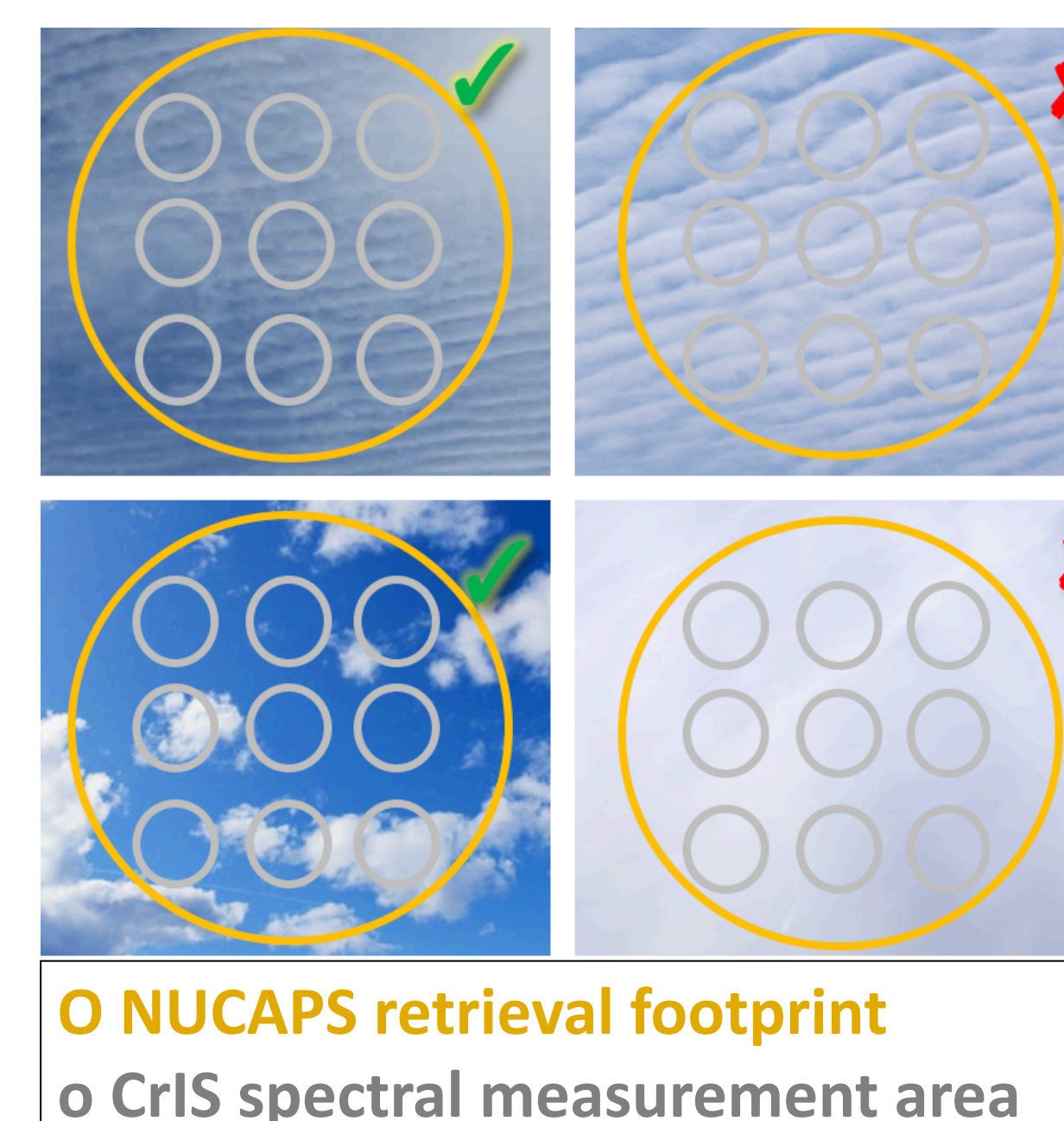
Usability and missing data within retrieval

- Convection already initiated, too many "data holes" from low quality or missing retrievals

Boundary layer

- Cases where CAPE values, the surface inversion, and drier mixed layer was inconsistent with radiosondes

Strengths, limitations communicated through training



Developed and narrated by S. Lindstrom

Strengths

- Provides soundings between radiosonde launches
- Provides a dense network where conventional observations are lacking
- NUCAPS can make retrievals over clear and partly cloudy scenes (top left)

Limitations

- Challenging to retrieve fine boundary layer structure
- NUCAPS fails in precipitating scenes or uniform cloud decks, so **NUCAPS is less helpful once convection initiates**

Training provided via Vlab, online videos, quick guides (bottom left)