

Evaluation of NUCAPS products in AWIPS-II: Results from the 2017 HWT



Ashley Wheeler¹, Nadia Smith¹, Chris Barnet¹, Antonia Gambacorta¹, Mitch Goldberg²

¹ STC, ² NOAA/JPSS

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WHAT IS NUCAPS?

- **NOAA Unique Combined Atmospheric Processing System (NUCAPS)** is a heritage algorithm derived from the Atmospheric Infrared Sounder (AIRS) Science Team algorithm
- NOAA operational algorithm for the CrIS/ATMS and IASI/AMSU sounder pairs since 2002
- Designed to be instrument independent as a NOAA enterprise algorithm
- Retrieval product: temperature, moisture, trace gases (O₃, CO, CO₂, SO₂, N₂O, HNO₃), cloud properties (cloud fraction, cloud top pressure), quality flags

Mixing Ratios

<http://goesrhwat.blogspot.com/2017/07/nucaps-mixing-ratio.html>

Forecaster compared mixing ratio at 700mb (top) & 850mb (bottom) from **Gridded NUCAPS** (left) & **RAP Model** (right)

700mb → both **Gridded NUCAPS** & **RAP** “generally” exhibited a dry tongue (**orange arrow**)

850mb → **Gridded NUCAPS** slightly lower than **RAP**

“Thus, confidence may be a bit better at levels at or above 700mb, but not so good for 850mb or lower. Overall, as you get closer to the surface, it looks like there is a tendency for NUCAPS to trend towards a drier solution than the models.” –ISU2004

This is a case where it could benefit forecasters to have a “blended” surface adjusted product in gridded layers.

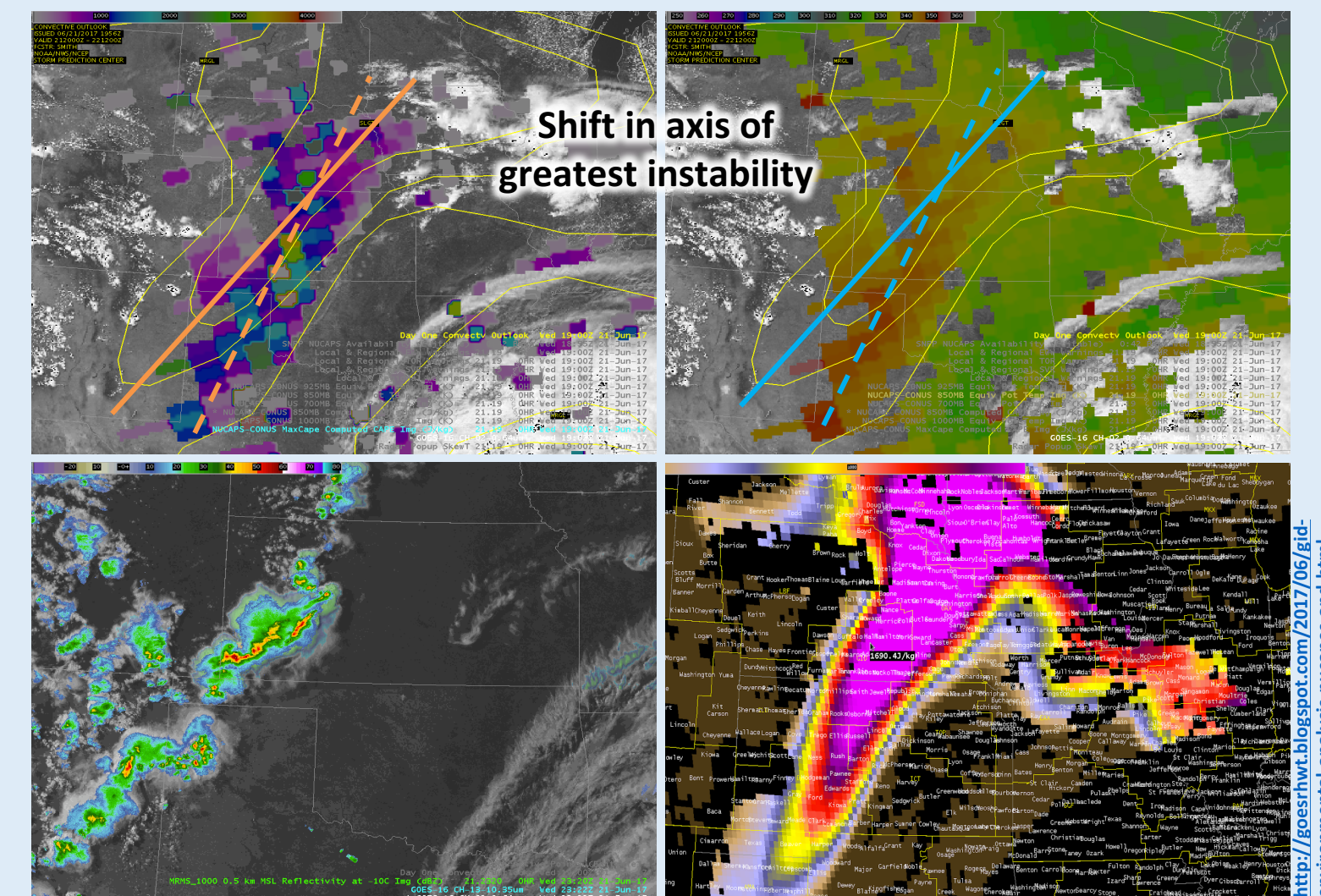
NUCAPS-Derived Convective Indices

Forecaster compared **Gridded NUCAPS CAPE & 850mb Theta-e** to SPC Day-1 Convective Outlook (yellow contours)

- Both **Gridded NUCAPS** products suggest that a better axis of largest instability is slightly east of SPC (shown as solid and dashed **blue/orange** lines)
- Titled axis seen also supported by GOES-16 Derived CAPE

“[NUCAPS] data indicated sufficient instability to keep convective development ongoing downstream and that increased intensity is possible as the storm moves into that region of higher instability.” –Kris White

<http://goesrhwat.blogspot.com/2017/06/nucaps-observations-in-w-kansas-for-21.html>



SPC Day-1 Convective Outlook (yellow contours) with Gridded NUCAPS Max CAPE (TOP LEFT) & 850mb Theta-e (TOP RIGHT), BOTTOM LEFT: MRMS -20 °C reflectivity, BOTTOM RIGHT: GOES-16 Derived CAPE

FORECASTER FEEDBACK

- + NUCAPS soundings are valuable in RAOB and radar sparse regions
- Latency is #1 limiting factor
- + NUCAPS provides independent measurements for model validation
- NUCAPS products need continuity across platforms and products
- + Gridded NUCAPS enables situational awareness of spatial patterns

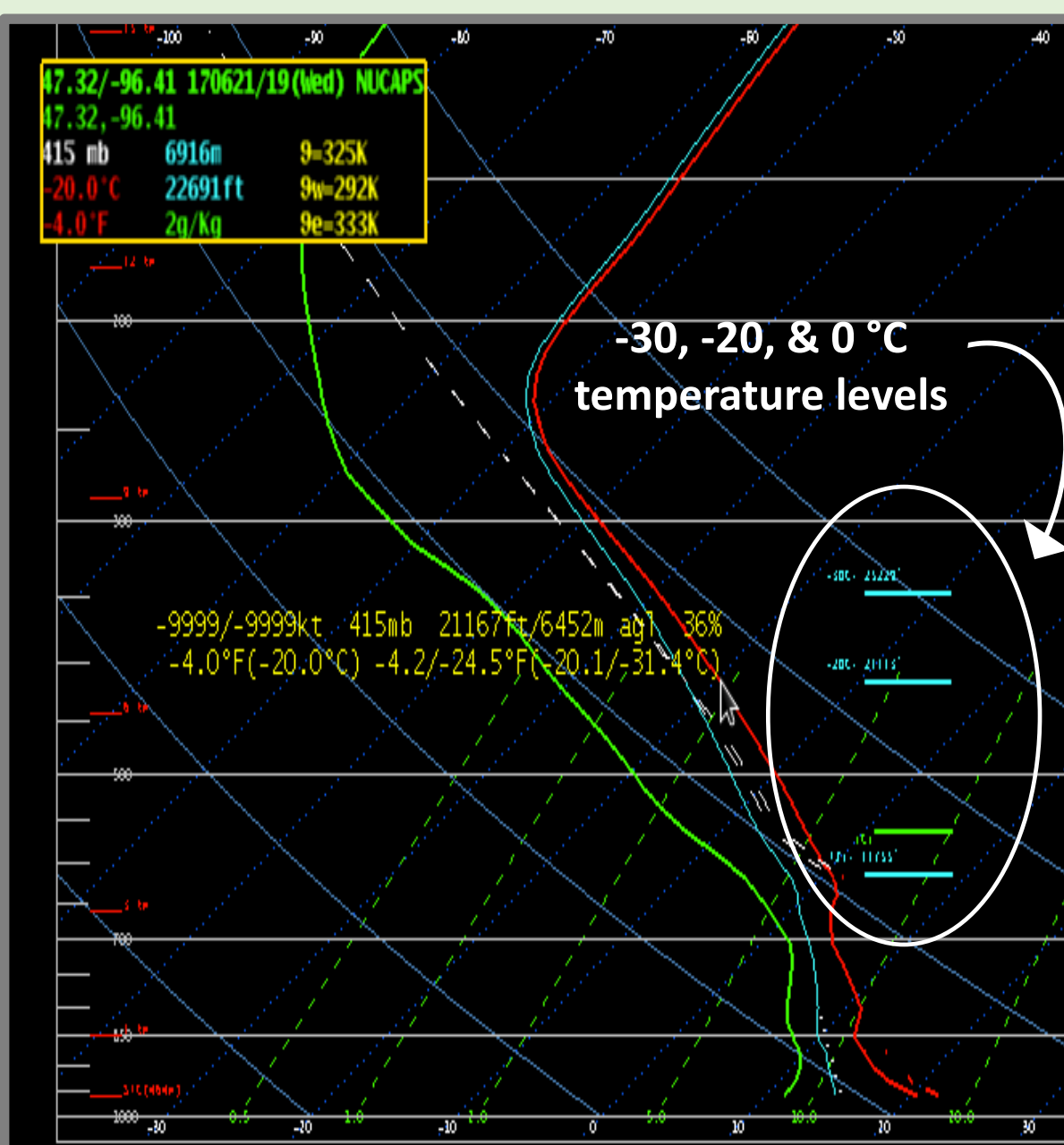
WHAT IS THE NOAA HWT?

- The **NOAA Hazardous Weather Testbed (HWT)** is a joint project between the National Weather Service (NWS) and the National Severe Storm Laboratory (NSSL), Hosted at the National Weather Center in Norman, Oklahoma
- Forecasters, along side developers/researchers, test and evaluate emerging technologies for National Weather Service operations
- NUCAPS products have been evaluated within AWIPS (Advanced Weather Interactive Processing System) during the HWT Experimental Warning Program (EWP) for the past 3 years
- In 2017 forecasters tested the following NUCAPS products: Operational NUCAPS Skew-T's, Surface Adjusted Skew-T's, Gridded NUCAPS plan view & vertical cross sections (CAPE, lapse rate, theta-e, etc.)

HWT BLOG CASES

Identifying Critical Temperature Levels

<http://goesrhwat.blogspot.com/2017/06/nucaps-for-0c-and-20c-levels.html>



NUCAPS Sounding Skew-T for 19z Wednesday June 21, 2017

Forecasters used **NUCAPS operational skew-T's** to quickly locate temperature levels (0,-20,-30 °C)

- Operational NUCAPS (without surface correction) has sufficient skill to accurately identify these levels
- These levels were used during storm interrogation to assess radar heights of 50 and 60 dBZ for size of hail aloft and warning issuance

“Many other tools use model data which can have their own errors, but NUCAPS is actual observation and can bring more confidence when analyzing storms in the vertical.” –Ironman

In future, these levels could be implemented as a gridded NUCAPS product viewed in “plan view”

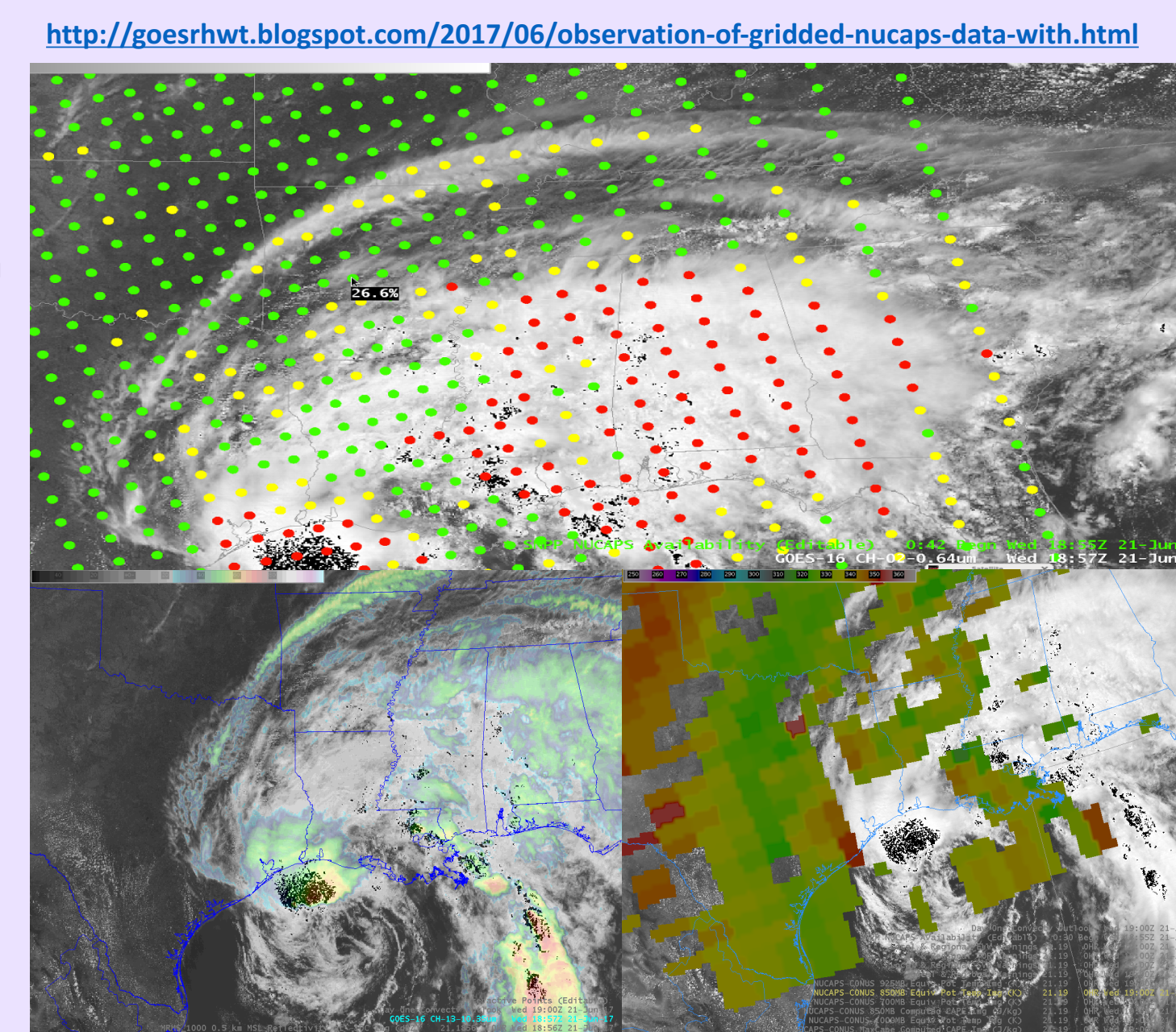
Tropical Storm Cindy

Forecaster used **Gridded NUCAPS** 850mb Theta-e and **Skew-T's** to identify the areas of deepest convection within Tropical Storm Cindy

- Noting that deeper convection confined to regions closer to center of circulation, and then along eastern side (main moisture axis)

“I have to say, this was a bit unexpected, but the soundings have tended to indicate a general lack of instability within this region of higher insolation and thus offered an appropriate adjustment of my mental model of the situation.” – Kris White

“In a similar fashion, I think that these data could be very valuable over open ocean locations, where there are less direct observations, and could provide valuable information about lapse rates and instability.” – Kris White



NUCAPS Tagged HWT Blog Posts : <http://goesrhwat.blogspot.com/search/label/NUCAPS>

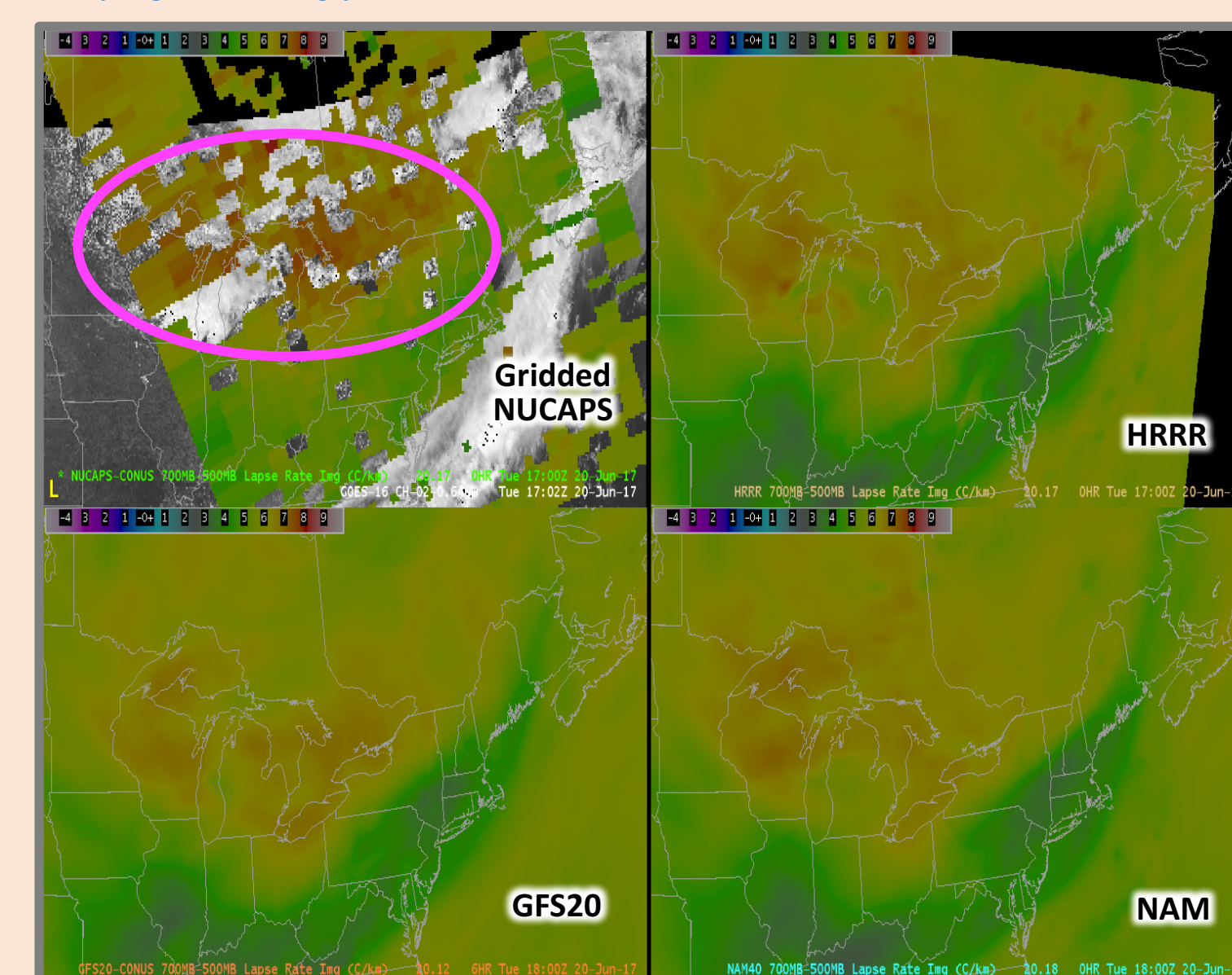
Contact Info: Ashley Wheeler (wheeler@stcnet.com)

WHAT MAKES THIS EFFORT SUCCESSFUL?

- Forecasters are evaluating products in real-time operations
- HWT live blog allows forecasters to document their successes/struggles in detail
- Provides the unique opportunity for forecaster and developers to interact, provide feedback, and learn from one another
- Products, such as NUCAPS, can be invited back to assess if you have met user suggestions from the previous year

700-500mb Lapse Rate Comparison to Models

<http://goesrhwat.blogspot.com/2017/06/hello-from-hazardous-weather-testbed-in.html>



Forecaster compared 700-500mb lapse rate from **Gridded NUCAPS** (top left), **HRRR** (top right), **GFS20** (bottom left), & **NAM** (bottom right)

- Gridded NUCAPS indicates slightly steeper lapse rates, over Great Lakes (**magenta**)

“While specific values at various locations differ by relatively small percentages, patterns and gradients are overall fairly similar.” – Kris White

Lead the forecaster to consider that there may be “**slightly more robust convective development in this region, than the model data alone imply**”

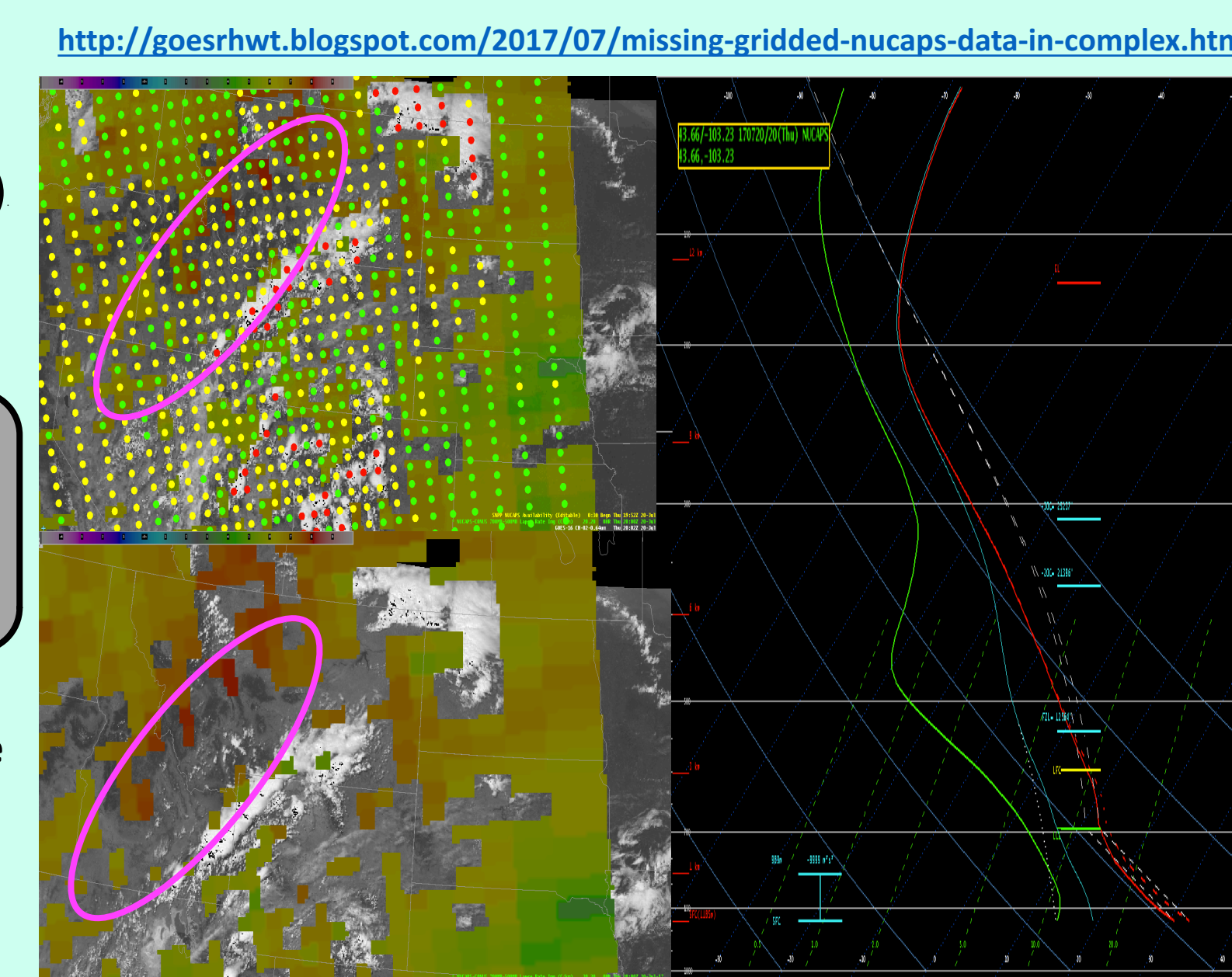
Observation Sparse Regions

A forecaster noticed that in the western US Rocky Mountain region **NUCAPS QC** consistently indicated lots of “yellow” (MW-only) soundings, even when there is relatively clear skies (**magenta**)

Could be a result of over simplified emissivity first guess over dry desert?

“For locations in the west, for this data to be useful and for us to have confidence in using it, we really need a more complete data set.” –64BoggsLites

Here is an example where forecasters in data sparse regions would opt to still use NUCAPS soundings regardless of being flagged “yellow” QC (MW-only). The forecaster explains, “A [yellow] sounding from the Black Hill...seems meteorologically reasonable” (shown in skew-T on left)



CONCLUSIONS

- By observing forecasters in their work setting we have a better appreciation and understanding of their needs...
- **Forecasters have difficult jobs in a fast paced and stressful environment that requires products be delivered in the simplest most efficient way, while still providing the maximum information content**
...and this does not have an obvious solution...
- *This can only be accomplished in interactive settings like the HWT and by **LISTENING** to forecaster so that we can find the balance between what the need and what NUCAPS can realistically provide*