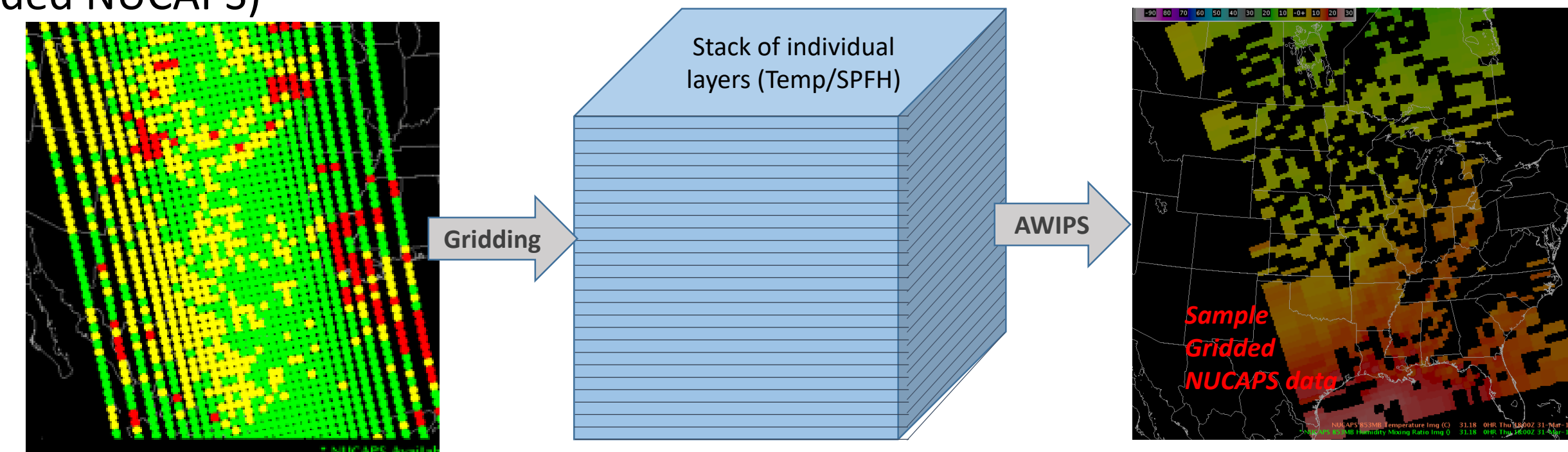
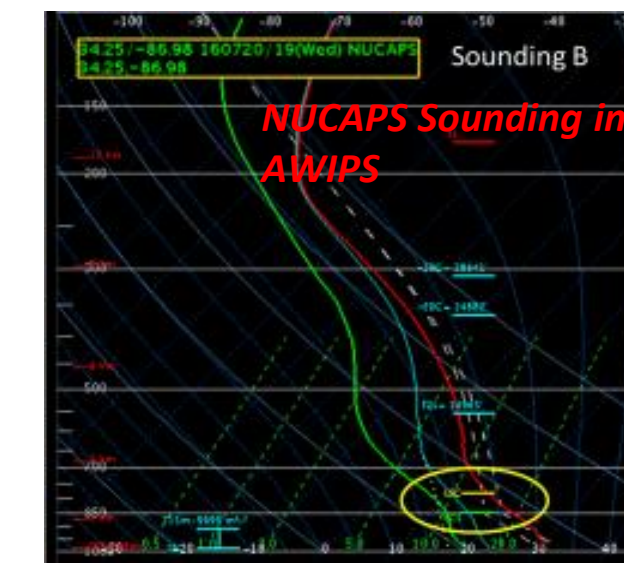
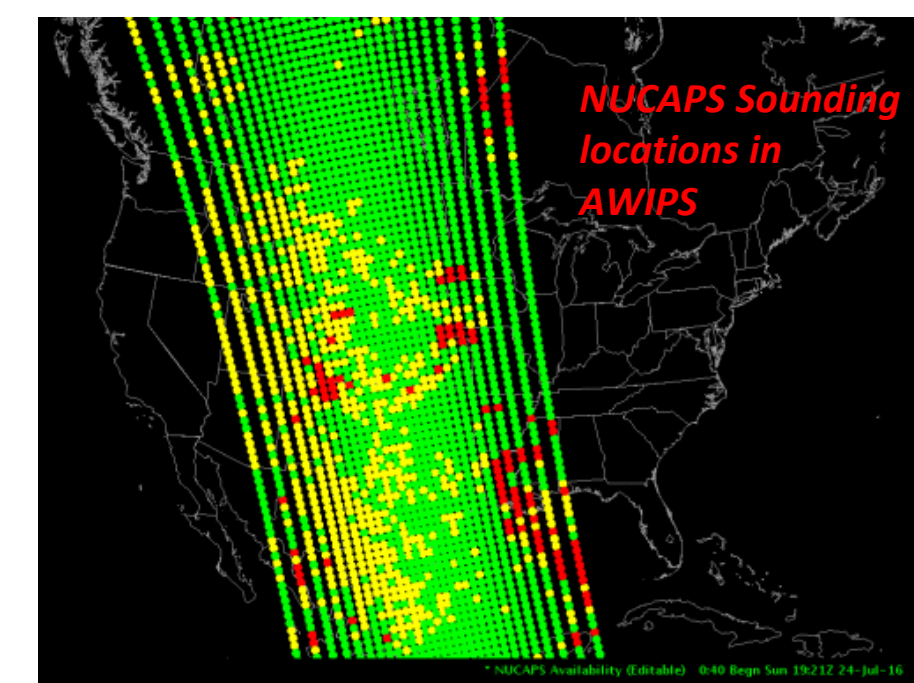


## Introduction

- The next-generation S-NPP and NOAA-20 Cross-track Infrared Sounder (CrIS) temperature and moisture profiles can provide valuable observations
  - Where conventional radiosonde observations are sparse
  - Between radiosonde launches
- CrIS observations are combined with the Advanced Technology Microwave Sounder (ATMS) to produce high quality vertical soundings in clear and partly cloudy conditions
- NUCAPS (NOAA Unique Combined Atmospheric Processing System) is the operational algorithm for processing combined hyperspectral infrared and microwave measurements
- NUCAPS Soundings are operationally available in AWIPS as Skew-T plots
- The capability to visualize the data in plan view or cross section would be valuable to maximize the benefits of NUCAPS data in AWIPS
- A multi-organizational collaboration through the JPPS Soundings Applications Initiative developed the capability for plan view and cross section displays of NUCAPS in AWIPS (i.e., Gridded NUCAPS)



NUCAPS Soundings: Need to click on each "point" to review the vertical information

- Pros: Can choose specific locations
- Cons: A lot of individual interrogation

A subset of 58 layers are output using Polar2Grid from the 100 layers output by NUCAPS. The grib2 file only contains:

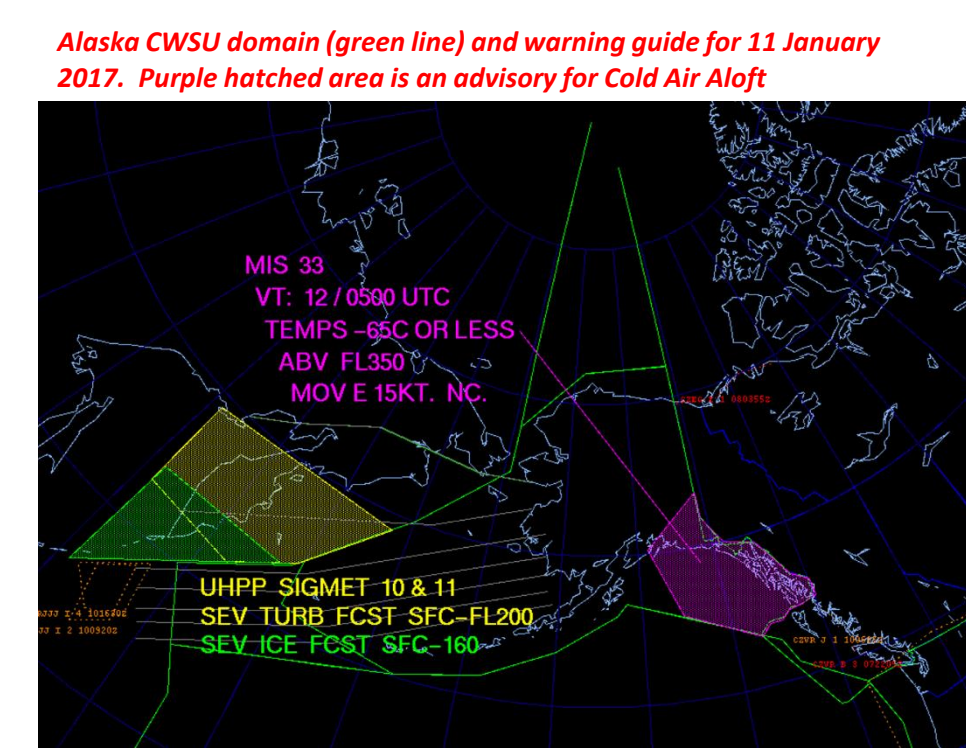
- Temperature, Specific humidity
- Surface pressure and temperature
- Topography

Ingested into AWIPS on a uniform model grid, so AWIPS will interrogate the information in the same way it handles model data.

- Plan view and cross sections
- Temperature, moisture, and stability indices.

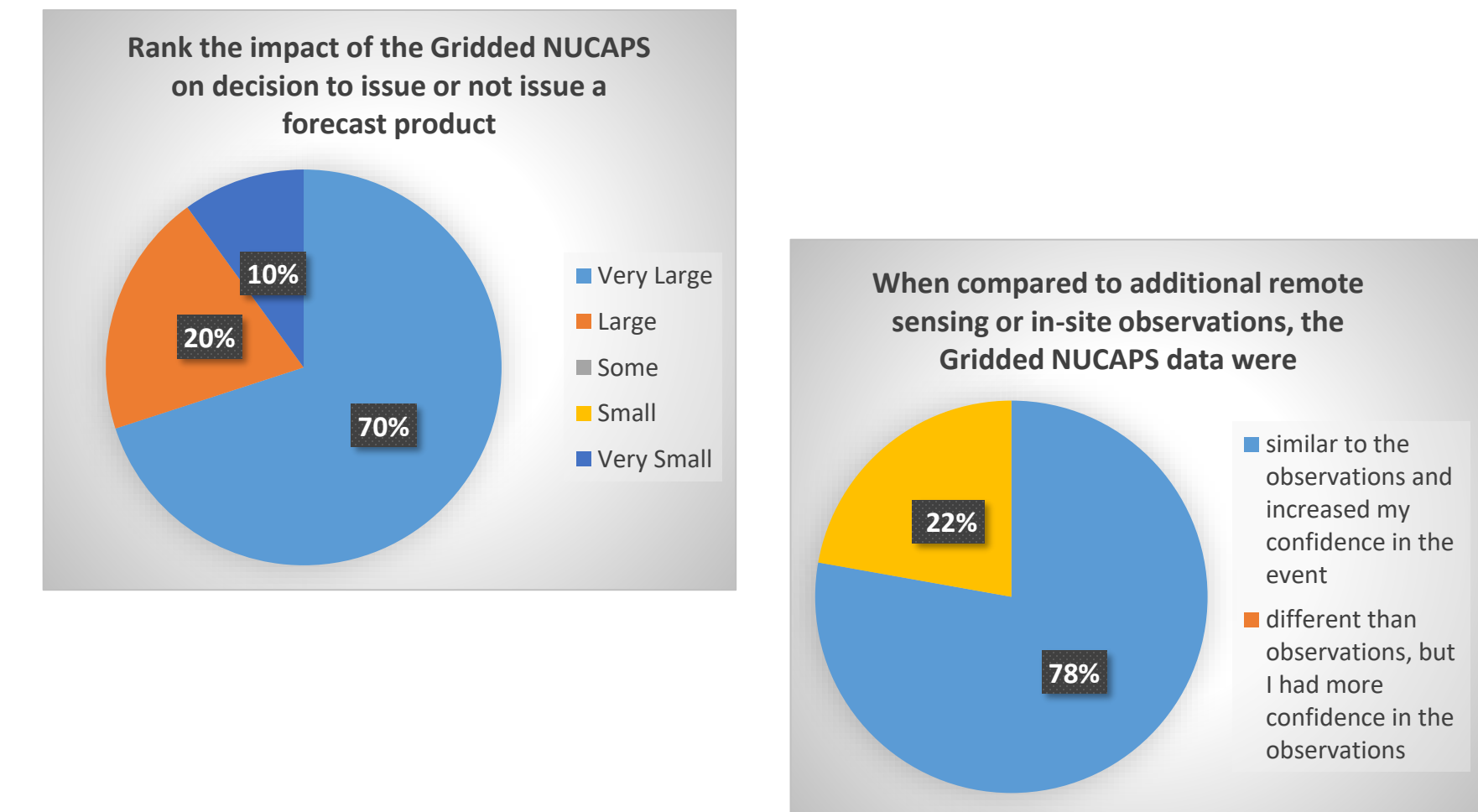
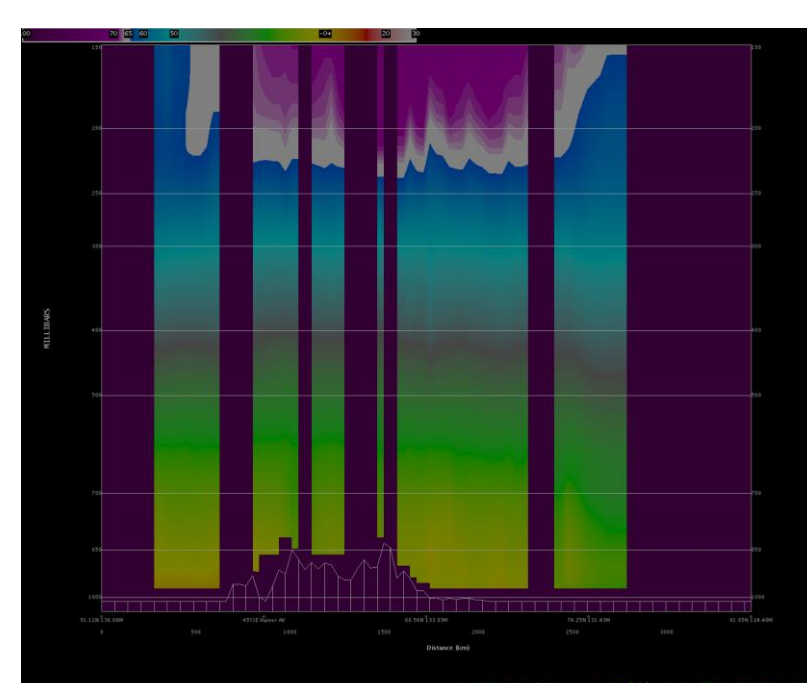
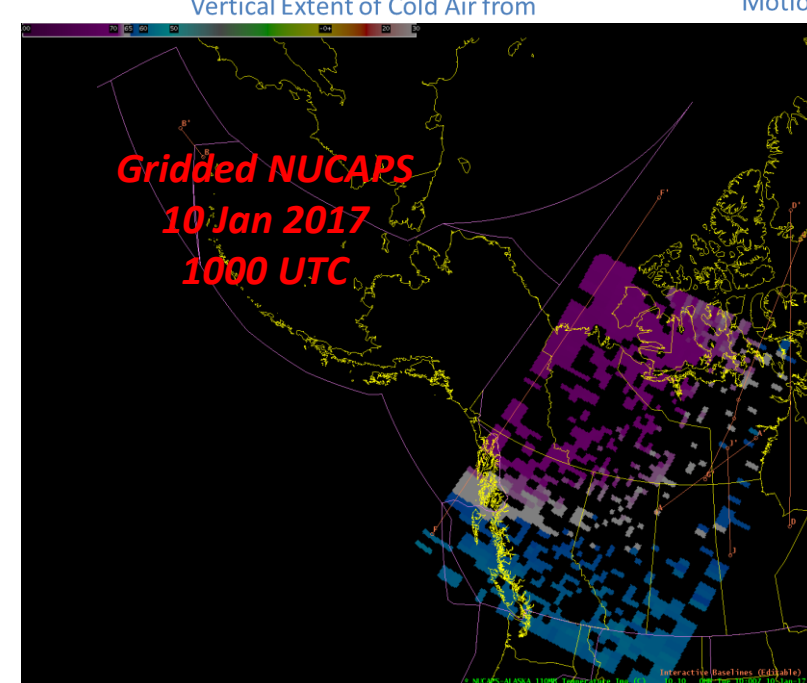
## Cold Air Aloft

- 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
- Use of satellite observations provides an opportunity for forecasters to observe the 3D extent of the Cold Air Aloft in real-time
- Forecasters at the Anchorage CWSU evaluated the Gridded NUCAPS during the 2016-2017 & 2017-2018 Winter
- Goal was to provide data to improve Cold Air Aloft analysis and increase confidence when issuing operational MIS statements used by the FAA and airlines.
- After two evaluations forecasters have integrated NUCAPS into their forecast process for CAA



Example text product disseminated by Alaska CWSU for Cold Air Aloft: valid 14 November 2015

Vertical Extent of Cold Air from Motion determined from data

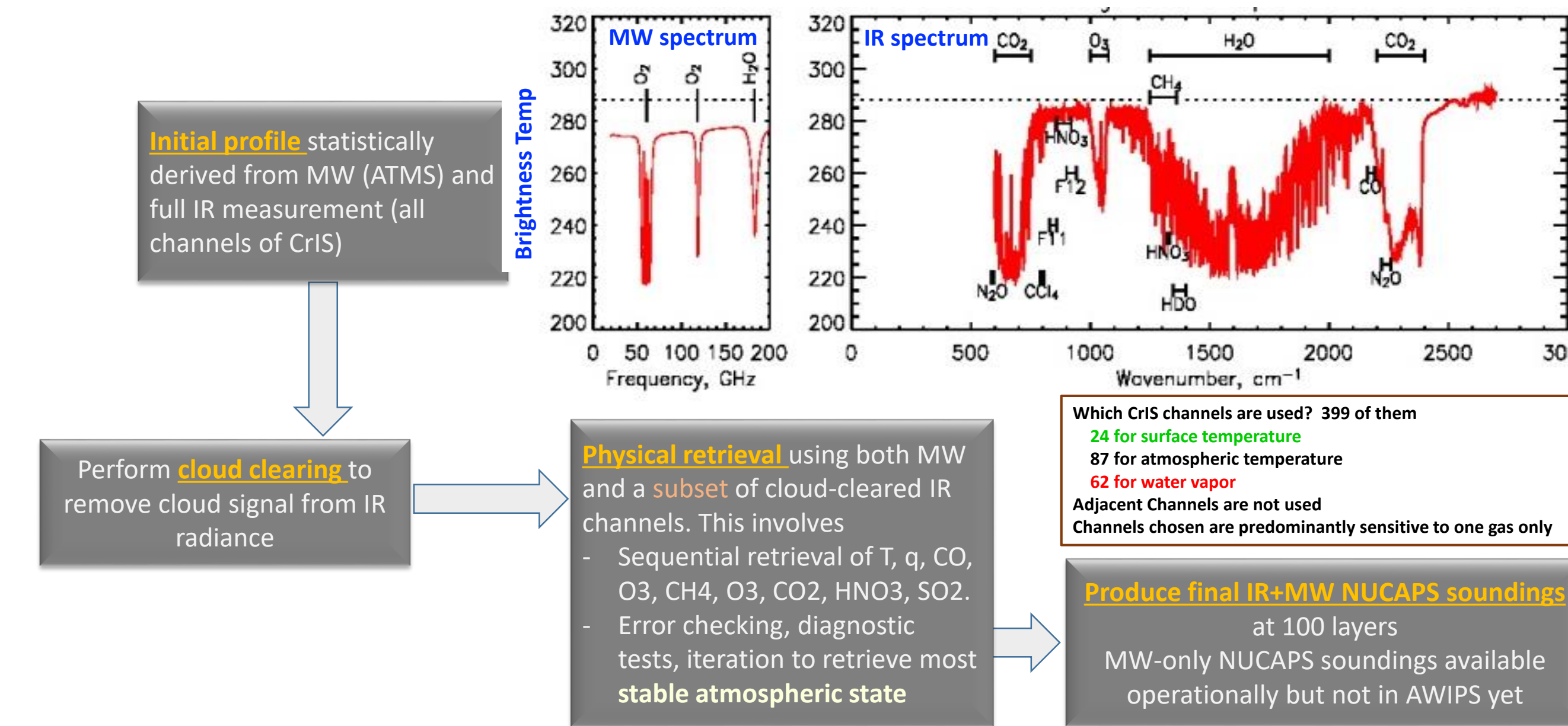


"Gridded NUCAPS data and soundings were in excellent agreement this morning with CAA over much of the state." - CW

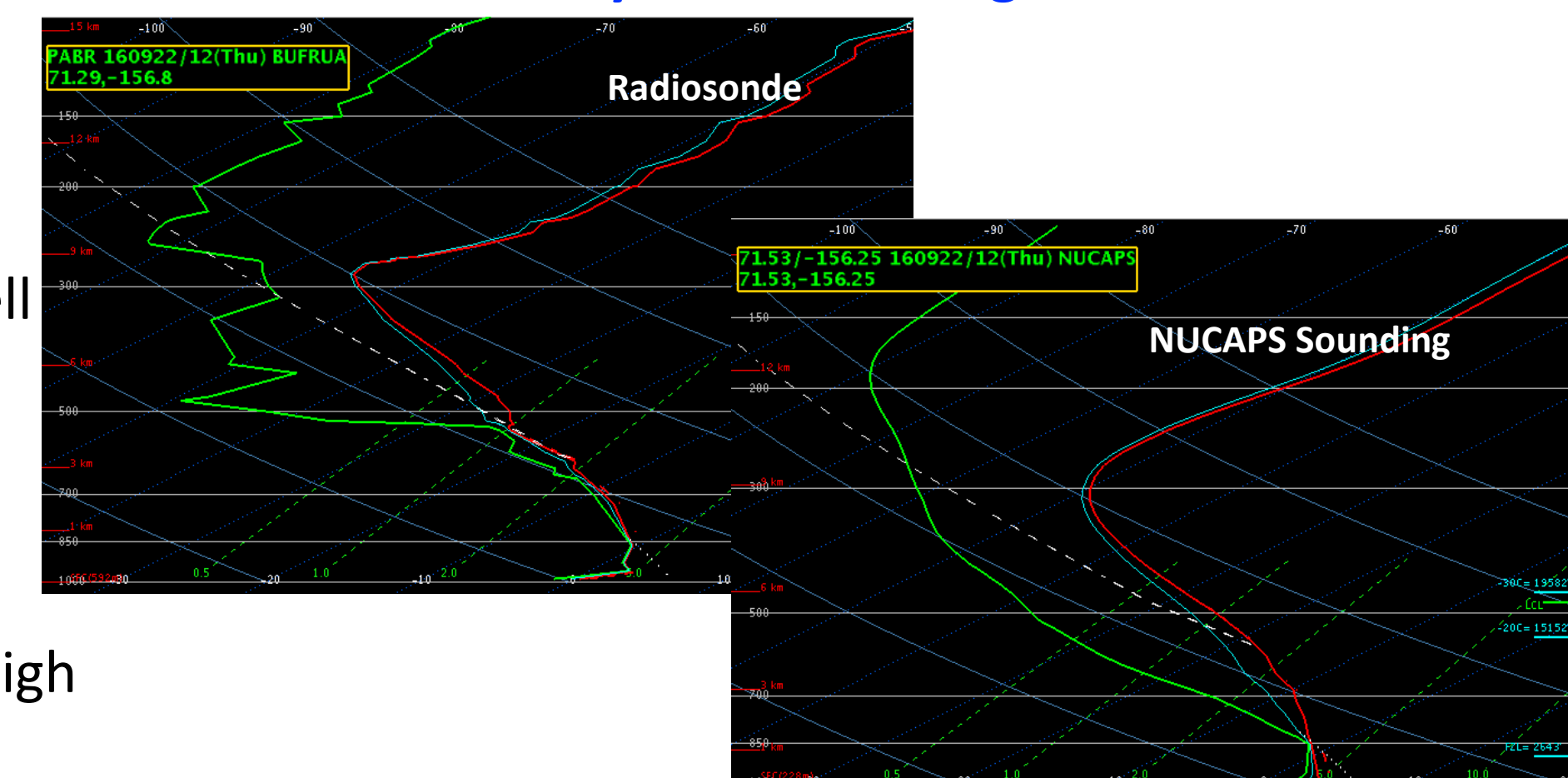
"NUCAPS trends matched NWP trends of the CAA area moving to the Panhandle and out of our airspace by 23/06Z" - GW

## Background

- A NUCAPS Sounding is retrieved from an integrated top-of-atmosphere IR+MW spectrum as a set of discrete parameters that are thermodynamically consistent

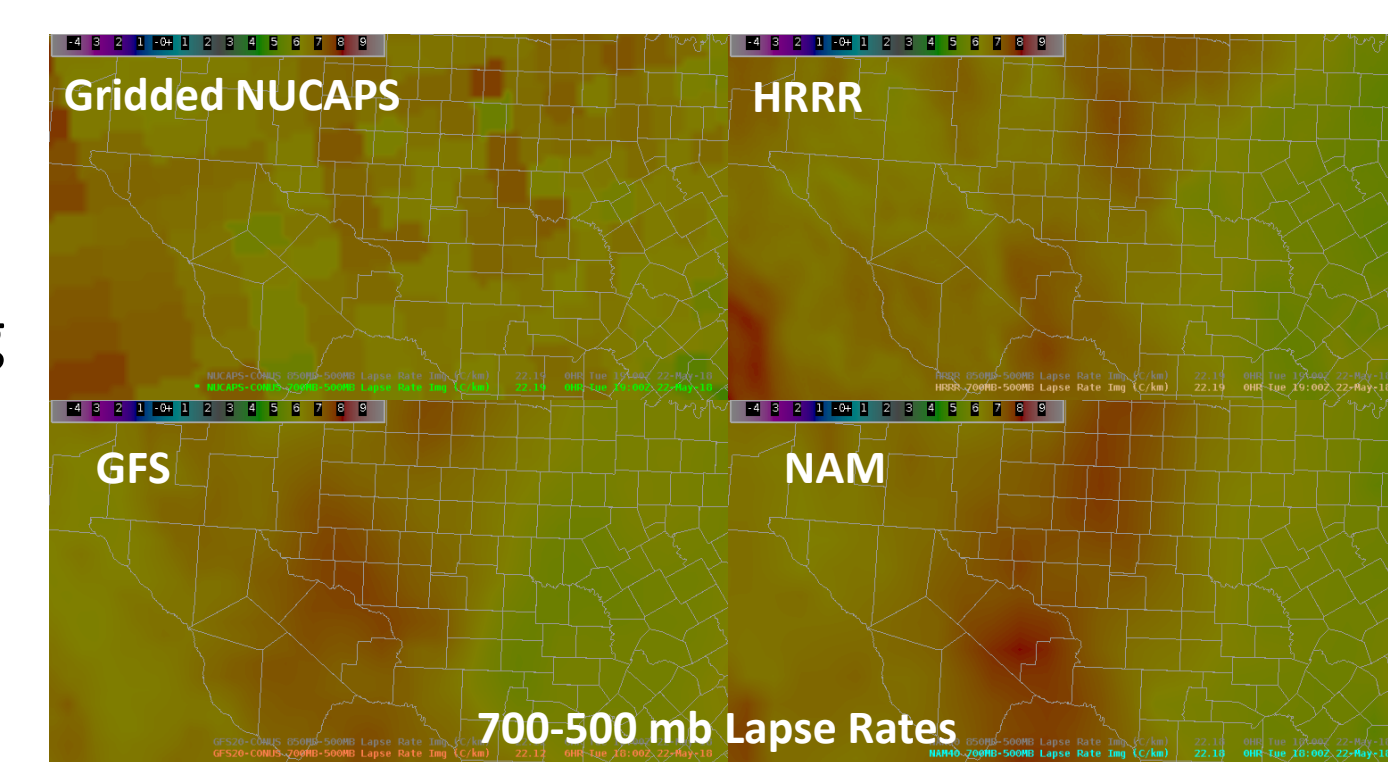


- NUCAPS retrieves temperature and moisture information as **thick layers stacked together to form a vertical atmospheric column** from surface to TOA
- How are the layers vertically distributed?
  - it varies slightly from scene to scene and is dependent on Earth surface temperature as well as local weather conditions
  - So what does this mean in operations?
    - ... compared to radiosondes, NUCAPS has a smoother appearance
    - ... compared to GOES soundings, NUCAPS has high vertical definition



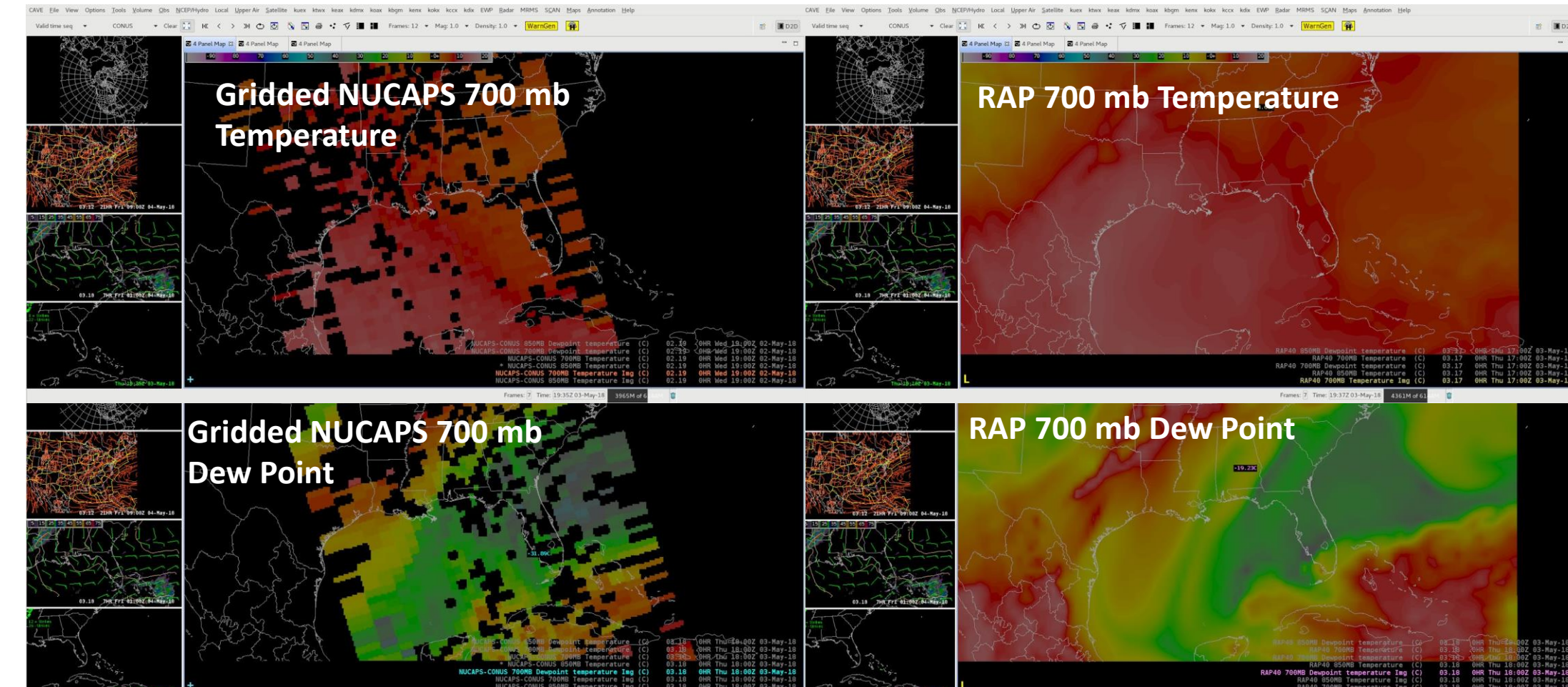
## Pre-Convective Environment

- Gridded NUCAPS was first demonstrated at the Hazardous Weather Testbed in 2016, while point Soundings were first demonstrated in 2015.
- The goal was to test the utility of Gridded NUCAPS for analyzing the pre-convective environment.
- The advantages of the Soundings are:
  - Observations between radiosonde launches
  - A dense network of observations over a 2,200 km swath
- The advantages of the Gridded product are:
  - Ability to view horizontal and vertical spatial gradients/patterns
  - A 2-D view of thermodynamic fields
- Forecaster feedback led to product improvements and best practices
  - View the data on standard pressure levels
  - Leverage AWIPS derived parameters to calculate and display stability indices or thermodynamic fields
  - Utility of spatial gradients in mid-level fields
  - AWIPS procedures and recommended fields to analyze
  - Best practices to address data quality and gaps



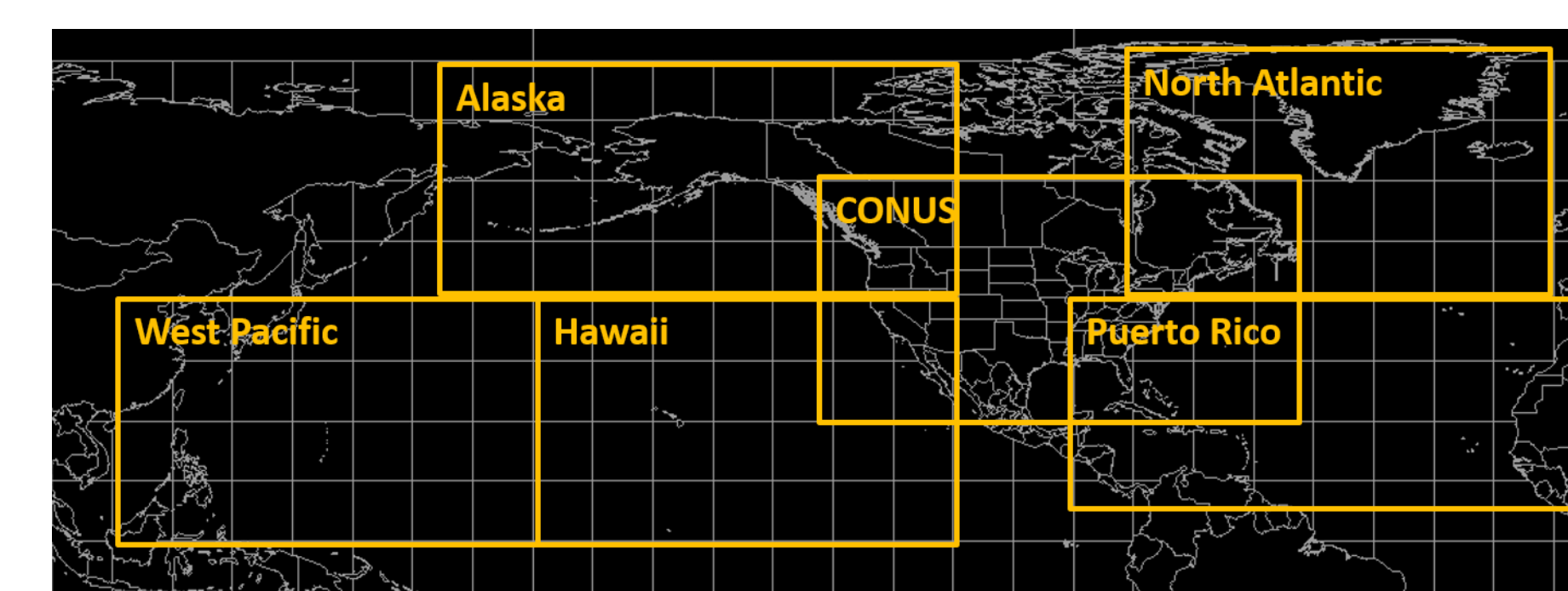
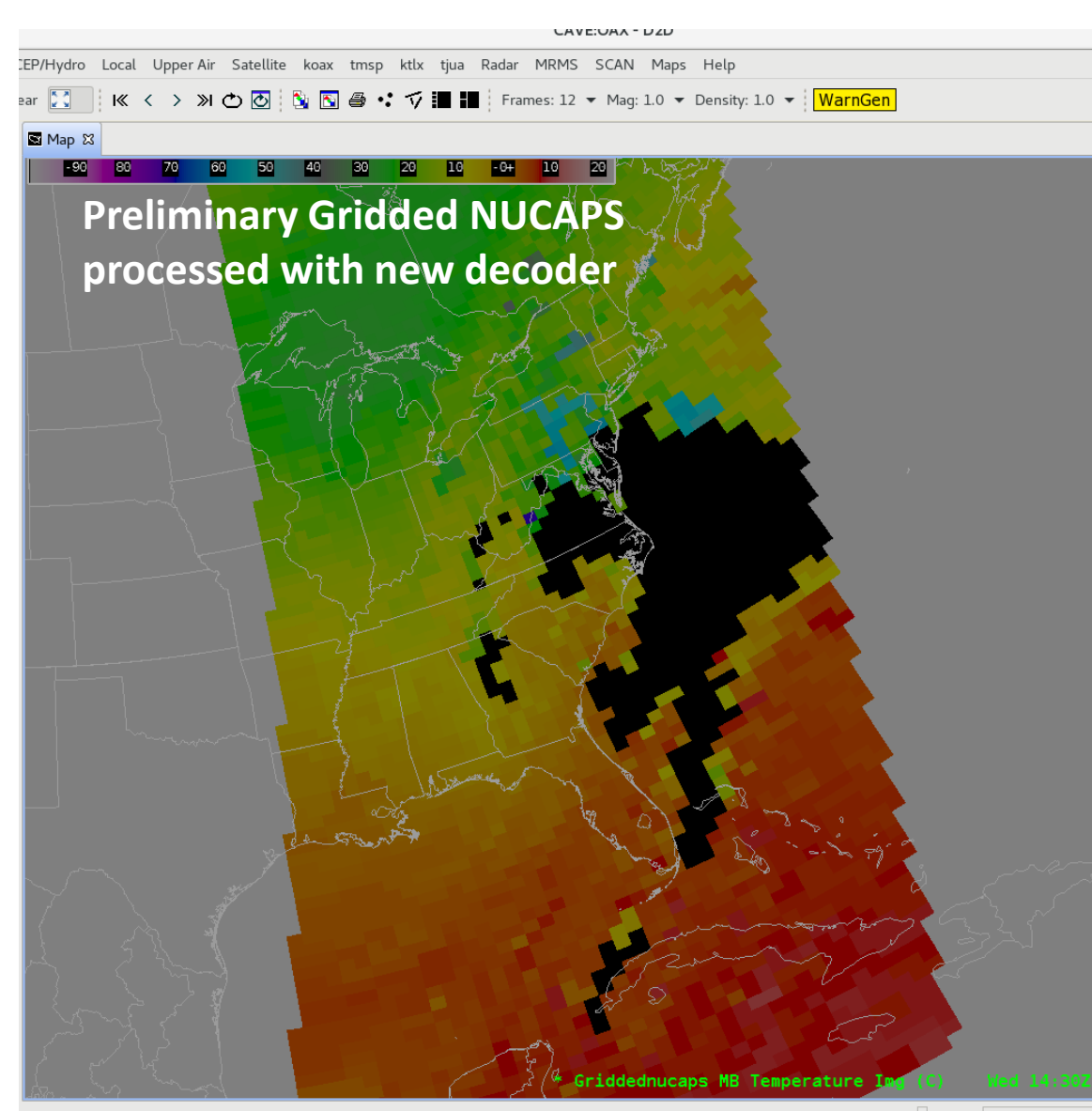
NUCAPS 700-500 mb lapse rates were generally around 6.5-7 C/km over SE NM & W TX. Comparing these lapse rates to the HRRR, GFS, & NAM40 the NUCAPS were the least steep with the GFS & NAM40 especially forecasting 700-500 mb lapse rate values of 7-7.5 C/km. In this case NUCAPS actually compared the best to SPC mesoanalysis values which are what I usually look at in a warning operation environment. This helped add to my confidence in the overall evolution of the event & widespread severe weather still looks unlikely. [sic] ~HWT Forecaster 2018

When evaluation NUCAPS temperatures, there is good agreement between NUCAPS and RAP when look at relative values. This seems to be the better interpretation of NUCAPS data that I've found so far, rather than looking at absolute temps. We can see from the smoothed out point soundings that literal values are not it's strength. Rather, "Temps at this level are higher over here, than they are over there" is more NUCAPS strength. That still has value in situational awareness. [sic] ~ HWT Forecaster 2018



## AWIPS Baseline

- Gridded NUCAPS as part of the AWIPS Baseline is under development now
- Targeting incorporation in AWIPS 19.1.1 with an early 2019 release to NWS
- S-NPP and NOAA-20 data delivered through the SBN will pass through the Gridded NUCAPS decoder to output a Grid Record and displayed similar to gridded model data
- Pre-defined grids covering CONUS, Alaska, Hawaii, West Pacific, Puerto Rico, and North Atlantic or Global option
- Scientists are working with the AWIPS developer to ensure forecaster requirements are incorporated
  - Vertical interpolation to standard levels
  - Display on flight levels for aviation forecasting
  - Minimum horizontal interpolation to retain data integrity and spatial gradients
  - Leverage derived parameters to calculate thermodynamic fields
  - Easy access menus and recommended display fields



## Future Applications

- Planned assessments with end users to test the utility for Fire Weather and Turbulence
- Investigation of Microwave-only soundings for applications in cloudy regions such as Icing and Winter Weather
- Determine the value of cloud information for applications that rely on cloud properties