



# Integrating NASA Aqua AIRS in near-real time weather forecasting: prototyping NUCAPS capabilities and tools

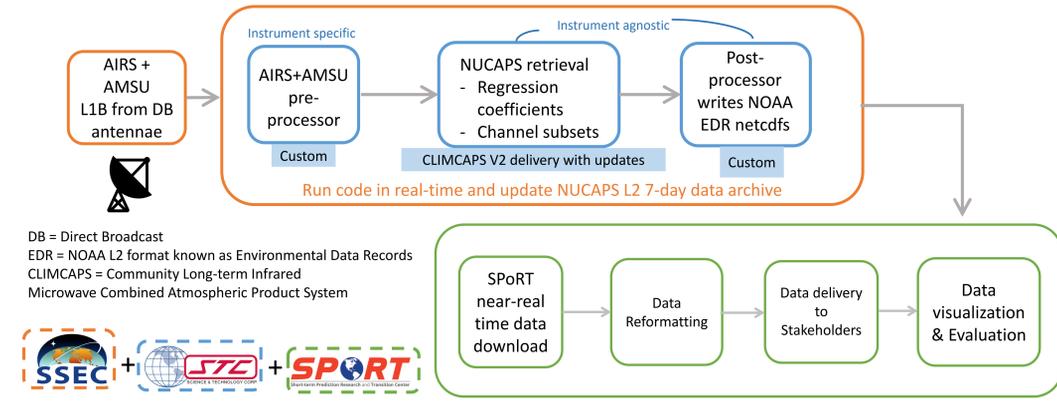
Emily Berndt<sup>1</sup>, Nadia Smith<sup>2</sup>, and Rebekah Esmaili<sup>2</sup>  
<sup>1</sup>NASA MSFC SPoRT and <sup>2</sup>Science and Technology Corporation



## Introduction

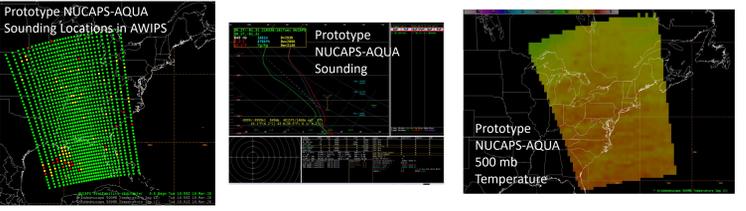
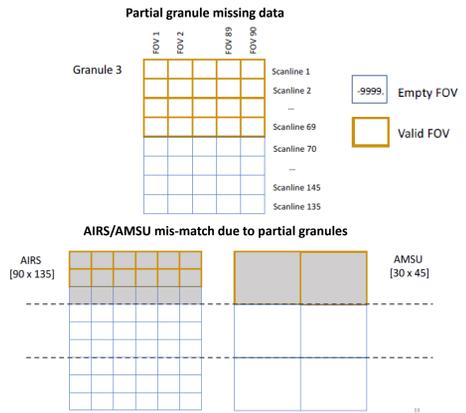
- A prototype near-real time system was developed to process NASA's Aqua Atmospheric Infrared Sounder (AIRS) retrievals for use in weather forecasting operations with the goal of providing observations in less than 3 hours.
- The system leveraged the NOAA Unique Combined Atmospheric Processing System (NUCAPS) algorithm to deliver NUCAPS Aqua to National Weather Service (NWS) forecasters through an innovative direct broadcast pathway.
- The NASA Short-term Prediction Research and Transition (SPoRT) Center, Science and Technology Corporation (STC), Space Science Engineering Center (SSEC), and the Jet Propulsion Laboratory (JPL) partnered to implement NUCAPS science code capable of processing AIRS within the Community Satellite Processing Package (CSPP) framework.
- The NUCAPS algorithm is based on the AIRS Science Team algorithm version 5.9 and is used to provide operational NUCAPS soundings to the NOAA NWS for display in the Advanced Weather Interactive Processing System (AWIPS).
- Integrating NASA Aqua into the NUCAPS algorithm expands the temporal and spatial resolution of satellite soundings available to forecasters.

## Processing System



## Challenges

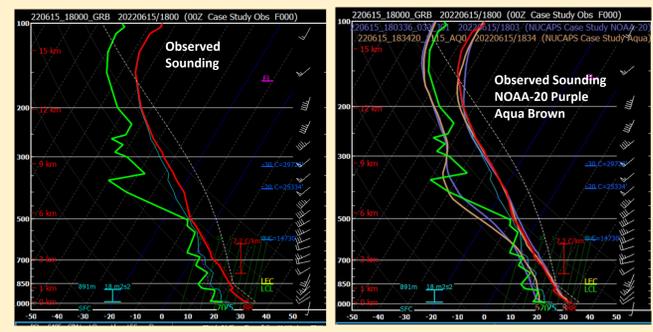
- Post-processor** adapted to create a format compatible with NOAA operational format
- Use of direct broadcast data** led to the need for logic to account for partial granules and AIRS/AMSU mis-matches due to limited observational line of sight
- Latency** sensitive to use of external versus locally stored GFS data
- Quality Flags** impacted by the lack of AMSU surface channels



## Stakeholder Feedback & Examples

### Pre-Convective Environment Across Green Bay, WI (GRB)

Just between Aqua and NOAA-20 you can see that the environment becomes much more moist over time (AQUA came around 19Z and NOAA-20 came around 18Z). The increase in temperatures and dew points in the low levels between the two NUCAPS soundings show that there was increasing low level lapse rates and increasing CAPE through time. **Then compare both of these to the special sounding sent out by GRB, you can see AQUA's vast improvement in the low level over NOAA-20.** The one caveat seems to be the smoothing of the values in the mid levels. Smoothing seems to have decreased the values almost too much for both satellite soundings. It is fairly within reason given that there is a dry layer in the mid levels on the observed, but the smoothing looks to have slightly overdone it.

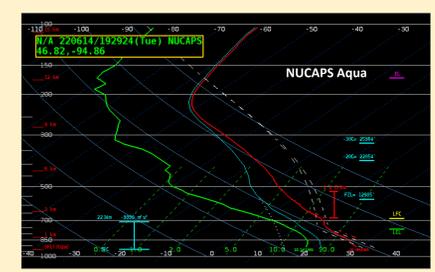


~Forecaster HWT 2022

### Isolated to Scattered Convection in Grand Forks, ND (FGF)

We had three overpasses right before the convection initiated. The 1823 UTC NOAA-20 NUCAPS had an MLCAPE of 2094 J/kg. The next overpass was at 2033 UTC with an MLCAPE of 1235 J/kg. that's quite a drop in MLCAPE compared to previous overpass. Two things to remember; this is on the edge of the field-of-view (matter of fact, the eastern edge). **We also have a NUCAPS Aqua overpass. This was almost directly under NADIR so we should have much better profile retrieval. Sure enough, MLCAPE value is almost 3000 J/kg in between the 1823 and 2003 UTC NOAA-20 sounding retrievals.**

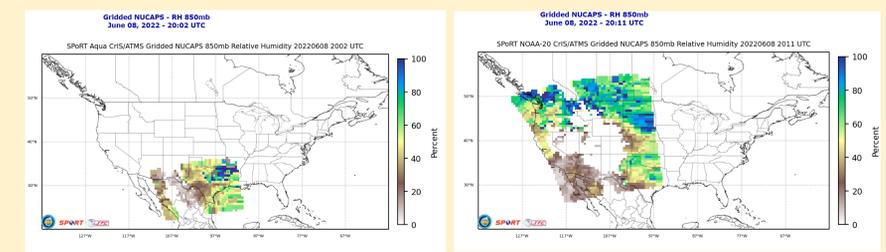
**They all combine to increase confidence on what conditions COULD be in areas where the models are saying one thing and an observational system is indicating potential reality** (remember, it's still a remote sensing platform with their own set of issues). In our case, the bulls-eye of 3000 J/kg in east central Minnesota is likely real and needs to be an area to watch...and that is where the Lightning Cast product at the start of our post indicated the potential for new activity to develop.



~Forecaster HWT 2022

### Storms developing in the area

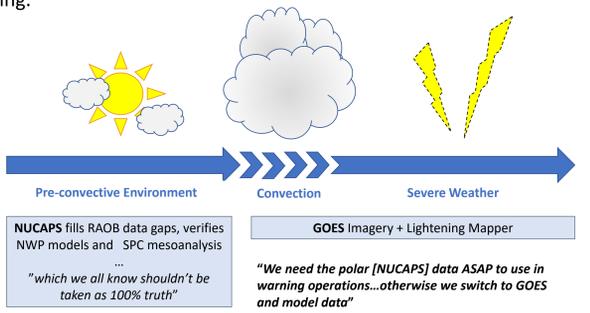
We showed above that the north side of the outflow would contain more instability - which is directly related to the moisture from the morning MCS outflow. **The Gridded NUCAPS provides additional insight using the 850mb moisture fields from both AQUA and NOAA20 respectively - validating our hypothesis.**



~Forecaster HWT 2022

## Pre-Convective Environment

- Collaborators in the Joint Polar Satellite System (JPSS) Sounding Initiative have introduced Hyperspectral Infrared Sounders (S-NPP, NOAA-20, MetOp-A/B) to NOAA NWS forecasters through the NOAA Hazardous Weather Testbed Spring Experiment
- A consistent message from forecasters is the need for more satellite soundings delivered with low latency
- The goal of this project was to develop a processing system to deliver NUCAPS Aqua in near-real time and experimentally demonstrate the value to operational forecasting.



Operational meteorologists need NUCAPS as mesoscale observations of real-time atmospheric state ahead of storm development – compare NUCAPS to NWP models and SPC mesoanalysis for **situational awareness and confidence in their conceptual models** of storm potential.

## NUCAPS Resource Links

[Sounder Applications Website](#)  
[STC NUCAPS GitHub](#)  
[NUCAPS THREDDS Server](#)  
[SHARPy](#)  
[SPoRT](#)  
[McIDAS-V](#)  
[NWS AWIPS](#)  
[SSEC RealEarth™](#)

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