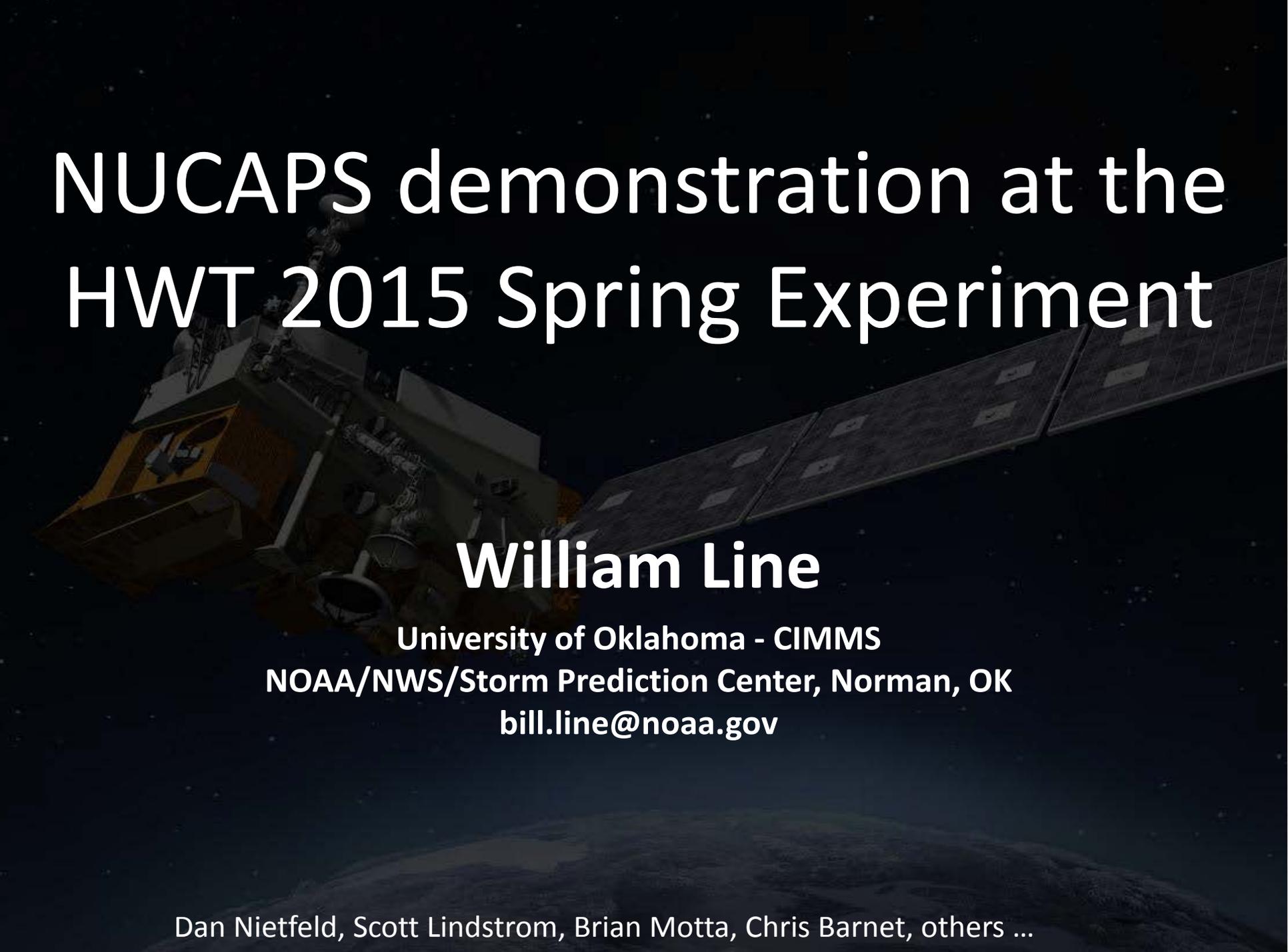


NUCAPS demonstration at the HWT 2015 Spring Experiment

A satellite is shown in space, with its solar panels extended. The Earth is visible in the background, showing a curved horizon and some cloud cover. The satellite has a complex structure with various instruments and antennas.

William Line

University of Oklahoma - CIMMS
NOAA/NWS/Storm Prediction Center, Norman, OK
bill.line@noaa.gov

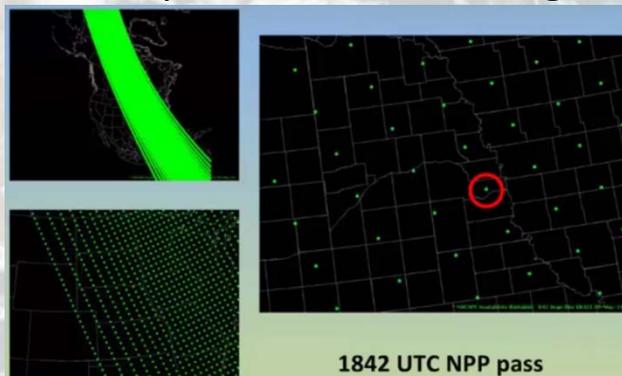
Dan Nietfeld, Scott Lindstrom, Brian Motta, Chris Barnet, others ...

- NOAA Unique CrIS ATMS Processing System
 - Operational CrIS+ATMS physical retrieval algorithm
- NUCAPS vertical temperature and moisture profiles are available from NPP operationally in AWIPS-II
- Can NUCAPS data provide unique value to the severe weather nowcast and warning process?

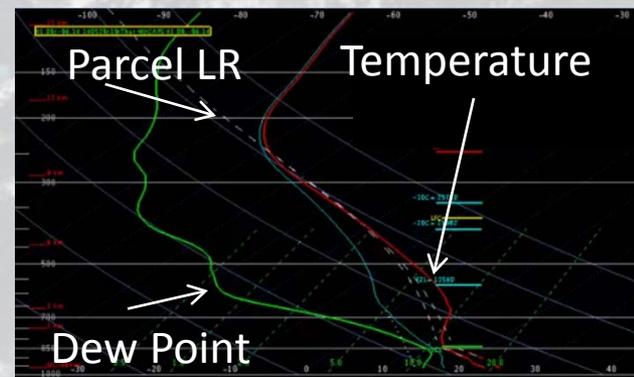
Observed Radiosondes
(12z and 18z)



Example NUCAPS Coverage



Example NUCAPS Skew-T Profile
in AWIPS-II NSHARP





Hazardous Weather Testbed

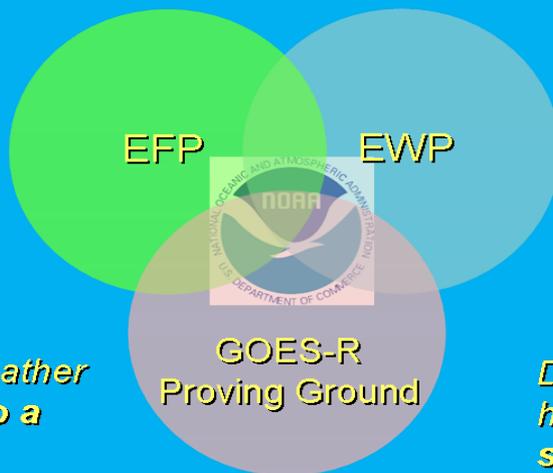


- Facility and organization
- Jointly managed by NSSL, SPC, WFO-Norman
- Annual Spring Experiment



Experimental Forecast Program

Prediction of hazardous weather events from a few hours to a week in advance



Experimental Warning Program

Detection and prediction of hazardous weather events up to several hours in advance



2015 Hazardous Weather Testbed (HWT) Experimental Warning Program (EWP) Spring Warning Project

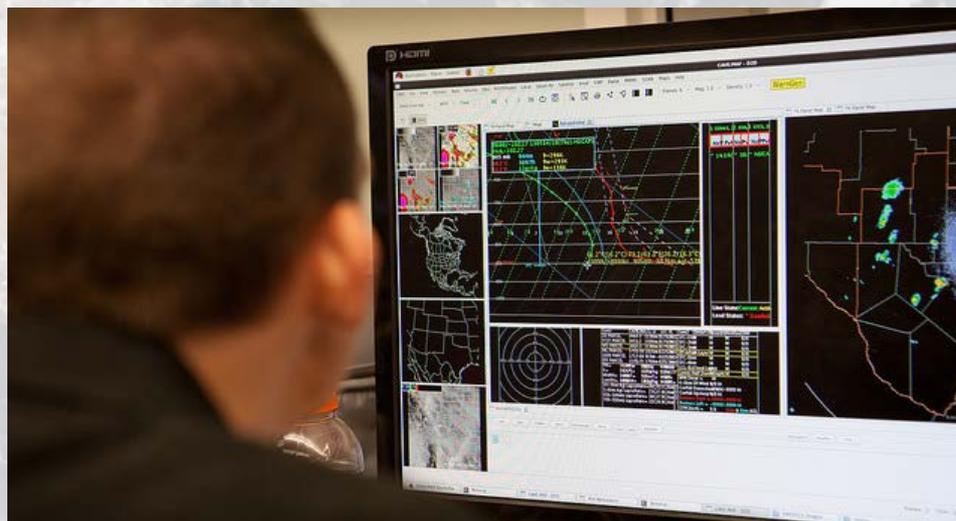


- Real-time, simulated nowcast/warning environment using AWIPS-II.
 - “mesoscale forecast updates” (via live blog posts)
 - experimental severe t-storm and tornado warnings (in AWIPS-II).
- Weeks of May 4, 11, 18, June 1, 8 (5 weeks)
 - Mon: 11a-7p, Tues-Thurs: Flex (start b/t 11a and 3p), Fri: 9a-1p
- 5 NWS forecasters, 1 broadcaster per week (30 total; and PI's)
- GOES-R/JPSS and ENI demonstration's (including NUCAPS)
- Training: 10-30 min Articulate PowerPoint Presentations
- Feedback: Daily and weekly debriefs, daily surveys, blog posts, TFFT Webinar
- **Final Report available shortly**



NUCAPS HWT-EWP 2015 Demonstration

- Capture the value added by NUCAPS to the severe weather nowcast and warning process
- Learn what adjustments could be made to enhance operational usefulness of NUCAPS in AWIPS-II
- Enlighten participants to the existence of NUCAPS in AWIPS-II



- 13 minute Articulate PowerPoint

- http://rammb.cira.colostate.edu/training/visit/training_sessions/nucaps_soundings_in_awips/

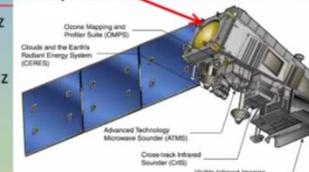
NUCAPS Soundings in AWIPS

Chris Barnet NOAA/STC Antonia Gambacorta NOAA/STC
 Scott Lindstrom UW CIMSS Bill Line NOAA / SPC
 Brian Motta NOAA / FDTD Dan Nietfeld NOAA / NWS OAX



NUCAPS

- NOAA Unique CrIS ATMS Processing System**
 - CrIS: Cross-track Infrared Sounder (1305 channels)
 - ATMS: Advanced Technology Microwave Sounder (2 channels)
- All instruments on **Suomi/NPP**
 - East Coast: 05z/17z
 - Plains: 07z/19z
 - West Coast: 11z/23z
 - Alaska: Lots!

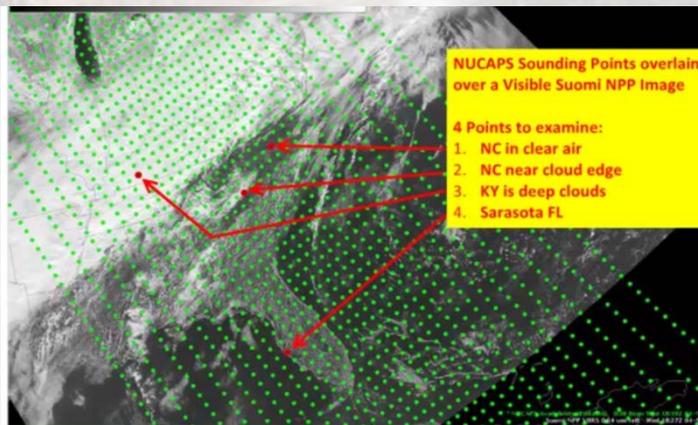


Svalbard Downlink → NSOF (NDE) → NWS Gateway → SBN → WFO

CONUS Data Flow

Summary of products from NUCAPS (and AWIPS-II)

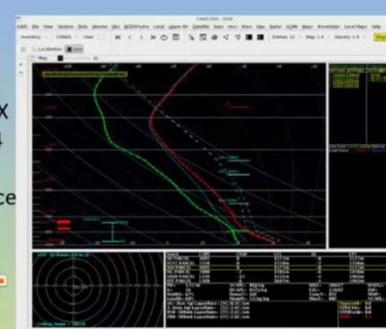
gas	Precision	d.o.f.	Interfering Parameters	Sensitivity
Temperature Profile, T(p), SST, LST	1.5K/km	6-10	Emissivity, H ₂ O, O ₃ , N ₂ O	surface to ~1 mb
Water Profile, H ₂ O(p)	15%	4-6	CH ₄ , HNO ₃	surface to ~300 mb
Cloud Top Pressure	25 mbar,	2	CO ₂ , H ₂ O	surface to tropopause
Cloud fraction	1.5K, 5%	18		
Ozone, O ₃	10%	1+	H ₂ O, emissivity	Lower stratosphere
Carbon Monoxide, CO	15%	≈ 1	H ₂ O, N ₂ O	Mid-troposphere
Methane, CH ₄	1.5%	≈ 1	H ₂ O, HNO ₃ , N ₂ O	Mid-troposphere
Carbon Dioxide, CO ₂	0.5%	≈ 1	H ₂ O, O ₃ , T(p)	Mid-troposphere
Sulfur Dioxide, SO ₂	≈ 50%	< 1	H ₂ O, HNO ₃	Volcanic flag
Nitric Acid, HNO ₃	≈ 50%	< 1	emissivity H ₂ O, CH ₄ , N ₂ O	Upper troposphere
Nitrous Oxide, N ₂ O	≈ 5%	< 1	H ₂ O, CO	Mid-troposphere



June 3, 2014 High Risk Severe Weather Event in Omaha

NUCAPS sounding 40 km south of OAX 1849Z June 3, 2014

Modified for surface METAR
 Ob of T=85, Td=68
 SB CAPE = 3095 ←



- Participants across all weeks felt the training articulate adequately prepared them for the NUCAPS evaluation.

NUCAPS in 2015 HWT

- Timing of profiles

- East: ~1730-1800
- Central: ~1900-1930Z
- West: 2030-2100Z



Plus ~75 minute
latency to AWIPS-II

- Most common uses in HWT

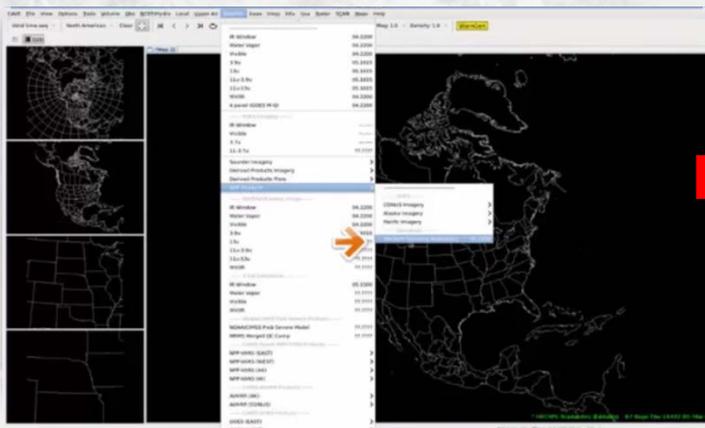
- Analysis of pre-convective environment
 - Asses instability, boundaries, etc
- Analysis of near-storm environment
- Comparisons with NWP, RAOBS

- ❖ Sfc/near-surface modifications to profiles necessary in most cases
- ❖ Clear-sky selections recommended

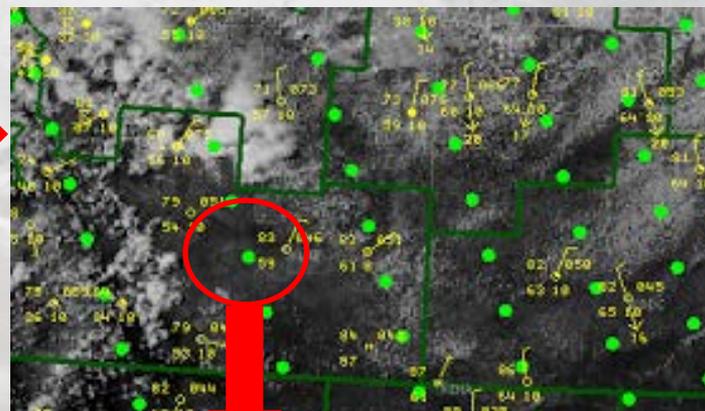
In general, forecasters felt that, when modified, the profiles provide an adequate and useful representation of the current state of the atmosphere ...

... leading them to see the value in having this information to fill the spatiotemporal gaps that exist in observed sounding information.

1. Load "NUCAPS Sounding Availability" with satellite imagery and sfc obs from AWIPS-II menu.



2. Sounding locations appear in AWIPS-II D2D. Select sounding in relatively clear-sky



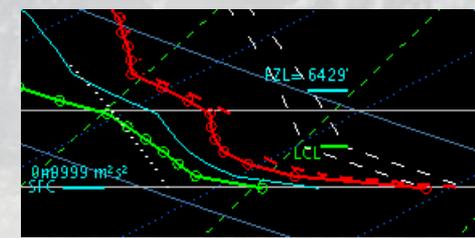
3. Temperature and Moisture profile load in AWIPS-II NSHARP skew-T application. Modify sfc if needed.



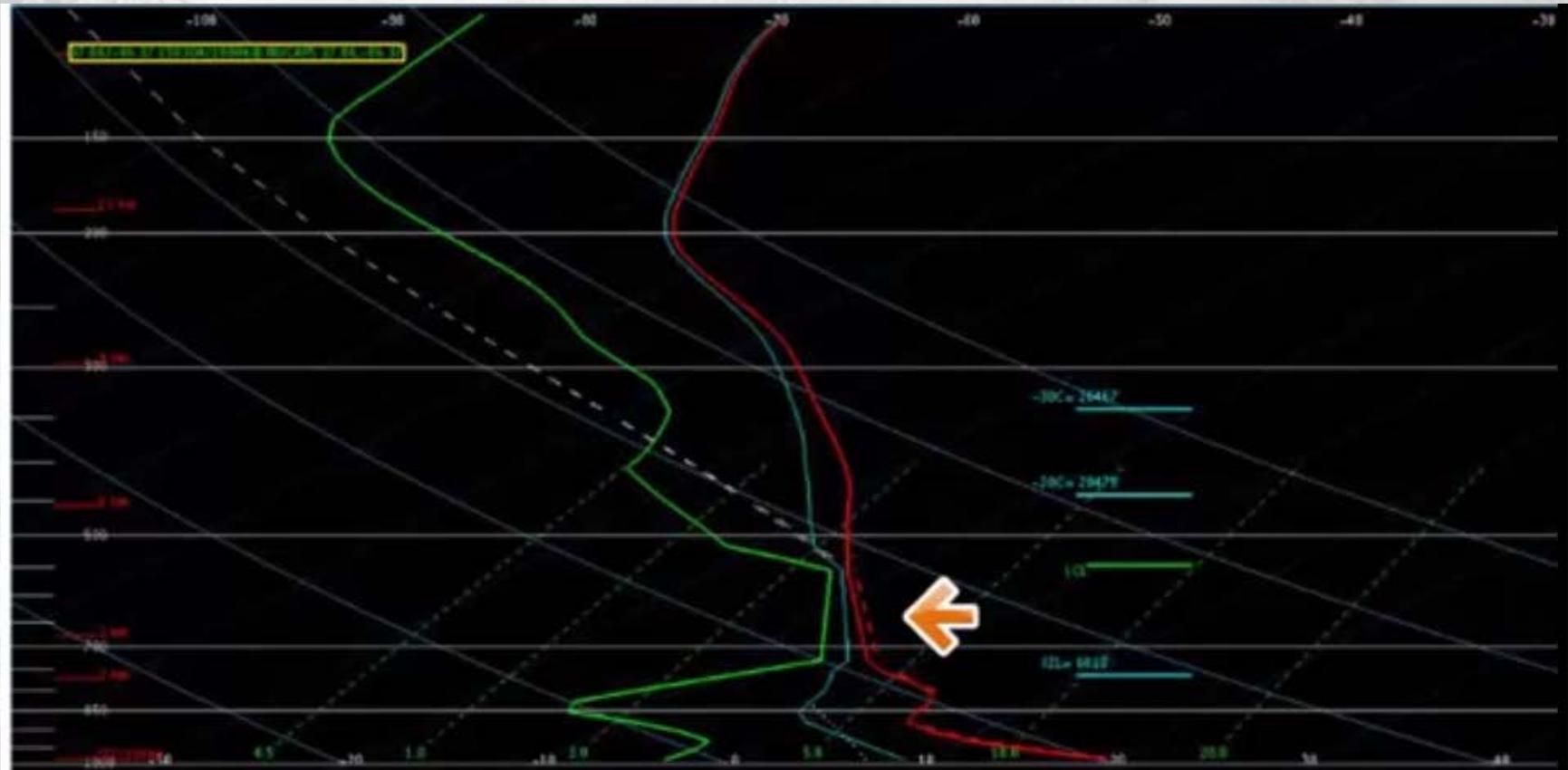
Additional modifications above sfc sometimes needed



OR



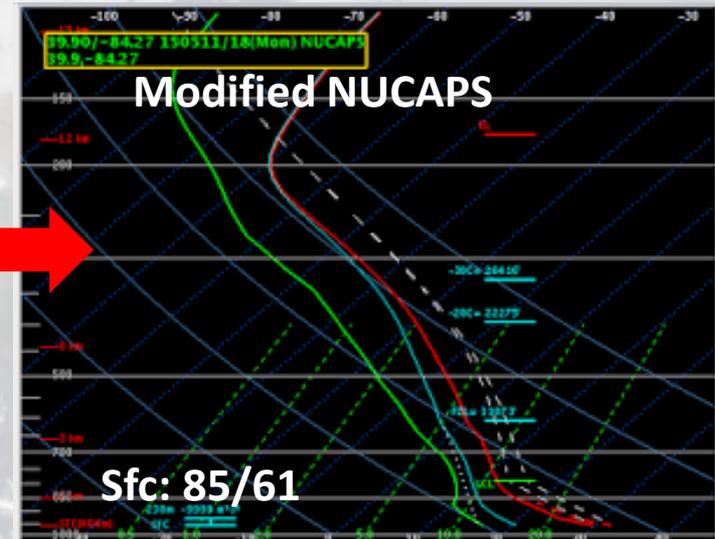
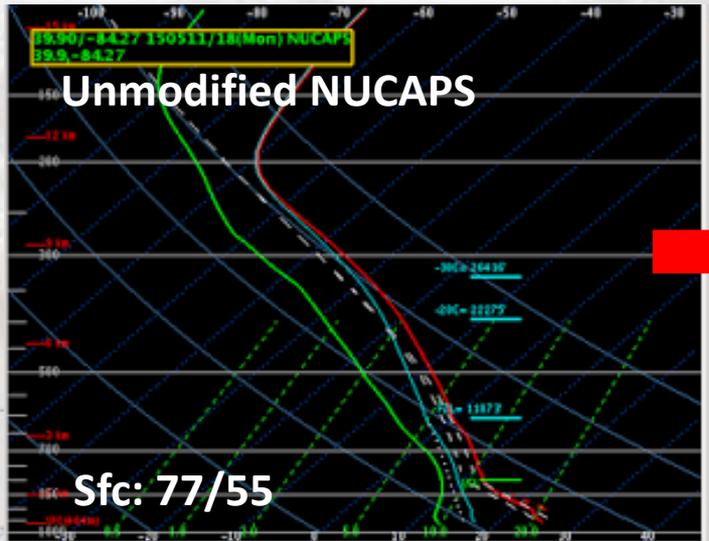
NUCAPS in Thick Clouds



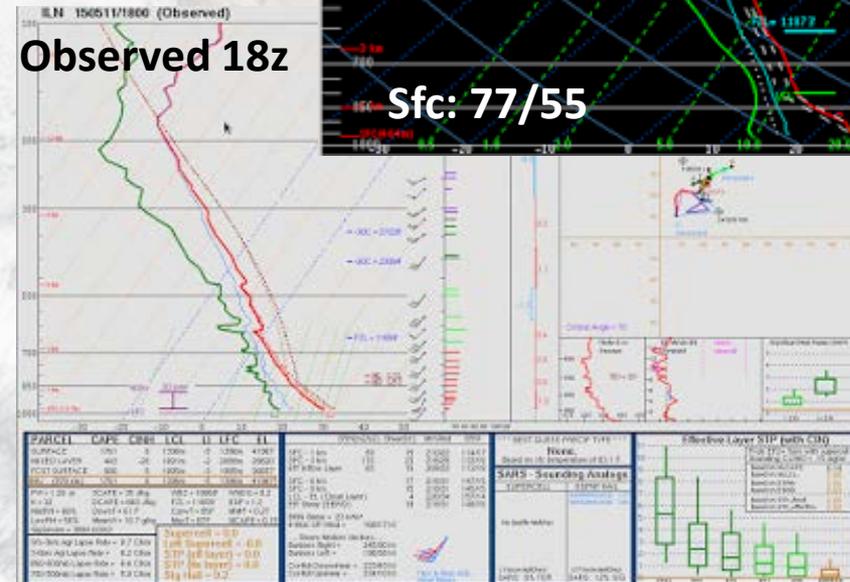
Blog Post: "Observed Radiosonde Data/NUCAPS Comparison"

May 11 - Wilmington, OH

"However, if the boundary layer temperature and dew point profile is modified using nearby METAR observations (85/61), the SBCAPE is more representative to the observed sounding (1761 vs. 1688 J/kg):"

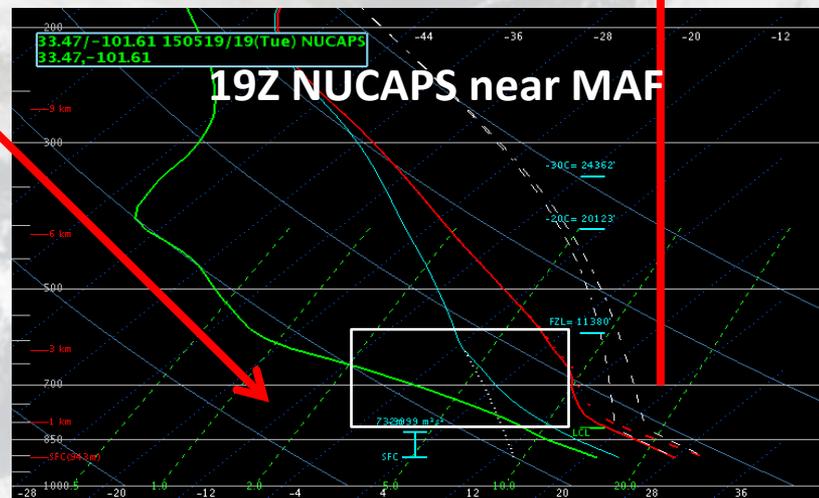
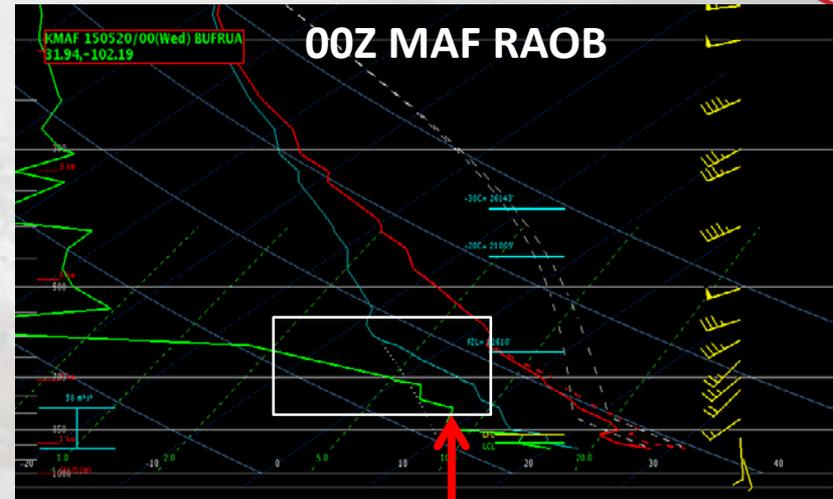
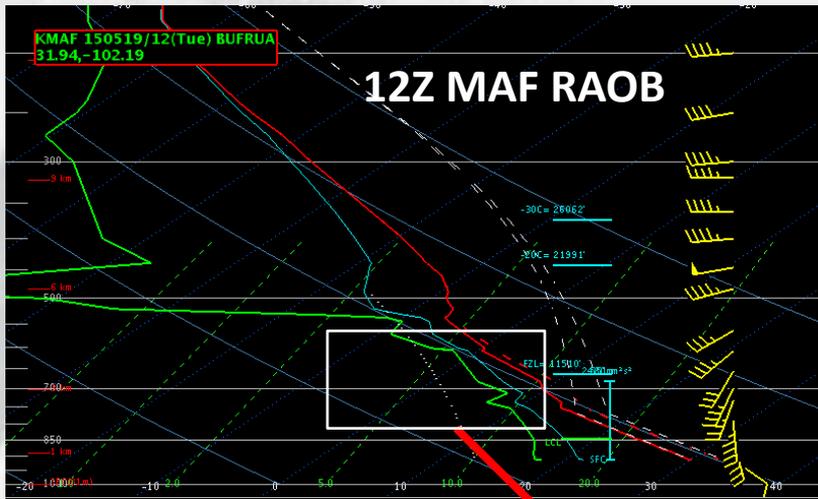


Observed 18z



"You can't just modify the surface values, you must modify the whole mixed layer, otherwise you get unrealistic lapse rates"

Blog Post: "West Texas Soundings" May 19 – Midland, TX



“The drying of the air at 600-800 mb since 12Z is reflected by intermediate NUCAPS soundings.”

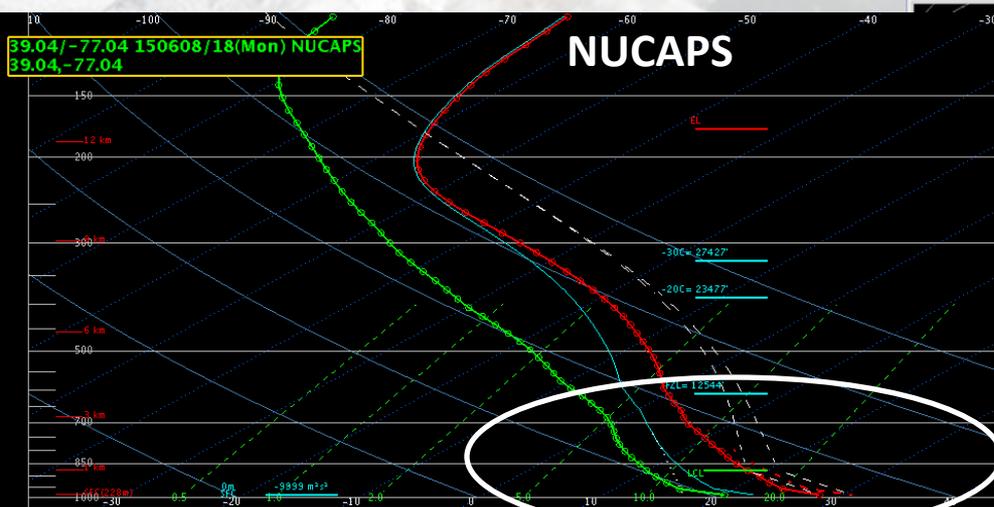
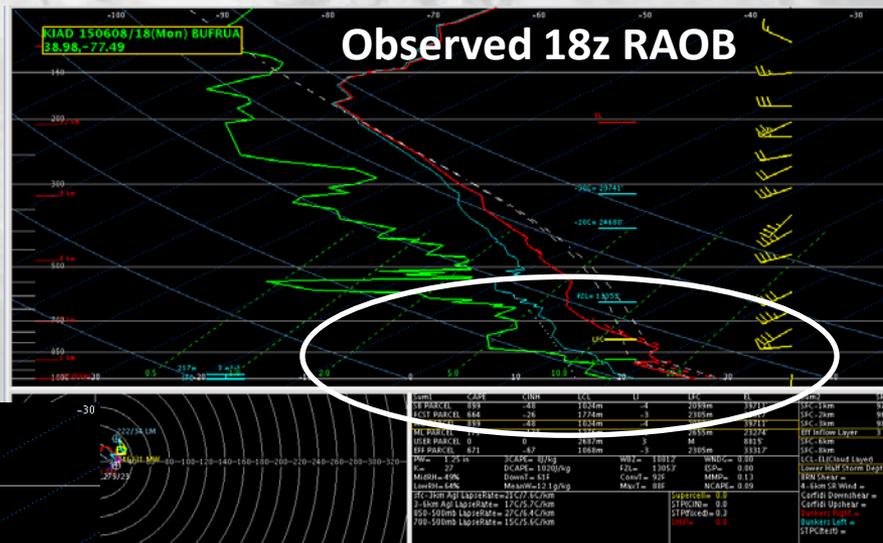
“The NUCAPS soundings are a good way to see changes in the airmass since the RAOB soundings have been taken.”

Blog Post: “NUCAPS compared to Observed IAD sounding”

June 8 - Sterling, VA

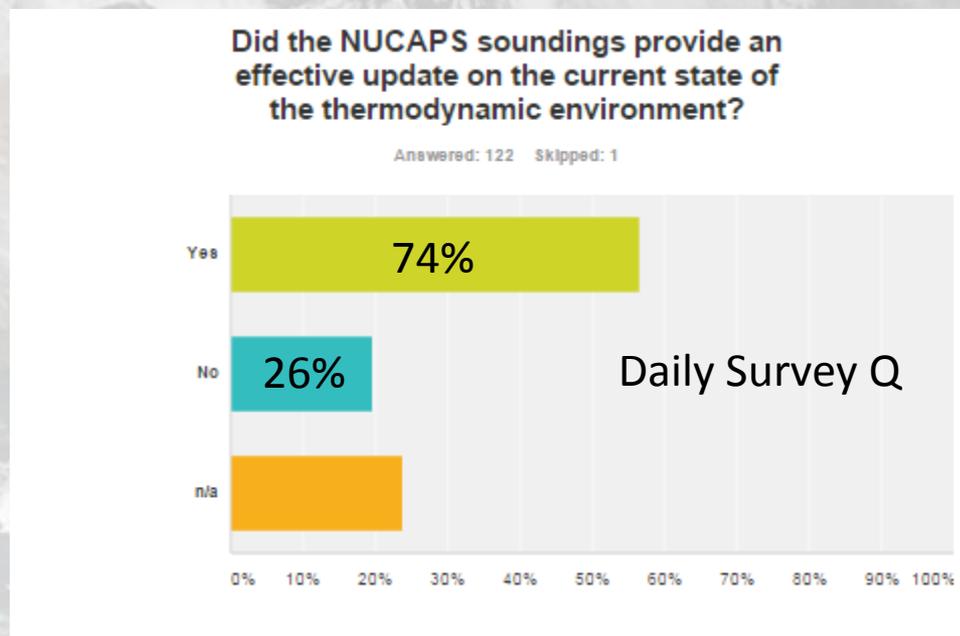
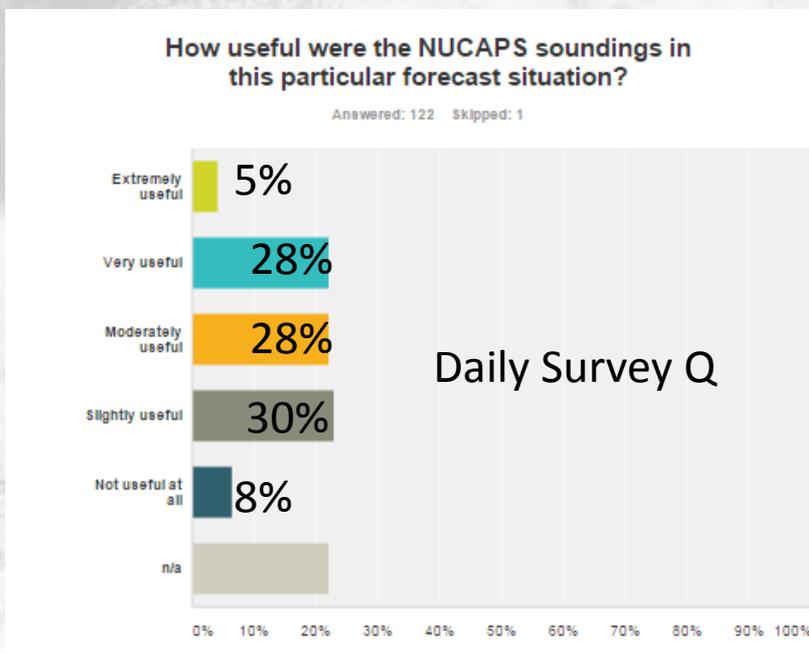
- “18 UTC NUCAPS sounding near IAD, modified for IAD surface data showing 2200 J/kg when compared to 900 J/kg in the observed IAD 18 UTC sounding. The observed sounding also shows an elevated mixed layer and capping near 825 mb which is not seen in the NUCAPS sounding.

“I'm still a little suspect of the NUCAPS data as it doesn't show the fine scale detail that is so valuable in a standard RAOB.”



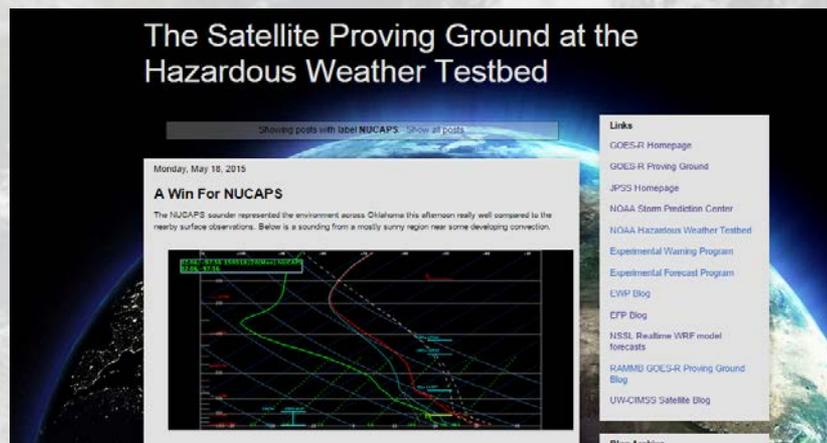
“Fusing of all the sources is really the way to go, they should all be blended together, instead of having to use them all (NWP, NUCAPS, etc)”

- All participants answered that they understand the differences between space-based soundings and RAOBs
- Only 1 NWS participant already uses NUCAPS at home office (Alaska)
 - 20/23 say they will



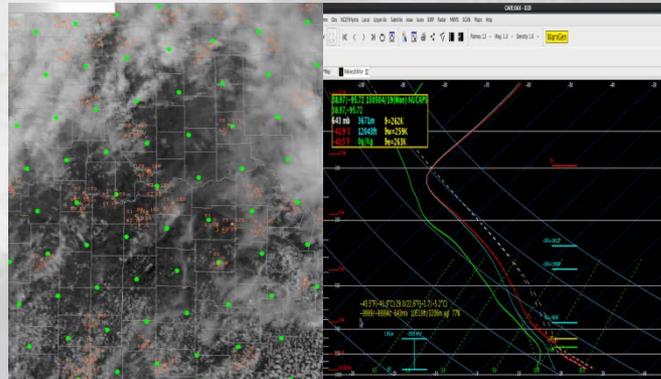
“In its current state, I would probably not use NUCAPS. It is cumbersome to modify the sounding by hand and try to determine the amount of mixing required...I would probably use it more when it automatically uses surface observations and mixes it for you.”

- General shape and stability/moisture parameter values seemed realistic
 - Comparable to observed soundings
- Important features and details such as capping inversions not depicted well (or at all) in the soundings
 - Stable layer sometimes apparent (bump); how to interpret this was unknown
- Surface/ML modification often necessary, too cumbersome
 - “Automating the modifications would be great, including the low-level mixing”
- QC Flags a must
 - “QC flags would give me more confidence in the soundings, as it is difficult to judge with just the cloud data.”
- Various AWIPS-II requests
- Training requests
 - More severe app examples
 - Verification statistics

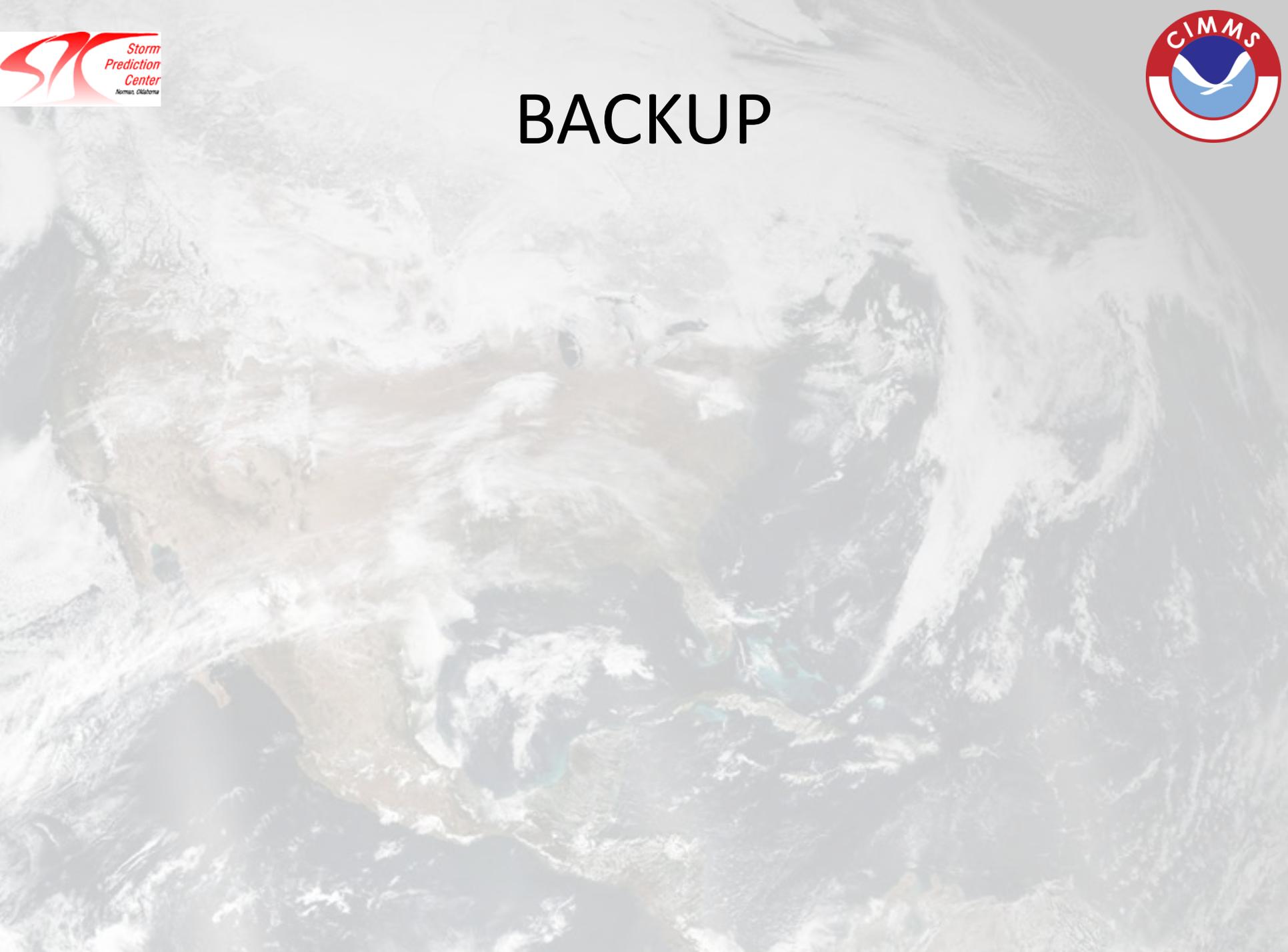


- Feedback available online
 - ❖ Blog: <http://goesrhwt.blogspot.com/search/label/NUCAPS>
 - ❖ “Tales” webinars: <http://hwt.nssl.noaa.gov/ewp/>
 - ❖ Final Report: Coming soon

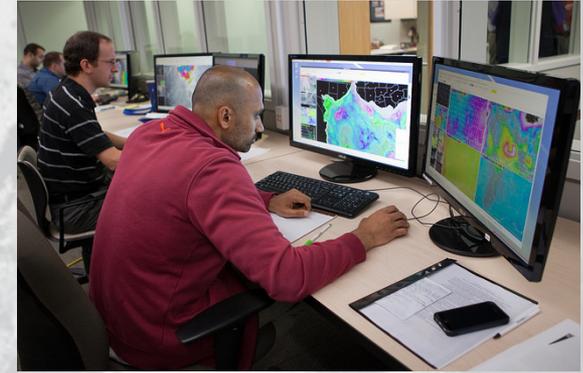
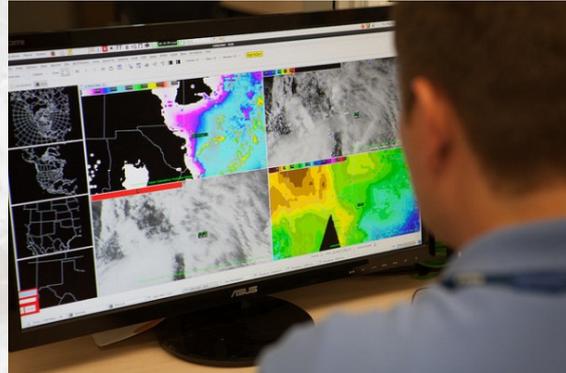
- 2016 Spring Experiment
 - Code upgrade
 - Additional satellites
 - QC flags
 - Additional visualization options
- 2017 Spring Experiment
 - Evaluate automated sfc modification NUCAPS project



BACKUP



Satellite Product Demonstrations in the HWT



- Forecaster feedback is abundant
 - Ideas for improving algorithm, enhancing display, best practices, etc.
- Test algorithms in operational systems
- Prepare/train various users for /current satellite systems
 - NWS forecasters (WFO, CWSU, SPC, etc.), broadcasters, researchers
- Foster interaction b/t research and operational communities
- Enhance/promote use of satellite data in forecast/warning ops

Some Forecaster Quotes

- “In San Diego, it will benefit us during the summer monsoon. Also, the San Diego RAOB is not representative of the mountains in our CWA”
- “I can see myself using this a lot in the winter.”
- “Drawbacks are they are only 2x day and seem to lack the vertical resolution and critical details of inversions and moisture compared to the RAP/HRRR/RAOB.”
- “I may not use it every day, but getting additional experience will help me understand the environments and situations where it will provide the most critical value.”
- “Presence of a cold pocket aloft and relatively low precipitable water values around a half an inch confirm elevated convection along with the scattered reports of severe hail in eastern Idaho”
- “With our office between ROAB sites, having the NUCAPS soundings will be a good way for us to get a handle on the conditions in our area.”
- “It would be helpful because the climate within our CWA varies so greatly. Our sounding is not representative of the environment over the deserts, and the nearest soundings are a bit too far and not consistent.”
- “This will be great for WR where observations are more scarce.”



Initial Requests (many are NSHARP-related)



- Quality control flags into AWIPS-II
- Automated correction of surface/ML conditions
- Ability to sample sounding locations “dots” for environmental information
- Provide nearest city after clicking on sounding and/or include map in sounding window with location marked
- Indicator in display after a sounding has been clicked
- Undo button when editing profile
- Overlay NUCAPS soundings with others (NWP, RAOB, etc)
- Make sure the AWIPS fix is implemented
 - Many requests for this code already have been fulfilled.

Blog Post: “Comparing NUCAPS Soundings at Two Locations in the FA”

June 03 – Jacksonville, FL

- “Having the NUCAPS soundings available was important to my situational awareness in this particular case... At my office in Columbia, SC, we do not have upper air and there really aren’t any upper air sites close by, so having these available would be extremely beneficial.”

