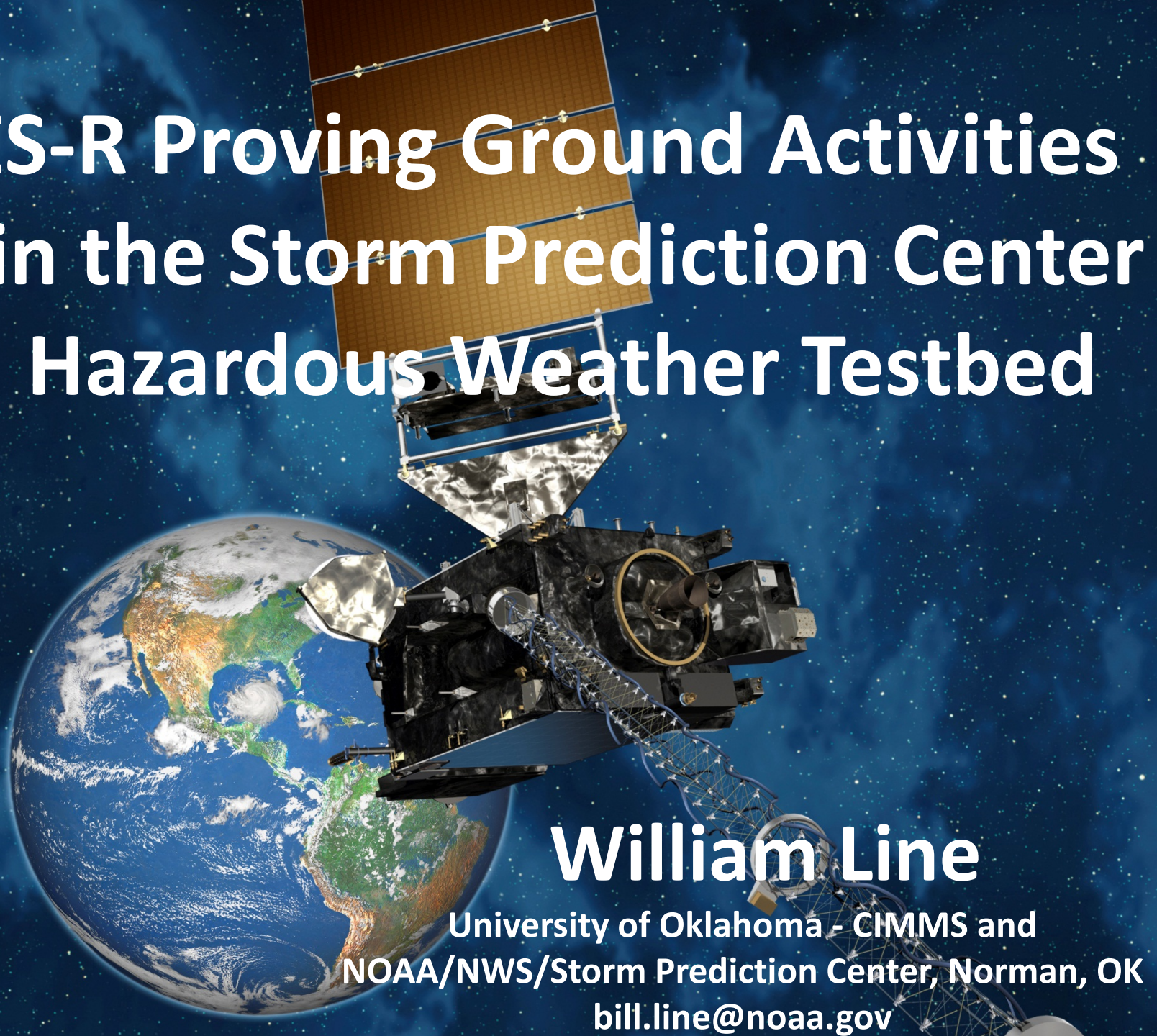
GOES-R Proving Ground Activities within the Storm Prediction Center and Hazardous Weather Testbed



William Line

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

About Me

- Undergraduate (2011) and Graduate School (2013) at University of Wisconsin – Madison
  - Research with Ralph Petersen at CIMSS
- May 22, 2013 – Began as GOES-R satellite liaison for SPC/HWT

Outline

- Product demonstrations in SPC
  - Pre-demonstration activities
  - GOES-R product demonstrations and feedback
  - Future
- Product demonstrations in HWT
  - 2013
  - 2014

SPC Products Issued

- Interested in satellite-based products (CONUS) that have the potential to improve:
  - forecasts and situational awareness to the <u>development</u>, <u>evolution</u> and <u>dissipation</u> of <u>organized</u> convective systems
    - Day 1, 2, 3, 4-8 convective outlooks, enhanced thunderstorm outlooks, severe thunderstorm watch, tornado watch, watch status reports, convective mesoscale discussions
  - short-range hazardous <u>winter weather</u> (heavy snow, freezing rain, blizzard conditions)
    - Winter weather mesoscale discussions
  - <u>fire weather</u>
    - Day 1, 2, 3-8 fire weather outlook
- 22 forecasters when fully staffed (currently 2 vacancies)

SPC Shadow Shift Goals

- One-on-one interactions with SPC forecasters during shifts in SPC operations
    - Build forecaster trust
    - Familiarization for liaison
    - Identify SPC forecast challenges
    - How can GOES-R products/capabilities help SPC forecasters?

- All the while, testing products on local machine and developing training material

SPC Shadow Shift Findings - GOES-R-related Highlights

- Importance of observational data to the SPC forecast process
  - And desire to fill temporal and spatial gaps
- Forecast challenges regarding convective initiation
- How long will mature convection last? Is convection starting to decay?
- Improved fog and low cloud detection at night
- Forecasters prefer to look at multiple products and fields together (overlays)
- Satellite data already utilized in SPC
  - Visible imagery most utilized, followed by water vapor, IR imagery (at night)… sounder TPW, and legacy fog/low cloud detection
- Most forecasters are (were) not very familiar with GOES-R capabilities, products, etc.
- Forecasters appreciate my presence and are very interested in learning more!

Real-time Demonstrations

- Products chosen based on needs expressed by the forecasters
- Deliver training to forecasters
  - One-on-one verbally, quick guides, examples, website
- Monitor demonstration products at spare forecast desk in SPC operations
- Keep forecasters on shift aware of products
- Demonstrations are year-round

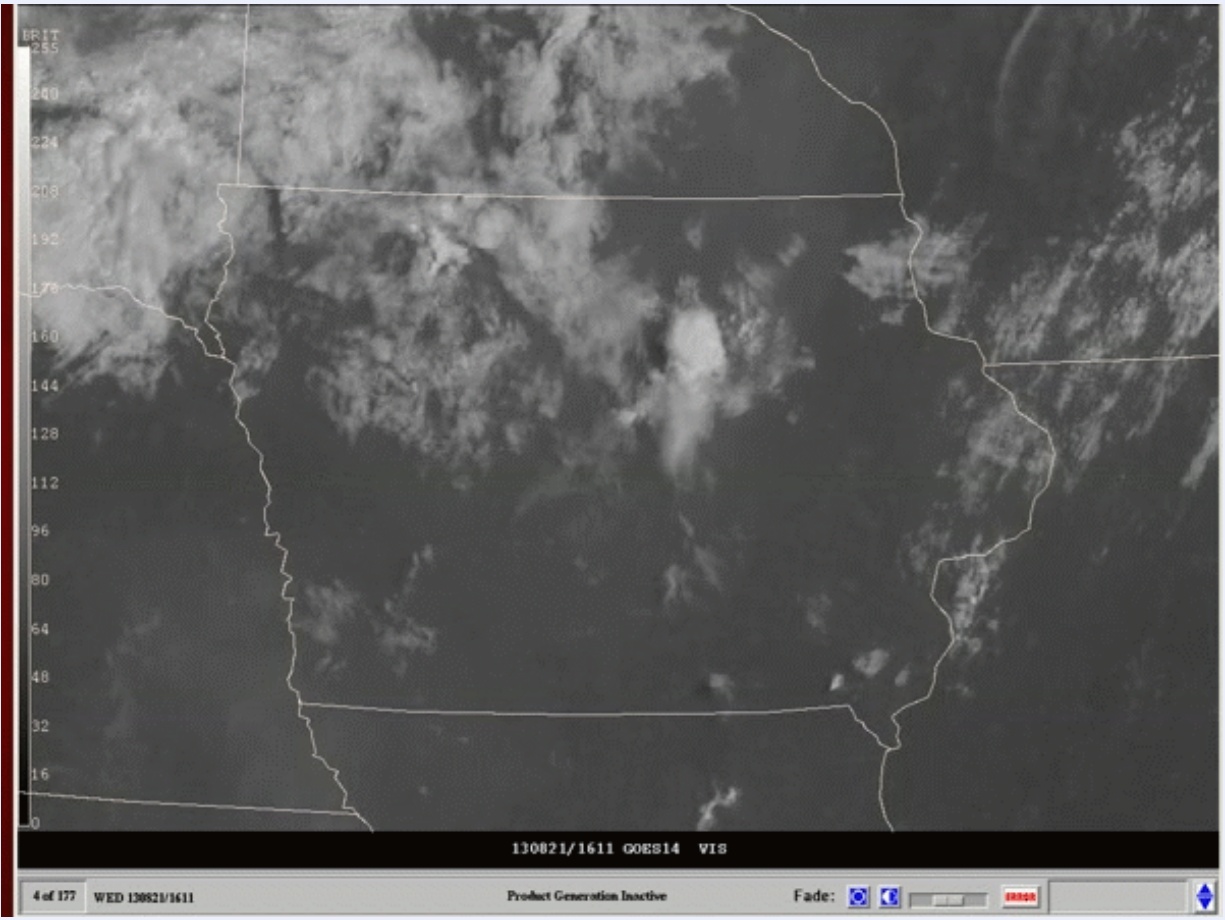
Real-time demonstrations: No one knows what will happen!

Initial GOES-R Product Demonstrations in SPC

- GOES-14 1-minute Imagery (SRSOR)
- Cloud Top Cooling (UW-CIMSS)
- Overshooting Top Detection (UW-CIMSS)
- NearCast Model Forecasts and Analyses (UW-CIMSS)

SRSOR

August 21, 2013



- Forecaster noted that he was able to determine initial convection would dissipate earlier than he would have noticed using 15 minute imagery.

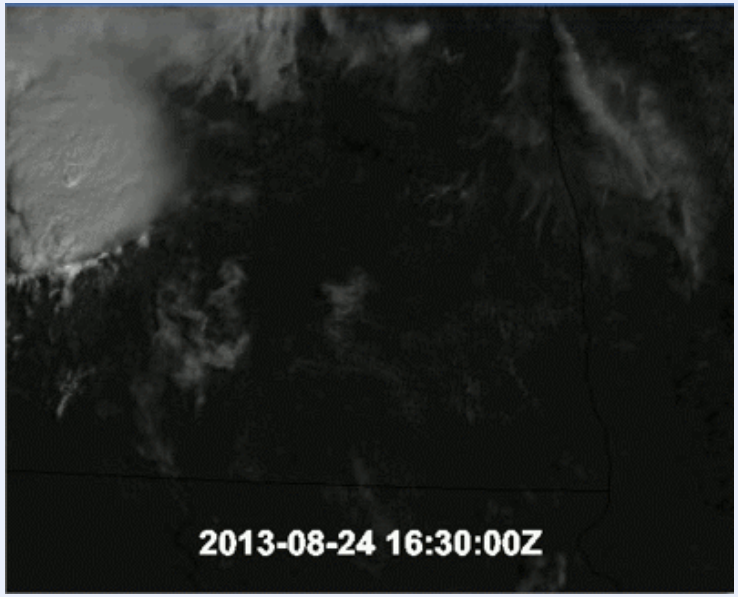
- *"You could really see the storm getting fed, then when this shut off, you knew it would dissipate."*

SRSOR

- Helpful in monitoring for <u>convection initiation</u>
  - *"I could see it being especially useful in the plains during a capped day, waiting for convection. You would really be able to see early development nicely, especially along a boundary."*
  - *"Used it to monitor convective initiation mostly. It helped to increase lead-time for convective development."*
- Helps forecasters understand what is going on quicker
  - *"Helped to more easily determine whether convection was elevated or rooted in the boundary layer."*
  - *"It has been interesting to watch varying cloud processes occur. In the past, you had to infer the evolution of the cloud elements by waiting ~15 minutes."*
  - *"Provides better continuity than current imagery."*
- *"It could be helpful in <u>radar gap areas</u>, and where there is less confidence in radar."*
- Several forecasters noted the 1-minute imagery's usefulness will be determined over a longer period of time and during various weather events.

SRSOR

SRSOR referenced in SPC Mesoscale Discussion 1764 on August 24



MESOSCALE DISCUSSION 1764
NWS STORM PREDICTION CENTER NORMAN OK
1238 PM CDT SAT AUG 24 2013

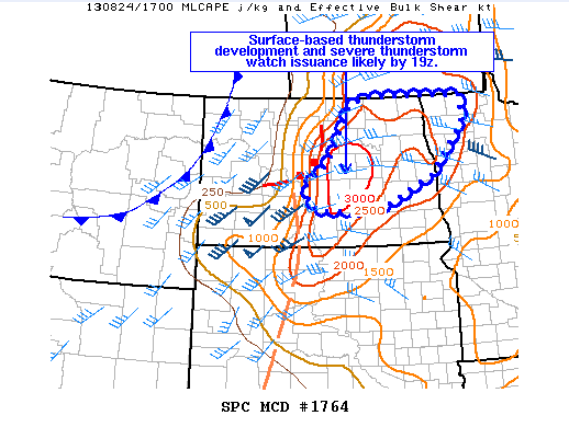
AREAS AFFECTED...CENTRAL/NE ND AND NW MN

CONCERNING...SEVERE POTENTIAL...WATCH LIKELY

VALID 241738Z - 241915Z

PROBABILITY OF WATCH ISSUANCE...80 PERCENT

SUMMARY...SURFACE-BASED THUNDERSTORM DEVELOPMENT IS EXPECTE
NEXT COUPLE OF HOURS /BY ABOUT 19Z/...BY WHICH TIME A SEVER
THUNDERSTORM WATCH IS LIKELY.



DISCUSSION...SUPER RAPID SCAN VISIBLE LOOPS SHOW THE DEVELOPMENT OF BOUNDARY LAYER CUMULUS ACROSS CENTRAL ND...NEAR THE INTERSECTION OF A SURFACE TROUGH AND THE COLD POOL WITH THE ONGOING STORMS NW OF BIS. STRONG SURFACE HEATING AND CONTINUED MOISTENING HAVE BOOSTED MLCAPE VALUES TO 2500-3000 J/KG AS CONVECTIVE INHIBITION WEAKENS ACROSS CENTRAL ND. THUS...THE RISK FOR SURFACE-BASED STORM DEVELOPMENT IS INCREASING EARLY THIS AFTERNOON. ONCE NEW STORMS FORM...THE ENVIRONMENT WILL SUPPORT ORGANIZED CLUSTERS/LINE SEGMENTS. THE KBIS VWP ALSO SAMPLED MIDLEVEL FLOW OF 40-50 KT...WHICH WILL CONTRIBUTE TO SUFFICIENT DEEP-LAYER VERTICAL SHEAR FOR SOME RISK OF SUPERCELLS. REGARDLESS...CONVECTION APPEARS LIKELY TO EVOLVE INTO A LINE/SMALL MCS LATER THIS AFTERNOON/EVENING...WITH AN ACCOMPANYING RISK FOR DAMAGING WINDS AND LARGE HAIL. AS A RESULT...A SEVERE THUNDERSTORM WATCH WILL LIKELY BE NEEDED BY ABOUT 19Z.

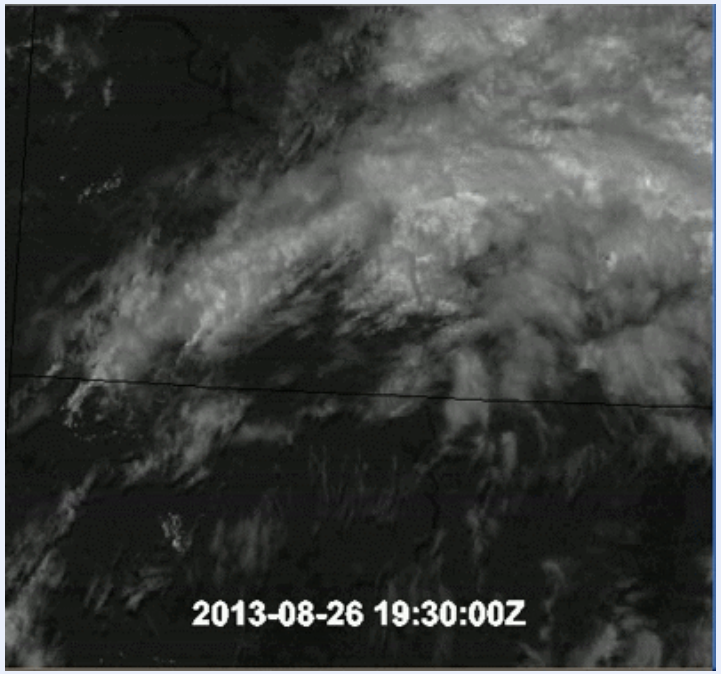
..THOMPSON/DIAL.. 08/24/2013

ATTN...WFO...FGF...BIS...

LAT...LON 48969599 48439595 47379696 46739848 46660025 46810067
47180077 47660012 47879996 48379970 48769949 49019899
48969599

SRSOR

SRSOR referenced in SPC Mesoscale Discussion 1777 on August 26



MESOSCALE DISCUSSION 1777
NWS STORM PREDICTION CENTER NORMAN OK
0350 PM CDT MON AUG 26 2013

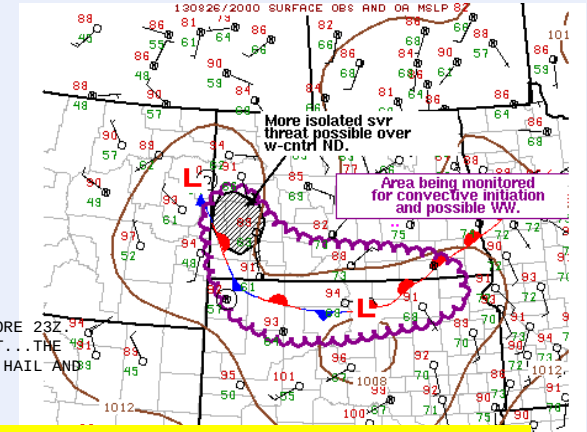
AREAS AFFECTED...NRN SD...FAR SRN AND SWRN ND

CONCERNING...SEVERE POTENTIAL...WATCH POSSIBLE

VALID 262050Z - 262145Z

PROBABILITY OF WATCH ISSUANCE...40 PERCENT

SUMMARY...VISIBLE SATELLITE TRENDS ARE BEING MONITORED FOR CONVECTIVE INITIATION ACROSS PARTS OF NRN SD AND SRN ND BEFORE 23Z. ALTHOUGH UNCERTAINTY REMAINS HIGH REGARDING TSTM DEVELOPMENT...THE ENVIRONMENT IS FAVORABLE FOR AN ACCOMPANYING RISK FOR LARGE HAIL AND ISOLATED DMGG WIND GUSTS...AND COULD REQUIRE A WW.



DISCUSSION...TOWERING CU ROOTED IN THE BOUNDARY LAYER IS INCREASING IN AREAL COVERAGE OVER THE PAST HR PER 1-MIN SUPER RAPID SCAN VISIBLE SATELLITE IMAGERY...INVOF A WEAKLY CONVERGENT SFC BOUNDARY ARCING FROM NWRN ND INTO E-CNTRL MT. SFC OBS INDICATE THIS BOUNDARY DELINEATES THE WRN EDGE OF RICHER LOW-LEVEL MOISTURE DRAPED ACROSS S-CNTRL ND. WHILE STILL UNCERTAIN...FURTHER HEATING/WEAKENING CINH COMBINED WITH WEAK ASCENT ASSOCIATED WITH A SUBTLE UPSTREAM IMPULSE EMBEDDED WITHIN A BELT OF STRONGER MIDLEVEL FLOW MAY LEAD TO INCREASING POTENTIAL FOR CONVECTIVE INITIATION WITHIN THE NEXT 1-2 HRS.

ANY TSTMS THAT DEVELOP WILL PROGRESS EWD INTO A PROGRESSIVELY MORE MOIST/UNSTABLE AIR MASS...WHERE MLCAPE VALUES ARE LIKELY EXCEEDING 2000 J/KG /PER RAP OBJECTIVE ANALYSIS ESTIMATES/ ALONG THE SRN FRINGE OF THICKER CLOUD COVER OVER ND. AND DESPITE RELATIVELY WEAK LOW-LEVEL FLOW...ELY SFC WINDS BENEATH APPROXIMATELY 40 KT WLY FLOW ALOFT WILL SUPPORT HODOGRAPHS FAVORABLE FOR A FEW SUPERCELLS...WITH LARGE HAIL AND DMGG WIND GUSTS THE PRIMARY THREATS. CONVECTIVE TRENDS WILL CONTINUE TO BE MONITORED FOR POSSIBLE WW ISSUANCE.

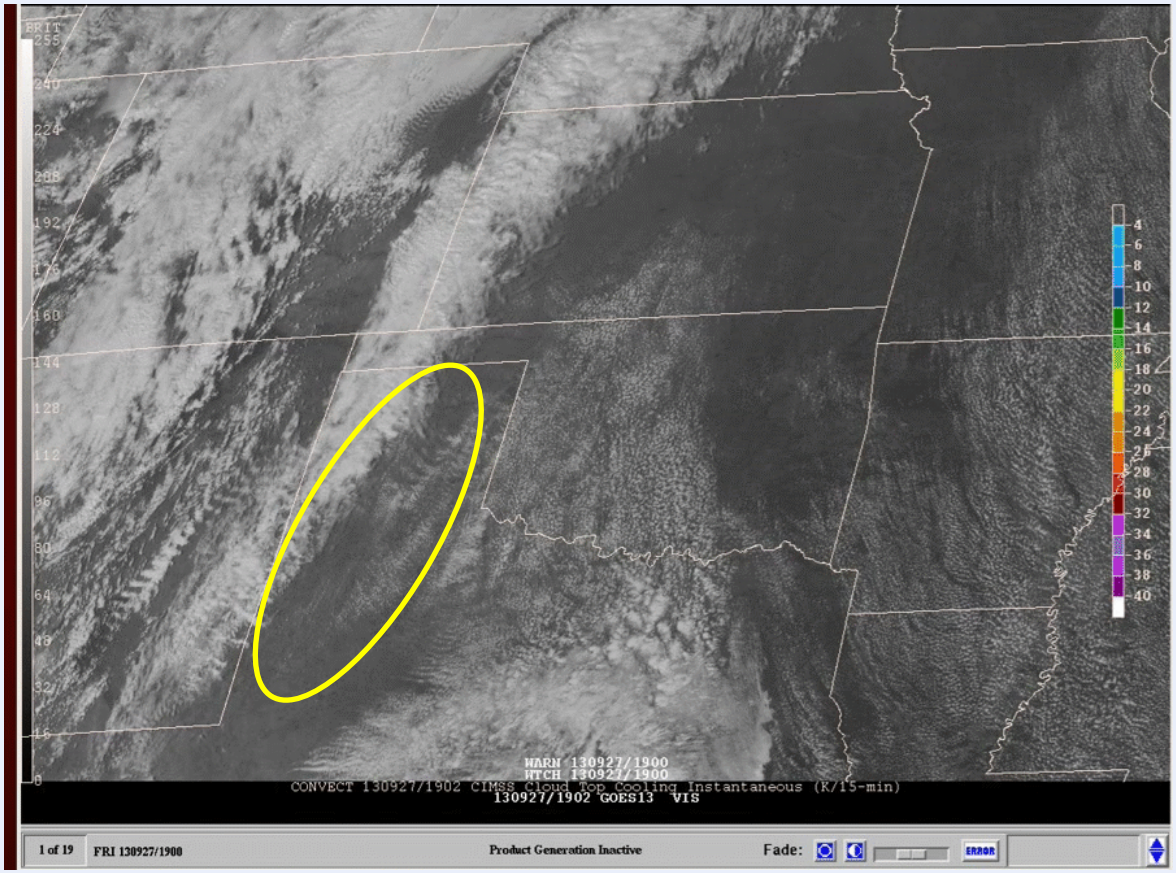
..ROGERS/THOMPSON.. 08/26/2013

ATTN...WFO...FGF...ABR...BIS...UNR...BYZ...GGW...

LAT...LON 45199829 44920054 44890208 45260326 45990390 47100418
47440386 47590329 47430291 46890228 46640157 46570081
46499939 46359824 46249775 46039740 45489737 45199829

Cloud Top Cooling

September 27, 2013



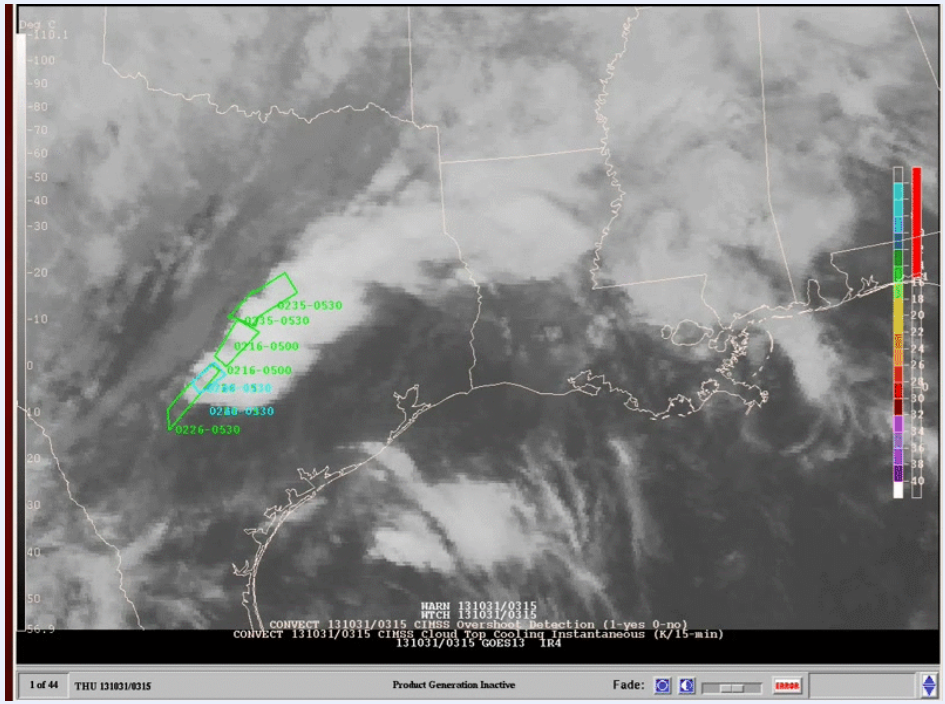
CTC product utilized by lead forecaster in severe thunderstorm watch issuance

Cloud Top Cooling

- Especially useful at night and where radar coverage is limited
  - *"CTC product could be useful at night when development is hard to see with IR."*
  - *"This could be useful in areas of limited radar coverage."*
- Forecasters like its simplicity, and that it quantifies information that is otherwise difficult to see
  - *"It's nice that it quantifies how rapidly storms are intensifying."*
  - *"When looking at just imagery, it is hard to tell what's developing rapidly, so it is nice to be able to quantify it."*
  - *"Tells you right away what is happening, making it obvious where cooling is occurring so you can spend less time analyzing the field. Easy product to understand."*
- Some forecasters feel that it provides them with information they already have
  - *" I can see what storms are growing quickly visually using visible satellite and radar imagery."*

Overshooting Top Detection

October 30/31, 2013



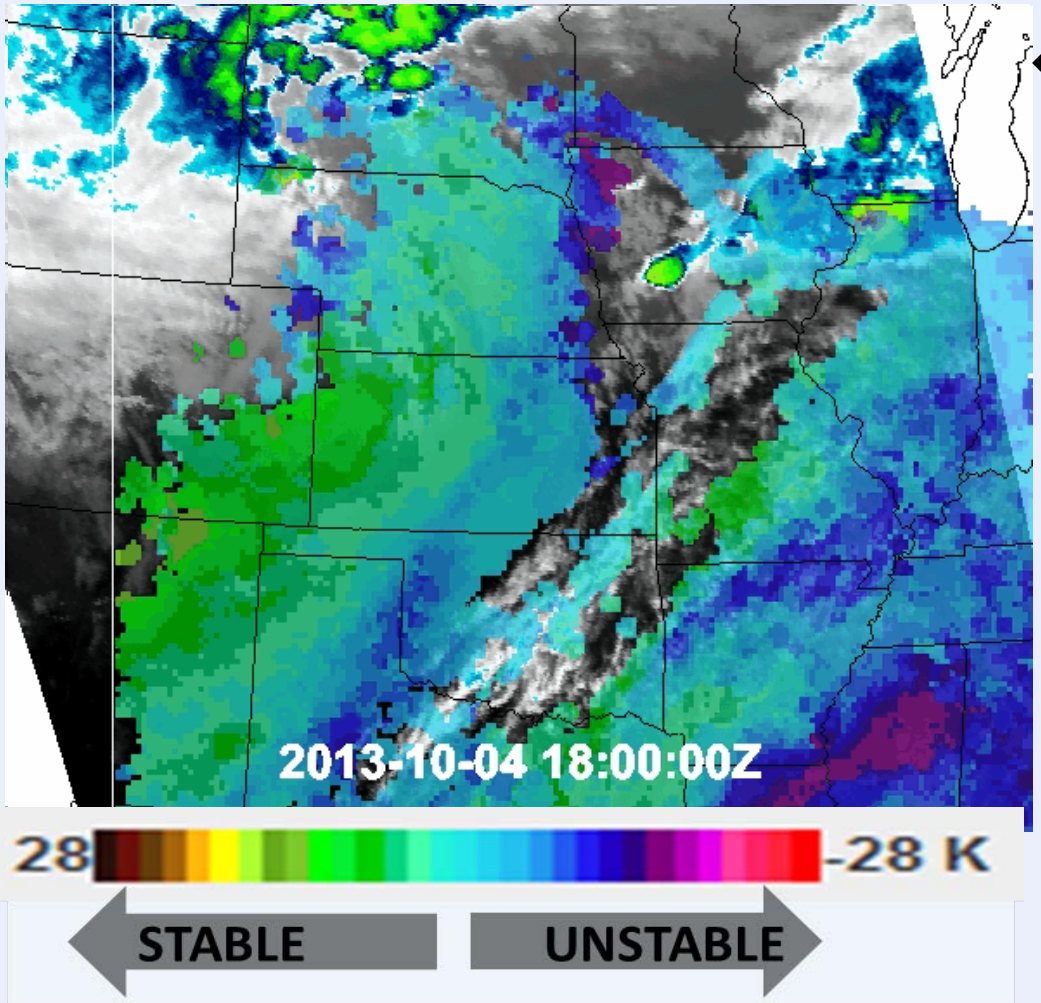
- Especially useful at night and in areas where radar coverage is limited
  - *"Could be useful at night and over the ocean to better quantify what is happening regarding where the strongest updrafts are."*

- Similar to the CTC product, forecasters like that it highlights a feature that may not be so obvious, allowing the forecaster to spend less time analyzing the imagery
  - *"I like that it helps to make OTs stand out."*
  - *"Though it is not critical, it is nice information to have available."*
  - *"Helps with situational awareness. It confirms some of what we already know during the day in areas of good radar coverage."*
- Forecasters find it useful to look at trends in OTDs
  - *"I Like that this is not limited to the initiation phase. I can use it to track mature storms."*
  - *"Looking at trends in OTDs would be helpful."*
  - *"Trends could help give some information about mature storm evolution."*

NearCast Model Forecasts and Analyses

VERTICAL THETA-E DIFFERENCE (MID-LOW)

ANALYSES

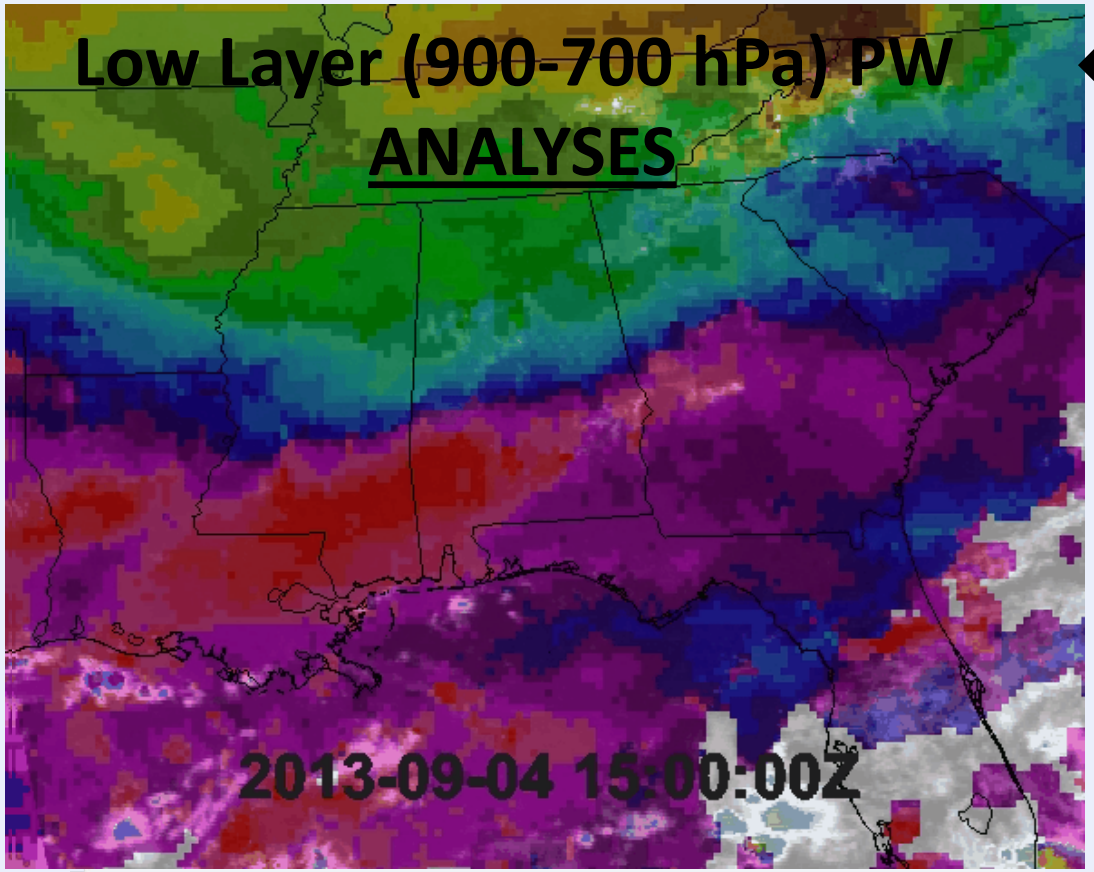


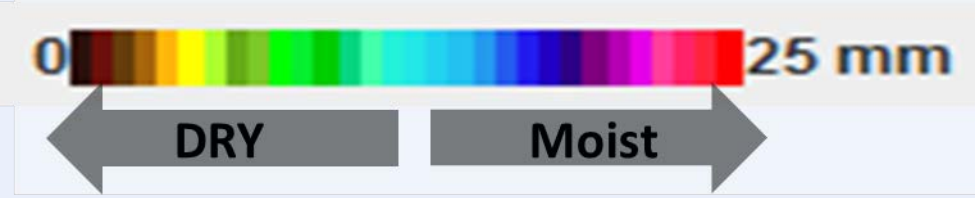
IR brightness temperature imagery under transparent NearCast display.

- *"This is great because it is information we do not already have available."*
- *"I like that it is observation-based, instead of model data, of which there are many products."*

- Forecasters expressed interest in looking at past few hours of NearCast analysis fields with satellite imagery overlaid (as opposed to forecasts).

NearCast Model Forecasts and Analyses



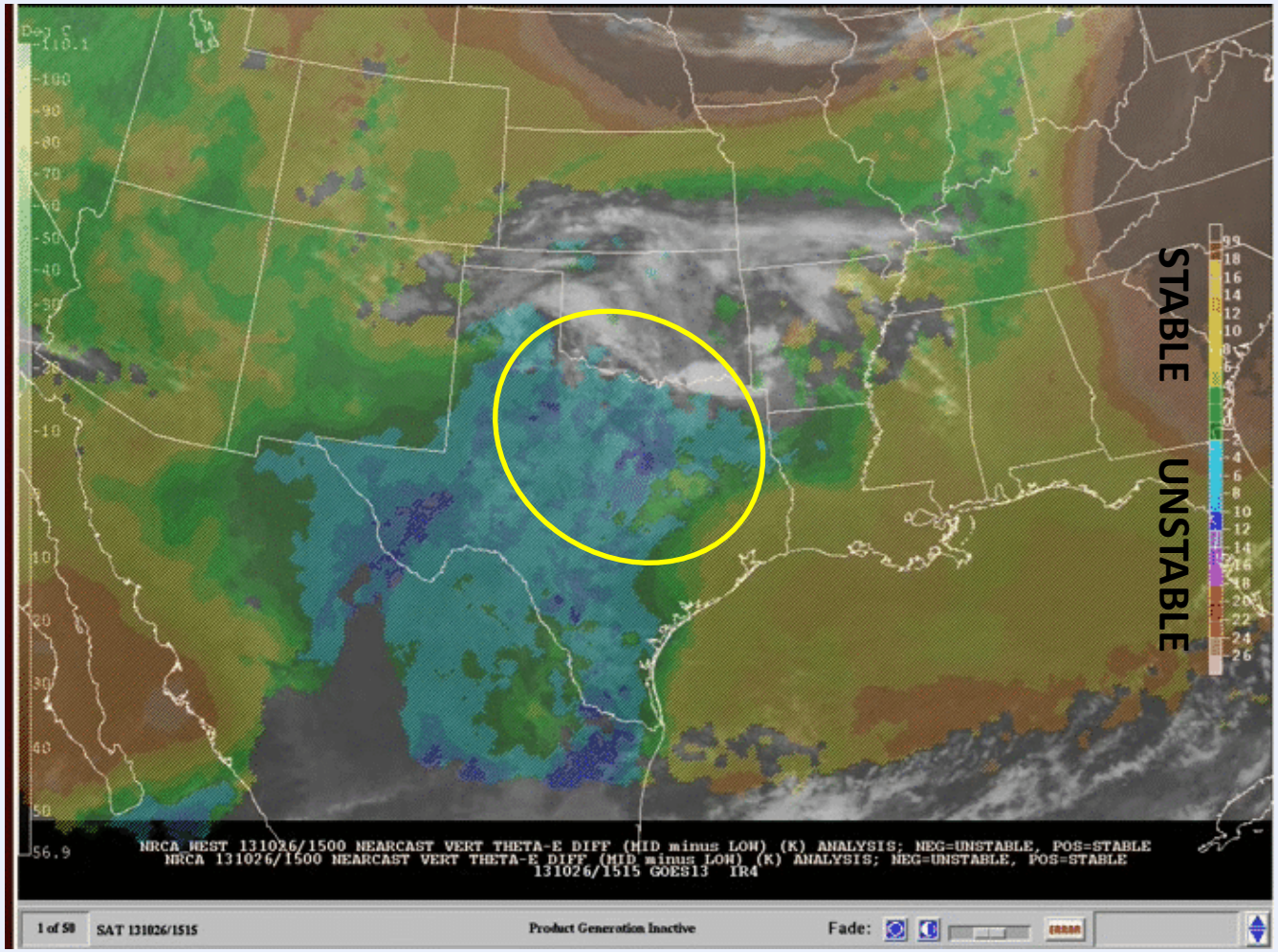


IR brightness temperature imagery under transparent NearCast display.

- *"This could be particularly useful in the south, where we have pulse thunderstorms, to show the moisture gradients."*

NearCast Model Forecasts and Analyses

October 26 IR and NearCast Stability Analyses



Additional GOES-R Products Currently Under Evaluation by Liaison (or soon)

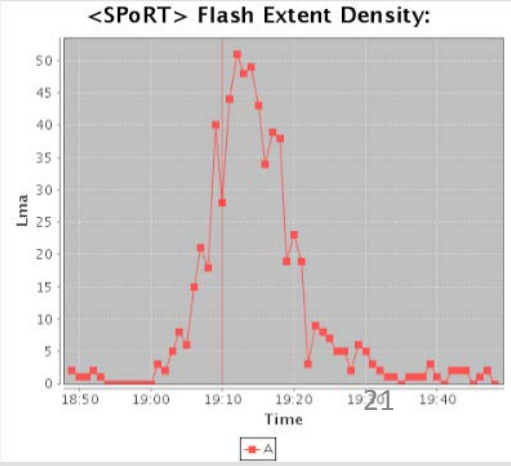
- Total Lightning Detection (pGLM) (SPoRT)
  - Gridded files (to view with imagery, contour, etc)
  - Comparison of 3 ground-based networks
- GOES-R Convective Initiation (UAH/SPoRT)
  - Updated algorithm; to use gridded files to develop unique methods of visualization
- GOES Sounder RGB Airmass (CIRA/SPoRT)
- GOES-R Fog and Low Stratus (UW-CIMSS)
- NSSL-WRF Simulated Satellite Forecasts (CIMSS/CIRA)
- Other products as they are developed

**GEO/LEO hybrid imagery, snowfall rate, tracking tool (AWIPS-2)

GOES-R PG Demonstrations in the HWT

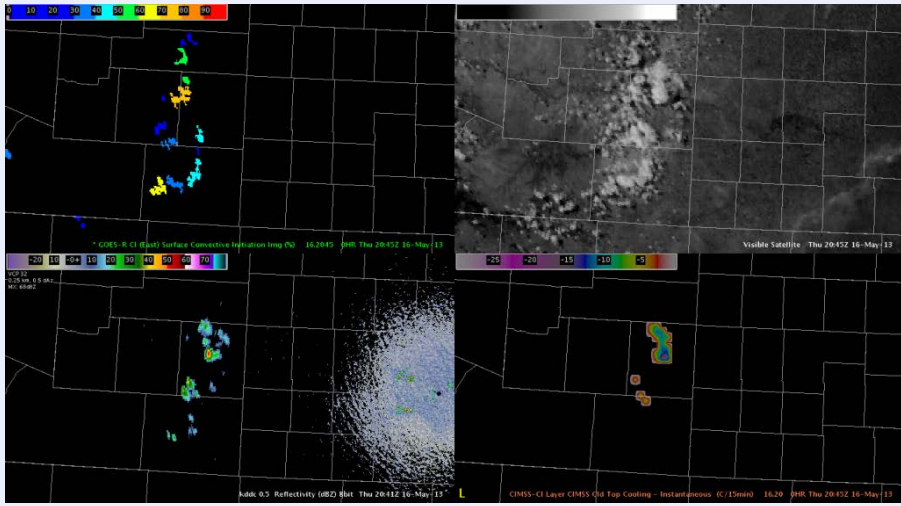
Hazardous Weather Testbed

- Spring Experiment (May/June)
  - Experimental Warning Program (EWP) - NSSL
    - Simulated warning operations environment
    - Benefit to WFO forecasters
    - AWIPS 2
    - GOES-R PG a significant component
  - Experimental Forecast Program (EFP) - SPC
    - Day 1 (2?) convective outlooks and outlook updates
    - Benefit to SPC forecasters
    - NAWIPS
    - Little GOES-R PG participation



2013 Spring Experiment

- GOES-R PG demonstrations in EWP
  - Simulated Cloud and Moisture imagery
  - Total Lightning Detection (pGLM)
  - UAH Convective Initiation
  - Cloud Top Cooling
  - NearCast Model
  - RGB Airmass



CI and CTC May 16, 2013

- Final report online: http://www.goes-r.gov/users/docs/pg-activities/PGFR-HWT-2013-Final.pdf
- Visit GOES-R PG at HWT Blog: http://www.goesrhwt.blogspot.com/

2014 Spring Experiment

- EWP - Week of May 5 – Week of May 19
  - UAH CI
  - Total Lightning (pGLM)
  - UW Severe Probabilities
  - NearCast
  - SPoRT tracking tool
- EFP – Week of May 5 through week of June 2
- New WES training case for EWP to be developed

Summary

- GOES-R product demonstrations are relatively new to SPC operations
  - Products to be introduced over time
  - To continue year-round
  - Forecasters are very open to trying new products, especially ones that are observation-based
- 2014 Spring Experiment planning beginning
  - GOES-R demos in EWP and EFP this year

Questions/Comments?

Email: bill.line@noaa.gov