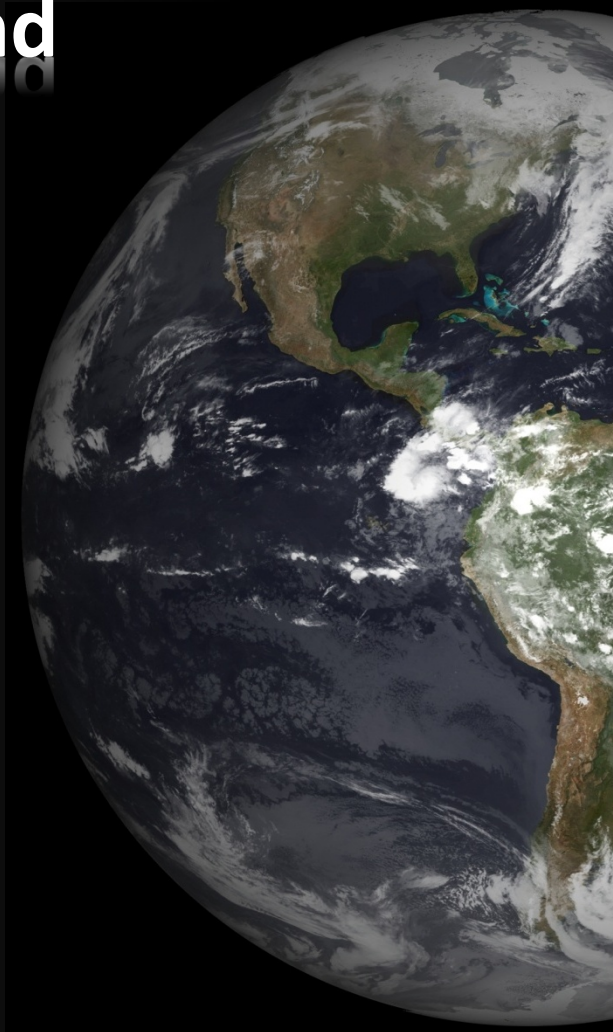
GOES-R Proving Ground: Results from the 2013 Demonstrations and Future Plans



Jim Gurka
NOAA/ NESDIS/ GOES-R Program Office
AMS Satellite Symposium
Atlanta, GA ; February 5, 2014

Contributors

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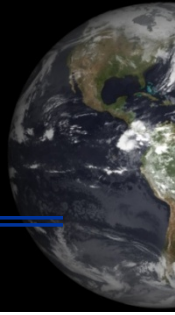
Outline

- GOES-R Proving Ground Overview (PG)
- Samples of GOES-R Proxy Products in the PG
- User Input from PG Demonstrations at HWT, NHC, and AWC
- Training
- What's Happening in 2014 and Beyond?
- Summary

GOES-R Proving Ground



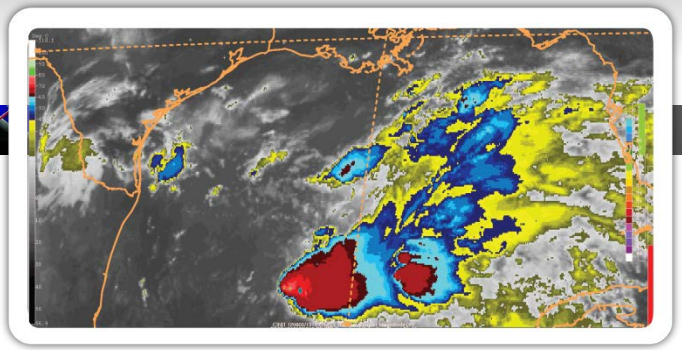
– What is the GOES-R Proving Ground?

- Collaborative effort between the GOES-R Program Office, selected NOAA/ NASA Cooperative Institutes, NWS forecast offices, NCEP National Centers, JCSDA, and NOAA Testbeds.

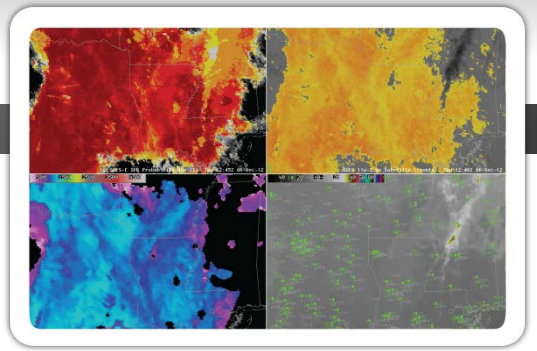
- Where proxy and simulated GOES-R products are tested, evaluated and integrated into operations before the GOES-R launch

- A key element of GOES-R User Readiness (Risk Mitigation)

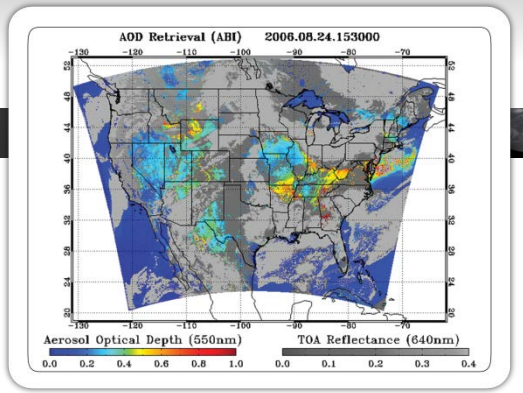
The GOES-R Proving Ground



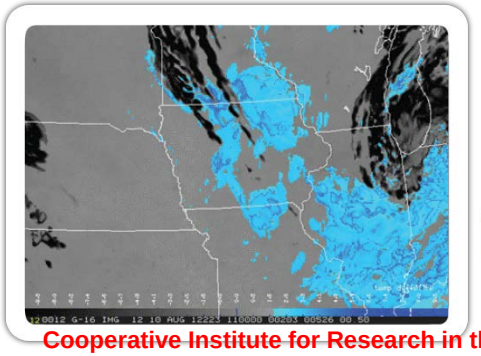
Aviation Weather Center (AWC) – Kansas City, MO
IR Imagery of Oceanic Storms



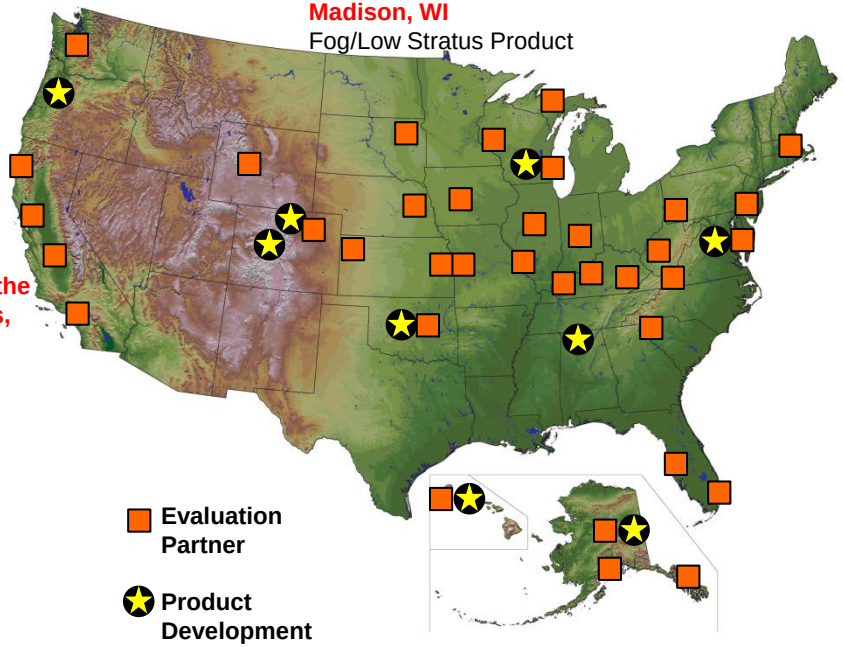
Cooperative Institute for Meteorological Satellite Studies (CIMSS)/Center for Satellite Applications and Research (STAR) – Madison, WI
Fog/Low Stratus Product

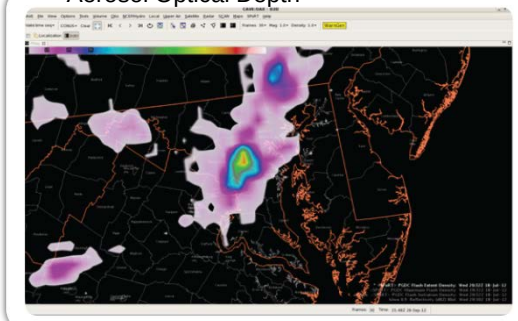


STAR/University of Maryland Baltimore County (UMBC)– College Park, MD
Aerosol Optical Depth

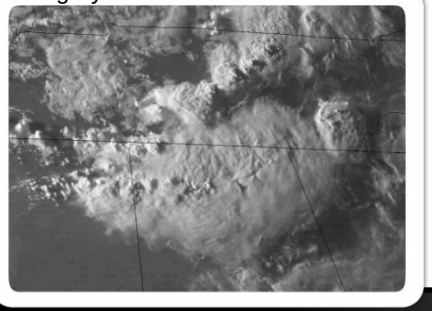


Cooperative Institute for Research in the Atmosphere (CIRA)/STAR – Ft. Collins, CO
ABI Synthetic Low Cloud Enhancement Imagery





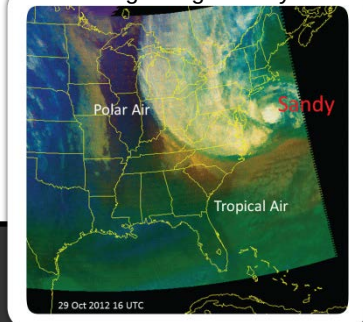
Short-term Prediction Research and Transition Center (SPoRT)/NASA – Huntsville, AL
GLM Lightning Density



Storm Prediction Center (SPC) – Norman, OK

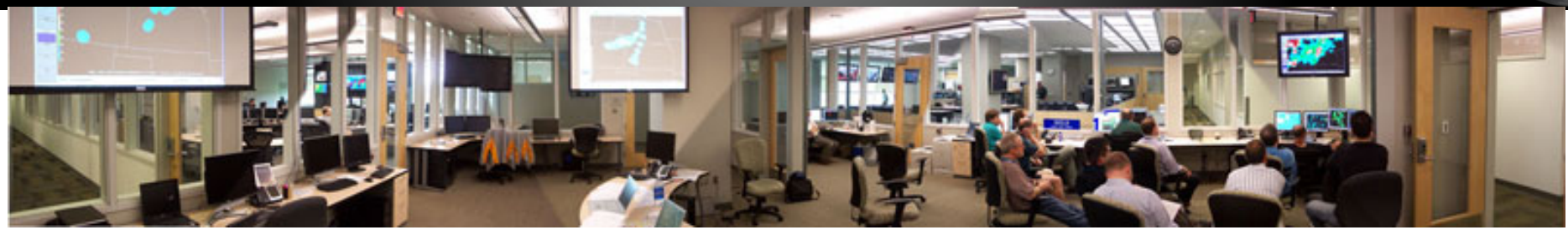
Evaluation Partner

Product Development Partner



National Hurricane Center (NHC) – Miami, FL
RGB Air Mass for Hurricane Sandy

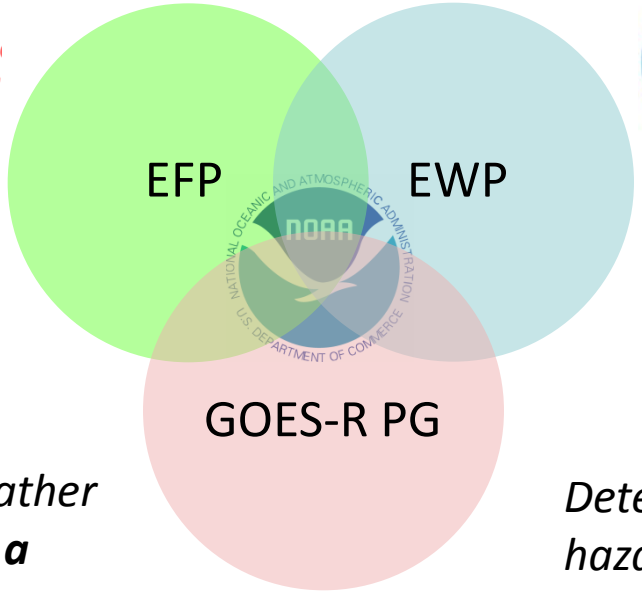
NOAA's Hazardous Weather Testbed



Storm Prediction Center
Norman, Oklahoma

Experimental
Forecast
Program

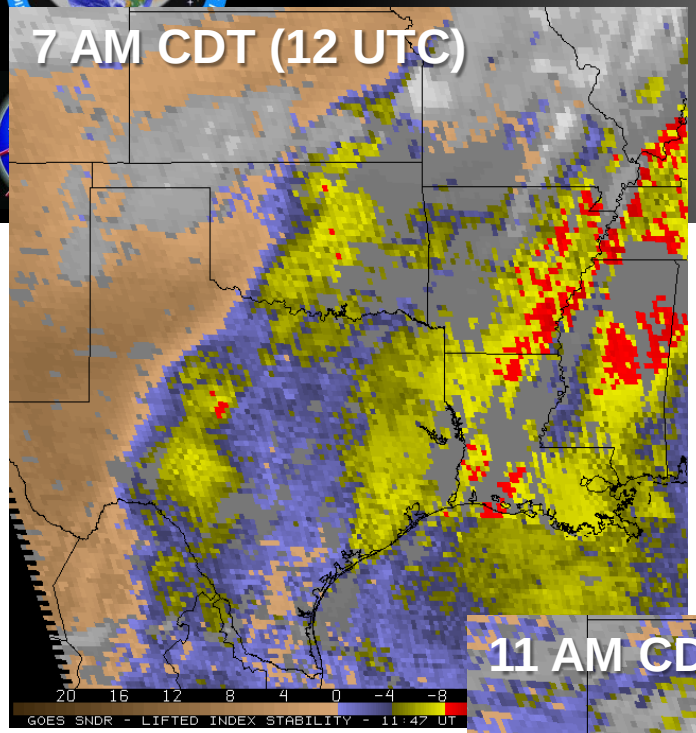
*Prediction of hazardous weather events from **a few hours to a week in advance***



NATIONAL SEVERE STORMS LABORATORY

Experimental
Warning
Program

*Detection and prediction of hazardous weather events **up to several hours in advance***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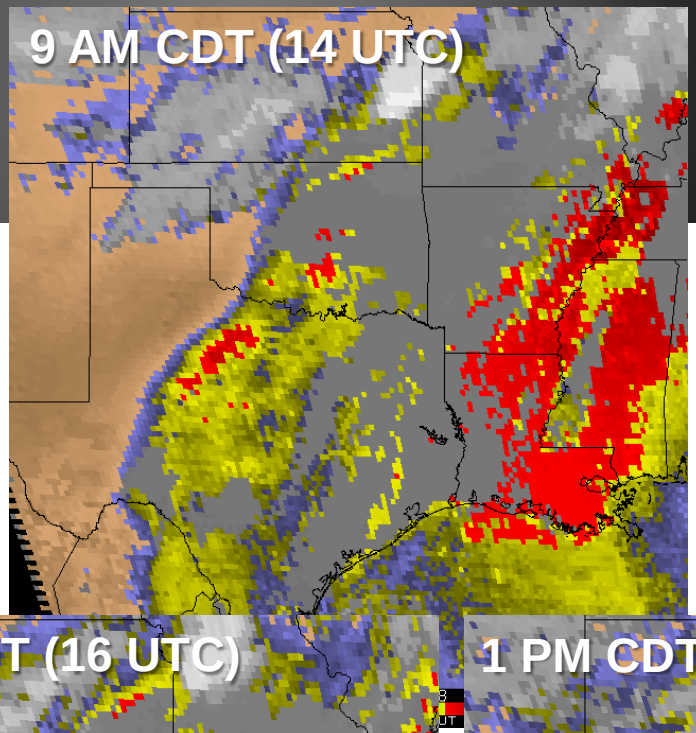
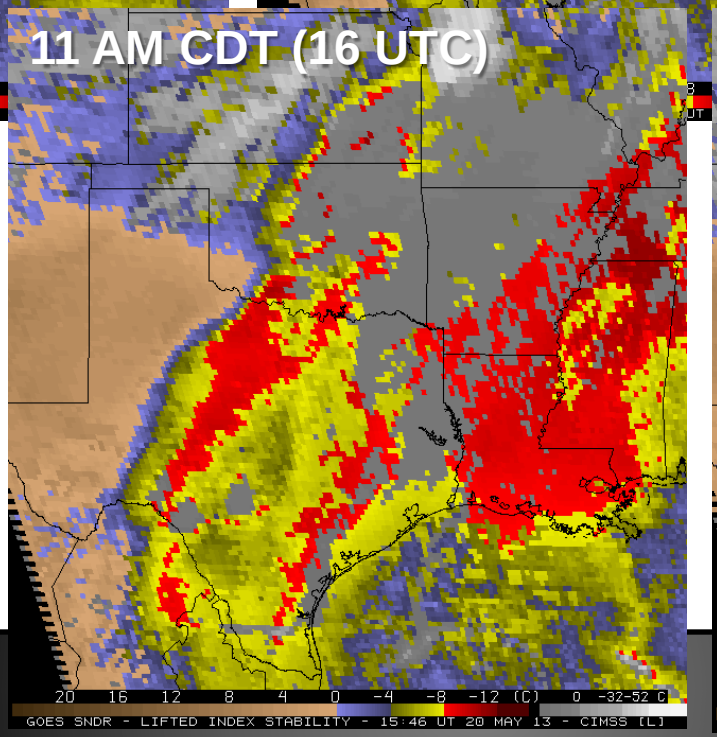
20 16 12 8 4 0 -4 -8
GOES SNDR - LIFTED INDEX STABILITY - 11:47 UT


9 AM CDT (14 UTC)


11 AM CDT (16 UTC)
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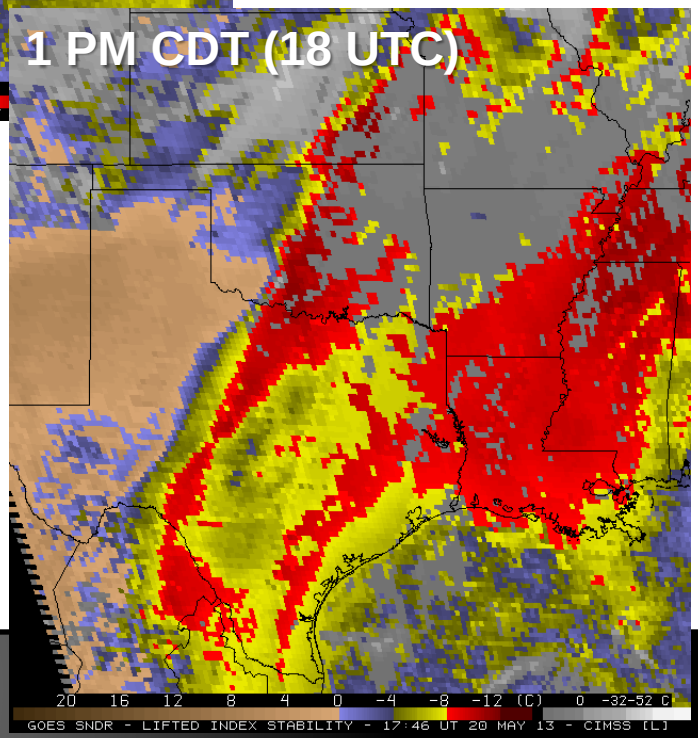
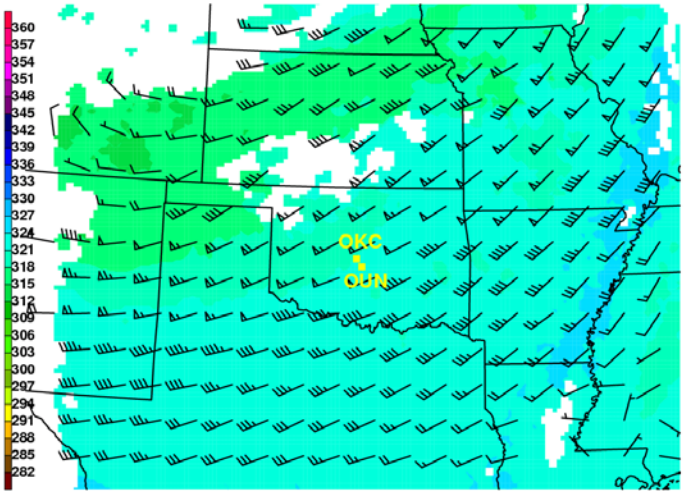
GOES SNDR - LIFTED INDEX STABILITY - 15:46 UT 20 MAY 13 - CIMSS [L]


1 PM CDT (18 UTC)
20 16 12 8 4 0 -4 -8 -12 (C) 0 -32-52 C
GOES SNDR - LIFTED INDEX STABILITY - 17:46 UT 20 MAY 13 - CIMSS [L]

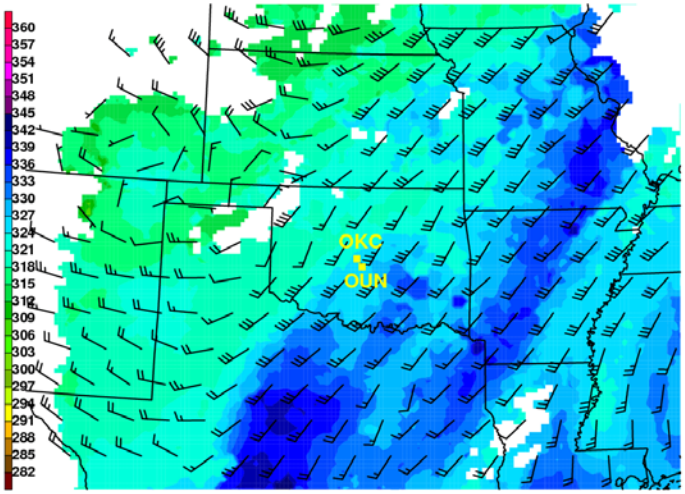
Wade

GOES-R NearCast – 0-6 h Forecasts

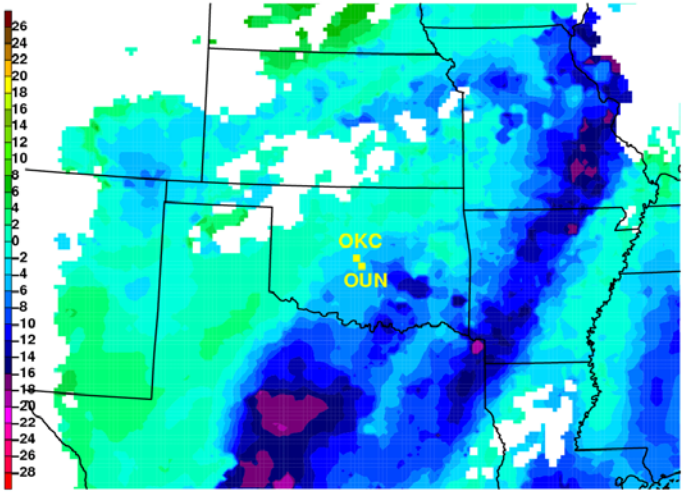
1500 UTC NearCast Forecasts Valid Between 1500-2100 UTC on 20 May 2013



NearCast Upper-Level Theta-E



NearCast Low-Level Theta-E

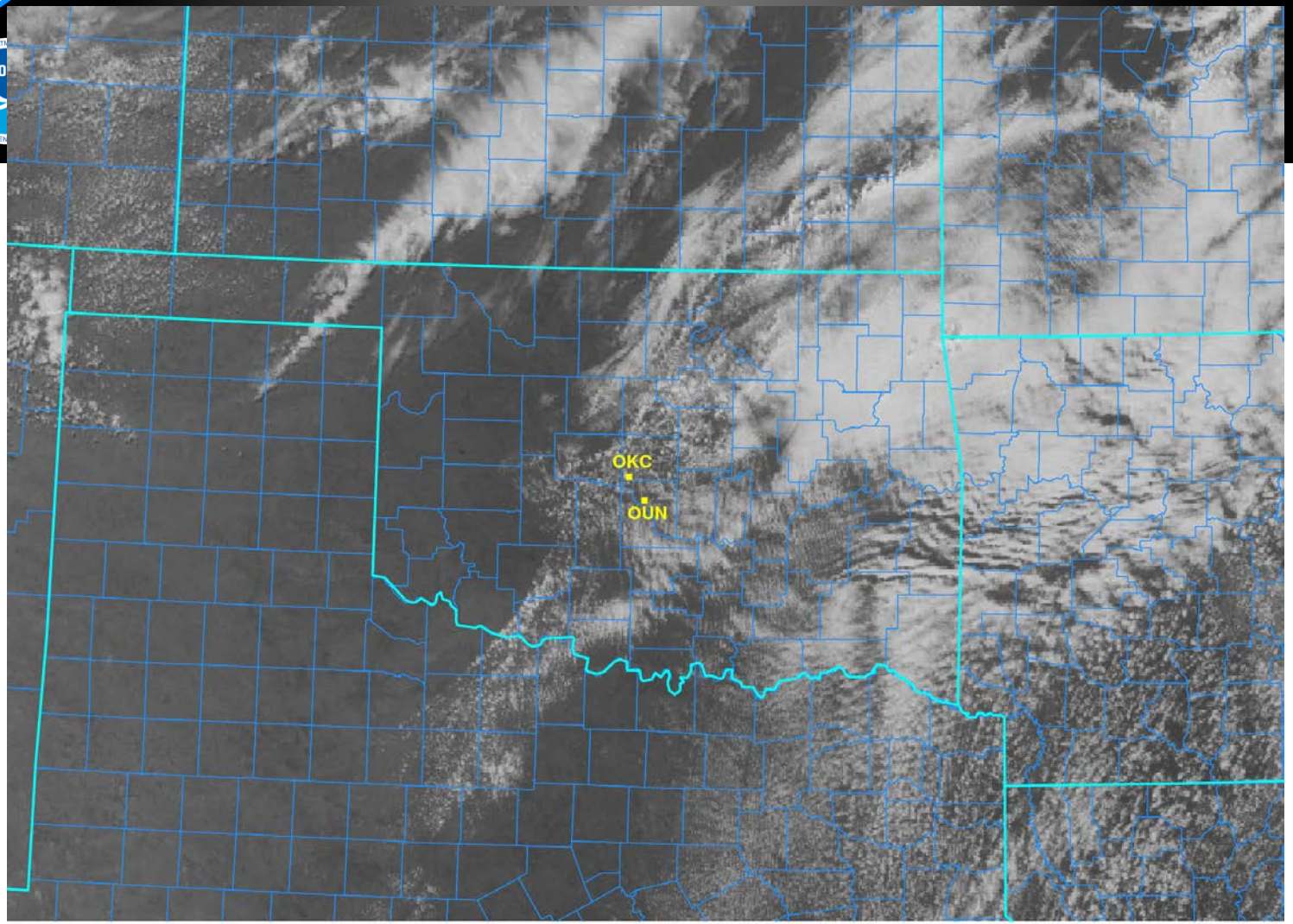


NearCast Mid-Low Theta-E Difference

- Upper and Low-Level Theta-E Difference → 500-780-hPa Convective Instability
- Cool and dry air progressing east above a northward surge of low-level warm and moist air.
- This results in a destabilization of the region to the east of the cold front and dryline.

A Lagrangian transport model of upper and lower-level moisture observations from the GOES Sounder is used to make short-term predictions of convective instability.

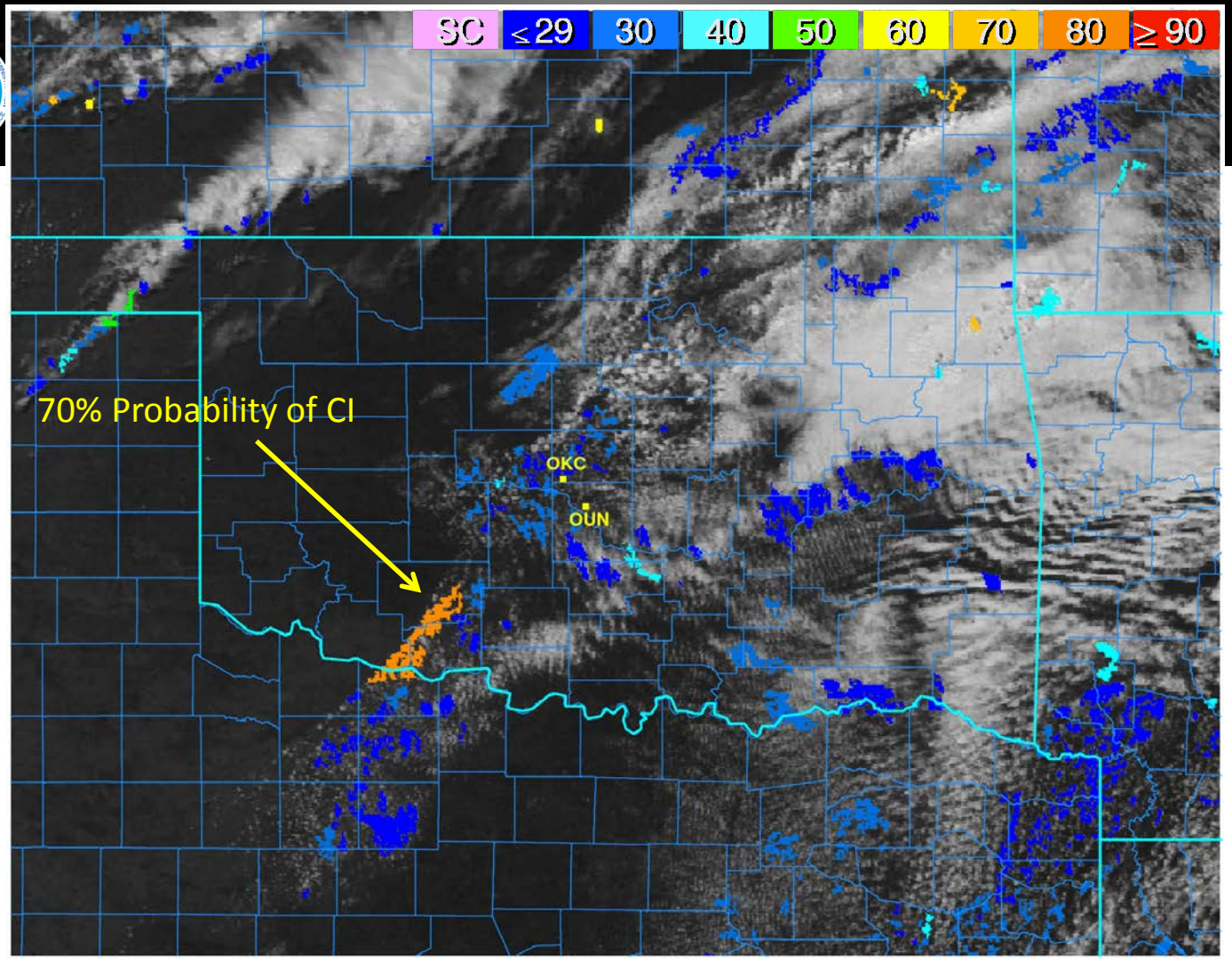
GOES-R CI (Probability Cloud Object Reaching 35 dBZ)



GOES-13 Visible valid 20 May 2013 at 1725 UTC

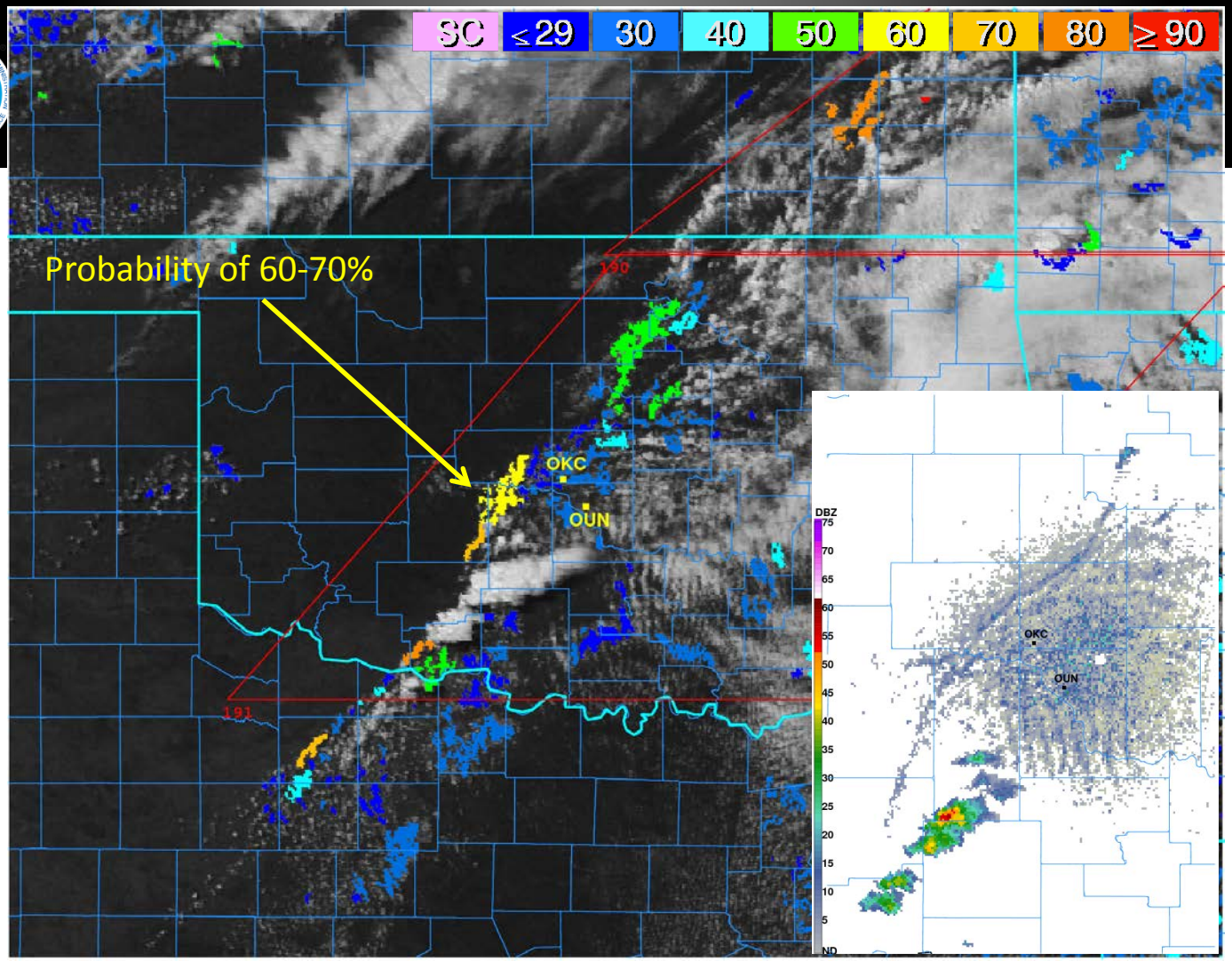
Determining which portion of a cumulus field will develop can be challenging.

GOES-R CI (Probability Cloud Object Reaching 35 dBZ)



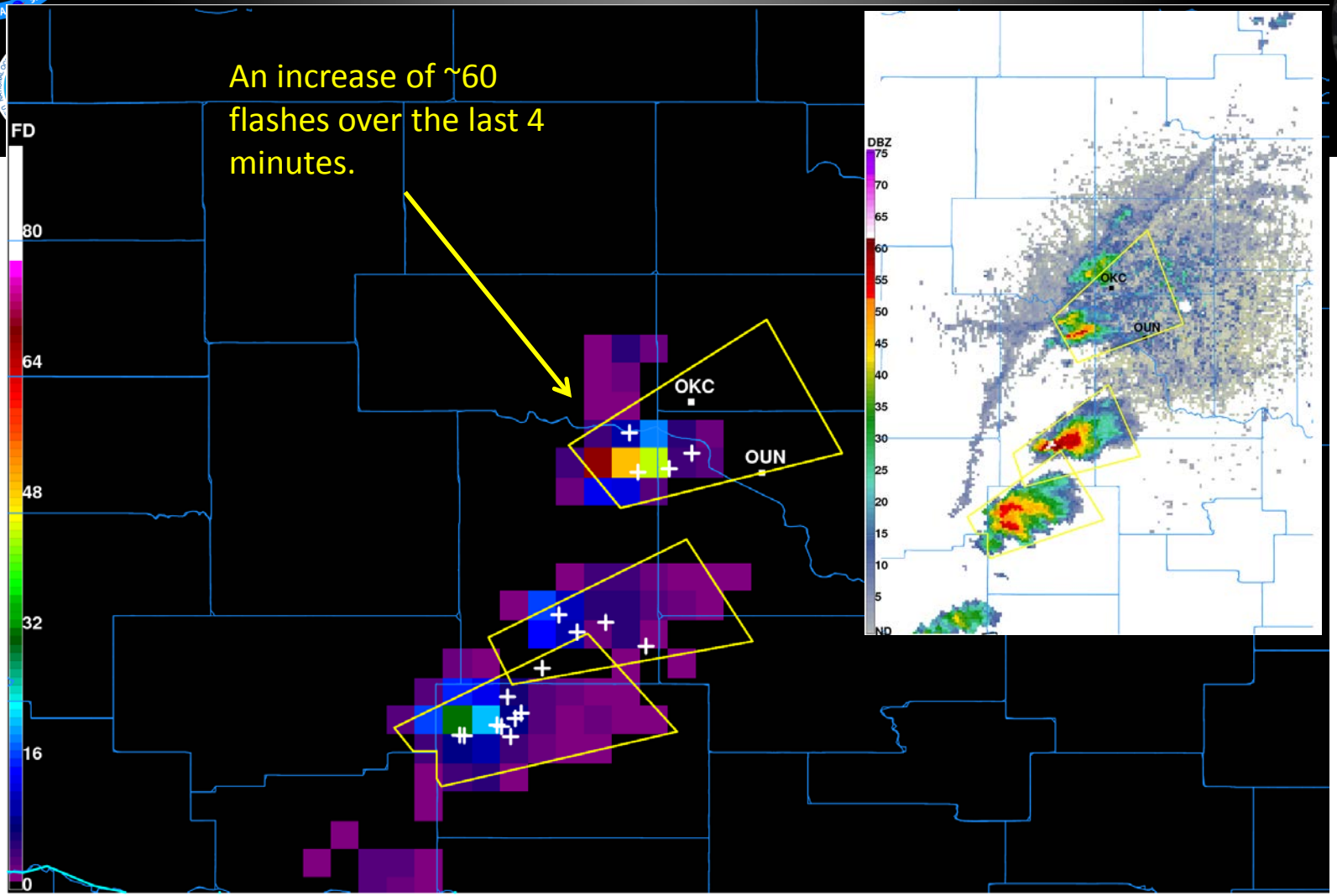
GOES-R CI (%) and GOES-13 Visible valid 20 May 2013 at 1732 UTC

GOES-R CI (Probability Cloud Object Reaching 35 dBZ)



GOES-R CI (%) and GOES-13 Visible valid 20 May 2013 at 1832 UTC
TLX 1km Base Reflectivity valid 20 May 2013 at 1836 UTC

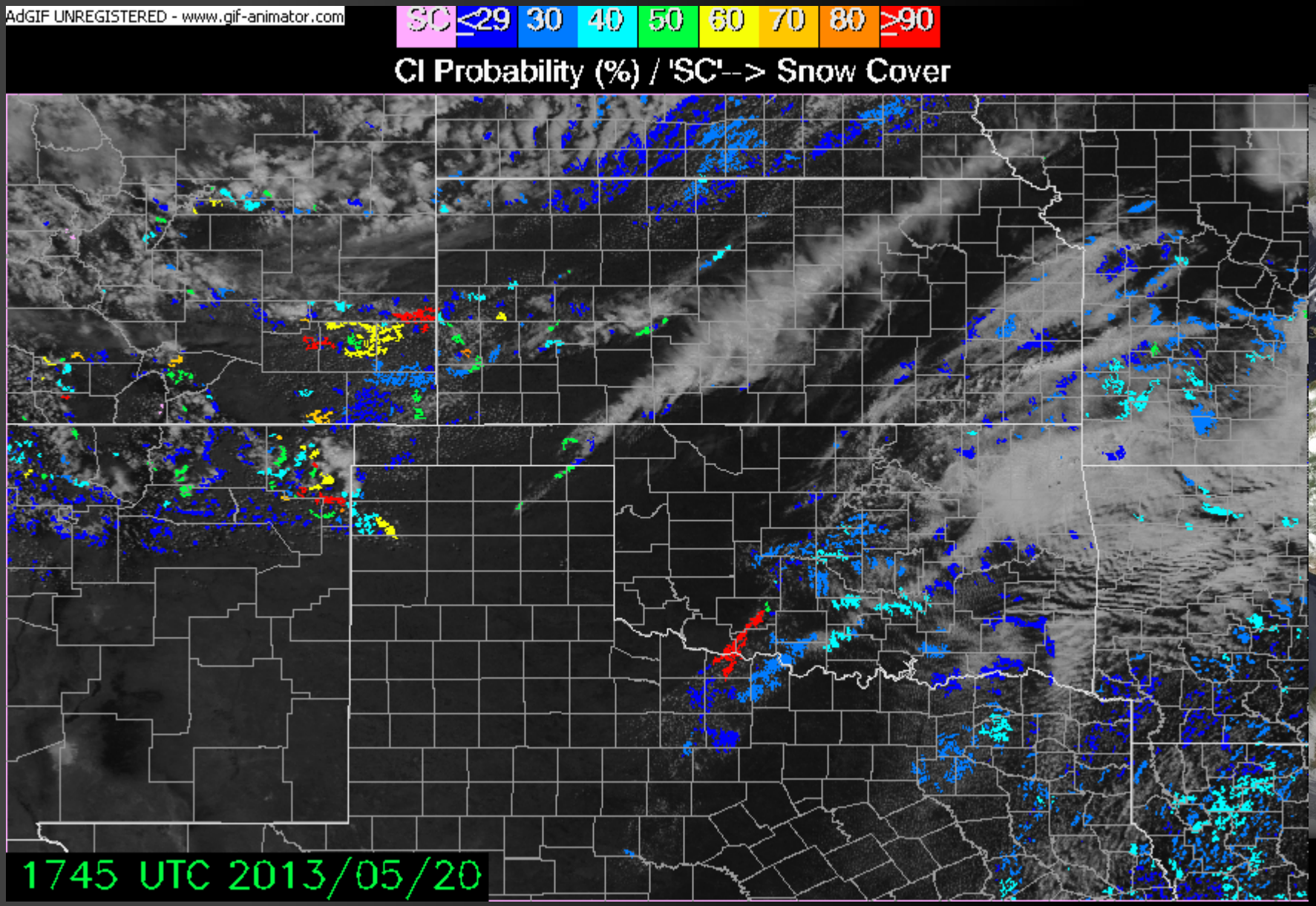
GOES-R Pseudo Geostationary Lightning Mapper



GOES-R Pseudo GLM Flash Extent Density and 2-min NLDN CG valid 20 May 2013 at 1912 UTC
TLX 1km Base Reflectivity valid 20 May 2013 at 1912 UTC

Lightning jumps are indicative of a strengthening updraft and often precede severe weather.

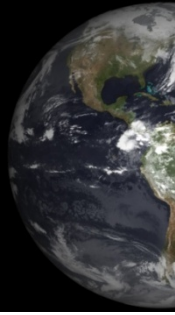
AdGIF UNREGISTERED - www.gif-animator.com



Some Feedback Gathered EWP

- In answer to question "if you could have only one product which would it be?"
  - All products mentioned: CI, Nearcast, CTC, Simulated imagery, PGLM, and RGB
- "The product that stood out for me was the WRF simulated IR imagery….great way to see how the models are doing"
- "CTC is useful. 18 deg. per 15 min gave 1 hr lead time for large hail."
- PGLM: "biggest benefit is where lightning itself is the main concern (large outdoor events)". "For warning decisions, could be good for marginal airmass type storms."
- "Love the theta E difference on Nearcast"

Some Feedback Gathered EWP



- Thursday: CTC working from GOES-15. Initial CTC worked really well over TX panhandle then struggled. Overall larger cooling rates differentiated cells that would blossom from those that would not.
- There was at least one lightning jump with storm over panhandle that produced a brief tornado.
- Nearcast showed lots of instability in TX where storms formed.

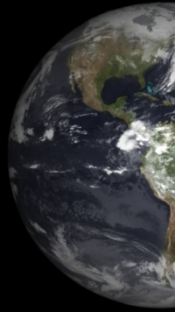
Proving Ground Forecaster Feedback

- **“The total lightning data is an excellent tool for monitoring convection…”**
- **“I utilized it as a situational awareness product …the data gave me more confidence in my warning.”**

“We saw several instances where the total lightning was picking up on storms before the AWIPS lightning [NLDN] program picked up on them. One could see the utility of this in the future, bringing with it a potential for lightning statements and potentially lightning based warnings.”

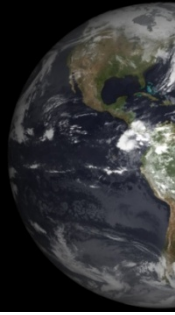
-Pat Spoden (SOO, NWSFO

The 2013 NHC Proving Ground



- Held from Aug 1-Nov 30, but most products available sooner
- 11 GOES-R products in demo plan
  - Hurricane Intensity Estimate
  - Super Rapid Scan Operations (SRSO) data
  - Tropical Overshooting Tops
  - 7 RGB or multi-spectral color products
  - Rapid Intensification Index with lightning input
- 1 S-NPP Product in demo plan
  - VIIRS Day-Night Band
- Proxy GOES-R ABI data from MSG, current GOES
- Proxy GOES-R GLM data from ground-based WWLLN

2013 NHC Proving Ground Highlights



- Very quiet season in Atlantic, East Pacific also quiet
  - ***No Atlantic Rapid Intensification cases, no major hurricanes***
  - ***Only one major hurricane in the East Pacific***
- No SRSO cases from GOES-14 due to slow season
- Air Mass and Dust RGBs used often by HSU and TAFB
- Considerable feedback on lightning data
  - Useful for continuity during GOES-east outage
  - Large lightning outbreaks for sheared storms
    - Consistent with rapid intensification algorithm
- Hurricane Intensity Estimate higher refresh rate useful during Humberto
- More efficient access to products obtained through new LDM feed to NHC from SPoRT

Lightning Outbreak Indicated Increased Shear in NHC's TD Eleven Forecast Discussion

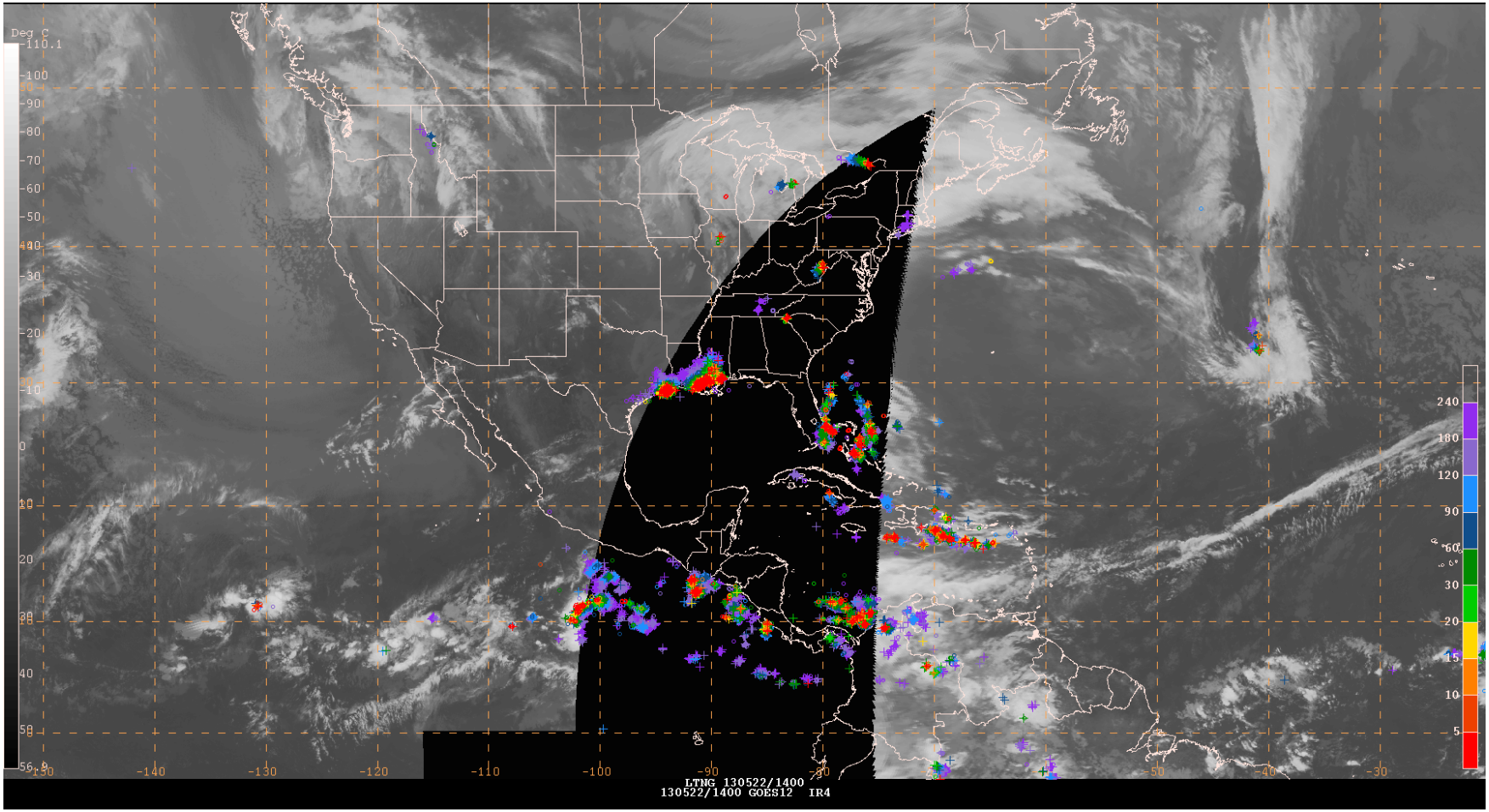
000
WTNT41 KNHC 300840
TCDAT1

TROPICAL DEPRESSION ELEVEN DISCUSSION NUMBER 6
NWS NATIONAL HURRICANE CENTER MIAMI FL AL112013
500 AM AST MON SEP 30 2013

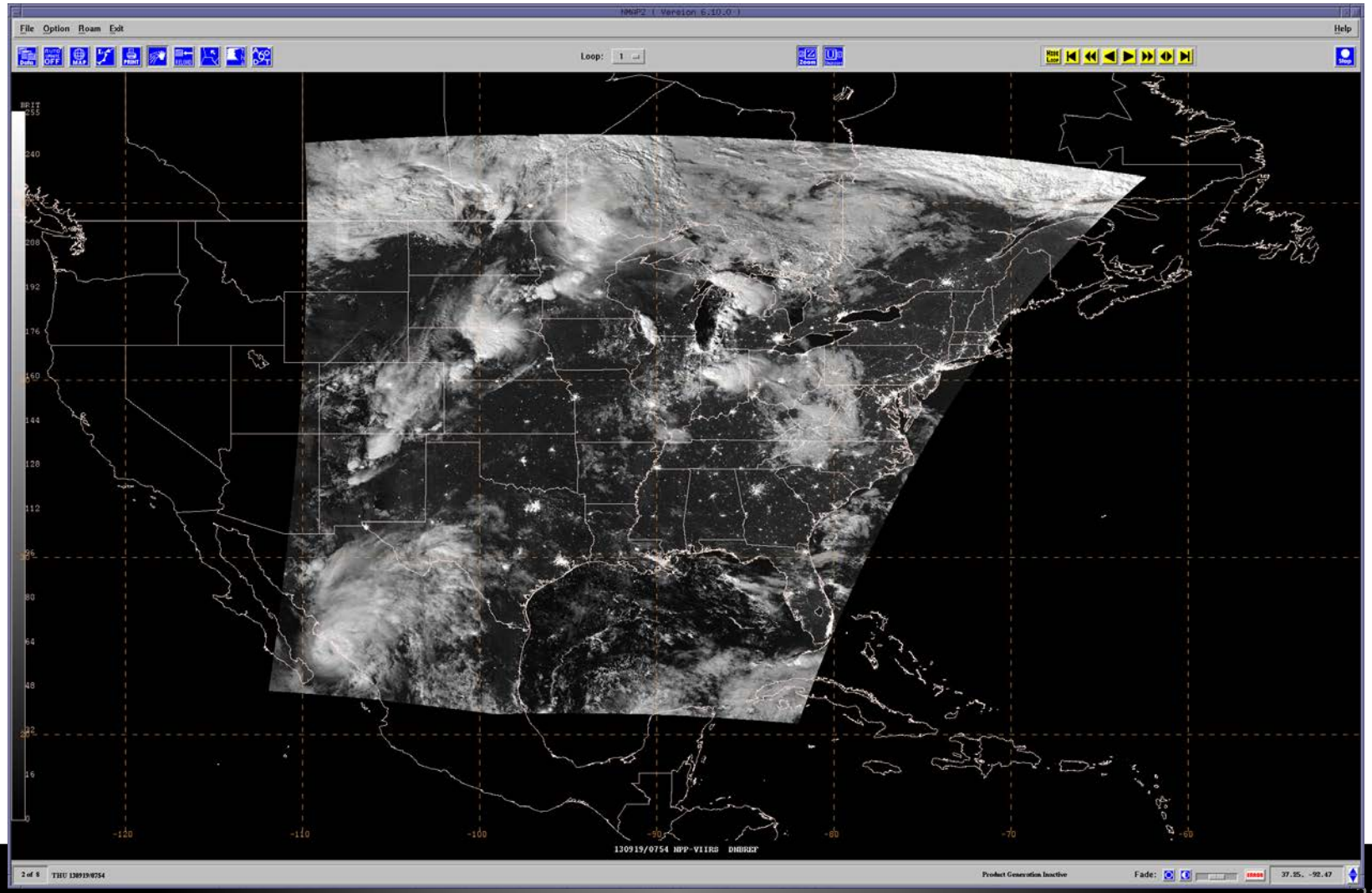
THE CONVECTIVE CLOUD SHIELD REMAINS SHEARED NORTHEAST THROUGH
SOUTHEAST OF THE CENTER. THERE HAS BEEN A NOTICEABLE INCREASE IN
LIGHTNING ACTIVITY DURING THE PAST COUPLE OF HOURS...WHICH IS OFTEN
INDICATIVE OF INCREASING VERTICAL WIND SHEAR. …

GOES-East Outage on May 22

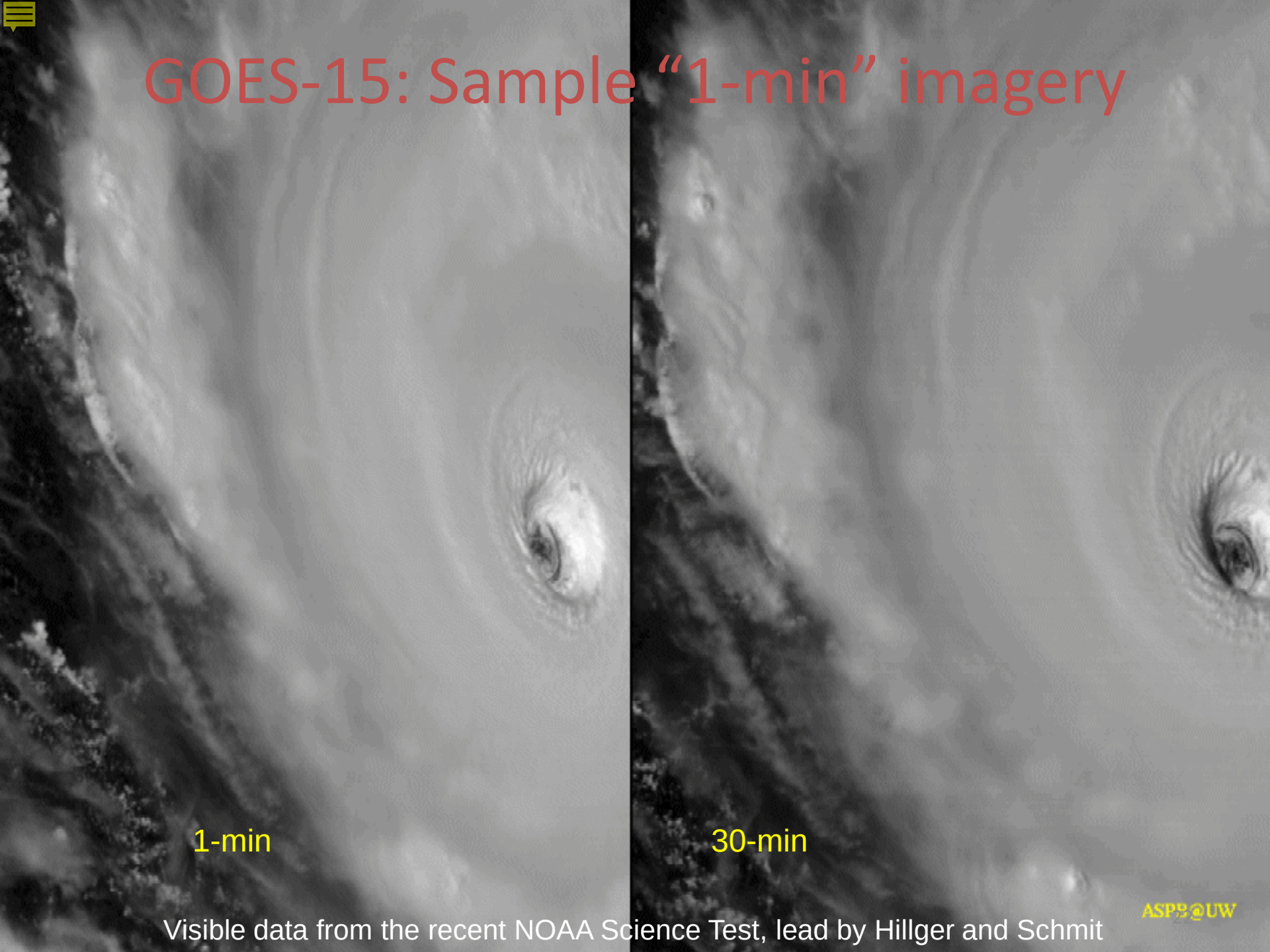
Lightning data provided continuity of convective activity in gap between GOES-west and MSG



VIIRS Day-Night Band for Hurricane Manuel (East Pacific) in N-AWIPS



GOES-15: Sample “1-min” imagery



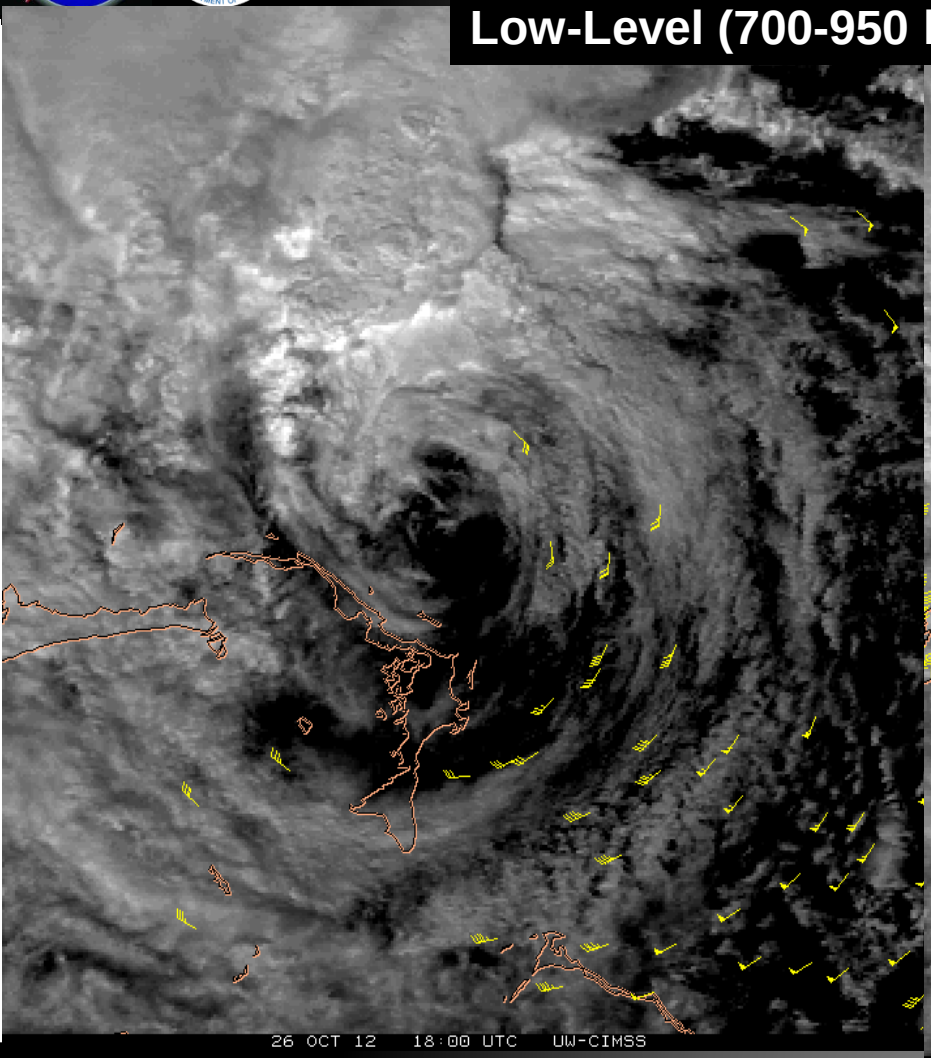
Visible data from the recent NOAA Science Test, lead by Hillger and Schmit

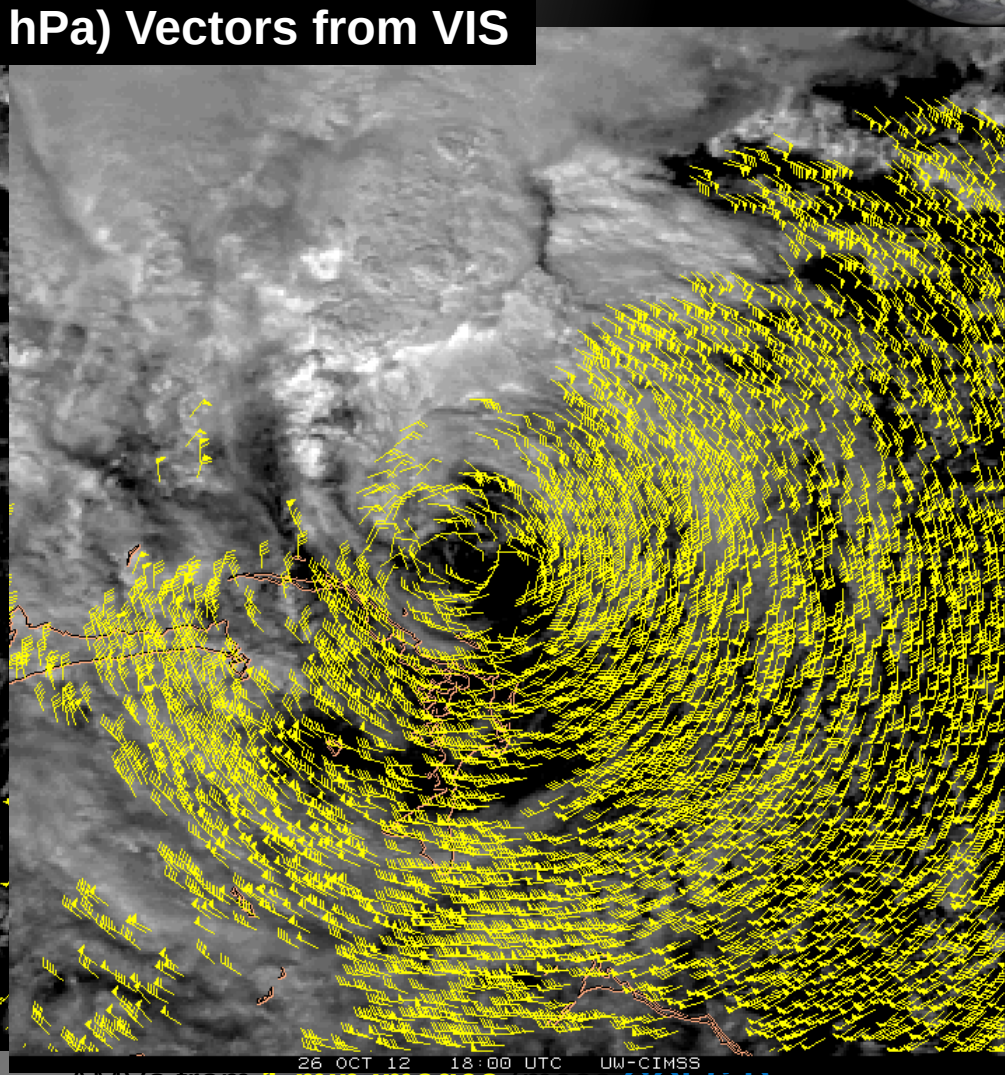
Atmospheric Motion Vectors from GOES-R

Proxy: AMVs from special GOES-14, 1-min super-rapid-scan operations

Hurricane Sandy

Low-Level (700-950 hPa) Vectors from VIS

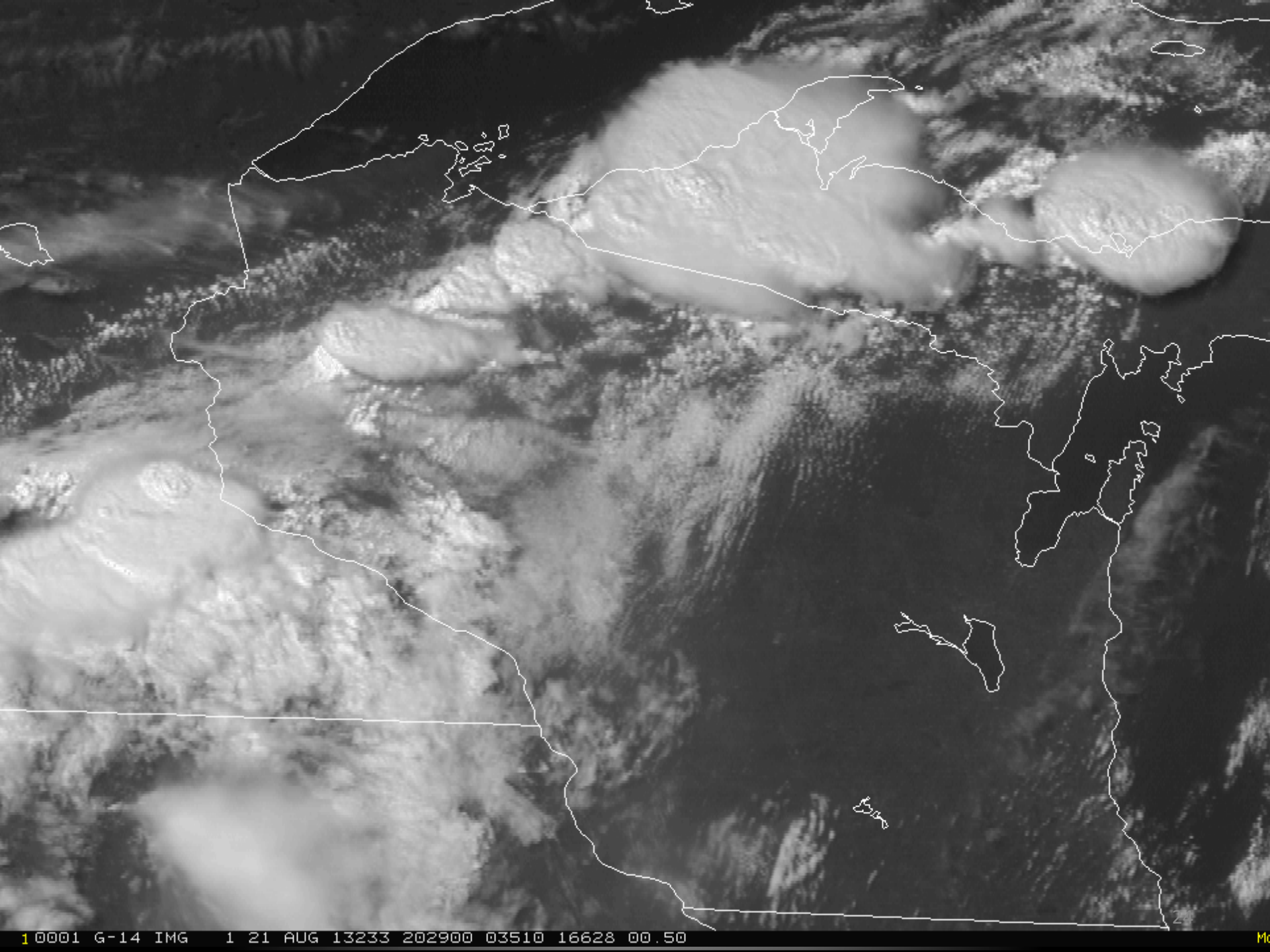




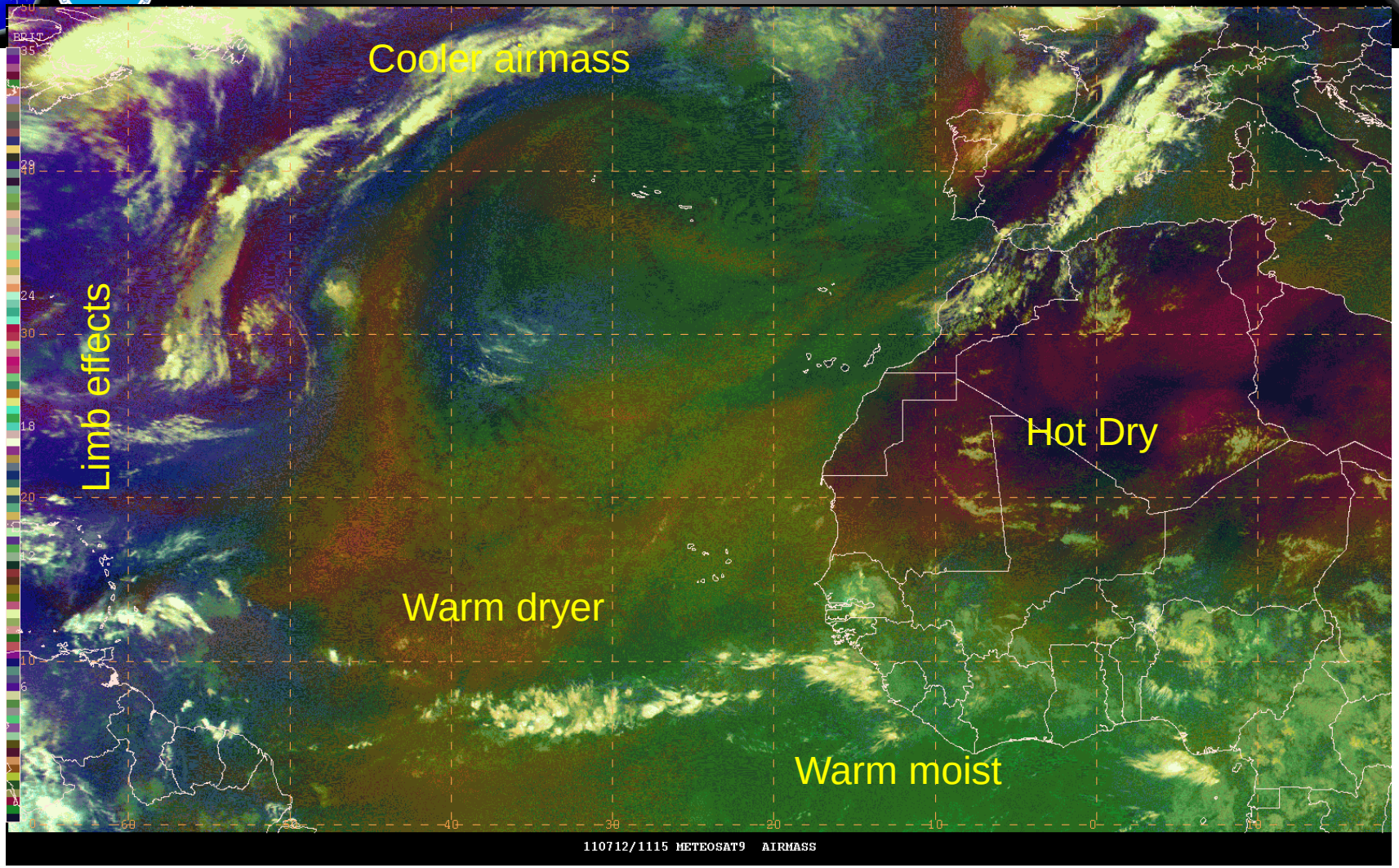
15-min images (routine GOES sampling) AMVs from **1-min images** (meso GOES-R

1800 UTC 26 Oct, 2012

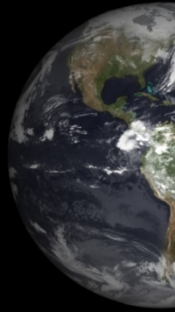
C. Velden (CIMSS)


1 0001 G-14 IMG 1 21 AUG 13233 202900 03510 16628 00.50

RGB Air Mass Product from SEVIRI



AWC 2013 demonstration forecaster input

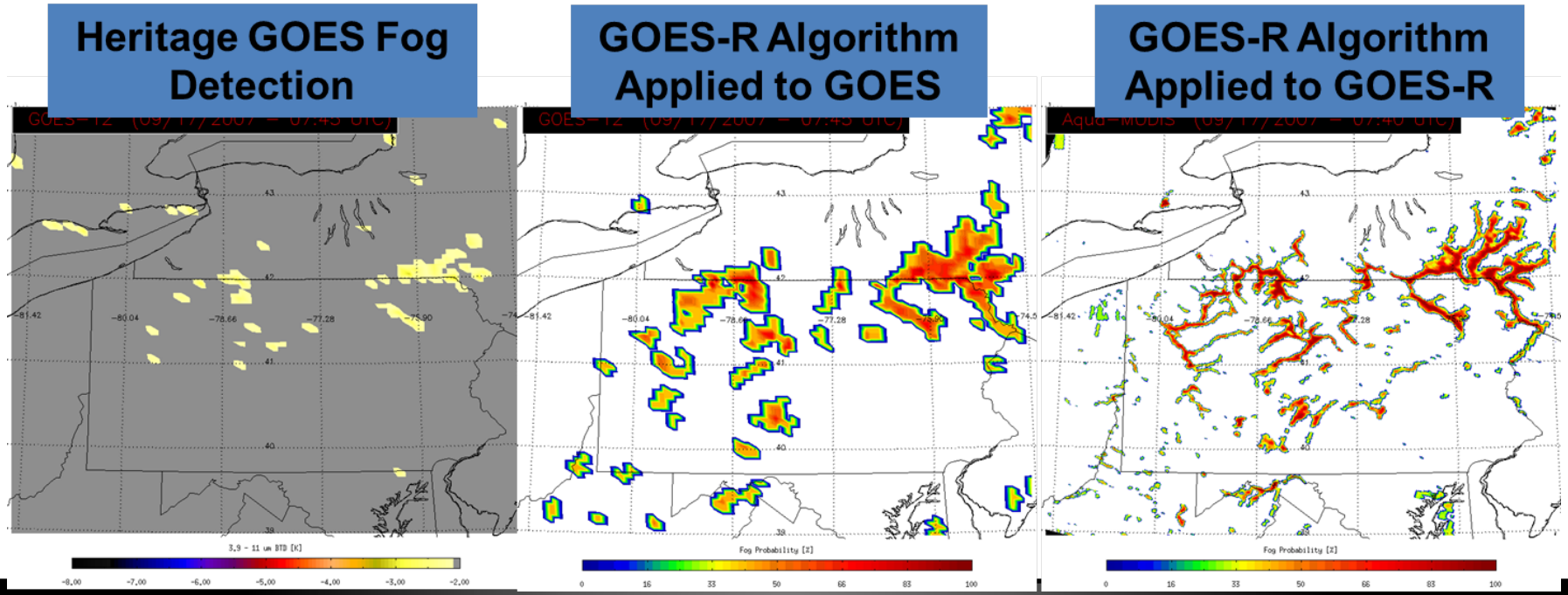


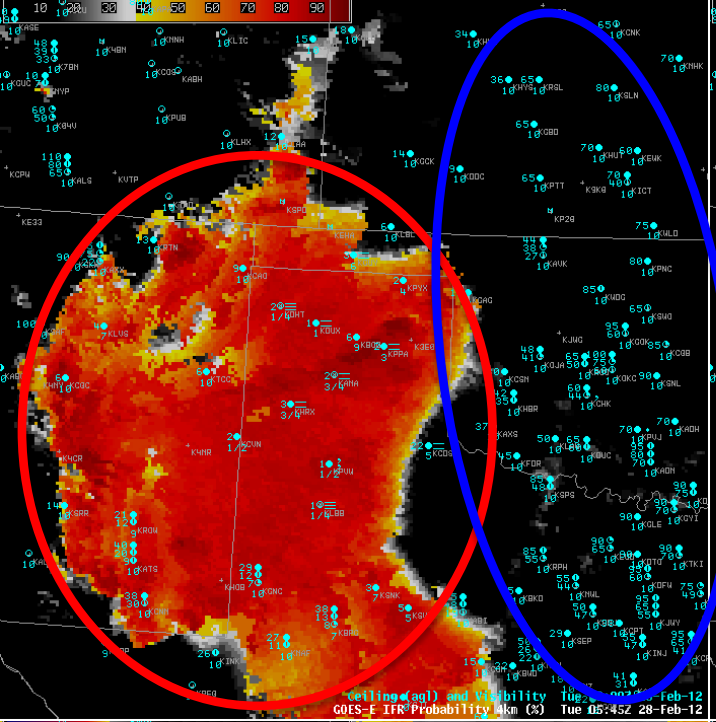
- Simulated Satellite Forecasts…. Most popular product in winter experiment; also popular in summer experiment
- NearCasting: valuable information on both the likelihood of convective initiation and behavior of ongoing convection
- Fog/Low Cloud: demonstrated in the winter experiment…. Useful at the National Aviation Meteorologist (NAM) desk for short range forecasting
- PGLM: most improvement of any product…new LMAs & better display
- Forecasters pleased with SRSO loops… look forward to operational use

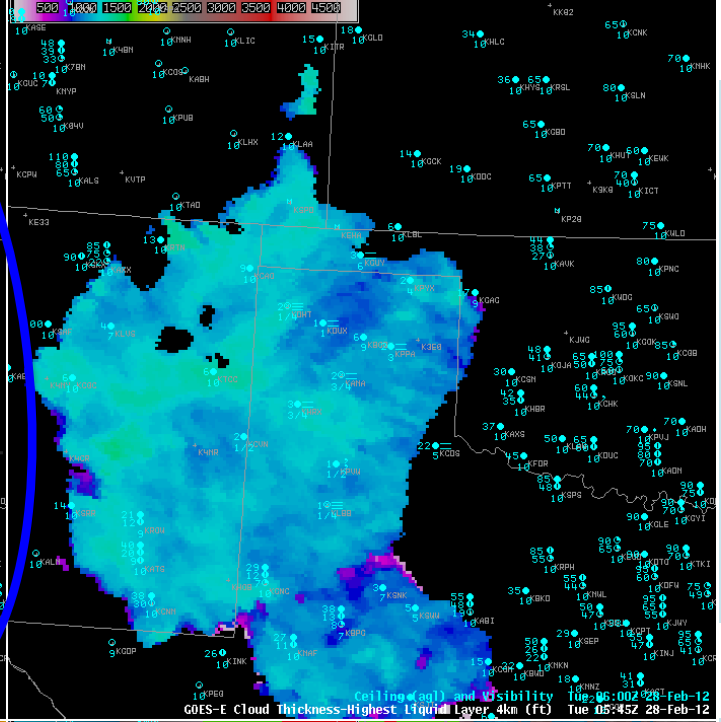
Future Capability: Fog Detection

The GOES-R fog detection product will significantly improve geostationary satellite fog monitoring capabilities because:

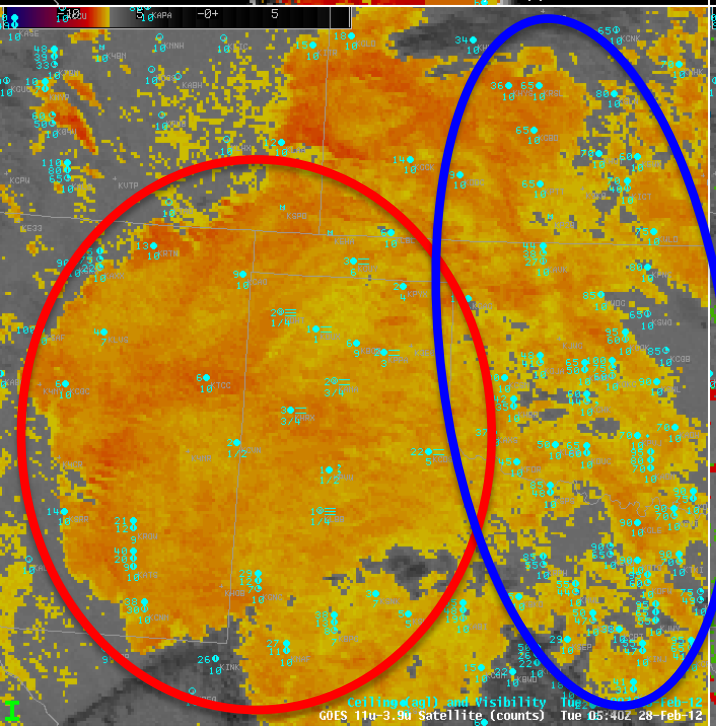
- ***Improved algorithm technology*** - the GOES-R algorithm provides quantitative information on fog probability, while heritage GOES fog detection products are more qualitative in nature
- ***Improved sensor technology*** - the ABI has greatly improved spectral information, spatial resolution, and temporal resolution

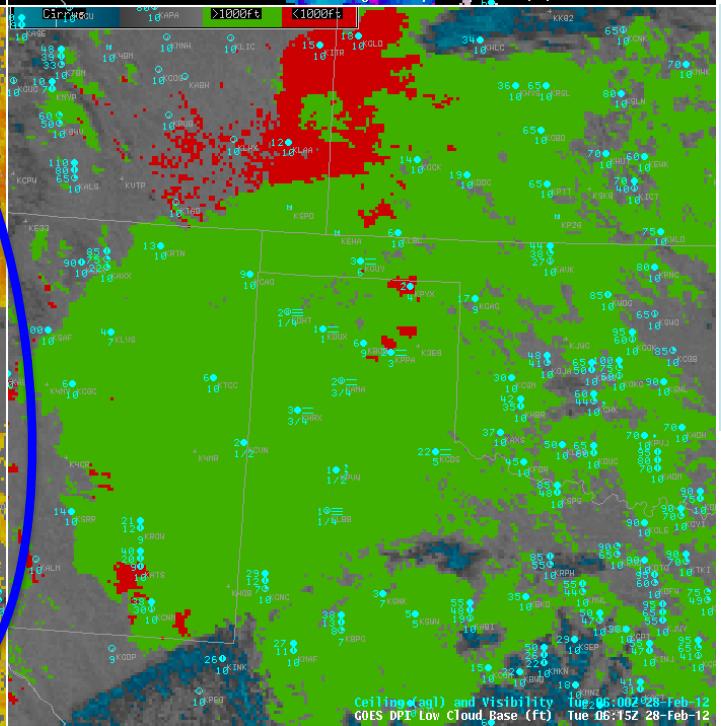






The majority of the surface stations located where the GOES-R IFR probabilities were elevated (red circle) reported ceilings and/or visibilities the met IFR criteria

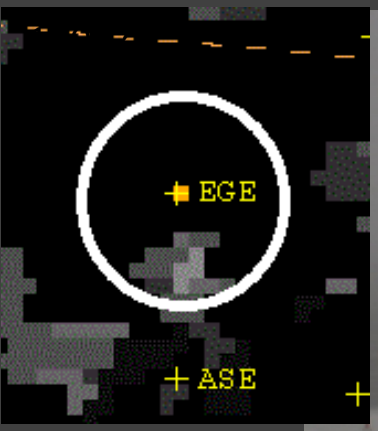




None of the surface stations east or northeast of the elevated GOES-R IFR probabilities (blue circle) reported IFR conditions

2/28/2012
05:45 UTC

Eagle, CO Fog Event – 12/29/13



GOES-R IFR/LIFR fused product inputs:

1. Four IR bands and cloud phase
2. RAP/GFS temp and RH data
3. Surface type/emissivity

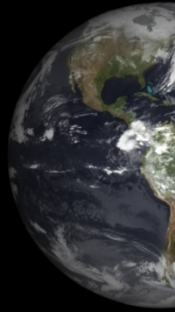
Ground Stop Arrivals Eagle, CO (EGE) due to LIFR FOG/CIGS

KEGE 291750Z 00000KT 1/4SM FZFG OVC002 M04/M05 A3025

1)ATCSCC/NWS Met monitored GOES-R Satellite probability of LIFR conditions
2)1830Z – GOES-R lost the one pixel of 70% probability IFR conditions
3)Met notified Terminal Specialist/Supervisor that clearing was imminent
4)Ground Stop canceled ahead of schedule
5)Customers saved time/$$ due to shortened Ground Stop

KEGE 291859Z 00000KT 10SM FEW030 M01/M03 A3021 RMK VIS E 3/4 FG BANK E

Product Assessment Highlights

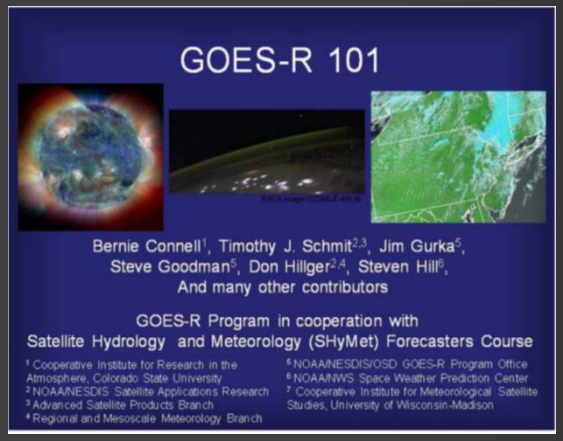


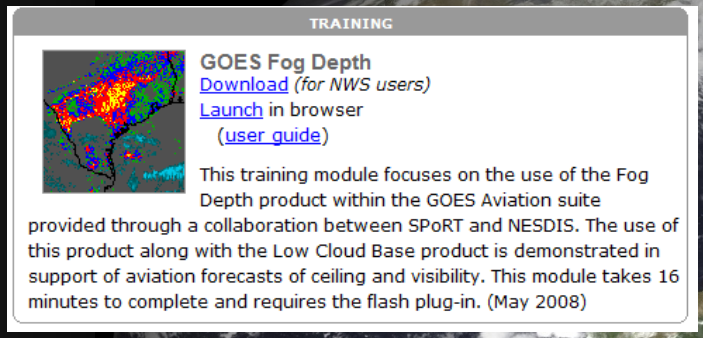
- Fog and low stratus (FLS) products are in process to become operational prior to GOES-R launch
- RGB dust product now used routinely by the Tropical Analysis Forecast Branch (TAFB)
- High Latitude and Arctic Experiment (Alaska Region)
  - Two versions of FLS products available on AWIPS in Alaska
  - MODIS (proxy for GOES-R imagery) used by RFC in Anchorage as input to their hydrological models during spring ice break up
  - GOES-R proxy volcanic ash product picking up cases of re-suspension in addition to new eruptions
- RGB airmass product used in experimental operations at OPC, WPC & SAB
- Simulated satellite forecasts available in experimental ops at AWC

Training and Education

Online Training Modules

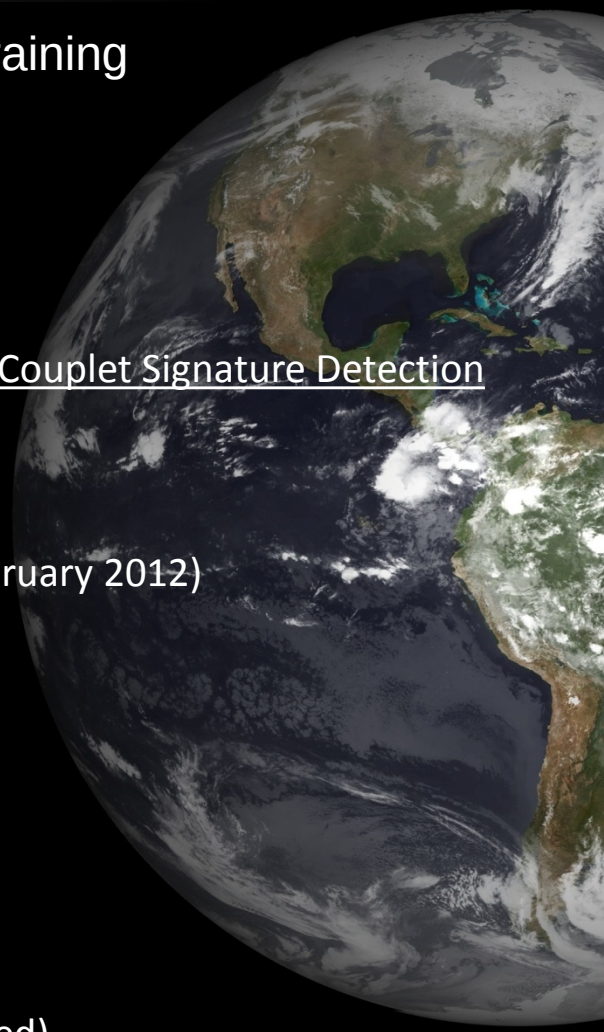
- GOES-R: Benefits of Next-Generation Environmental Monitoring (COMET)
- GOES-R 101
- Remote Sensing Using Satellite, 2nd Edition (COMET)
- GOES-R ABI: Next Generation Satellite Imagery (COMET)
- Numerous Microwave modules (COMET)
- GOES Channel Selection v2 (COMET)
- Advanced Satellite Sounding: the Benefits of Hyperspectral observations
- Multispectral Satellite Applications: RGB Products Explained (COMET)
- Coming attractions from COMET:
- Polar Sat updates on hyperspectral, wildland fires, and VIIRS
- Nighttime Polar Applications Module
- Satellite Data Informing NWP
- Satellite Feature ID: Three Dimensionality of Water Vapor
- Spanish Translations: 21 modules
- French Translations: 14 modules





VISIT

Virtual Institute for Satellite Integration Training



FY11-12 Live Training Sessions

Synthetic Imagery in Forecasting Orographic Cirrus (January 2011)

Synthetic Imagery in Forecasting Severe Weather (February 2011)

Objective Satellite-Based Overshooting Top and Enhanced-V Anvil Thermal Couplet Signature Detection (February 2011)

Volcanoes and Volcanic Ash Part 2 (March 2011)

GOES-15 Becomes GOES-West (December 2011)

VISIT Satellite Chats (short, interactive discussions, Q&A, monthly since February 2012)

Topics:

- Fog and Low-Cloud Detection from Satellite (2-22-2012)
- Water Vapor Imagery (3-21-2012)
- Satellite Related Severe Weather Products (4-25-2012)
- Fire Weather Imagery and Products (5-23-2012)
- Mesoscale Convective Vortices (6-27-2012)

Synthetic Imagery in Forecasting Low Clouds and Fog (April 2012)

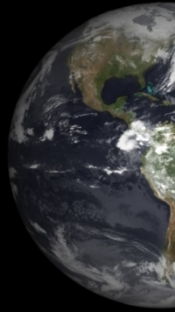
Pseudo GOES Lightning Mapper (May 2012)

Tropical Cyclone Intensity Model Guidance Used by NHC (June 2012, updated)

Tropical Cyclone Track Model Guidance Used by NHC (June 2012, updated)

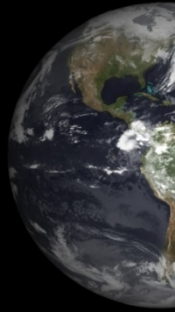
Convective Cloud Top Cooling, UW Convective Initiation Algorithm (July 2012)

Future Plans: 2014 And Beyond



- Continue to apply lessons learned to incorporate new improvements each year. Example:
  - Based on forecaster input, switched to probabilistic CI forecast
- Demonstrate products and decision aids in NOAA Testbeds, NCEP Centers, WFOs, and the NWS Proving Ground at Training Center
- Transition from Warning Related Products to remaining Baseline Products, Day 2 Future Capability, fused products, Decision Aids, Decision Support Services
- Continue to develop, demonstrate, and test as part of decision support services
- Use Himawari as a source of ABI proxy data
- Enhanced JPSS, international, and broadcaster community collaboration

Summary



- GOES-R Proving Ground provides mechanism to:
  - Involve CIs, AWG, National Centers, NOAA Testbeds and WFOs in user readiness
  - Get prototype GOES-R products in hands of forecasters
  - Keep lines of communication open between developers and forecasters
  - Allow end user to have say in final product, how it is displayed and integrated into operations
- With adjustments based on user feedback…Proving Ground continues to grow and plans are in place for 2014 and beyond.
- For GOES-R to be a success, forecasters must be able to use GOES-R products on Day 1!

Thank you!

For more information visit www.goes-r.gov

Questions?