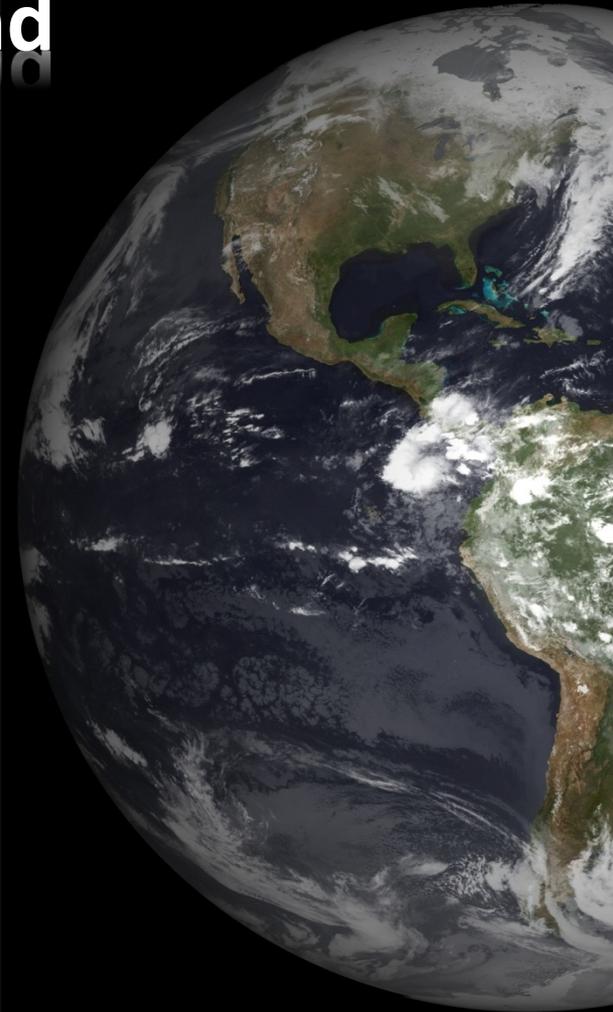
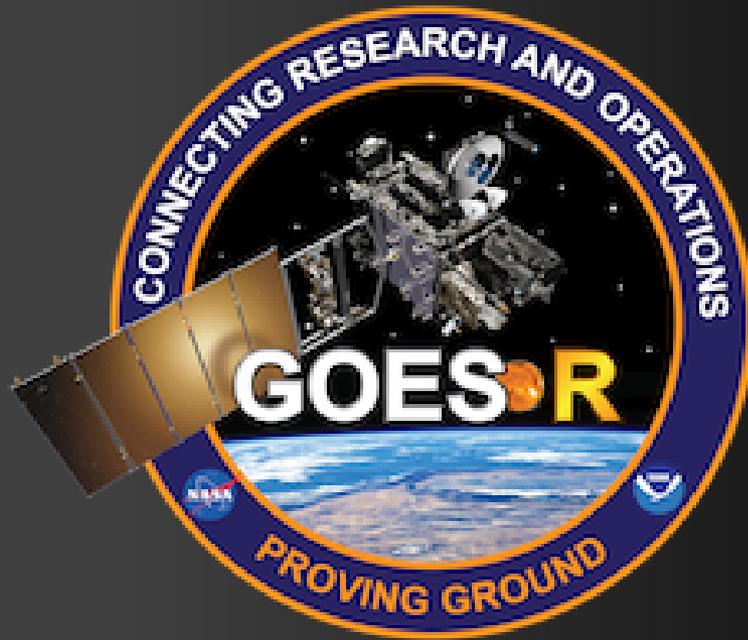


The GOES-R Proving Ground: Results from the 2012 Demonstrations and Future Plans



Jim Gurka

NOAA/ NESDIS/ GOES-R Program Office

9th AMS Annual Symposium on Future Operational Satellite Systems

Austin TX, Jan. 9, 2013



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General Dynamics Information Technology



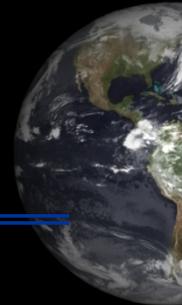
Outline



- GOES-R Proving Ground Overview (PG)
- Samples of GOES-R Proxy Products in the PG
- User Input from HWT Spring Experiment; NHC; and AWC Demonstrations
- Training
- What's Happening in 2013 and Beyond?
- Summary



GOES-R Proving Ground

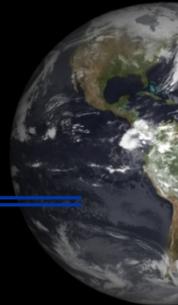


– What is the GOES-R Proving Ground?

- 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)



Proving Ground Mission Statement

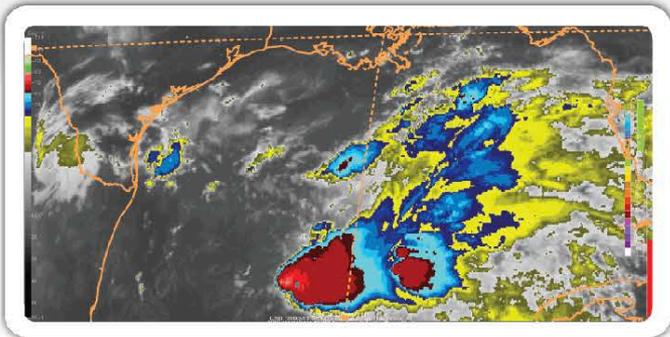


The GOES-R Proving Ground engages NWS in pre-operational demonstrations of selected capabilities of next generation GOES

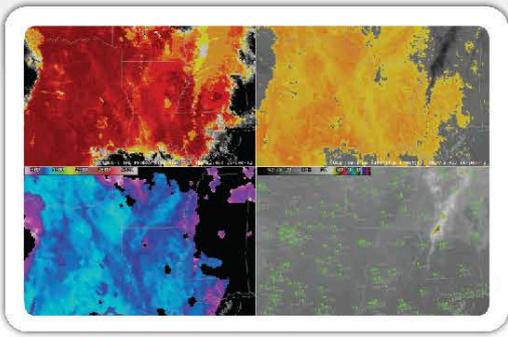
- **Objective is to bridge the gap between research and operations by:**
 - Utilizing current systems (satellite, terrestrial, or model/synthetic) to emulate future GOES-R capabilities
 - Infusing GOES-R products and techniques into NWS operations with emphasis on AWIPS and transitioning to AWIPS-II.
 - Engaging in a dialogue to provide feedback to developers from users
- **The Proving Ground accomplishes its mission through:**
 - Sustained interaction between developers and end users for training, product evaluation, and solicitation of user feedback.
 - Close coordination with GOES-R Algorithm Working Group (AWG) and Risk Reduction programs as sources of demonstration products, promoting a smooth transition to operations

Intended outcomes are Day-1 readiness and maximum utilization for both the developers and users of GOES-R products, and an effective transition to operations

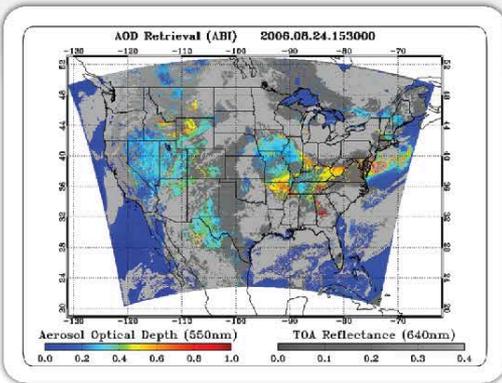
The GOES-R Proving Ground



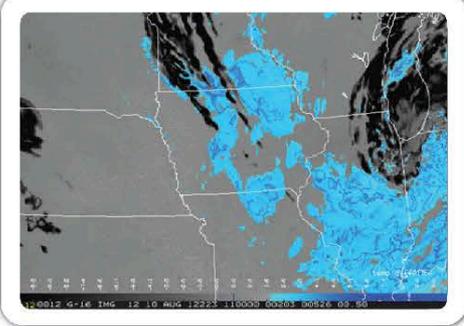
AWC – Kansas City, MO IR Imagery of Oceanic Storms



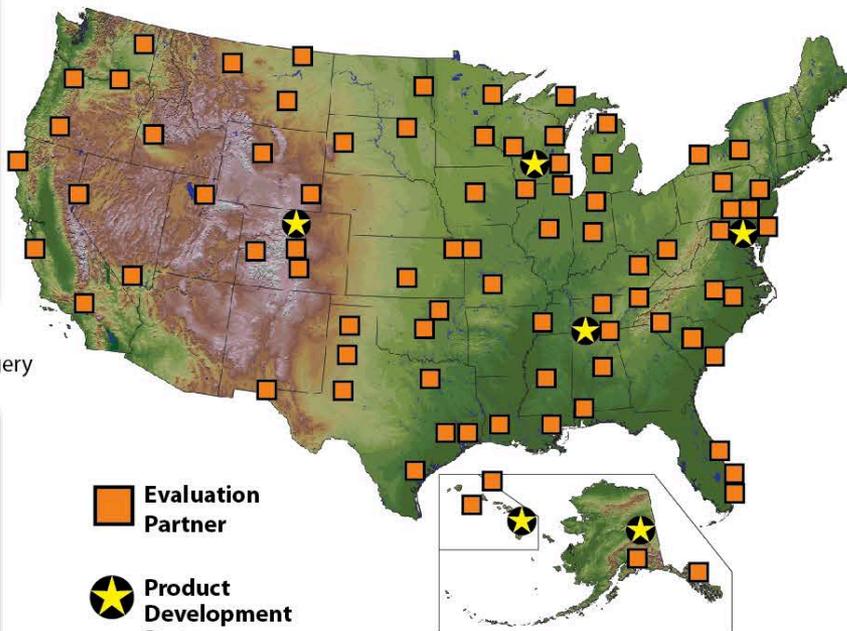
CIMSS/STAR – Madison, WI Fog/Low Cloud Product



STAR/UMBC – College Park, MD Aerosol Optical Depth

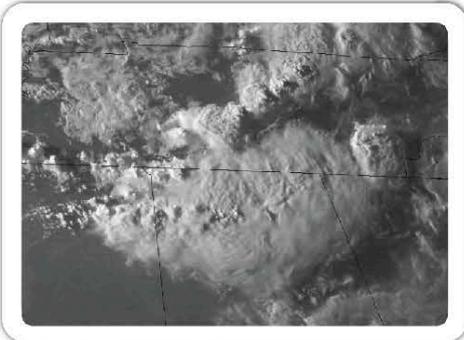


CIRA/STAR – Ft. Collins, CO ABI Synthetic Low Cloud Enhancement Imagery

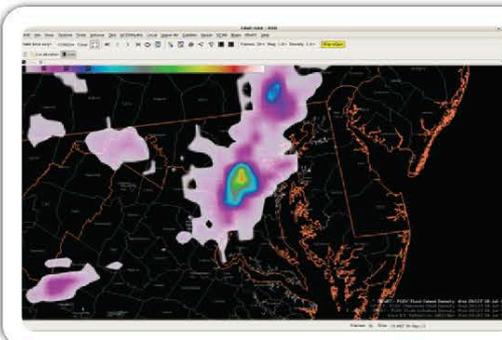


Orange Square Evaluation Partner

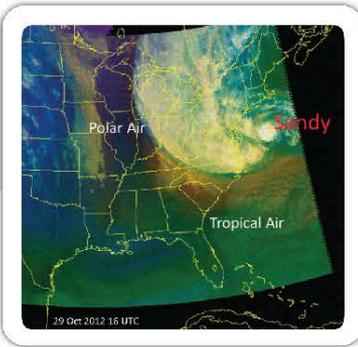
Yellow Star Product Development Partner



SPC – Norman, OK Severe Storms 1-Min Visible Imagery of Overshooting Tops



SPoRT/NASA – Huntsville, AL GLM Lightning Density



NHC – Miami, FL RGB Air Mass for Hurricane Sandy



Proving Ground Product Evaluation



The following products are part of current GOES-R Proving Ground demonstrations:

Baseline Products

- Cloud and Moisture Imagery
- Volcanic Ash: Detection and Height
- Hurricane Intensity
- Lightning Detection: Events, Groups & Flashes
- Rainfall Rate/QPE
- Total Precipitable Water
- Fire/Hot Spot Characterization
- Cloud Top Phase
- Cloud Top Height
- Cloud Top Temperature
- Derived Motion Winds
- Aerosol Detection
- Aerosol Optical Depth

Future Capabilities

- Aircraft Icing Threat
- Convective Initiation
- Enhanced "V"/Overshooting Top Detection
- Low Cloud and Fog
- SO₂ Detection

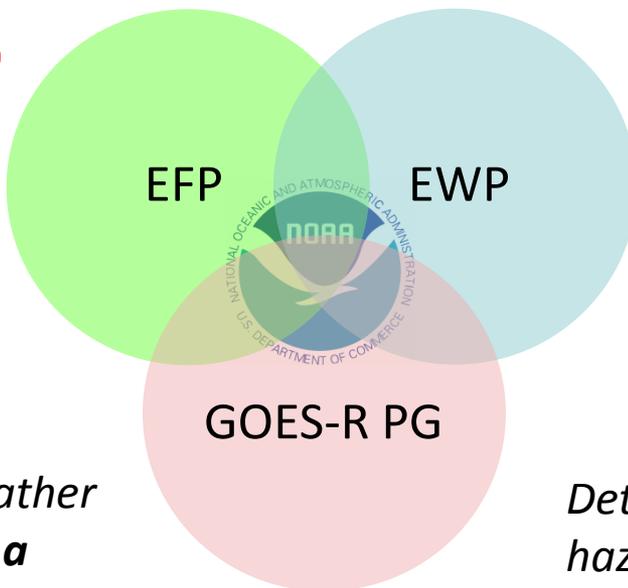


NOAA's Hazardous Weather Testbed



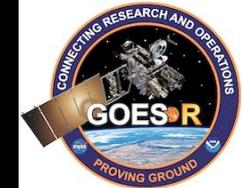
Experimental
Forecast
Program

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



Experimental
Warning
Program

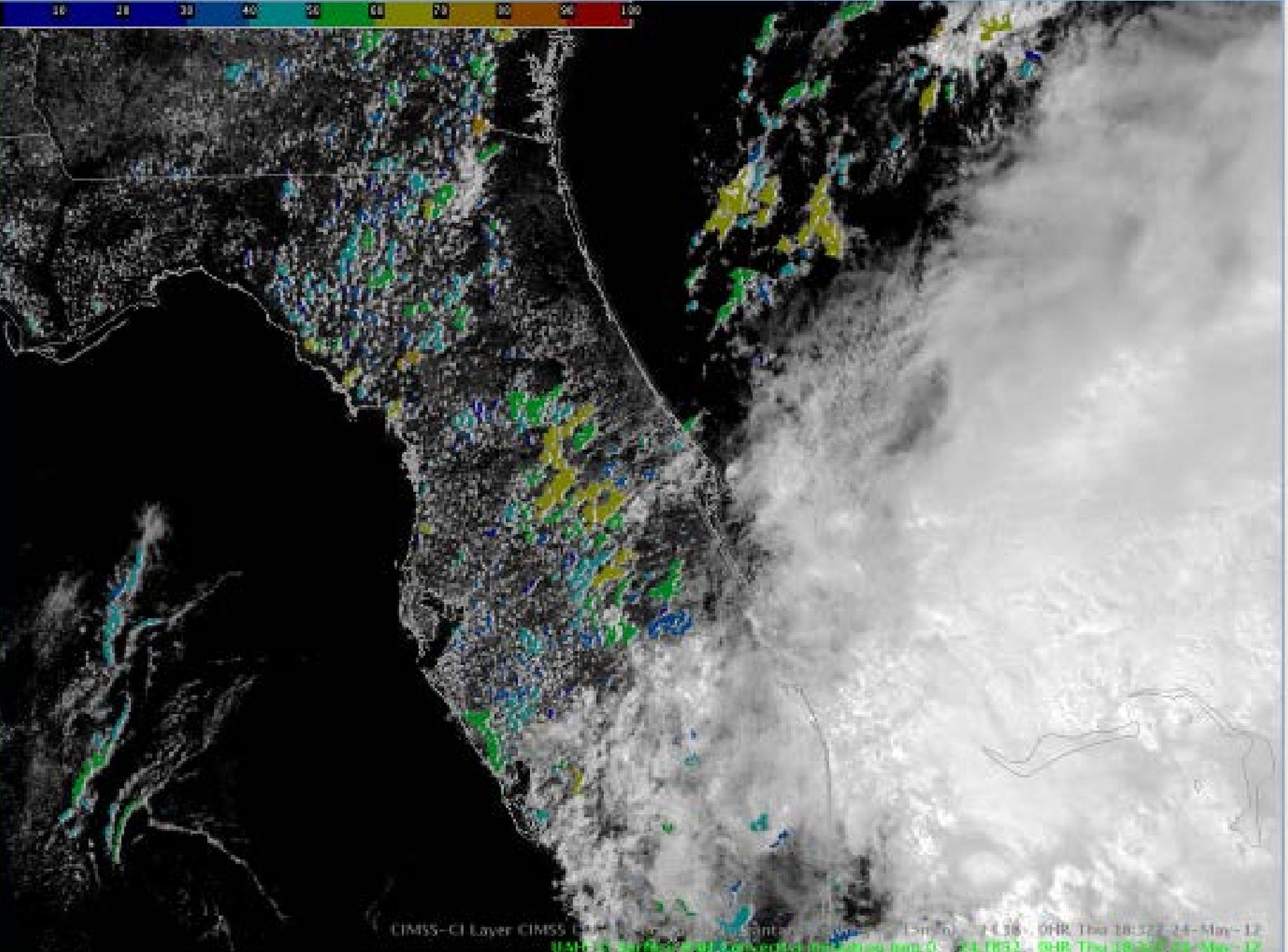
*Detection and prediction of hazardous weather events **up to several hours in advance***



2012: By the numbers...

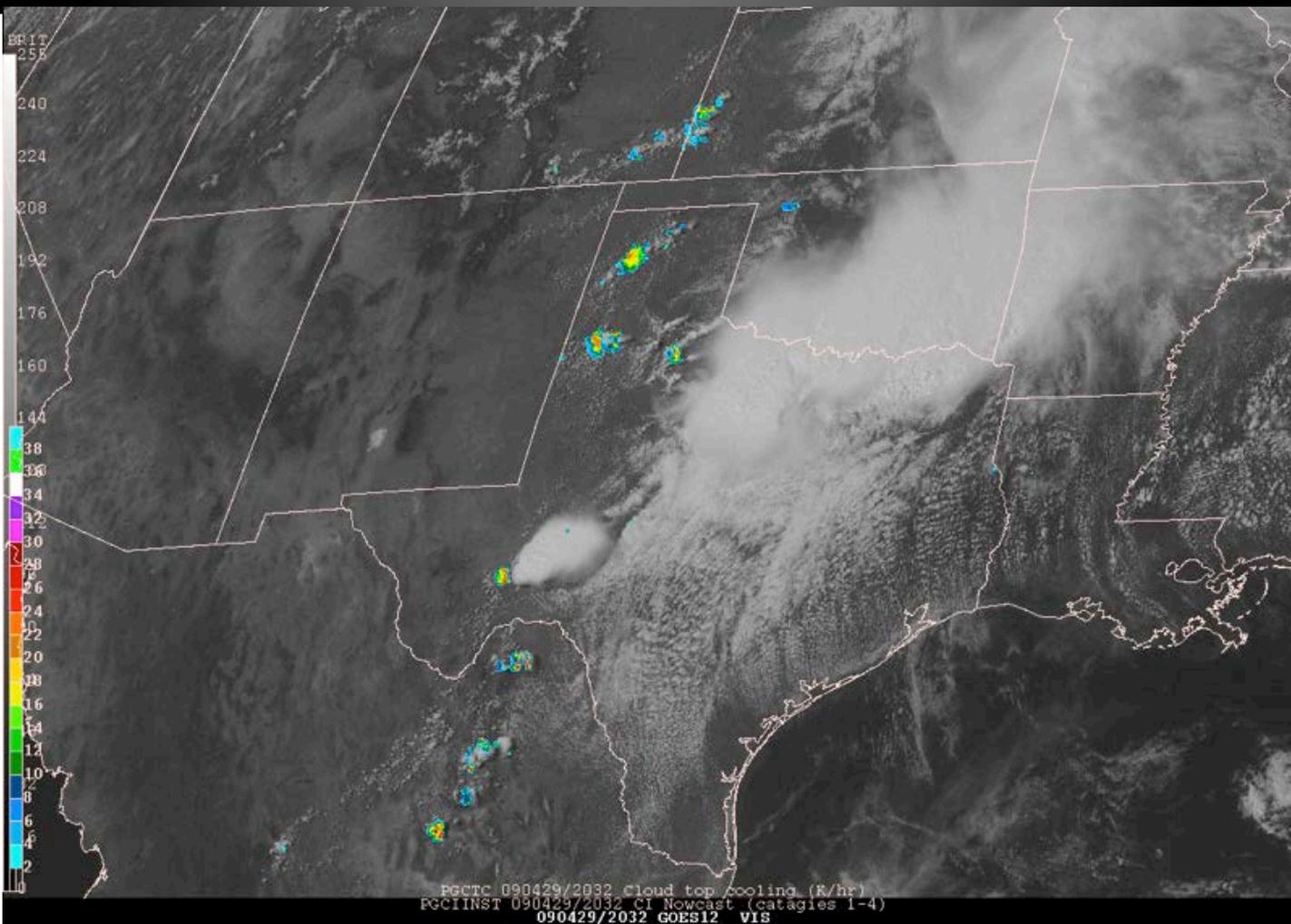
- **6-week period (7 May – 15 June)**
 - No EWP operations Memorial Day week
- **28 NWS forecasters**
 - WFO and CWSU
- **18 visiting scientists**
 - CIMSS, CIRA, SPoRT, UAH, DWD, AFWA
- **6 products demonstrated**
- **225 blog posts**
 - Most from NWS forecasters
- **109 completed surveys**
- **5 weekly webinars**







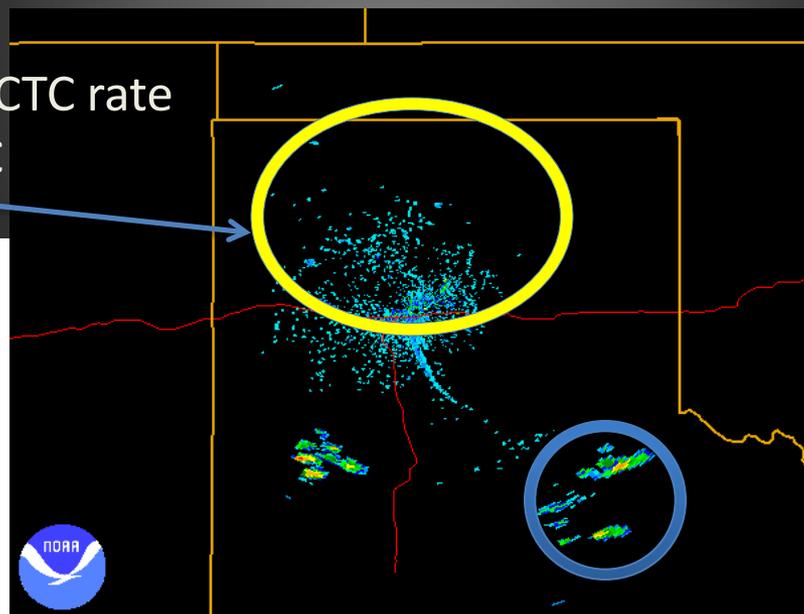
2009-04-29 Dryline Case



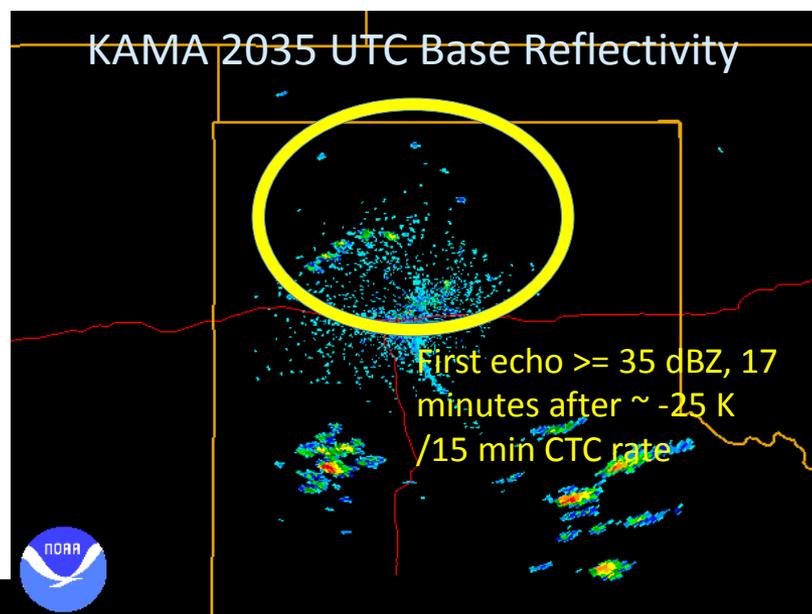


KAMA 2018 UTC Base Reflectivity

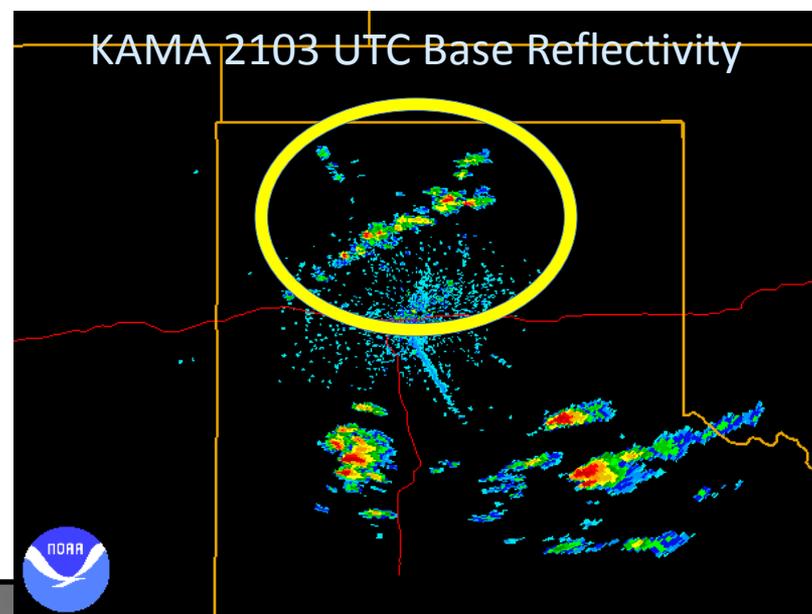
Strong UW-CTC rate
at 2015 UTC



KAMA 2035 UTC Base Reflectivity



KAMA 2103 UTC Base Reflectivity

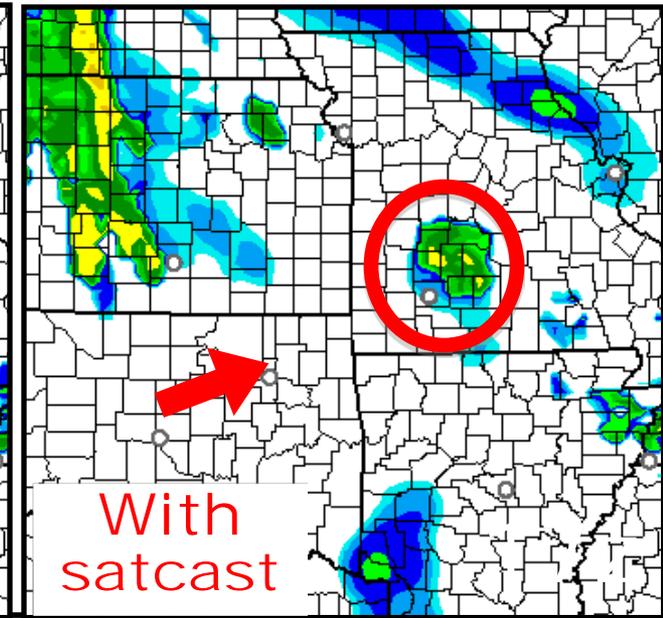
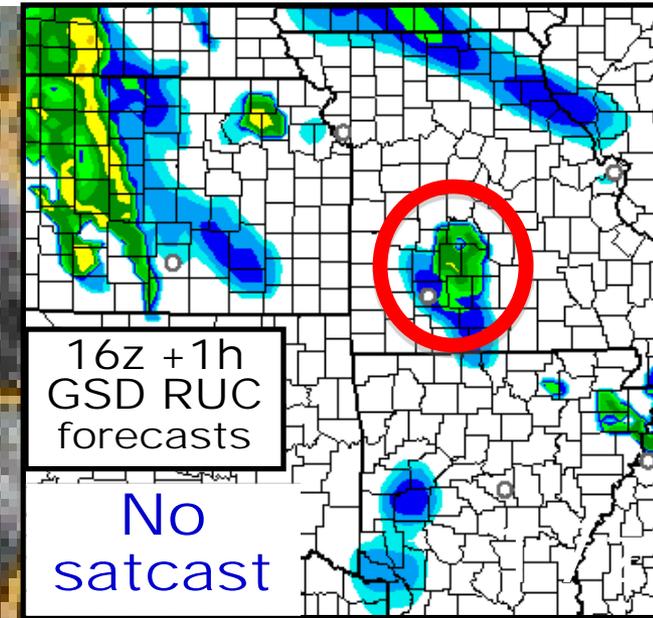
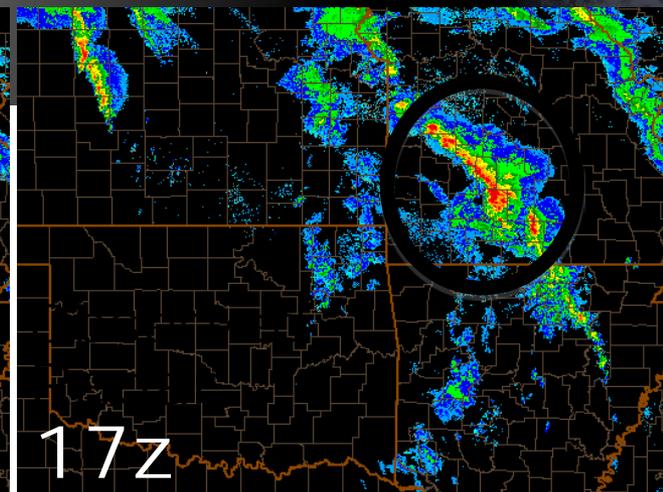
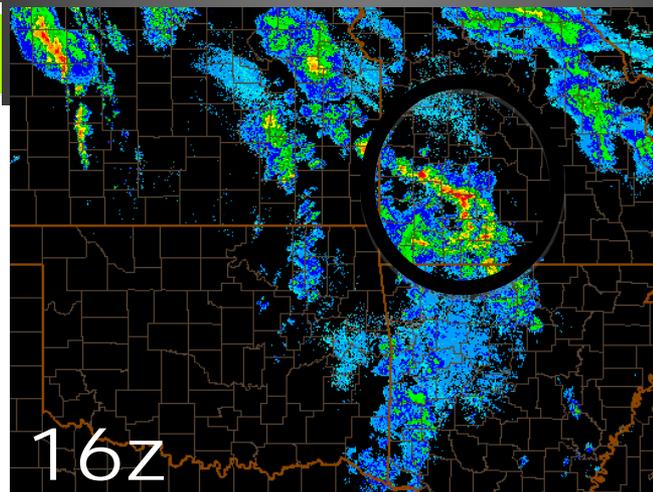
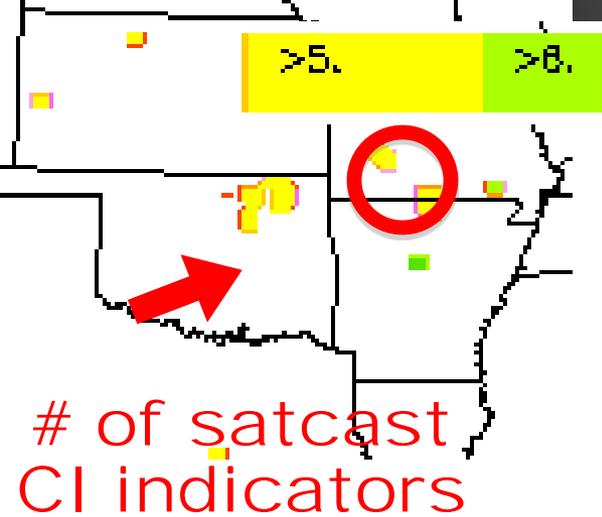




Assimilation of AWG "Satcast" Convection Initiation Indicators Into the RUC / RAP Model



Courtesy of T. Smith and S. Weygandt, NOAA-ESRL/GSD



Improved storm growth with "natural" QC from assimilation of satcast CI data in RUC, coding of satcast assimilation in RAP / HRRR system o

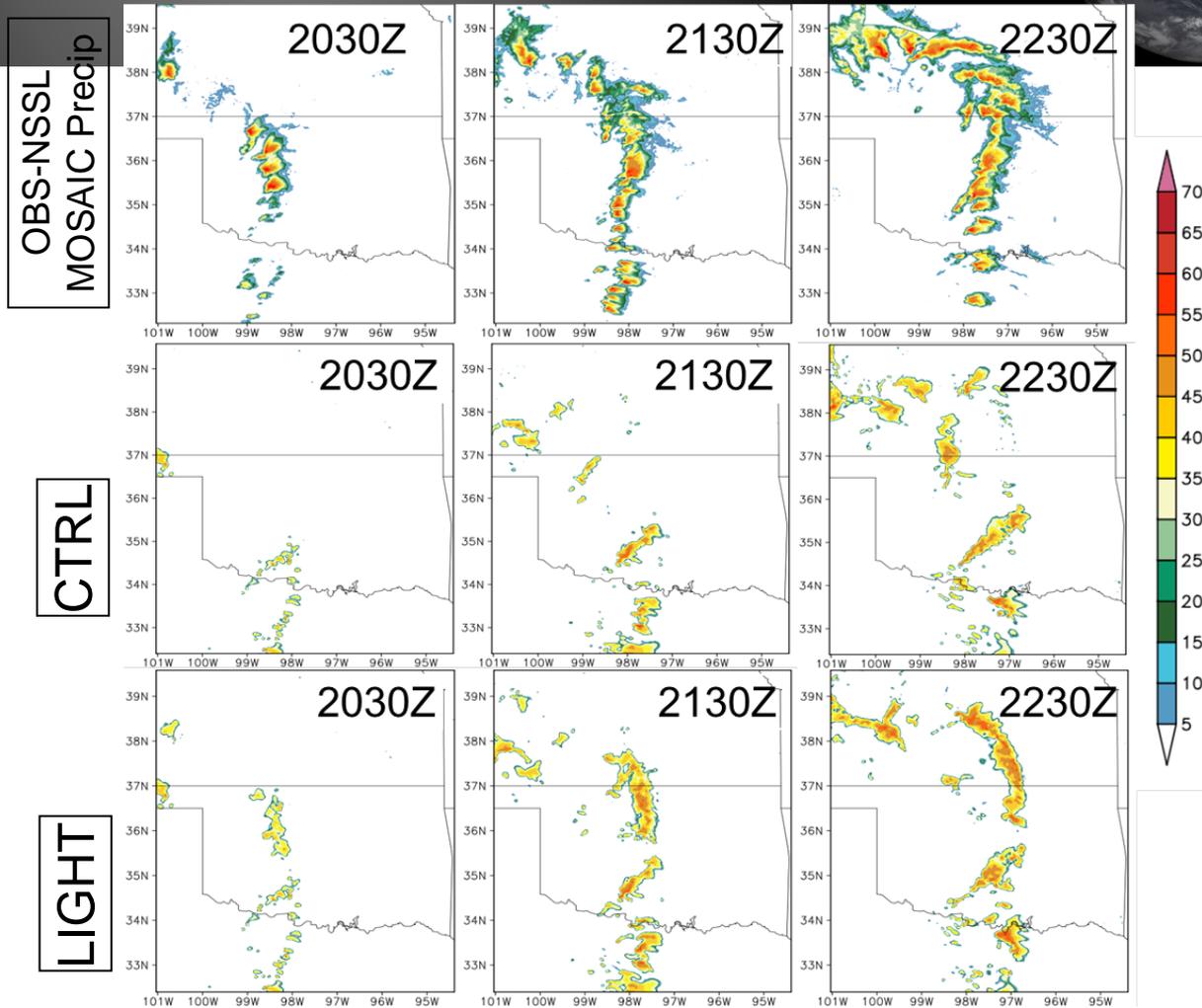
Total Lightning Proxy Data Used Within NWP Models to Provide Better Initial Conditions



- GLM Total lightning proxy data from the ENTLN were assimilated into the WRF-ARW model at cloud-resolving scales.

- [Improved Initial Conditions](#) will provide a better physical background at analysis time towards improving short term high impact weather forecasts (~3h). Lightning data also used to [limit the presence of spurious convection](#) (and cold pools). Key in radar data sparse areas.

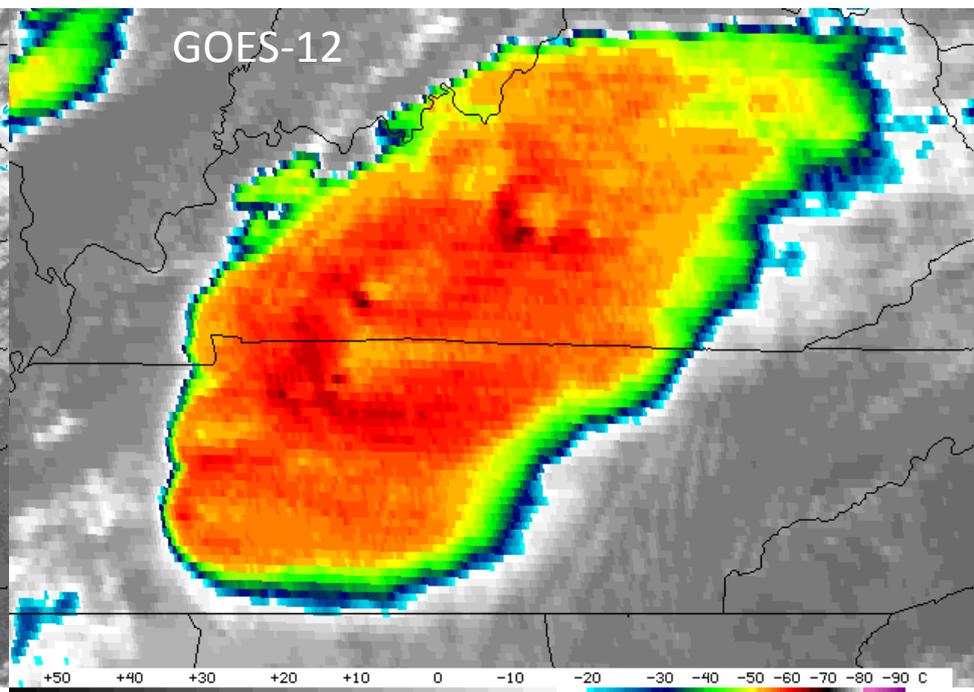
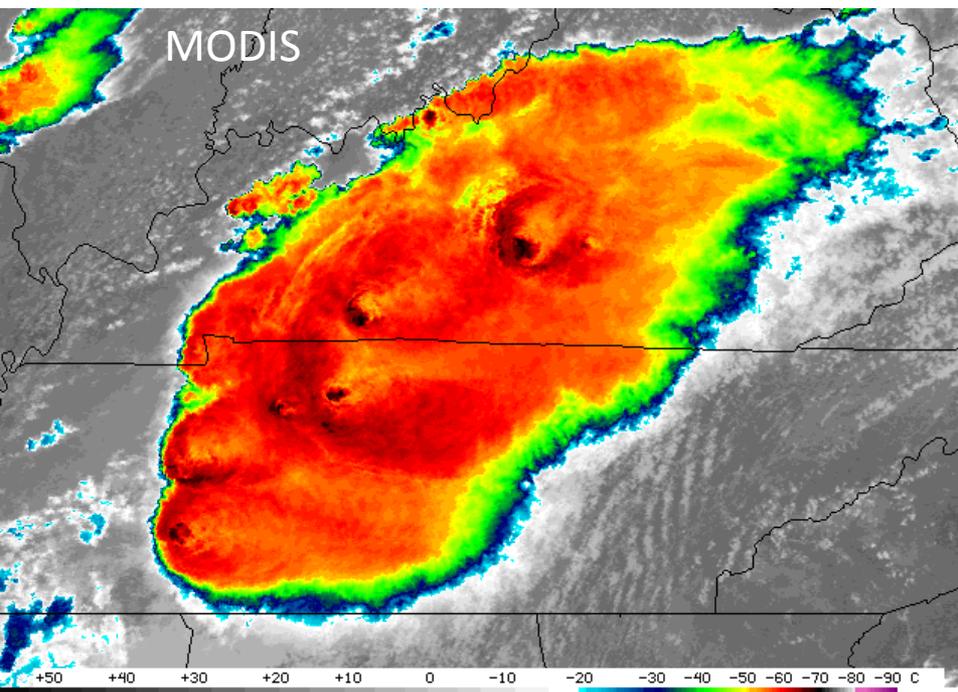
- To alleviate the need to use proxies for lightning in the model (e.g. lightning threats), [full charging/discharge physics](#) are currently being implemented into WRF-ARW within the NSSL 2-moment microphysics.





Challenge: Detect Detailed Cloud Top Temperature Patterns In Current Operational Geostationary IR Imagery

The overshooting top and enhanced-V signatures are much less distinct in 4 km GOES-12 vs. 1 km MODIS IR imagery, making them difficult to detect with an objective algorithm





Using the GOES-12 Sounder to Nearcast Severe Weather

<http://cimss.ssec.wisc.edu/model/nrc/>

Robert Aune (NESDIS) and Ralph Petersen (CIMSS)



The CIMSS Near-casting Model uses hourly GOES Sounder retrievals of layered precipitable water (PW) and equivalent potential temperature (Theta-E) to predict severe weather outbreaks up to **6 hours in advance!**

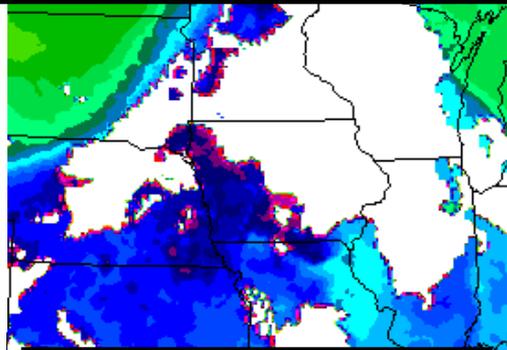
Hourly, multi-layered observations from the GOES Sounder are projected forward in time along Lagrangian trajectories forced by gradient winds. "Trajectory observations" from the previous six hours are retained in the analysis. Destabilization is indicated when theta-E decreases with height.

Limitations:

- Sounder channels support only two layers for near-casting
- Only useful for elevated convection – Sounder can't detect low-level moisture
- Frequent false alarms – Sounder can't detect inversions

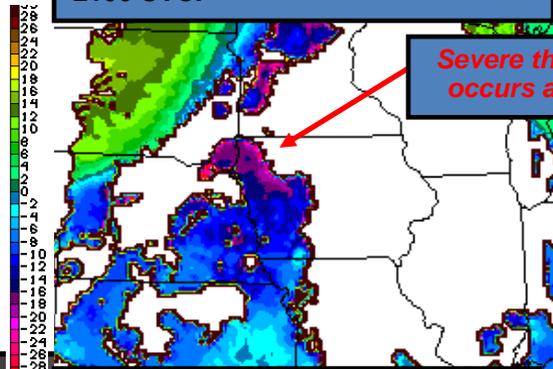
One Example of a Successful Near-cast

Low-level Theta-E NearCasts shows warm moist air band moving into far NW Iowa by 2100 UTC.



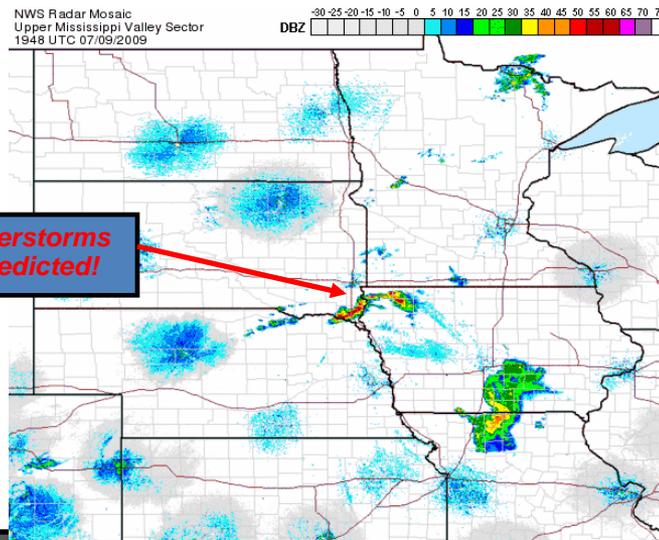
6-hour NearCast for 2100 UTC
Low level Theta-E

Vertical Theta-E Differences predict complete convective instability by 2100 UTC.



6-hour NearCast for 2100 UTC
Low to Mid level Theta-E Differences

Severe thunderstorms occurs as predicted!



Rapid Development of Convection over NW Iowa between 2000 and 2100 UTC 9 July 2009



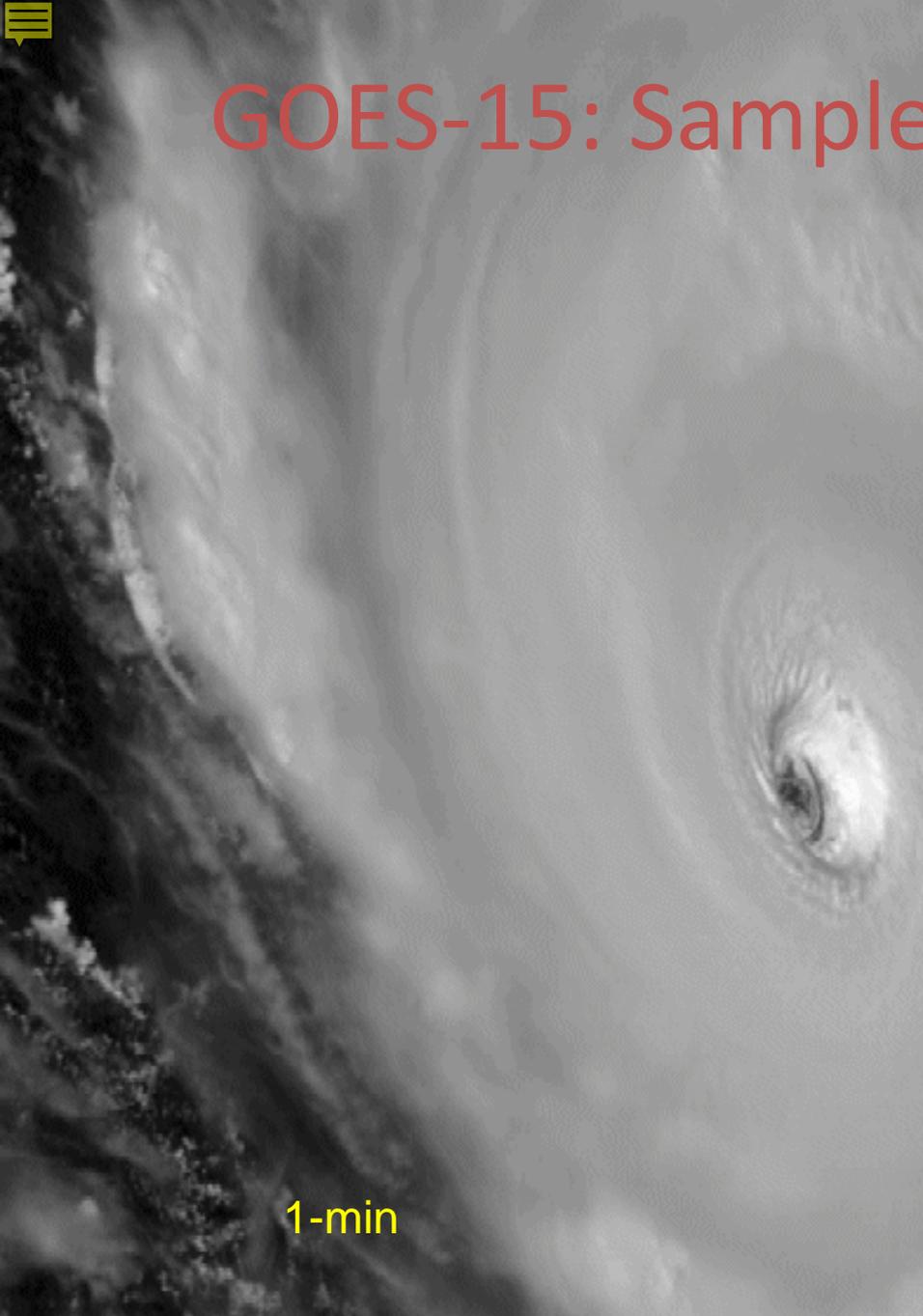
The 2012 NHC Proving Ground Products

Aug 1-Nov 30, 2012

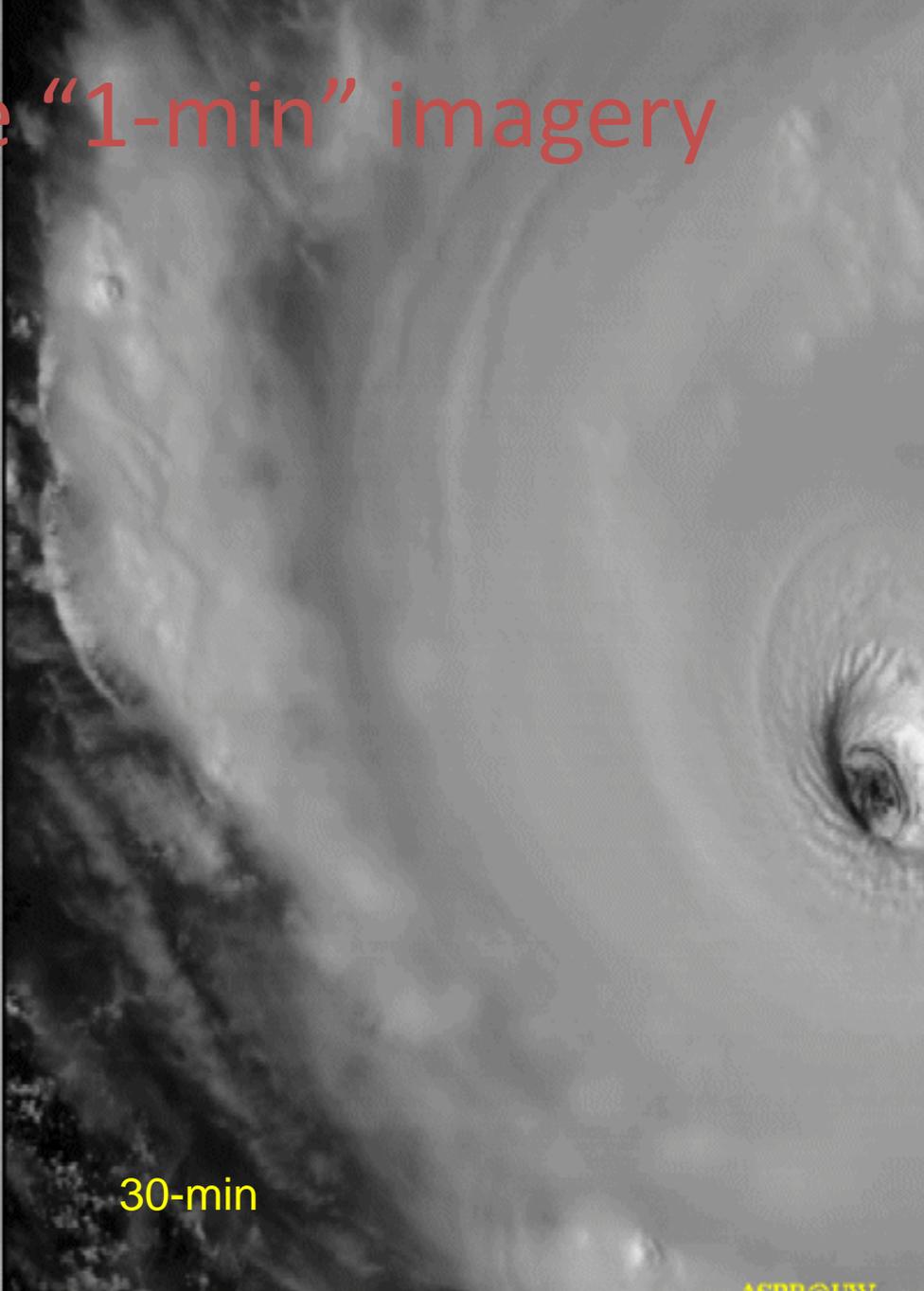


- 1. Hurricane Intensity Estimate (HIE)**
- 2. Super Rapid Scan Imagery**
- 3. Objective Tropical Overshooting Tops (TOT)**
- 4. Saharan Air Layer (SAL) Product**
- 5. Pseudo Natural Color Imagery**
- 6. GOES-R Natural Color Imagery**
- 7. Red-Green-Blue (RGB) Air Mass Product**
- 8. RGB Dust Product**
- 9. Rapid Intensification Index (RII)**

GOES-15: Sample "1-min" imagery

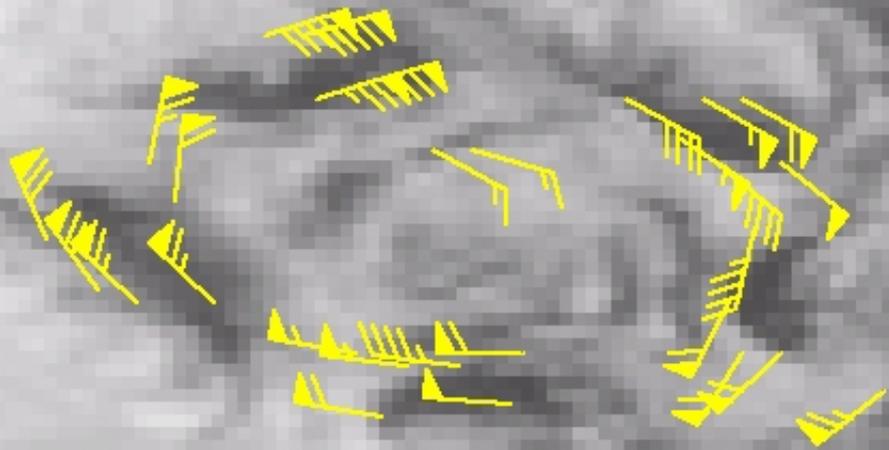


1-min



30-min

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



From C. Velden, UW/CIMSS

GOES-12 SRS0 12 SEP 03 13:07 UTC HURRICANE ISABEL

Rapid scan (3-min) low-level winds in the hurricane eye

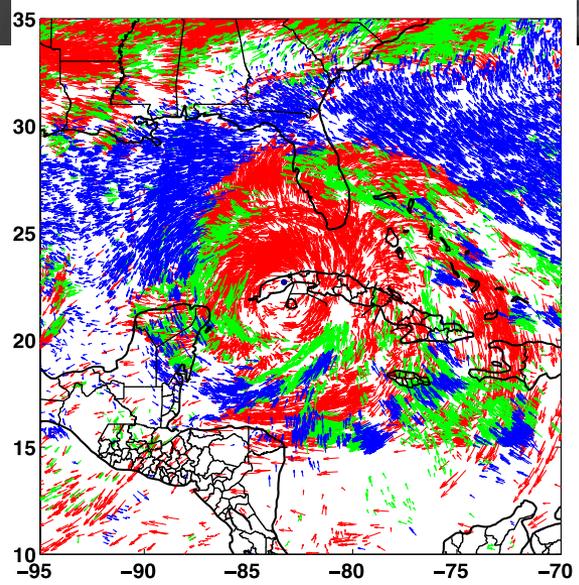
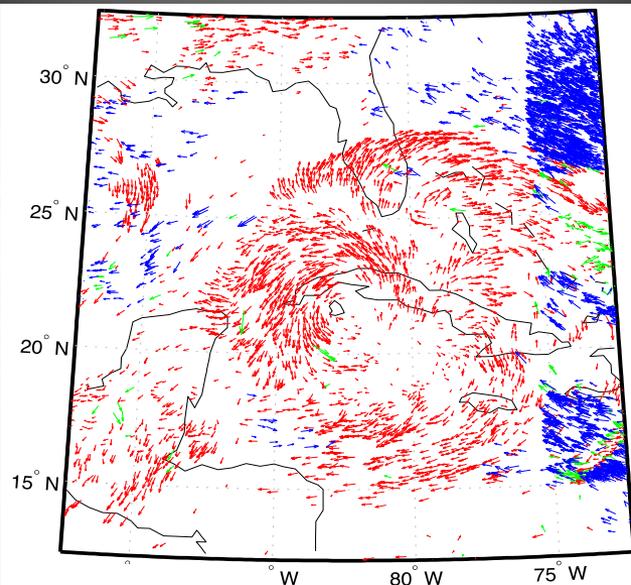
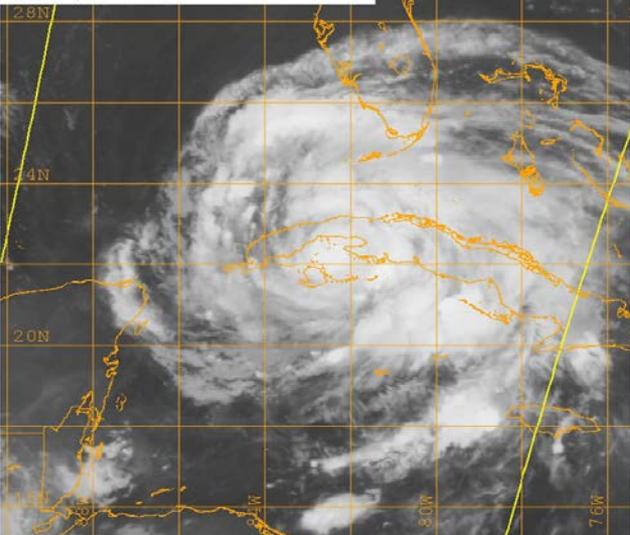


Influence of Assimilating High-resolution Satellite-Derived Winds on Mesoscale Analyses and Forecasts of Tropical Cyclones

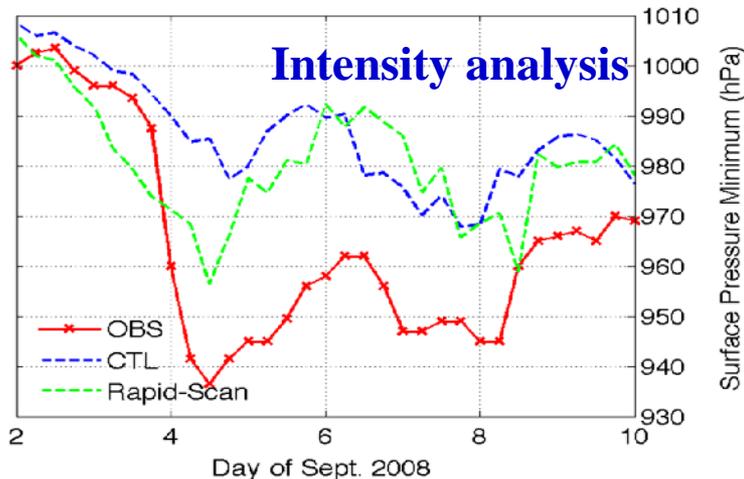
-- Example: Hurricane Ike (2008) --



09/09/08 1200Z 091 IKE
09/09/08 1215Z F-15 OVERPASS
09/09/08 1215Z GOES-12 IR

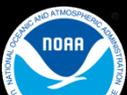


$P \leq 350$ hPa $350 < P \leq 800$ hPa $P > 800$ hPa

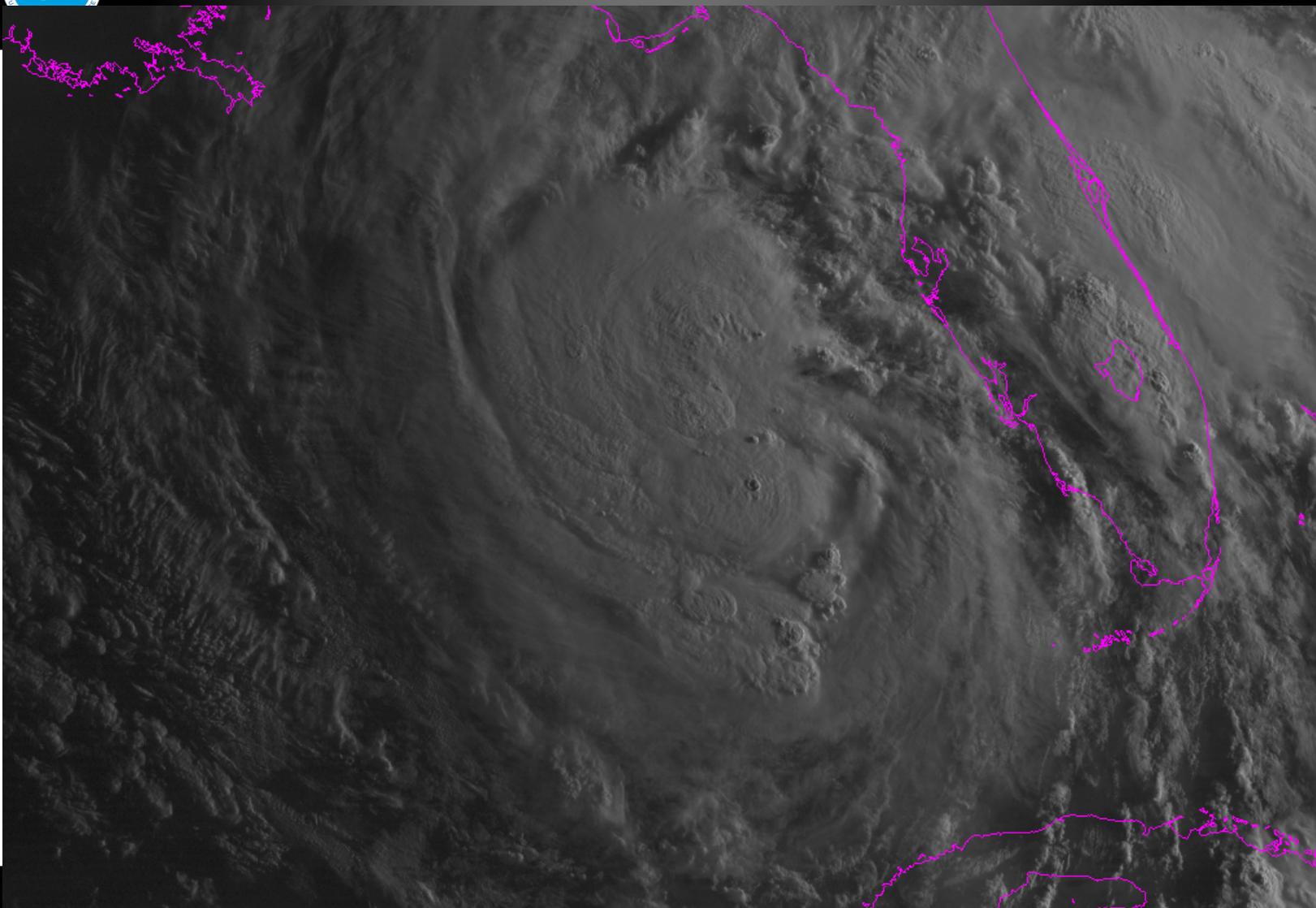


Above: As a proxy for GOES-R 5-minute imagery, GOES-East rapid-scan imagery (7-min) is used to derive winds. The coverage vs. normally-available winds is substantially increased over Hurricane Ike.

Left: Assimilation of the rapid-scan winds into the mesoscale DART/WRF system produces superior analyses of Hurricane Ike's intensity (OBS) over a Control (CTL) without the winds. *C. Velden, CIMSS*



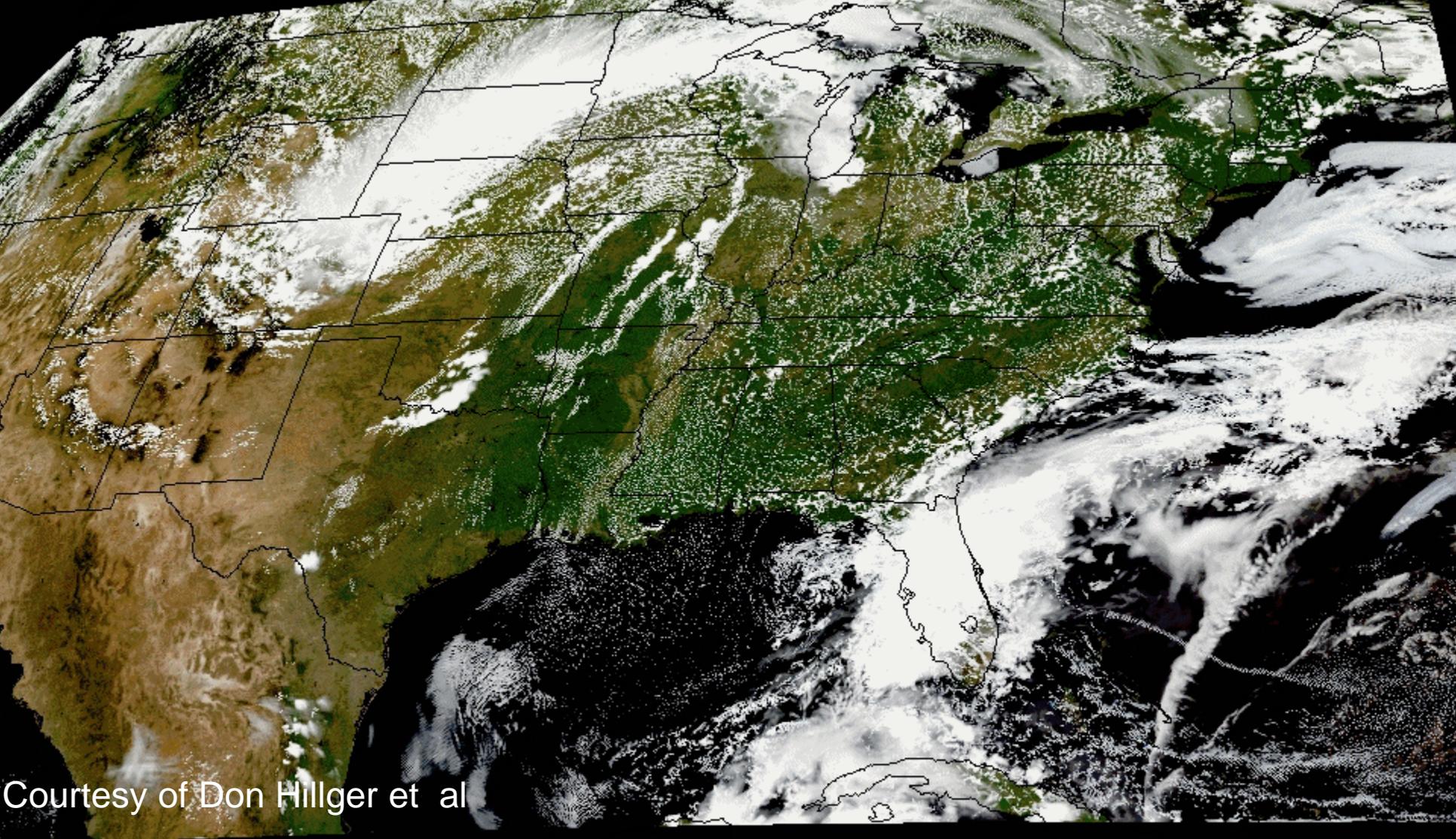
GOES-14 SRSO for Isaac 8/27



10001 G-14 IMG 1 27 AUG 12240 120000 04855 17412 01.00

McIDAS

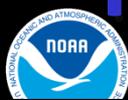
21



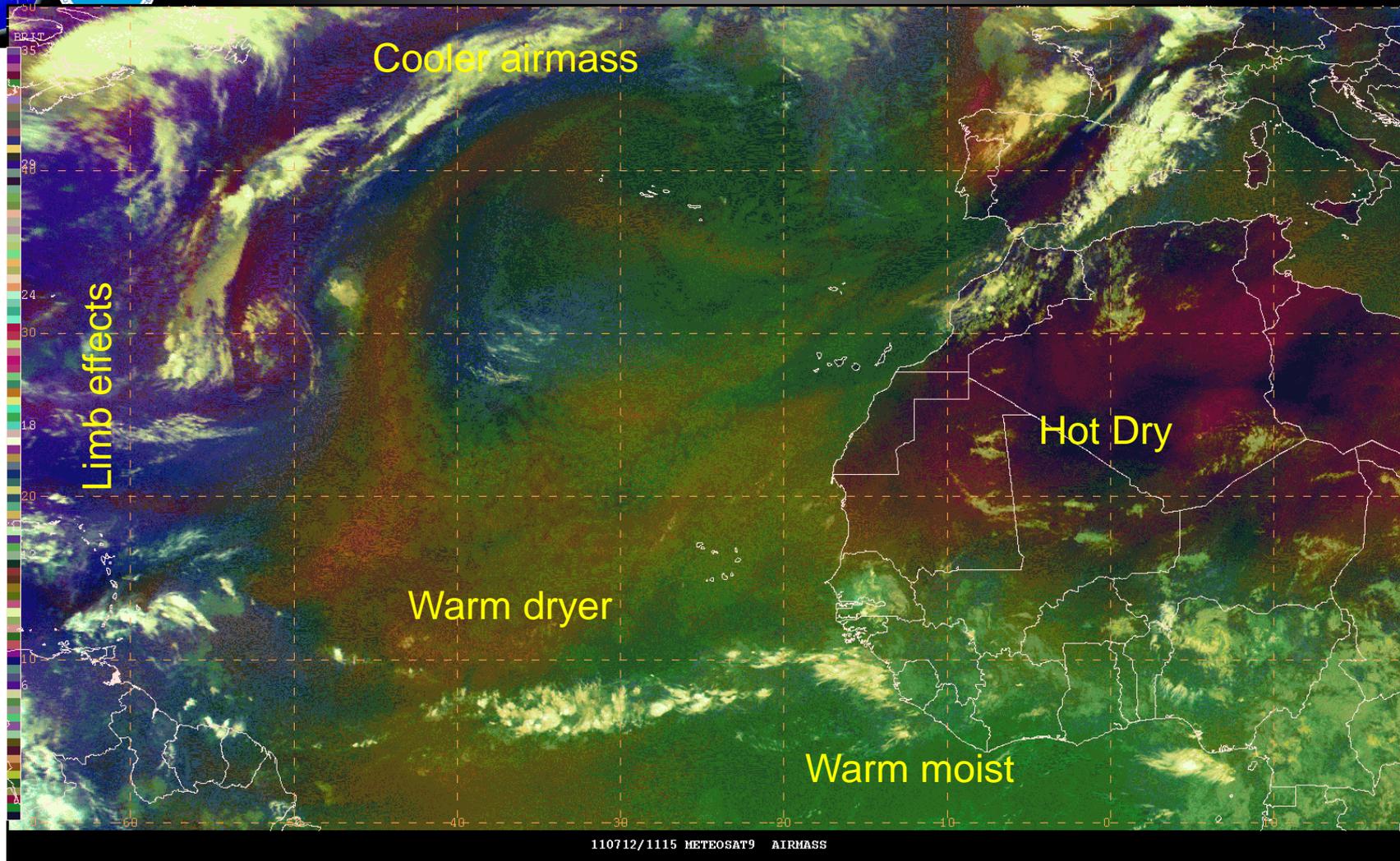
Courtesy of Don Hillger et al

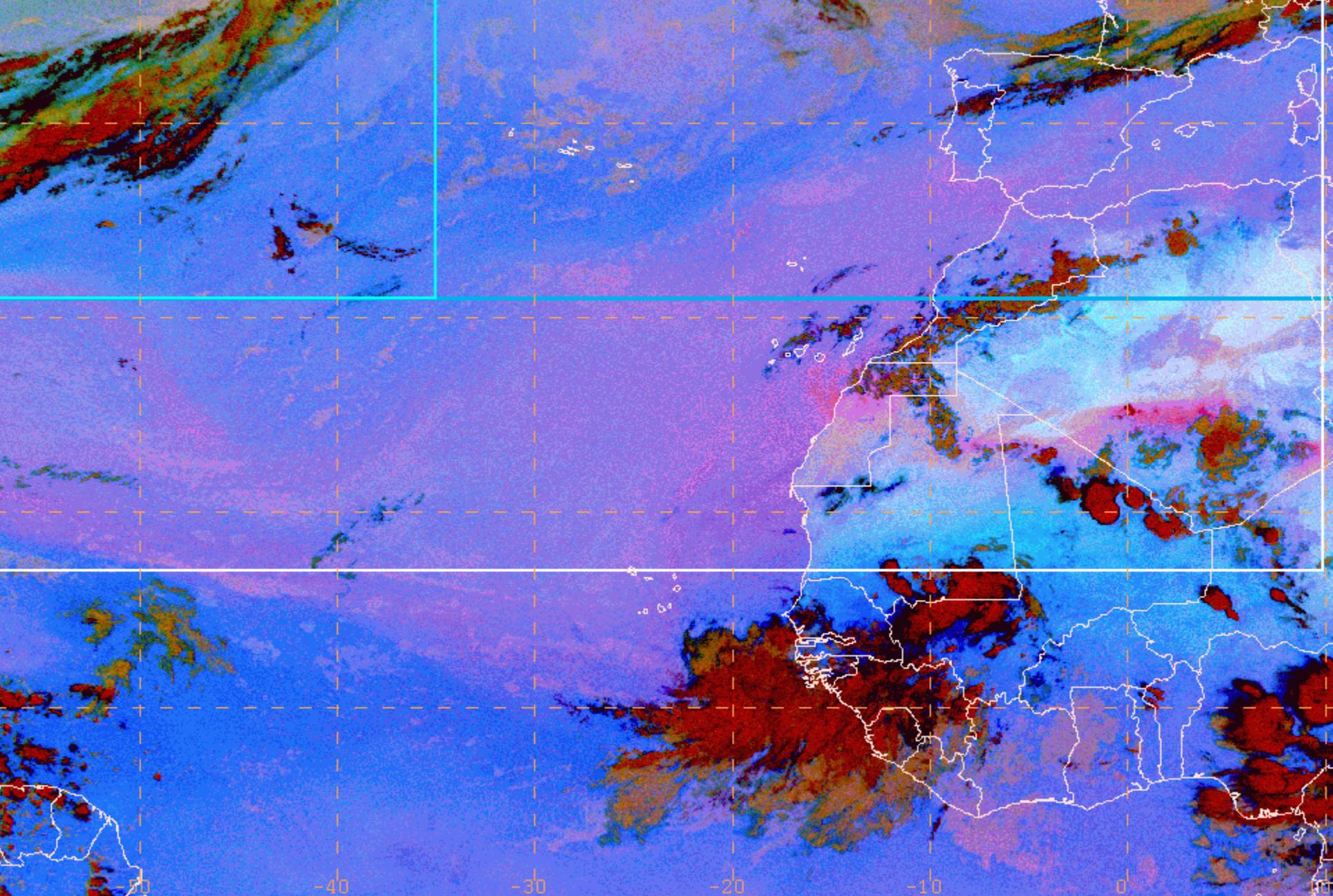
G-16 IMG 2005-06-04 2200 UTC BAND 4 (RGB) 0.55 UM

NOAA/CI



RGB Air Mass Product from SEVIRI





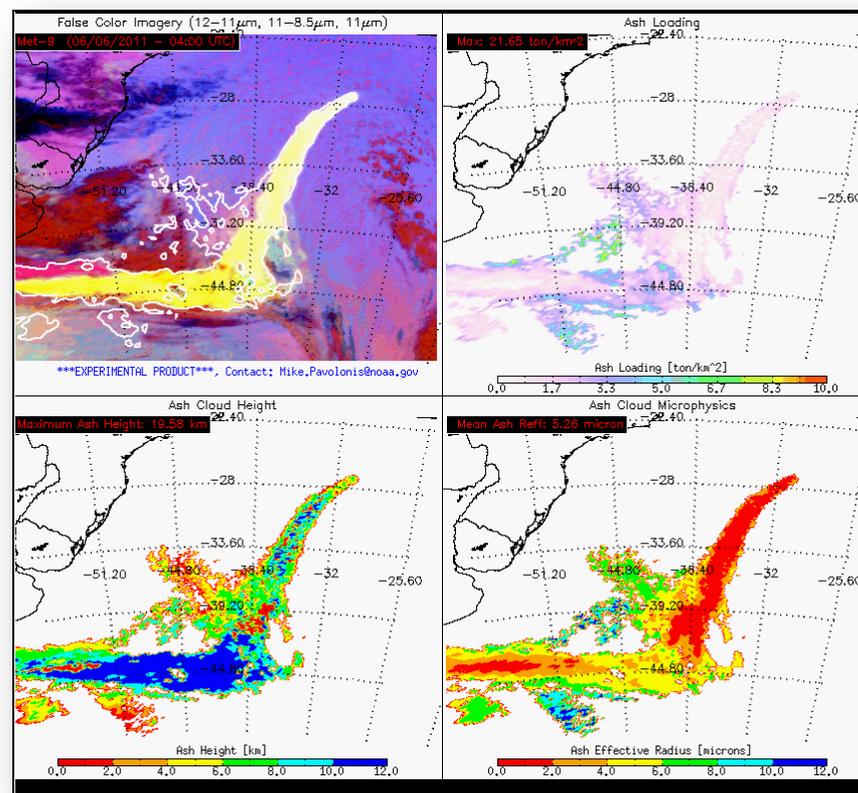
120720/1915 METEOSAT9 DUST



Aviation Baseline Product: Volcanic Ash Product Suite



- Chile's Puyehue-Cordón Caulle Volcano erupted on June 4, 2011, forming a tall ash plume above the Andes Mountains
- The GOES-R Proving Ground provides near real-time volcanic ash retrieval products (using Meteosat SEVIRI data as a proxy for the GOES-R Advanced Baseline Imager) to identify a significant volcanic ash plume emerging over the Atlantic Ocean impacting aviation operations with many cancelled flights.
- Similar data was provided by STAR to the London Volcanic Ash Advisory Center (VAAC) during the eruption of Eyjafjallajökull in Iceland in May 2010.



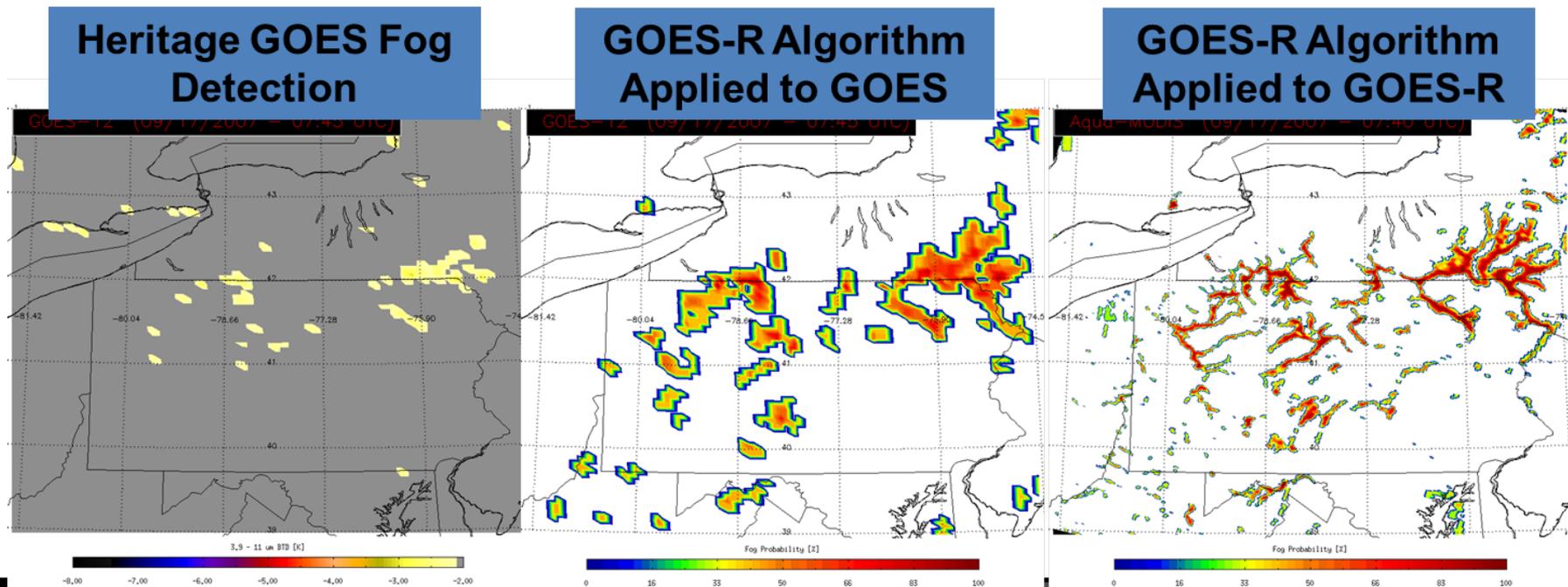


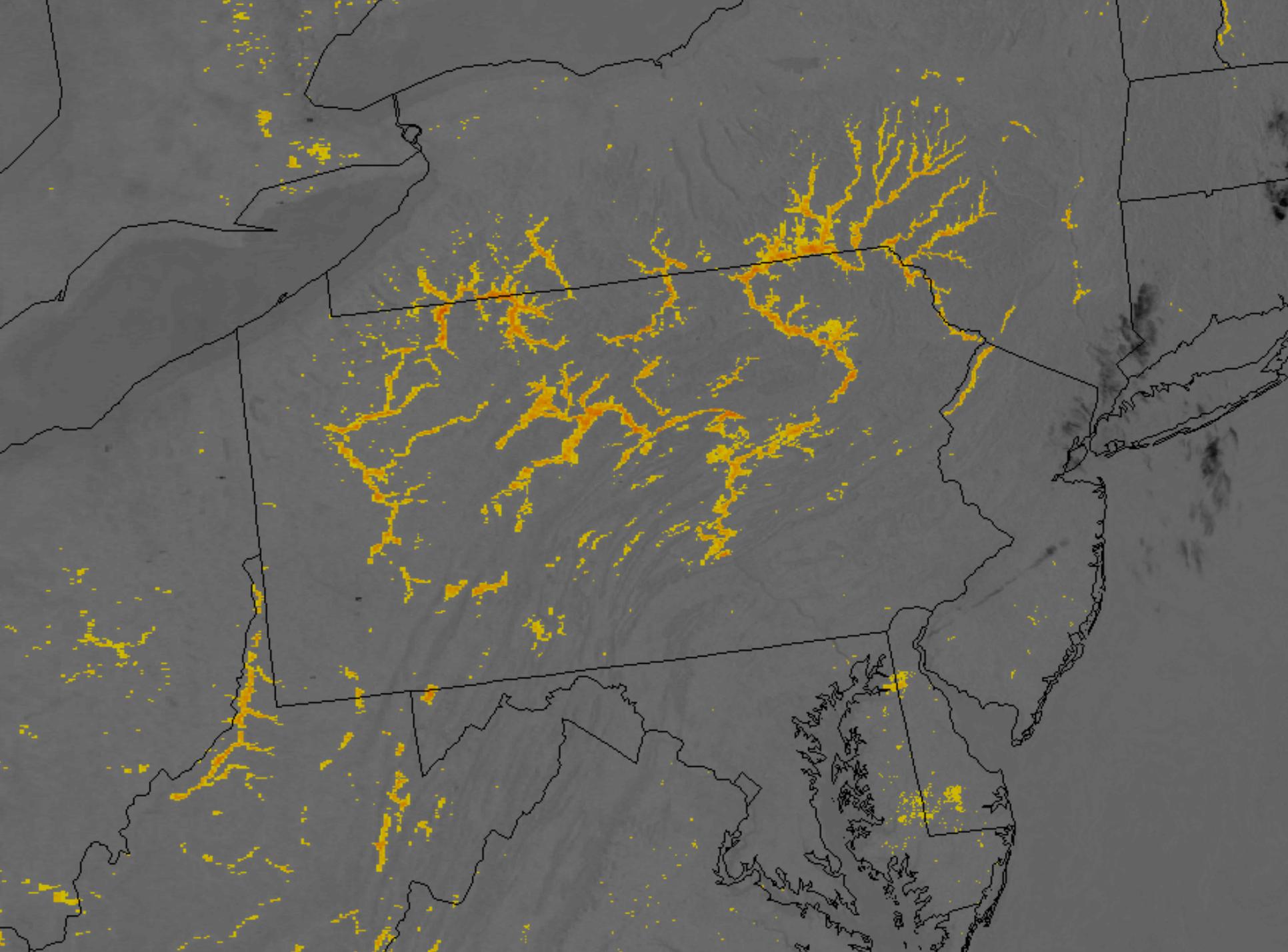
Future Capability: Fog Detection



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







HWT Spring Experiment



– Forecasters pleased with **“Strength of Signal”** output from SATCAST

- Used SATCAST 83% of time during warning ops in EWP
- Increased SATCAST strength 30-60 min prior to CI with potential for longer lead times for severe
- “We’ve seen this all week... UAH gives a heads up that general convection is building, then a short time later UW-CTC typically picks up on the stronger convection building.”
- Increase in false alarm rate over high terrain
- 88% of participants comfortable using the product

– **Cloud Top Cooling Rate (UW-CTC)**

- Used CTC 89% of time during warning ops
- Lead time over occurrence of 60 dBZ composite reflectivity and 1.0 MESH: 10 – 90 min with most around 30 min
- With knowledge of environment and ongoing supercell activity... warnings issued with CTC



HWT Spring Experiment



– Simulated Satellite Imagery

- “Synthetic WRF imagery can enhance forecasts by providing model data in a familiar satellite format which makes model analysis, model comparison to obs and model forecast projections easier to visualize and understand”

– Pseudo Geostationary Lightning Mapper (pGLM)

- Total lightning data showed good correlation with updraft intensity and typically seen “well ahead of the first CG (cloud to ground) flash
- Pulled focus to individual storms of interest
- Particularly useful during days with marginally severe and numerous storms over CWA

– Nearcast

- Forecasters used Nearcast product 70% of time in warning ops
- Found instability fields particularly useful in determining convective maintenance

– GOES Sounder Airmass RGB

- Useful for quick look at synoptic scale atmosphere
- “Looping this product can show airmass movement and jet position/structure”



NHC First Half Highlights

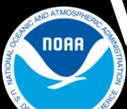
- Many SRSO cases obtained from GOES-14
 - ASPB and CIMSS lead
- Most RGB and related products in N-AWIPS
 - Air Mass (SEVIRI and GOES sounder), Dust, Pseudo-Natural Color, SAL
- Very positive feedback on RGB Air Mass Product
 - Used in NHC forecast discussions and TAFB tropical weather discussions
- NHC leveraging data distribution from SPoRT to get routine microwave imagery
 - *One of the most useful NHC PG contributions so far*



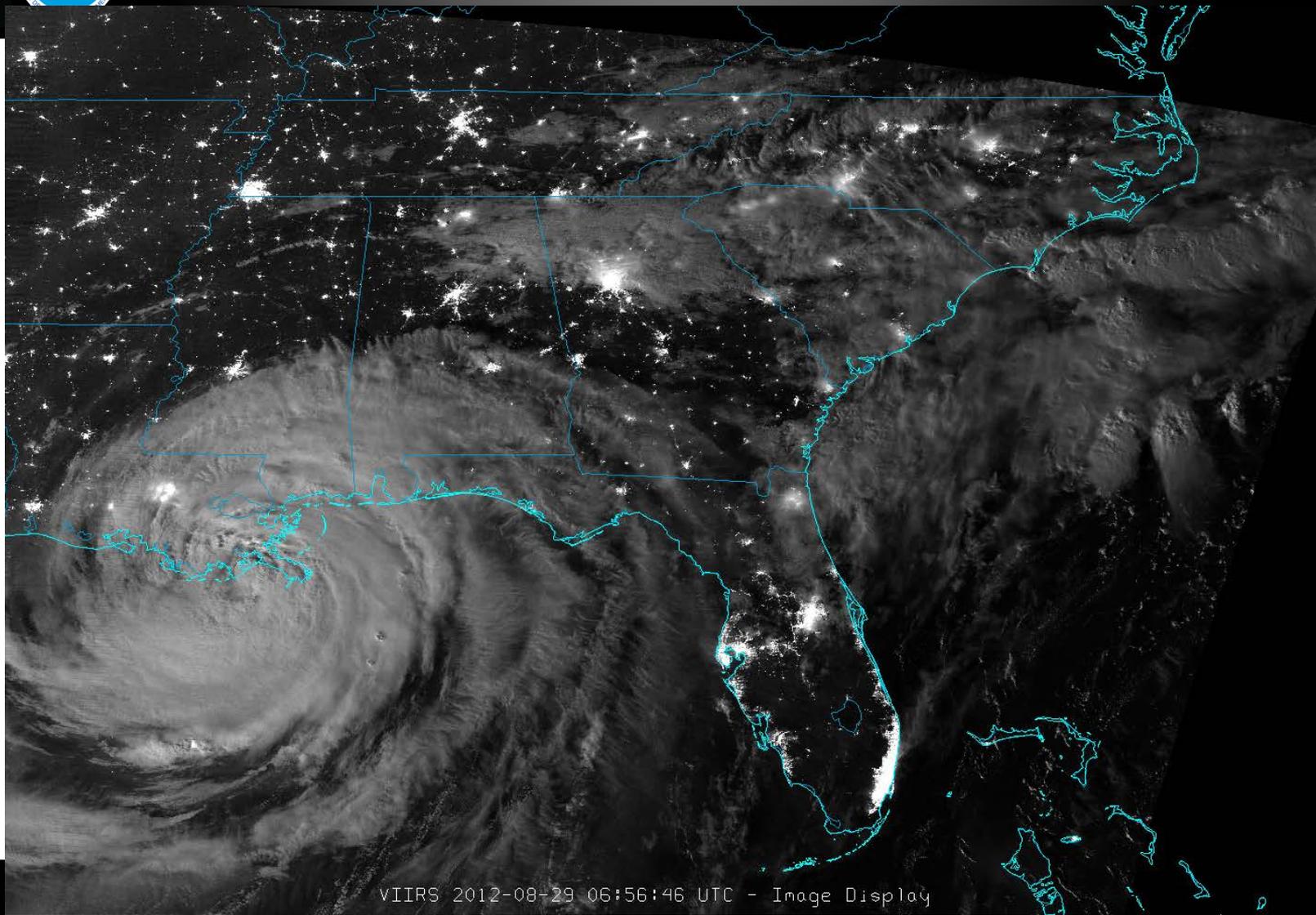
Plans for 2013



- Add new RGB products for storm inner core
 - Most RGB products for storm environment
- Work towards direct generation of RGB products on NHC AWIPS-2 systems
- Add NPP Products
 - High resolution Vis, IR, Day-Night Band
 - Direct readout from CIMSS for CONUS
 - Larger domain from NESDIS + other sources
- ATMS/CrIS
 - Temperature/moisture soundings
 - Intensity/size retrievals
 - Maximum potential intensity estimates



VIIRS Day-Night Band for Hurricane Isaac



VIIRS 2012-08-29 06:56:46 UTC - Image Display



AWC 2012 demonstration forecaster input



- CTC: 'this product is an excellent source of enhancing the situational awareness for future convective initiation, particularly in rapid scan mode'
- NearCasting: 'The product was VERY useful in terms of assessing where the atmosphere would be most favorable for convection should there be a trigger and/or broad-scale lift support'
- Fog/Low Cloud: 'This product will be very helpful in identifying both advancing and dissipating fog layers, particularly on the West Coast.'
- PGLM: This product showed potential in identifying electrically active areas not associated with CG strikes.



Additional 2012 Demonstrations



- OPC and SAB (Camp Springs MD)
 - Focus on offshore thunderstorms
- High Latitude and Arctic Experiment (Alaska Region)
 - Focus on snow/cloud/ash/aviation
- HPC and SAB (Camp Springs MD)
 - Focus on precipitation/QPF
- Air Quality (UMBC)
 - Focus on aerosol detection
- Pacific Region (Hawaii)
 - Focus on tropical cyclones/heavy rainfall/aviation
- Space Weather (NWS SWPC: Boulder CO)
 - Focus on GOES-R like level 2 products

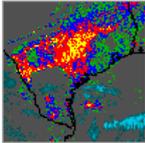
Training and Education



Online Training Modules

- GOES-R: Benefits of Next-Generation Environmental Monitoring (COMET)
- GOES-R 101
- Satellite Hydrology and Meteorology for Forecasters (SHyMet)
- SPoRT product training modules
- Commerce Learning Center

TRAINING



GOES Fog Depth
[Download](#) (for NWS users)
[Launch](#) in browser
 (user guide)

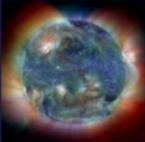
This training module focuses on the use of the Fog Depth product within the GOES Aviation suite provided through a collaboration between SPoRT and NESDIS. The use of this product along with the Low Cloud Base product is demonstrated in support of aviation forecasts of ceiling and visibility. This module takes 16 minutes to complete and requires the flash plug-in. (May 2008)

Printed Materials

- GOES-R Fact Sheets (17)
- GOES-R Tri-fold



GOES-R 101





Bernie Connell¹, Timothy J. Schmit^{2,3}, Jim Gurka⁵,
 Steve Goodman⁶, Don Hillger^{2,4}, Steven Hill⁶,
 And many other contributors

GOES-R Program in cooperation with
 Satellite Hydrology and Meteorology (SHyMet) Forecasters Course

¹ Cooperative Institute for Research in the Atmosphere, Colorado State University

² NOAA/NESDIS Satellite Applications Research

³ Advanced Satellite Products Branch

⁴ Regional and Mesoscale Meteorology Branch

⁵ NOAA/NESDIS/OSD GOES-R Program Office

⁶ NOAA/NWS Space Weather Prediction Center

⁷ Cooperative Institute for Meteorological Satellite Studies, University of Wisconsin-Madison

Outreach Projects (with NWSFOs)

- COMET will reach out to the GOES-R Proving Ground Partners and connect them with university faculty to use current and prototype data products for the purpose of building a bridge from products that are currently available to those that will become available when GOES-R is launched.



Future Plans: 2013 And Beyond



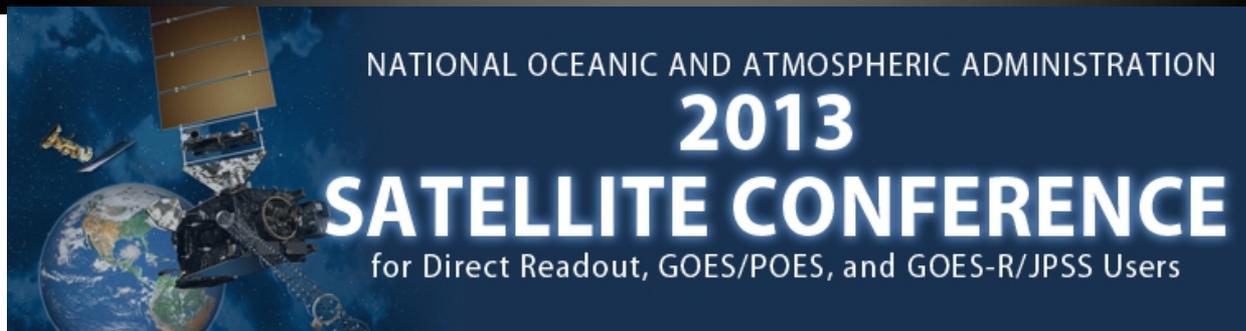
- Continue to apply lessons learned to incorporate new improvements each year. Example:
 - From HWT Spring Experiment... obvious that forecaster application of new products improves with additional training. In 2012 forecasters had access to satellite training material prior to arrival in Norman.
- Demonstrate 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
- 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 2013 and beyond.
- For GOES-R to be a success, forecasters must be able to use GOES-R products on Day 1!



Call for Poster Abstracts
NOAA Satellite Conference
for
Direct Readout, GOES/POES, and GOES-R/JPSS Users
NOAA Center for Weather and Climate Prediction (NCWCP)
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For more information:
<http://satelliteconferences.noaa.gov/2013/>

Questions?

