

# The GOES-R Proving Ground: 2012 Update



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# Outline



- What is the GOES-R Proving Ground?
- Examples of GOES-R Proxy Products tested at:
  - Cooperative Institutes
  - HWT Spring Experiment
  - NHC 2011 Hurricane Season
  - Aviation Testbed at AWC and Alaska
- Lessons Learned and User Input
- PG activities in 2012
- 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



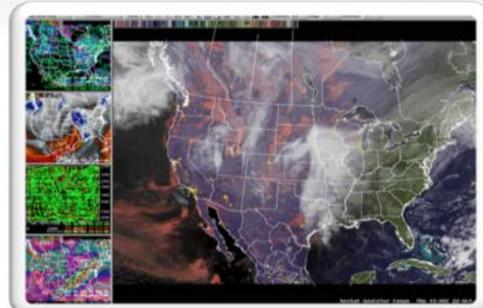
The GOES-R Proving Ground engages NWS in pre-operational demonstrations of selected capabilities of next generation GOES

- **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

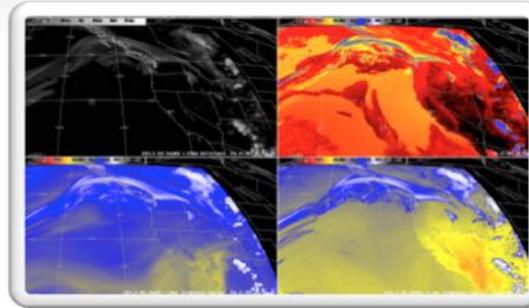
Intended outcomes are Day-1 readiness and maximum utilization for both the developers and users of GOES-R products, and an effective transition to operations



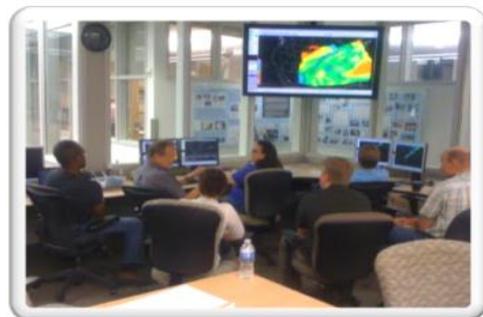
# GOES-R Proving Ground Partners



**CIRA - Ft. Collins, CO**  
ABI Simulated Natural Color

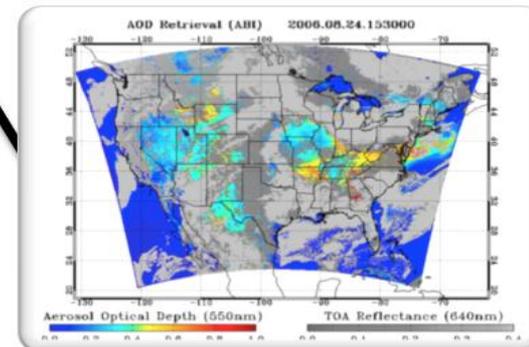


**CIMSS - Madison, WI**  
Simulated ABI Bands

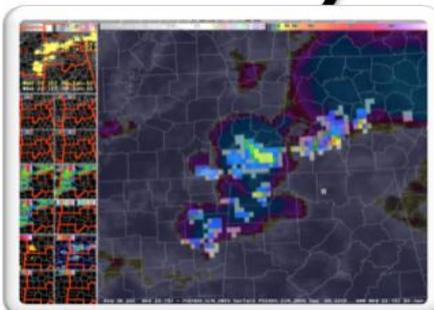


**SPC - Oklahoma City, OK**  
Nearcast Training at the Hazardous Weather Testbed

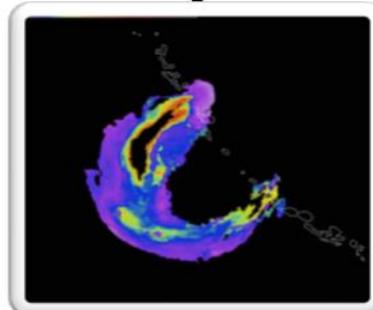
-  PG Evaluation Partner
-  PG Product Development Partner
-  Cooperative Institute



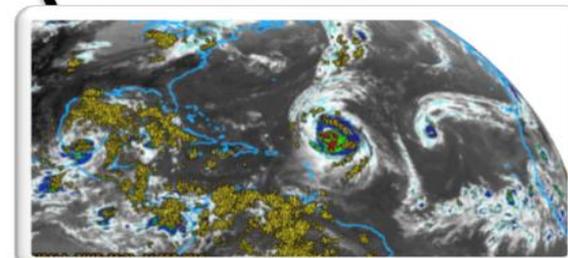
**STAR - Camp Springs, MD**  
Aerosol Optical Depth Product



**SPoRT - Huntsville, AL**  
GLM Lightning Flash Density



**AFC - Anchorage, AK**  
Volcanic Ash Product



**NHC - Miami, FL**  
Rapid Intensification Index



# 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
- SO<sub>2</sub> Detection

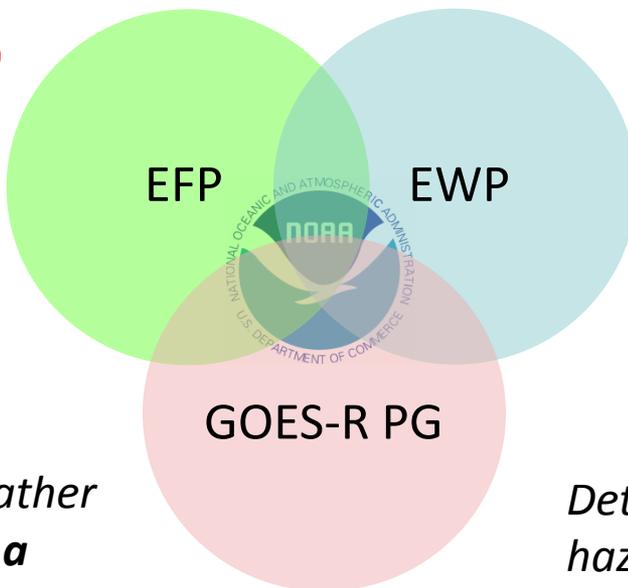


# NOAA's Hazardous Weather Testbed



**E**xperimental  
**F**orecast  
**P**rogram

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



**E**xperimental  
**W**arning  
**P**rogram

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



# 2011 Spring Experiment



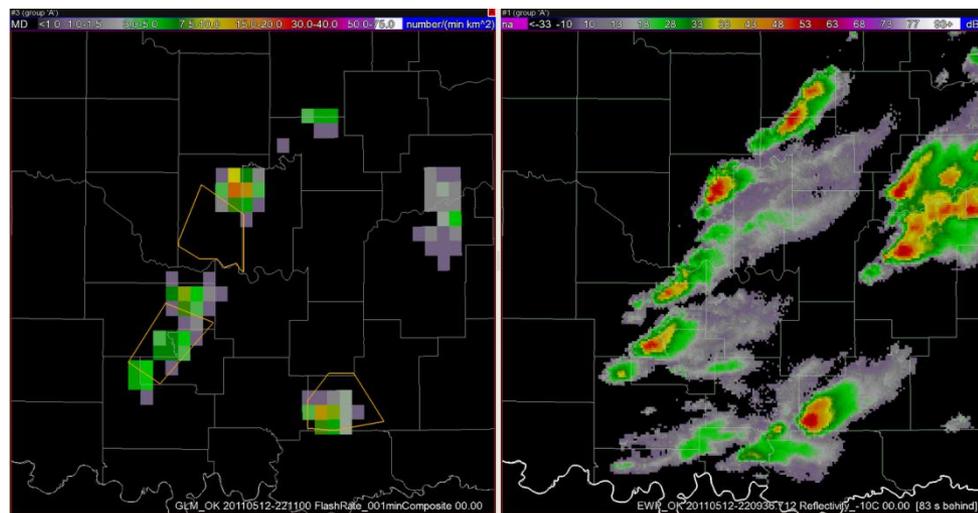
- 5 week period May 9 – June 10
- 24 NWS forecasters and a multitude of visiting scientists participated
- New convective initiation desk within EFP
  - Most used products included simulated CMI; band differences; Nearcast products
  - Direct application to their 3-6 hour forecast time scale
- Morning shift created within the EWP to better integrate GOES-R products into warning operations
  - Most used products included convective initiation nowcast product and pseudo GLM total lightning product



# Baseline Product: Lightning Detection with the Geostationary Lightning Mapper (GLM)



- A Pseudo GLM (PGLM) total lightning product assisted in a severe thunderstorm warning at NOAA's Hazardous Weather Testbed on May 12, 2011 in Norman, Oklahoma. A rapid increase of the total lightning rate, along with the forecaster's interrogation of radar data, led to a severe thunderstorm warning, later verified with several severe hail reports.
- Research using total lightning trends to diagnose severe storm intensification indicates the potential to increase warning lead-time to 20 minutes or more
- The PGLM flash extent density was a useful precursor in identifying when the first cloud-to-ground strikes would occur. The PGLM preceded the first cloud-to-ground strike by approximately 30 minutes.
- GLM's ability to detect in-cloud lightning before the first ground strike provides a valuable early warning indicator to enhance lightning safety



The PGLM flash extent density is on the left with the corresponding radar reflectivity on the right.



# 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!**

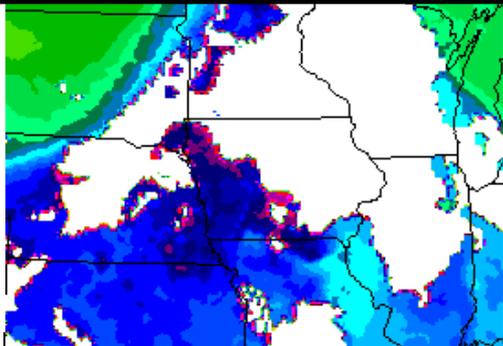
Hourly, multi-layered observations from the GOES Sounder are projected forward in time along Lagrangian trajectories forced by gradient winds. "Trajectory observations" from the previous six hours are retained in the analysis. Destabilization is indicated when theta-E decreases with height.

## 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

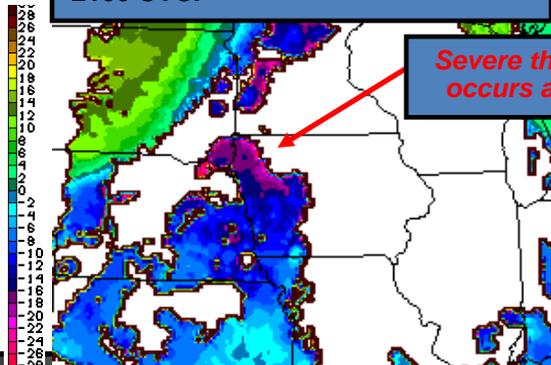
## One Example of a Successful Near-cast

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



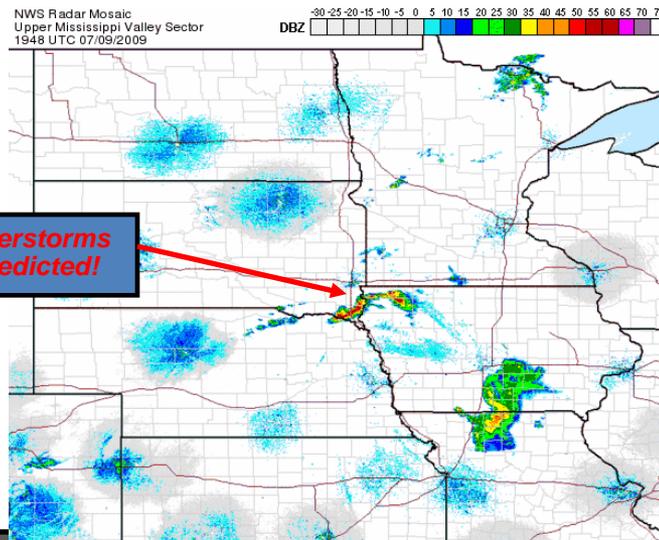
6-hour NearCast for 2100 UTC  
Low level Theta-E

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



# HWT 2011 Spring Experiment



## Evaluating Products with greatest operational value

- Nearcasting products
  - Routinely used at all the desks in both the EFP and EWP
  - Did a good job showing where convection is likely and just as important... where it can be ruled out in the next 1-6 hours
- LMA: pseudo GLM products
  - Routinely used in the EWP
  - Extremely useful during warning ops to ID cells with rapid intensification
  - Numerous examples operational value in generating forecasts and warnings and in identifying when 1<sup>st</sup> cloud to ground flash will occur
- Simulated CMI from NSSL WRF
  - Part of daily routine at the CI desk for model performance evaluation
  - Forecasters impressed with capability to detect low-level moisture pooling and convective instability via band differences



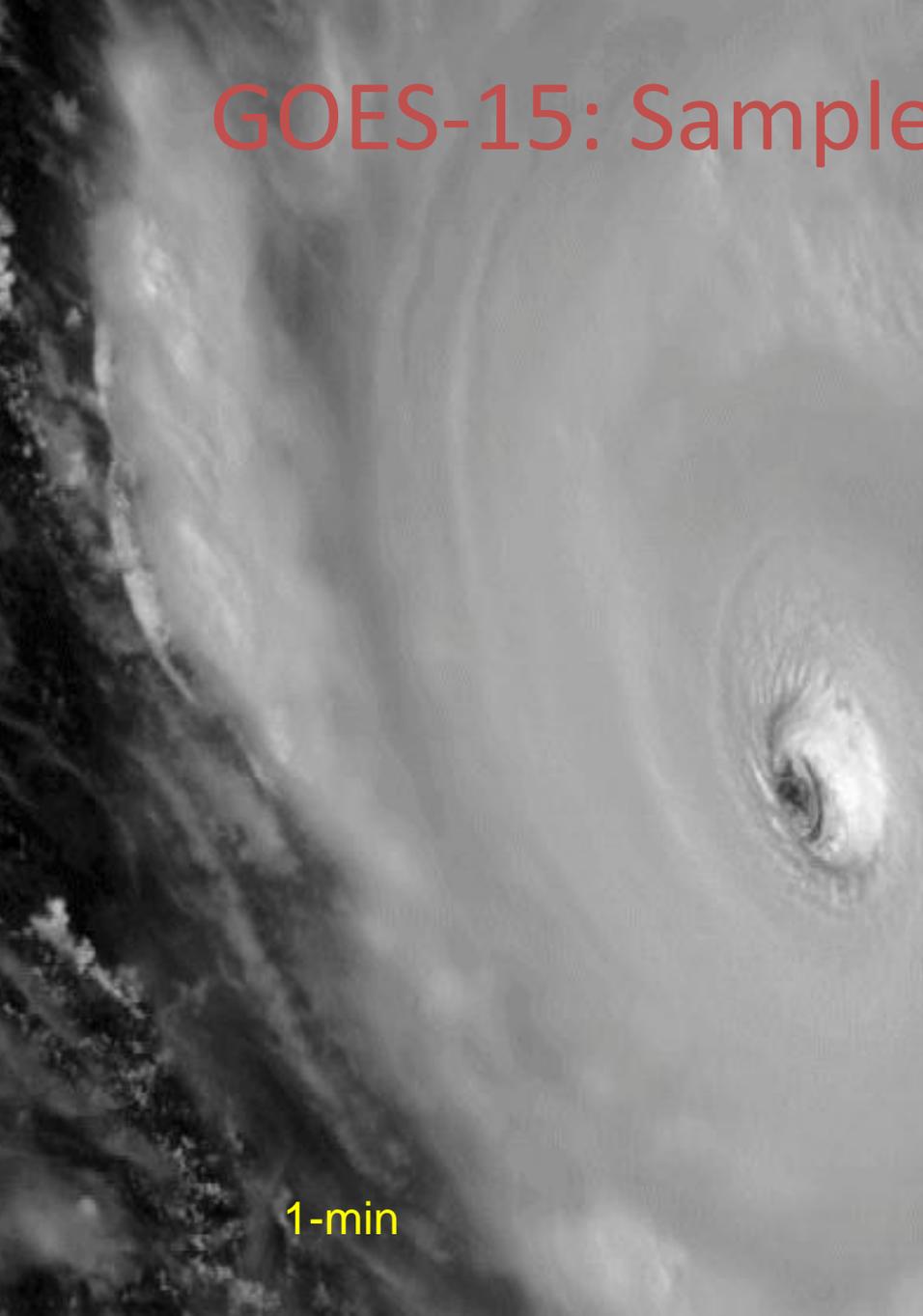
# HWT: Forecaster Feedback from 2011 Lightning Detection



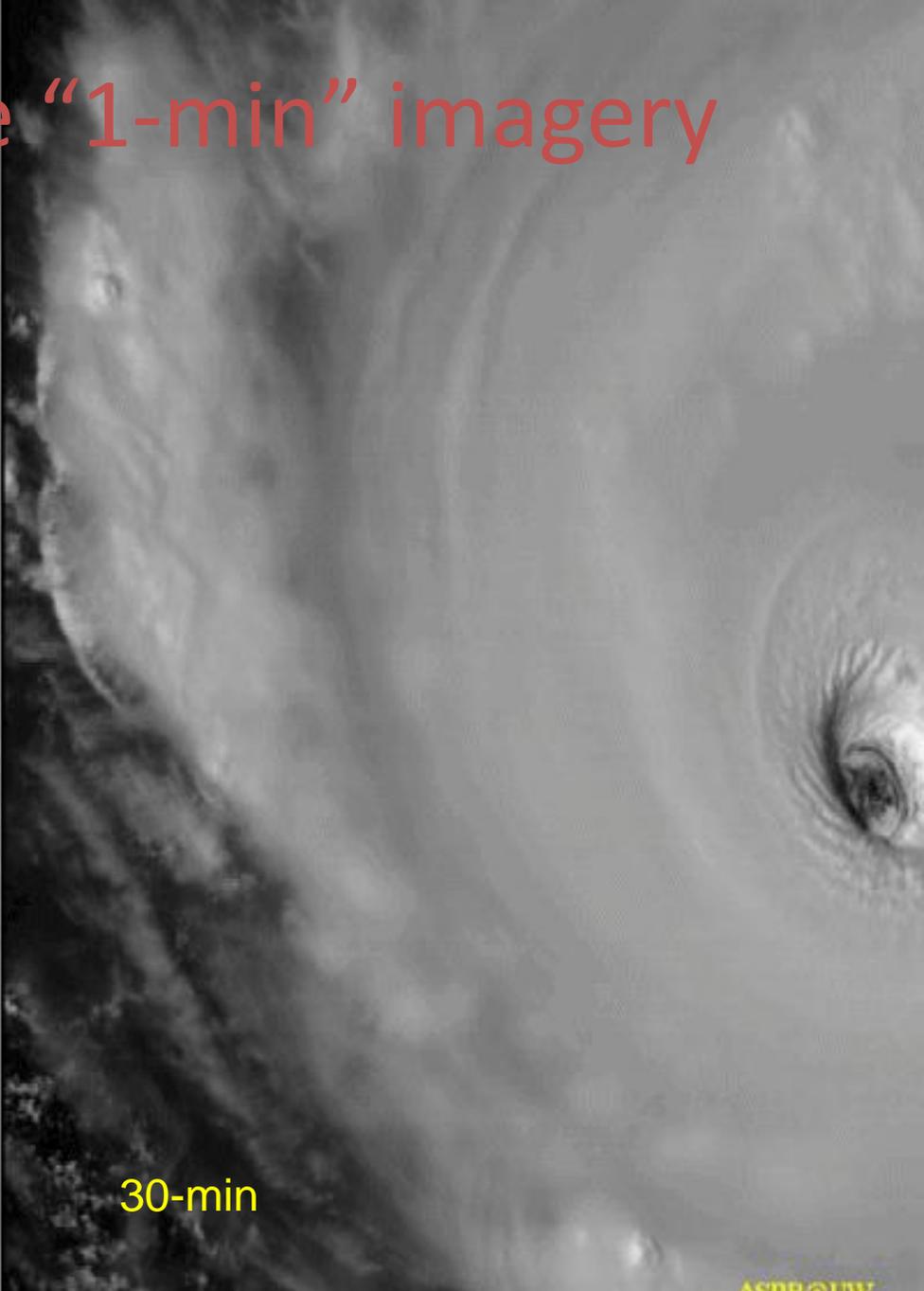
- “The total lightning data is an excellent tool for monitoring convection, I see much promise for such data in the future, especially since CG strikes may be only a small fraction of the total lightning strikes within a given storm.”
- “I utilized it as a situational awareness product and then kept a watch on my tried and true radar practices to issue the warning. The PGLM data gave me more confidence in my warning. Which is always something that is positive.”



# GOES-15: Sample "1-min" imagery

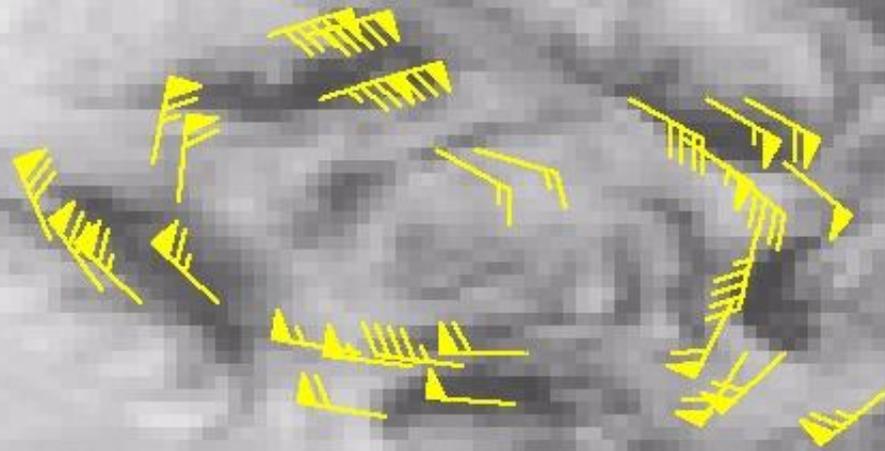


1-min



30-min

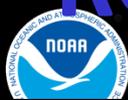
Visible data from the recent NOAA Science Test, lead by Hillger and Schmit



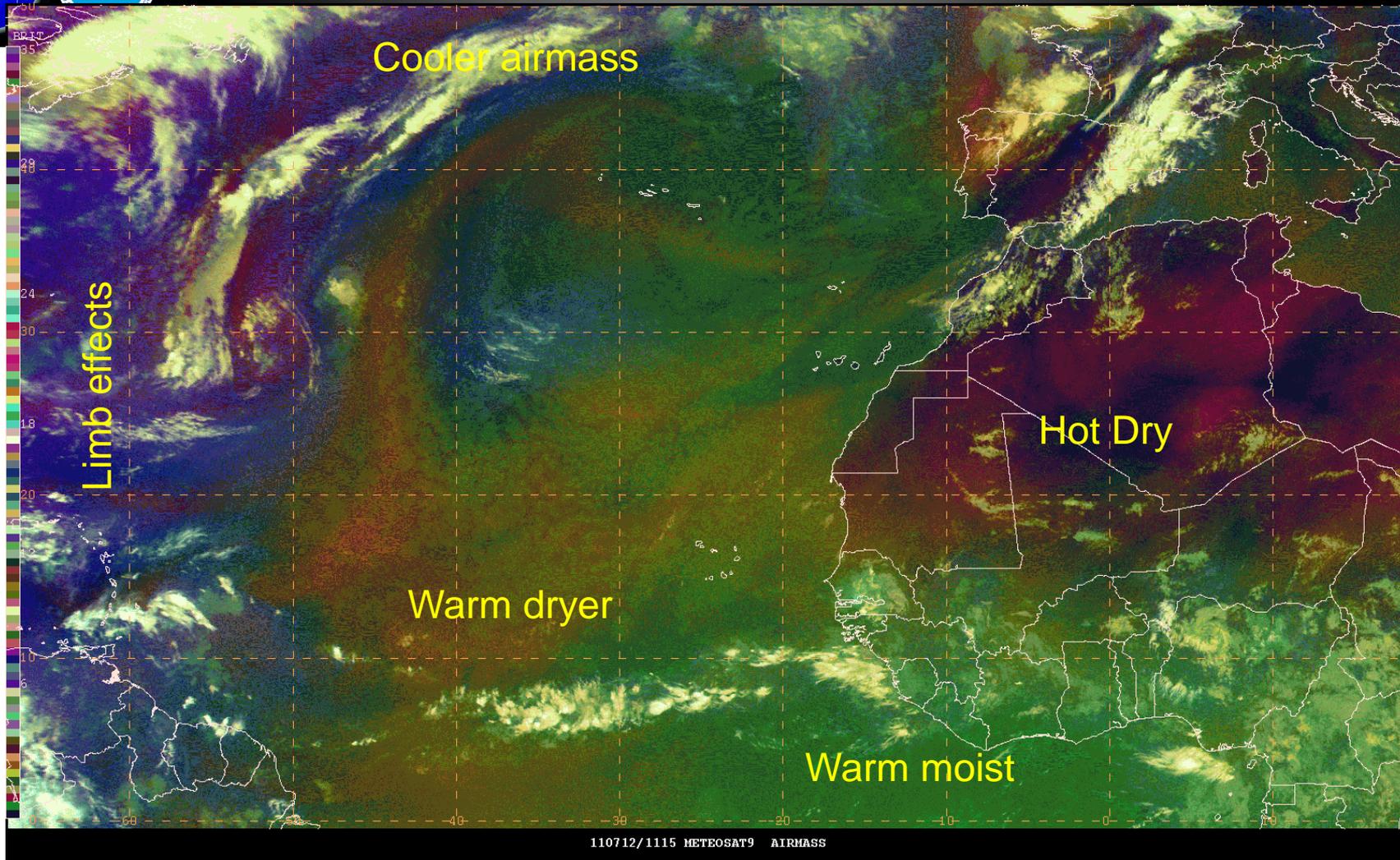
From C. Velden, UW/CIMSS

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

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



# RGB Air Mass Product from SEVIRI





# 2011 NHC Experiment



## Products evaluated and user feedback:

- Hurricane Intensity Estimate (HIE)
  - Generated from MSG and GOES-East
  - HIE more responsive in showing intensification compared to ADT
  - Useful in decision to upgrade TD 12 to Katia
- RGB Air Mass Product
  - Generated from MSG and GOES Sounder.
  - Availability in N-AWIPS greatly increased utility
  - Helped Identify extratropical transition of Lee, Irene & Katia
  - Color contrast too subtle in GOES Sounder version
  - May need a limb correction for SEVIRI version
- SAL Product
  - SEVIRI based product: only available via web pages.... needed on N-AWIPS
- SRSO data
  - Valuable around sunrise for storm center location; and A/C recon go – no go decisions
  - Per forecaster recommendation... web site at CIRA with PG SRSO cases for further study
    - <http://rammb.cira.colostate.edu/products/sroso/>
- GOES-R Natural Color Imagery
  - Generated from MODIS.... Problem with image too green at large zenith angles... correction under development



# 2011 NHC Experiment



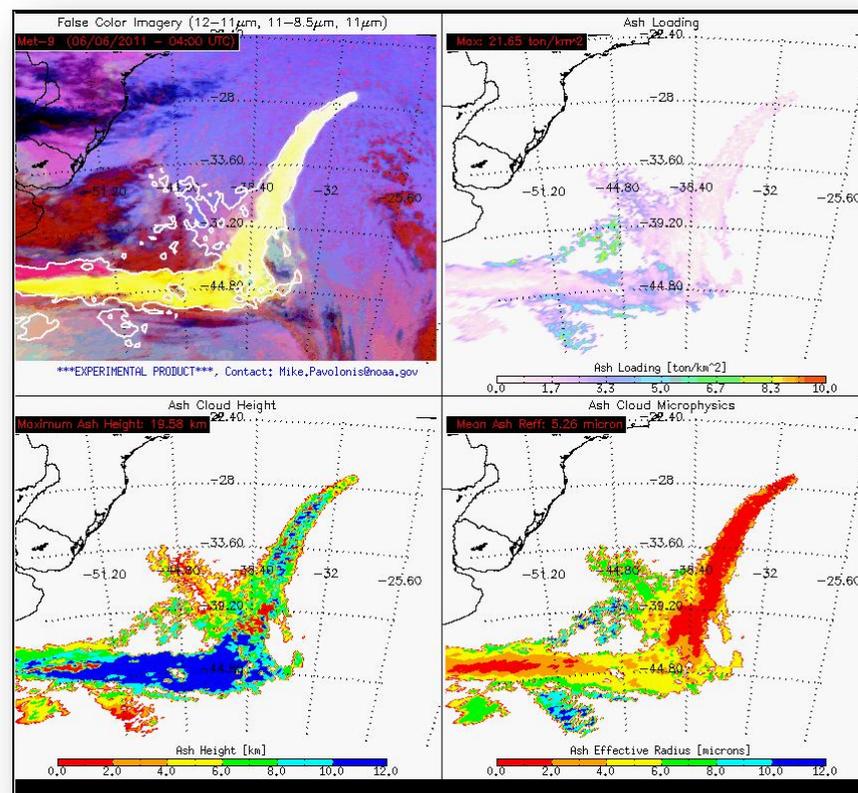
- Rapid Intensification Index (RII)
  - CIRA to perform quantitative evaluation of entire 2011 season
  - Rapid Weakening Index showed some promise in East Pacific
  - Lightning time series plot may be useful to ID intensifying or weakening systems
  - May be a correlation between rapid intensification and overshooting tops... to be investigated
- RGB Dust Product
  - MSG product... utilization increased with move to N-AWIPS
  - Very useful in showing that pre-Irene disturbance would have dry air issues
  - Some large outbreaks can be identified to the outer edge of image
  - Limitation: Stratocumulus shows up as dust... refined version being worked.
- Tropical Overshooting Top Detection
  - Inconclusive... but may be useful for locating most active areas of convection



# 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.



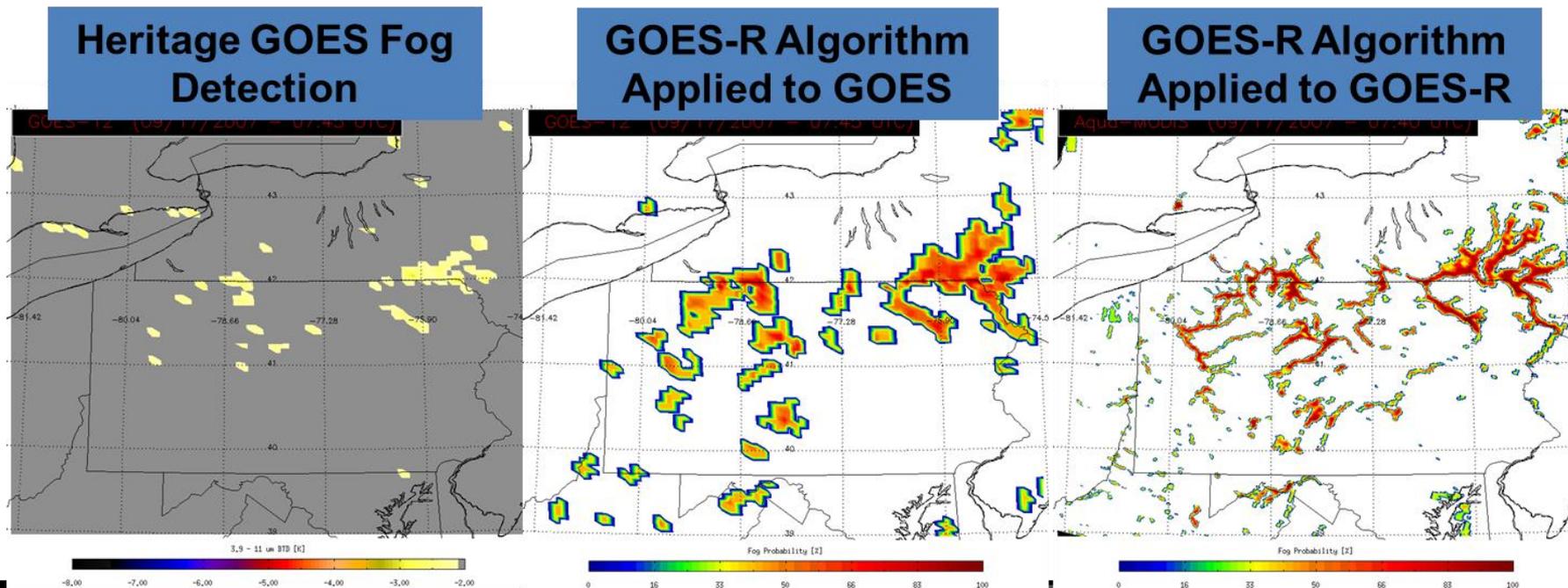


# Future Capability: Fog Detection



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





# Training and Education



GOES-R:  
Benefits of Next-Generation  
Environmental Monitoring

GOES-R Mission

Health Impacts

Satellite System and Services

Satellite Synergy

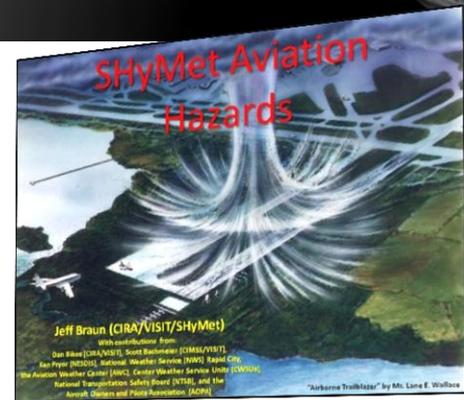
Global Observing System

## GOES-R 101

Bernie Connell<sup>1</sup>, Timothy J. Schmit<sup>2,3</sup>, Jim Gurka<sup>5</sup>,  
Steve Goodman<sup>5</sup>, Don Hillger<sup>2,4</sup>, Steven Hill<sup>6</sup>,  
And many other contributors

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

<sup>1</sup> Cooperative Institute for Research in the Atmosphere, Colorado State University  
<sup>2</sup> NOAA/NESDIS Satellite Applications Research  
<sup>3</sup> Advanced Satellite Products Branch  
<sup>4</sup> Regional and Mesoscale Meteorology Branch  
<sup>5</sup> NOAA/NESDIS/OSD GOES-R Program Office  
<sup>6</sup> NOAA/NWS Space Weather Prediction Center  
<sup>7</sup> Cooperative Institute for Meteorological Satellite Studies, University of Wisconsin-Madison



## Online training modules

- [http://meted.ucar.edu/goes\\_r/envmon/](http://meted.ucar.edu/goes_r/envmon/)
- <http://cimss.ssec.wisc.edu/satmet/>
- <http://rammb.cira.colostate.edu/visit/video/goesr101/player.html>
- [http://rammb.cira.colostate.edu/training/shymet/forecaster\\_intro.asp](http://rammb.cira.colostate.edu/training/shymet/forecaster_intro.asp)

- **Proving Ground is both a source and a recipient of Training**
- **COMET Summer Faculty Course:** “Integrating Satellite Data and Products into Geoscience Courses with Emphasis on Advances in Geostationary Satellite System,” Aug. 8-12, 2011.
- **Outreach Projects (with NWSFOs):** reach out to GOES-R Proving Ground Partners and connect with faculty and students to prepare for GOES-R



# What is available now?



Listed/linked on GOES-R Home page

- Proving Ground Overview
- GOES-R 101 (SHyMet)
- Satellite Meteorology for Grades 7 – 12
- GOES-R: Benefits of Next-Generation Environmental Monitoring (COMET)
- GOES-R Trifold flyer
- <http://www.goes-r.gov/users/training.html>



# 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



# Future Plans: 2012 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 will have 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, 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
- Proving Ground continues to grow and plans are in place for 2012 and beyond.
- For GOES-R to be a success, forecasters must be able to use GOES-R products on Day 1!

**Backup**

