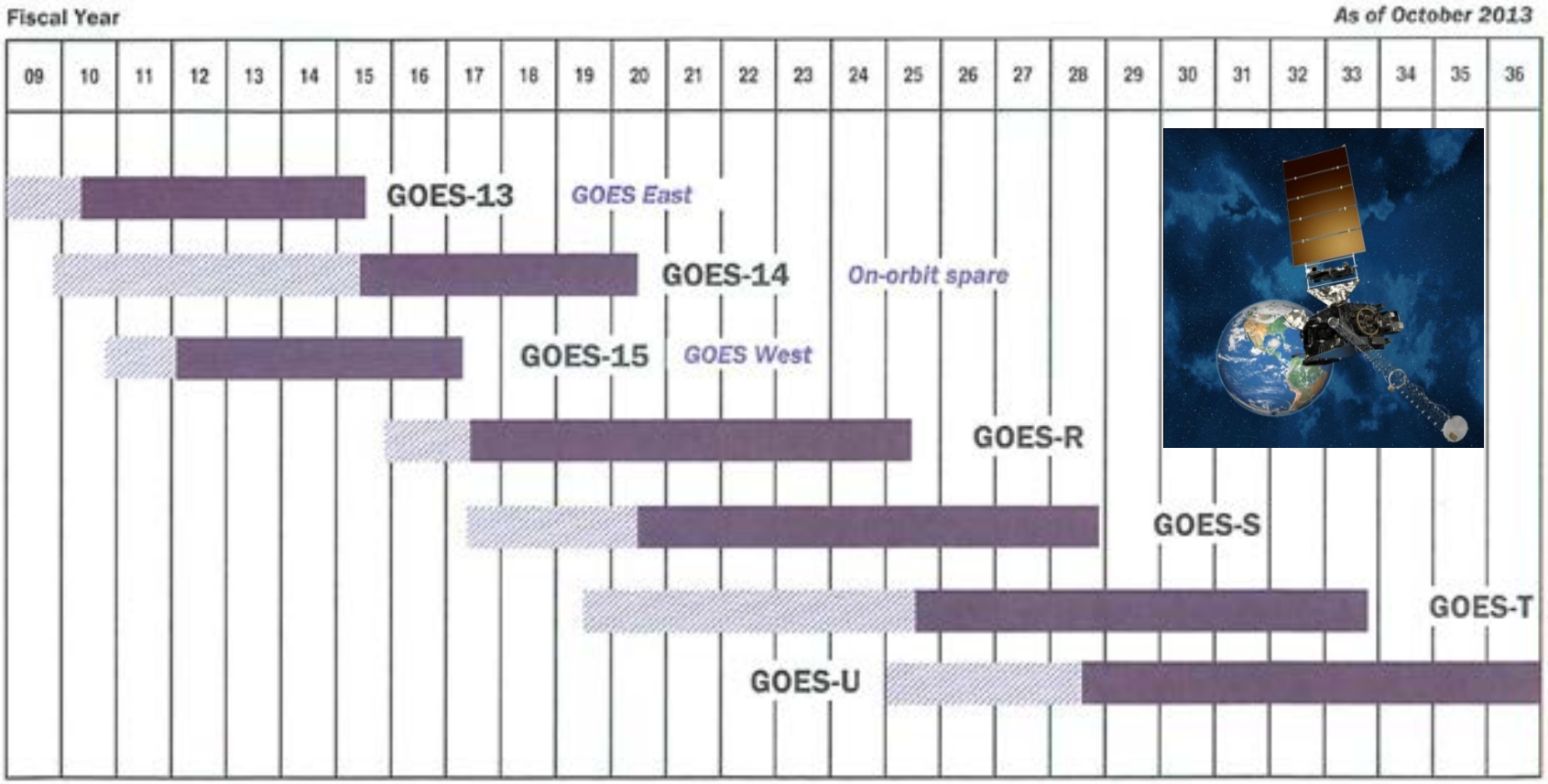
# An Overview of the GOES-R Program

**Greg Mandt**

GOES-R System Program Director

AMS 94st Annual Meeting and
10th Annual Symposium on Future National Operational Environmental Satellite Systems
Atlanta, GA
February 4, 2014

# Continuity of GOES Operational Satellite Program



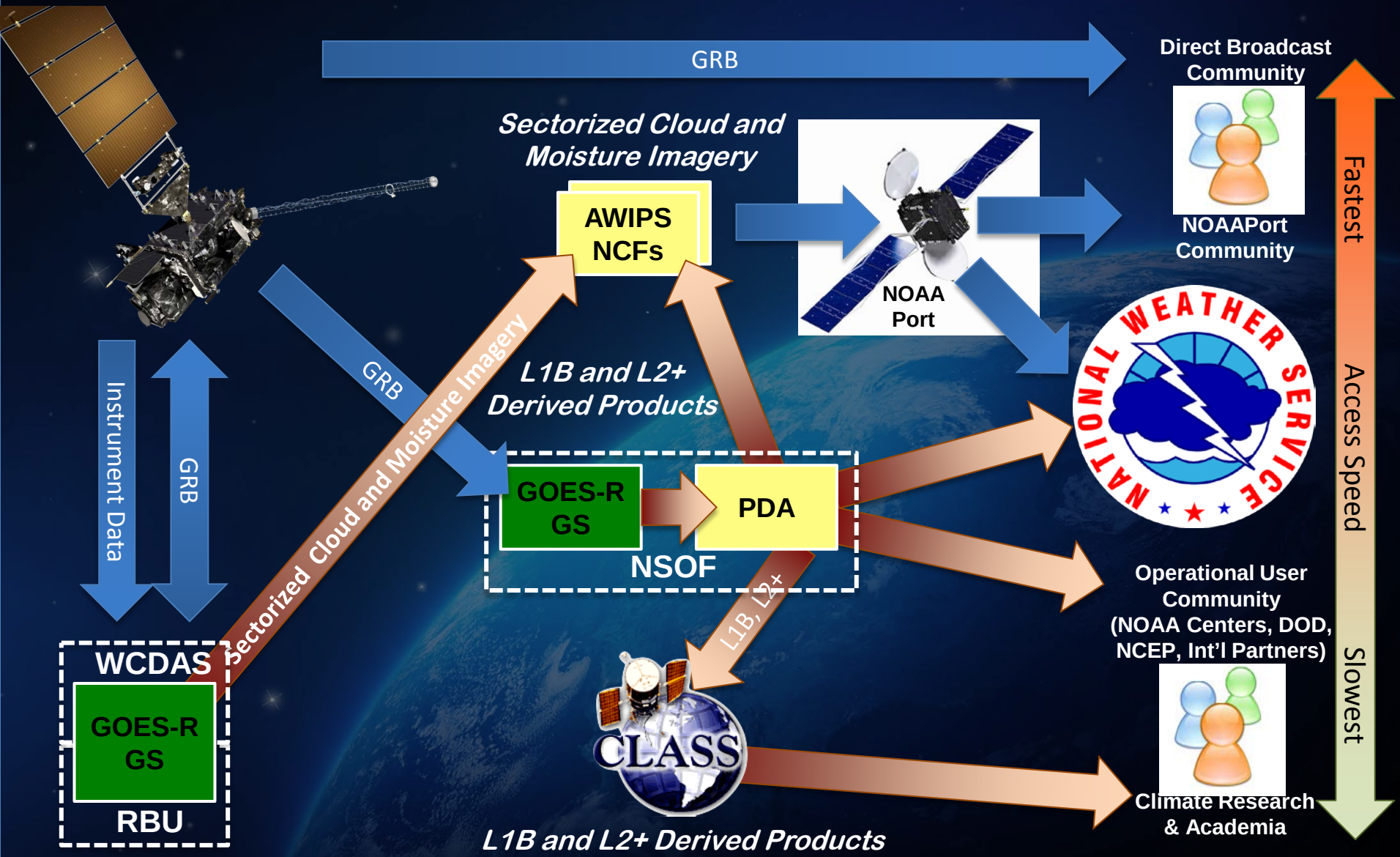

Approved: Mary E. Kicza
Assistant Administrator for Satellite and Information Services

GOES: Geostationary Operational Environmental Satellite

- On-orbit storage
- Operational
- Operational beyond design life

# GOES-R Architecture Overview

# GOES-R Data Distribution



# GOES-R Instruments

## Terrestrial Weather

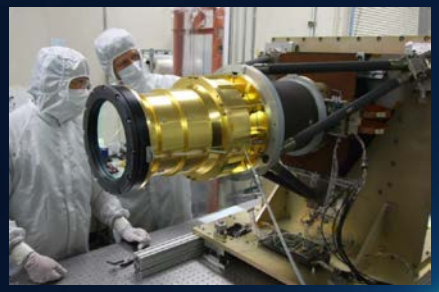
### Visual & IR Imagery

***Advanced Baseline Imager (ABI)***

Exelis
Ft. Wayne, IN

### Lightning Mapping

***Geostationary Lightning Mapper (GLM)***

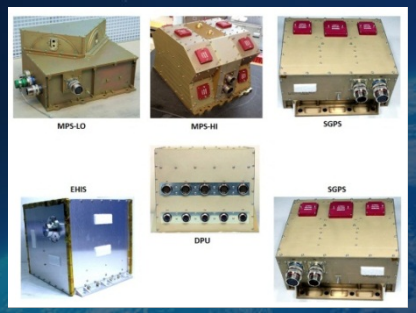


Lockheed Martin Advanced Technology Center
Palo Alto, CA

## Space Weather

### Space Weather Monitoring

***Space Environment In Situ Suite (SEISS)***




Assurance Technology Corp.
Carlisle, MA

***Magnetometer***

Lockheed Martin Space Systems Co.
Newtown, PA

### Solar Imaging

***Solar Ultra-Violet Imager (SUVI)***

Lockheed Martin Advanced Technology Center

***Extreme UV/X-Ray Irradiance Sensors (EXIS)***

Laboratory for Atmospheric and Space Physics
Boulder, CO

*Geostationary Lightning Mapper: Sam Edgington – Wed, Feb. 5, 1:30 PM*
*NOAA Operational Space Weather Monitoring: Current Capabilities and Future Directions: William Denig – Wed, Feb. 5, 4:15 PM*

# Flight Segment Progress

ABI PFM Pre-Shipment Review Complete
Delivery February 2014

Spacecraft Propellant Fuel Tank Installed

SUVI Pre-Shipment Review Complete
Delivery February 2014

SEISS Pre-Shipment Review Complete
Delivery February 2013

GLM Pre-Environmental Review Complete

Cleanroom at LM-Denver
Ready for Satellite I&T

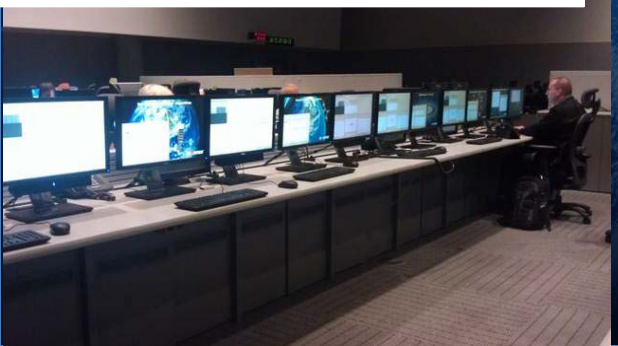
EXIS "Family" in Cleanroom at LASP
EXIS Flight Model 1 Delivery February 2014

# Ground Segment Progress

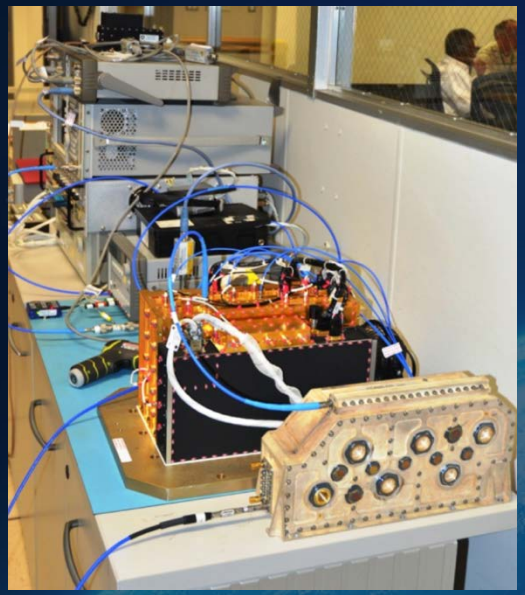
**Facility Upgrades at WCDAS**

**RBU Facilities Work Complete**

**Mission Management System Delivered**



**Completed SARSAT Radio Frequency Compatibility Testing**



**Antenna Feed Installation at WCDAS**

**Enterprise Infrastructure PSR Complete. Equipment Delivered to WCDAS January 20, 2014**

**GOES-R Rebroadcast Simulators Shipped**

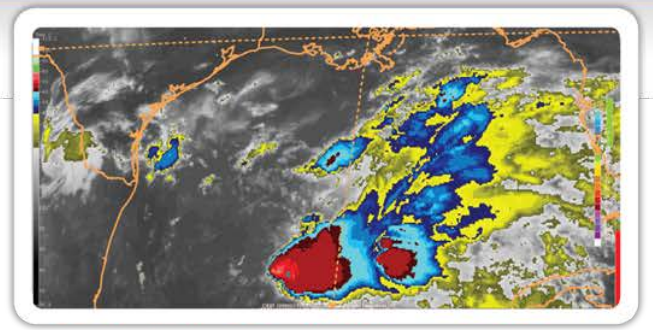
# GOES-R Milestones

| | | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 |
|---|---|---|---|---|---|---|---|---|
| Program/ System | | Mission SDR | | Mission PDR | Mission CDR | Mission Readiness Review<br>Launch Readiness Review | | |
| Flight Segment | Spacecraft | S/C SDR | S/C PDR | S/C CDR | EXIS PSR | S/C System Module and Propulsion Core delivery<br>S/C System Module and Propulsion Core mate | | |
| | Instruments | All instruments have passed CDR | | | ABI PSR<br>SEISS PSR<br>SUVI PSR<br>GLM PER | ABI Delivery<br>EXIS Delivery<br>SEISS Delivery<br>SUVI Delivery<br>GLM Delivery | | |
| Ground Segment | | Core GS PDR<br>Antenna System PDR<br>100 % delivery of baseline product algorithms | GS Project PDR | Core GS CDR<br>Antenna System CDR<br>ESPDS CDR<br>CLASS CDR<br>GS Project CDR | RMMU Interim Release Avail.<br>EI Interim Release Avail.<br>IPS Interim Release Avail.<br>MMFR Interim Release Avail.<br>FPS Interim Release Avail.<br>Phase 3 Antennas Delivered (1 WCDAS, 1 RBU, 2 NSOF) | Phase 1 Antennas Delivered (2 WCDAS, 1 NSOF)<br>Phase 2 Antennas Delivered (2 RBU, 1 NSOF) | | |

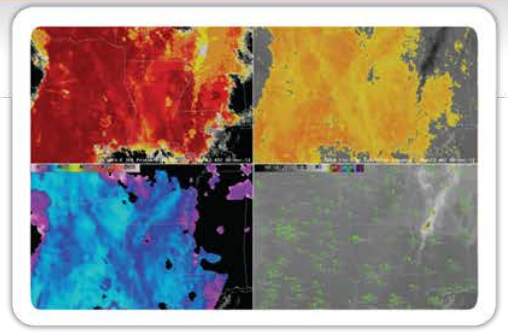
**Launch Readiness 2Q FY 2016**

Development → Integration and Testing

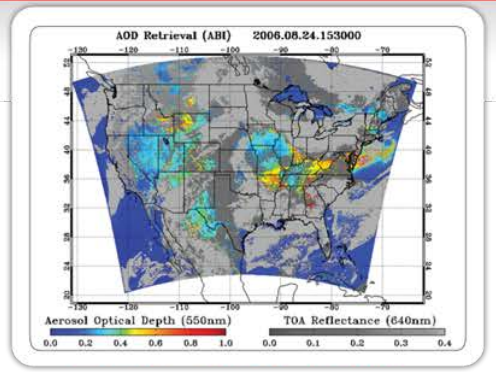
# The GOES-R Proving Ground



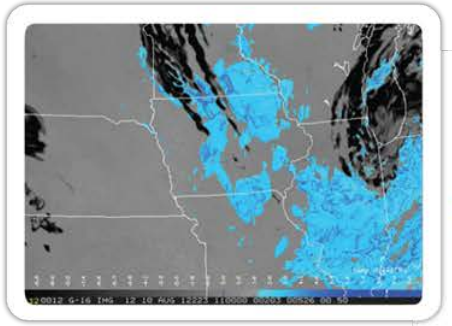
**Aviation Weather Center (AWC) – Kansas City, MO**
IR Imagery of Oceanic Storms



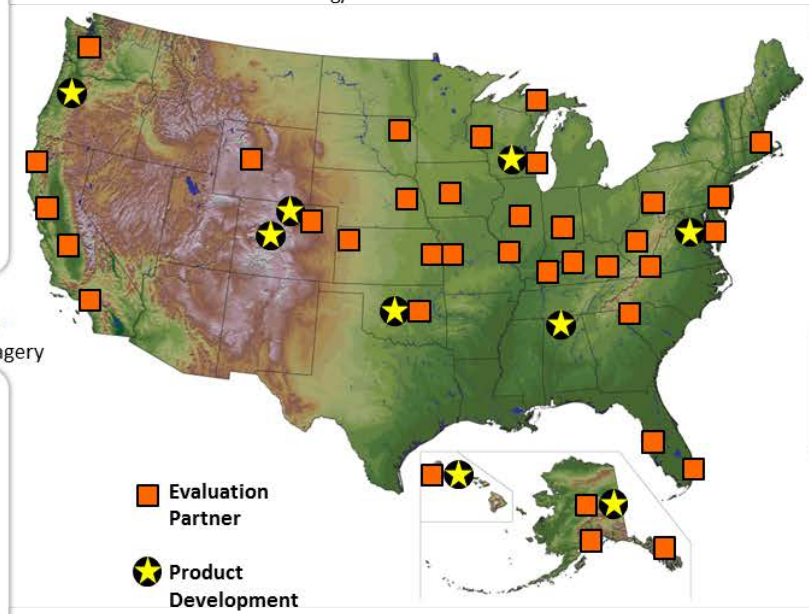
**Cooperative Institute for Meteorological Satellite Studies (CIMSS)/Center for Satellite Applications and Research (STAR) – Madison, WI**
Fog/Low Stratus Product




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

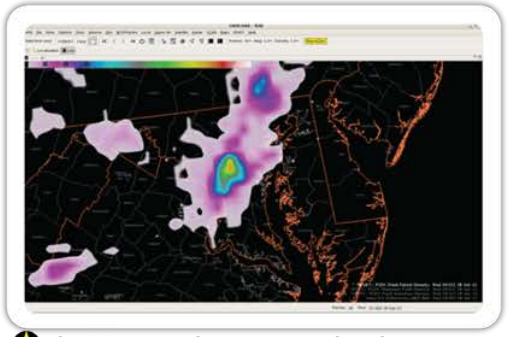


**Cooperative Institute for Research in the Atmosphere (CIRA)/STAR – Ft. Collins, CO**
ABI Synthetic Low Cloud Enhancement Imagery

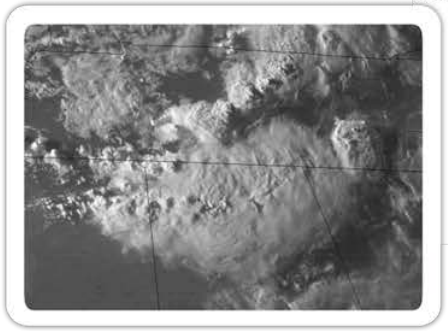


**Evaluation Partner**

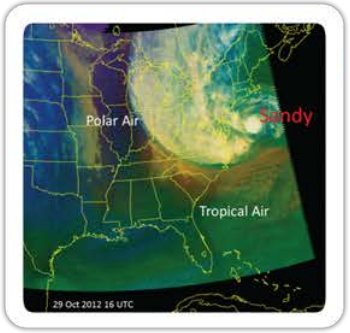
**Product Development Partner**



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



**Storm Prediction Center (SPC) – Norman, OK**
Severe Storms 1-Min Visible Imagery of Overshooting Tops




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

# Satellite Liaisons

- Stationed at most of the National Centers and the NWS Training Center
- Research-to-operations liaisons
  - Running the various GOES-R demonstrations
  - Improving upon training from the product developers to present to testbed participants
  - Providing participant feedback to the developers for further improvement.

*The GOES-R/JPSS Proving Ground: A National Centers Perspective: Amanda Terborg – Wed, Feb. 5, 11:00 AM*

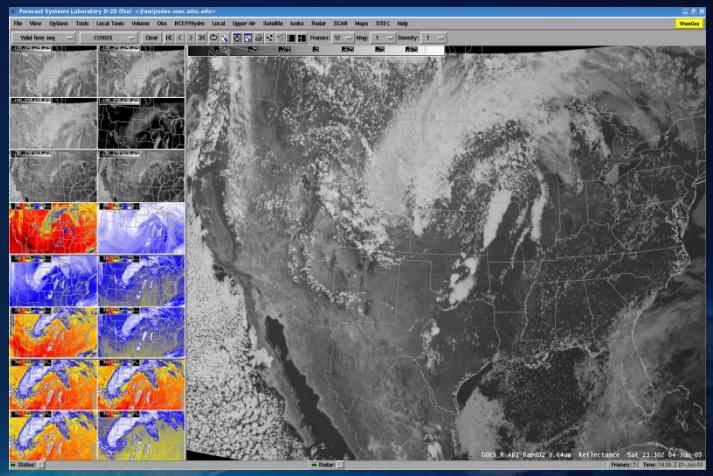
*Danger at Sea: Diagnosing and Communicating the Threat for Strong Maritime Thunderstorms: Michael Folmer – Wed, Feb. 5, 11:15 AM*

# Exposing NWS Forecasters to Prototype GOES-R Products

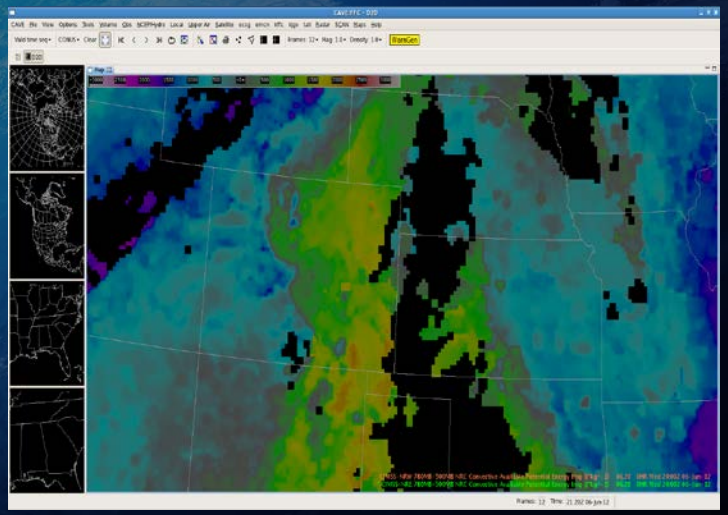
- Synthetic GOES-R Products representing ABI were employed at the Hazardous Weather Testbed and other NOAA testbeds

- Synthetic GOES-R products can help increase forecaster utilization on day one

- Facilitates user training



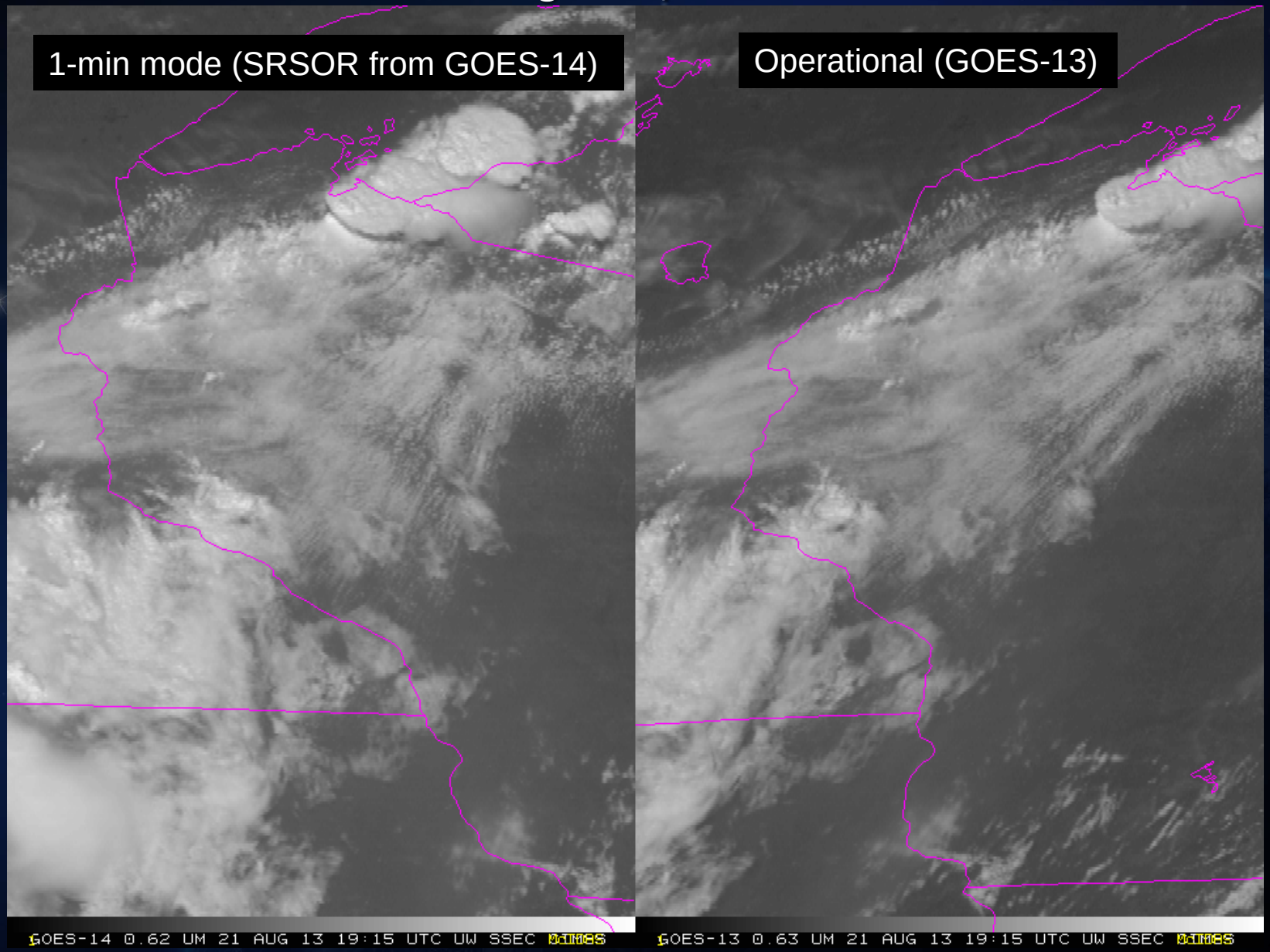
Simulated ABI bands in AWIPS



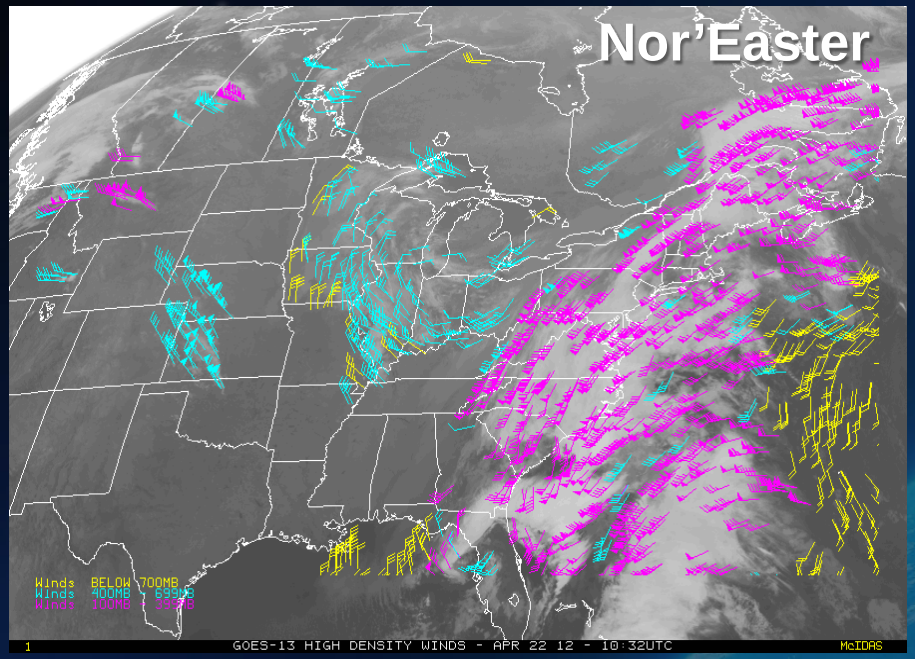
CAPE- an example of Derived Stability Indices indicates a strong instability axis extending into the high plains east of the Rockies.

# SRSO-R Imagery of Convection over the Upper Midwest

## August 21, 2013



# GOES-13 Winds Using GOES-R Clear-Sky Mask, Cloud and Derived Motion Winds (DMW) Algorithms

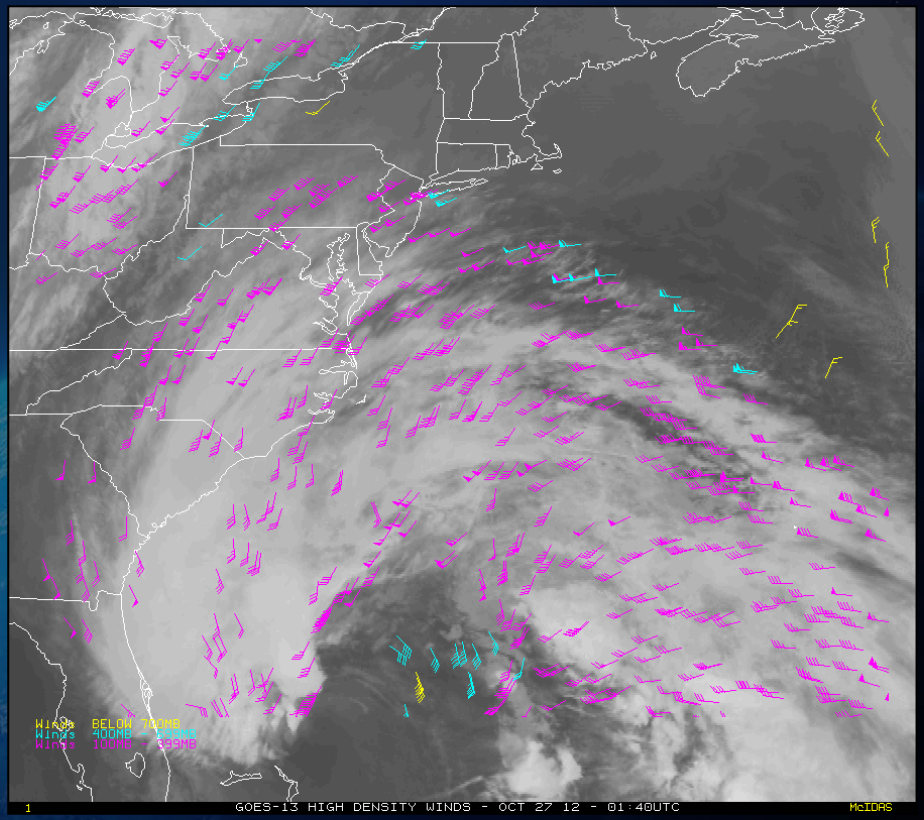



High-Level 100-400 mb  Mid-Level 400-700 mb  Low-Level >700 mb

**Cloud-drift winds derived from 15-min GOES-13 11um imagery 1000 UTC 22 April 2012 – 0800 UTC 23 April 2012**

*Significance:* Early demonstration of GOES-R algorithms using current operational GOES imagers. Plans and work in place to replace existing operational GOES cloud and DMW algorithms with GOES-R algorithms.

## Hurricane Sandy

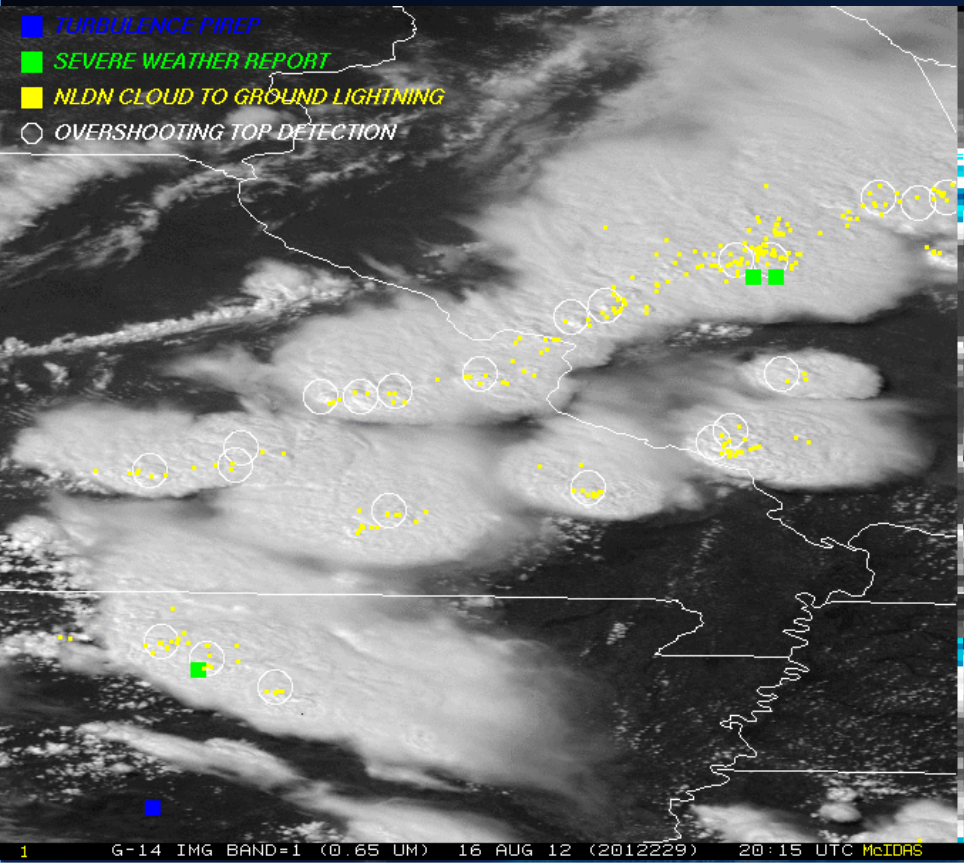


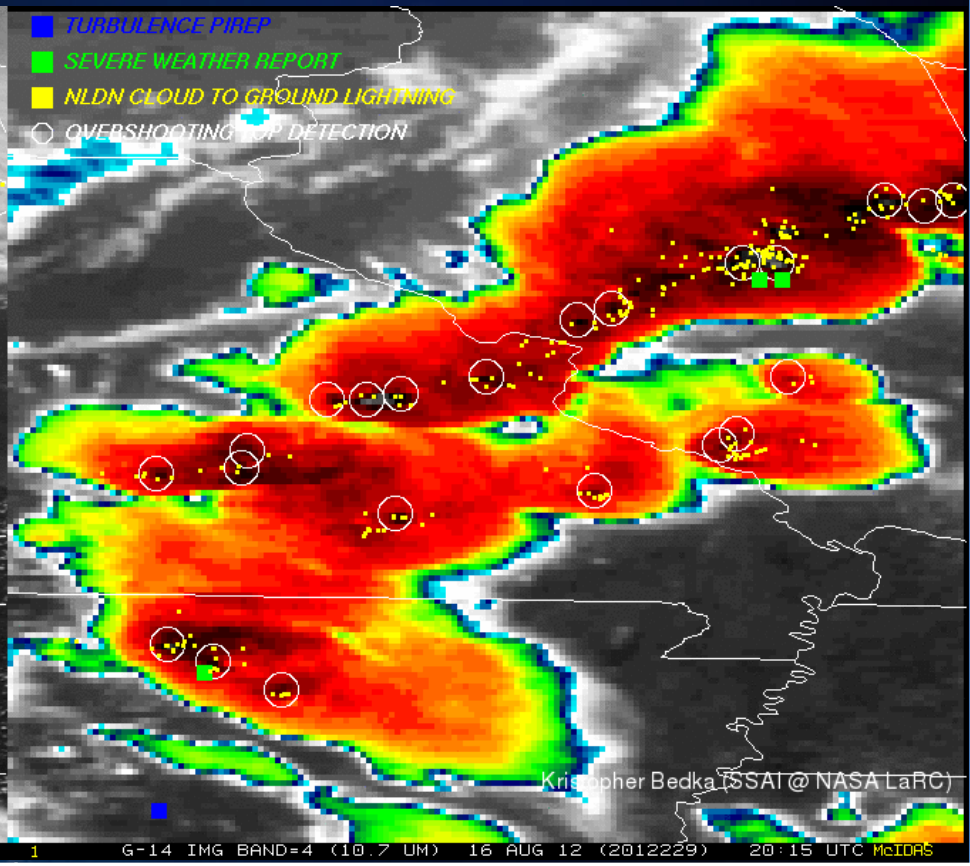

High-Level 100-400 mb  Mid-Level 400-700 mb  Low-Level >700 mb

**Cloud-drift winds derived from 15-minute GOES-13 LWIR (11um) imagery over Hurricane Sandy (4-day loop)**

# GOES-R Super Rapid Scan

## Moving toward data fusion




Kristopher Bedka (SSAI @ NASA LaRC)

### Proving Ground Demonstration at AWC Testbed

User comment: 'Cloud Top Cooling product is an excellent source of enhancing the situational awareness for future convective initiation, particularly in rapid scan mode'. *(AWC Testbed forecaster, June 2012)*

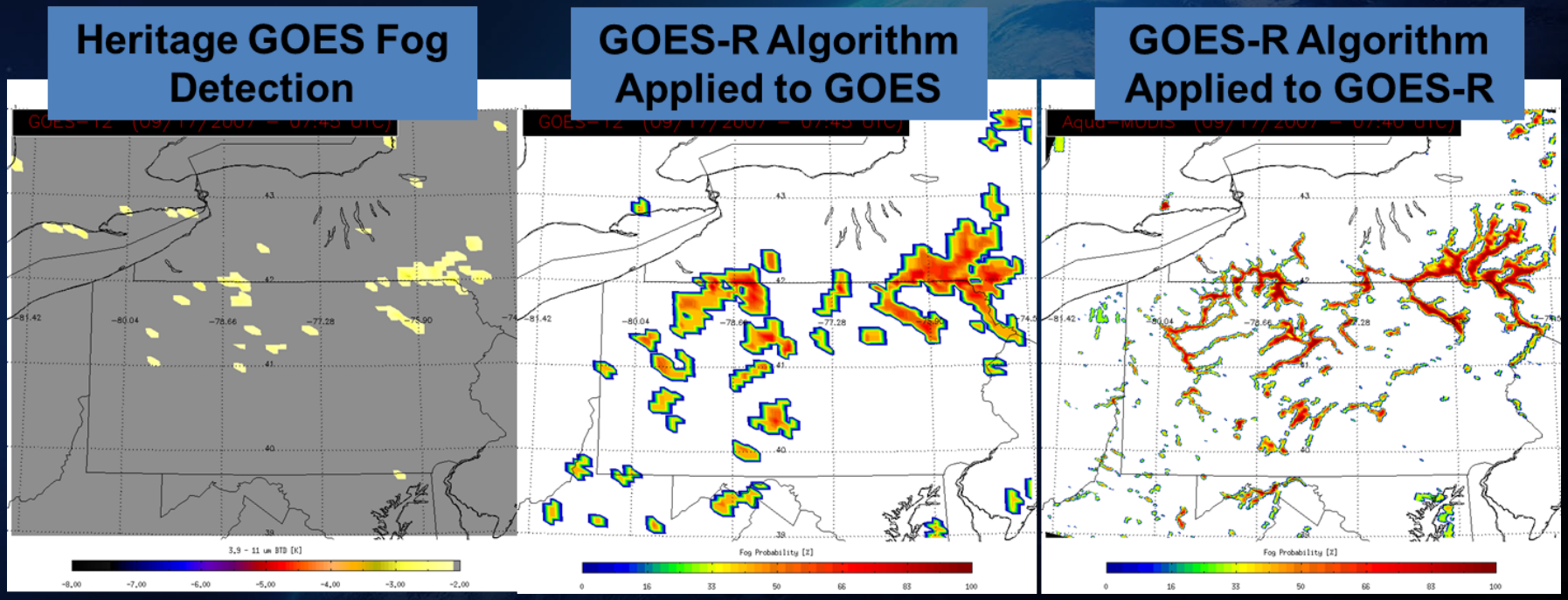
### Why NWS needs this?

- Situational Awareness
- Warning confidence
- Decision Support (venues)

# Fog Detection

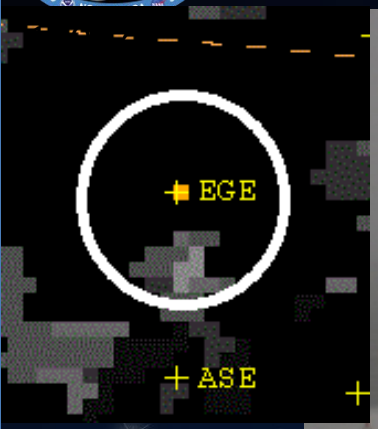
**The GOES-R fog detection product will significantly improve geostationary satellite fog monitoring capabilities because:**

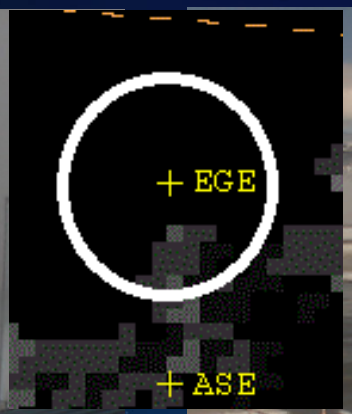
- ***Improved algorithm technology*** - the GOES-R algorithm provides quantitative information on fog probability, while heritage GOES fog detection products are more qualitative in nature
- ***Improved sensor technology*** - the ABI has greatly improved spectral information, spatial resolution, and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




*Courtesy: Mike Pavolonis/NESDIS STAR*

# Eagle, CO Fog Event – 12/29/13





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

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

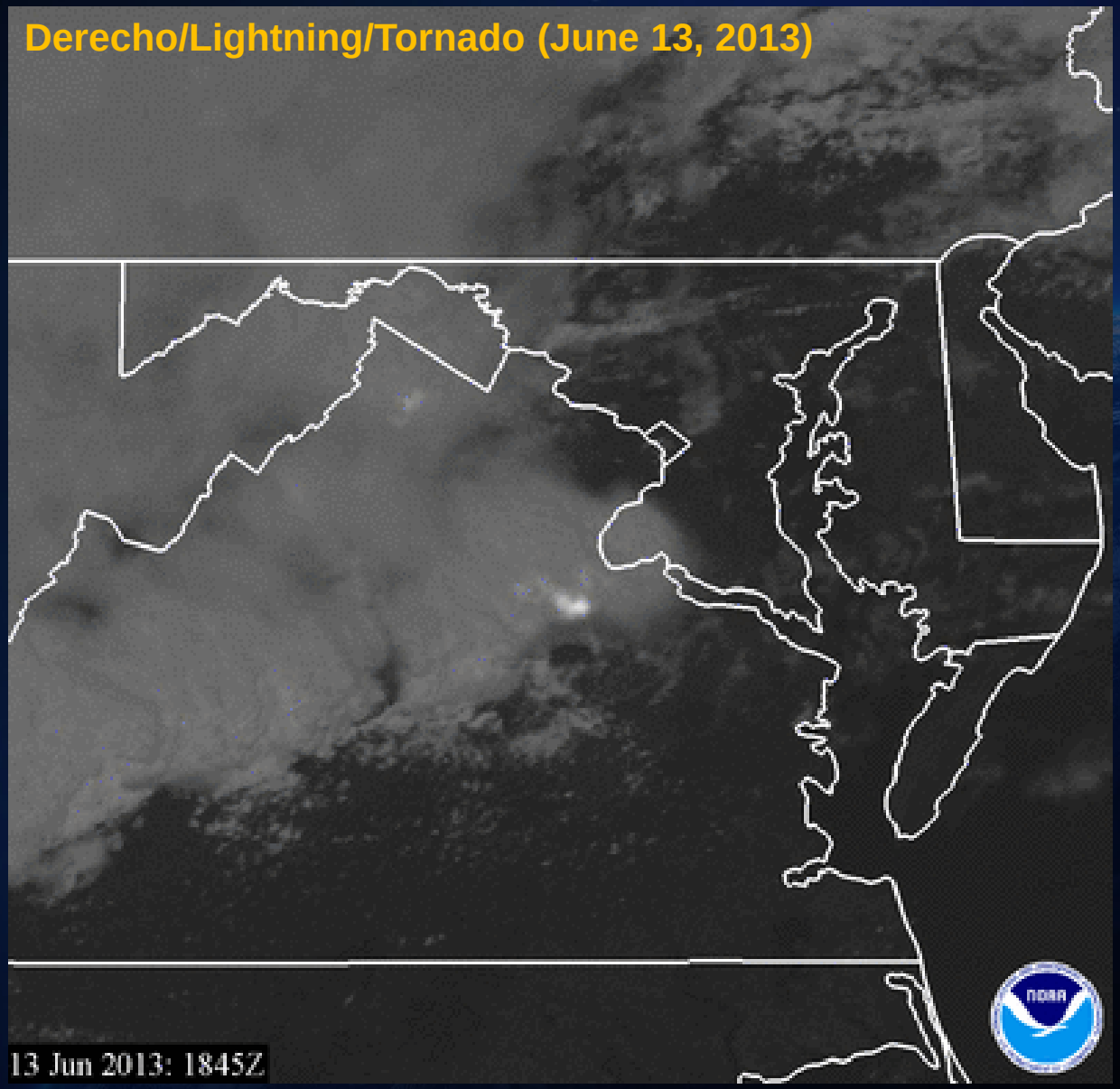
**GOES-R IFR/LIFR fused product inputs:**

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

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

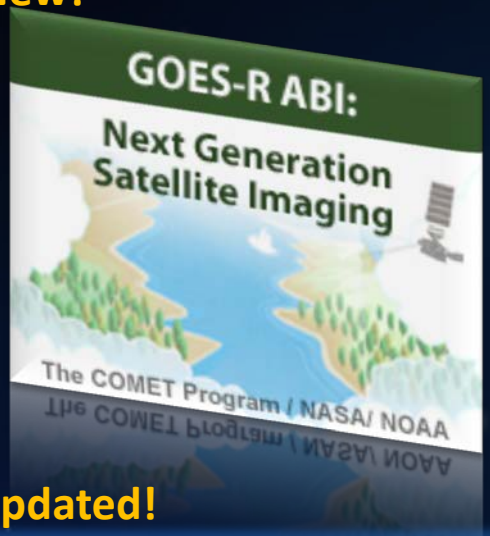
*KEGE **291859Z** 00000KT **10SM FEW030** M01/M03 A3021 RMK **VIS E 3/4 FG BANK E***

# GOES-R Rapid Refresh- 1-min Imagery and Lightning



# Training and User Education Materials

New!




Updated!

## Online Training Modules

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

## Printed Materials

- GOES-R Fact Sheets (18)
- User Readiness Plan
- GRB Downlink Specifications and Product Users Guide
- Proving Ground Demonstration Final Reports and Annual Reports

New!

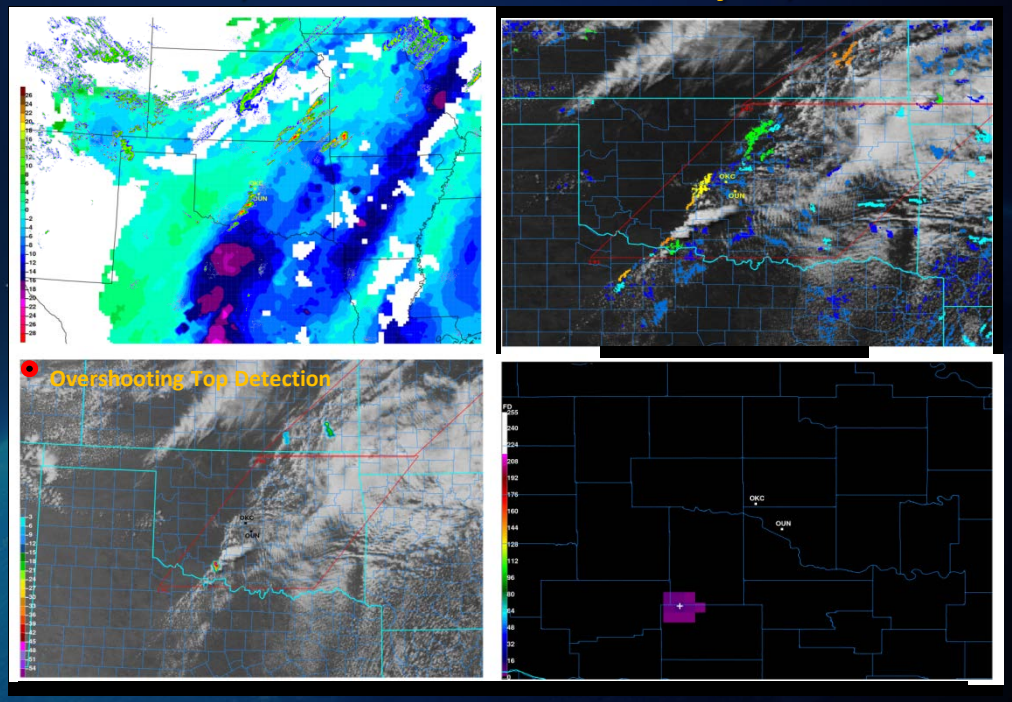
*New and Updated Environmental Satellite Education Resources from COMET: Wendy Schreiber-Abshire – Tue, Feb. 4, 1:45 PM*

*Colorado Lightning Mapping Array Collaborations through the GOES-R Visiting Scientist Program: Geoffrey Stano – Wed, Feb. 5, 2:00 PM*

# GOES-R Science Seminars

- Promote more frequent communication with the user community about GOES-R science and demonstration activities
  - Semi-monthly virtual science seminars
  - Allow scientists to highlight their work to the rest of the community
  - http://www.goes-r.gov/users/sci-sem/index.html

**GOES-R Convective Situational Awareness Display**
**Moore, OK Tornado Outbreak May 20, 2013**

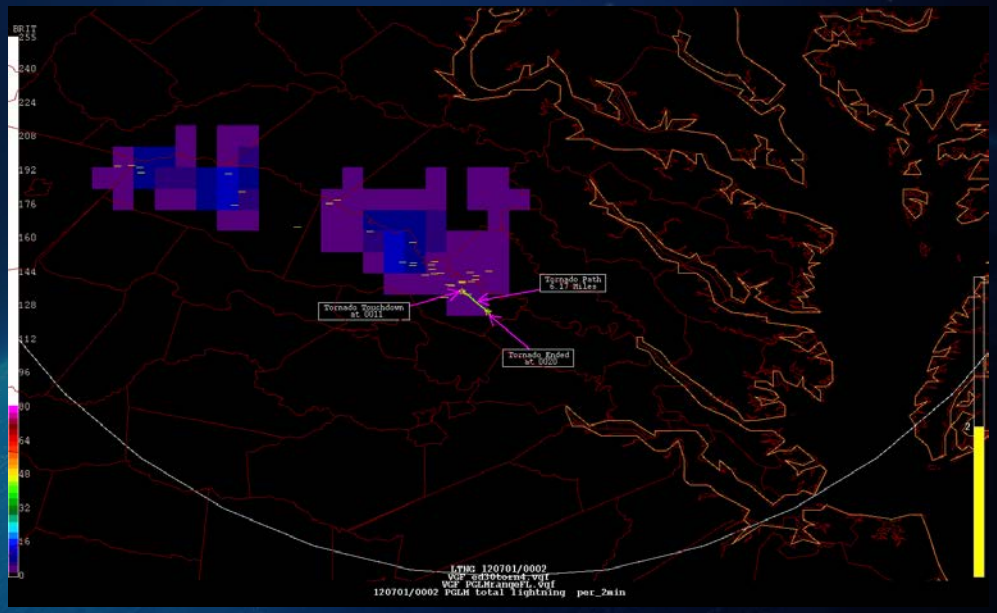



*From January 24, 2014 Science Seminar on Severe Weather. These products provide enhanced situational awareness of the convective environment. Courtesy of Chad Gravelle, CIMSS*

# GOES-R/JPSS Proving Ground Virtual Forecaster Forums

- Opportunity for WFO and National Center forecasters to present how they have used GOES-R or JPSS Proving Ground products
  - Held twice a year
  - What worked/did not work, recommendations or modifications to the products, and any other feedback
  - http://www.goes-r.gov/users/2014-01-27-PG-VFF.html

**pGLM "jump" during tornadic event in Hanover County , VA**




*January 22, 2014 Virtual Forecaster Forum:*

- *pGLM flash density increased at 0004 1 July*
- *Tornado at 0011 1 July*
- *dBZ increase from 60 to 70 during event*

*Courtesy of Ed Holicky, Forecaster, AWC*

# International Collaboration

- Japan Meteorological Agency (JMA)
  - Information exchange and collaborative research on volcanic ash and cloud analysis science
  - Algorithm Working Group team member visits
- European Organization for the Exploitation of Meteorological Satellites (EUMETSAT)
  - Collaboration in research and applications through the Convection Working Group and the Satellite Application Facilities
  - Collaboration with GLM cal/val activities
  - Development of training materials through the World Meteorological Organization (WMO) Virtual Laboratory

*EUMETSAT Convection Working Group Meeting at the Czech Hydrometeorological Institute in Prague, March 2012*

# GRB Simulators

- On-site testing of user ingest and data handling systems
- Four simulators designated for loan
  - Verification of GRB receive system compatibility with GRB transmission
  - http://go.usa.gov/WvXY
- Industry Day: October 25, 2013
  - NOAA Science Center, Silver Spring, MD

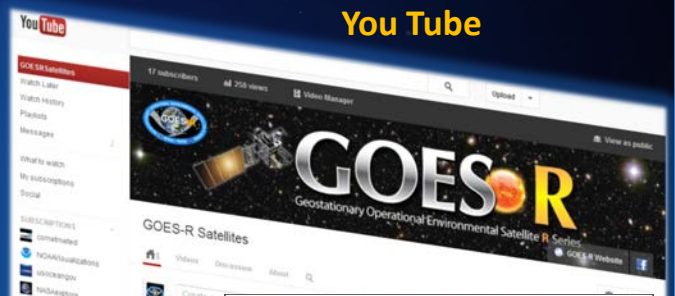
Front | Rear

# Education and Public Outreach Update

New! Quarterly Newsletter

New! Brochure

You Tube



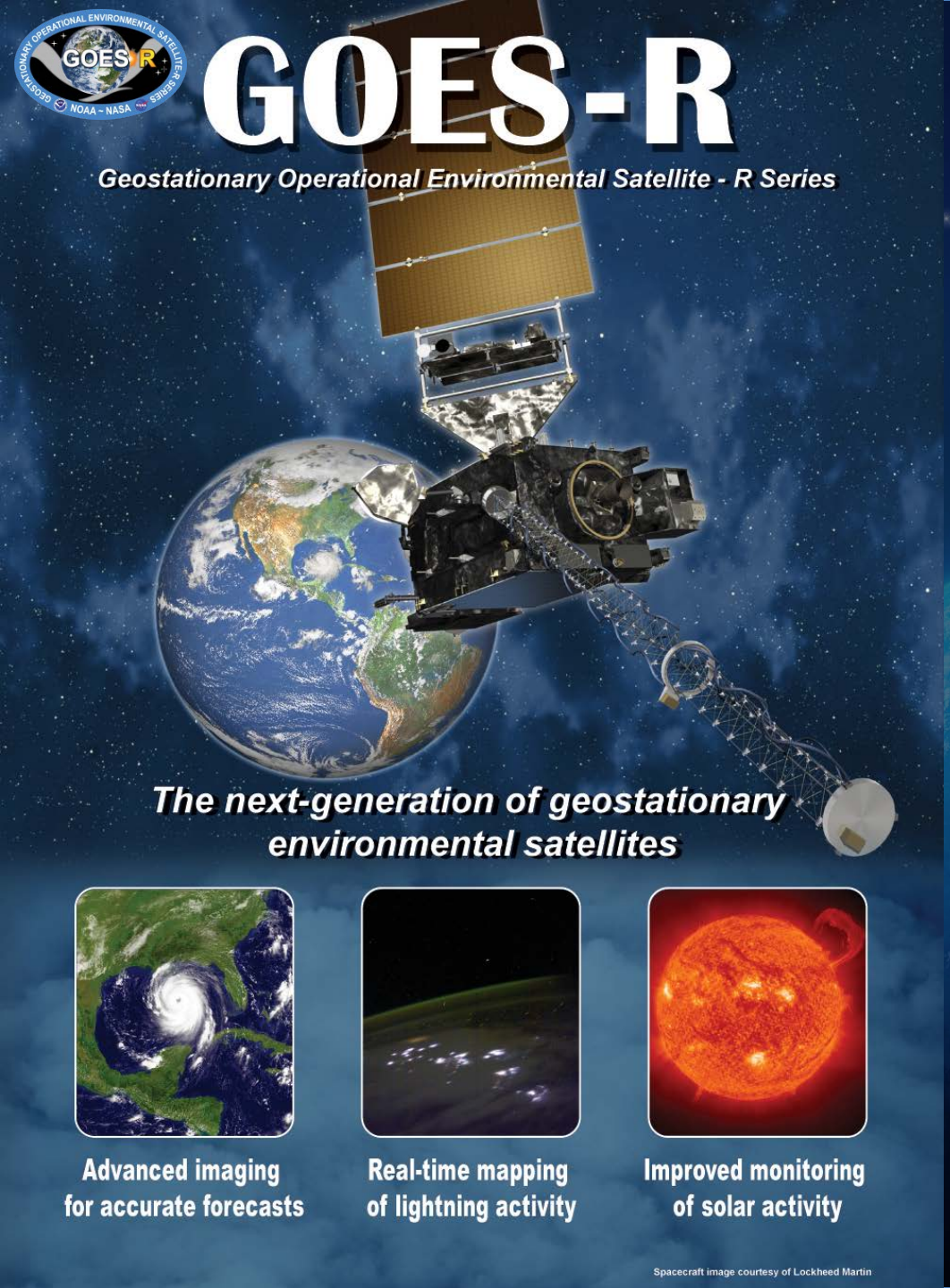

New! ABI Fact Sheet

New! ABI Video

Nearly 6,000 FB "Likes!"

New! ABI Game

New! iOS Search and Rescue Game




# Thank you!

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