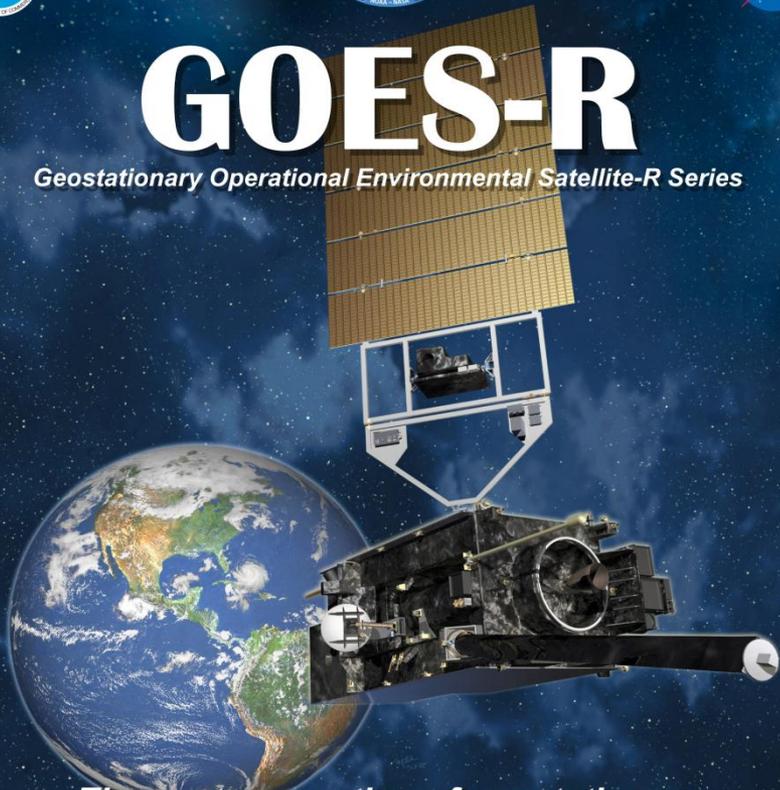




GOES-R

Geostationary Operational Environmental Satellite-R Series



The next-generation of geostationary environmental satellites



Advanced imaging for accurate forecasts



Real-time mapping of lightning activity



Improved monitoring of solar activity

Spacecraft image courtesy of Lockheed Martin

GOES-R Program *Update*

Steve Goodman

Senior Program Scientist

NOAA/NESDIS

<http://www.goes-r.gov>

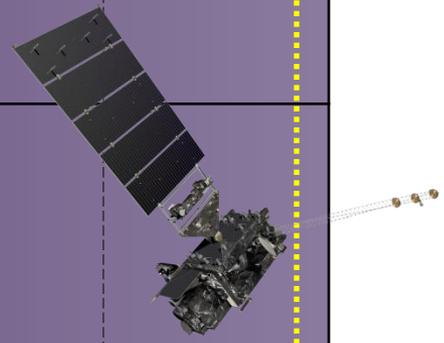
**GOES-R Science Week
Annual GLM Science Meeting
Huntsville, AL
September 19-20, 2011**



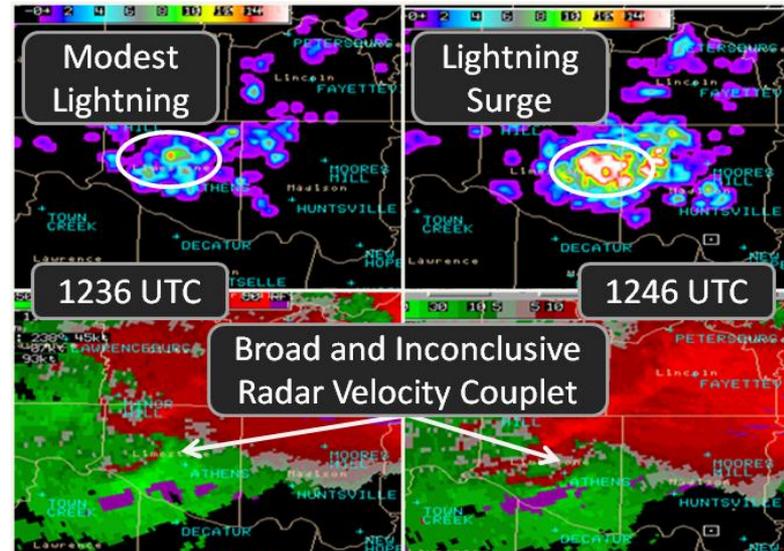
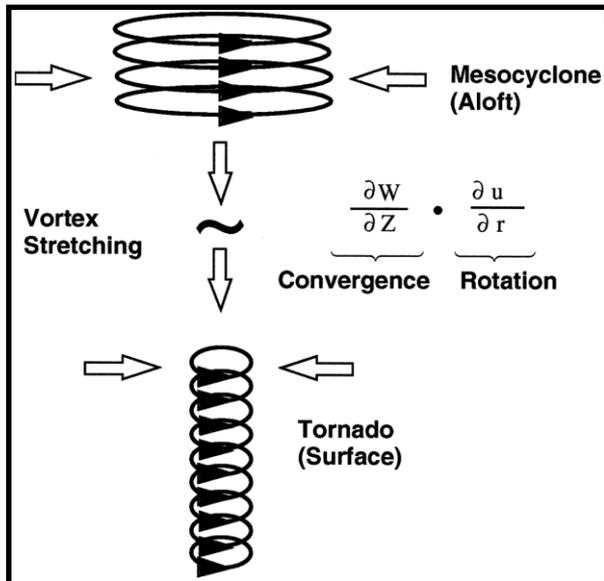
<http://www.facebook.com/GOESRsatellite>

	2010	2011	2012	2013	2014	2015	
Program/ System	✓ System Design Review complete	✓	<ul style="list-style-type: none"> ● Mission PDR Part I complete ● Mission PDR Part II ● Mission CDR 				
Flight Segment	Spacecraft	✓ S/C SDR complete	✓ S/C PDR complete	● S/C CDR			
		Instruments	✓ All instruments have passed CDR	✓ ABI Delta CDR complete	<ul style="list-style-type: none"> ● ABI Delivery ● SEISS Delivery ● EXIS Delivery ● SUVI Delivery ● GLM Delivery 		
Ground Segment	<ul style="list-style-type: none"> Antenna System PDR completed ✓ 100 % delivery of baseline product algorithms 		<ul style="list-style-type: none"> ✓ Core GS PDR complete ✓ ✓ 	<ul style="list-style-type: none"> ● Antenna System CDR GS Project PDR complete ● ESPDS CDR ● CLASS CDR ● GS CDR 	<ul style="list-style-type: none"> ● RBU/NSOF/WCDAS installation ● WCDAS complete ● RBU complete ● NSOF complete 		

Launch Readiness Oct. 2015



GOES R3 Science- Future Capability: GLM Will Improve Severe Weather Warnings



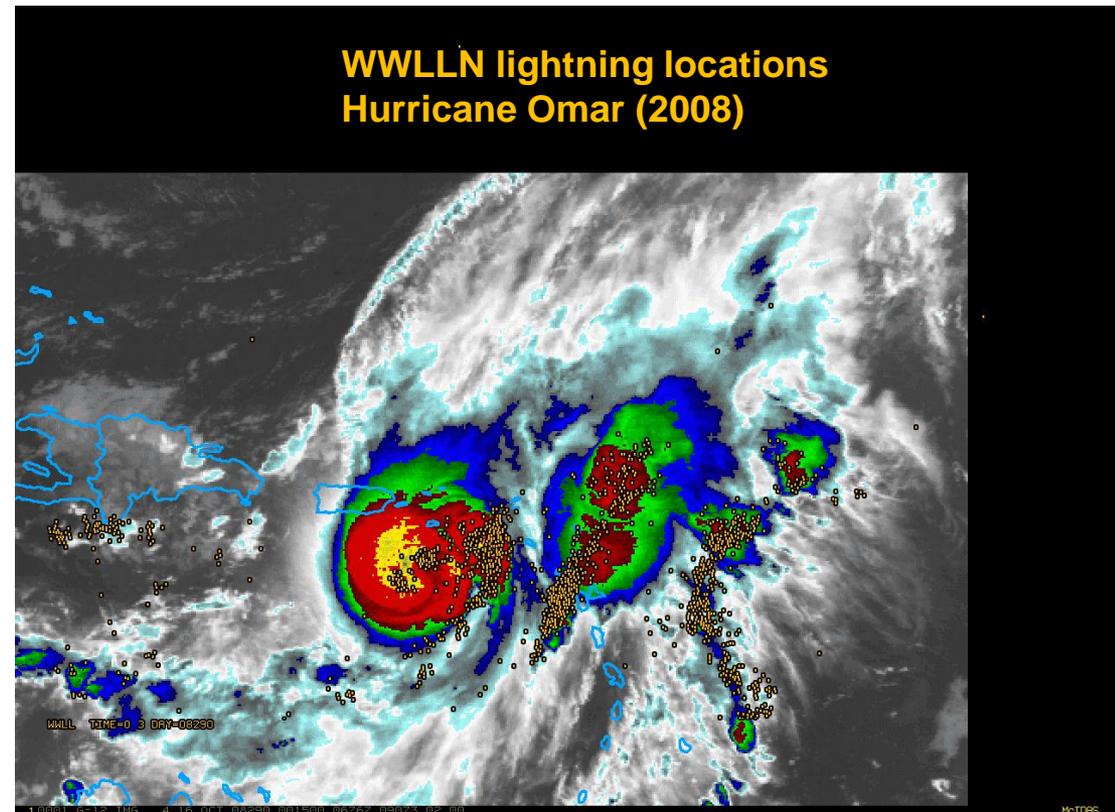
Skill scores and average lead times using the sample set of 711 thunderstorms for both total lightning and CG lightning, correlating trends in lightning to severe weather.

	POD	FAR	CSI	HSS	lead time (all)	lead time (tornado)
Total lightning	79%	36%	55%	0.71	20.65 mins	21.32 mins

National Average for Tornado warning lead-time is only 13 minutes

GOES R3 Science- Future Capability: TC Rapid Intensification Index

- Inner core and rainband lightning provide predictive information
- Added to other predictors such as SST and vertical shear
- Used to forecast rapid intensification and rapid weakening
- Impact of lightning can be determined quantitatively from product verification

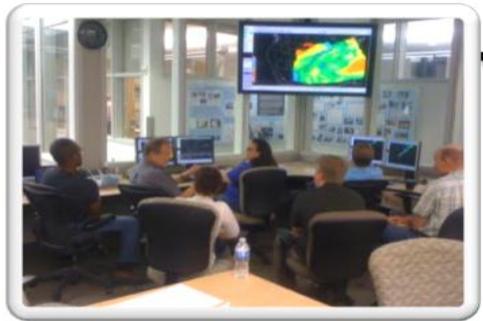




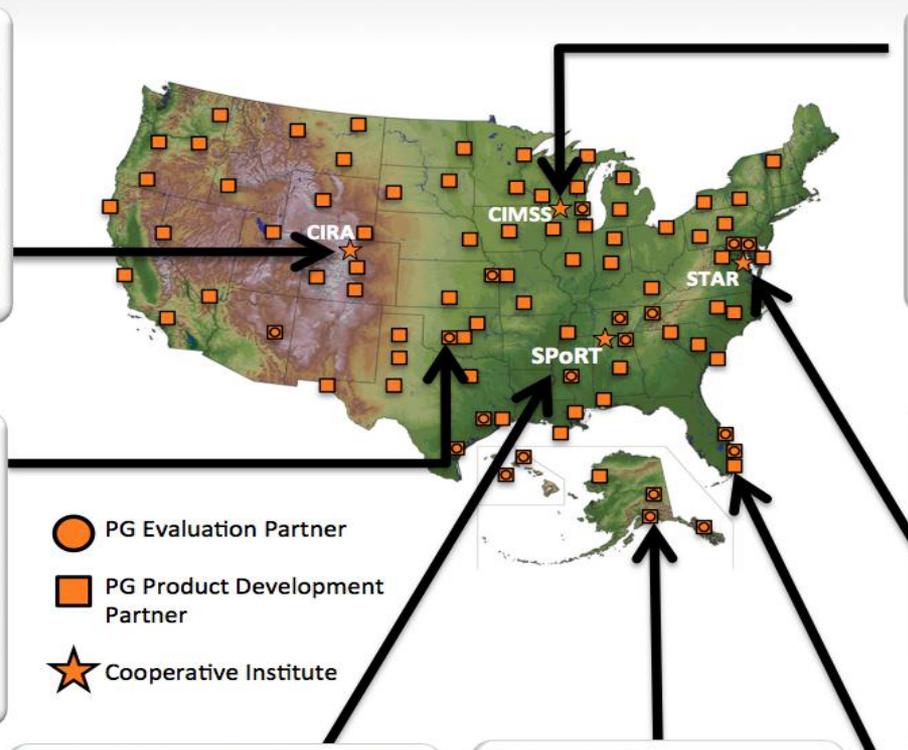
GOES-R Proving Ground Partners



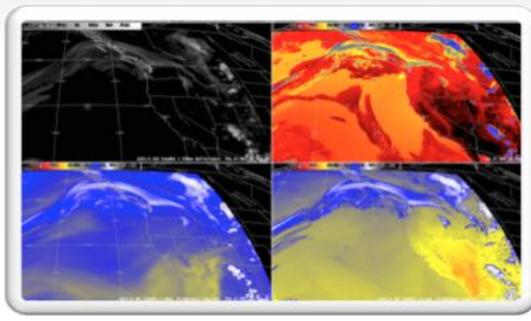
CIRA - Ft. Collins, CO
ABI Simulated Natural Color



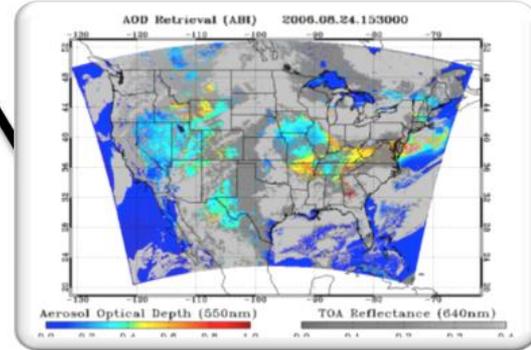
SPC - Oklahoma City, OK
Nearcast Training at the Hazardous Weather Testbed



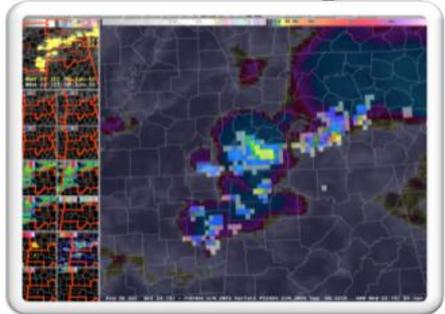
- PG Evaluation Partner
- PG Product Development Partner
- Cooperative Institute



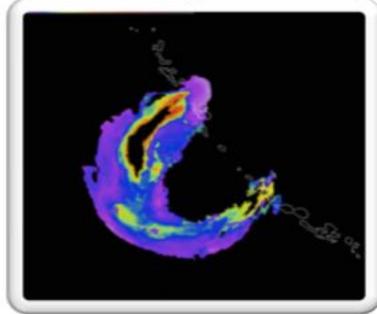
CIMSS - Madison, WI
Simulated ABI Bands



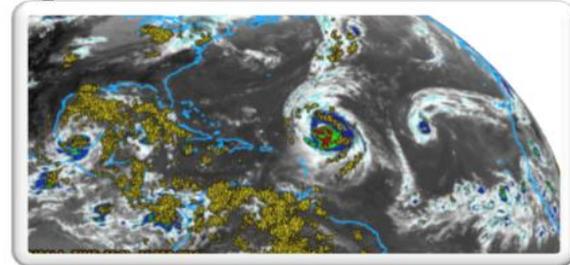
STAR - Camp Springs, MD
Aerosol Optical Depth Product



SPoRT - Huntsville, AL
GLM Lightning Flash Density



AFC - Anchorage, AK
Volcanic Ash Product



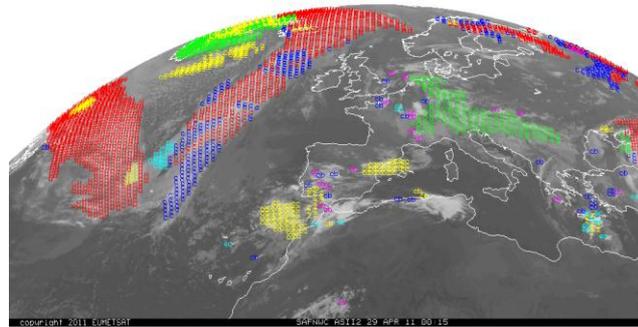
NHC - Miami, FL Rapid Intensification Index

Visiting Scientists: Satellite Champions

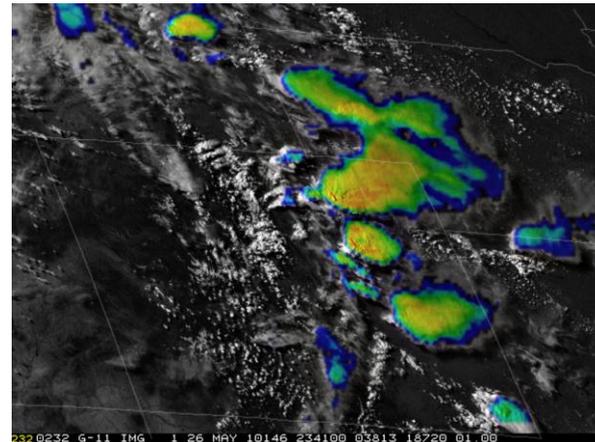
NWS Centers	Visiting Scientist/PI	CI	NOAA Host
SPC/HWT	C. Siewert, K. Kuhlman	OU-CIMMS	Russ Schneider
OPC, HPC, SAB	M. Follmer, S. Rudlosky	CICS	J. Sienkiewicz, E. Danaher, J. Kibler
AWC	new hire	UW-CIMSS	David Bright
NWS Training Center	new hire	UW-CIMSS	John Ogren
Pac Region	S. Businger /new hire	UH-JIMAR	Bill Ward
AK Region	T. Heinrichs	UAF-CIFAR	Gary Hufford
Multiple	R. Brummer	STAR/CSU-CIRA	Various
Multiple	W. Feltz	STAR/UW-CIMSS	Various
Multiple	G. Jedlovec	NASA-SPoRT	Various
SwPC	W. Denig	NGDC/CIRES	Rodney Viereck
NWS HQS	A. Huff/ S. Kondragunta/R. Hoff	STAR/UMBC	Ivanka Stajner

GOES-R Visiting Scientist Program

- Ama Ba (NWS MDL): Automatic Satellite Image Interpretation Product: “first-hand information about the use and benefits of the NWC SAF products for a potential use in NWS operations.”
- Dan Lindsey (NESDIS STAR): “Dr. Setvak introduced the Sandwich Product. This product allows one to easily co-locate various cloud-top features (overshooting tops, plumes, gravity waves, etc.) with the associated brightness temperature features, such as cold and warm portions of a storm top, or BT minima...The higher resolution data available with GOES-R will greatly improve this product.”
- **Call for VSP Proposals October, 2011**



Symbol:	Conceptual Model:
SAT + NWP:	
w (red)	warm front
c (blue)	cold front
c (red)	cold front in warm air advection
~ (magenta)	wave
~ (red)	developing wave
~ (green)	upper wave
o (green)	occlusion
Dl (cyan)	dry intrusion
ec (cyan)	enhanced cumulus
m.cb, ● (blue)	MCS, Cb (decaying stage, ● = embedded)
m.cb, ● (yellow)	MCS, Cb (mature stage, ● = embedded)
m.cb, ● (magenta)	MCS, Cb (mature stage, ● = embedded)
co (yellow)	comma cloudiness
L (yellow)	lee cloudiness
ji (yellow)	front intensification in left exit region of a Jet Streak
ul (yellow)	upper level low
z (yellow)	cold air cloudiness
F (yellow)	fibre



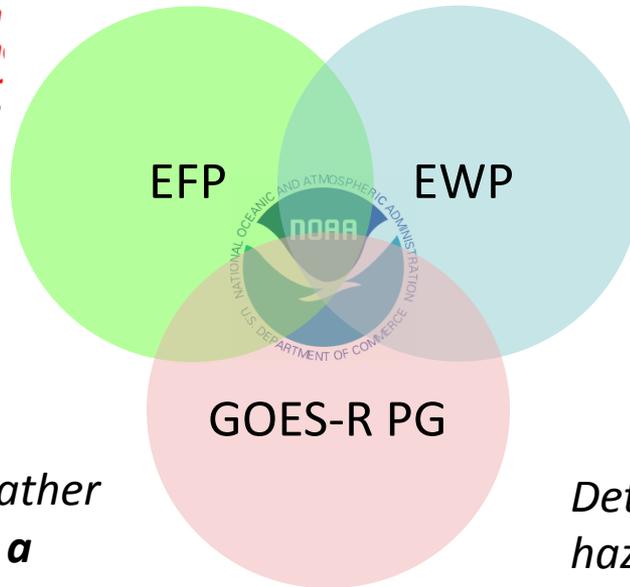
Example of a "sandwich" product, in which a GOES-11 color-enhanced 10.7 μm image is blended with the corresponding visible image, from 26 May 2010 over Colorado. A number of supercell thunderstorms are active at this time. The warmer colors (red, orange) represent colder brightness temps.

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

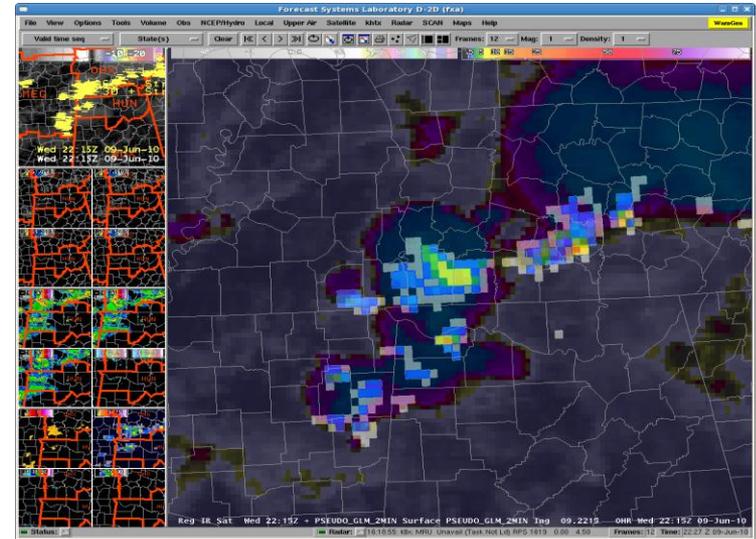
*Detection and prediction of hazardous weather events **up to several hours in advance***



Total Lightning Detection

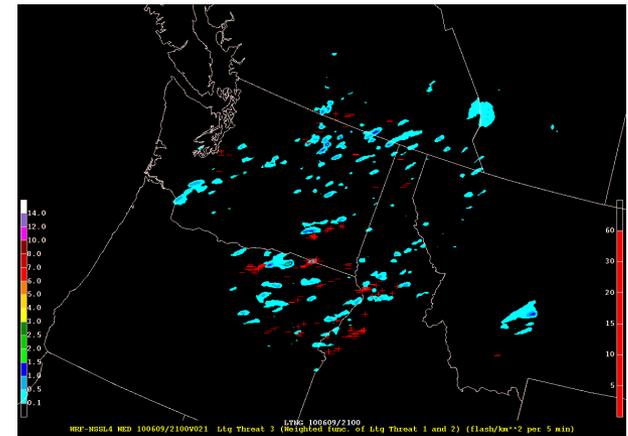
- **Pseudo-GLM**

- Data from ground-based total lightning detection networks
 - Huntsville, AL; Washington, DC; Melbourne, FL; and Norman, OK
- Raw data sorted into flashes and interpolated to an 8km grid
- Running 2-minute average



- **Simulated lightning threat**

- Based on NSSL-WRF OZ 4km data
- Estimates total lightning from vertical ice content and flux within cloud objects (see McCaul et al., 2009)



GOES-R Warning Product Set

Initial focus on products that offer NWS near-real time Warning Related utility.

Baseline Products:

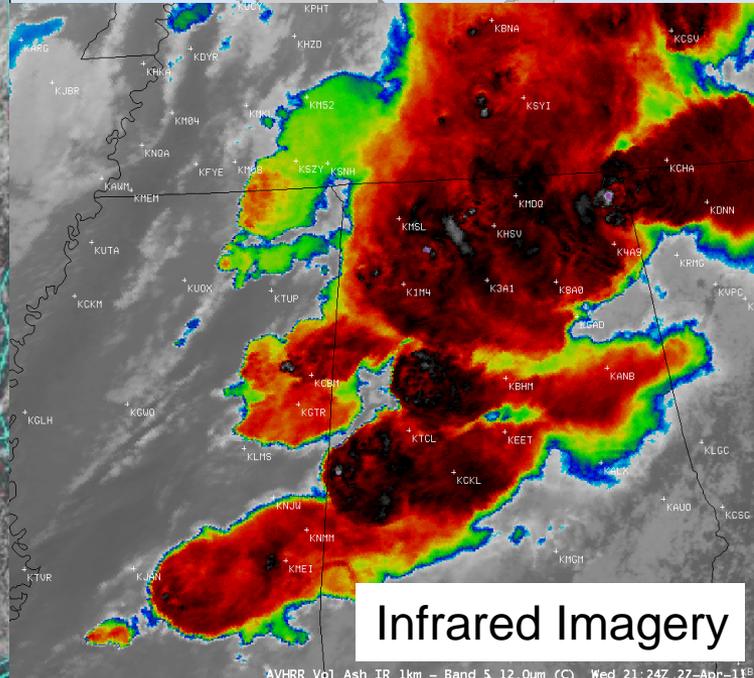
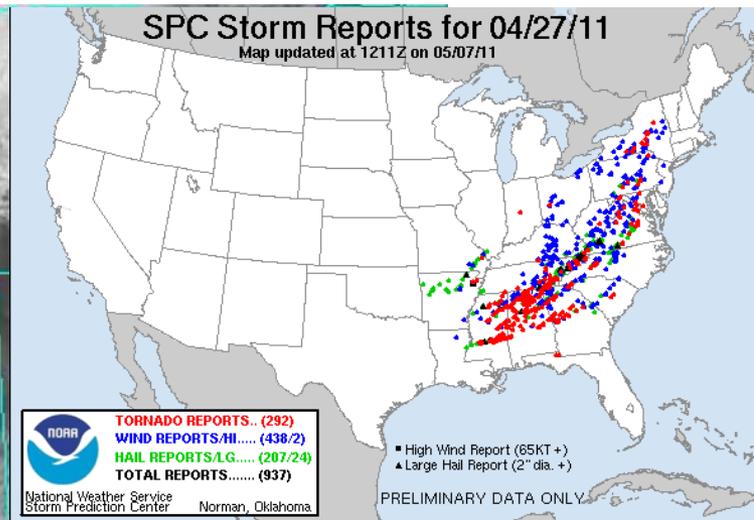
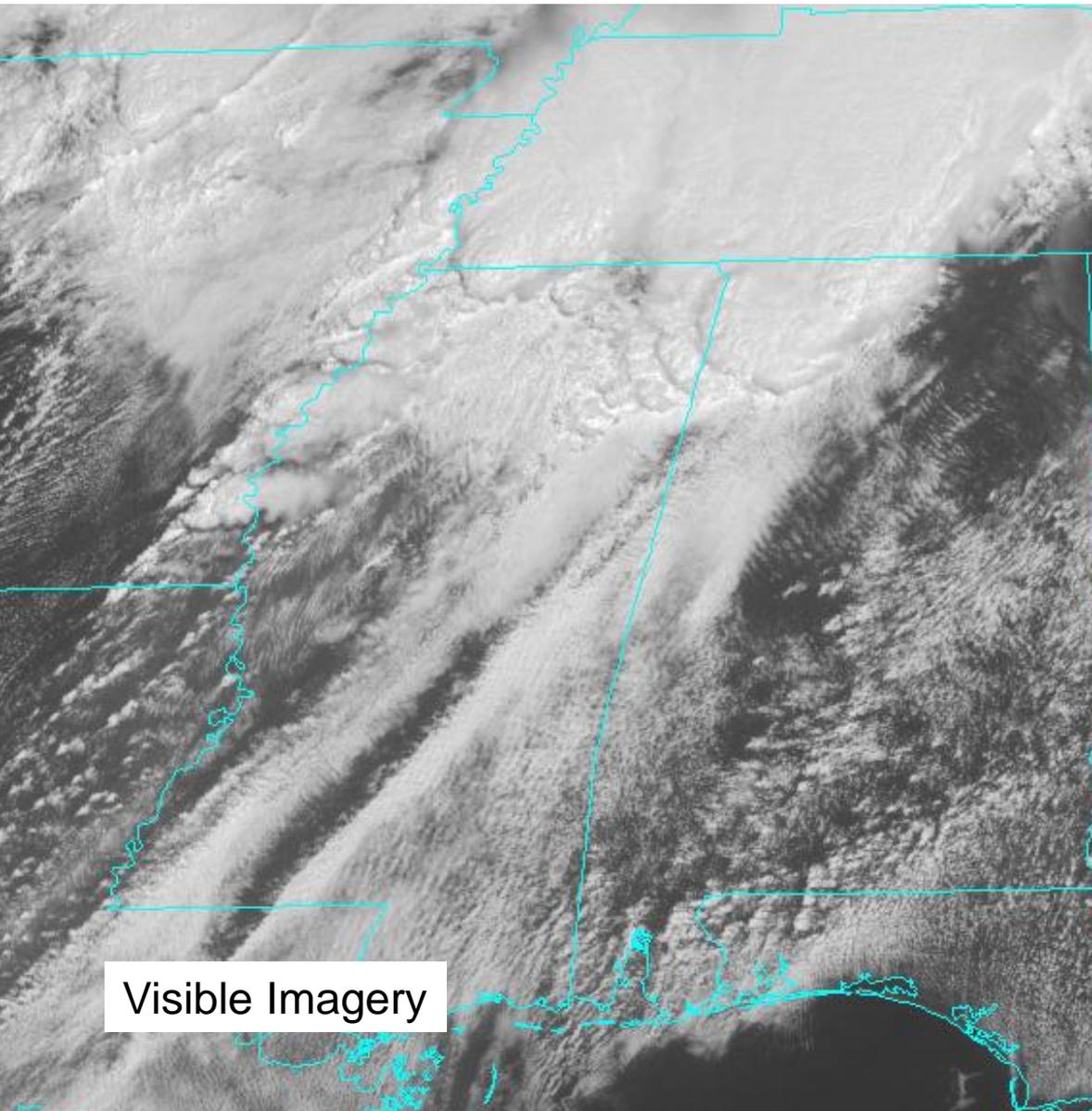
- Cloud and Moisture Imagery
- Hurricane Intensity
- Lightning Detection: Events, Groups & Flashes
- Rainfall Rate / QPE
- Total Precipitable Water
- Fire/Hot Spot Characterization
- Volcanic Ash: Detection & Height

Future Capabilities:

- Aircraft Icing Threat
- Trop. Fold Turbulence Prediction
- Convective Initiation
- Enhanced "V" / Overshooting Top Detection
- Low Cloud and Fog
- SO₂ Detection



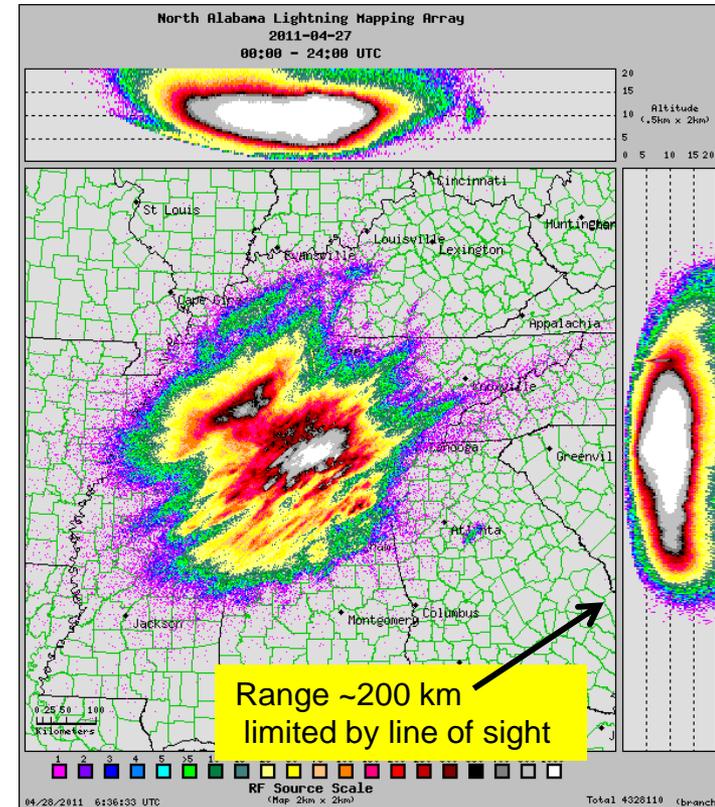
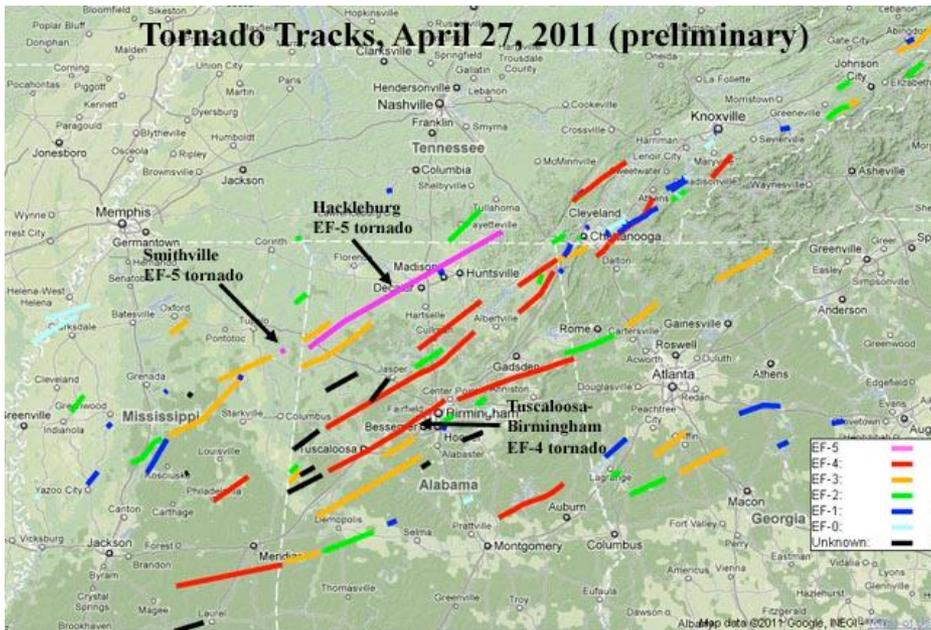
Tornado Outbreak April 27, 2011



GLM Lightning Testbed 04/27/11

North Alabama VHF Lightning Mapping Array (LMA, 13-stations)

- GLM proxy for total lightning, forecaster demonstrations
- Research indicates potential to increase severe storm and tornado warning lead-time up to 20+ min
- NESDIS, OAR, NWS coordinating on a national demo field test to assess “lightning jump” algorithm
- 650,000 in N. Alabama without power for 1 week
- TVA replaced 353 transmission structures and lines in 74 days at cost of \$25M
- Half of the 300+ fatalities in manufactured homes



Tuscaloosa, AL Damage



HWT: Forecaster Feedback from 2011

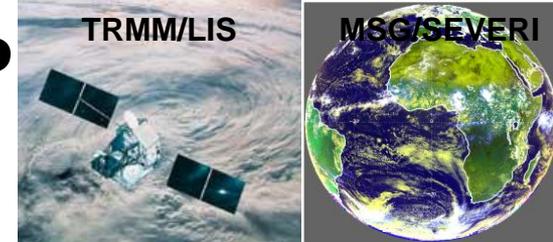
Lightning Detection

- “The total lightning data is an excellent tool for monitoring convection, I see much promise for such data in the future...”
- “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.”
- “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.”





CHUVA Ground Validation IOP Sao Paulo, Brazil 2011-2012



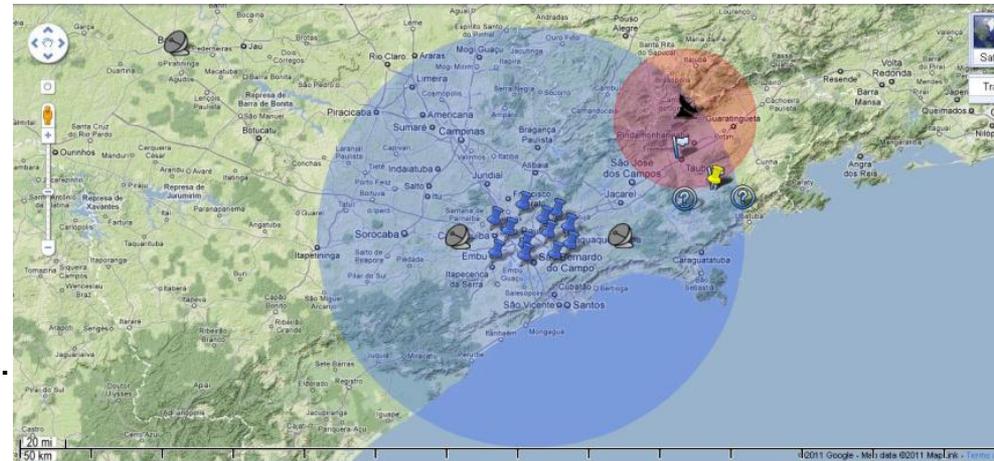
- **Field Campaign**

- Leverage observing assets associated with CHUVA with U.S. supplied portable LMA network (and European supplied LINET) to generate proxy data sets for GLM and ABI that include total lightning (LIS and ground-based) and SEVERI.
- Allow GLM and Combined AWG/Science teams to better address and assess several areas of on-going research

- **Science Objectives:**

- Algorithm and Proxy Data Validation
- Validation Systems Performance Assessment
- Storm Electrification/Physics
- Nowcasting, Applications for GLM+ABI+

- **Key scientific measurements:** VHF 3-D Lightning Mapping Array (LMA), LINET, TRMM/LIS, MSG SEVERI (ABI proxy data), high speed digital video, VLF lightning networks, dual-pol radar, electric field change



12-station LMA and radar sites

Training and Education



GOES-R 101



Bernie Connell¹, Timothy J. Schmit^{2,3}, Jim Gurka⁵,
Steve Goodman⁵, 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



Online training modules

- 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

• **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):** 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.

Follow us on Facebook

Did You Know?

The GOES-R [Proving Ground](#) coordinates with [93 product development and evaluation partners](#), including weather offices on the national, regional, and local level.

The [Advanced Baseline Imager \(ABI\)](#) will be capable of scanning the Earth at 5X the rate of the current GOES imager.

GOES-R will have six different instruments to monitor Earth and

On May 22, 2011 a devastating EF5 tornado struck Joplin, MO, killing 160 people. The Geostationary Lightning Mapper (GLM) will provide tornado warning lead time of 20 minutes or more.



Photo - CC BY-ND/Tim Lindenbaum/Flickr

Geostationary Lightning Mapper

Earlier tornado warnings

- 1
- 2
- 3
- 4
- 5
- 6
- 7

The Geostationary Operational Environmental Satellite – R Series (GOES-R) program is a key element to meeting the [National Oceanic and Atmospheric Administration \(NOAA\)](#) mission. The advanced spacecraft and instrument technology used on the GOES-R series will result in more timely and accurate weather forecasts. It will improve support for the detection and observations of meteorological phenomena and directly affect public safety, protection of property, and ultimately, economic health and development. The first launch of the GOES-R series satellite is scheduled for 2015.



Enter Search Term(s):

Recent News

The GOES-R Program participated in an entrance conference (meeting) with the Government Accountability Office (GAO) on September 1, 2011, in Silver Spring, MD - along with representatives from NASA, NESDIS, and NWS - to initiate GAO's next review cycle of the GOES-R Program which is being conducted at the request of the House Committee on Science, Space, and Technology. [More](#)

The GOES-R Program successfully completed the technical portion of the [Mission Preliminary Design Review \(MPDR\)](#) on August 12, 2011. The Standing Review Board recommended that the Program proceed to the critical design phase pending completion of part II of the MPDR, which will assess programmatic components such as the program's schedule. Part II will be held in the coming weeks.

Upcoming Events

Sept. 19-23, 2011: GOES-R Science Week will take place at the National Space Science and Technology Center in Huntsville, AL. [Registration](#)

October 15-21, 2011: The 7th GOES Users' Conference/36th NWA Annual Meeting will take place in Birmingham, AL. [GUC Info](#) | [GUC Agenda](#) Updated Sept. 15, 2011

December 5-9, 2011: The American Geophysical Union Fall Meeting 2011 will take place in San Francisco, CA. [Registration](#)

- ### Learn More
- + [Frequently Asked Questions \(FAQs\)](#)
 - + [Flyout Schedule](#)
 - + [Trifold Flyer](#)
 - + [Fact Sheets](#)
 - + [Related Links](#)
 - + [GOES-R Merchandise](#)
 - + [Past Conference Materials](#)





User Community Proving Ground

Post to your blogs

initiated to facilitate research-to-operations with the principal focus being on the forecaster/AWIPS-II environment; to prepare for the GOES-R information, to get real-world experience by leveraging existing resources, and to evaluate product tailoring. The GOES-R Proving Ground engages NWS, EPA, DoD, and other operational environments in pre-operational demonstrations of selected capabilities of next generation GOES with the objective 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-like products and techniques into NWS operations with emphasis on AWIPS and transitioning to AWIPS-II
- Engaging in a dialogue to provide feedback between developers and users

The GOES-R project engages the National Weather Service (NWS) forecast and warning community in preoperational demonstrations of selected capabilities anticipated from the next generation of NOAA geostationary earth observing systems.

The Proving Ground was established to realize the benefits of the GOES-R system as soon as the satellites are launched and operational. GOES-R will mark the first major technological advances in geostationary observations since 1994. The advances include improvements upon existing data such as increased spatial, temporal, and spectral resolutions for Earth monitoring and improved space weather observations and initiation of new operational observations such as lightning mapping.

Many of the GOES-R products will be aimed at monitoring severe weather and helping forecasters issue earlier, more accurate severe weather warnings. In order to create the most useful severe weather tools possible, the GOES-R Proving



The GOES-R Overshooting Top Detection (OTD) algorithm identified an overshooting top at NOAA's Hazardous Weather Testbed with the severe thunderstorm and tornado that struck in Springfield, MA on June 1, 2011. The OTD singled out the most intense thunderstorm cell out of a very large storm complex over Southern and Central New England. National Weather Service forecasters at the HWT Experimental Warning Program and Convective Initiation desk were alerted to the developing severe storm with 28 minute lead time before the first tornado report.

For More Information

- [CIMSS GOES-R Proving Ground Website](#)
- [Proving Ground Partners Page](#)
- [Proving Ground Products Website](#)
- [GOES-R Proving Ground Facebook Page](#)

Blogs

- [CIMSS Satellite Blog](#)
- [RAMMB GOES-R Proving Ground Blog](#)
- [GOES-R Proving Ground at NOAA's Hazardous Weather Testbed](#)
- [The Wide World of SPoRT Blog](#)

Fact Sheets

- [Proving Ground Severe Weather Fact Sheet](#)
- [National Hurricane Center 2010 Experiment](#)

Documents

- [GOES-R Proving Ground Update](#) - September 2011
- [GOES-R Proving Ground Program Plan \(PGPP\)](#)
- [GOES-R Proving Ground Hazardous Weather Testbed 2011 Spring Experiment Operations Plan](#)
- [Proving Ground Status Spreadsheet](#)
- [Proving Ground Annual Meeting presentations](#)

Meetings, Workshops

- 2011

- GOES-R Proving Ground Annual Meeting, Boulder, CO May 17-19
- Algorithm Working Group Annual Meeting, Fort Collins, CO, June 12-14
- Southern Thunder- ST11, Norman, OK, July 11-14
- OCONUS Proving Ground Workshop, Juneau, AK, July 26-28
- Int Conference on Atmospheric Electricity, Rio de Janeiro, Brazil, Aug 9-13
- EUMETSAT MetSat User's Conference, Oslo, Norway, Sept 5-9
- GOES Users Conference (joint with NWA), Birmingham, AL, Oct 19-21, 2011
- Fall AGU, Dec 5-9

- 2012

- AMS Annual Meeting, Jan 22-26
- Joint WoF-High Impact Weather Workshop, Norman, OK February
- ILDC/ILMC Lightning Conferences, Broomfield, CO, April 2-5
- GOES-R Science Week II (AWG, Cal/Val, R3, PG, Training), NWS Training Center, Kansas City, April 30-May 4
- WMO Nowcasting and Very-Short Range Forecasting Symposium, Rio de Janeiro, Brazil, Aug 21-25
- 2012 GLM Annual Science Meeting, Huntsville, AL, Sept 19-20 TBD

Summary

- GLM Instrument Development on Track
 - GLM CDR Dec 2010
- Risk Reduction Science Program- more emphasis on NWS integrated observations and NWP for Future Capabilities- “fused capabilities and services”
- Proving Ground continues to grow and plans are in place for continued demonstrations with forecasters
 - National demo of lightning jump algorithm
 - BAMS article in review
- CHUVA Campaign begins in October - provides a rich GLM-ABI data set for algorithm development, validation, and for applications development
 - Science Workshop in Brazil 2012-2013 TBD
- DC3 Campaign Spring 2012