The GOES-R Proving Ground

Presented by Jim Gurka

NOAA/NESDIS/GOES-R Program Office

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AMS Annual Meeting, Atlanta GA

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Etc.

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, and NOAA Testbeds.

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

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

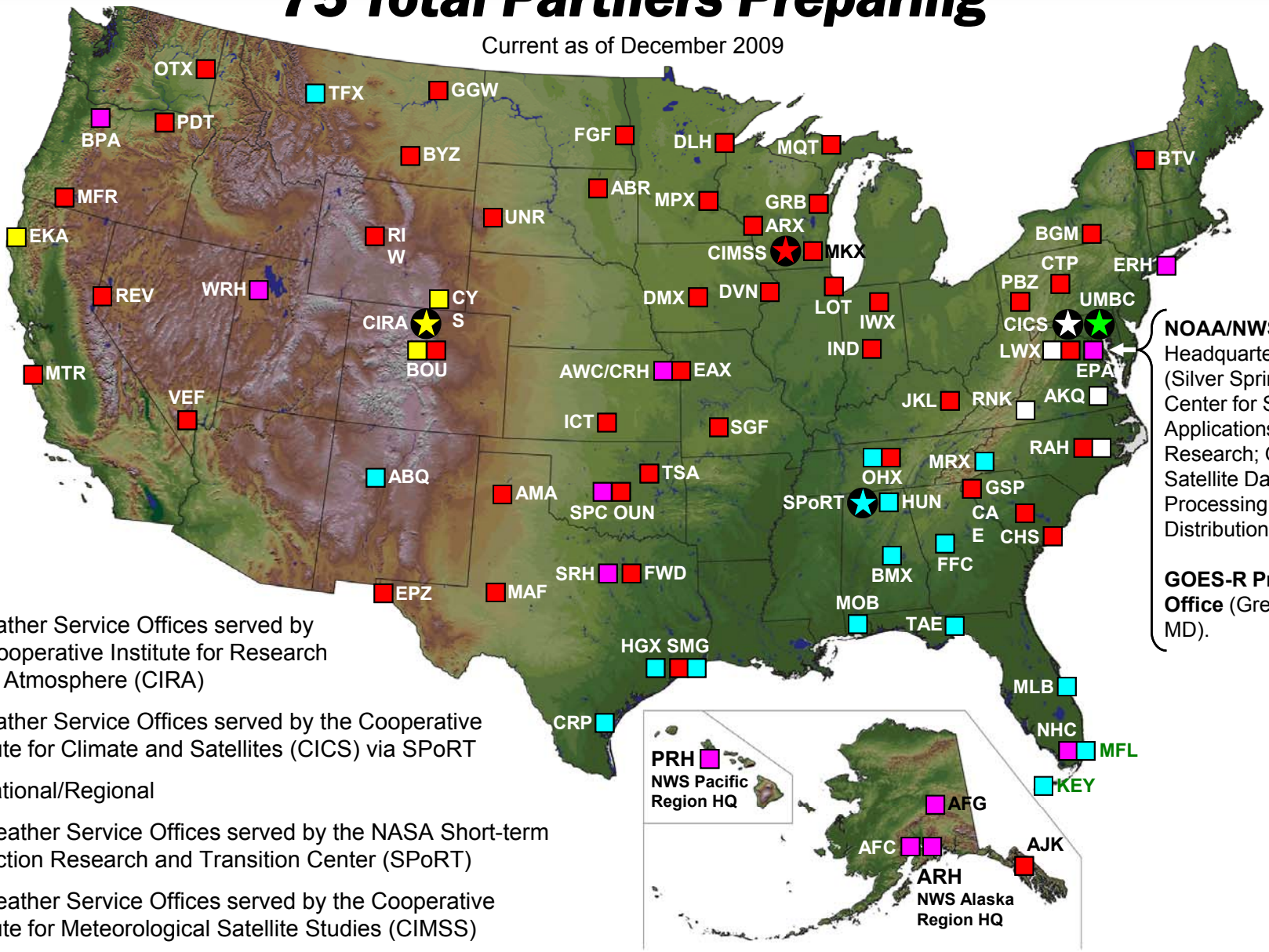
GOES-R Proving Ground

- Place where technologies and ideas are tested and proven before being fielded in operations
- Evaluates how infusion of technology or process in forecast environment impacts operations
- Integrates technology or process with other available tools
- User readiness risk mitigation
- Key component: operational testing by those independent of the development process
- Key Benefit: users more accepting of fielded technology
  - They have had a say in the design
  - Design better fits an identified need

GOES-R Proving Ground Partners

75 Total Partners Preparing

Current as of December 2009



NOAA/NWS Headquarters (Silver Spring, MD); Center for Satellite Applications and Research; Office of Satellite Data Processing and Distribution.

GOES-R Program Office (Greenbelt, MD).

- ***3*** Weather Service Offices served by the Cooperative Institute for Research in the Atmosphere (CIRA)
- ***4*** Weather Service Offices served by the Cooperative Institute for Climate and Satellites (CICS) via SPoRT
- ***11*** National/Regional
- ***15*** Weather Service Offices served by the NASA Short-term Prediction Research and Transition Center (SPoRT)
- ***46*** Weather Service Offices served by the Cooperative Institute for Meteorological Satellite Studies (CIMSS)

GOES-R Proving Ground Partners

75 Total Partners Preparing

Current as of December 2009

46 Weather Service Offices served by the Cooperative Institute for Meteorological Satellite Studies (CIMSS)

- Aberdeen, South Dakota (ABR)
- Amarillo, Texas (AMA)
- Billings, Montana (BYZ)
- Binghamton, New York (BGM)
- Boulder, Colorado (BOU)
- Burlington, Vermont (BTV)
- Charleston, South Carolina (CHS)
- Chicago, Illinois (LOT)
- Columbia, South Carolina (CAE)
- Dallas/Fort Worth, Texas (FWD)
- Davenport, Iowa (DVN)
- Des Moines, Iowa (DMX)
- Duluth, Minnesota (DLH)
- El Paso, Texas (EPZ)
- Fargo, North Dakota (FGF)
- Glasgow, Montana (GGW)
- Green Bay, Wisconsin (GRB)
- Greenville, South Carolina (GSP)
- Indianapolis, Indiana (IND)
- Jackson, Kentucky (JKL)
- Juneau, Alaska (AJK)
- Kansas City, Missouri (EAX)
- La Crosse, Wisconsin (ARX)
- Las Vegas, Nevada (VEF)
- Marquette, Michigan (MQT)
- Medford, Oregon (MFR)
- Midland, Texas (MAF)
- Milwaukee, Wisconsin (MKX)
- Minneapolis, Minnesota (MPX)
- Monterey, California (MTR)
- Nashville, Tennessee (OHX)
- Norman, Oklahoma (OUN)
- Northern Indiana (IWX)
- Pendleton, Oregon (PDT)
- Pittsburgh, Pennsylvania (PBZ)
- Raleigh, North Carolina (RAH)
- Rapid City, South Dakota (UNR)
- Reno, Nevada (REV)
- Riverton, Wyoming (RIW)
- Spokane, Washington (OTX)
- Springfield, Missouri (SGF)
- State College, Pennsylvania (CTP)
- Sterling, Virginia (LWX)
- Tulsa, Oklahoma (TSA)
- Wichita, Kansas (ICT)
- Spaceflight Meteorology Group (SMG)

Univ. of Maryland, Baltimore, Co.

- State/Local/Tribal Air Quality Forecast Offices (non-NOAA)

UMBC
AN HONORS UNIVERSITY IN MARYLAND

3 Weather Service Offices served by the Cooperative Institute for Research in the Atmosphere (CIRA)

- Boulder, Colorado (BOU)
- Cheyenne, Wyoming (CYS)
- Eureka, California (EKA)

15 Weather Service Offices served by the NASA Short-term Prediction Research and Transition Center (SPoRT)

- Albuquerque, New Mexico (ABQ)
- Birmingham, Alabama (BMX)
- Corpus Christi, Texas ( )
- Great Falls, Montana (TFX)
- Houston, Texas (HGX)
- Huntsville, Alabama (HUN)
- Key West WFO (KEY)
- Melbourne, Florida (MLB)
- Miami, Florida (MFL)
- Mobile, Alabama (MOB)
- Morristown, Tennessee (MRX)
- Nashville, Tennessee (OHX)
- Peachtree City WFO (FFC)
- Spaceflight Meteorology Group (SMG)
- Tallahassee, Florida (TAE)

4 Weather Service Offices served by the Cooperative Institute for Climate and Satellites (CICS) via SPoRT

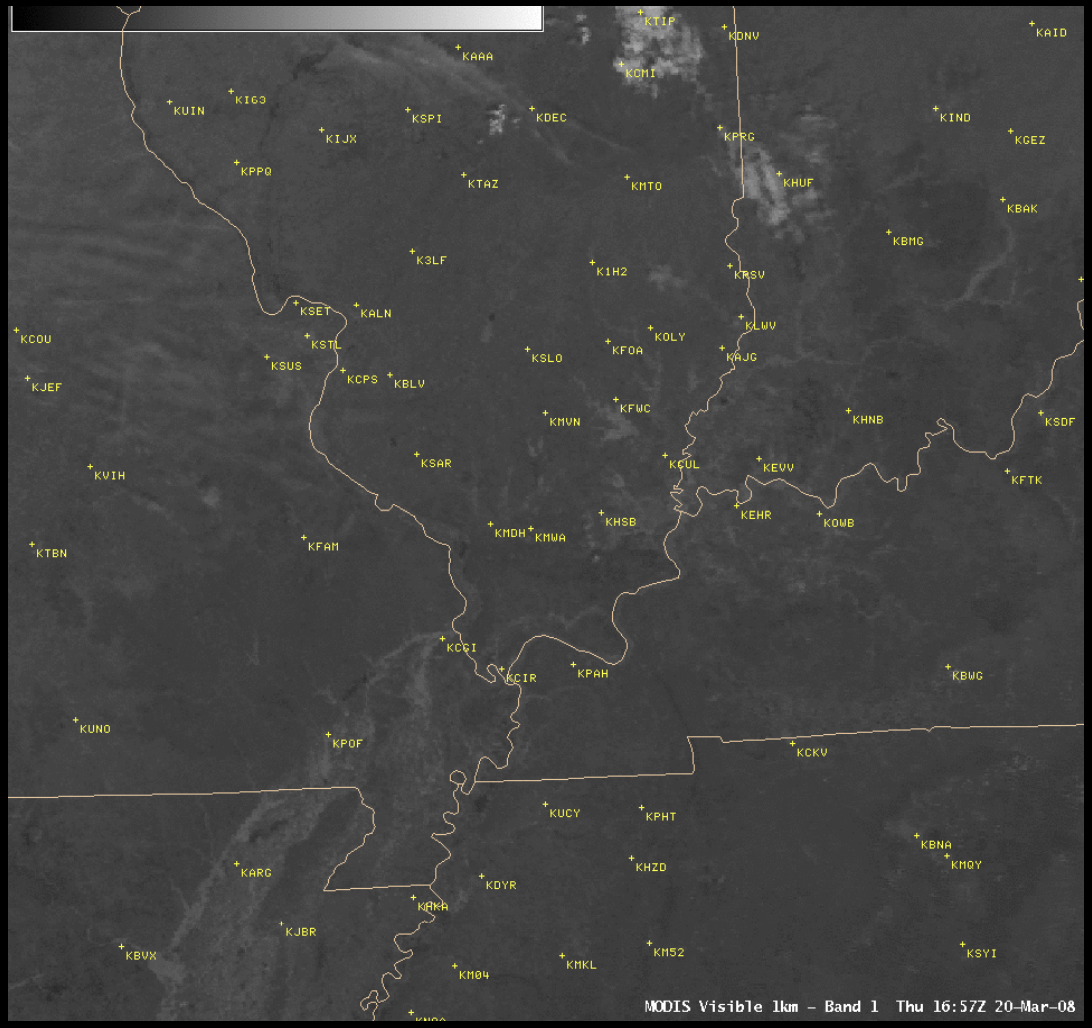
- Blacksburg Virginia (RNK)
- Raleigh, North Carolina (RAH)
- Sterling, Virginia (LWX)
- Wakefield, Virginia (AKQ)

11 National and Regional Centers

- Alaska, Anchorage (ARH)
  - Anchorage and Fairbanks
- Eastern, Bohemia, New York (ERH)
- Central, Kansas City, Missouri (CRH)
- Pacific, Honolulu, Hawaii (PRH)
- Southern, Fort Worth, Texas (SRH)
- Western, Salt Lake City, Utah (WRH)
- Aviation Weather, Kansas City (AWC)
- Bonneville Power Administration (BPA)
- Environmental Protection Agency (EPA)
- National Hurricane Center, Miami (NHC)
- Storm Prediction Center, Norman (SPC)

CIMSS "Satellite Proving Ground":

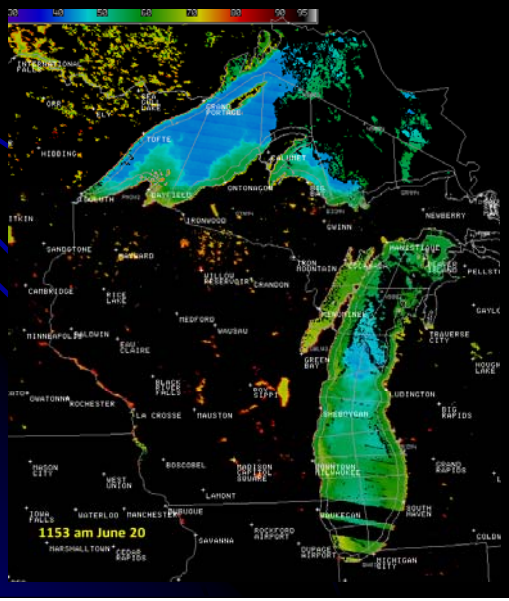
NOAA's Cooperative Institute for Meteorological Satellite Studies (CIMSS) is engaging in activities that serve as a "Satellite Proving Ground" for new satellite products that are not yet operationally available in the National Weather Service AWIPS environment.

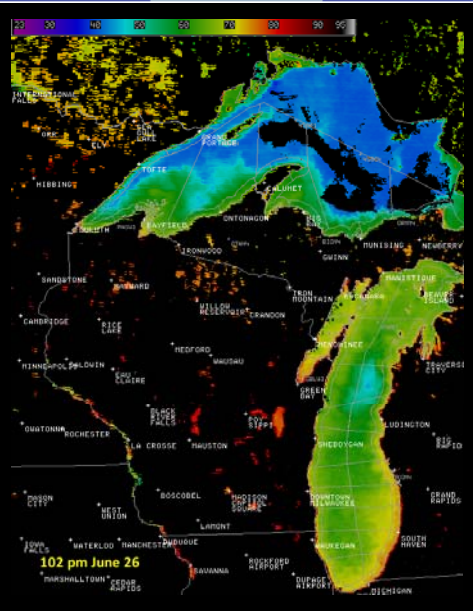


AWIPS images of the MODIS visible channel and near-IR "snow/ice channel", highlighting the extent of river flooding across the central Mississippi River and Ohio River valley regions on 20 March 2008.

MODIS in AWIPS

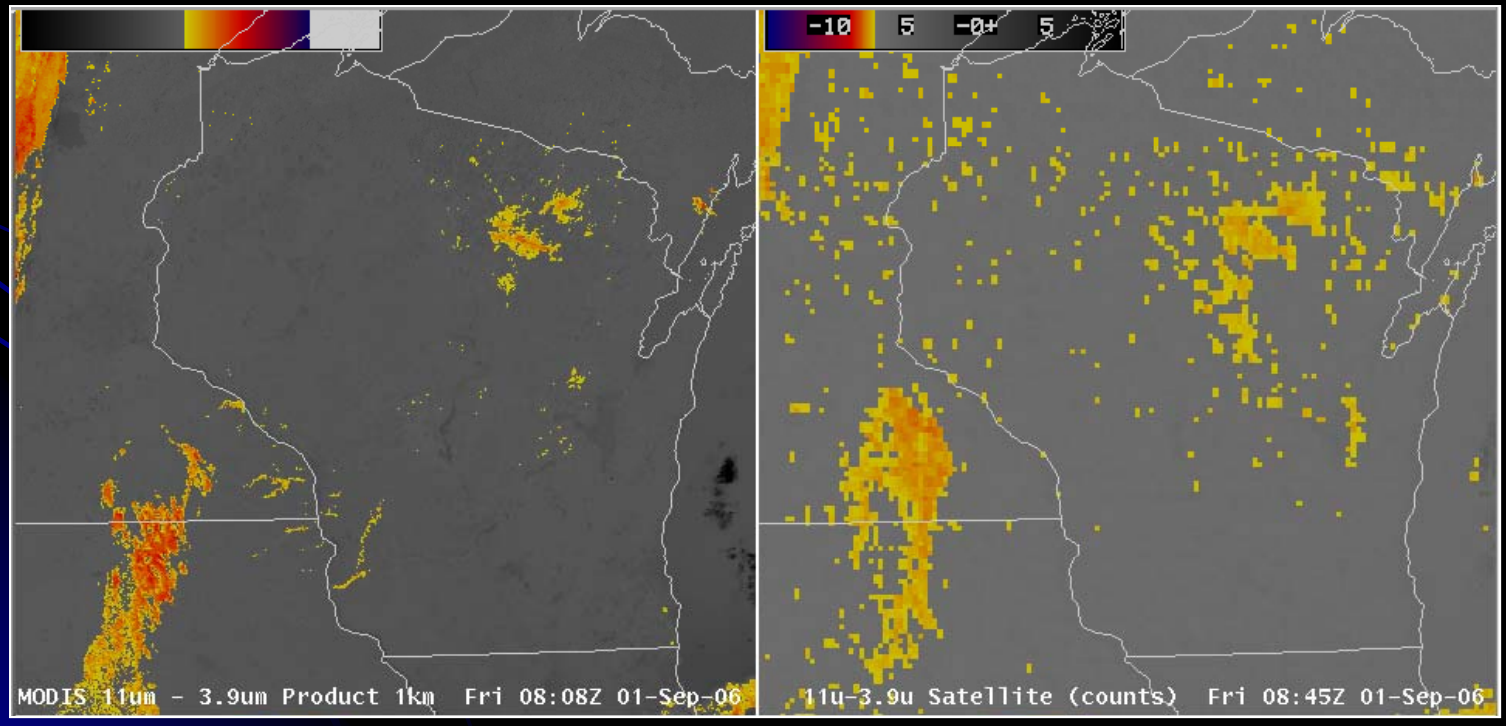
- http://www.crh.noaa.gov/news/display_cmsstory.php?wfo=mkx&storyid=29173&source=0
- Lake Michigan Waters Warming Rapidly -- Light winds, abundant sunshine and unseasonable warm temperatures over the past week across Wisconsin and the western Great Lakes have resulted in Lake Michigan water temperatures warming 10 to 20 degrees.





Area Forecast Discussion

MAIN SHORT TERM FORECAST PROBLEM IS EAST FLOW AND MARINE LAYER INFLUENCE OVER EASTERN WISCONSIN...AND DENSE FOG POTENTIAL IN THE WEST. THINK MOST OF THE DENSE FOG WOULD BE IN THE RIVER VALLEYS...WITH A TENDENCY FOR PATCHY FOG AND SOME STRATUS AGAIN IN THE EAST WITH MORE OF A GRADIENT. MODIS 1 KM IMAGERY LAST NIGHT SHOWED THE DENSE FOG IN LONE ROCK AND BOSCOBEL WAS CONFINED TO THE IMMEDIATE WISCONSIN RIVER VALLEY...IMPORTANT INFORMATION. THE LOCAL RIVER VALLEY DENSE FOG IS NOT SEEN IN THE NORMAL 2 KM GOES. (HENTZ/MKX)



Hail Damage Paths

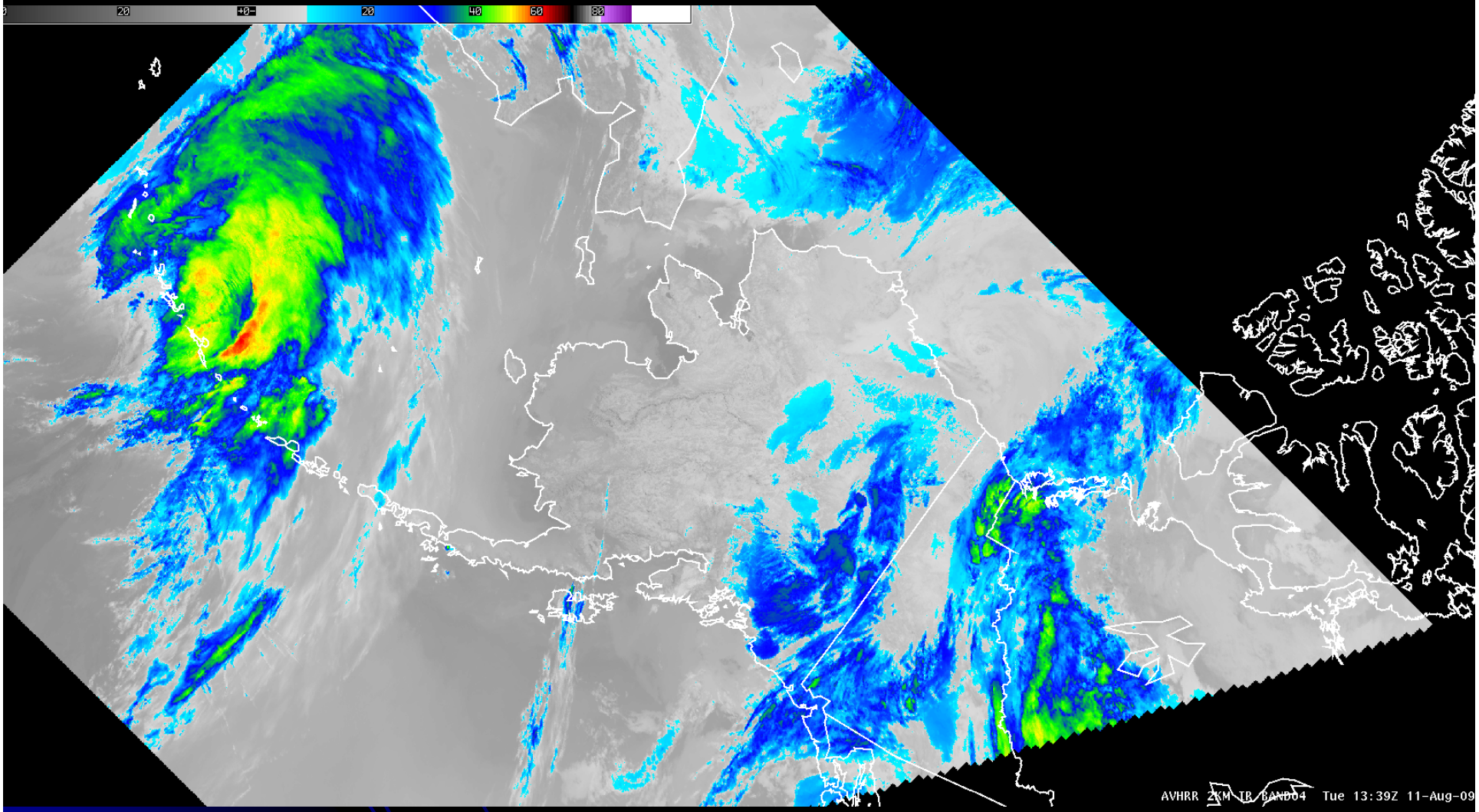
S. Bachmeier, CIMSS

Enhanced cumulus development due to differential heating along the hail swath

http://cimss.ssec.wisc.edu/goes/blog/wp-content/uploads/2009/08/090809_g12_ir_ani

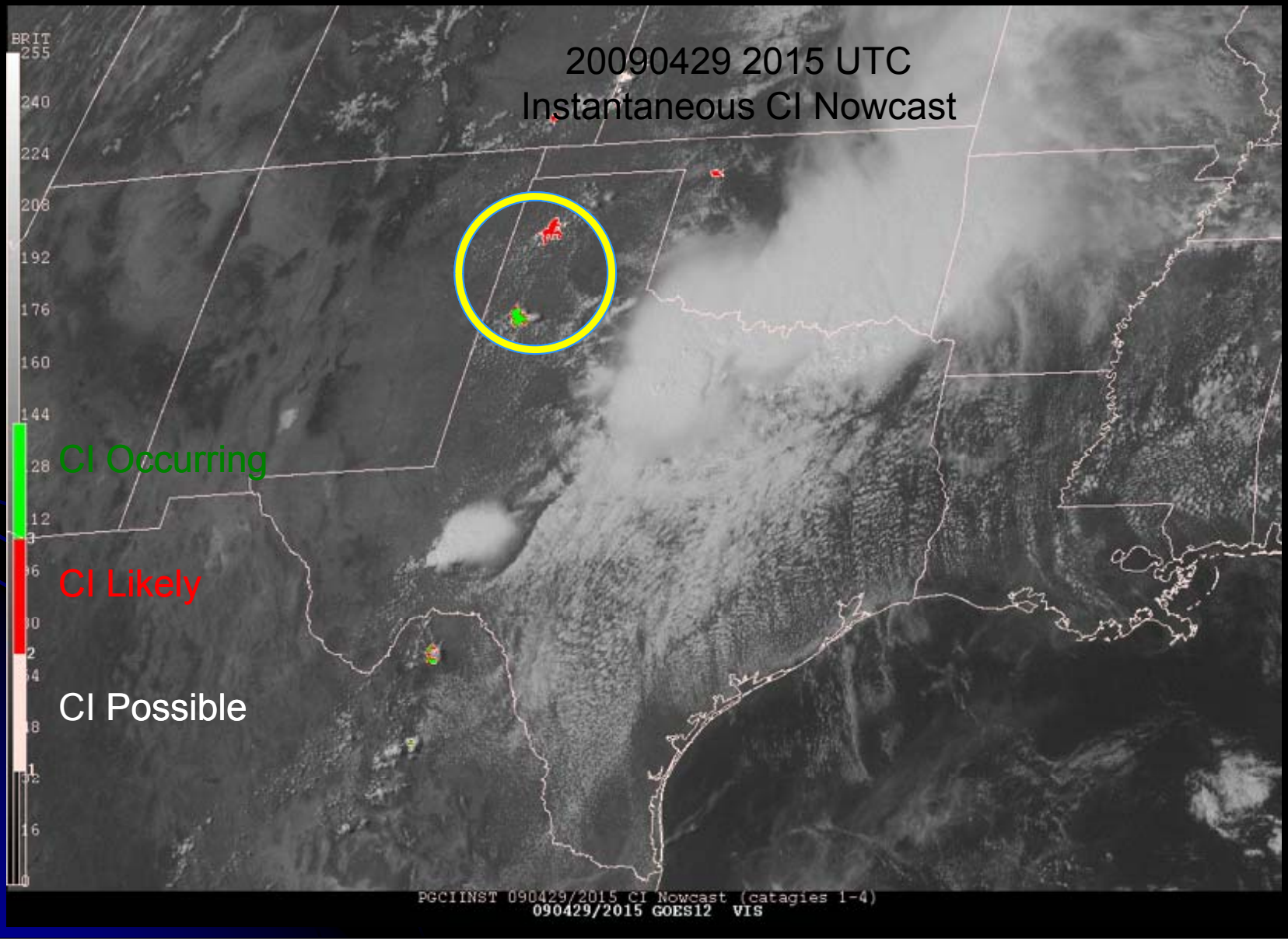
S. Bachmeier, CIMSS

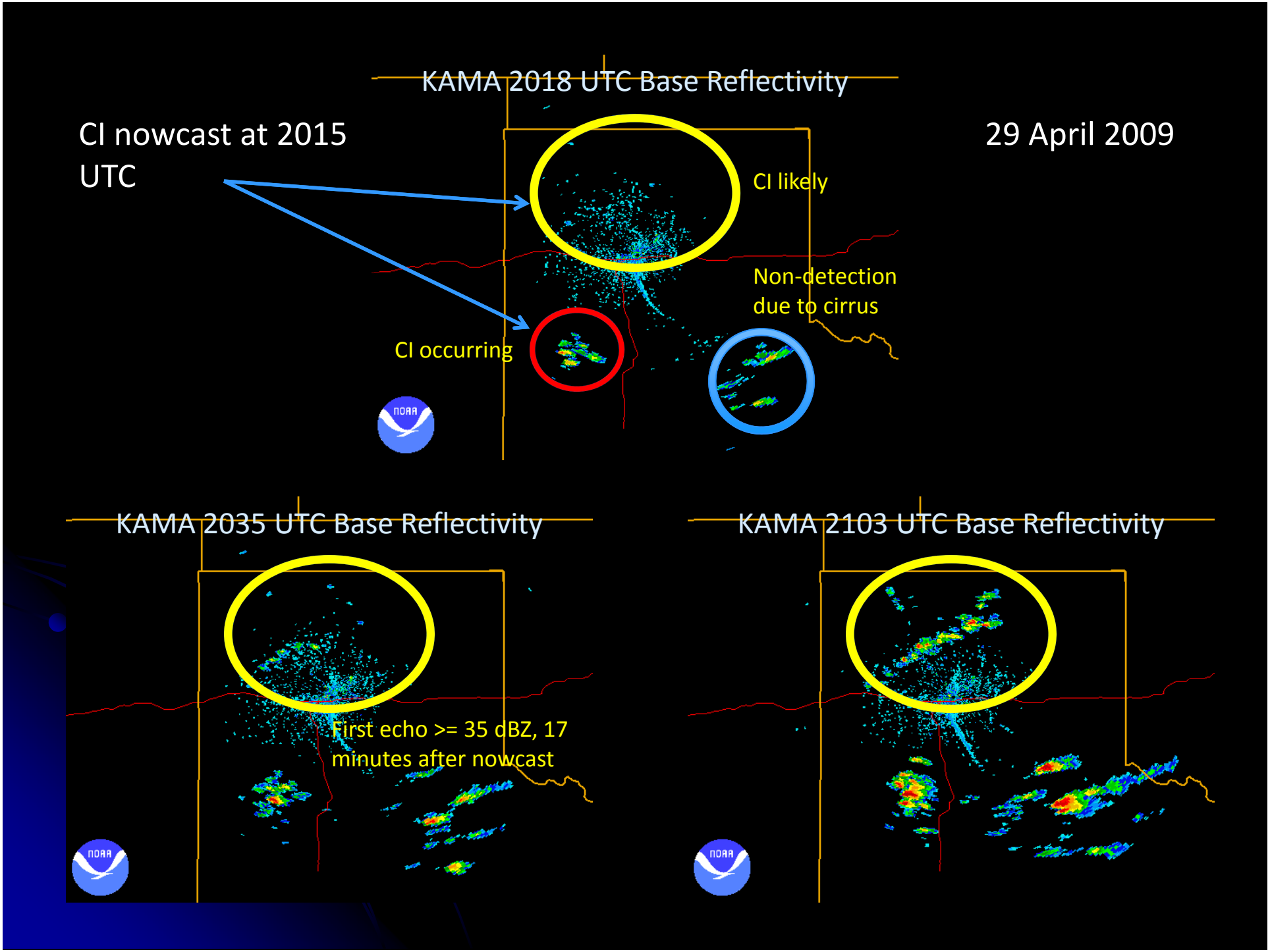
AVHRR in AWIPS



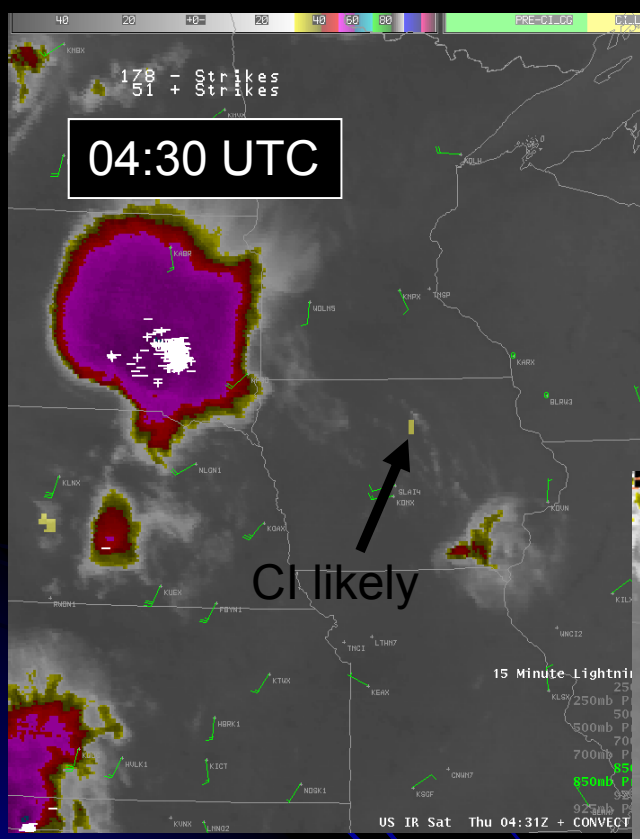
Example of other products:
http://cimss.ssec.wisc.edu/goes/blog/wp-content/uploads/2009/08/090811_avhrr_ir_type_anim.gif

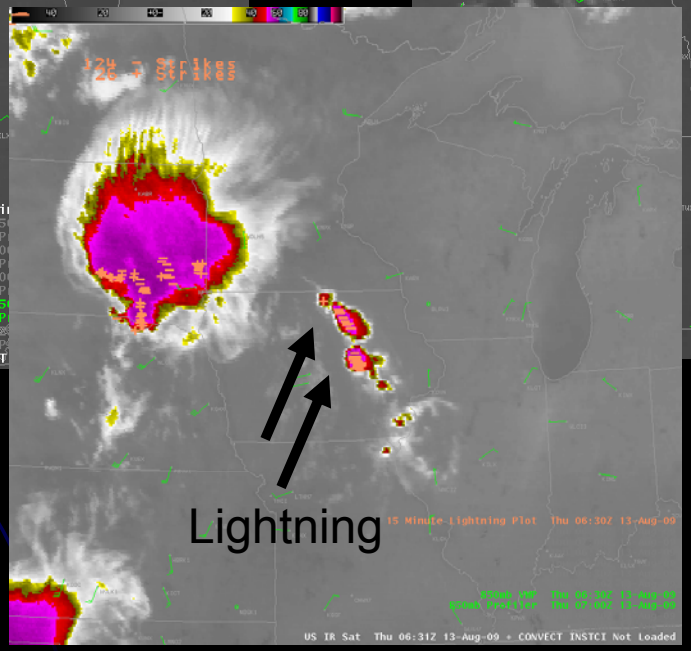
20090429 Dryline CI Case
SPC HWT Proving Ground

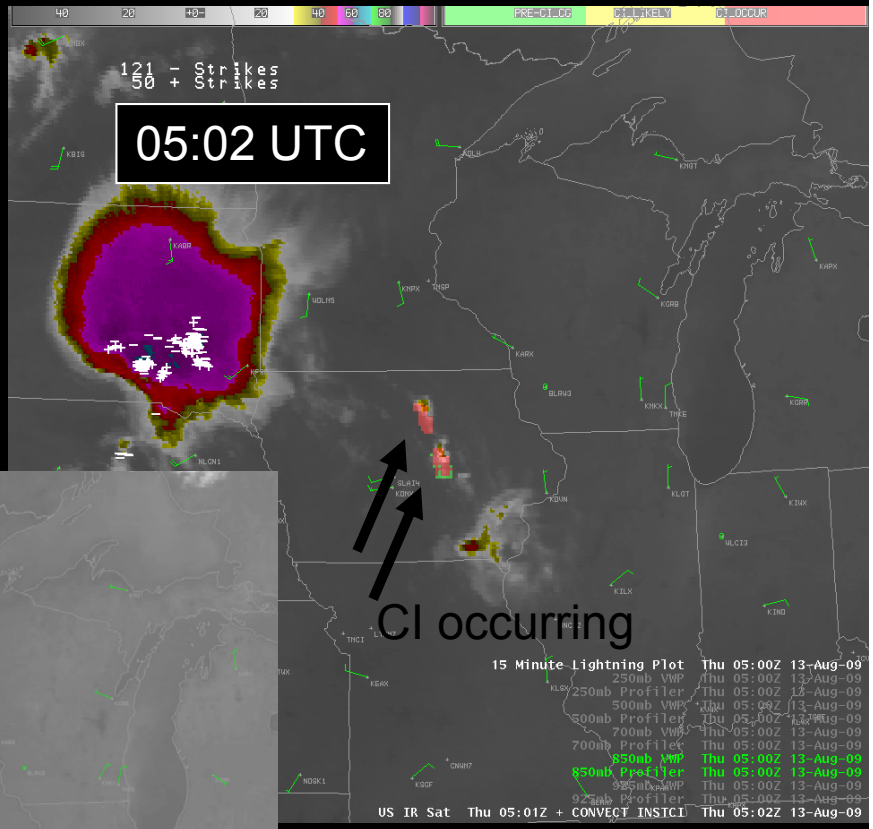



KAMA 2018 UTC Base Reflectivity
CI nowcast at 2015 UTC
29 April 2009
CI likely
Non-detection due to cirrus
CI occurring
KAMA 2035 UTC Base Reflectivity
First echo >= 35 dBZ, 17 minutes after nowcast
KAMA 2103 UTC Base Reflectivity

AWIPS CI/CTC Interaction with Sullivan (MKE) NWS Office







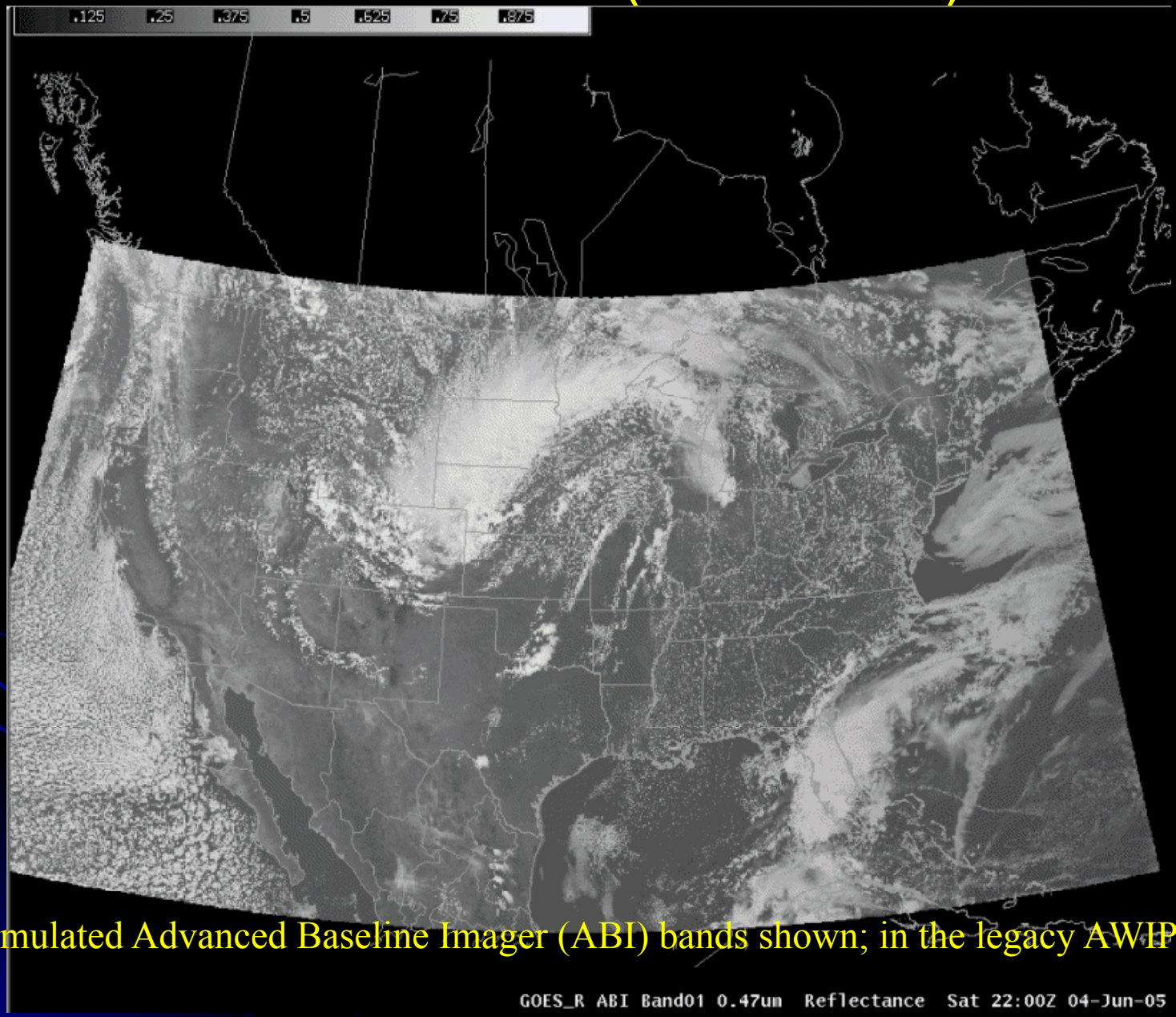
Forecaster generated screen captures from AWIPS at MKE

AWIPS CI/CTC Interaction with Sullivan (MKE) NWS Office

"The UWCI performed very well in Iowa last night! These thunderstorms fired up along an existing boundary and are coincident with the leading edge of 700mb moisture transport and weak 850mb warm air advection."

- Marcia Cronce NWS Forecaster

ABI in AWIPS (via netCDF)



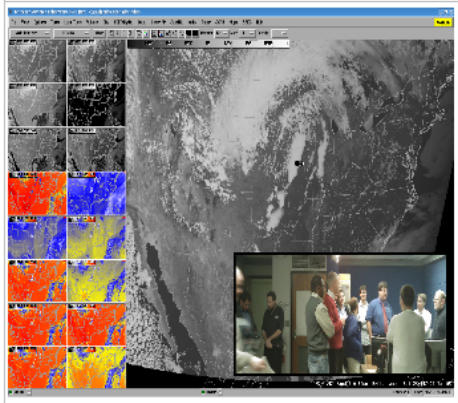
Simulated Advanced Baseline Imager (ABI) bands shown; in the legacy AWIPS.

Wx Event Simulator (all ABI bands)

WEATHER EVENT SIMULATOR (WES)

CIMSS University of Wisconsin-Madison

April-2009.



WES SIMULATION GUIDE:

ADVANCE-BASELINE-IMAGER (ABI).

June 04-05, 2005.
Continental United States (CONUS).

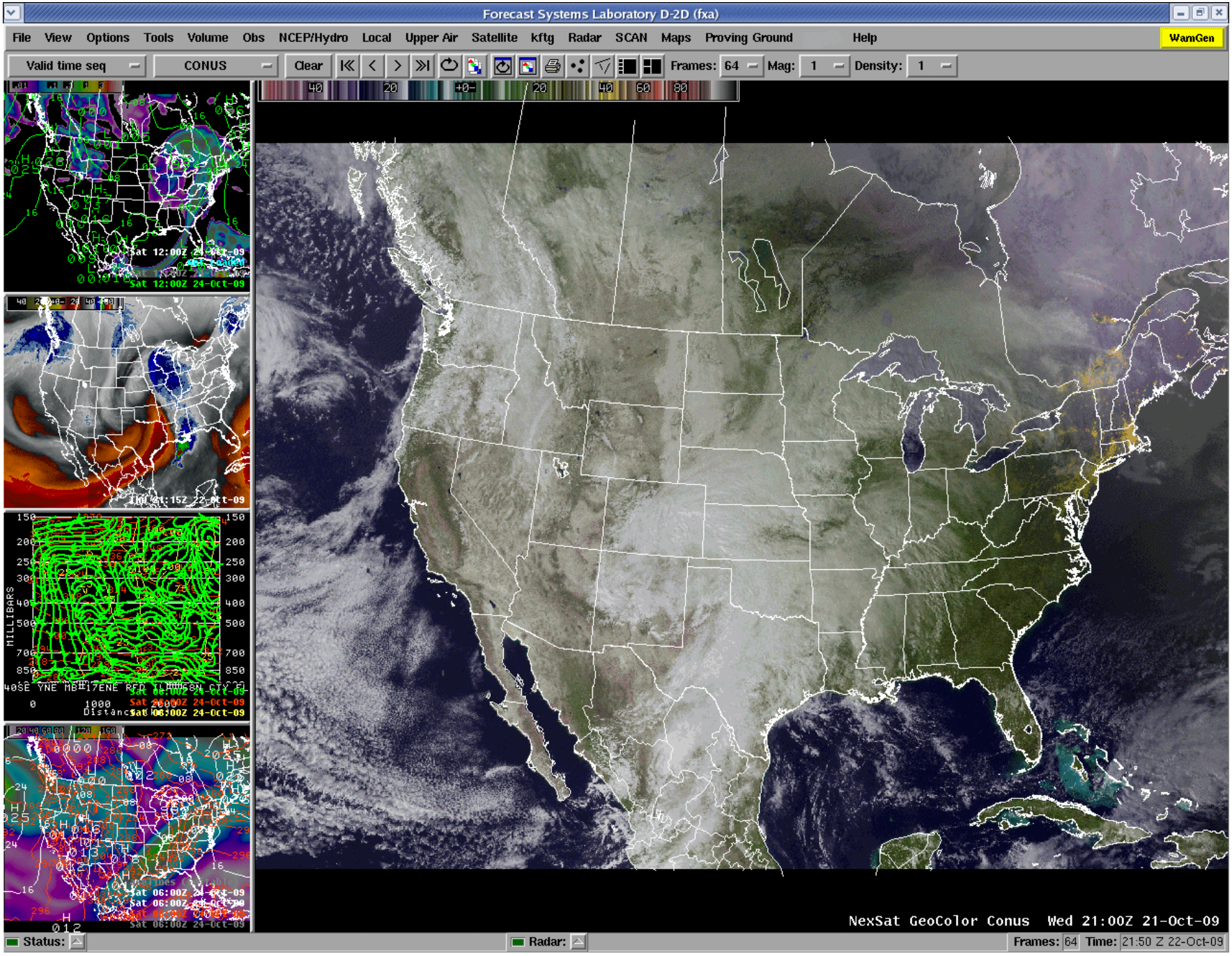
The ABI WES Development Team
CIMSS University of Wisconsin-Madison

WES guide underway

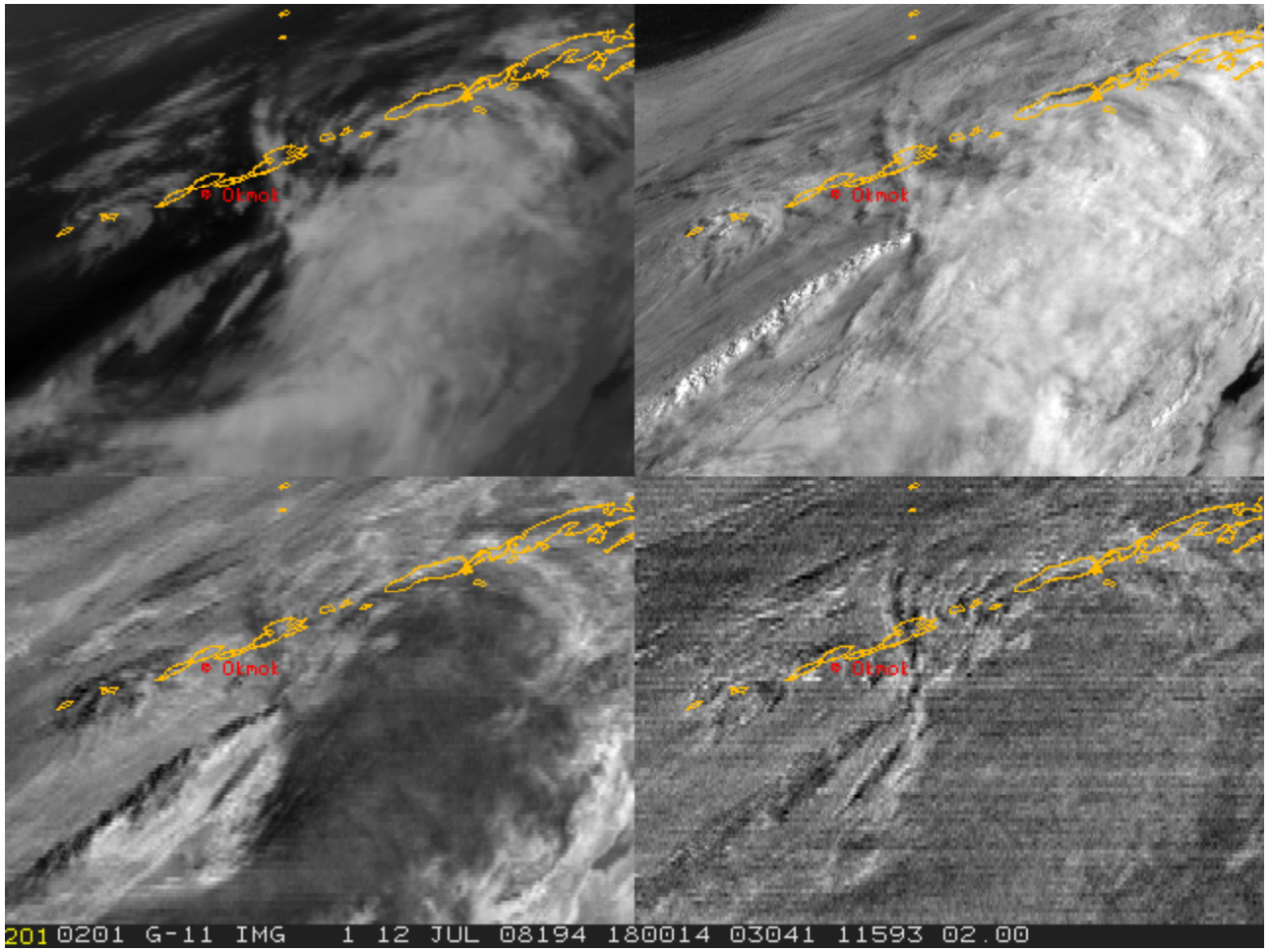
CIRA / RAMMB Roles

- Coordination with CIMSS, SPoRT, GPO, other PG components
  - Product documentation, distribution methods, AWIPS development, web page, feedback methods
- WFO Interaction
  - Direct interaction with Boulder and Cheyenne WFOs
  - Remote interaction with additional WFOs
- NCEP Interaction
  - Coordination of 2010 PG with National Hurricane Center
  - Participation in SPC PG
- Leveraging Ongoing CIRA/RAMMB Activities
  - NexSat for NPOESS, CloudSat, Joint Hurricane Testbed , GOES-R Risk Reduction, VISIT, SHyMet

GeoColor AWIPS PG Product (21Oct09 21UTC - 22Oct09 21UTC)

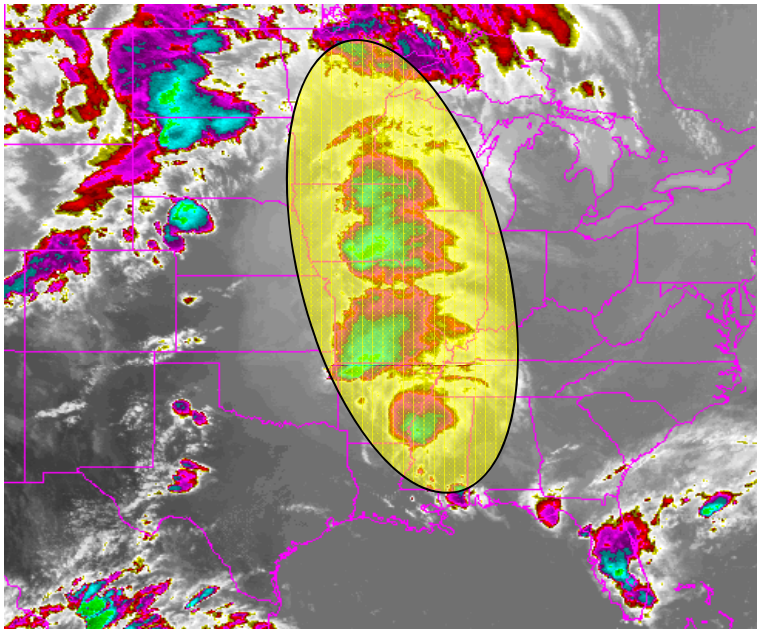


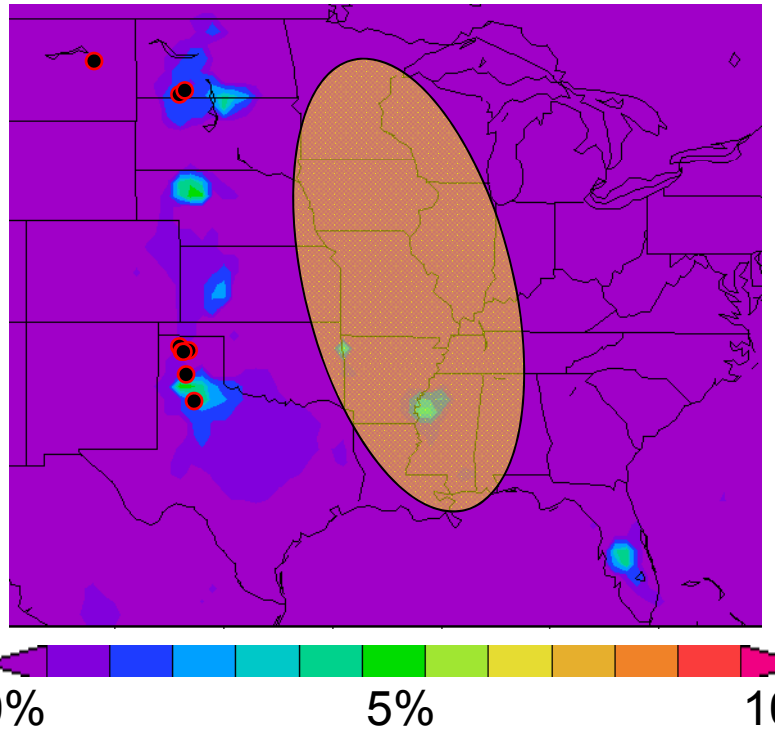
Principal Component Image (PCI) Analysis
Volcanic Ash Enhancement



Analysis of Initial Okmok Eruption: Imagery for the Okmok (Alaska Aleutian) volcano eruption from 12/13 July 2008 has been analyzed thru Principal Component Image (PCI) analysis. PCIs extract dominant image combinations from the available GOES bands.

SPC Interaction-Statistical Hail Product





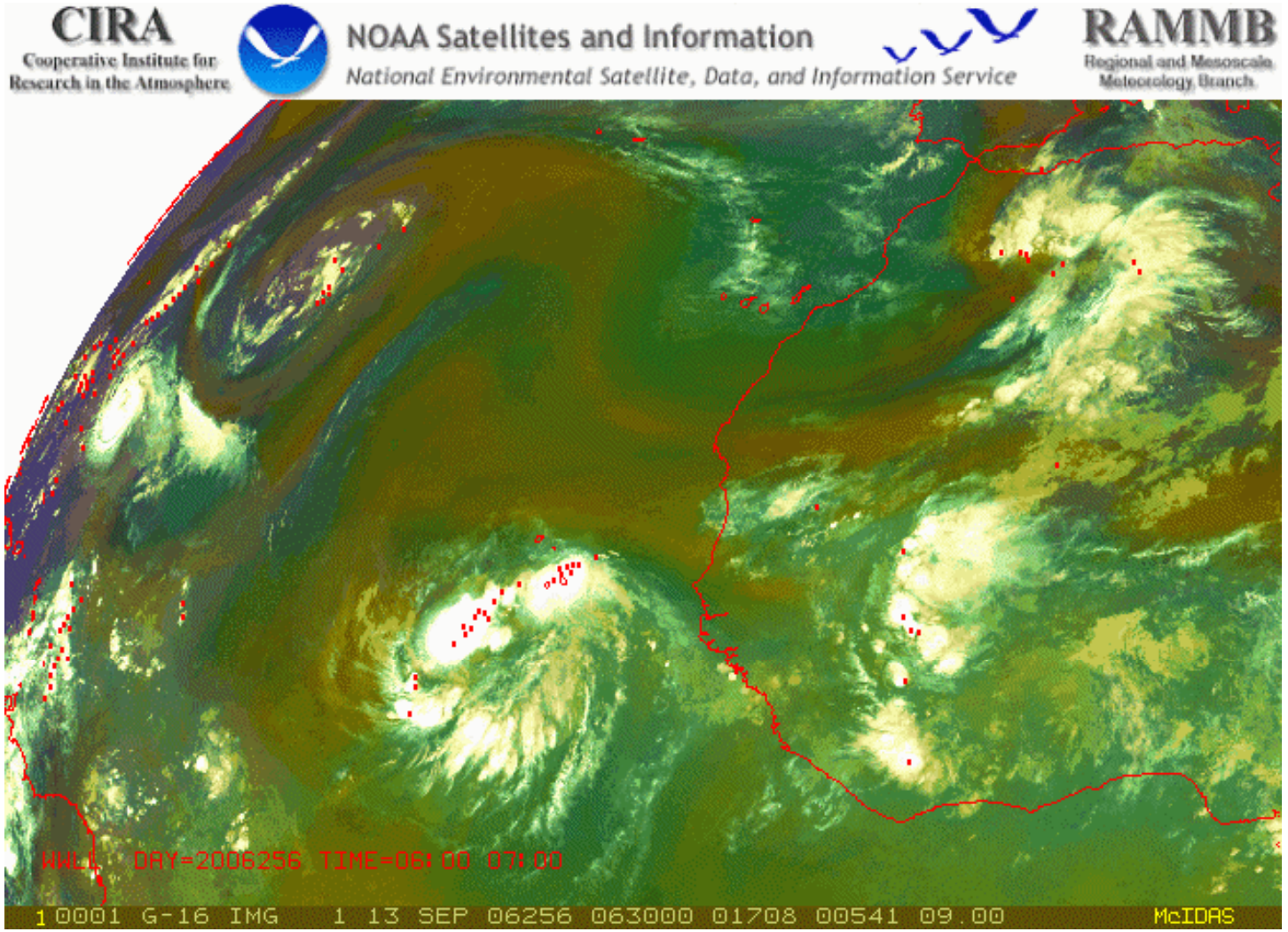
GOES-12 10.7 micron image from 12 May 2009 at 2300 UTC (left), and probability of severe hail within a 0.5x0.5 degree lat/lon box in the next hour (right). SPC Hail Reports for 2300-0000 UTC shown as circles.

→Maps will be generated for 0-1, 1-2, …, 5-6 hr forecasts, making the tool useful for convective outlooks, mesoscale discussions, and watches. The product was demonstrated at SPC during the Spring Experiment. *(SME: Dan Lindsey)*

NHC Proving Ground

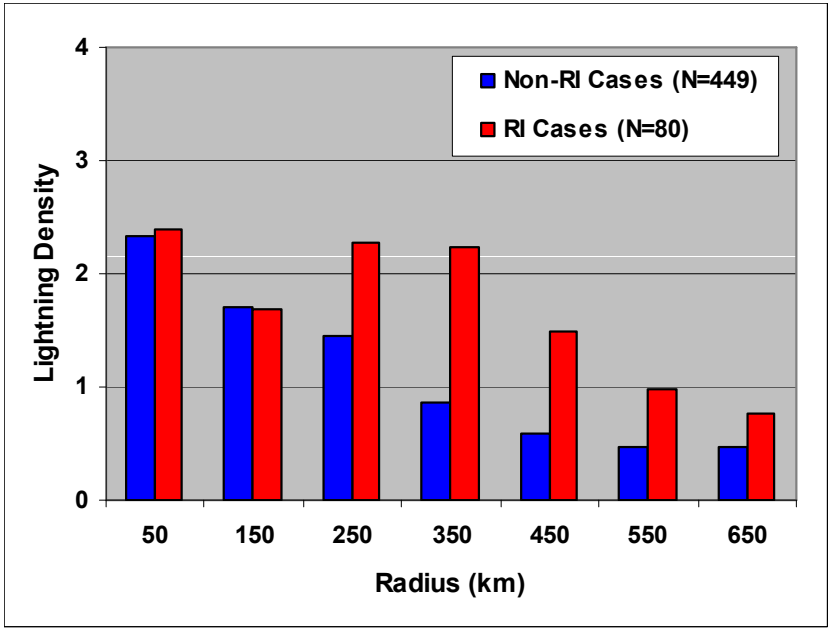
- AWG hurricane products very limited
  - Hurricane Intensity Estimate
- Focus on Day 2, new applications
  - Air mass product from MSG
  - Dust/Aerosol products
  - Lightning applications from ground-based WWLLN
  - Anvil thickness product
  - Additional products from CIMSS
- Developing methods for product display and forecaster feedback
- Coordination with Hurricane Forecast Improvement Project (HFIP)
  - May collect special rapid scan datasets

RGB Air Mass Product with Lightning



GLM Application to Tropical Cyclone Rapid Intensity Prediction

- WWLLN lightning data normalized to total lightning
- Combine lightning input with statistical input from SHIPS model
- Test in 2010 proving ground



Caption: Lighting density in outer radii Good discriminator of rapid intensification Provided vertical shear is accounted for.

SPoRT GOES-R Proving Ground Activities

Collaborate with Algorithm Working Groups (AWGs) and Proving Ground (PG) teams to prepare forecasters for unique data and products coming from GOES-R sensors by:

- transitioning proxy and simulated products to the operational environment linking products to forecast problems
- develop appropriate product training for end user education
- conduct assessments of utility of products on improved forecast capabilities

SPoRT emphasis on:

- high resolution proxy ABI products and multichannel combinations of image data – situational awareness
- pseudo GLM products – lightning warning and severe weather
- WRF-based lightning forecasts – lightning threat forecasts

Examples presented in following charts

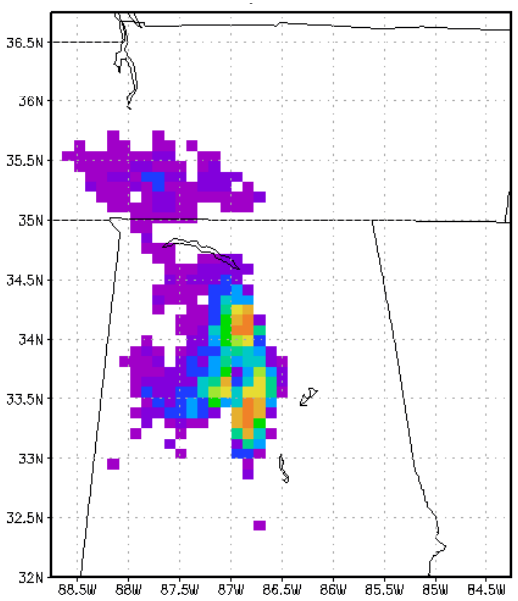
SPoRT Pseudo GLM Product

Provide forecaster exposure to GLM data, differences from LMA, applicability to severe weather forecasting – benefits transition of full AWG proxy when available

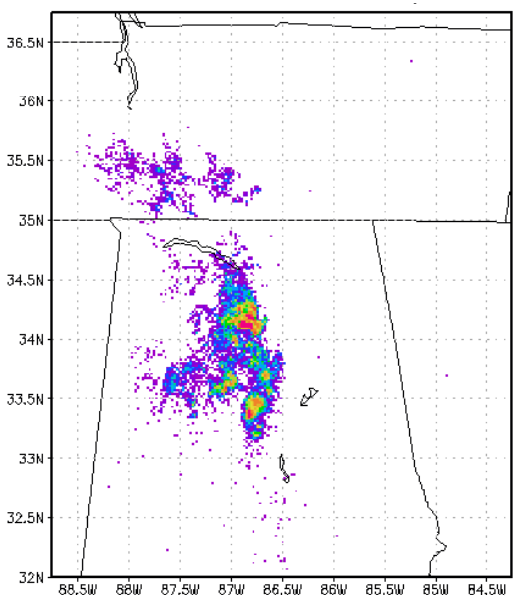
Flash Extent Density derived from LMA data at GLM resolution

- different from AWG proxy - no optical data
- forecaster demonstration and education
- applicable to other total lightning networks
- focus on AWIPS II development with user feedback

Pseudo GLM Flash Extent



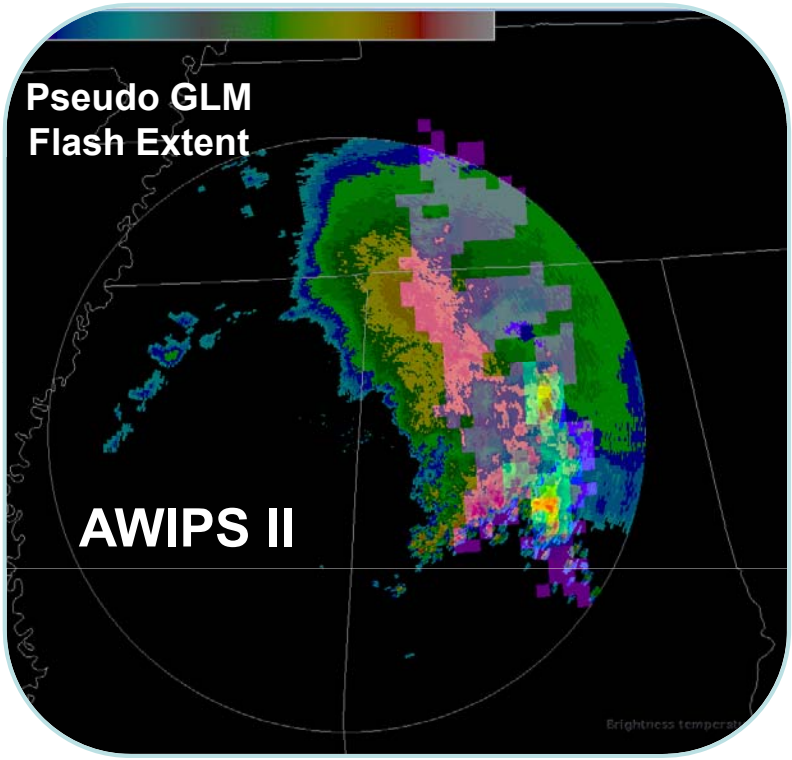
LMA Source Densities



SPoRT Pseudo GLM Product in AWIPS II

AWIPS II will allow for a more versatile ingest and display of total lightning data

- point data and imagery (as in AWIPS)
- Better control of display / values
- allow for the development of 3D displays
- greater interaction with other data sets



Radar reflectivity combined with pseudo GLM flash extent product in the AWIPS II environment

WRF-based Lightning Forecasts

Improve guidance on lightning threat (1-24h) using high resolution WRF runs that adequately represent storm microphysics

- use two proxy fields from explicitly simulated convection:
  - graupel flux near -15 C (captures LTG time variability)
  - vertically integrated ice (captures LTG threat area)
- simulate flash rate density and calibrated to match LMA observations
- each threat calibrated to yield accurate quantitative peak flash rate densities
- both threat fields are highly correlated in space – can combine the two

ABI imagery and GLM data will provide unique observations for nowcasting and lightning warning. WRF-based lightning forecasts provide guidance on precursor favorable regions for lightning activity.

SPoRT

SPoRT is working collaboratively with AWGs and PG teams to prepare forecasters for unique data and products coming from GOES-R sensors

ABI proxy imagery and products and pseudo GLM data will be disseminated to selected WFOs (early 2010) and to the PG testbed as part of the Hazardous Weather Testbed (HWT) and 2010 NSSL Spring Program

- focus on displays in AWIPS II where products can be better displayed
- preliminary product list focuses on current forecast problems

Forecast Problem	Proxy Data	Product(s)
Diagnosing changing weather	ABI	High resolution imagery and derived products
Diagnosing low clouds and fog	ABI	Enhanced channel difference imagery
Local temperature forecasts	ABI	Land surface temperature
Visibility reductions due to smoke and fire weather support	ABI	Color composites, active fires and burn areas
Lead time for severe weather	GLM	Total lightning products, WRF lightning threat
Sea breeze impact	ABI	Local model forecasts initialized with surface parameters and SSTs

Lessons Learned at SPC

- Convective Initiation (CI)/Cloud Top Cooling (CTC)
  - CTC is valuable product in itself
  - Diagnostic tool rather than prognostic over SE warm sector environments
  - Masked where thick cirrus present
  - Thin cirrus over land/water/water clouds and expanding edge false alarms
  - Avg. lead time ~15 minutes over radar (for successful nowcasts)
  - Full disk 30 min. scan limitations (false alarms/missed nowcasts)
  - Cloud detection limitations due to poor spatial/spectral resolution
  - Instantaneous fields more useful to forecasters than accumulated fields
  - Overlay on visible/IR essential to forecasters
  - Continue CTC after CI occurs (storm severity) interest from forecasters
  - Effective for terrain/dryline convection
  - CI misses some CTC signals
  - Works well in rapid scan operations

Summary

- The GOES-R Proving Ground is critical to mission success
- Program Plan under development
- Phase I spin-up at CIMSS, CIRA (2008)
- Phase II added SPoRT, AQ, Alaska, Pacific
  - HWT IOP with VORTEX-2 (2010)
- Need real time and archived events (AWIPS2, WES)
- PG is the ultimate tool for user interaction
- Must maintain focus on clear path to operations
- Ensuring pathway into operations by developing GOES-R proxy products for the AWIPS2 environment
- Existing and Planned collaborations with NOAA Testbeds-HWT, JHT, DTC, HMT