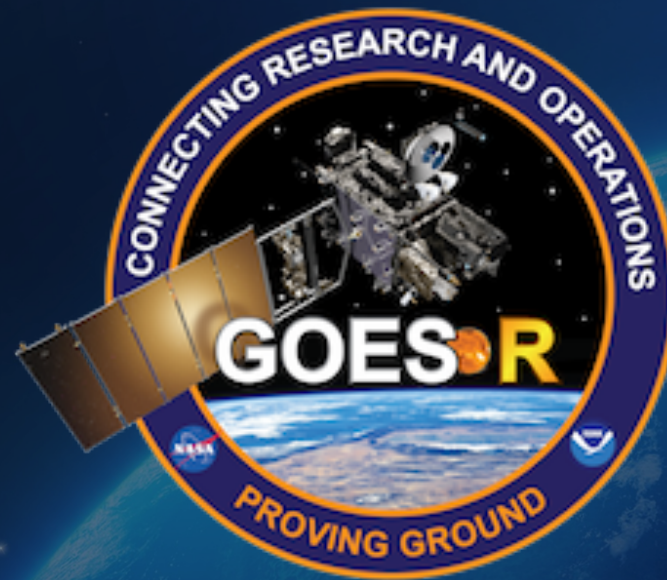


The GOES-R Proving Ground: Accelerating User Readiness for the Next Generation of Geostationary Operational Satellites



Steve Goodman

NOAA/ NESDIS/ GOES-R Program Office

4th Asia Oceania Meteorological Satellite Users Conference

Melbourne, Australia, 9-11 October, 2013



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Steve Goodman
NOAA/NESDIS

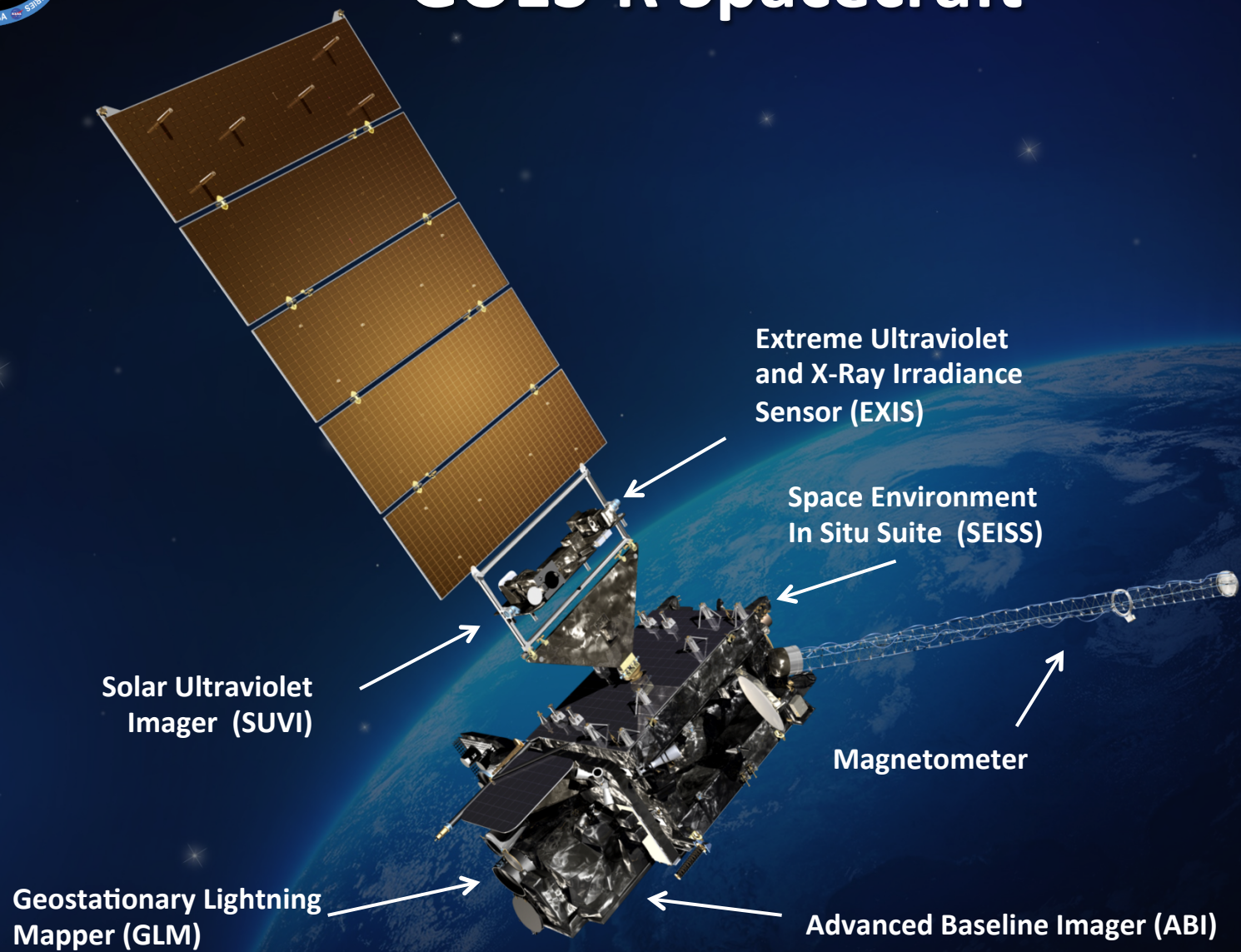


Outline

- GOES-R Mission and Products
- GOES-R Proving Ground Demonstrations
- Training
- Summary



GOES-R Spacecraft





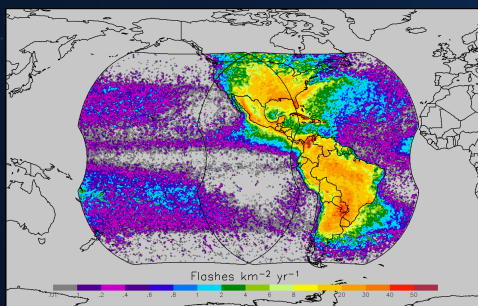
Mission Objectives - Why GOES-R?



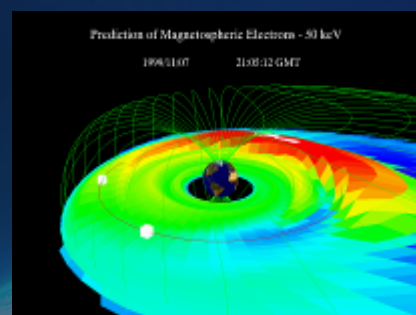
The GOES-R Series will provide significant improvements in the detection and observations of meteorological phenomena that directly impact public safety, protection of property, and our Nation's economic health and prosperity



Visual & IR Imagery



Lightning Mapping



Space Weather Monitoring



Solar Imaging

- ✓ Improves hurricane track & intensity forecasts
- ✓ Increases thunderstorm & tornado warning lead time
- ✓ Improves aviation flight route planning
- ✓ Data for long-term climate variability studies

- ✓ Improves solar flare warnings for communications and navigation disruptions
- ✓ More accurate monitoring of energetic particles responsible for radiation hazards to humans and spacecraft
- ✓ Monitoring Coronal Mass Ejections to improve geomagnetic storm forecasting



GOES-R ABI Products



Baseline Products

Advanced Baseline Imager (ABI)

Aerosol Detection (Including Smoke and Dust)
Aerosol Optical Depth (AOD)
Clear Sky Masks
Cloud and Moisture Imagery
Cloud Optical Depth
Cloud Particle Size Distribution
Cloud Top Height
Cloud Top Phase
Cloud Top Pressure
Cloud Top Temperature
Derived Motion Winds
Derived Stability Indices
Downward Shortwave Radiation: Surface
Fire/Hot Spot Characterization
Hurricane Intensity Estimation
Land Surface Temperature (Skin)
Legacy Vertical Moisture Profile
Legacy Vertical Temperature Profile
Radiances
Rainfall Rate/QPE
Reflected Shortwave Radiation: TOA
Sea Surface Temperature (Skin)
Snow Cover
Total Precipitable Water
Volcanic Ash: Detection and Height

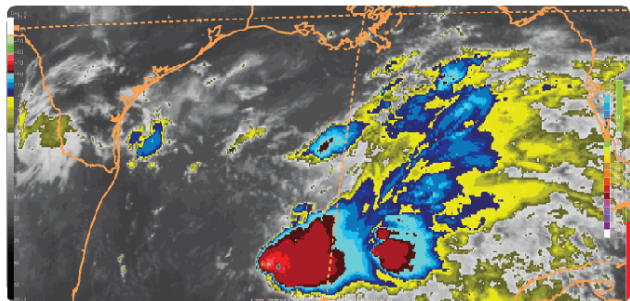
Future Capabilities

Advanced Baseline Imager (ABI)

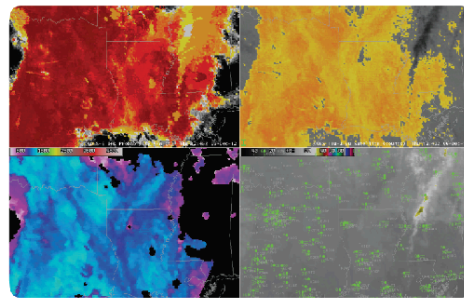
Absorbed Shortwave Radiation: Surface
Aerosol Particle Size
Aircraft Icing Threat
Cloud Ice Water Path
Cloud Layers/Heights
Cloud Liquid Water
Cloud Type
Convective Initiation
Currents
Currents: Offshore
Downward Longwave Radiation: Surface
Enhanced "V"/Overshooting Top Detection
Flood/Standing Water
Ice Cover
Low Cloud and Fog
Ozone Total
Probability of Rainfall
Rainfall Potential
Sea and Lake Ice: Age
Sea and Lake Ice: Concentration
Sea and Lake Ice: Motion
Snow Depth (Over Plains)
SO₂ Detection
Surface Albedo
Surface Emissivity
Tropopause Folding Turbulence Prediction
Upward Longwave Radiation: Surface
Upward Longwave Radiation: TOA
Vegetation Fraction: Green
Vegetation Index
Visibility



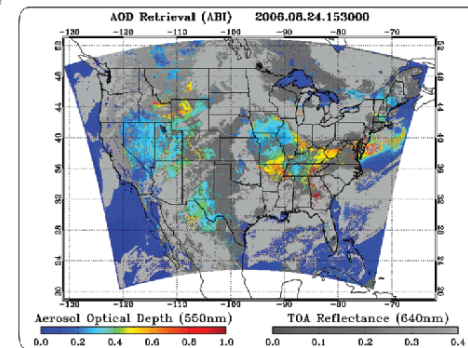
The GOES-R Proving Ground



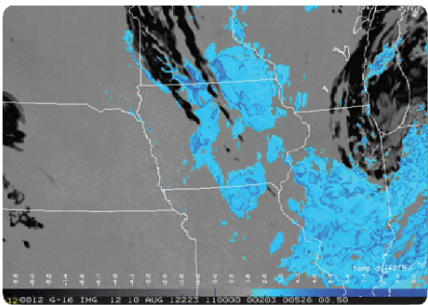
AWC – Kansas City, MO IR Imagery of Oceanic Storms



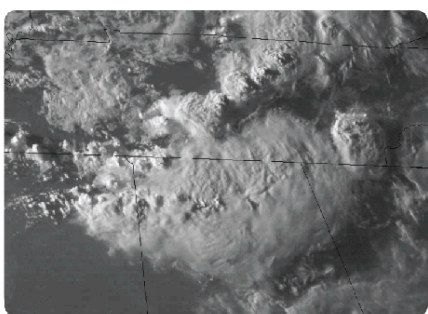
CIMSS/STAR – Madison, WI
Fog/Low Cloud Product



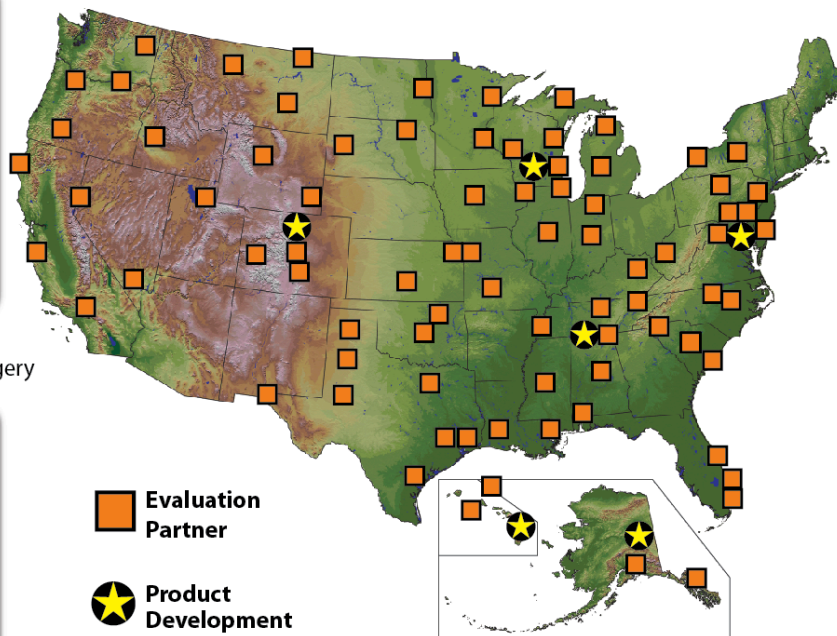
STAR/UMBC – College Park, MD
Aerosol Optical Depth



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

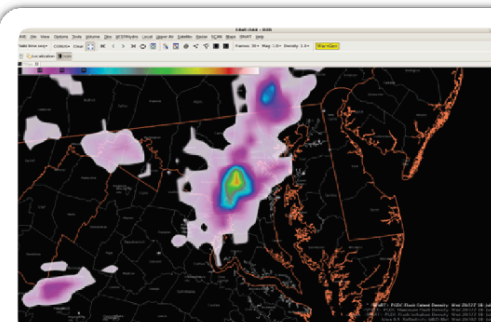


SPC – Norman, OK
Severe Storms 1-Min Visible Imagery of Overshooting Tops

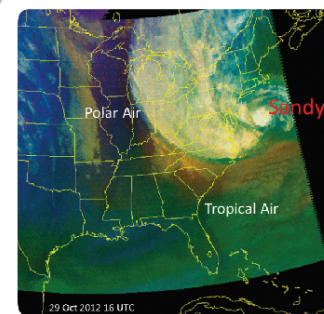


Evaluation Partner

Product Development Partner



SPoRT/NASA – Huntsville, AL
GLM Lightning Density



NHC – Miami, FL
RGB Air Mass for Hurricane Sandy



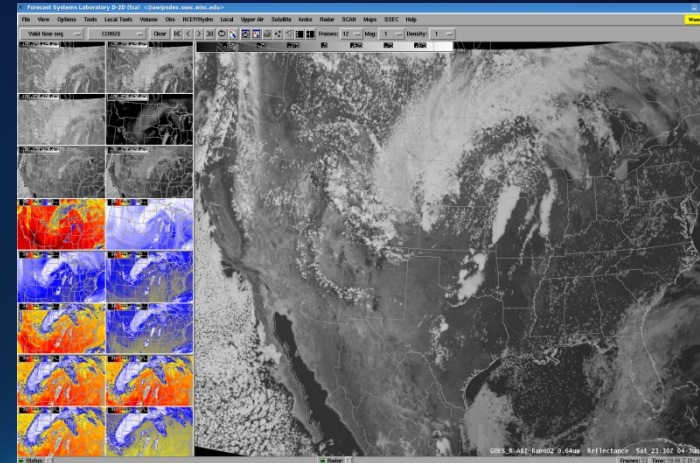
Introducing NWS Forecasters to Prototype GOES-R Products



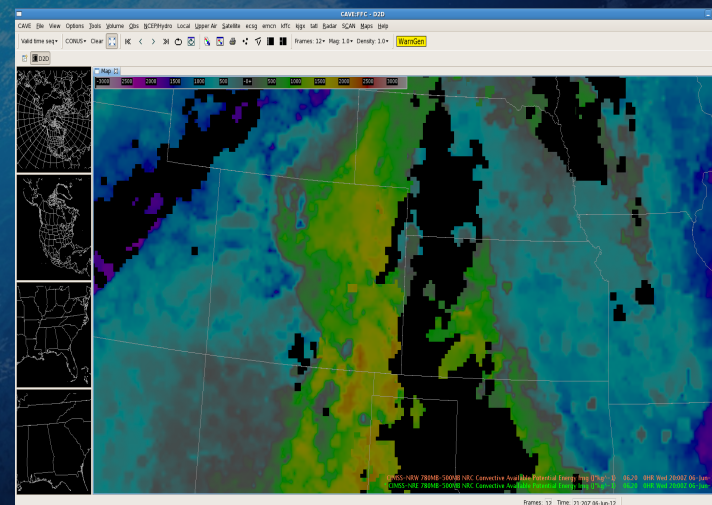
- Synthetic GOES-R Products representing ABI were demonstrated at the Hazardous Weather Testbed and other NOAA testbeds
- Synthetic GOES-R products can help increase forecaster utilization on day one

“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”

- Facilitates user training



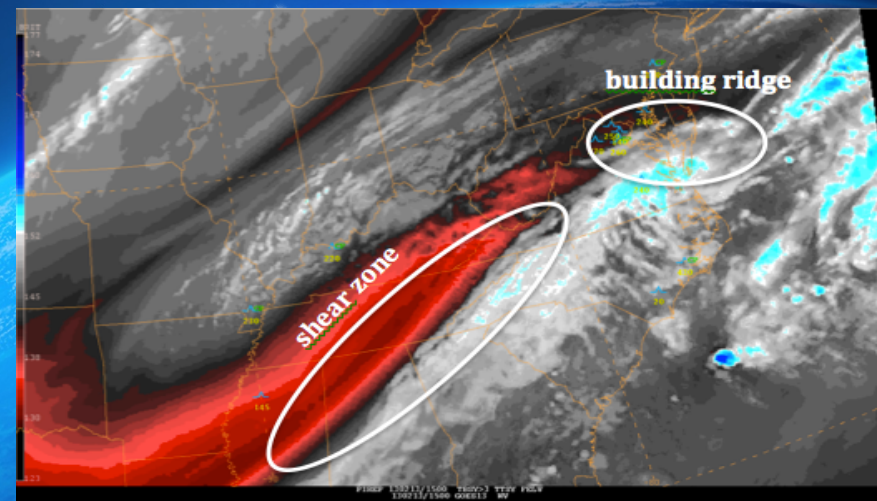
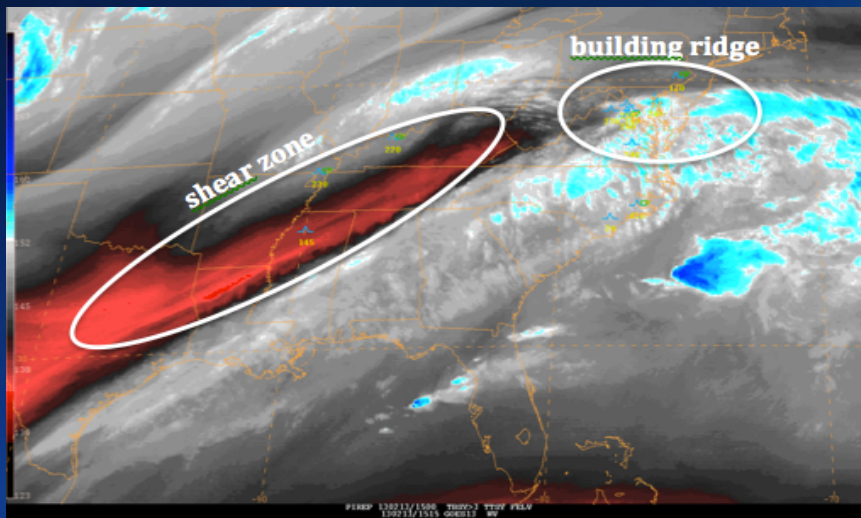
Simulated ABI bands in AWIPS



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

Simulated Cloud and Moisture Imagery

The simulated imagery was praised for picking up not only the intense shear zone over the southern Mississippi Valley, but also the 'notches and bumpiness' in the building ridge over the Mid-Atlantic, both of which are features typically associated with moderate or great turbulence events.

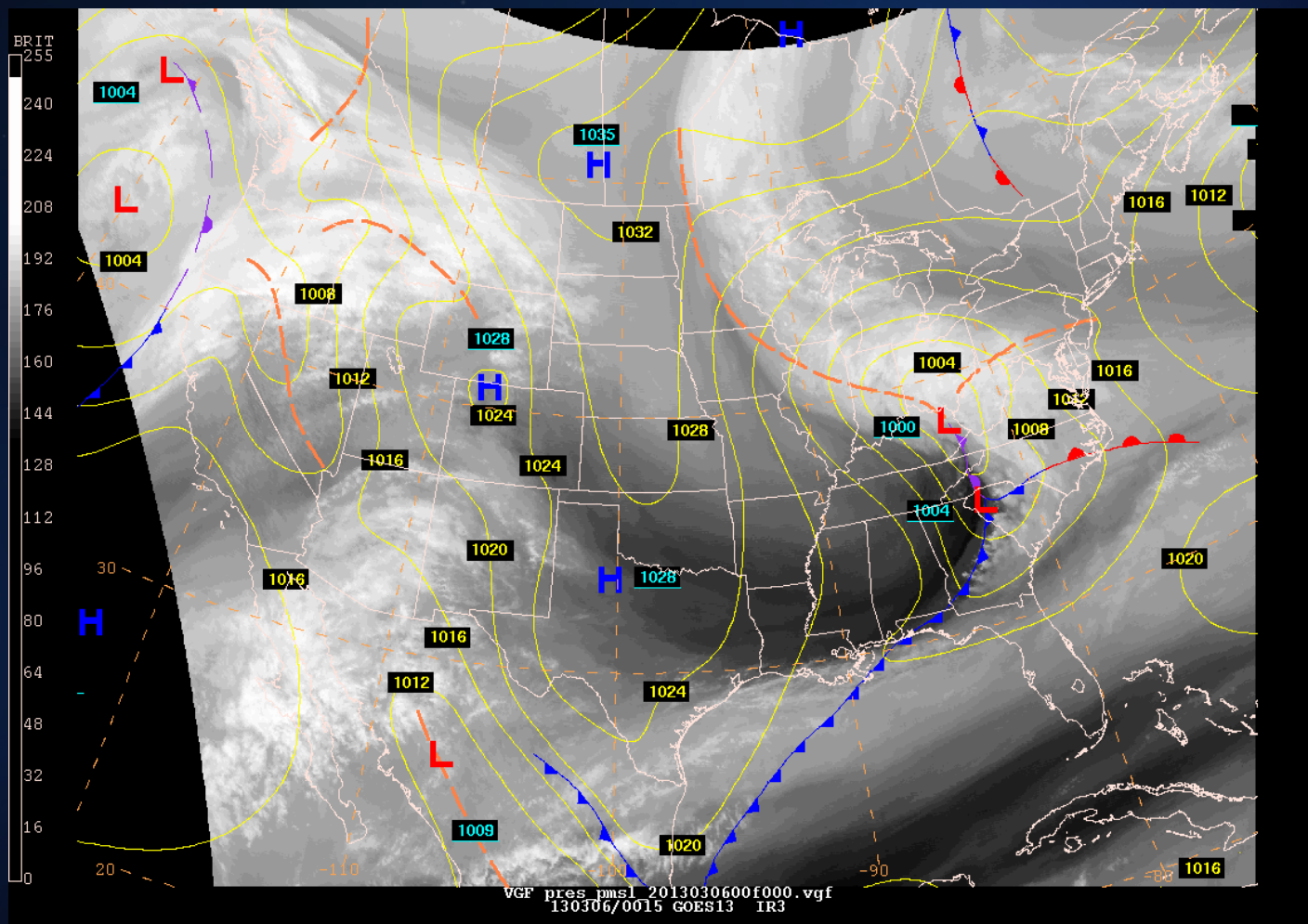


AWC Demo. 20130213 1515 UTC. Strong jet with core winds > 150 kts, (left) GOES-13 water vapor and 1500 UTC MOG turbulence PIREPs, (right) 1500 UTC NSSL-WRF simulated water

“It was very helpful in determining the signatures associated with moderate or greater turbulence events.”

March 6 & 7, 2013 Nor'easter

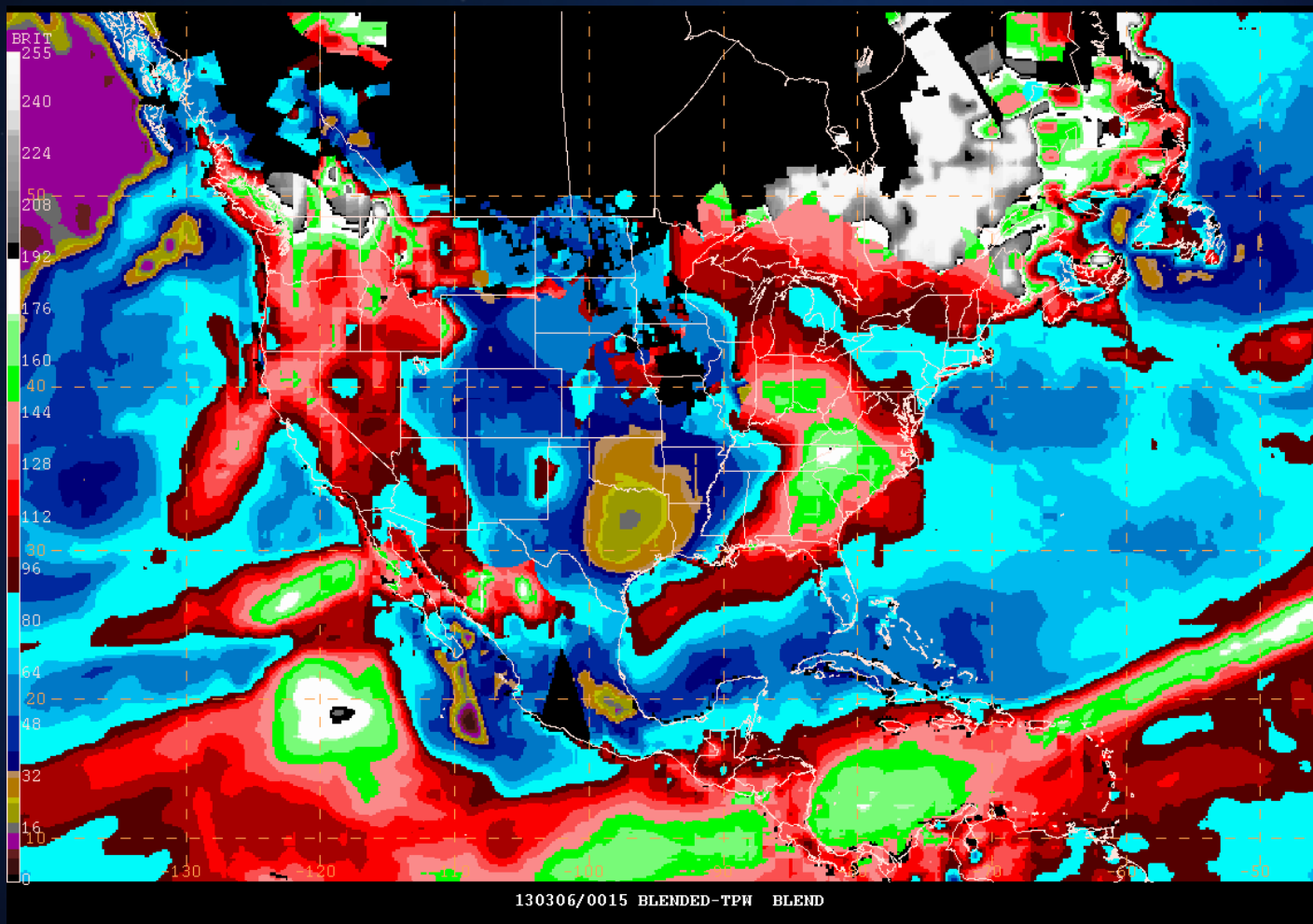
GOES-13 WV overlaid with WPC sfc analyses





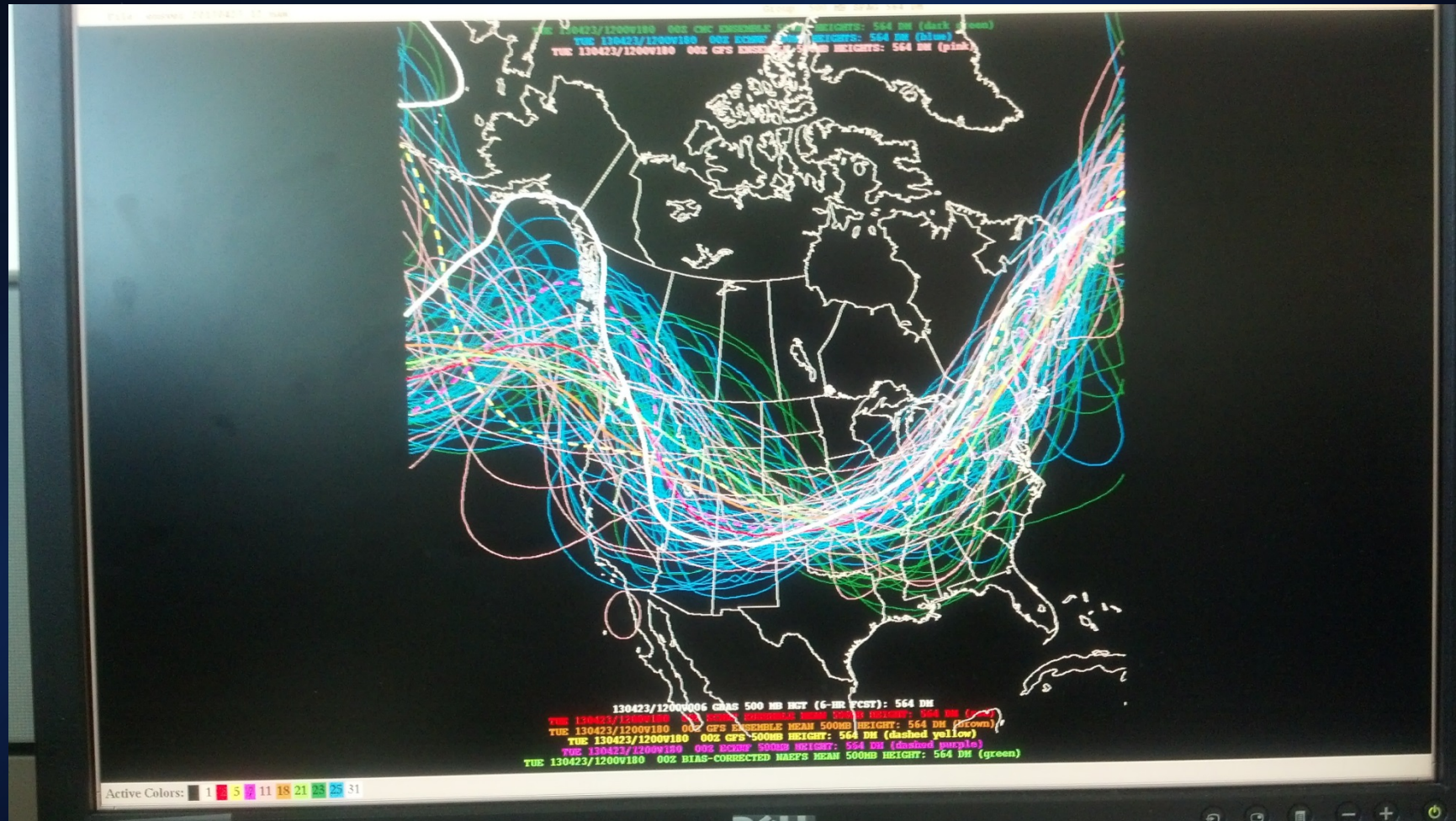
March 6 & 7, 2013 Nor'easter

Blended Total Precipitable Water Percent of Normal



Medium Range Forecast Issues

Spaghetti Plot of the 564 DM Height Line



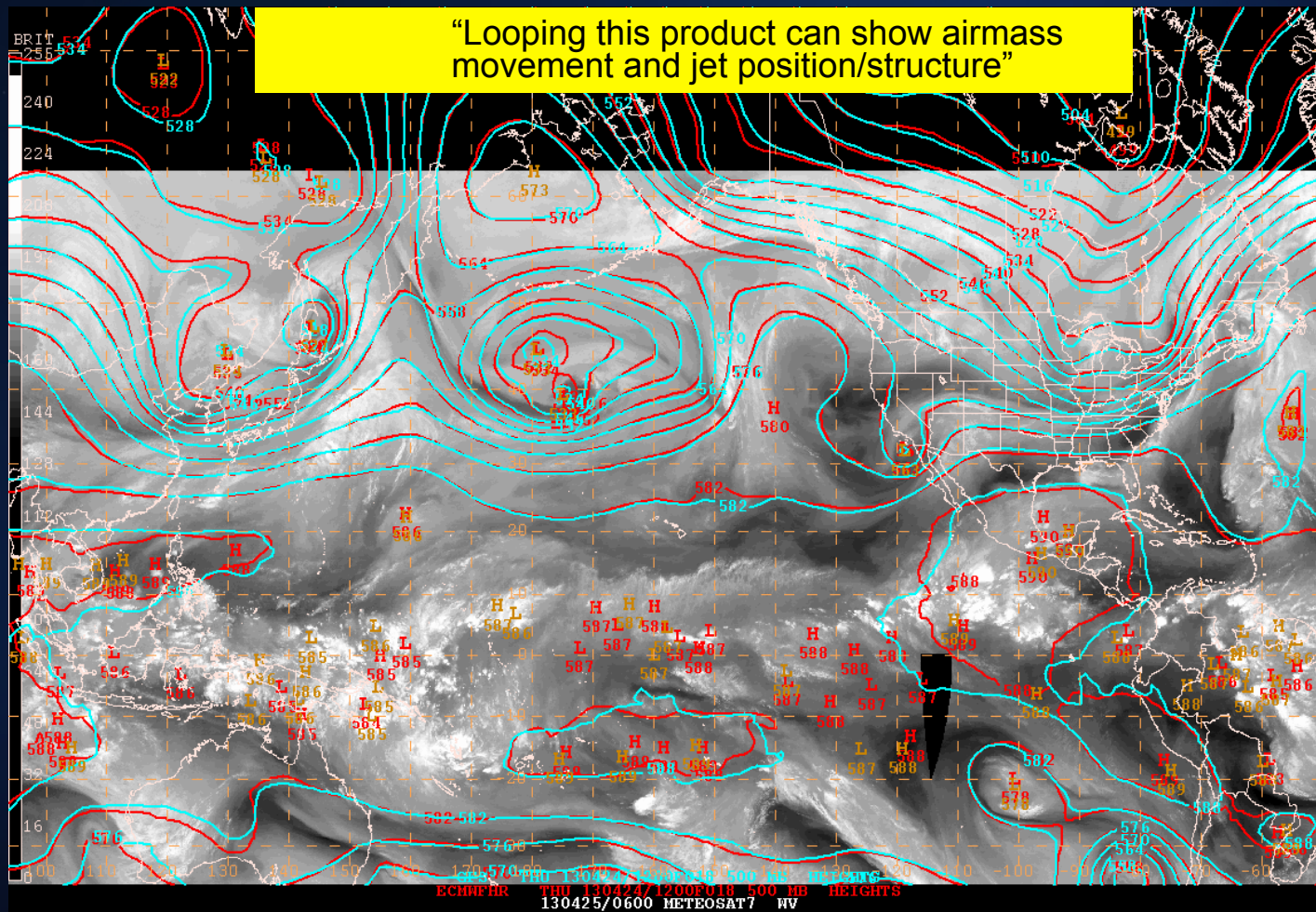
Courtesy of Michael Schichtel (WPC)



Satellite Observations vs. Model Forecasts

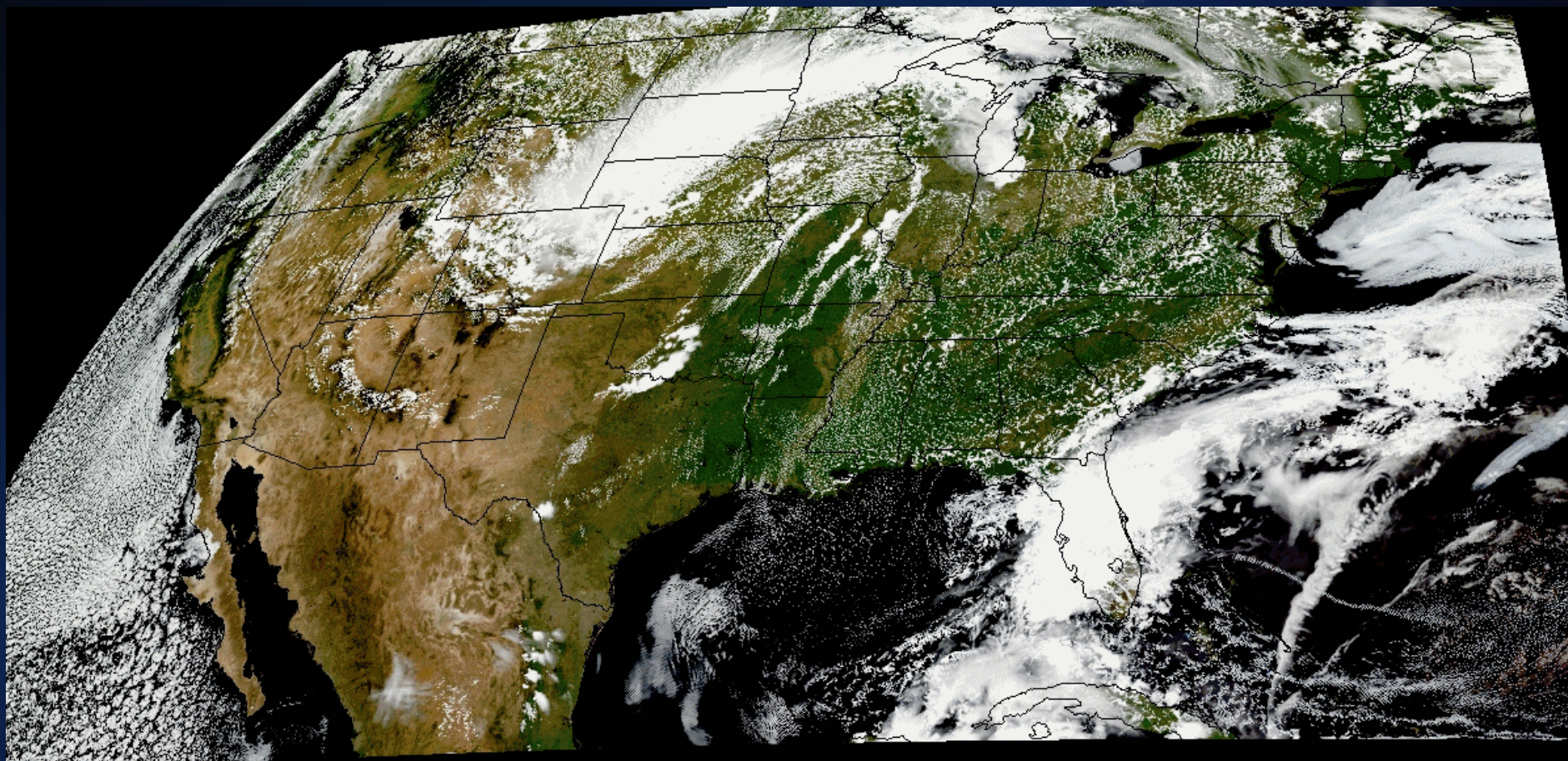


GFS and ECMWF 500 mb Heights overlaid on WV





GOES-R Pseudo Natural Color (R-IR-B bands)



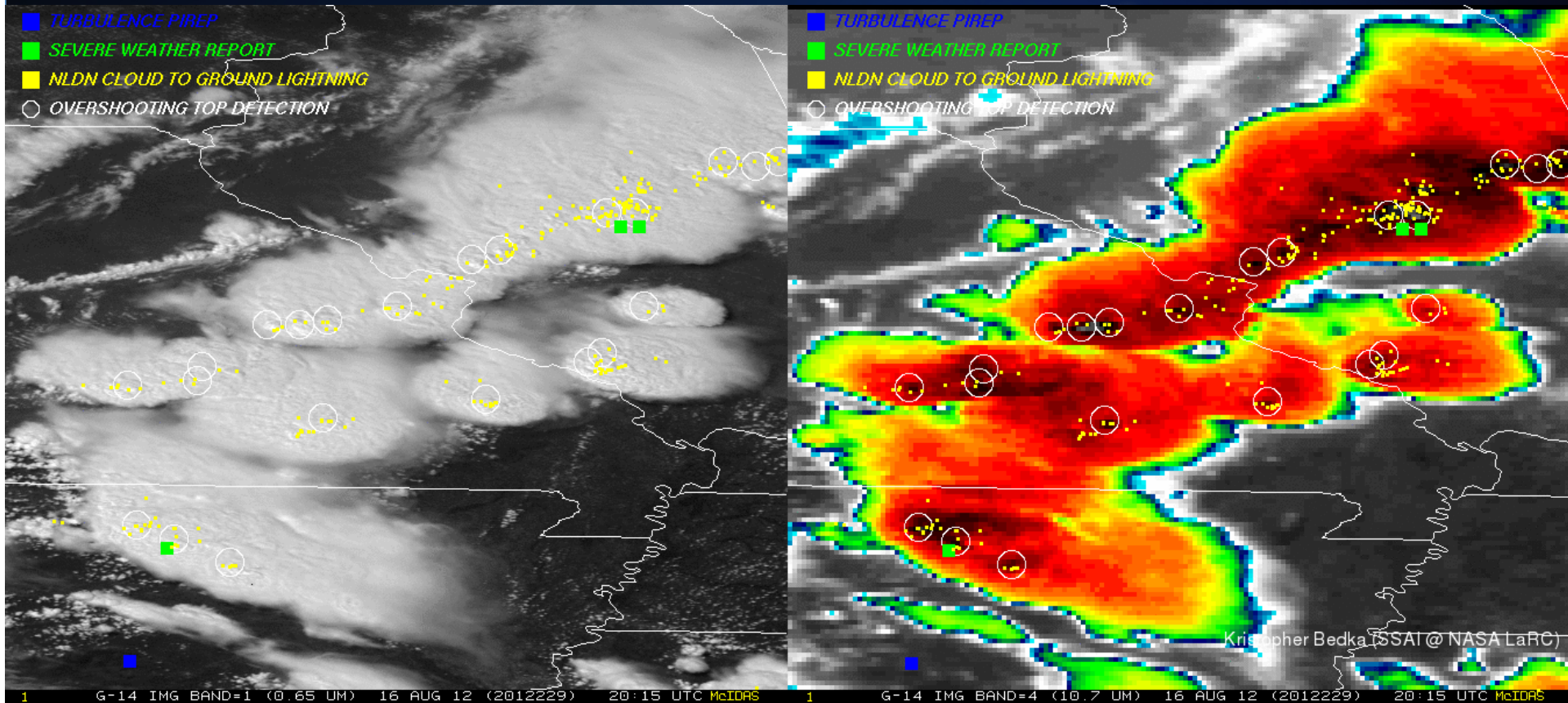
12

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

NOAA/CIRA

GOES-R Super Rapid Scan

Moving toward data fusion



Proving Ground Demonstration at AWC Testbed

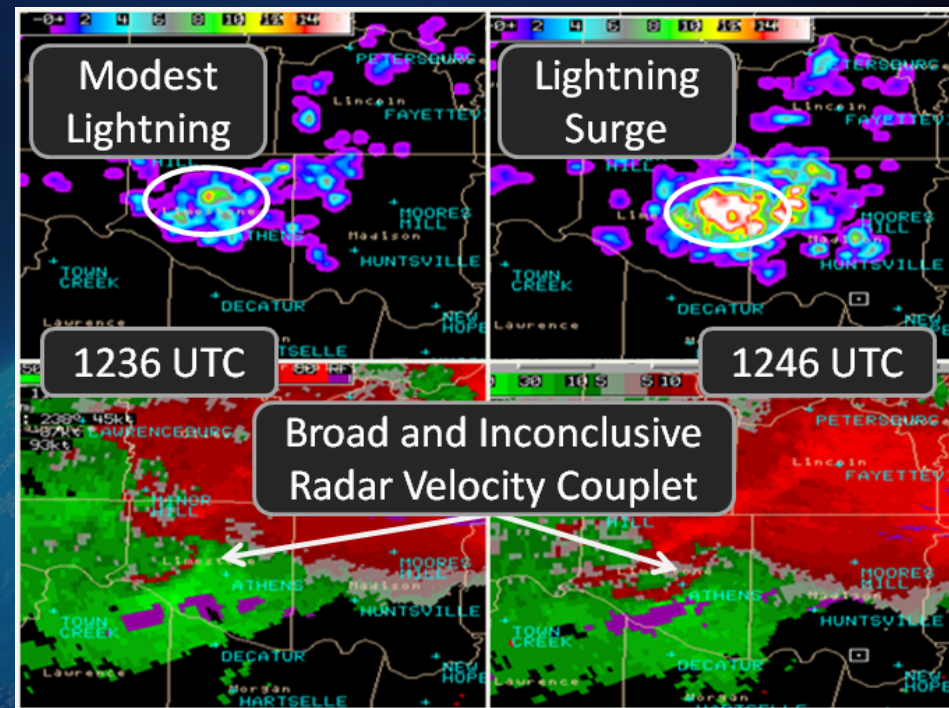
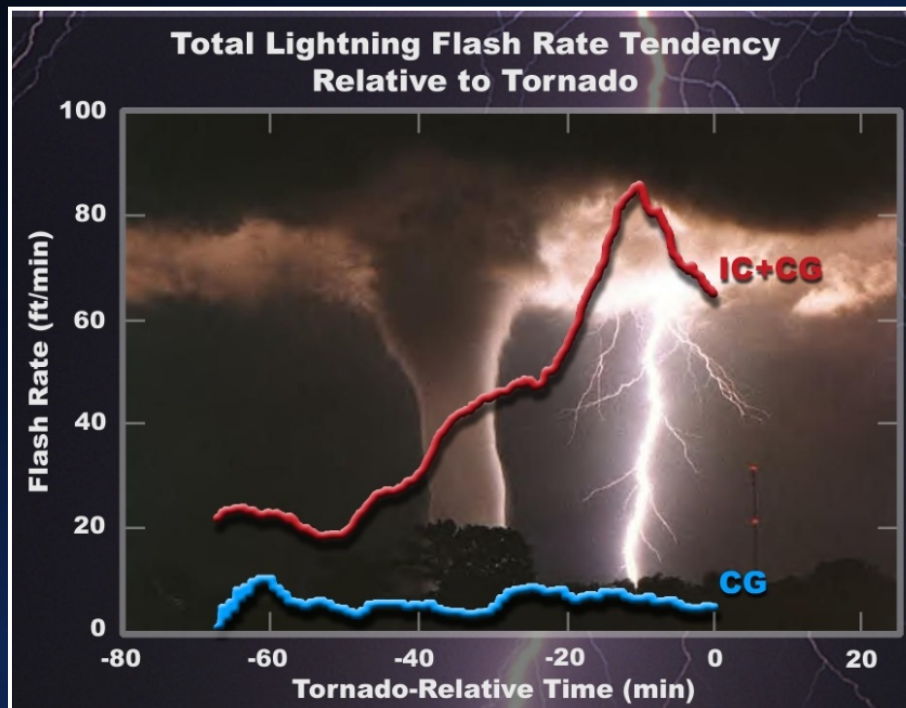
User comment: 'Cloud Top Cooling product is an excellent source of enhancing the situational awareness for future convective initiation, particularly in rapid scan mode'. (*AWC Testbed forecaster, June 2012*)

Why NWS needs this?

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

Lightning Jumps and Severe Storms

Improved forecaster situational awareness and confidence results in more accurate severe storm warnings (i.e., improved lead times and reduced false alarms)



Schultz et al. 2011

- Using lightning data alone, predicted severe weather with 20.65 min lead time
- 79% probability of detection (POD)
- 36% false alarm rate (FAR)

Rudlosky et al. 2013

- Severe = 1.44 jumps h^{-1} ; Non-severe = 0.92 jumps h^{-1}
- Adding a 10 mm Maximum Expected Size of Hail (MESH) threshold:
- Severe = 1.25 jumps h^{-1} ; Non-severe = 0.61 jumps h^{-1}



Proving Ground Forecaster Feedback

- “The total lightning data is an excellent tool for monitoring convection...”
- “I utilized it as a situational awareness product ...the data gave me more confidence in my warning.”

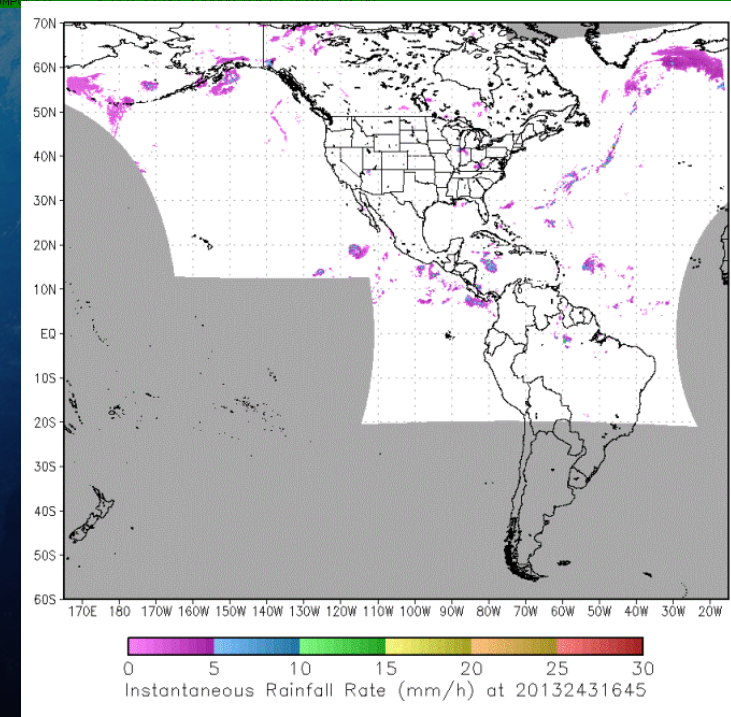
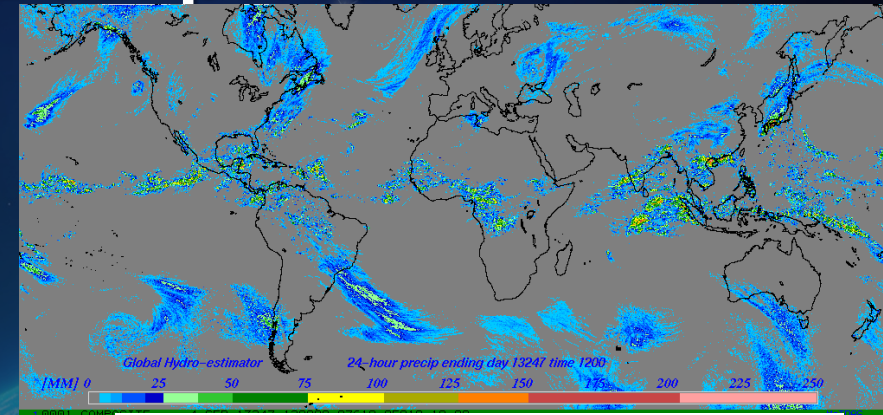
“We saw several instances where the total lightning was picking up on storms before the AWIPS lightning [NLDN] program picked up on them. One could see the utility of this in the future, bringing with it a potential for lightning statements and potentially lightning based warnings.”

-Pat Spoden (SOO, NWSFO Paducah, KY)



Rainfall Rate – Multi-Platform, Multi-Sensor Geo, Polar, GPM, Dual-pol radar

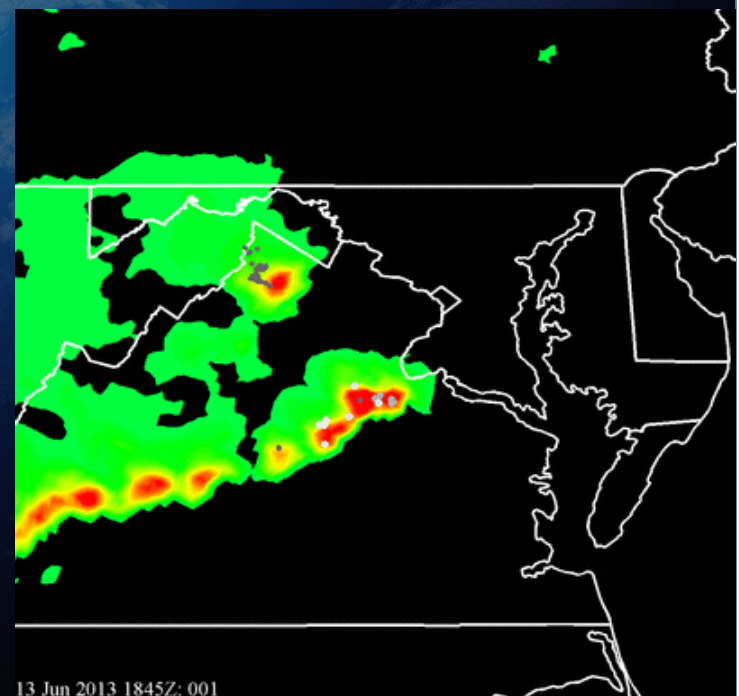
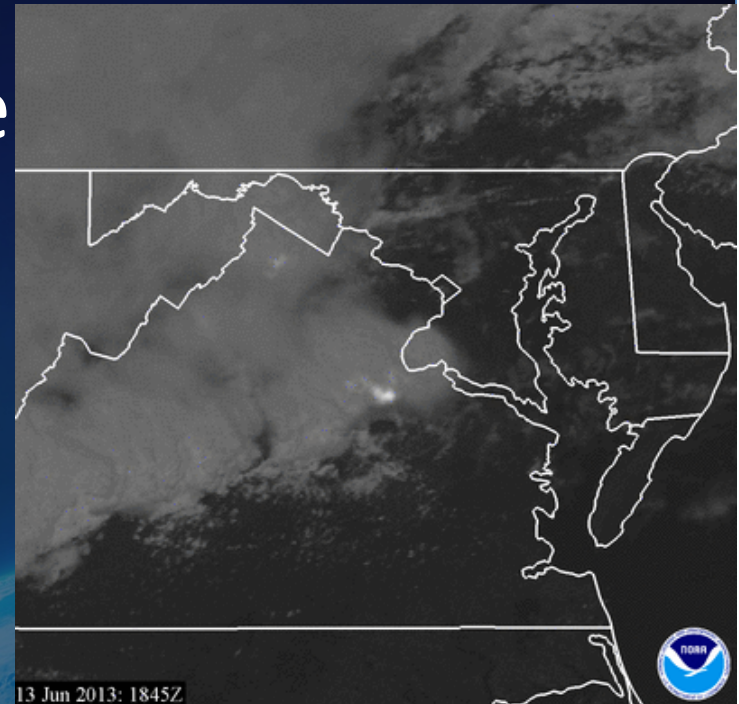
- Current Algorithm: Global Hydro-Estimator
 - Global coverage, 65 S – 65 N at satellite scan schedule
 - Single-band (IR window) algorithm with fixed calibration using NWP model data to adjust for moisture, stability, topography
- Next-Generation Algorithm
 - Multi-band algorithm with adjustable calibration (vs. MW rain rates)
 - Current-GOES (2/5 bands) being run in real time and evaluated by several NWS forecast offices
 - Feedback leading to algorithm improvements





Satellite QPE - The Future

- Fusion – Science
 - JPSS and GOES-R Risk reduction programs
 - MW and IR
 - MW, IR and lightning
 - Orographic enhancements
 - Snowfall rates
 - Fusion (regional, short term)
 - NOAA PMM Team
 - Utilization on TRMM and GPM
 - Fusion (global, longer term)
- Fusion – Systems
 - NESDIS Ground Systems Enterprise
 - Reduce “stove pipes”
 - We are pushing for the GPM-based PPS as a prototype (next slide)
 - NOAA wide precipitation products
 - Ambitious effort but would fold in all types of products if we can





CSTL RR - SCaMPR Comparison



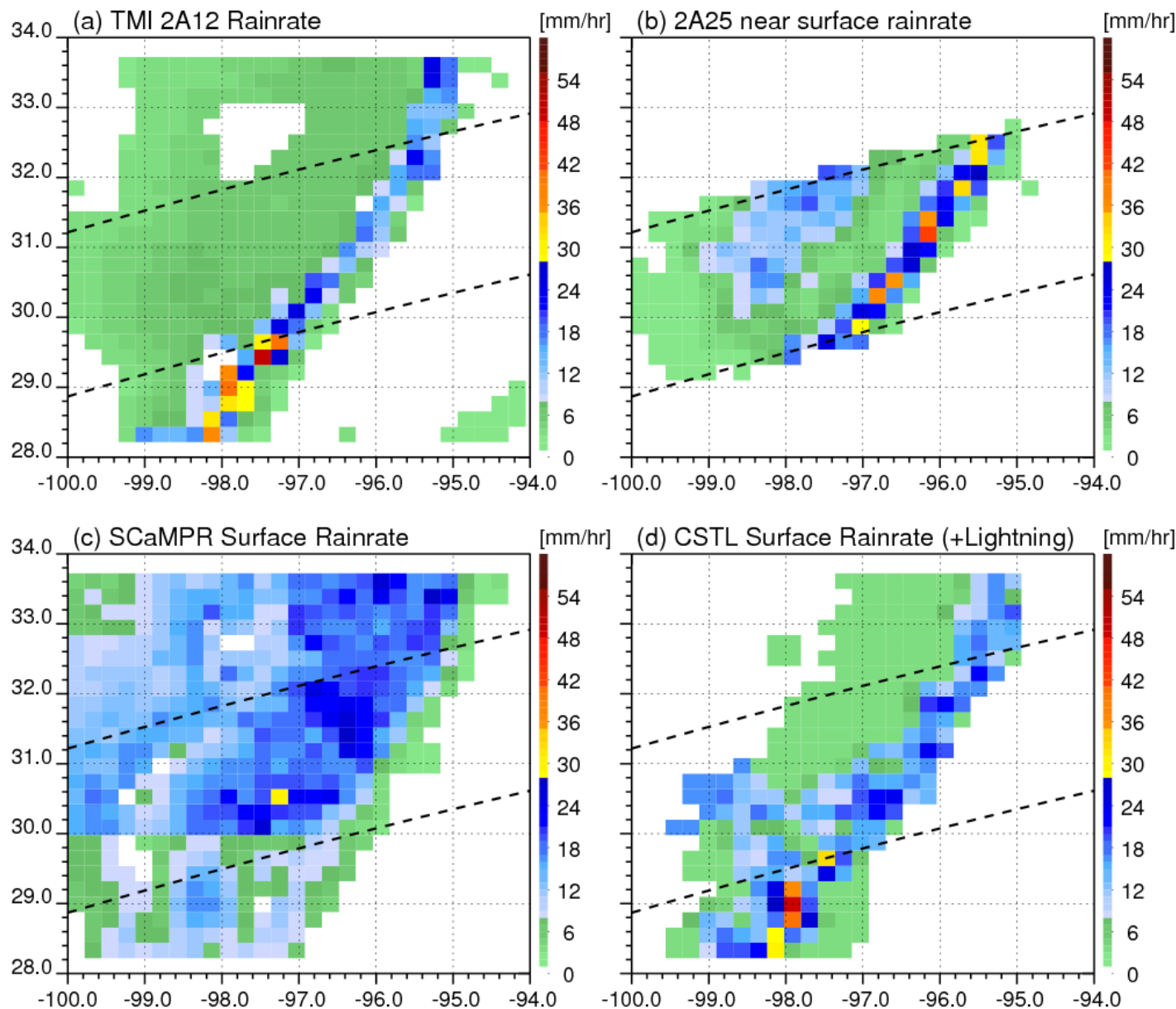
PMW

SCaMPR

Radar

CSTL
(Final Product)

20120320, 0854UTC, Orbit: 81709, Lat: 31.0, Lon: -97.0





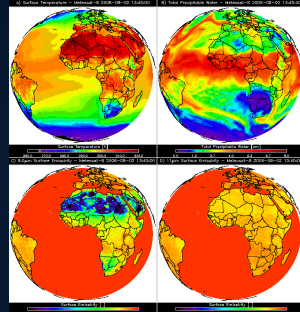
Fused Fog/Low Cloud Detection Approach



Static Ancillary Data

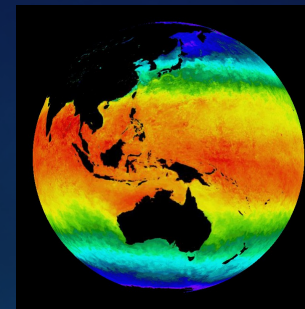


+



- DEM
- Surface Type
- Surface Emissivity

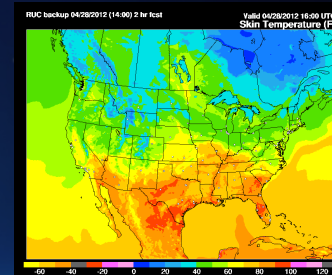
Daily SST Data



0.25 degree OISST

+

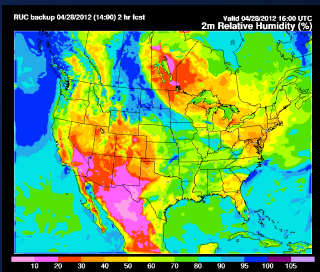
NWP



- Surface Temperature
- Profiles of T and q
- RUC/RAP (2-3 hr forecast) or GFS (12 hr forecast)

Clear Sky RTM

NWP RH Profiles

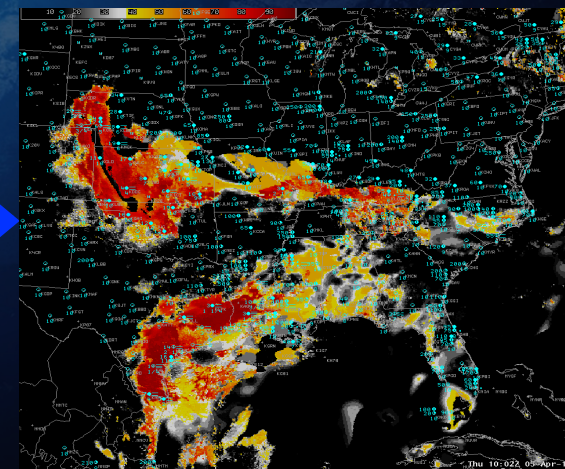


- RUC (2-3 hr forecast) or GFS (12 hr forecast)

Naïve
Bayesian
Model

Total run time:
2 - 3 minutes

IFR and LIFR Probability



*****IMPORTANT: Other sources of relevant data (e.g. sfc obs) influence results through the model fields**



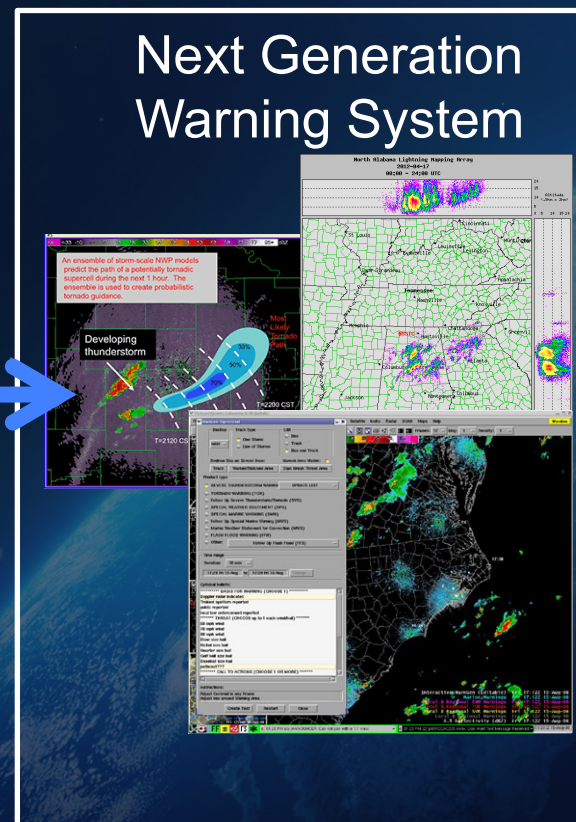
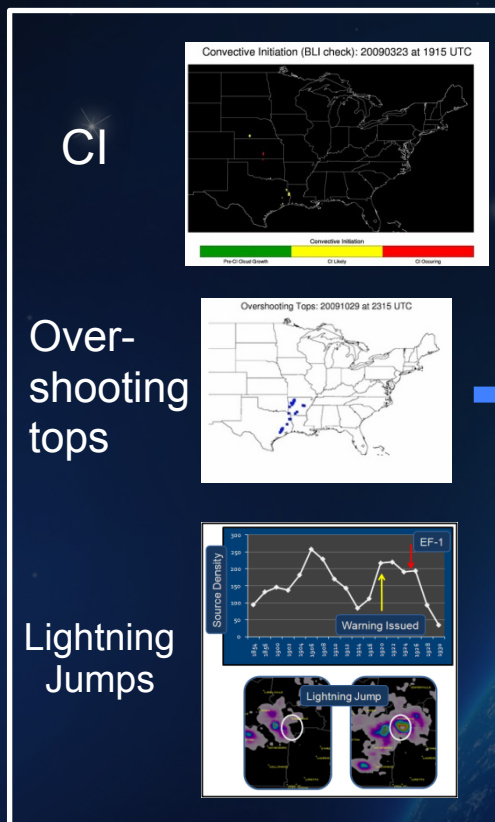
Observations from HWT-EFP

- Use of Satellite products...integral part of situational awareness: Used water vapor imagery to track basic flow, short wave troughs, and upper level drying.
 - On Monday.... Simulated water vapor close to reality... gave confidence in model forecasts
- Tuesday...used vis to evaluate clear areas for heating; IR window for presence of mid clouds (indicator of lift); used blended PW product (for possible derecho in E TX, LA, and Srn Arkansas); also used blended PW on Friday
- Throughout week used vis loops to track progress of convective development
- Need more training for team leaders to make use of more proxy GOES-R products such as simulated window channel for AM cloud cover fcst; RGB; Nearcast products.



NWS Vision to Integrate ABI and GLM Products with Other Data and Models

A Potential Operational Example: Convective Initiation/Severe Wx
How can we integrate the information in future tools?



Why NWS needs this?

Situational Awareness
Warning confidence
Decision Support (venues)

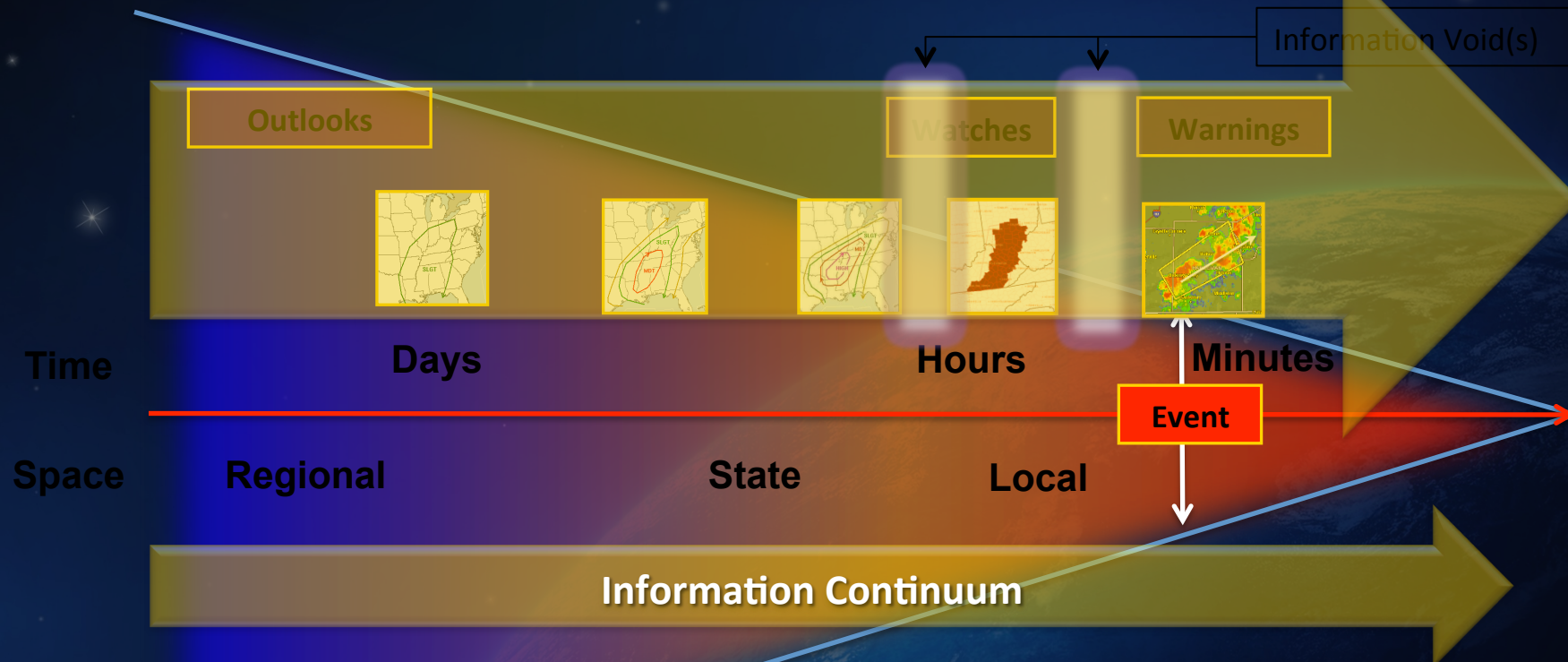
Situational Awareness:

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)*



Current Warning System “Challenges” Moving Towards Impact-based DSS

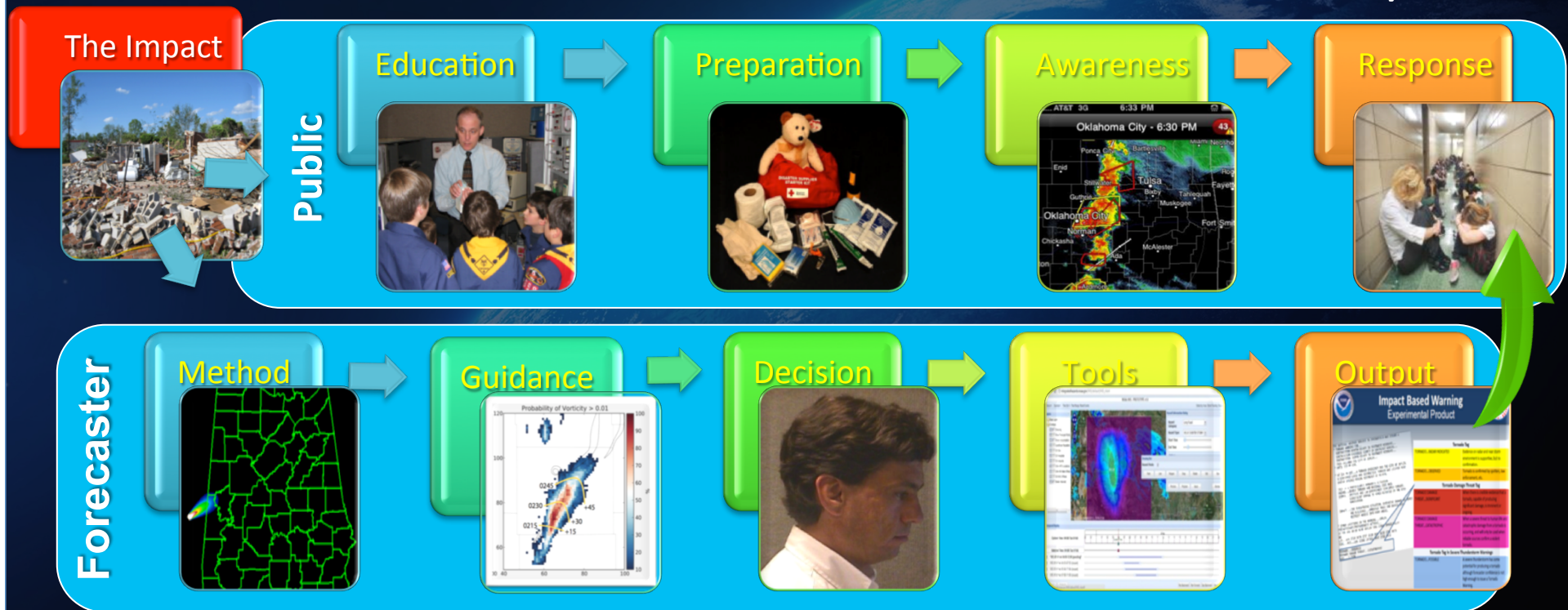


- Product-centric and binary.
- More information needed.
- More information available.

Adapted from Dr. Heather Lazrus (SSWIM)

Effective Response

- Start at the end...
 - “Look at the desired response and work our way backwards from there.” - Dr. Russ Schneider/SPC





Training and User Education Update



New!



Updated!



Online Training Modules

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

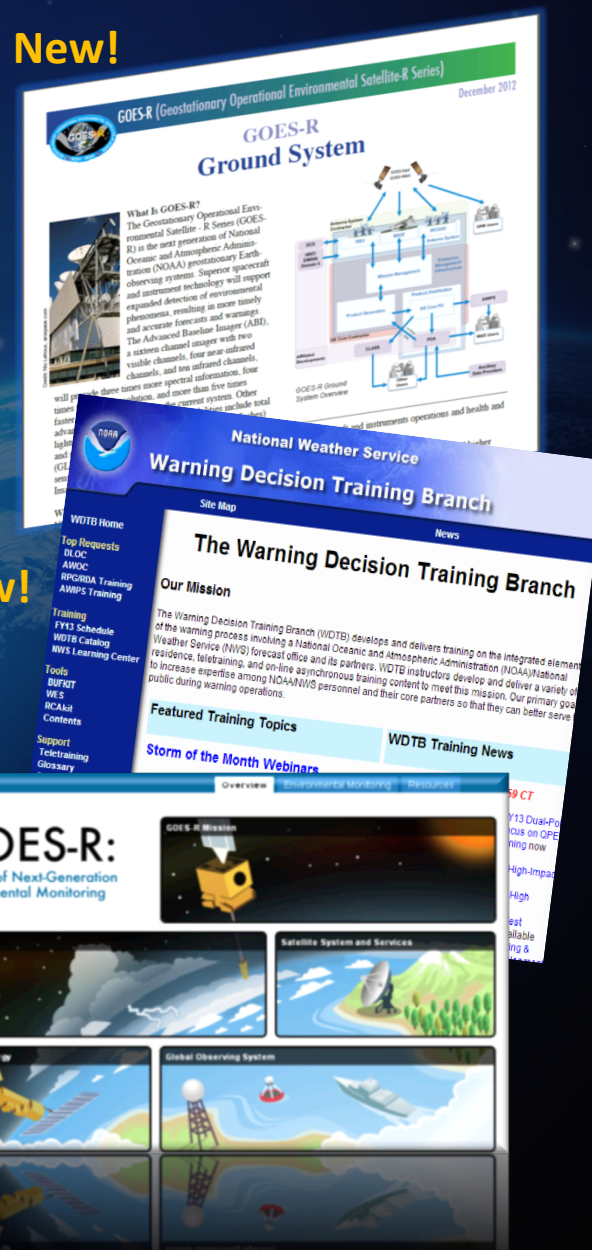
Printed Materials

- GOES-R Fact Sheets (18)
- GOES-R Tri-fold
- User Readiness Plan
- GRB Downlink Specifications and Product Users Guide

GRB Simulators

- Available late 2013 – Industry Day October 25, 2013

New!

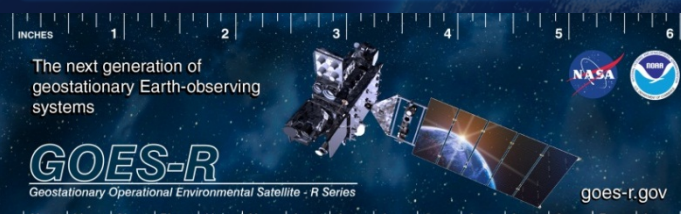




Education and Public Outreach Update



<https://www.youtube.com/user/goesrsatellites>

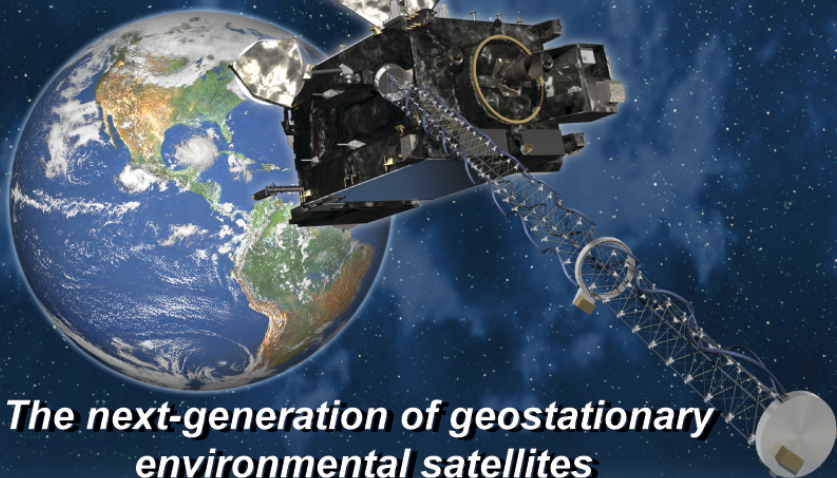


www.facebook.com/GOESRsatellite

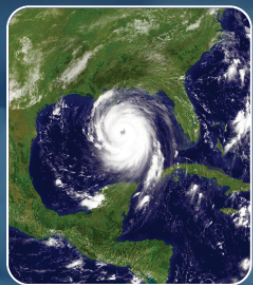


GOES-R

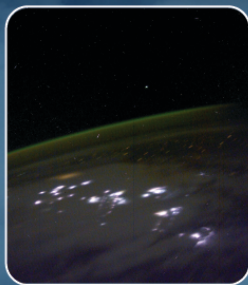
Geostationary Operational Environmental Satellite - R Series



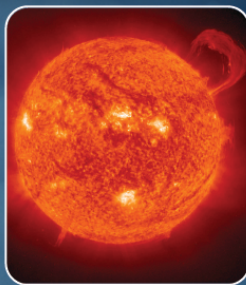
The next-generation of geostationary environmental satellites



**Advanced imaging
for accurate forecasts**



**Real-time mapping
of lightning activity**



**Improved monitoring
of solar activity**

Spacecraft image courtesy of Lockheed Martin



Thank you!

For more information
visit **www.goes-r.gov**

