GOES-R Proving Ground Round-Up

Steven J. Goodman
GOES-R Program Chief Scientist
NOAA/NESDIS USA

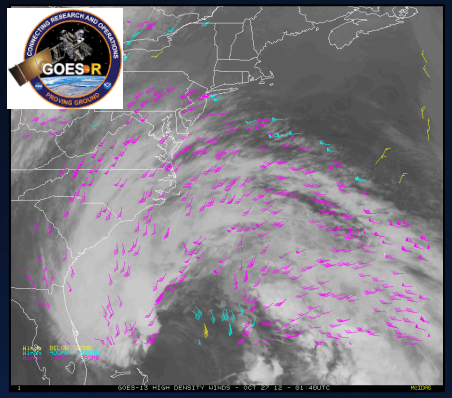
NOAA Testbed & Proving Ground Annual Workshop
Boulder, CO, April 14-16, 2015

Outline

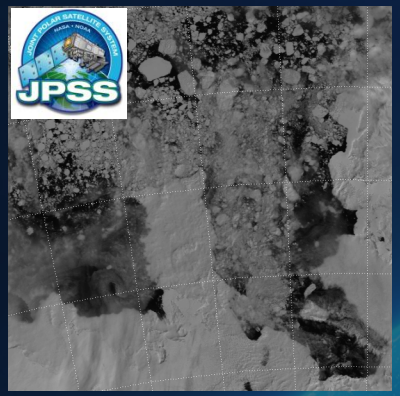
- Science Priorities
- Project Selection Criteria
- 2014 Accomplishments
- 2015 Plans
- Summary

Satellite Proving Ground

Supporting demonstration and utilization of new capabilities by the end users
Facilitating the transition of GOES-R and JPSS to operations
Incorporating user feedback for product improvements

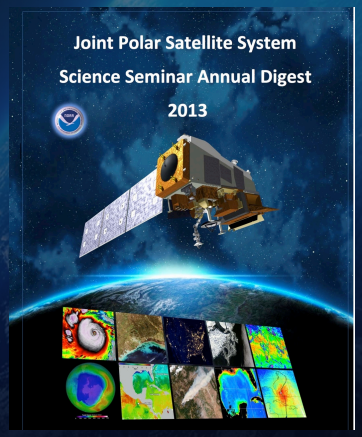


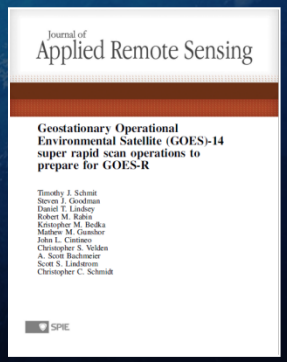
Hurricane Sandy-
GOES High Density
Atmospheric Motion Vectors

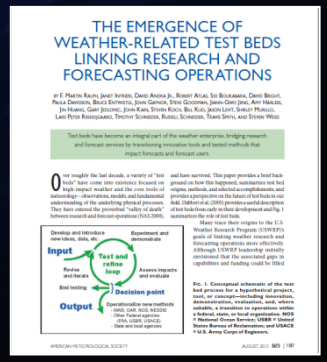


S-NPP Day/Night Band
Ice Detection

NOAA Hazardous Weather Testbed (HWT)







http://www.goes-r.gov/users/proving-ground.html


GOES-R
launches in
March
2016!

GOES-R 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

Geostationary Lightning Mapper (GLM)

Lightning Detection: Events, Groups & Flashes

Space Environment In-Situ Suite (SEISS)

Energetic Heavy Ions
Magnetospheric Electrons & Protons: Low Energy
Magnetospheric Electrons: Med & High Energy
Magnetospheric Protons: Med & High Energy
Solar and Galactic Protons

Magnetometer (MAG)

Geomagnetic Field

Extreme Ultraviolet and X-ray Irradiance Suite (EXIS)

Solar Flux: EUV
Solar Flux: X-ray Irradiance

Solar Ultraviolet Imager (SUVI)

Solar EUV Imagery

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)
SO_2 Detection
Surface Albedo
Surface Emissivity
Tropopause Folding Turbulence Prediction
Upward Longwave Radiation: Surface
Upward Longwave Radiation: TOA
Vegetation Fraction: Green
Vegetation Index
Visibility

Product List- Science Priorities Represents the Original L1RD User Requirements

NOAT Priorities for Future Capabilities/New Products

- **Fog and Low Stratus** underway within the NESDIS SPSRB process
  - First implement with current GOES, then Enterprise Geo/Polar product
- Currently funded by GOES-R Risk Reduction

  SO2 Detection, ProbSevere, Convective Initiation
- NOAT Recommended Top 5 Future Capabilities

  Cloud Cover Layers

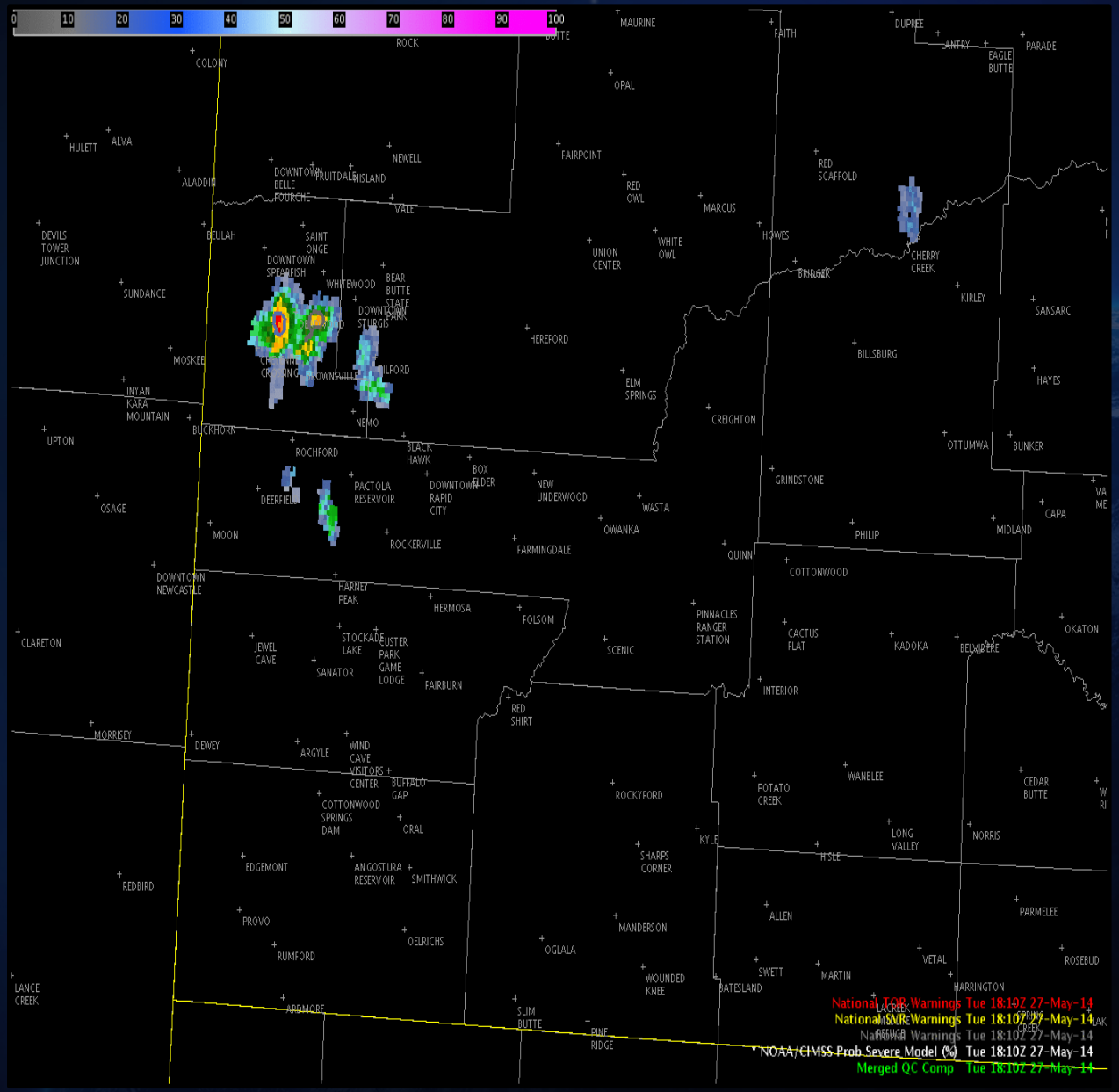
  Aerosol Particle Size

  Ice Concentration

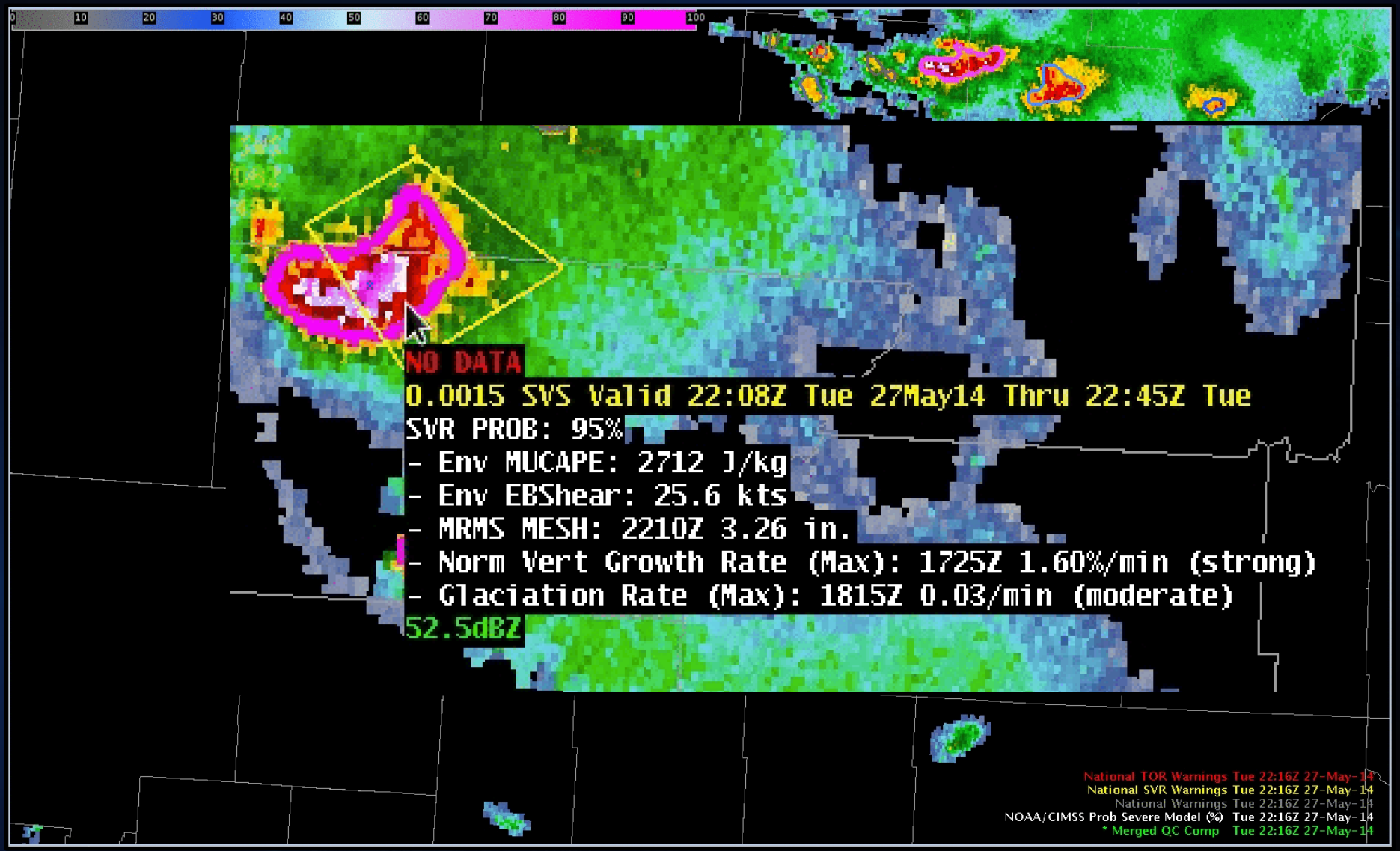
  Ice Age/Thickness

  Ice Motion

Probability of Severe Convection



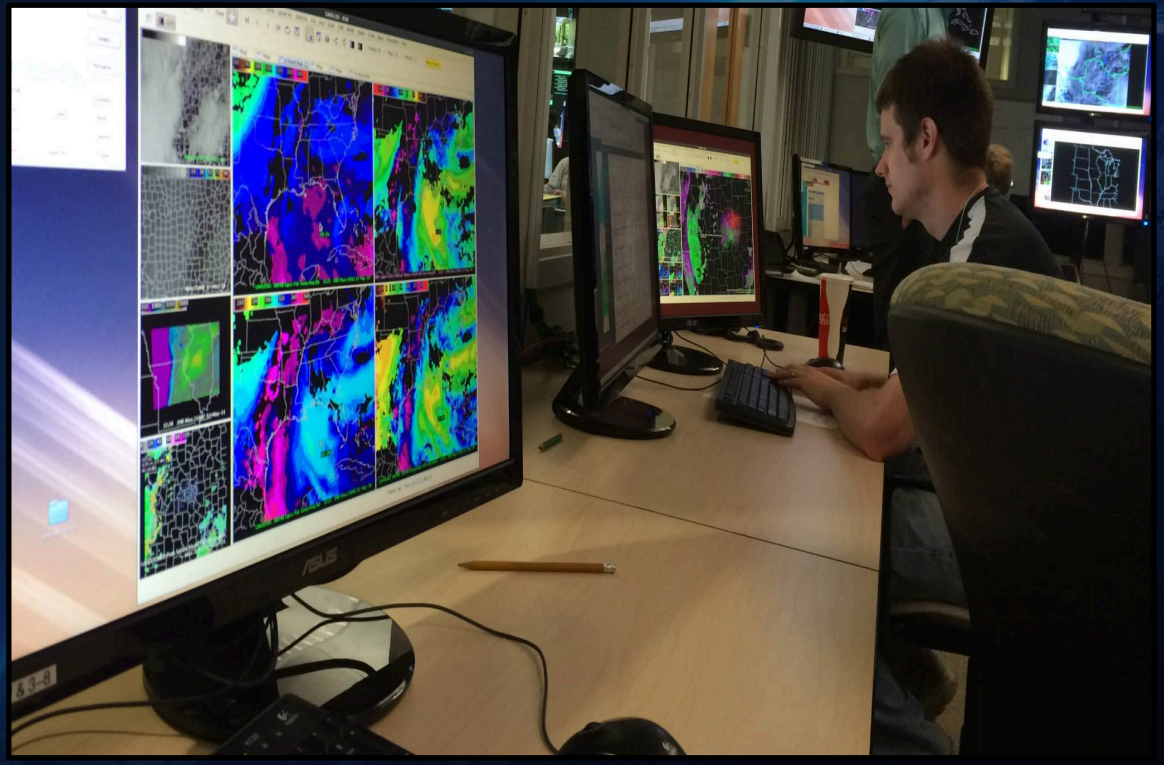
Probability of Severe Convection



GOES-R/Broadcast Meteorology Collaboration

Outreach efforts to introduce GOES-R products to forecasters and accelerate user readiness for the advanced capabilities of GOES-R.

GOES-R funded 4 broadcast meteorologists (with NWS forecasters) to attend the Hazardous Weather Testbed in Norman, OK this past May.



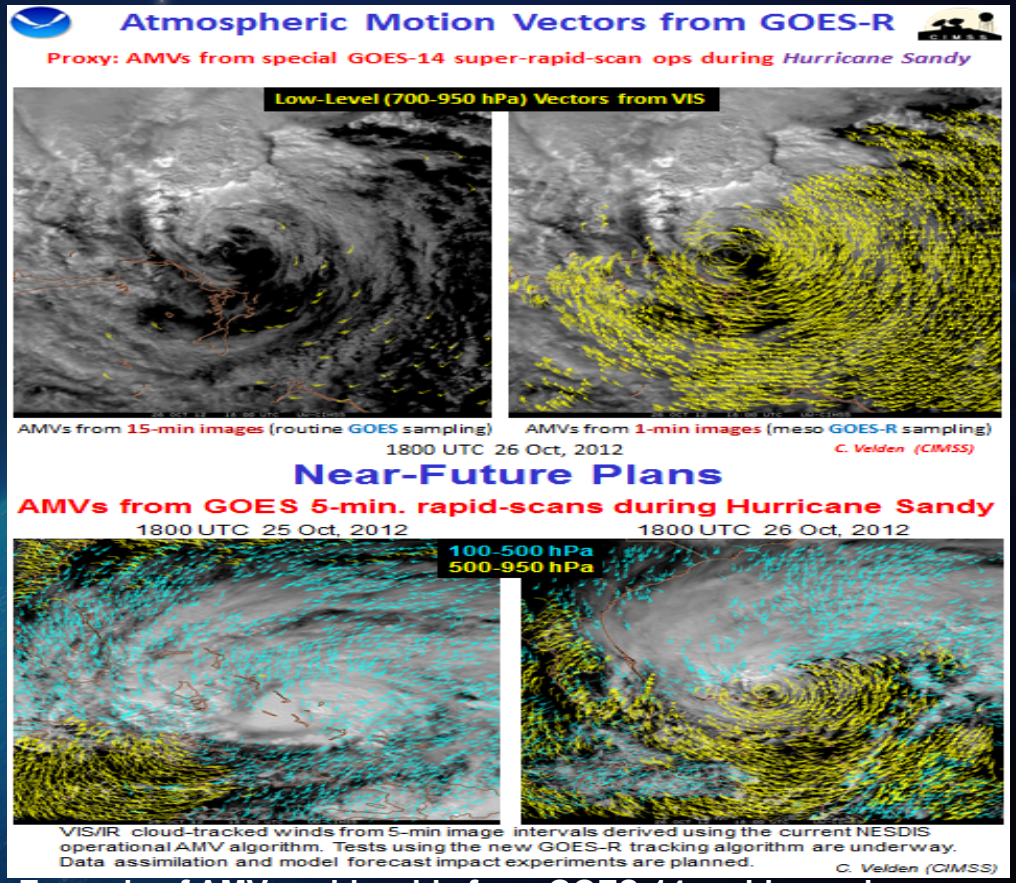
Courtesy of Erica Grow, WHSAV

GOES-R Proving Ground at NHC

NHC Proving Ground Product	Category	Evaluation Goals
GOES-R natural color	Mature	Included in NHC PG for several years Continue to obtain feedback, time permitting
RGB air mass		
RGB dust		
Saharan Air Layer (SAL)		
Pseudo natural color imagery product		
Hurricane Intensity Estimate (HIE)	Quantitative	Continue to obtain feedback, quantitative verification
Rapid Intensification Index (RII)		
RGB daytime microphysics	Introductory	Emphasize and obtain feedback on tropical applications – all were introduced in late 2013, little exposure
RGB nighttime microphysics		
RGB convective storms		
S-NPP Day/Night Band		
CIRA RGB Dust (DEBRA)	Comparison	Encourage forecasters to display comparison products w/ originals, provide strengths and weaknesses
Lightning density		
Super rapid scan imagery	Underutilized	Continue to be included, modified, or given less emphasis?
Tropical overshooting tops (TOT)		

Development and Optimization of Mesoscale Atmospheric Motion Vectors (AMVs) using Novel GOES-R Processing Algorithms on 1-5 min. SRSO Proxy Data, and Demonstration of Readiness for GOES-R Applications via Impact Studies in Mesoscale NWP Systems

- Super-rapid-scan operations (SRSO) imagery (available at 1-5 min. frequency) provided during special GOES tests can be used as proxy data for GOES-R readiness.
- We can exploit this temporal upgrade towards the development and optimization of AMV production, particularly in situations where super-dense datasets are needed such as in hurricanes or mesoscale applications.
- Case study AMV datasets will be processed and optimized, then provided to our mesoscale and hurricane NWP partners for data assimilation and model forecast impact testing.



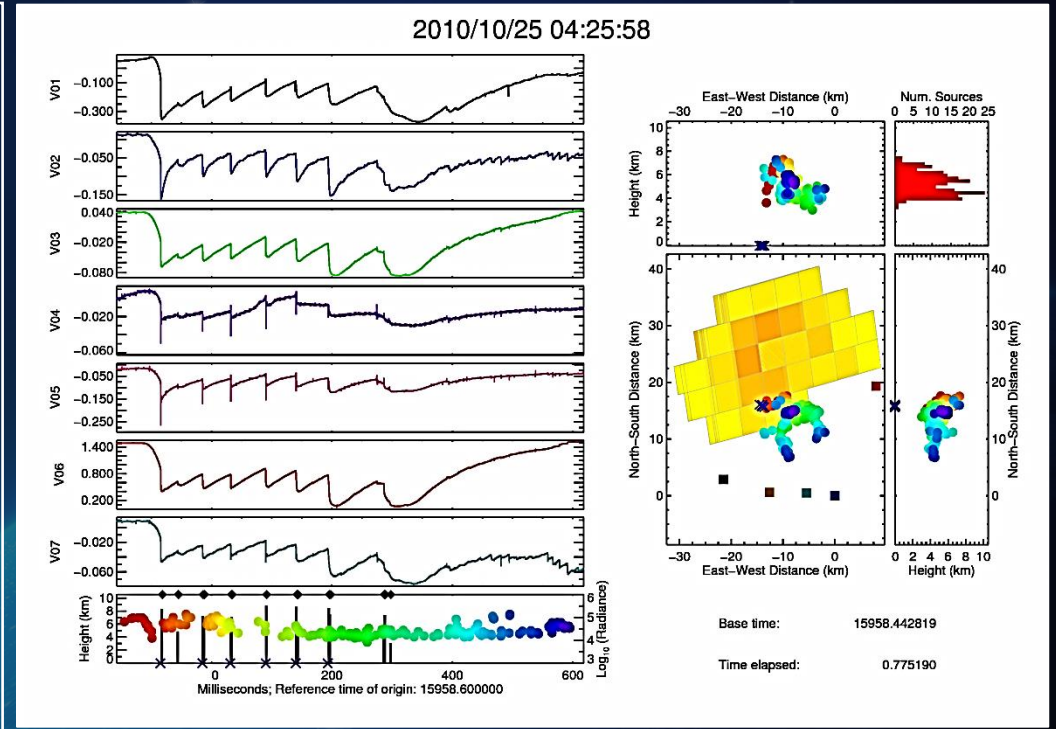
Example of AMVs achievable from GOES-14 rapid scan imagery (1-5 min.) available during Hurricane Sandy. The coverage and flow definition is greatly enhanced vs. that from current operational AMVs.

Optimization of AMVs from GOES-R for hurricane and mesoscale applications

C. Velden (UW/CIMSS), J. Daniels (STAR), S. Weygandt (ESRL)

Toward an Operational Use of Stroke Level Lightning Data in Severe Weather Forecasting

- Ongoing research using lightning data in the context of severe weather forecasting is promising.
- However, only flash level data is used – but not all flashes are equal, energetically.
- GLM will provide data that correspond to strokes (called groups in GLM nomenclature).
- We will use existing LIS data and ground based electric field networks (e.g., HAMMA) to relate optical measurements to strokes, which are more closely related to the electrical energy output of a storm.
- Ultimately, we seek to establish a new paradigm in which GLM data can be better used to relate electrical energy to storm dynamics.



A single lightning flash observed by HAMMA (colored waveforms) and LIS (gray bars and yellow/red squares). The return strokes are detected by each system – this is the most energetic process in a flash.

Explore how to best use GLM data in relation to storm development

Phillip M. Bitzer and Larry Carey, University of Alabama in Huntsville

Fused Fog/Low Cloud Detection Approach

Satellite Data

-Minimum channel requirement: 0.65, 3.9, 6.7/7.3, 11, and 12/13.3 µm
-Previous image for temporal continuity (GEO only)
-Cloud Phase

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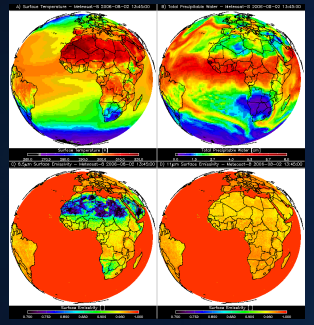
Static Ancillary Data



-DEM
-Surface Type
-Surface Emissivity

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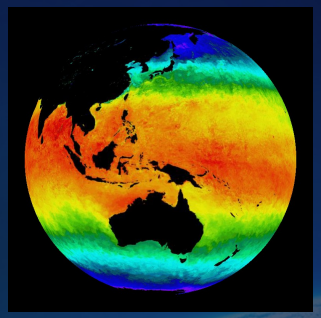
Daily SST Data



0.25 degree OISST

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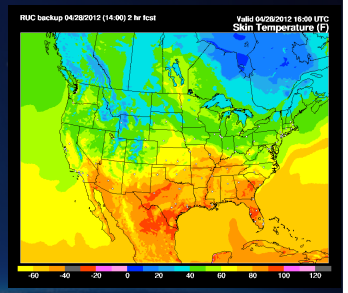
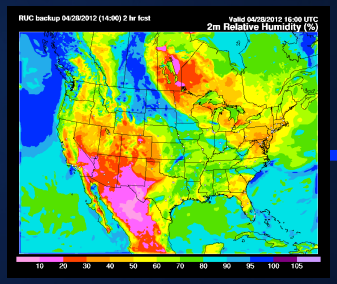
NWP



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

Clear Sky RTM

NWP RH Profiles

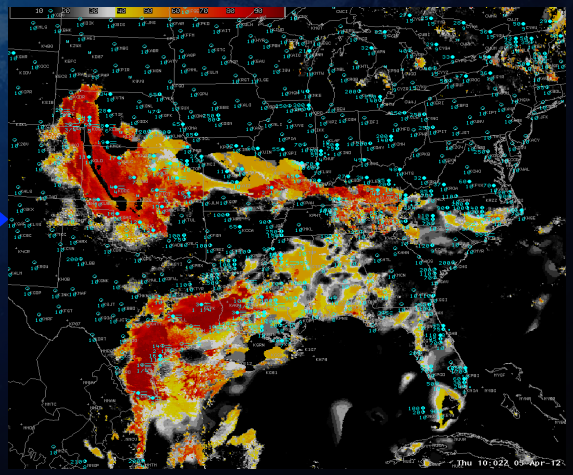


-RUC/RAP (2-3 hr forecast) or GFS (12 hr forecast)

Naïve Bayesian Model

Total run time: 2 - 3 minutes

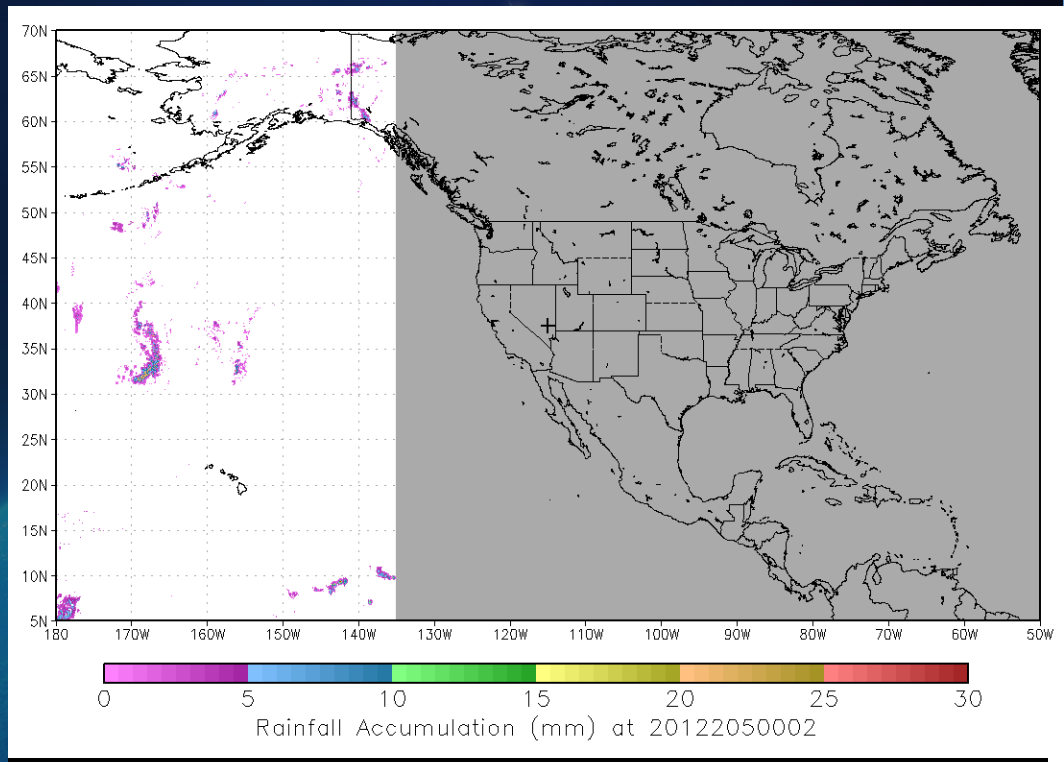
IFR and LIFR Probability



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

Improving Real-time GOES-R Rainfall Rate Estimates through Infusion of Ground Radar and Gauge Data and Evaluating the Impacts on NWS Flash and River Flood Prediction

- Low-latency, high-resolution quantitative precipitation estimates (QPE) are critical for NWS river and flash flood forecast operations
- Integrating satellite data into the operational QPE data stream will improve coverage, especially OCONUS
- FY 14/15 GOES-R3 project will add radar data to the calibration of the GOES-R Rainfall Rate algorithm (which currently calibrates against microwave rain rates) and optimally merge the satellite QPE with radar and gauges
- Output will be provided to the NWS via the Multi-Radar Multi-Sensor System (MRMS) becoming operational at NCEP Central Operations (NCO)



Current-GOES version of the GOES-R Rainfall Rate algorithm (no radar input; calibrated against MW only)

Low-latency multi-sensor QPE will be provided to NWS field offices for hydrologic forecasting

Y. Zhang (NWS/OHD), R. Kuligowski (NESDIS/STAR), and J. J. Gourley (OAR/NSSL)

GOES-14 Super Rapid Scan Operations to Prepare for GOES-R (SRSOR)

SRSOR plans for 2015 : May 18-June 12, and August 10-22:

http://cimss.ssec.wisc.edu/goes/srsor2015/GOES-14_SRSOR.html

Data during parts of 2012 (Hurricane Sandy, convection), 2013 (CA Rim Fire, convection) and 2014 (Hurricane Marie, convection):

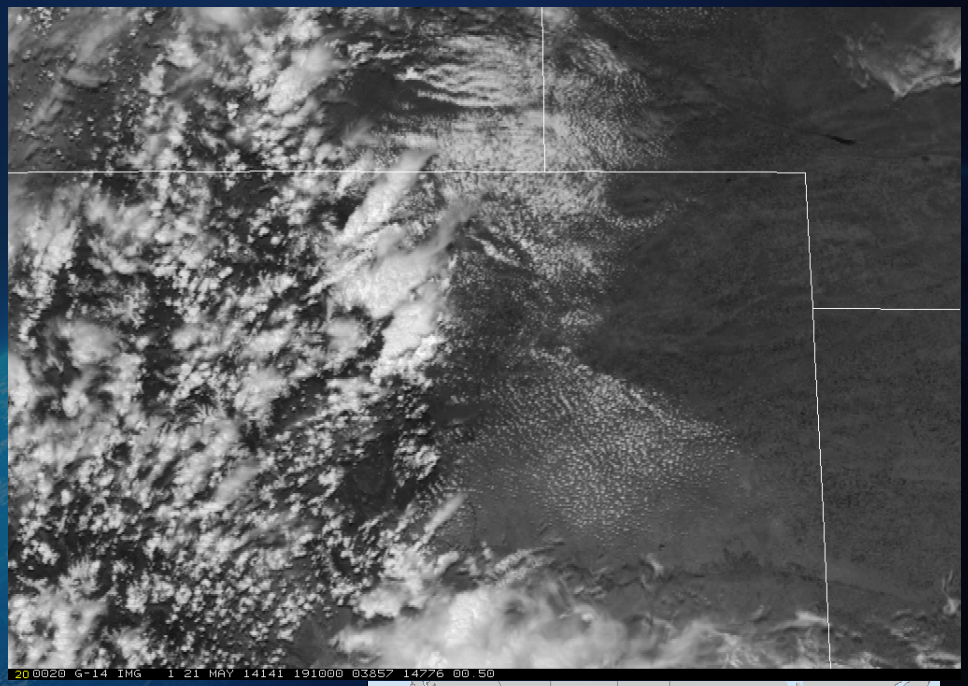
http://cimss.ssec.wisc.edu/goes/srsor/GOES-14_SRSOR.html

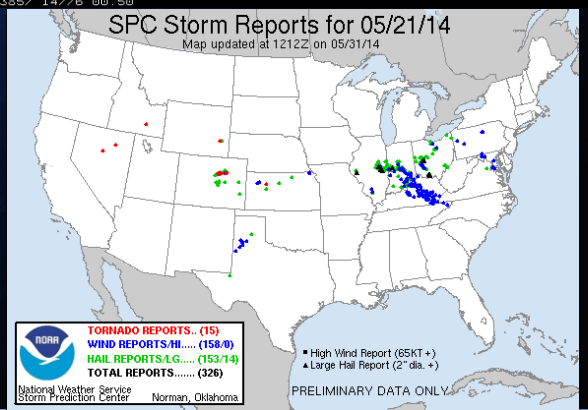
http://cimss.ssec.wisc.edu/goes/srsor2013/GOES-14_SRSOR.html

http://cimss.ssec.wisc.edu/goes/srsor2014/GOES-14_SRSOR.html

GOES-14 provided very unique data and offered a glimpse into the possibilities that will be provided by the ABI on GOES-R in one minute mesoscale imagery

DIA Tornadic Storm



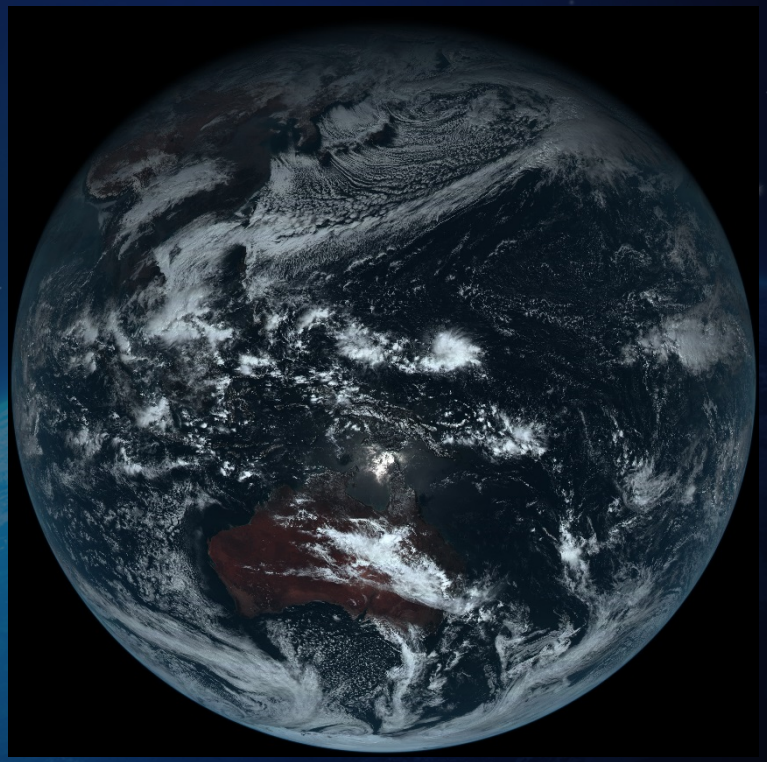


Forecaster Demonstration of 1-min Imagery

- Blog posts with SPC examples/comments on Satellite Liaison Blog: http://satelliteliaisonblog.wordpress.com/
  - *"Post-storm initiation, the high-resolution data allowed for careful analysis of overshooting and collapsing tops, the character of the storm anvils (ie. health of the storm) and the identification of convectively generated outflows."* - SPC forecaster
  - *Using cloud character and trends to diagnose boundary locations and motion, and nowcast their potential for either CI or influences on upshear storms to interact therewith."* – SPC Forecaster
  - ***"Satellite imagery at 1-min temporal resolution needs to become the new standard for severe weather operations." – SPC Forecaster***
- Comments from HWT
  - All EWP survey respondents agreed that the 1-minute imagery provided additional value compared to 5- or 15- minute imagery.
  - *"It allowed you to see so much more structure/trends. You could easily see areas of subsidence as cu were squashed or boundaries where things were being enhanced.* – Forecaster in EWP
  - *"Around great lakes looking at advection fog, I wish we had 1 minute updates so we could see how much fog is spreading inland."* – Forecaster in EWP
  - *"Cumulus clouds growing into thunderstorms on the 1 minute imagery definitely provided lead time to when storms might develop, which is great for timing watch issuance's before the storms become severe. This is not easily observed with the 5 minute or longer visible imagery."* - EFP

FY15- Himawari 8

- Japan Meteorological Agency (JMA)
  - Information exchange and collaborative research on volcanic ash and cloud analysis science
  - Algorithm Working Group team member visits
  - Access to full resolution HIMAWARI imagery for Proving Ground demonstrations



Himawari 8 True Color Composite from December 18, 2014

http://www.data.jma.go.jp/mscweb/en/himawari89/index.html

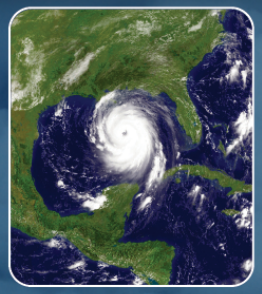
Summary

- GOES-R is coming - Launch early 2016
- New sensors, products, and services will help improve forecasts and increase lead times for warnings and decision makers
- Presents Challenges and Opportunities for model assimilation, data fusion and tools- hierarchical clustering, Warn on Forecast/PHI, ensemble NWP
- Product testing as soon as 2 months post-launch, also available to users for science assessment
- User preparation is essential to take advantage of the advanced capabilities to support a Weather Ready Nation - Hemisphere - World

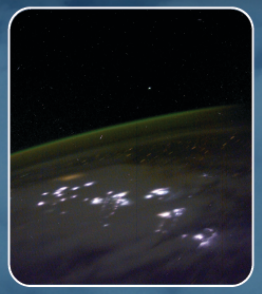
GOES-R

Geostationary Operational Environmental Satellite - R Series

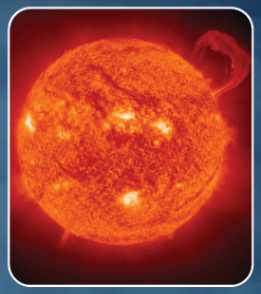
The next-generation of geostationary environmental satellites



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

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