Results from GOES-R and JPSS Proving Ground Demonstrations at the HWT 2015 Spring Experiment

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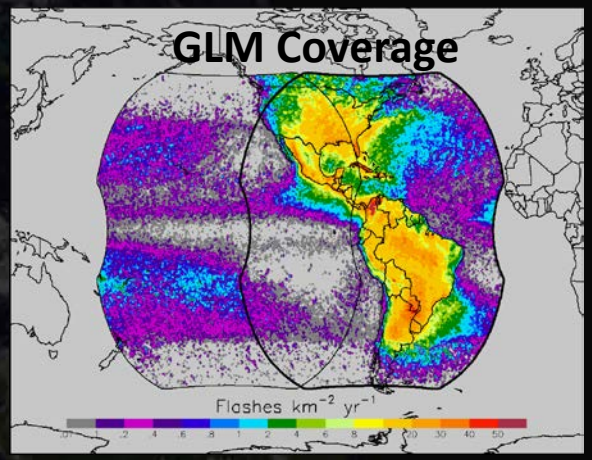
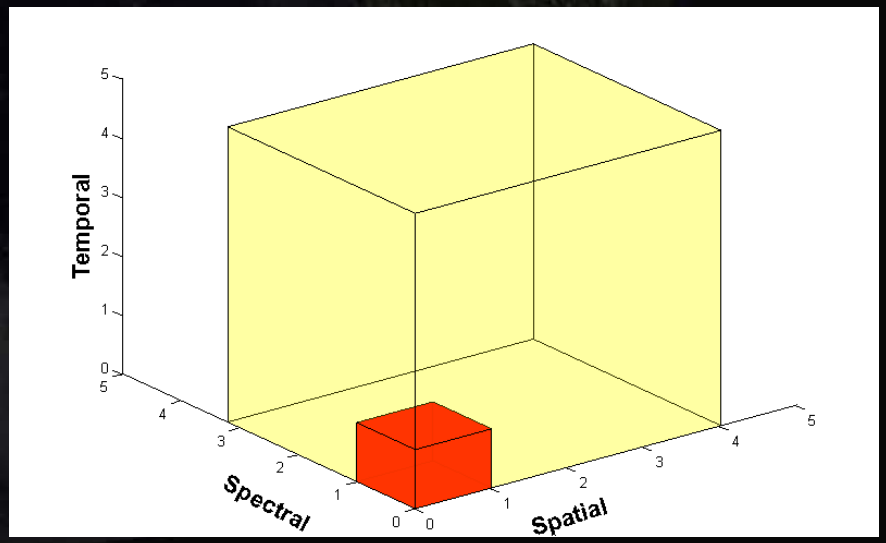
GOES-R

- Next generation of NOAA/NASA geo weather satellites
  - R-Series includes 4 satellites
  - First to launch in Oct 2016



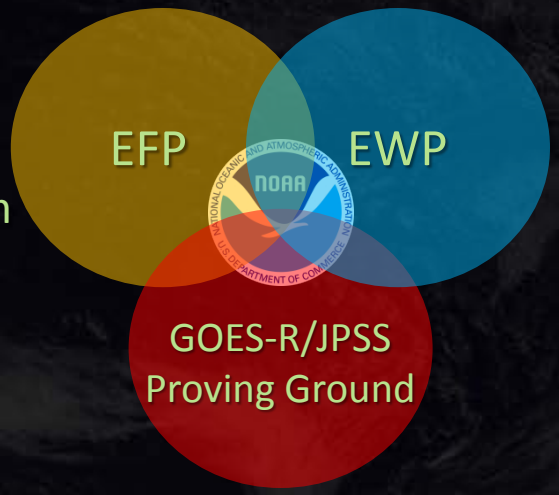
- Geostationary Lightning Mapper (GLM)

- Advanced Baseline Imager (ABI)
  - 3x more spectral bands
    - 16 on ABI vs. 5 today
  - 4x spatial resolution
    - IR: 2 km vs. 4 km
    - 0.64 um vis: 0.5 km vs. 1 km
  - 5x temporal coverage
    - 5-min vs. 25-min full disk



GOES-R and JPSS in the Hazardous Weather Testbed

- Product developers observe their recently developed GOES-R and JPSS algorithms being used alongside standard observational and forecast products in a simulated operational forecast and warning environment (Research to Operations, **R2O**)
- Feedback received from participants leads to the continued modification and development of GOES-R and JPSS algorithms (Operations to Research, **O2R**)
- Education and training received by participants helps to ensure **readiness** for the receipt and use of GOES-R and JPSS data



Experimental **F**orecast **P**rogram

*Prediction of hazardous weather events from **a few hours to a week in advance***

Experimental **W**arning **P**rogram

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

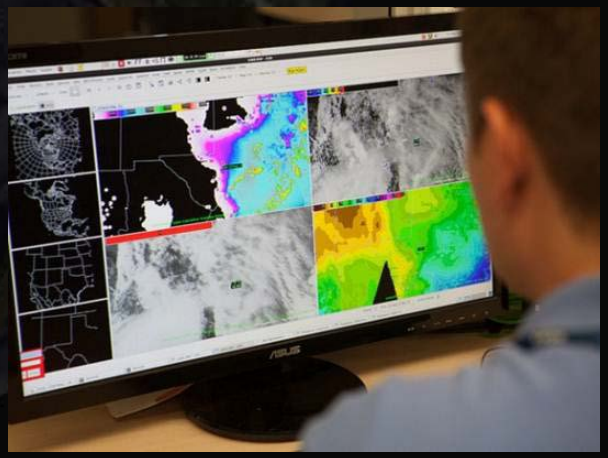
2015 HWT /EWP
Spring Warning Project

- Real-time, simulated nowcast/warning environment using AWIPS-II.
  - “mesoscale forecast updates” (via live blog posts)
  - experimental severe t-storm and tornado warnings (in AWIPS-II).
- Weeks of May 4, 11, 18, June 1, 8 (5 weeks)
  - Mon: 11a-7p, Tues-Thurs: Flex (start b/t 11a and 3p), Fri: 9a-1p
- 5 NWS forecasters, 1 broadcaster per week (30 total; and PI’s)
- GOES-R/JPSS and ENI demonstration's
- Training: 10-30 min Articulate PowerPoint Presentations
- Feedback: Daily and weekly debriefs, daily and weekly surveys, blog posts, TFTT Webinar

- **Final Report: http://www.goes-r.gov/users/pg-activities-01.html**

GOES-R and JPSS products demonstrated during 2015 Spring Experiment

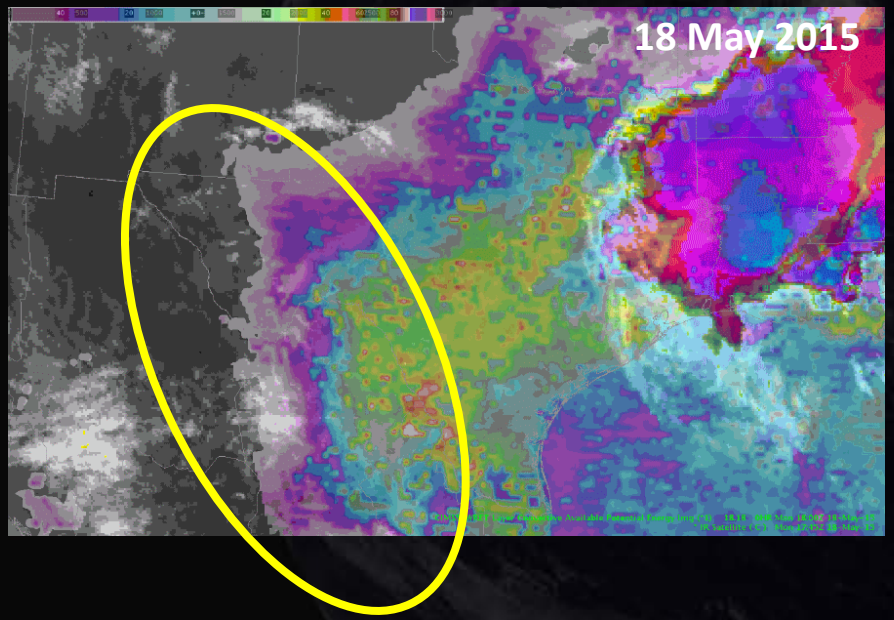
- GOES-R Legacy Atmospheric Profile (LAP) Thermodynamic Products
- GOES-R Convective Initiation
- Probability of Severe Model
- GOES-14 Super Rapid Scan Operations for GOES-R (SRSOR) 1-minute imagery (5/18 – 6/11)
- PGLM Total Lightning (in LMA networks)
- Lightning Jump Algorithm (using ENI)
- NUCAPS Temperature and Moisture Profiles (from Suomi-NPP)



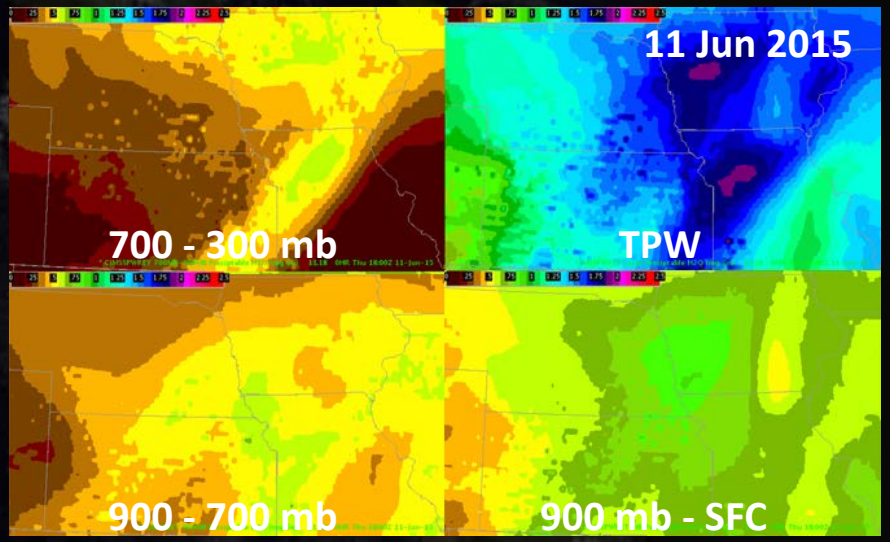
GOES-R LAP Products

- CAPE, LI, SI, KI, TT, TPW, LPW in the SFC-900 mb, 900-700 mb, and 700-300mb atm. layers.
- GOES-R3 algorithm fuses clear-sky ABI LAP algorithm, cloudy-sky algorithm, and NWP.

LAP CAPE and GOES IRW



LAP TPW and Layer PW



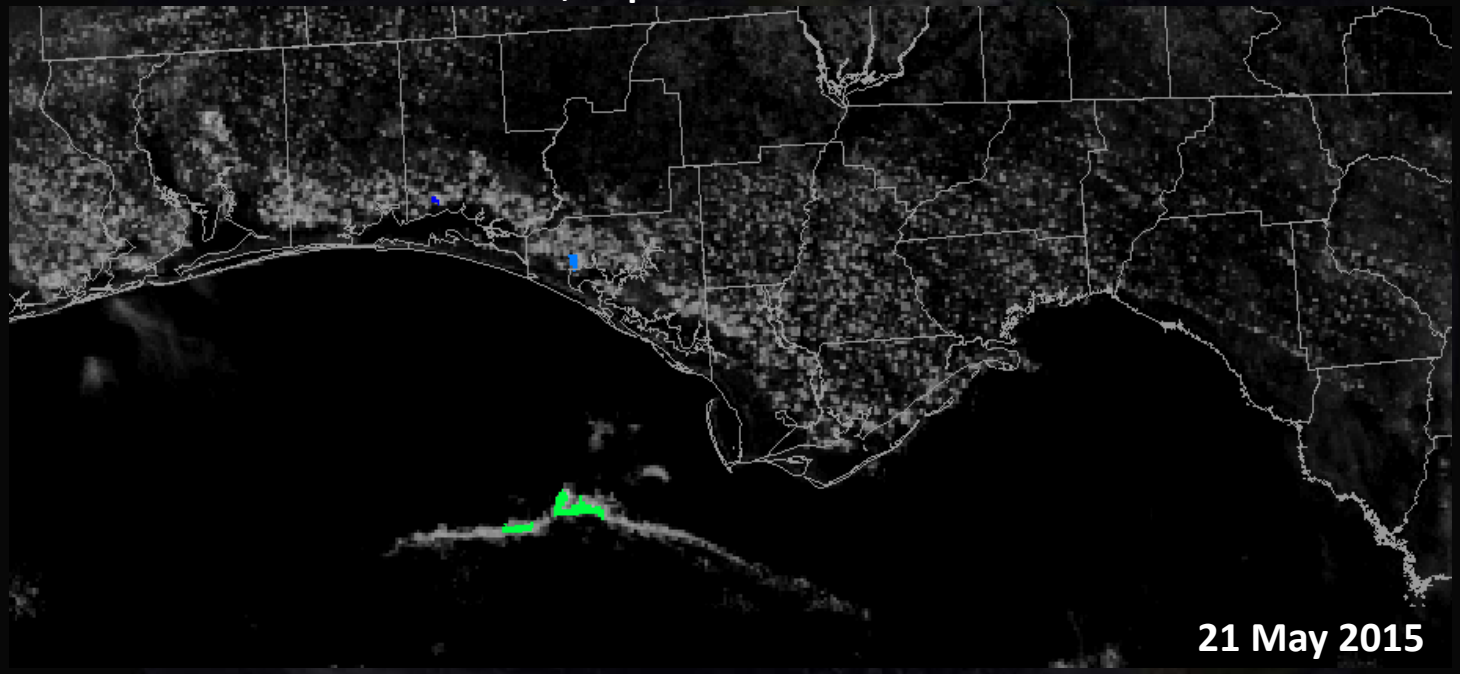
- *"… **mesoscale analysis** … at the beginning of the radar shift."*
- *"It was most useful to pay attention to the **gradients and trends** in the fields."*

❖ Suggestions: fix sometimes unrealistic spatial variations in fields and inaccurate CAPE absolute values. implement a way of knowing which of the three algorithms the data are from at any given point, improved training on layer PW.

GOES-R Convective Initiation

- Fuses GOES cloud products and RAP-derived environmental fields and uses a logistic regression framework to produce probability of future convective initiation.

GOES VIS, CI probabilities

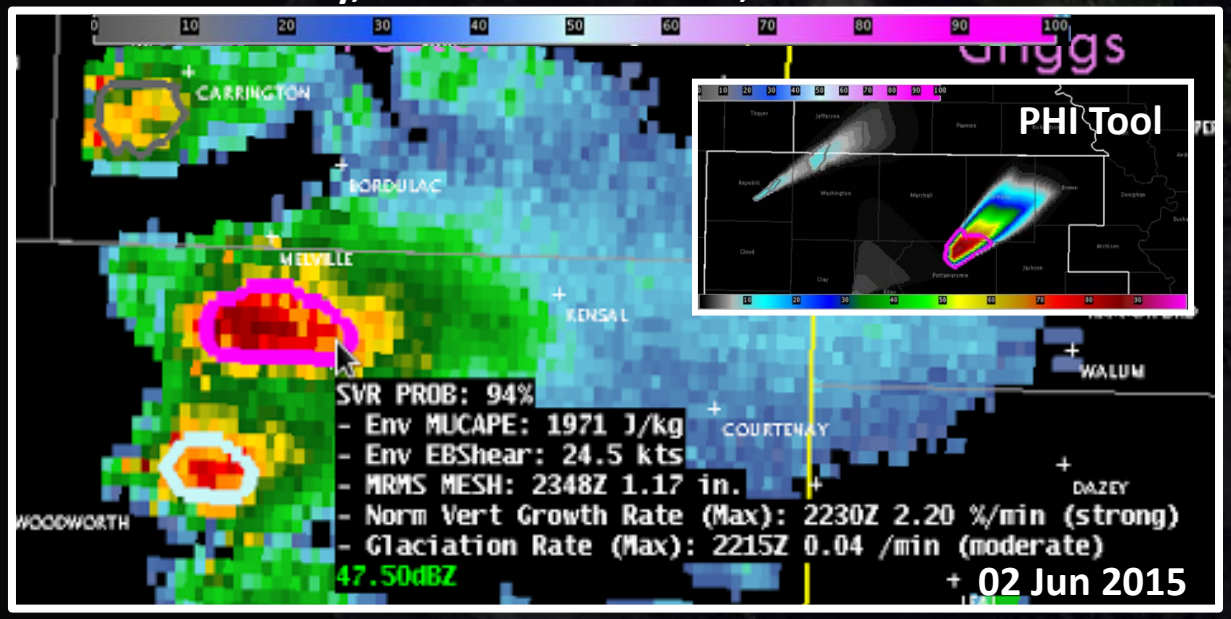


- *"It provides great **situational awareness** about initial convective development and helps focus in on which areas to watch."*
- *"higher probabilities **draw my attention** to the areas where convection would eventually go."*
- *Suggestions: improved performance under cirrus clouds and in areas of congested cu, would like an algorithm that provides CI probabilities to severe convection.*

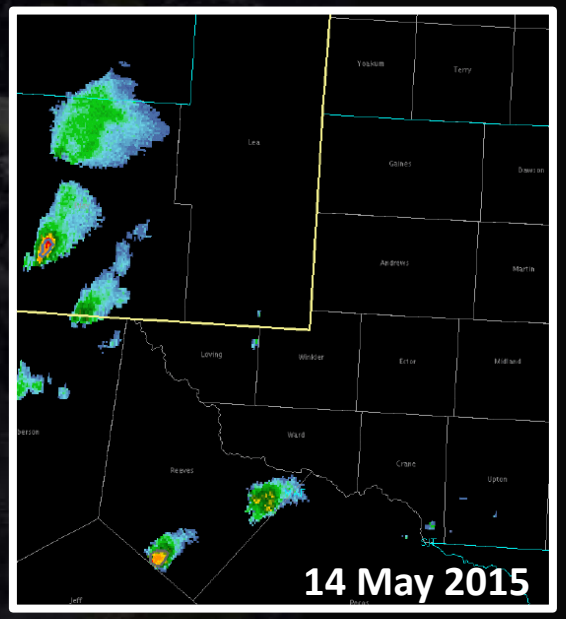
ProbSevere Model

- Fuses GOES cloud products, radar information, and RAP-derived environmental fields and uses object-based tracking in both GOES and radar imagery and a statistical model to produce probability of future severe weather.

Radar reflectivity, ProbSevere contours, ProbSevere readout



Radar reflectivity, ProbSevere contours, HWT Warnings

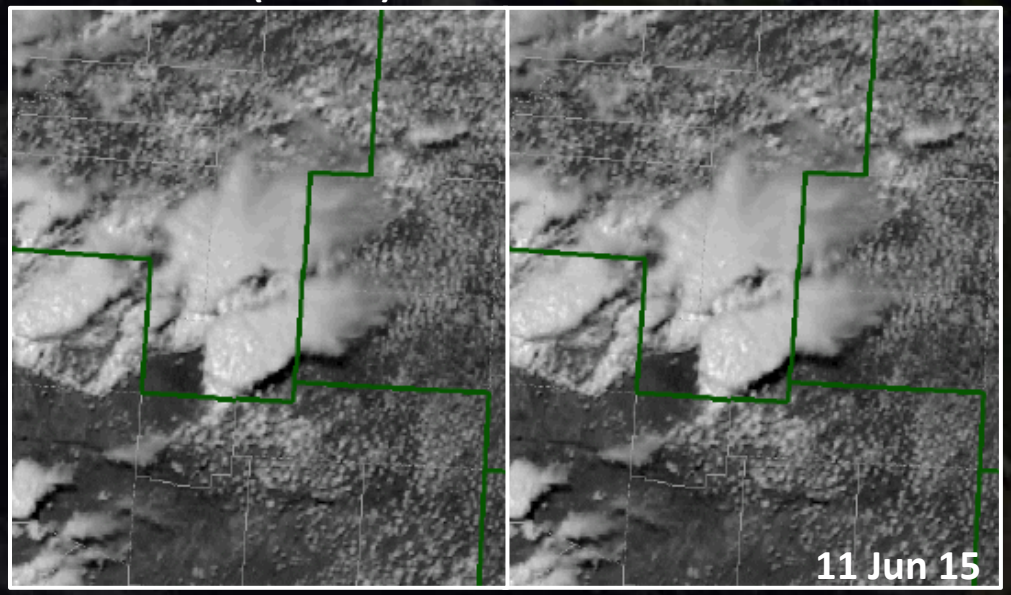


- *"It did provide an opportunity to assess the situation quickly and figure out which of the ongoing storms need our attention first." … "**Great situational awareness tool**"*
- *"Gave me **confidence** to load up Warngen and issue after a cursory look at the radar data"*
- Suggestions: probabilities by specific threat, time series of recent probabilities, use of lightning data as a predictor, improved performance when severe wind was the main threat.

GOES-14 SRSOR (1-min) Imagery

- Spring 2015 GOES-14 SRSOR: May 18 – June 11.
- One, daily-changing ~1500 km x 2000 km sector.

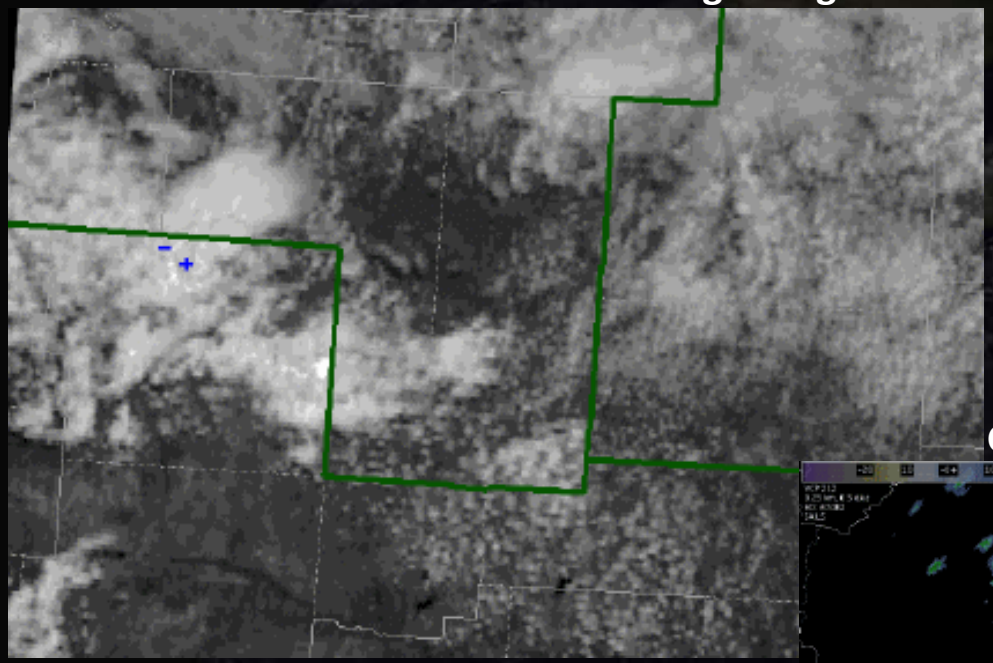
GOES 1-min (SRSOR) VIS **GOES 15-min VIS**



- *"The 1-min temporal resolution allows for visual tracking of **individual small convective cell development**. This detail is not as easily detected in the 15 min imagery."*
- *"Felt it **kept me ahead of the game** and able to plan for the next piece of data to look at."*
- *"Was very helpful in seeing **"dud" updrafts** basically in realtime so that we knew storms were not imminent."*

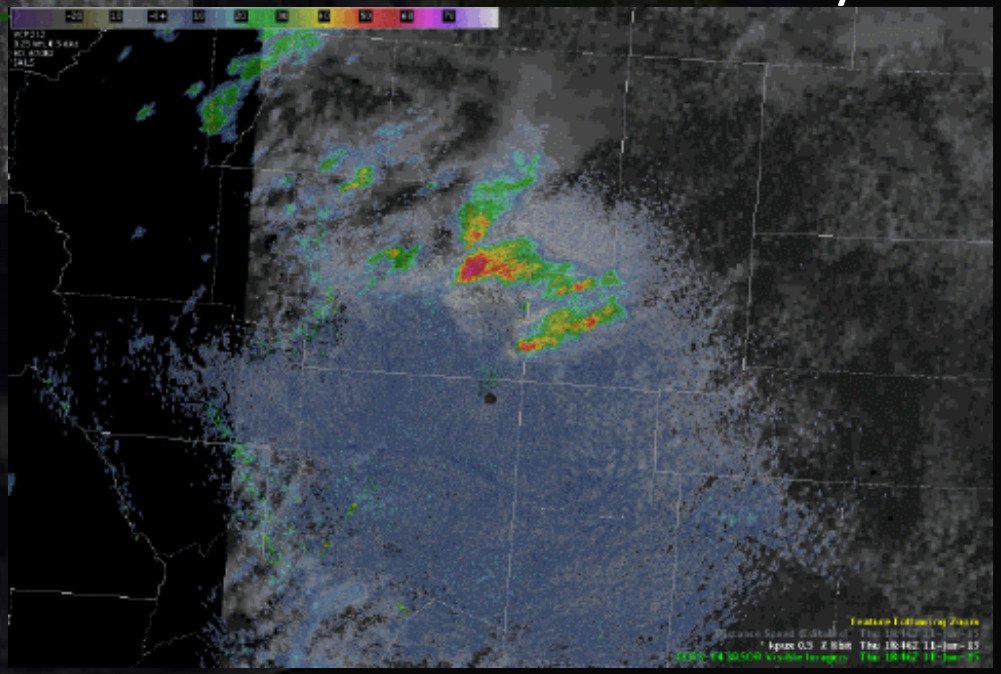
GOES-14 SRSOR (1-min) Imagery Combining with other datasets

GOES 1-min VIS and ENI total lightning



"I would love to have a Super Rapid Scan Satellite loop with reflectivity, and lightning somewhere on my D2D as a way to stay grounded with what is happening in real time during severe weather operations."

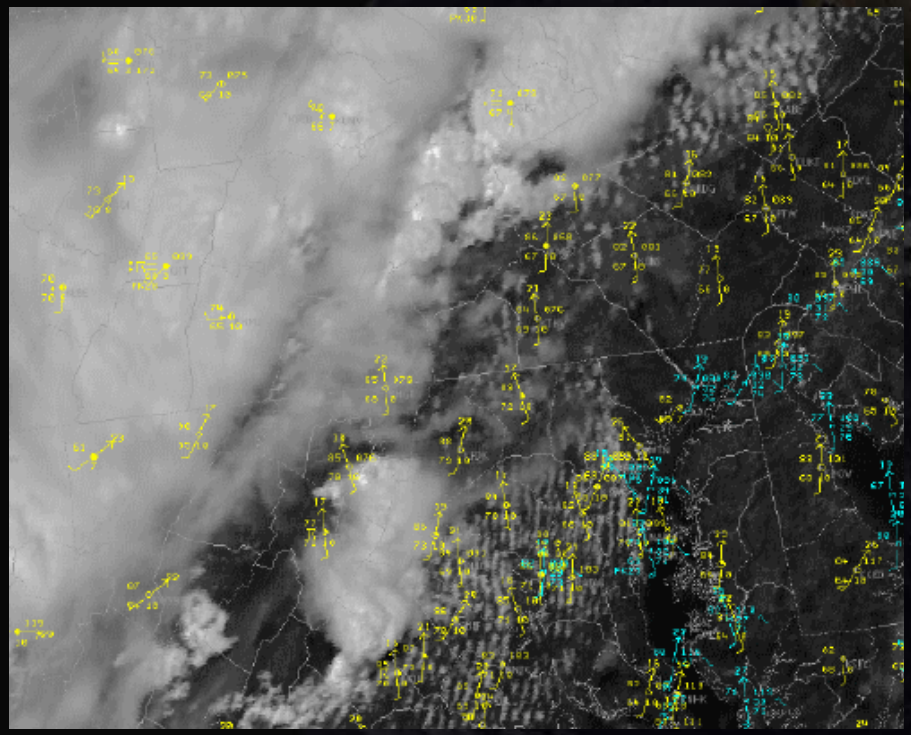
GOES 1-min VIS and radar reflectivity



*"Evident are storm structure, outflow boundary, inflow, and anvil development and storm top outflow all in the same image. This helps verify the **conceptual model** of supercells."*

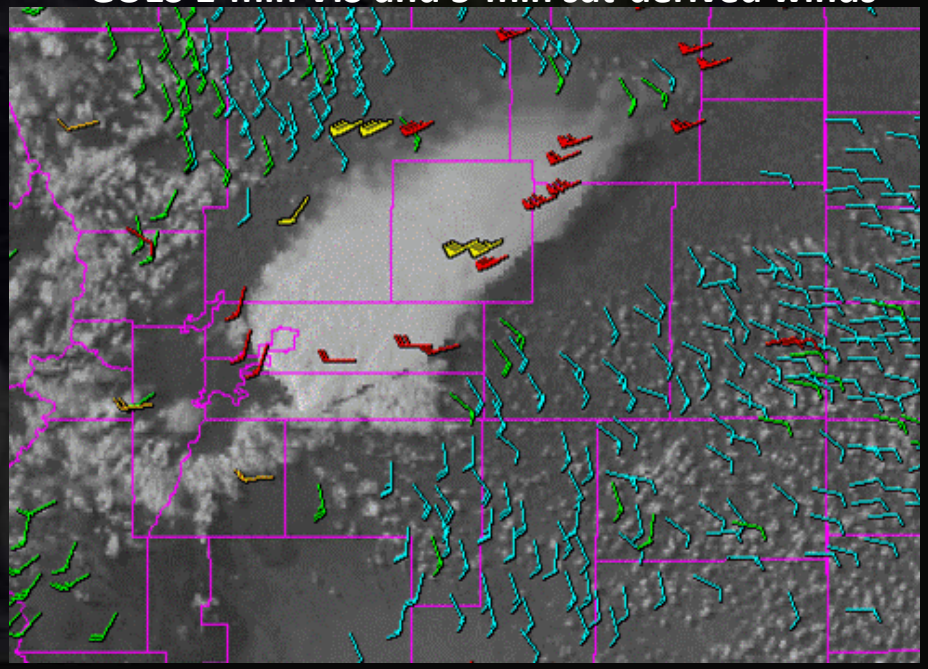
GOES-14 SRSOR (1-min) Imagery Algorithms

GOES 1-min VIS and automated-OTD



Cloud-top cooling information

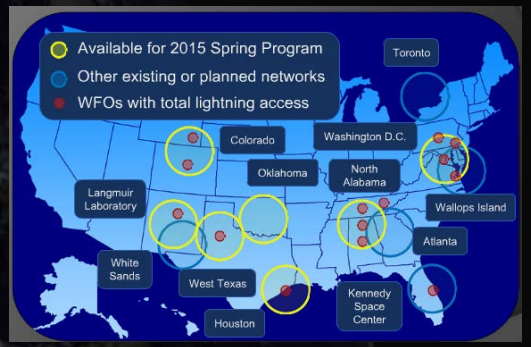
GOES 1-min VIS and 5-min sat-derived winds



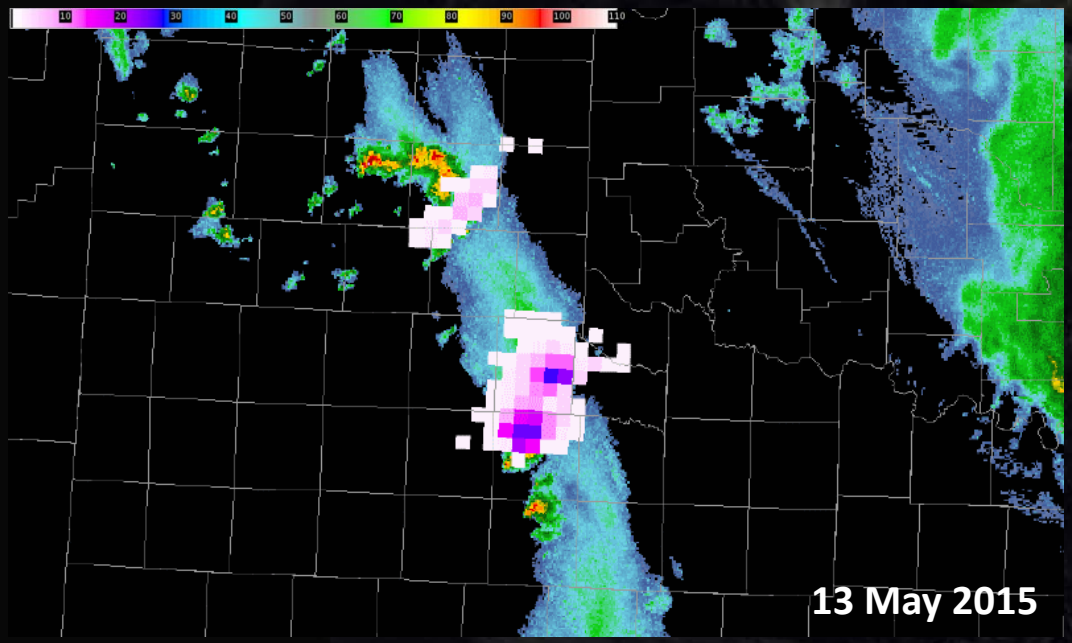
"It is nice to be able to quantify the OTs, something you can't do quickly without an algorithm."

Pseudo Geostationary Lightning Mapper (PGLM) Total Lightning

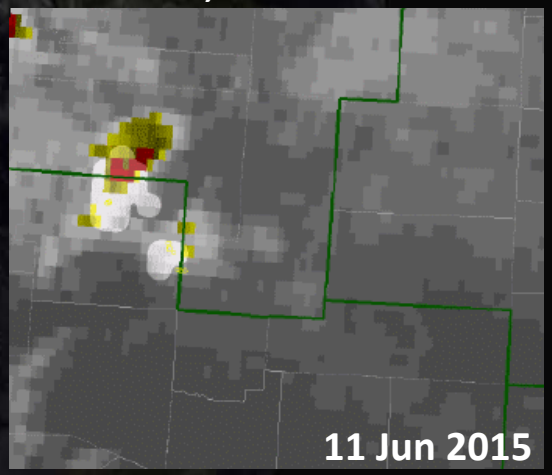
- Pseudo Geostationary Lightning Mapper (PGLM) total lightning products were created using Lightning Mapping Array (LMA) data from regional networks around the US.



PGLM FED, radar reflectivity



PGLM FED, GOES 1-min IRW



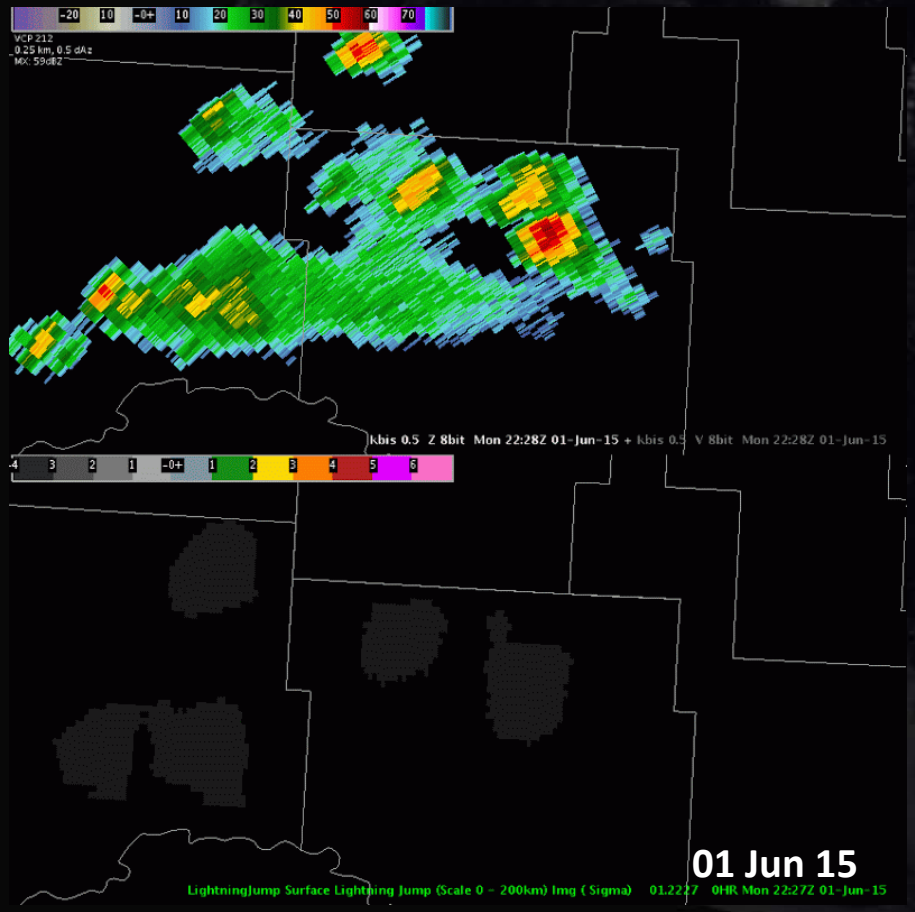
- *"One of the primary ways to monitor convective growth and changes in storm intensity."*
- Many comments related to the value of total lightning products for Decision Support Services for locations such as outdoor venues as well as for marine and fire weather forecasting.

❖ Suggestions: improved training on the proper incorporation of total lightning information into the warning-decision process.

Lightning Jump Algorithm

- The Lightning Jump Algorithm (LJA) demonstrated in 2015 uses data from the Earth Networks Total Lightning Network and computes the degree of jump (sigma-level) in total lightning activity for a tracked storm object.

Radar reflectivity (Top) Lightning Jump sigma-level (bottom)



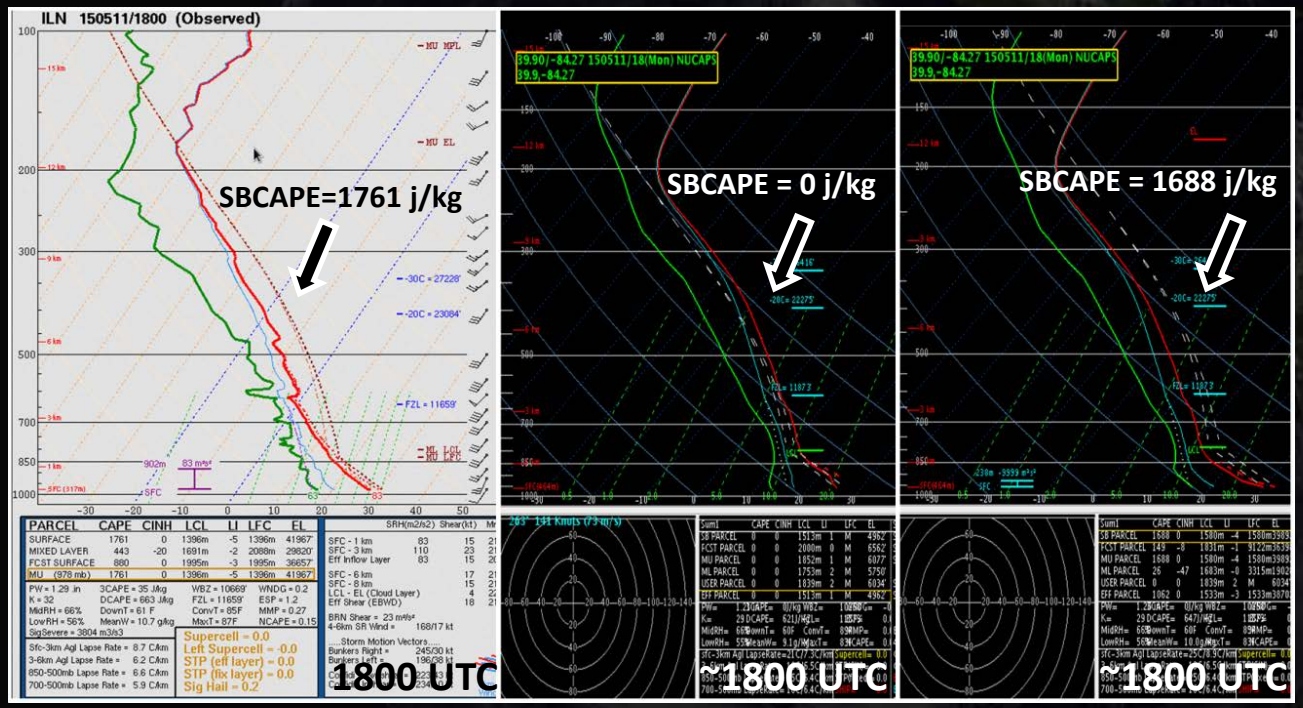
- *"The LJA really helped with both **warning** operations and **situational awareness**. It was one of the first products to identify rapid intensification."*
- *"I found it to be very useful for **a quick visualization**... having a product that was an easy 0-6 scale made for fast analysis."*

❖ Suggestions: improved training on the use of LJA in operations, metadata added to the LJA grid, time-series information.

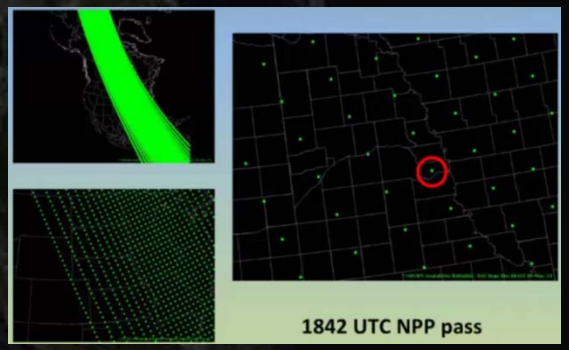
NOAA Unique CrIS ATMS Processing System (NUCAPS)

- NUCAPS algorithm generates temperature and moisture profiles using information from the Cross-track Infrared Sounder (CrIS) and Advanced Technology Microwave Sounder (ATMS) instruments aboard the Joint Polar Satellite System (JPSS) Suomi-NPP satellite.

ILN radiosonde (left), un-modified NUCAPS (middle), sfc-modified NUCAPS (right)



Example NUCAPS Coverage



- *"… a good way to see **changes in the airmass** since the RAOB soundings have been taken."*
- *"… our closest ROAB site was out of our CWA, so they helped to **fill in the gap** in coverage."*

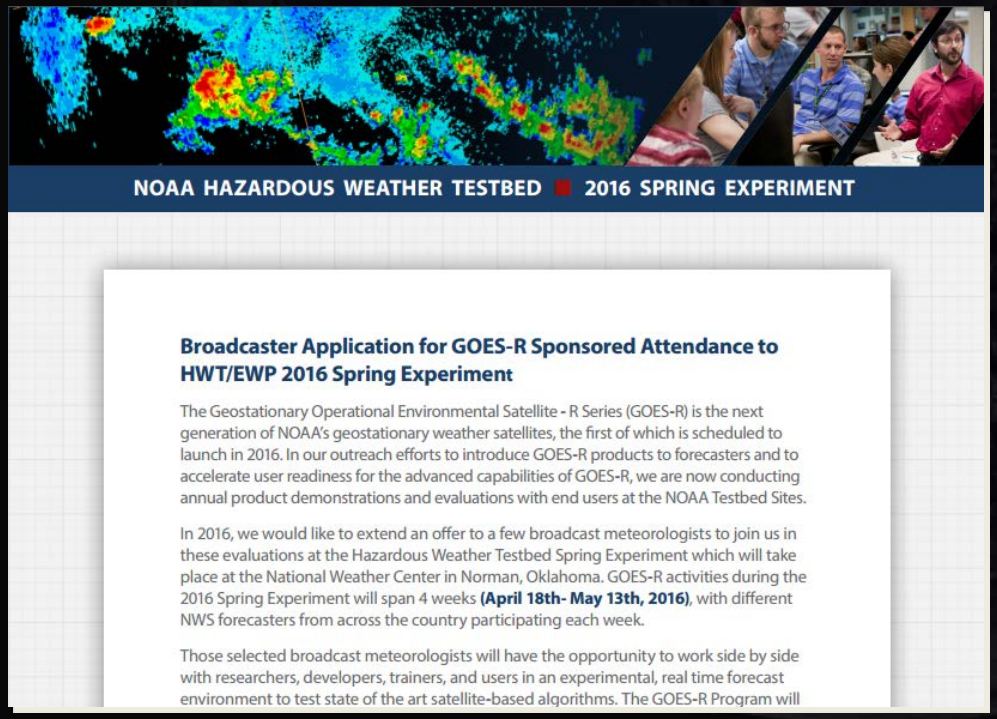
❖ Participants would like to see QC flags, automated surface/low-level modifications, more frequent data, and various NSHARP-related changes.

HWT 2016 Spring Experiment GOES-R/JPSS Activities

- Dates: Weeks of April 18, 25, May 2, 9 (4 total weeks)
  - During planned SRSOR
- Forecasters: 3 NWS, 1 broadcaster per week
- Experiment design will be similar to that of last year.
- Tentative projects: SRSOR Imagery, SRSOR Imagery parallax corrected, SRSOR AMV's, CI-Severe, CI-SRSOR, ProbSevere, GOES Sounder LAP, PGLM, JPSS NUCAPS
- The GOES-R/JPSS PG/UR meeting is being planned for the week of May 9 in Norman at the NWC.

Broadcasters in HWT 2016

- Participation completely funded by GOES-R
- Participate along side, to same extent, as NWS participants
- 2016 HWT Spring Experiment (1 per week; 4 total)
  - **Apply Now!:** http://www.goes-r.gov/downloads/2016-HWT-Spring-Experiment-Application.pdf



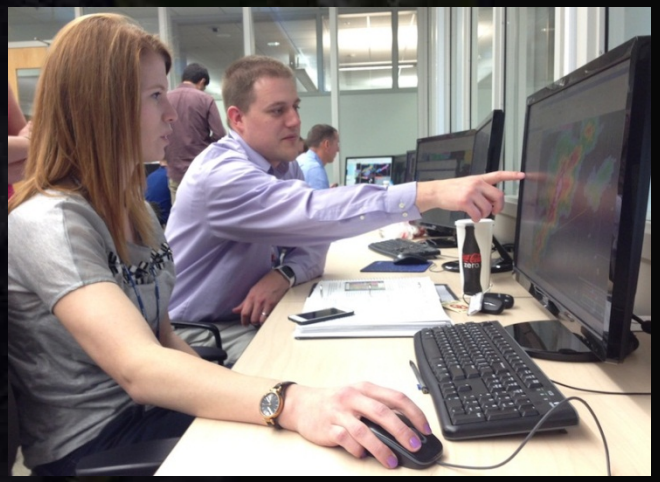
NOAA HAZARDOUS WEATHER TESTBED ■ 2016 SPRING EXPERIMENT

Broadcaster Application for GOES-R Sponsored Attendance to HWT/EWP 2016 Spring Experiment

The Geostationary Operational Environmental Satellite - R Series (GOES-R) is the next generation of NOAA's geostationary weather satellites, the first of which is scheduled to launch in 2016. In our outreach efforts to introduce GOES-R products to forecasters and to accelerate user readiness for the advanced capabilities of GOES-R, we are now conducting annual product demonstrations and evaluations with end users at the NOAA Testbed Sites.

In 2016, we would like to extend an offer to a few broadcast meteorologists to join us in these evaluations at the Hazardous Weather Testbed Spring Experiment which will take place at the National Weather Center in Norman, Oklahoma. GOES-R activities during the 2016 Spring Experiment will span 4 weeks **(April 18th- May 13th, 2016)**, with different NWS forecasters from across the country participating each week.

Those selected broadcast meteorologists will have the opportunity to work side by side with researchers, developers, trainers, and users in an experimental, real time forecast environment to test state of the art satellite-based algorithms. The GOES-R Program will



Summary

- GOES-R Launch Oct 2016
- GOES-14 SRSOR 2016: Feb 1-25, April 18 – May 15, …
- HWT helps to prepare users for future satellite technology, test algorithms
- Accepted WAF article: *"Use of Geostationary Super Rapid Scan Satellite Imagery by the Storm Prediction Center"*

- *GOES-R HWT Blog: http://www.goesrhwt.blogspot.com/*
- *HWT SE Webpage: http://hwt.nssl.noaa.gov/spring_experiment*

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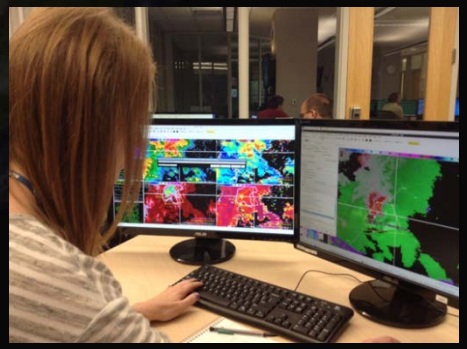

SPC RSO Criterion Change

- SPC criterion for requesting GOES Rapid Scan Operations (RSO) has recently changed
  - Old: Day 1 Moderate Risk
  - **New: Day 1 Enhanced Risk**

SPC Severe Thunderstorm Risk Categories					
THUNDERSTORMS (no label)	1 - MARGINAL (MRGL)	2 - SLIGHT (SLGT)	3 - ENHANCED (ENH)	4 - MODERATE (MDT)	5 - HIGH (HIGH)

- This change will:
  - result in more frequent RSO requests from SPC
  - improve NWS forecaster situational awareness on convectively active days
  - further help to prepare users for higher frequency GOES-R data