
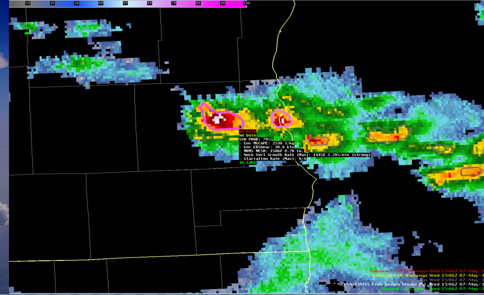


Next Generation Geostationary Satellite Observations in a Multi-Sensor Severe Weather Nowcasting Tool

EUMETSAT Satellite Conference, Rome, Italy
4 October 2017

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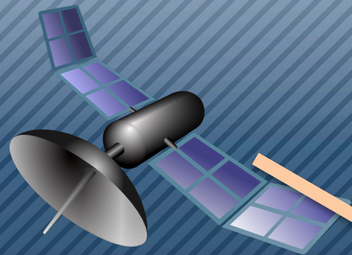
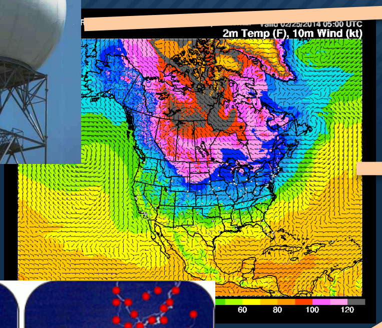
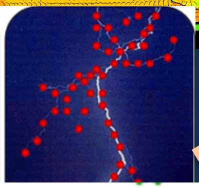
Justin Sieglaff (UW-CIMSS)
Jason Brunner (UW-CIMSS)
Dan Lindsey (NOAA/NESDIS)

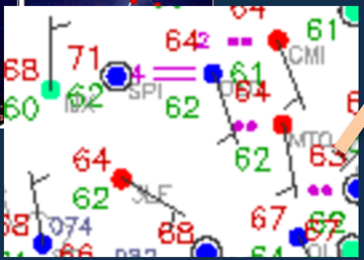
NOAA/CIMSS ProbSevere model

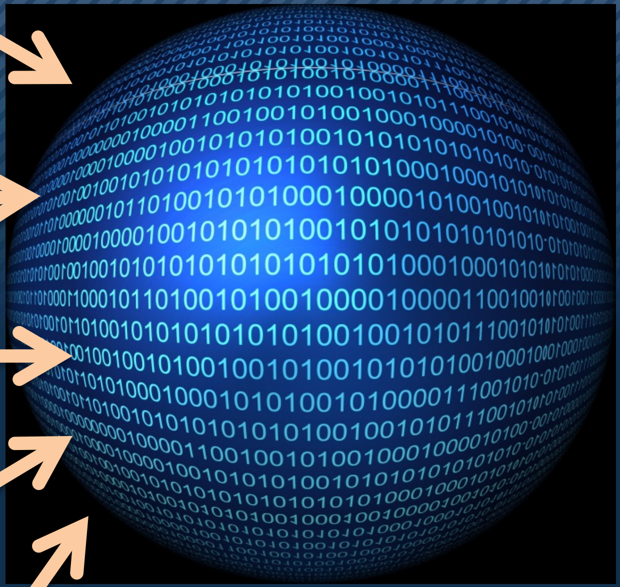
Motivation: convert "Big Data" into actionable information for weather hazards

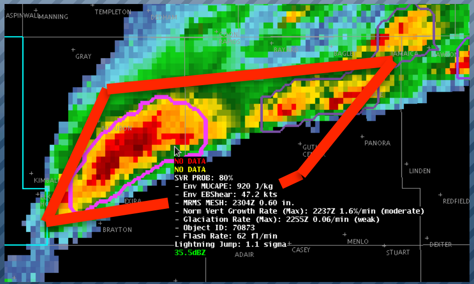








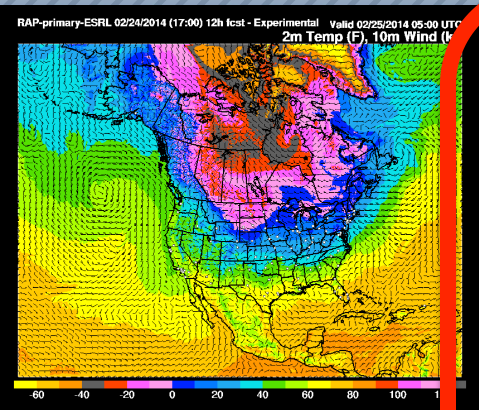


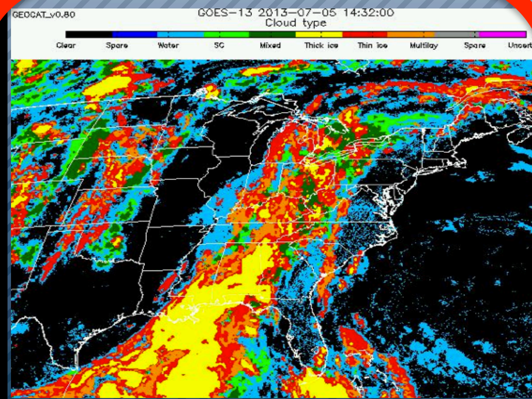


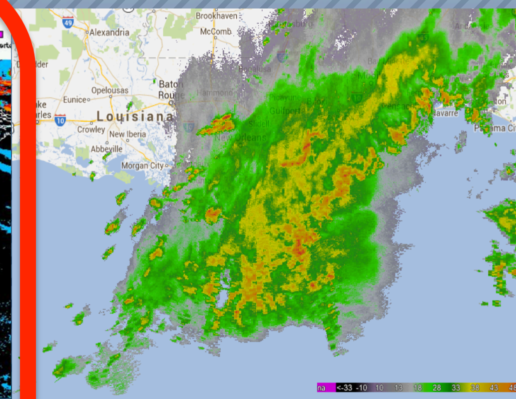
NOAA/CIMSS ProbSevere model

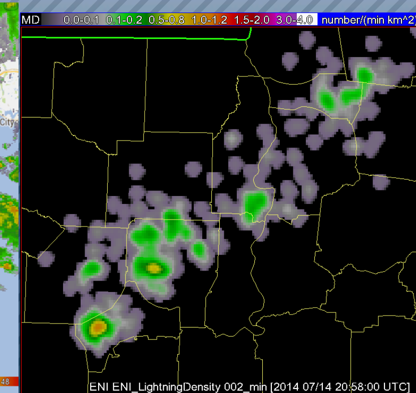
Images are from NOAA, NASA, or public domain

NOAA / CIMSS ProbSevere model









High-resolution NWP Data → storm environment

Satellite Imagery and Derived Products → evolution of cumulus to cumulonimbus

Radar Imagery and Derived Products → storm tracking and hydrometeor properties

Total Lightning → storm electrification

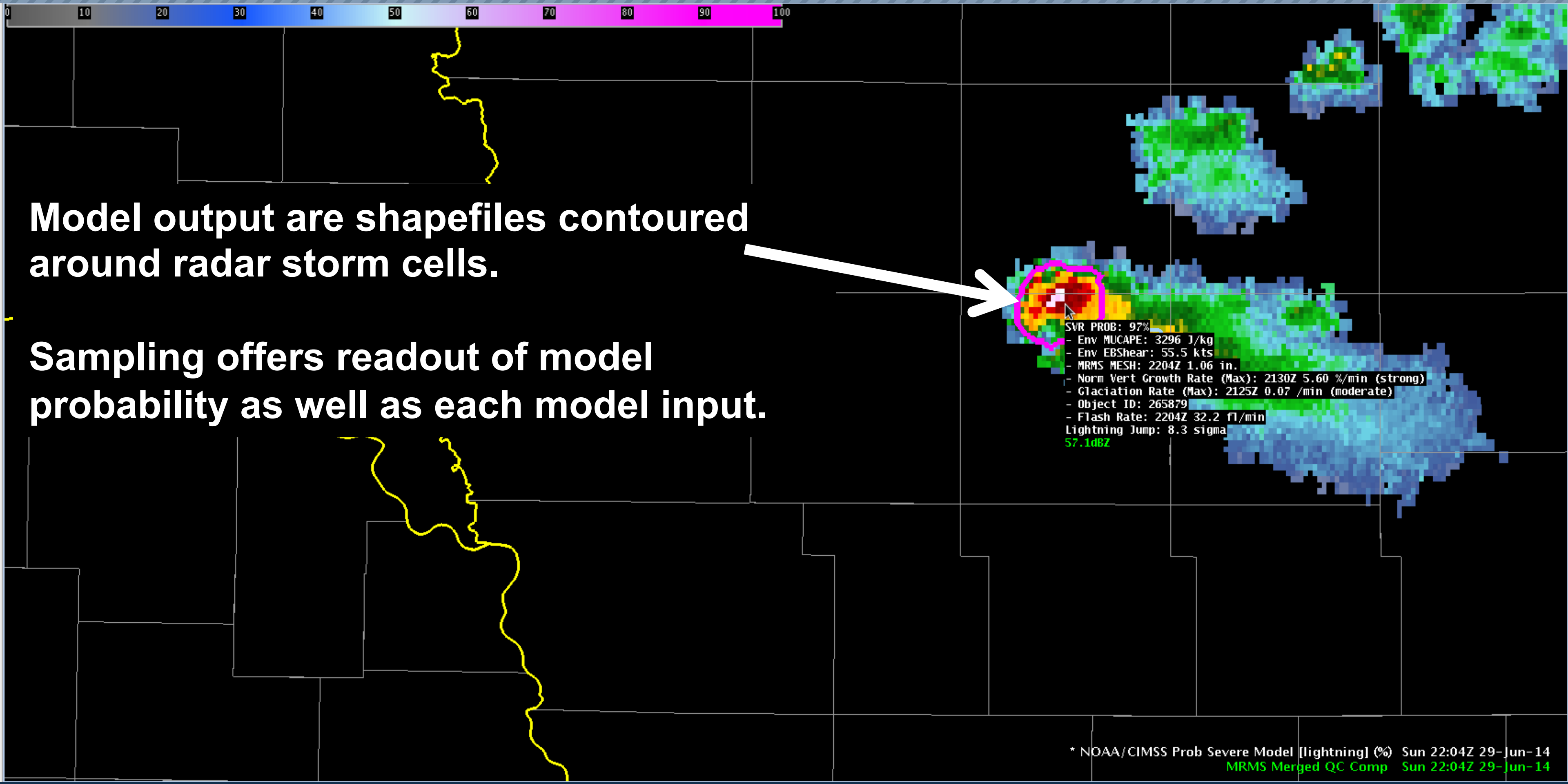
Probability a thunderstorm will produce severe weather in the future (up to 90 minutes)

Images are from NOAA, UW-CIMSS, and OU-CIMMS

ProbSevere model display

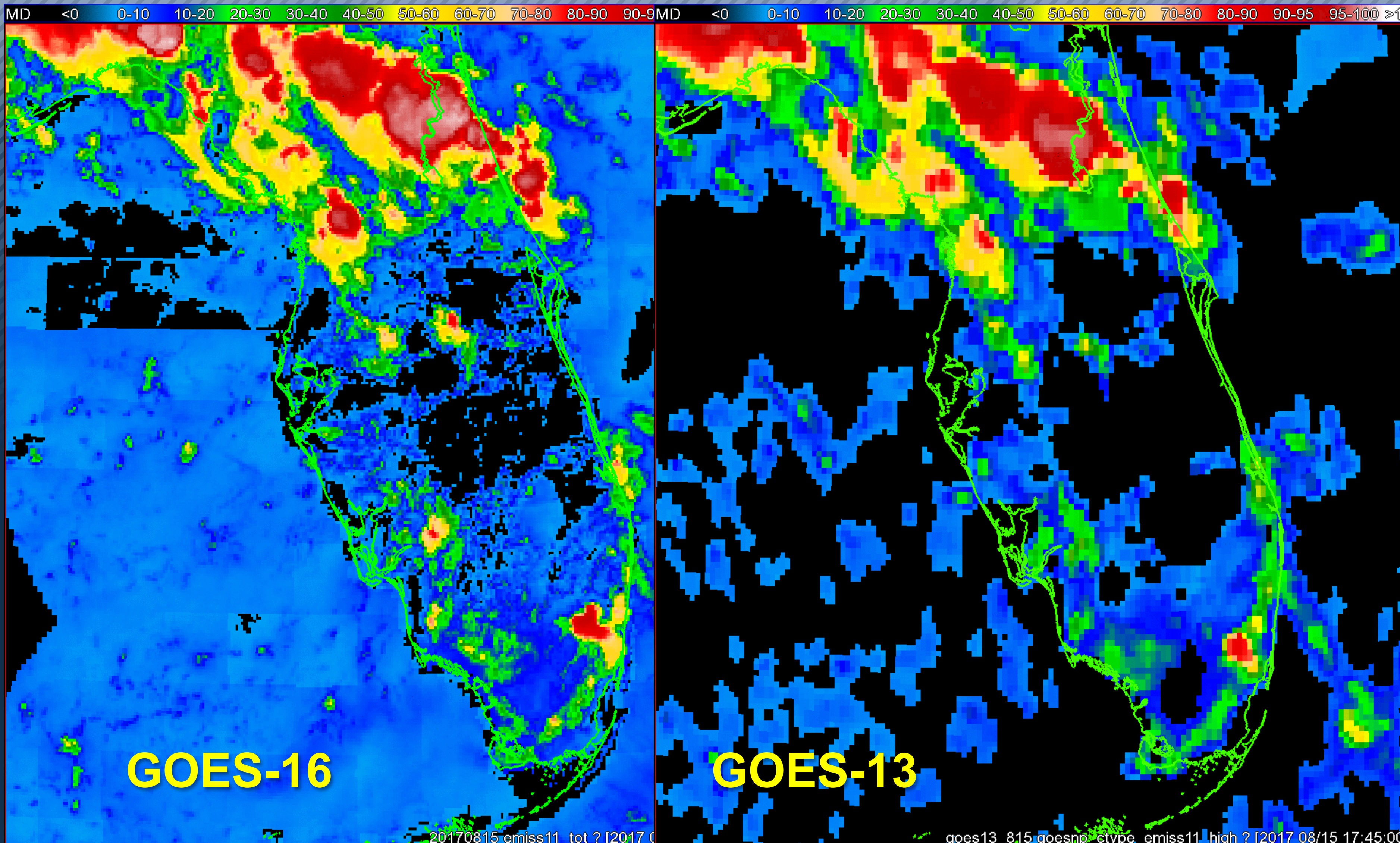
Model output are shapefiles contoured around radar storm cells.

Sampling offers readout of model probability as well as each model input.



11-μm top-of-troposphere emissivity (ε_{tot})

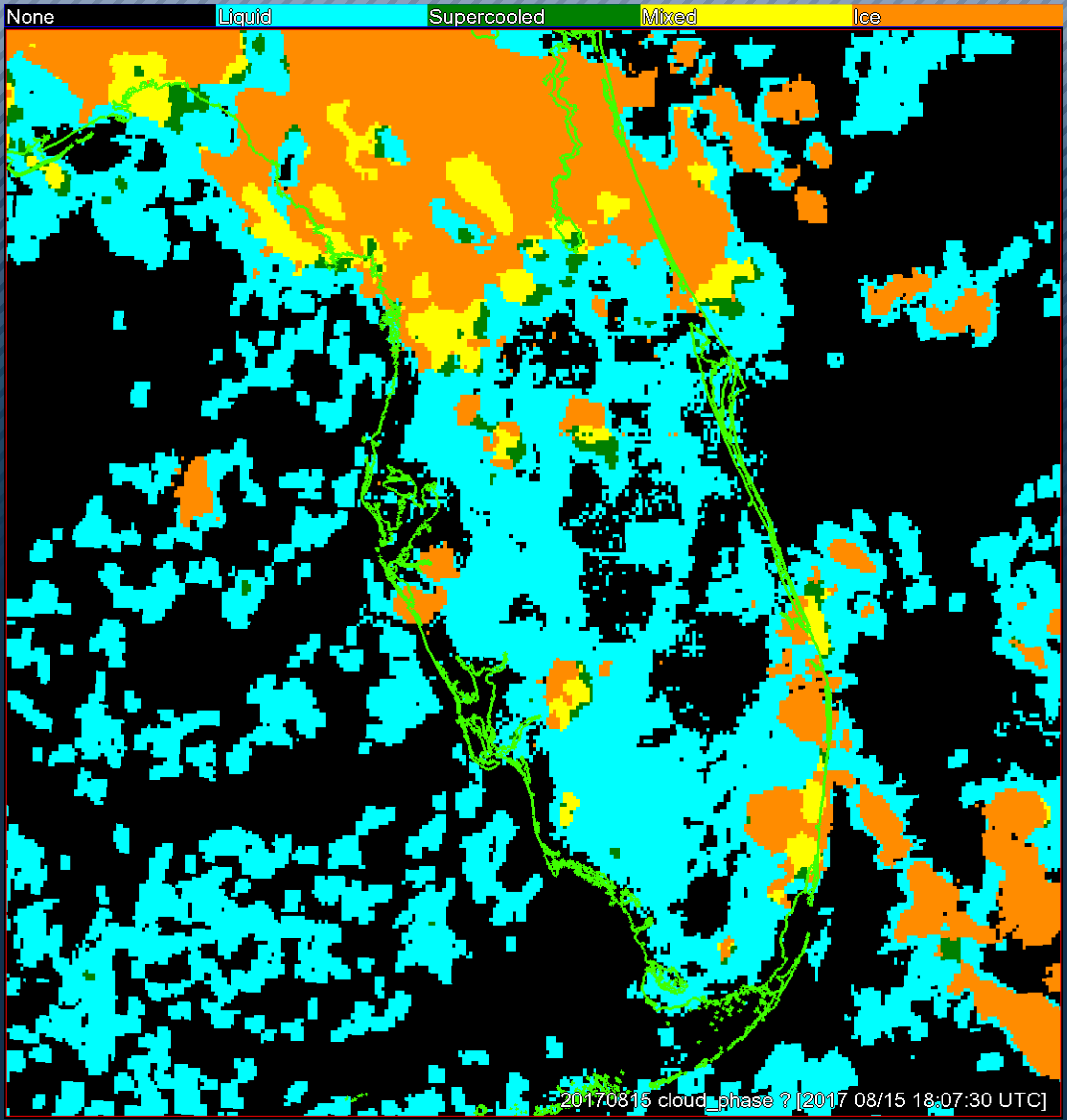
(Pavolonis 2010)



severe (Cintineo et al. 2013)

NOAA/CIMSS ProbSevere model

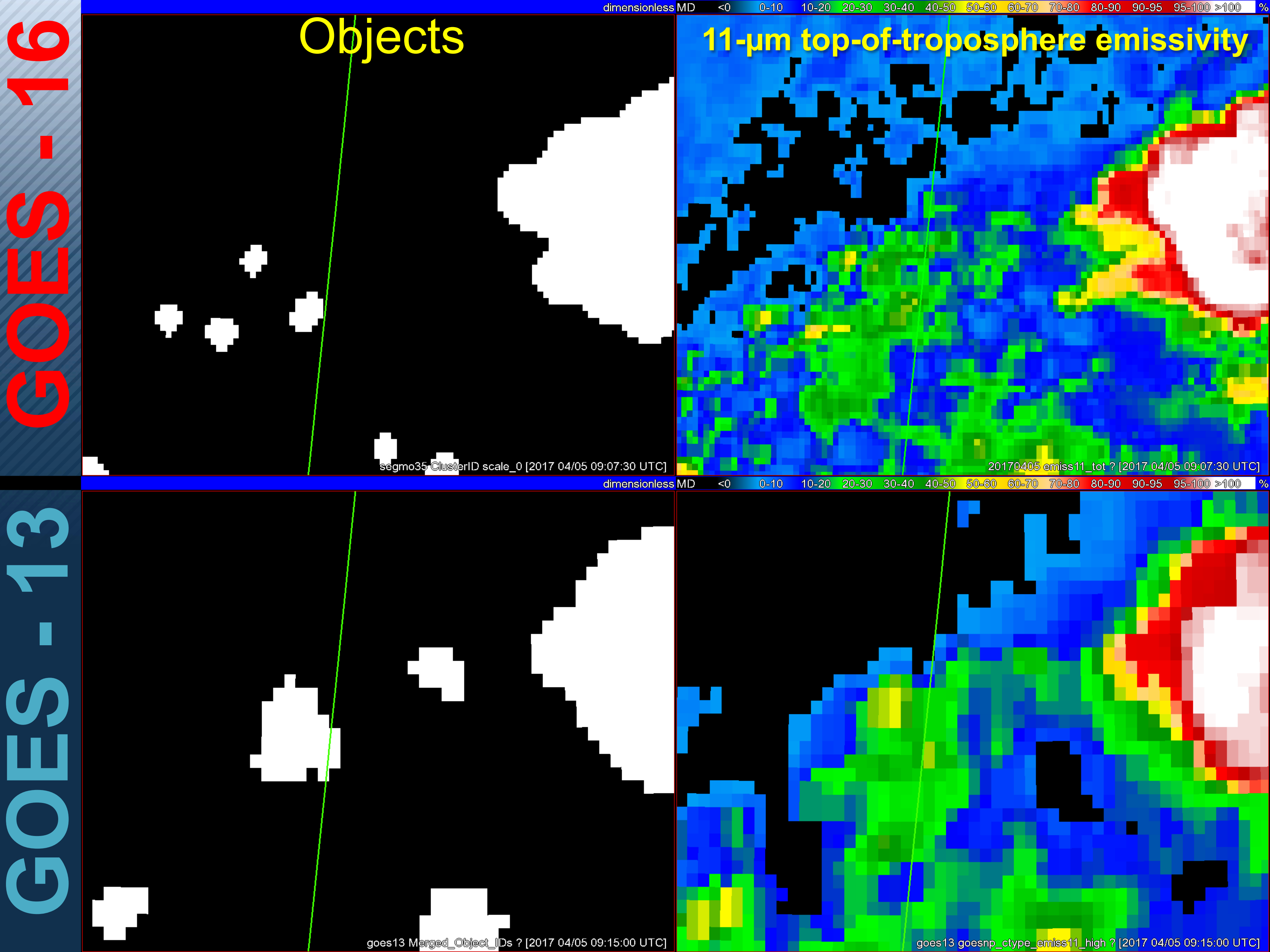
Cloud-top phase

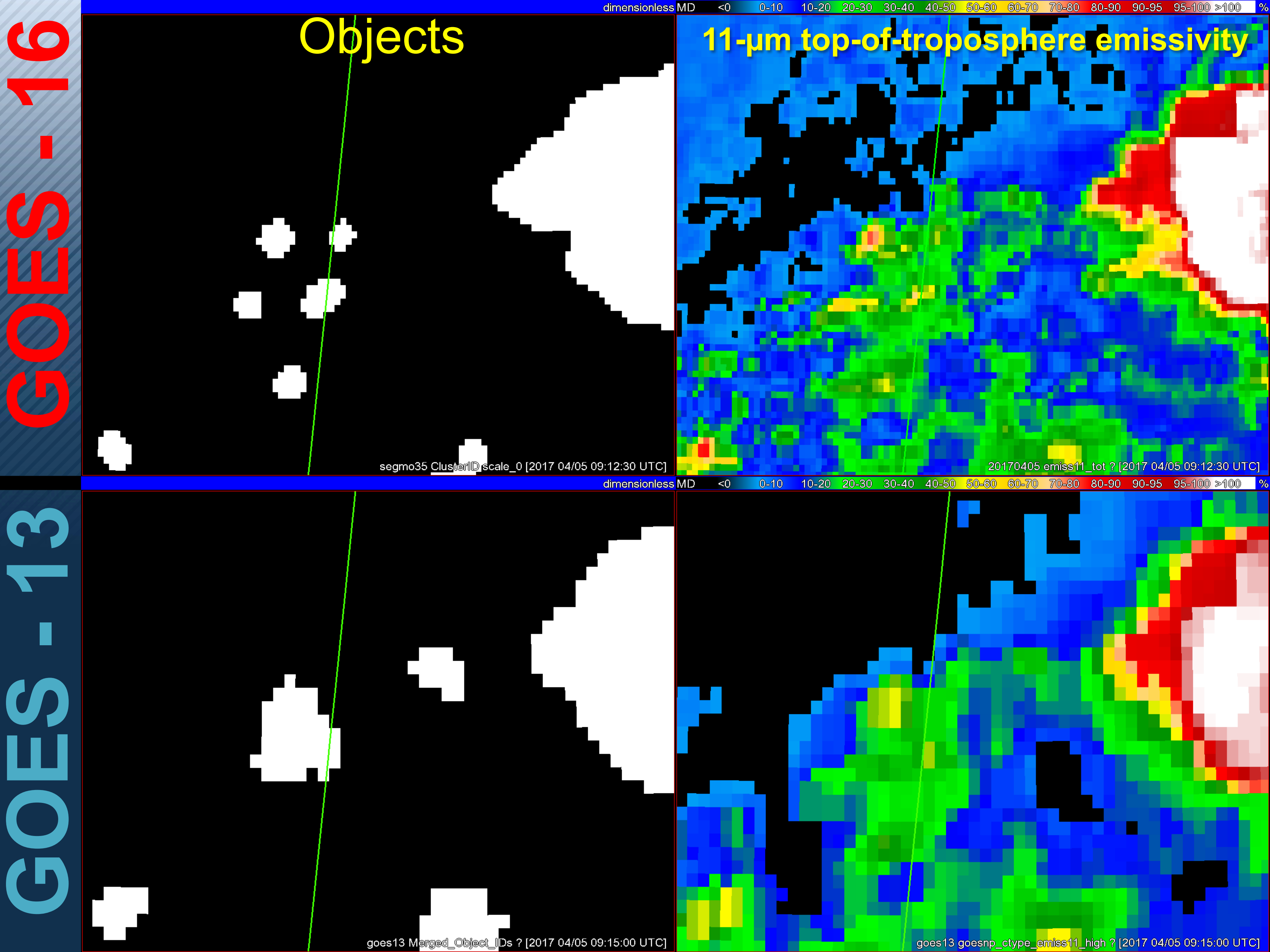


- Phase of water at top of cloud (warm liquid, supercooled, mixed phase, ice)
- Storms that convert from liquid → ice faster tend to be more severe (Cintineo et al. 2013)
- Infer updraft strength
- Predictor: maximum rate of change in cloud-top phase (Δ*ice*) in satellite cloud object
  - "Glaciation rate"

NOAA/CIMSS ProbSevere model

NOAA/CIMSS ProbSevere model


GOES - 16
GOES - 13
Objects
11-µm top-of-troposphere emissivity
dimensionless MD <0 0-10 10-20 20-30 30-40 40-50 50-60 60-70 70-80 80-90 90-95 95-100 >100 %
segmo35 ClusterID scale_0 [2017 04/05 09:07:30 UTC]
20170405 emiss11_tot ? [2017 04/05 09:07:30 UTC]
goes13 Merged_Object_IDs ? [2017 04/05 09:15:00 UTC]
goes13 goesnp_ctype_emiss11_high ? [2017 04/05 09:15:00 UTC]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segmo35 ClusterID scale_0 [2017 04/05 09:12:30 UTC]
20170405 emiss11_tot ? [2017 04/05 09:12:30 UTC]
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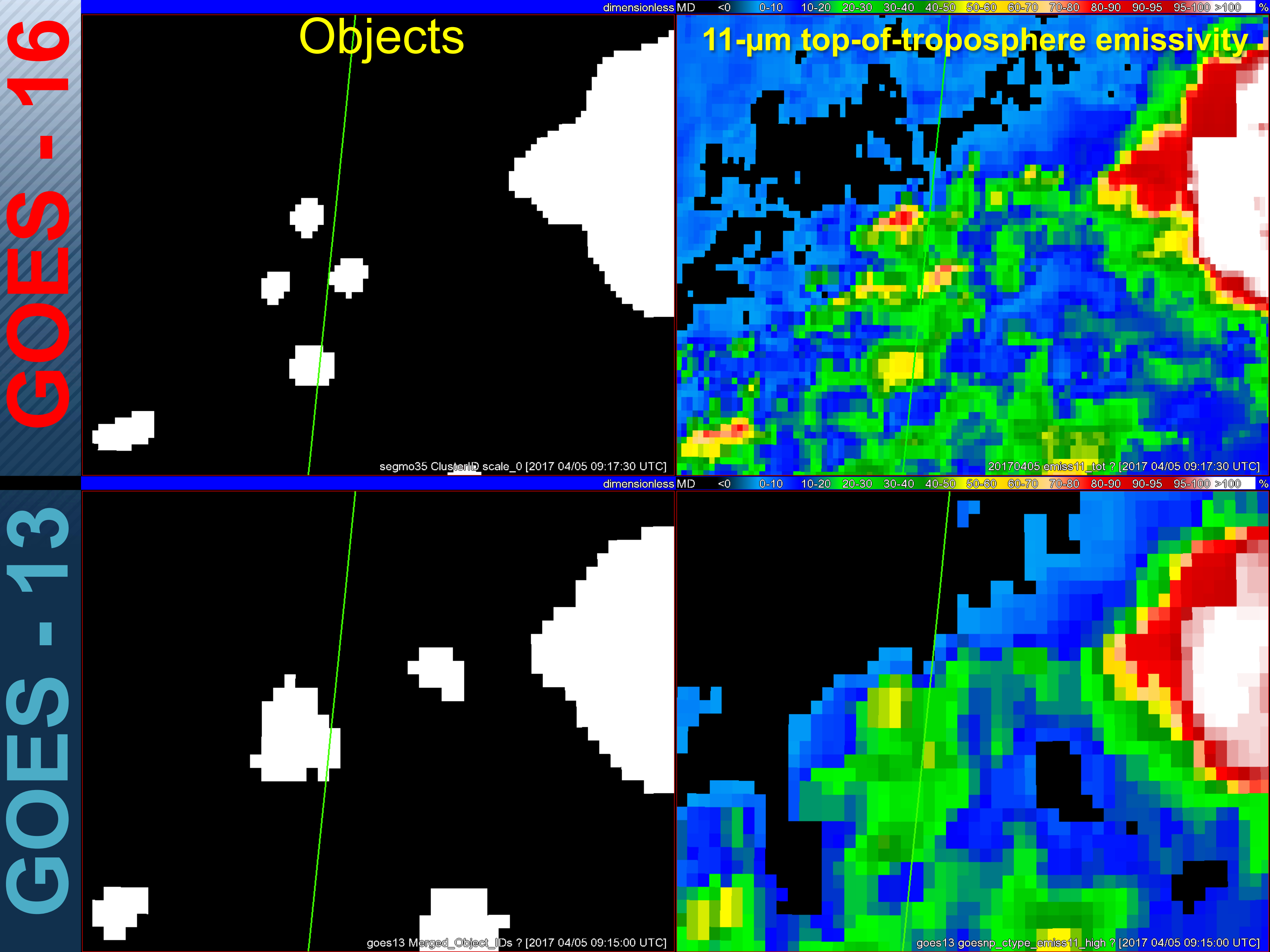
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20170405 emiss11_tot ? [2017 04/05 09:17:30 UTC]
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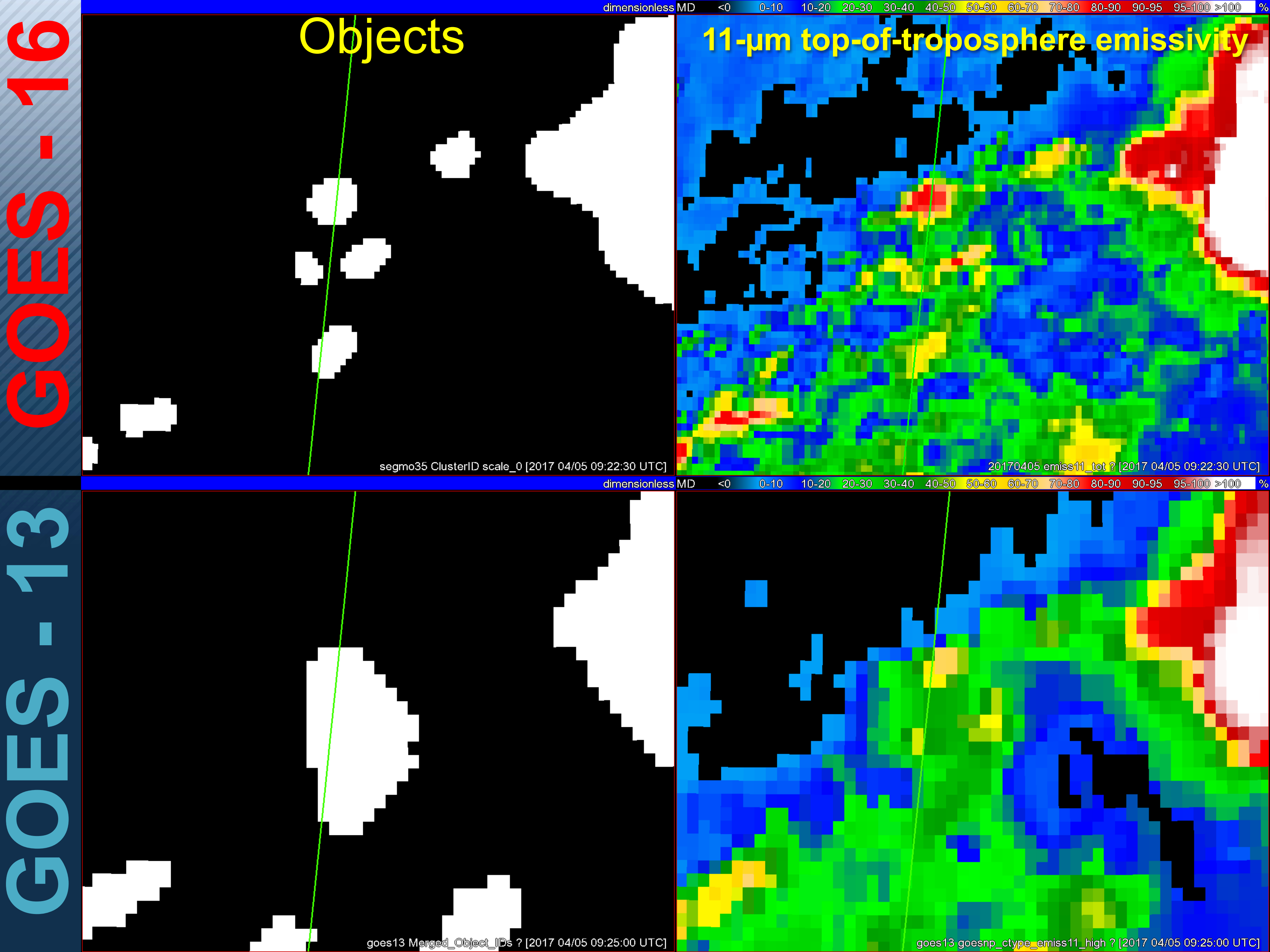

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20170405 emiss11_tot ? [2017 04/05 09:22:30 UTC]
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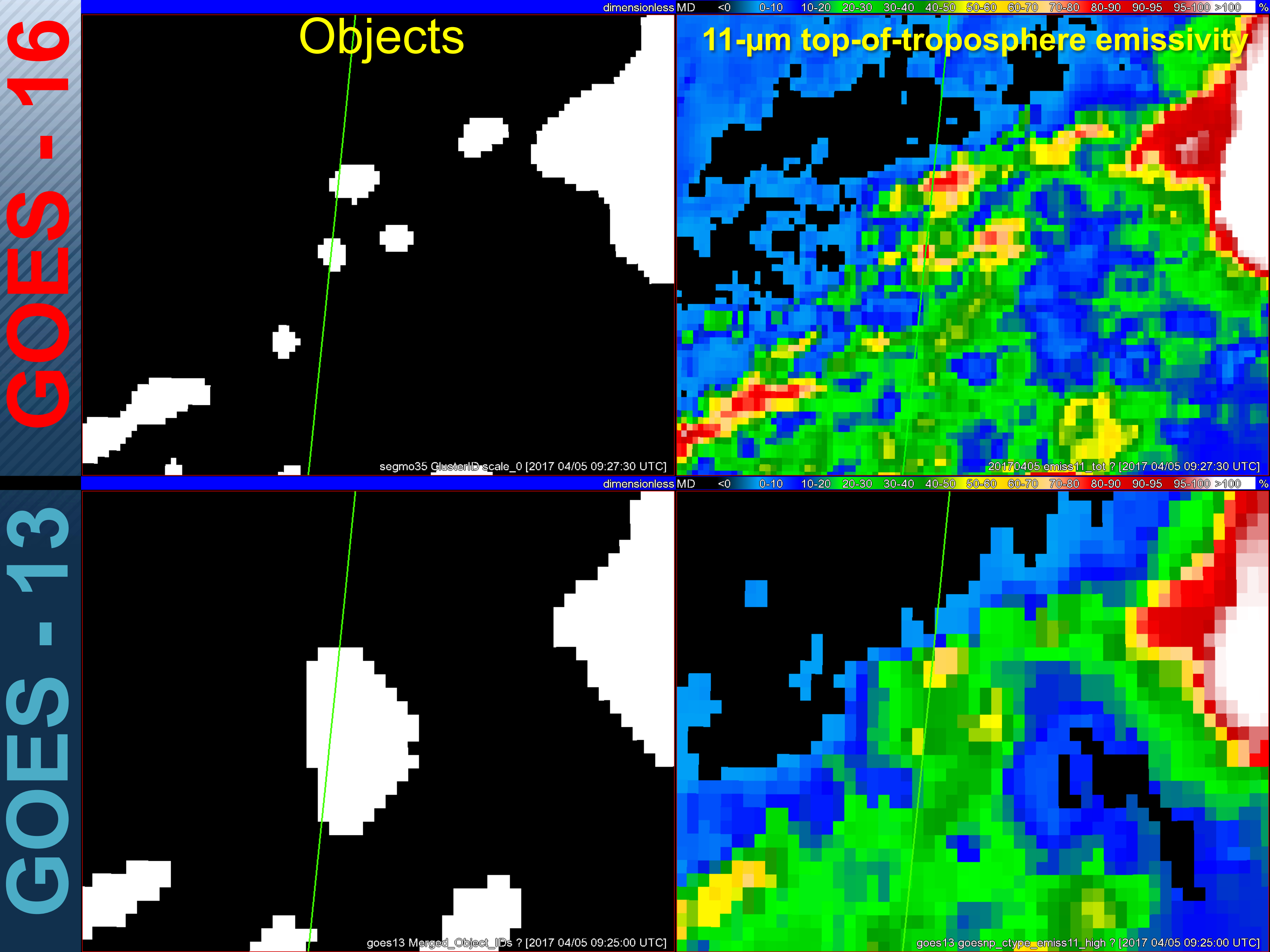

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segmo35 ClusterID scale_0 [2017 04/05 09:27:30 UTC]
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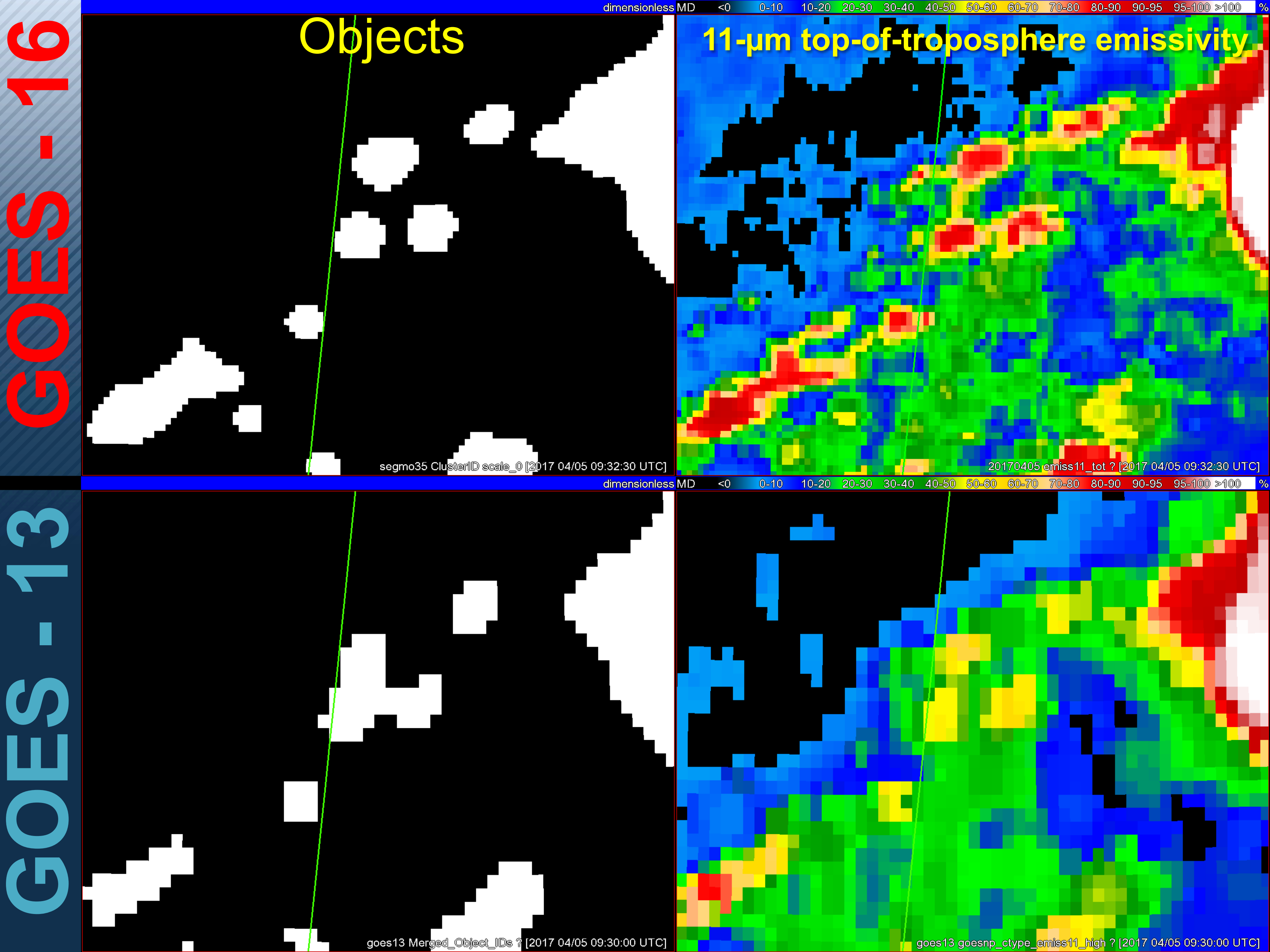
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Objects
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segmo35 ClusterID scale_0 [2017 04/05 09:32:30 UTC]
20170405 emiss11_tot ? [2017 04/05 09:32:30 UTC]
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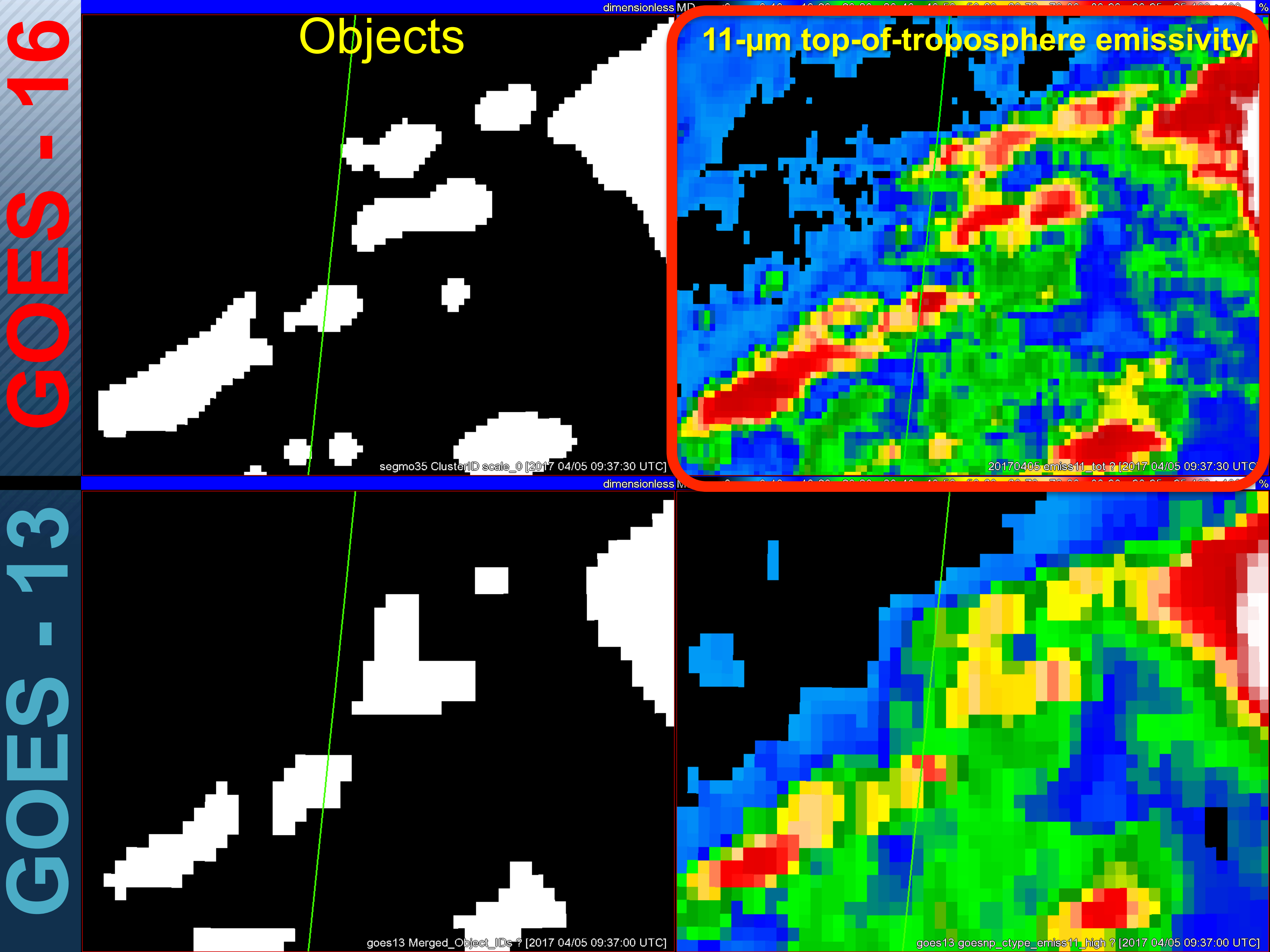
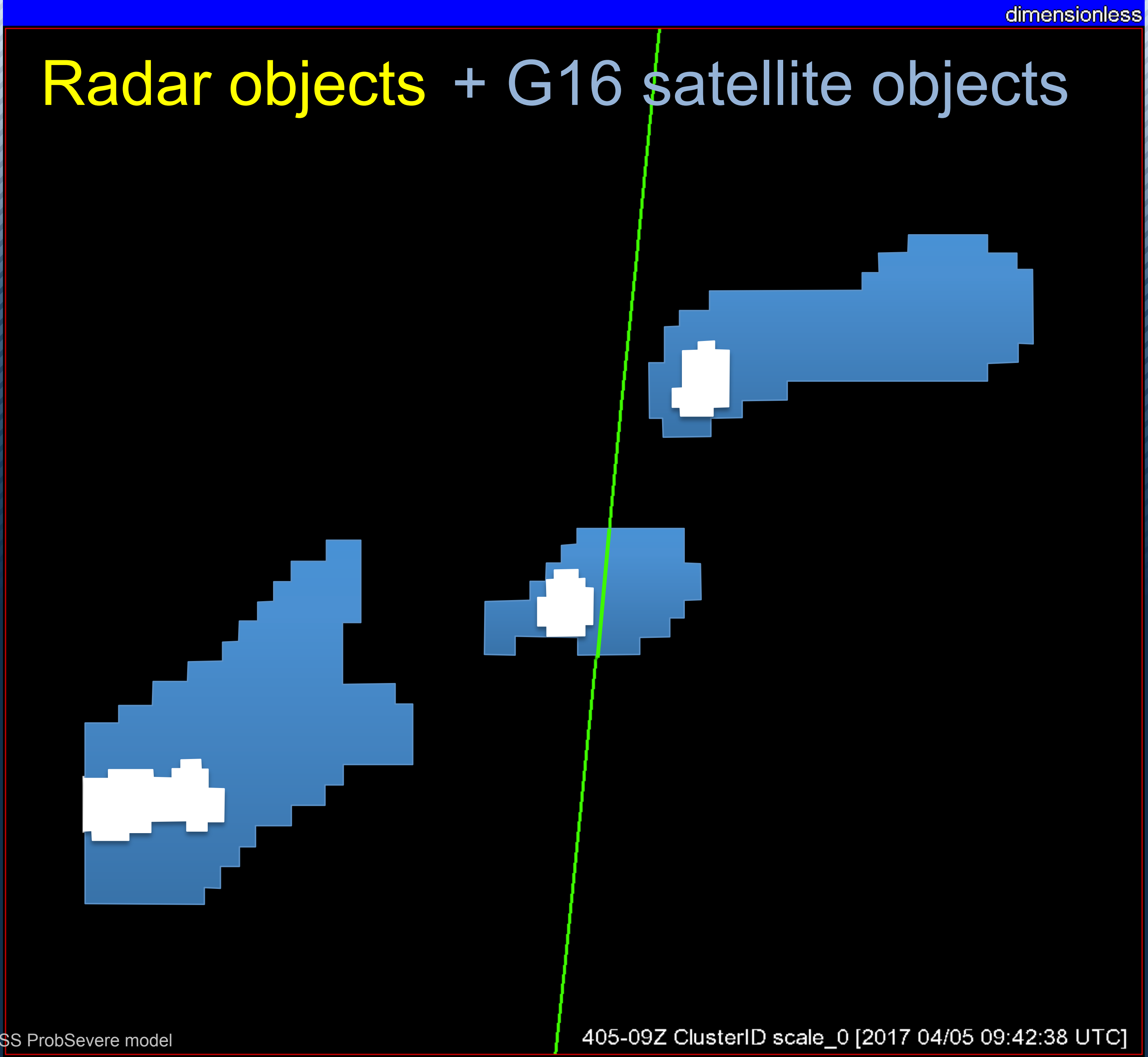
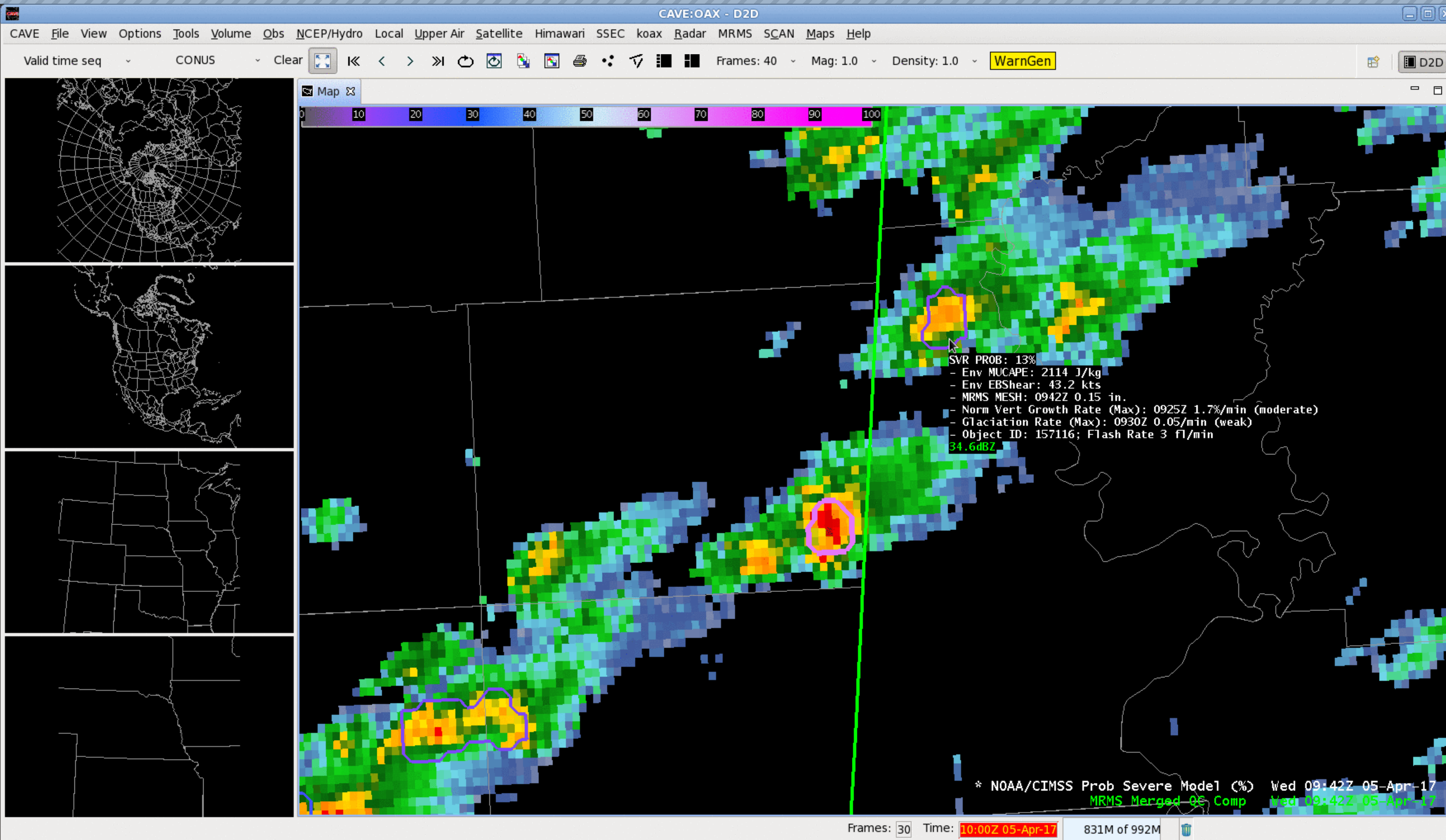

GOES-16
GOES-13
Objects
11-µm top-of-troposphere emissivity
dimensionless
segmo35 ClusterID scale_0 [2017 04/05 09:37:30 UTC]
20170405 emiss11_tot ? [2017 04/05 09:37:30 UTC
goes13 Merged_Object_IDs ? [2017 04/05 09:37:00 UTC]
goes13 goesnp_ctype_emiss11_high ? [2017 04/05 09:37:00 UTC]

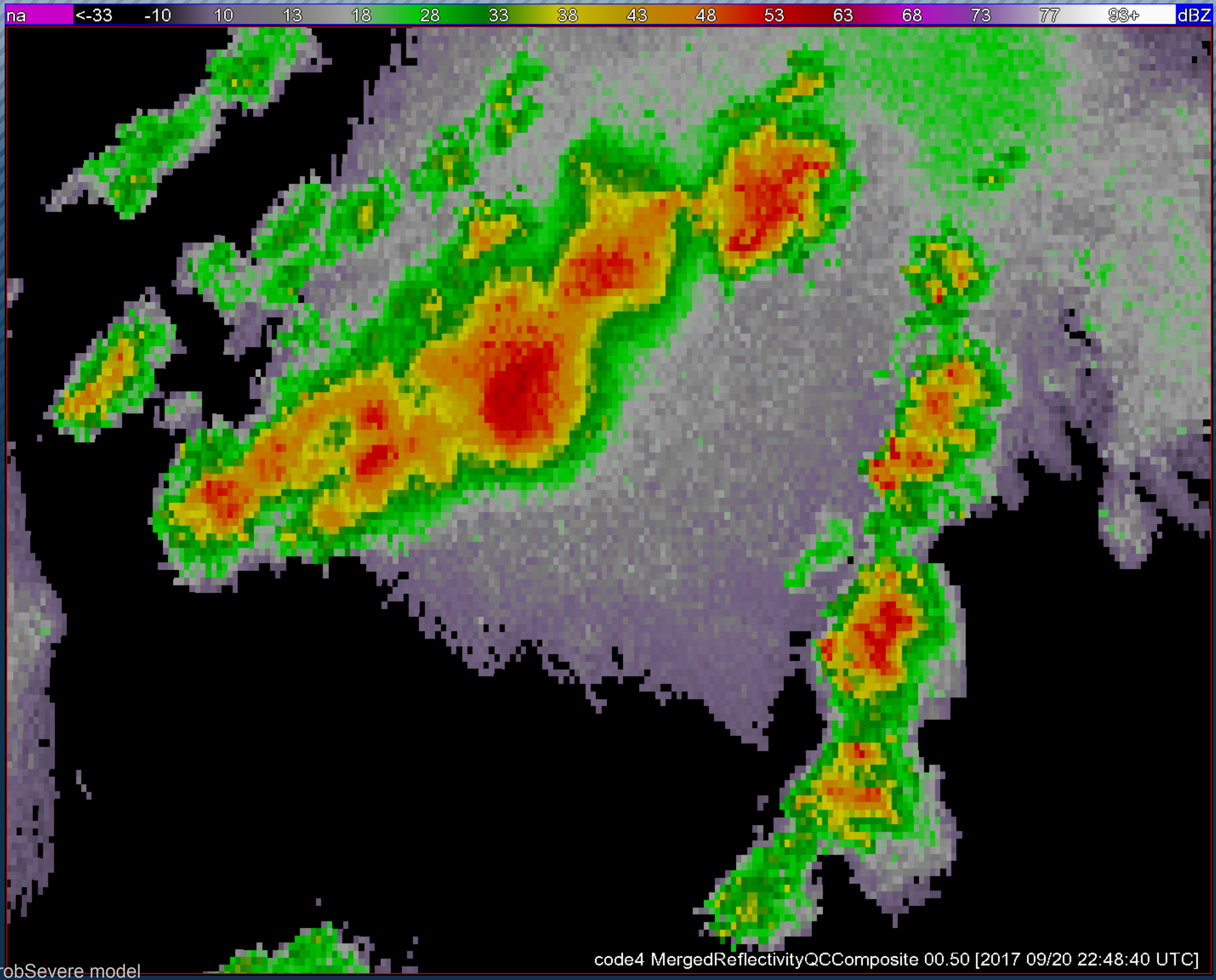


NOAA/CIMSS ProbSevere model



NOAA/CIMSS ProbSevere model

Geostationary Lightning Mapper (GLM) integration



NOAA/CIMSS ProbSevere model

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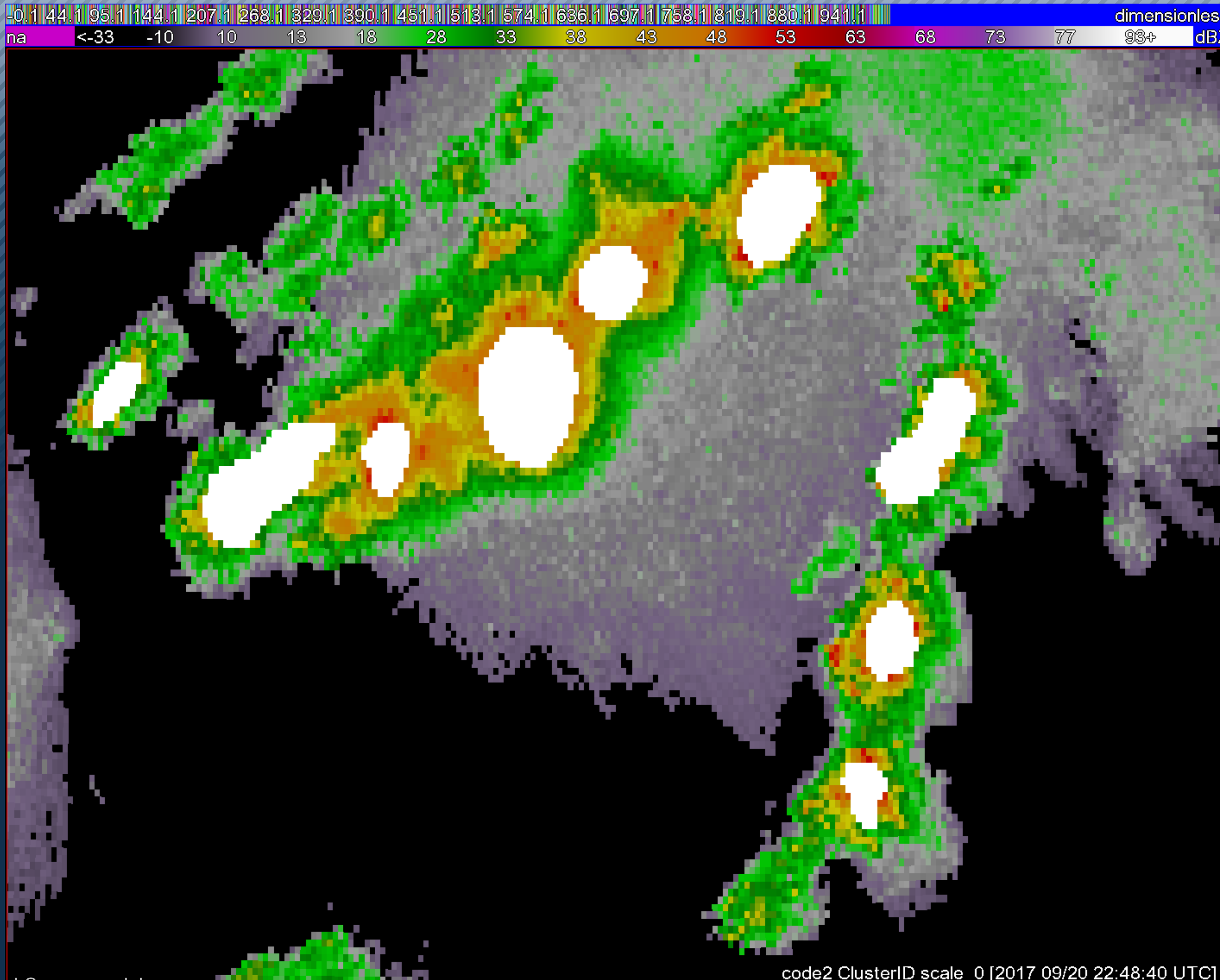


NOAA/CIMSS ProbSevere model

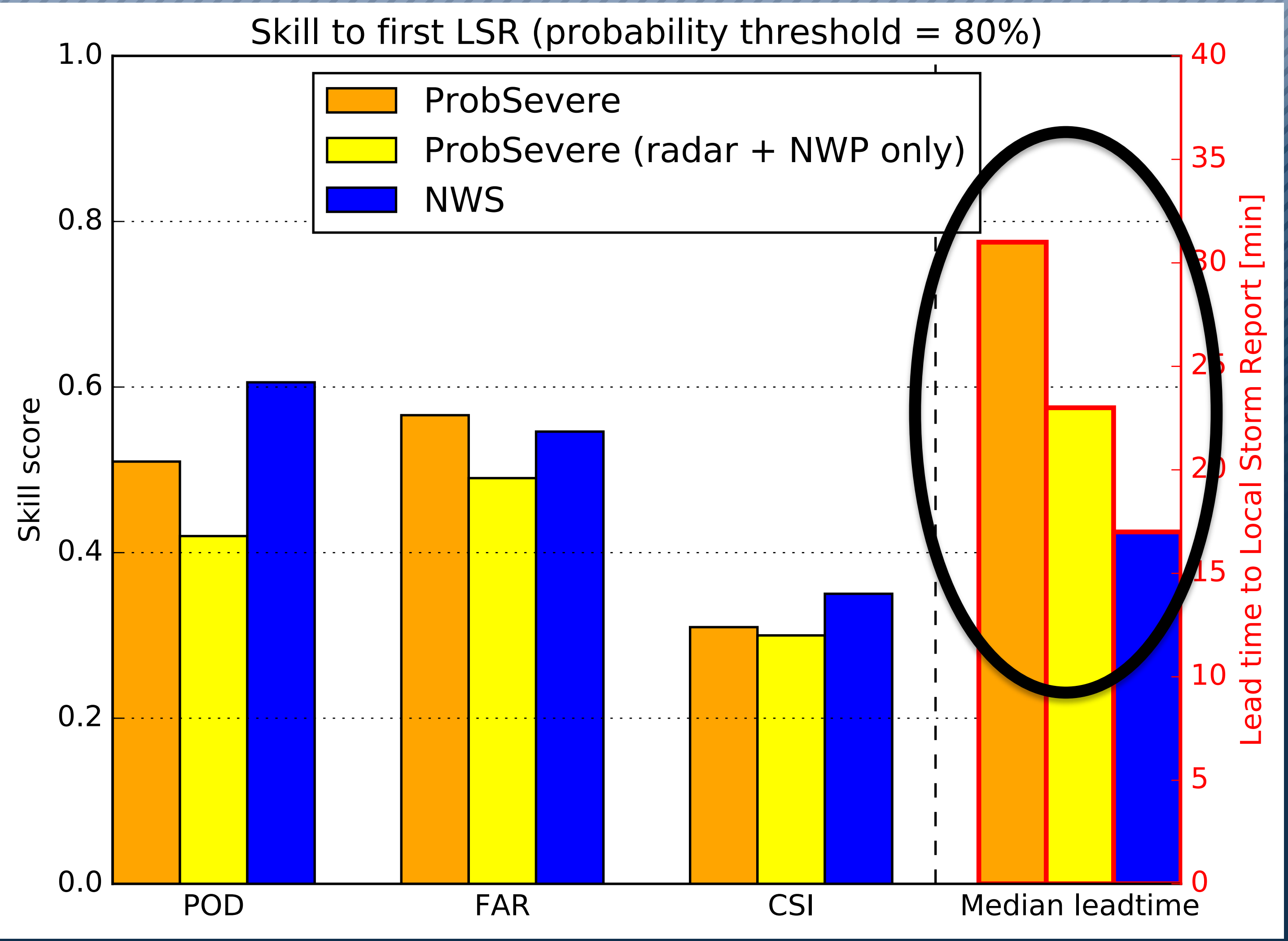
Geostationary Lightning Mapper (GLM) integration

NOAA/CIMSS ProbSevere model

Geostationary Lightning Mapper (GLM) integration

NOAA/CIMSS ProbSevere model

ProbSevere skill
– for storms with satellite growth –

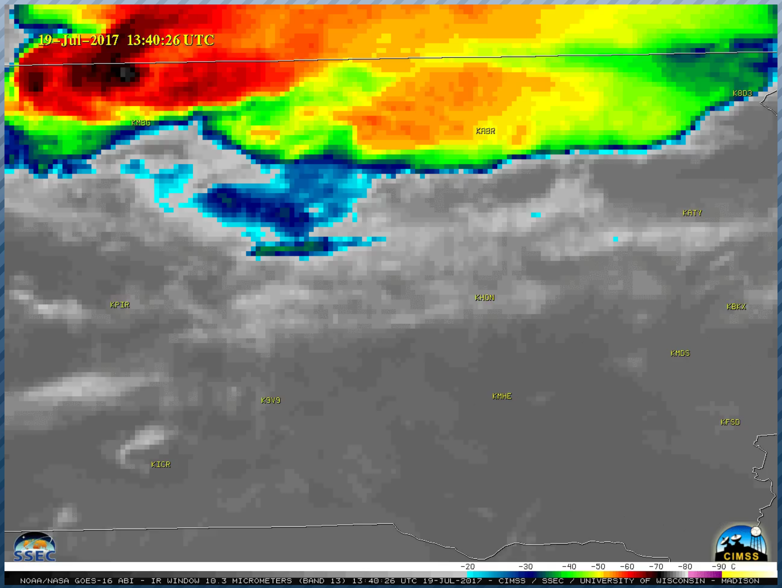


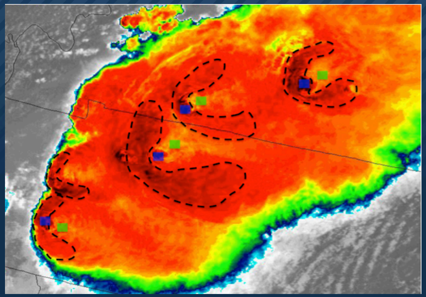
Using GOES 13/15 and ground-based lightning network (Earth Networks[SM])

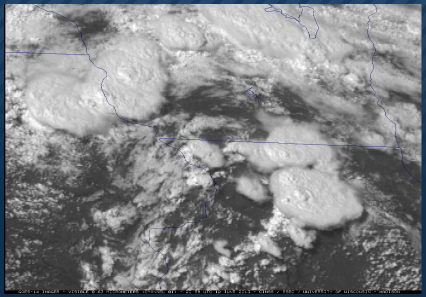
NOAA/CIMSS ProbSevere model

Future Research

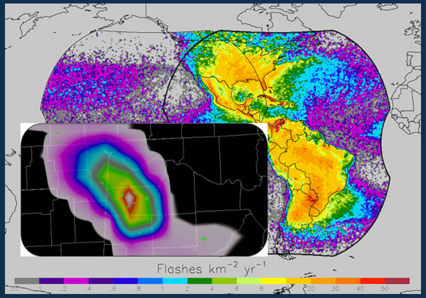
- Quantitatively assess G16 growth rates (relative to GOES-1[3-5])
- Super-rapid scan growth rates ($\Delta t \leq 1$ min)
- Cb storm-top properties







- Total lightning + satellite imager + NWP only product



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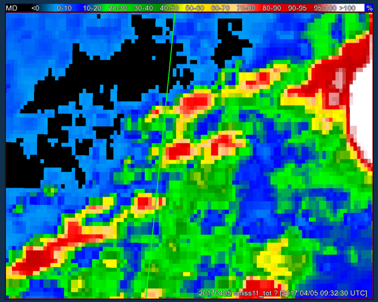

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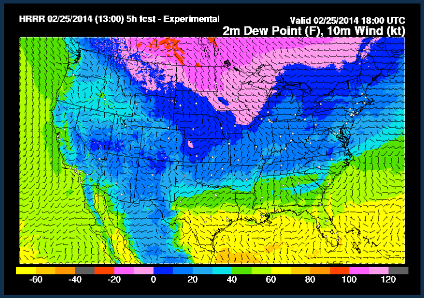


NOAA/CIMSS ProbSevere model

Images are from NOAA, NASA, and UW-CIMSS

Take Away Points

- "Big Data" era requires mining pertinent information from numerous sources into environmental intelligence
- Temporal trends in derived satellite fields help inform severity and add lead time to severe convective hazards
- Qualitatively, GOES-16 improves satellite identification/tracking and storm severity prediction (over GOES-1[3-5])
  - Working now to measure improvement quantitatively
- Working toward GLM total lightning integration
- Future work will explore a strong/severe thunderstorm product in the absence of radar data

ADDITIONAL RESOURCES

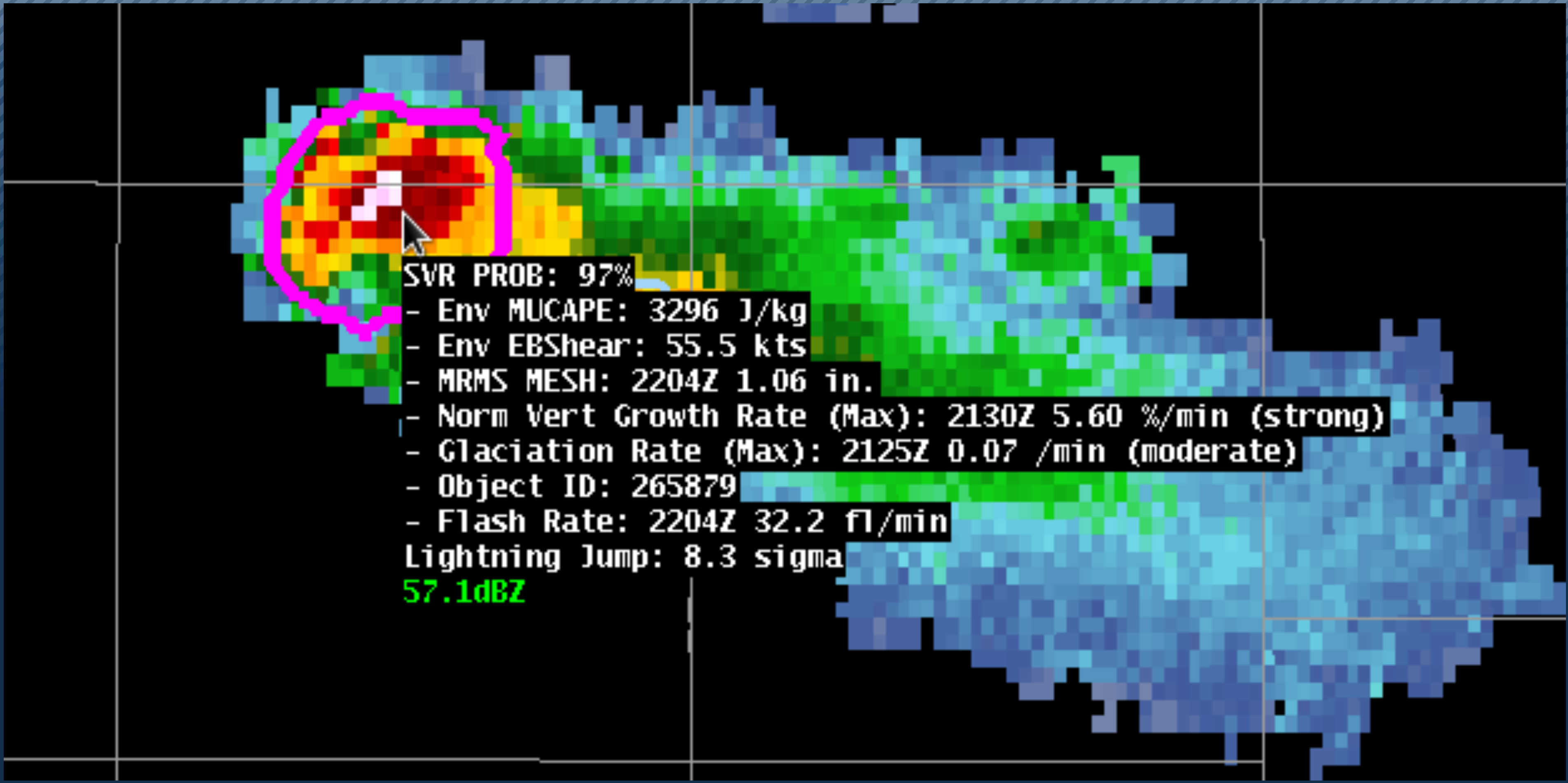
- **Mike Pavolonis (michael.pavolonis@noaa.gov)**
- **John Cintineo (john.cintineo@ssec.wisc.edu)**
- **Justin Sieglaff (justin.sieglaff@ssec.wisc.edu)**
- **Dan Lindsey (dan.lindsey@noaa.gov)**

ProbSevere training module and supplemental training material:
http://cimss.ssec.wisc.edu/severe_conv/training/training.html
See ProbSevere blog posts:
http://goesrhwt.blogspot.com/search/label/ProbSevere
Real-time ProbSevere on the web:
http://cimss.ssec.wisc.edu/severe_conv/probsev.html

References:

- Cintineo, J. L., M. J. Pavolonis, J. M. Sieglaff, D. T. Lindsey, L. Cronce, J. Gerth, B. Rodenkirch, J. Brunner, and C. Gravelle, 2017: The NOAA/CIMSS ProbSevere Model - incorporation of total lightning and validation. *Wea. Forecasting*, in review
- Cintineo, J. L., M. J. Pavolonis, J. M. Sieglaff, and D. T. Lindsey, 2014: An empirical model for assessing the severe weather potential of developing convection. Weather and Forecasting, 29 (3), 639–653.
- Cintineo, J. L., M. J. Pavolonis, J. M. Sieglaff, and A. K. Heidinger, 2013: Evolution of severe and nonsevere convection inferred from GOES-derived cloud properties. Journal of Applied Meteorology and Climatology, 52 (9), 2009–2023.
- Pavolonis, M. J., 2010: Advances in Extracting Cloud Composition Information from Spaceborne Infrared Radiances-A Robust Alternative to Brightness Temperatures. Part I: Theory. Journal of Applied Meteorology and Climatology, 49, 1992-2012, doi: 10.1175/2010JAMC2433.1 ER.

Questions?



SVR PROB: 97%
- Env MUCAPE: 3296 J/kg
- Env EBShear: 55.5 kts
- MRMS MESH: 2204Z 1.06 in.
- Norm Vert Growth Rate (Max): 2130Z 5.60 %/min (strong)
- Glaciation Rate (Max): 2125Z 0.07 /min (moderate)
- Object ID: 265879
- Flash Rate: 2204Z 32.2 fl/min
Lightning Jump: 8.3 sigma
57.1dBZ

Extra slides

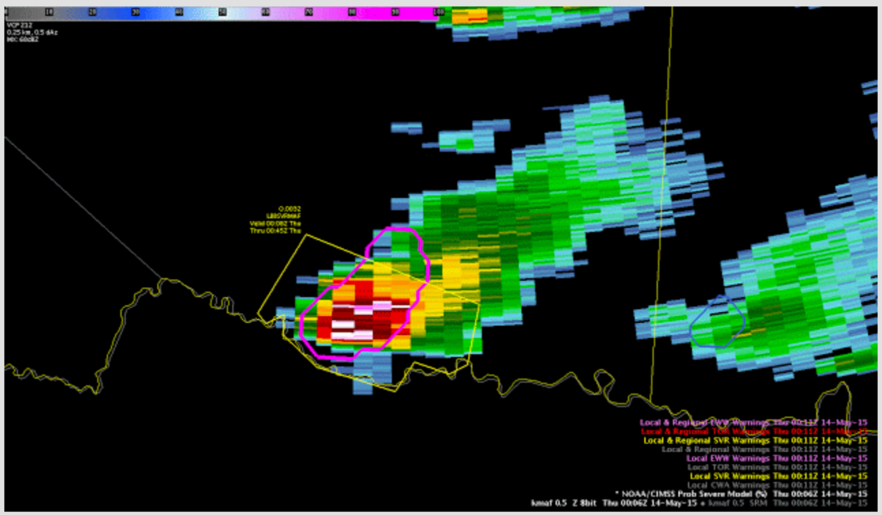
Feedback at the NOAA Hazardous Weather Testbed (HWT)

http://goesrhwt.blogspot.com/search?q=ProbSevere

Wednesday, May 13, 2015

ProbSevere in Warning Decision Making…Part 2

Here is another example where ProbSevere rapidly increased form 18% to 94% (click image to animate):

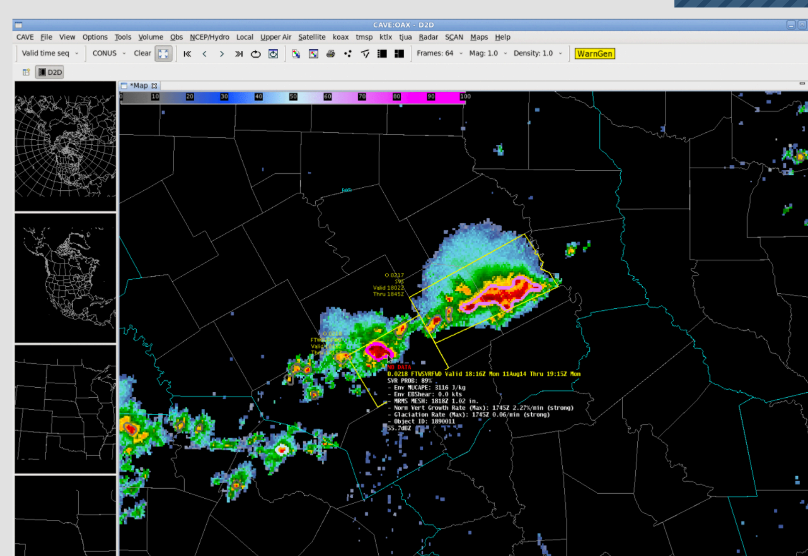


"The normalized vertical growth rate and the glaciation rate were both strong. In this case, I was confident enough to use the ProbSevere by itself to issue a severe thunderstorm warning."

http://goesrhwt.blogspot.com/2015/05/probsevere-in-warning-decision.html

Monday, August 11, 2014

Satellite growth rate utility in ProbSevere



"These examples show how temporal trends in satellite-derived fields can help signal severe potential in slowly developing and more rapidly developing convection."

http://goesrhwt.blogspot.com/2014/08/satellite-growth-rate-utility-in.html