1. Title Slide

Title: Convective Initiation and 0-6 hr Storm Nowcasting for GOES-R

Authors and Affiliations

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Topics: Severe Weather and Lightning

Program: GOES-R3

2. Introduction

- Information and techniques learned from the creation of an improved GOES-R CI algorithm can be transferred into improved strategies for direct assimilation of current and future satellite datasets (that describe the CI process related to physical processes within cumulus clouds), leading to increased accuracy in NWP of the onset of new convective storms.

- The assimilation of the raw infrared satellite-based observed cloud-top cooling rate and other multi-spectral fields into rapid-update NWP models such as the Rapid Refresh (RAP) and eventually the High Resolution Rapid Refresh (HRRR) will provide the NWP models with a better description of initiating convective storms, leading to beneficial improvements to short- (0-6 hrs) and subsequently longer-range mesoscale forecasts (6-24 hrs).

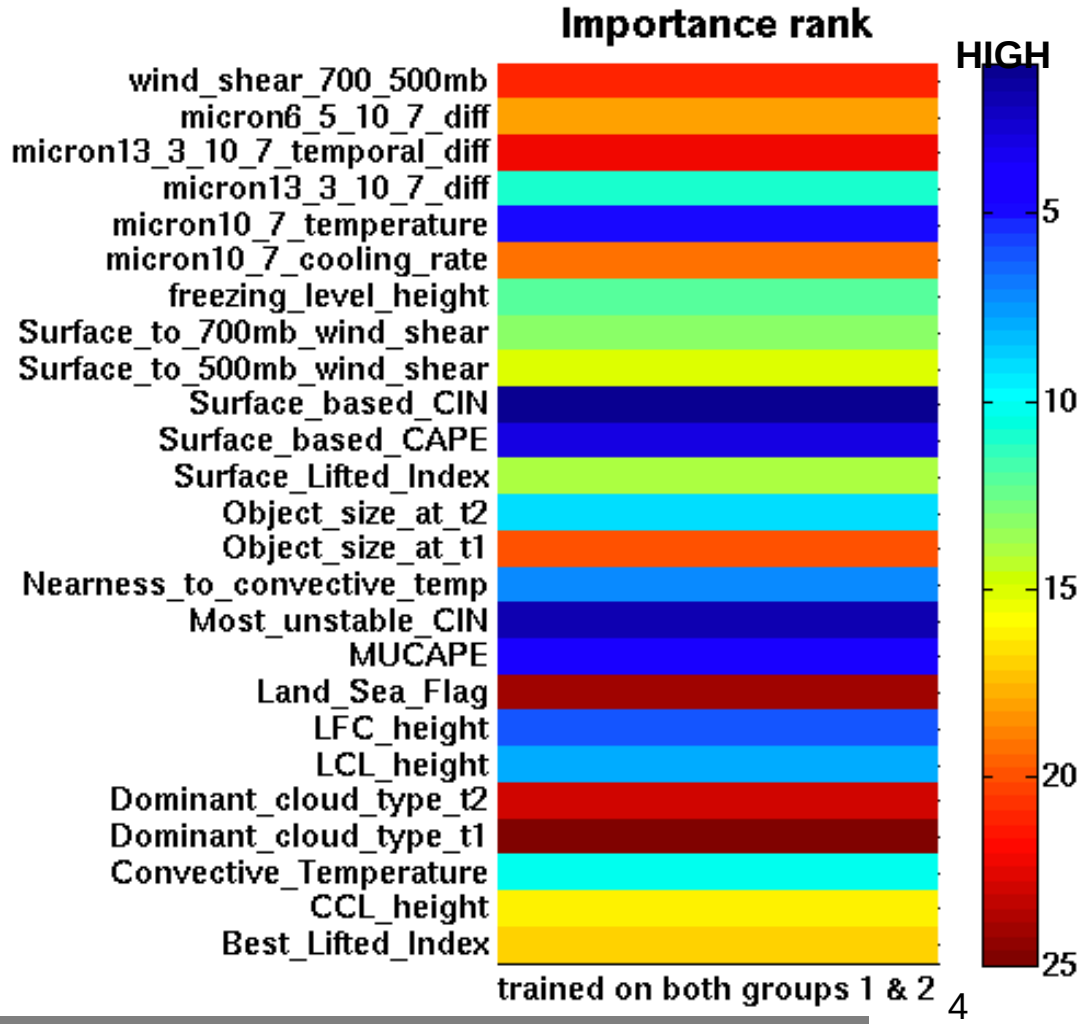
3. Methodology/Expected Outcomes

- Toward improving the 0-6 hour CI and convective storm forecasts provided by the rapid update NWP models, this project will focus on two themes over three years:
  - Data assimilation activities involving the use of AWG CI indicators and Cloud Properties as input into the RAP and HRRR models to more accurately initiate CI events, and
  - Maintenance and enhancement of a coupled NWP-GOES-R CI algorithm at UAHuntsville as a means for continued support of a real-time data feed to ESRL for assimilation of CI nowcast output into the aforementioned short-term prediction NWP models.
  - Enhancement of the GOES-R CI Nowcast algorithm using GOES-R DMV Winds (for object tracking) and GOES-R Cloud Properties (for enhanced CI detection at night and beneath thin cirrus clouds).

4. Results

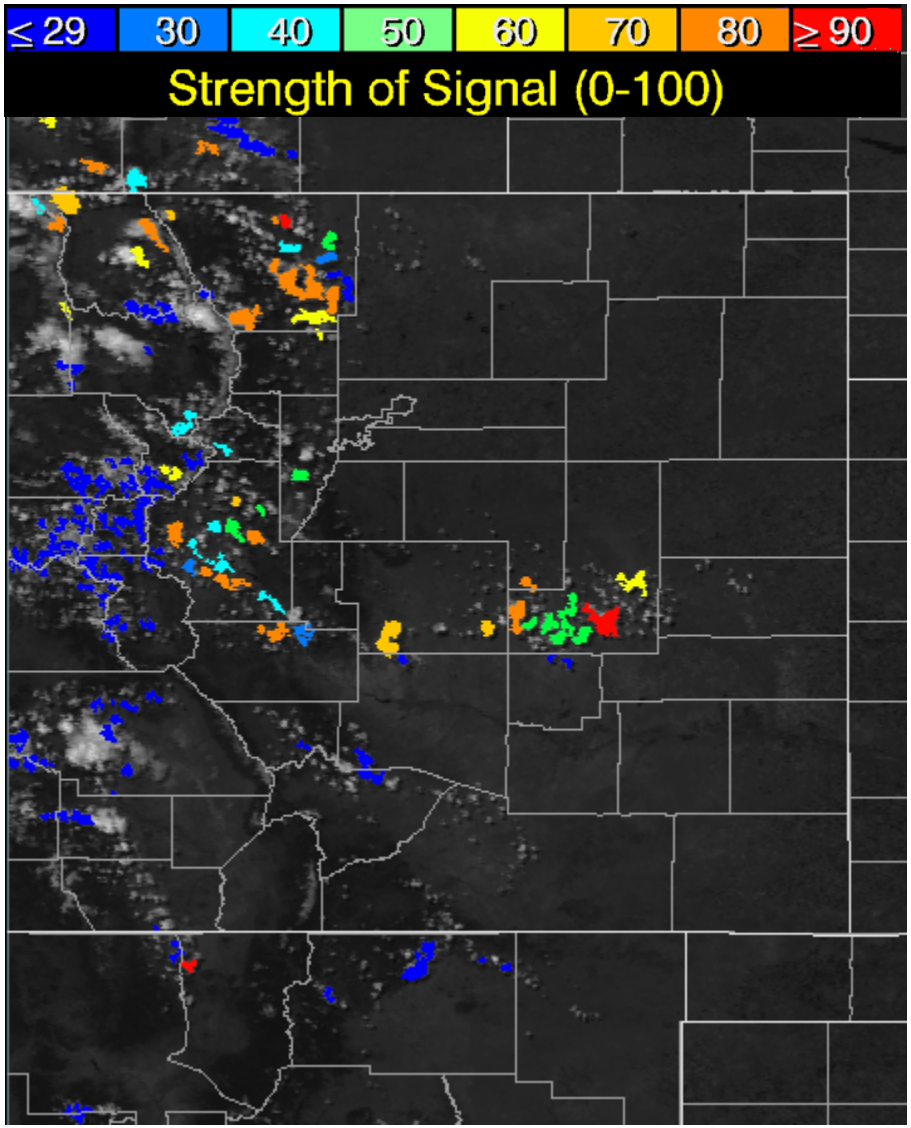
Establish importance ranking for ~20 NWP variables together with GOES data for nowcasting convective initiation (first-time occurrence of a ≥35 dBZ echo)

3.6 Surface CIN
3.3 Most unstable CIN
3.3 Surface CAPE
3.2 Most unstable CAPE
3.0 10.7 µm temp
2.7 LFC height
2.4 Nearness to convective temp
2.4 LCL height
2.3 Object size at time 2
2.3 Convective Temperature
2.2 13.3-10.7 µm difference
2.1 Freezing level height
2.0 Surface to 700 mb wind shear
2.0 Surface Lifted Index
2.0 Surface to 500 mb wind shear
2.0 CCL height
1.8 Best Lifted Index
1.7 6.5-10.7 µm
1.6 10.7 µm cooling rate
1.3 Object size at time 1
1.0 Wind shear 700-500 mb
1.0 Time change 13.3-10.7
0.9 Dominant cloud type at time 2
0.4 Land/Sea Flag
0.4 Dominant cloud type at time 1

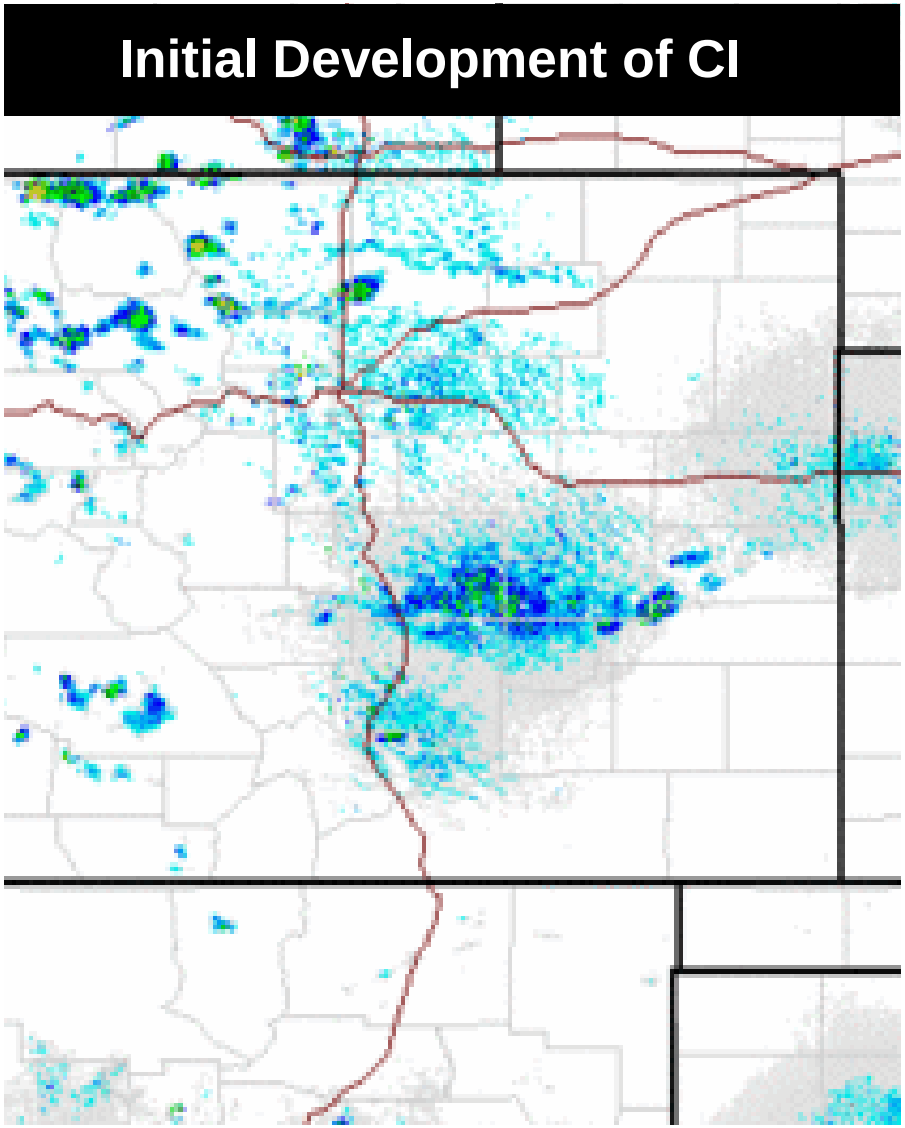


Apply in a Logistical Regression Framework

View of GOES-R CI (Colorado)



Output from
04/24/2012 1715 UTC



Radar Valid
04/24/2012 1808 UTC

Use of GOES Cloud Properties in CI Nowcasting

Initial τ	01–10	11–20	21–30	31–40	41–50	>50
Events:	89	63	37	15	11	33
Reflectance (ρ)	0.38	0.62	0.73	0.77	0.79	0.89
T_B	261.6	244.3	232.8	236.7	239.0	232.1
Emissivity (ε)	0.011	1.001	1.002	0.993	1.001	1.003
Cloud water path (CWP)	0.07	0.23	0.53	0.72	0.78	1.75
Optical depth (τ)	5.0	14.2	24.3	33.5	44.0	89.7
Effective radius	19.5	26.9	34.7	28.6	29.9	30.8
Cloud top height (C_z)	6.7	9.9	11.5	11.2	11.0	11.1
	5.9	8.5	10.1	9.7	9.6	9.8
	4.7	5.1	5.7	5.2	4.7	4.3
30-min trend ρ	0.30	0.19	0.11	0.04	0.15	−0.02
30-min trend ε	0.508	−0.024	−0.004	0.008	0.000	−0.002
30-min trend τ	34.9	47.8	52.8	29.4	55.4	0.4
30-min trend CWP	0.69	1.02	1.23	0.58	1.24	0.17
30-min trend C_z	3.1	1.1	0.7	0.5	1.2	1.1
30-min trend T_B	−19.6	−12.1	−4.9	−3.2	−10.4	−7.7

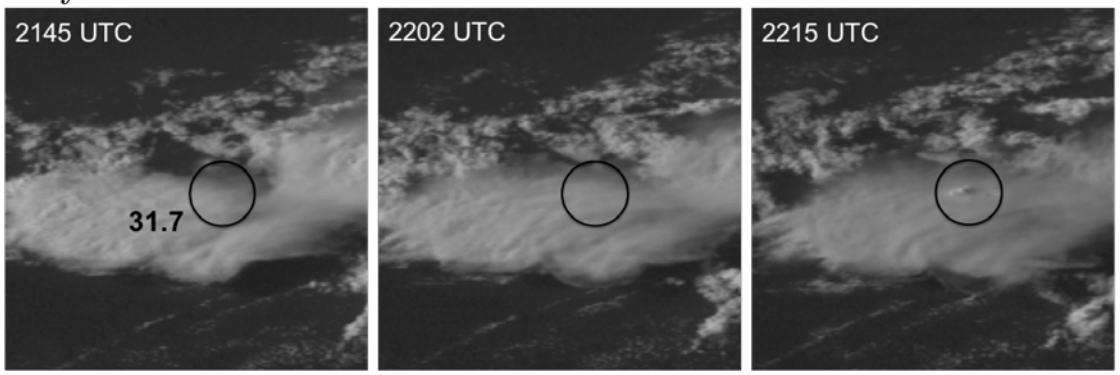
- Cloud properties are useful if the optical depth of higher clouds (cirrus) are less than ~20, and especially if <10.

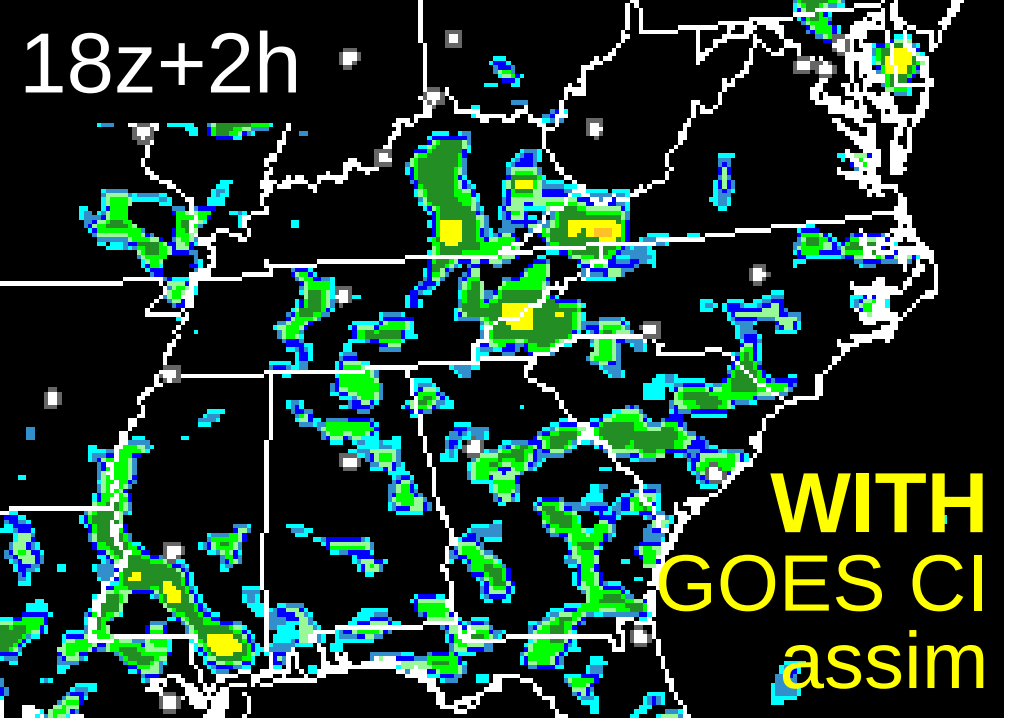
- Time trends of cloud properties are valuable for detecting convective cloud growth (purple highlighted region).

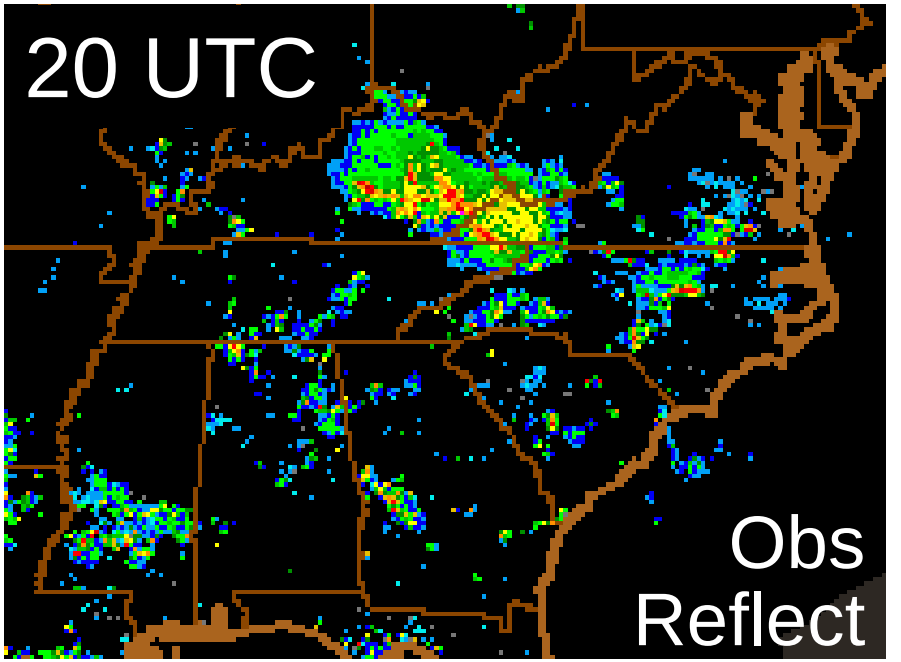
- The goal is to detect convective initiation is less than optimal situations, as shown to the right.

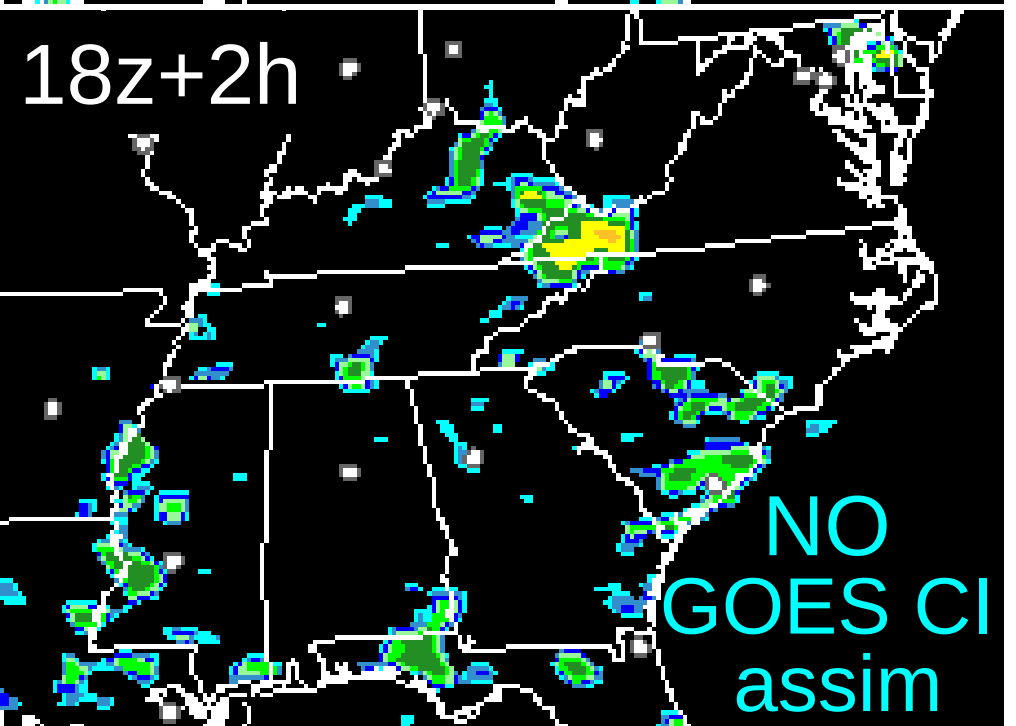
Mecikalski et al. (2013)

29 May 2011









Assimilation of "GOES-R CI" cooling rates provides more realistic short-range forecast of convective initiation and development

5. Possible Path to Operations

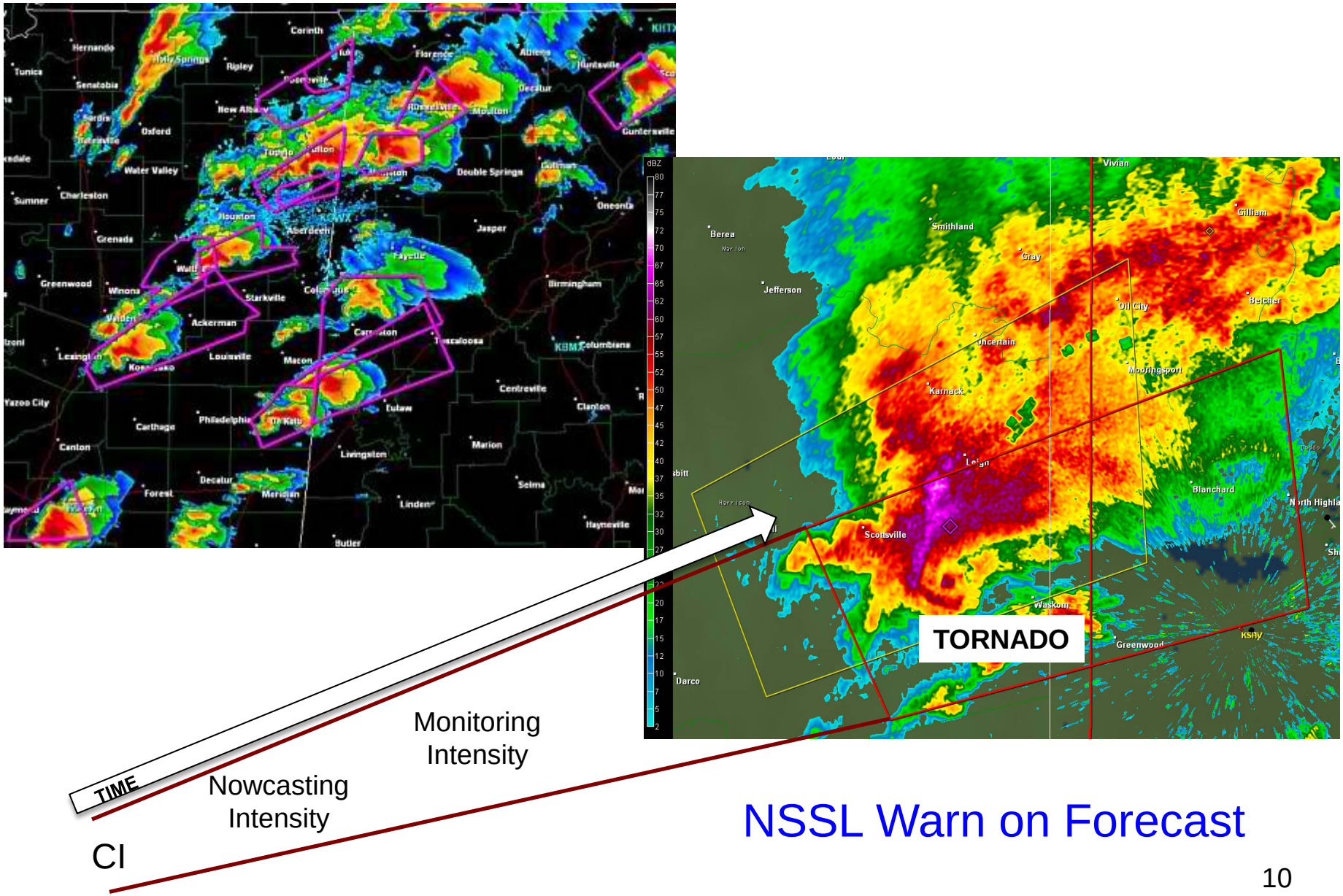
- The GOES/GOES-R CI algorithm is being used routinely ~12 NWSFOs and at least one CWSU (Atlanta).
- Transition activities for Proving Ground supported by NASA SPoRT.
- Plans to demonstrate enhanced (NWP+GOES) CI algorithm at HWT in 2013.
- Plans also to demonstrate at AWC and/or OPC within 2013.
- NOAA ESRL to adopt use of GOES CI datasets within RAP model, beginning in spring 2013.
- Plans into 2014 are towards a First-Flash (CG & Total) Lightning Initiation and Lightning Amount 0–1 hour nowcast.
- Considerable support and interest in Europe (Nowcasting SAF, DWD, EUMETSAT, …)

6. Future Plans

- This proposal fits a longer-term plan, into ~2017 and beyond, that eventually will use the CI interest fields to:
  - Nowcast future storm intensity (i.e. which storms are likely to possess “severe” characteristics);
  - Nowcast the occurrence of lightning, which will support future lightning alerts and storm-related process algorithms using GOES-R Geostationary Lightning Mapper (GLM) datasets.

- Both of themes will leverage prior and existing projects that diagnose and nowcast storm intensity (at UAHuntsville & CIMSS), determine probabilistic hazards (University of Oklahoma), and estimate lightning initiation nowcasting using GOES/GOES-R (UAHuntsville), while fusing multiple datasets within nowcasting systems.

Extending the Warning Cone Backwards in Time



7. Publication List

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