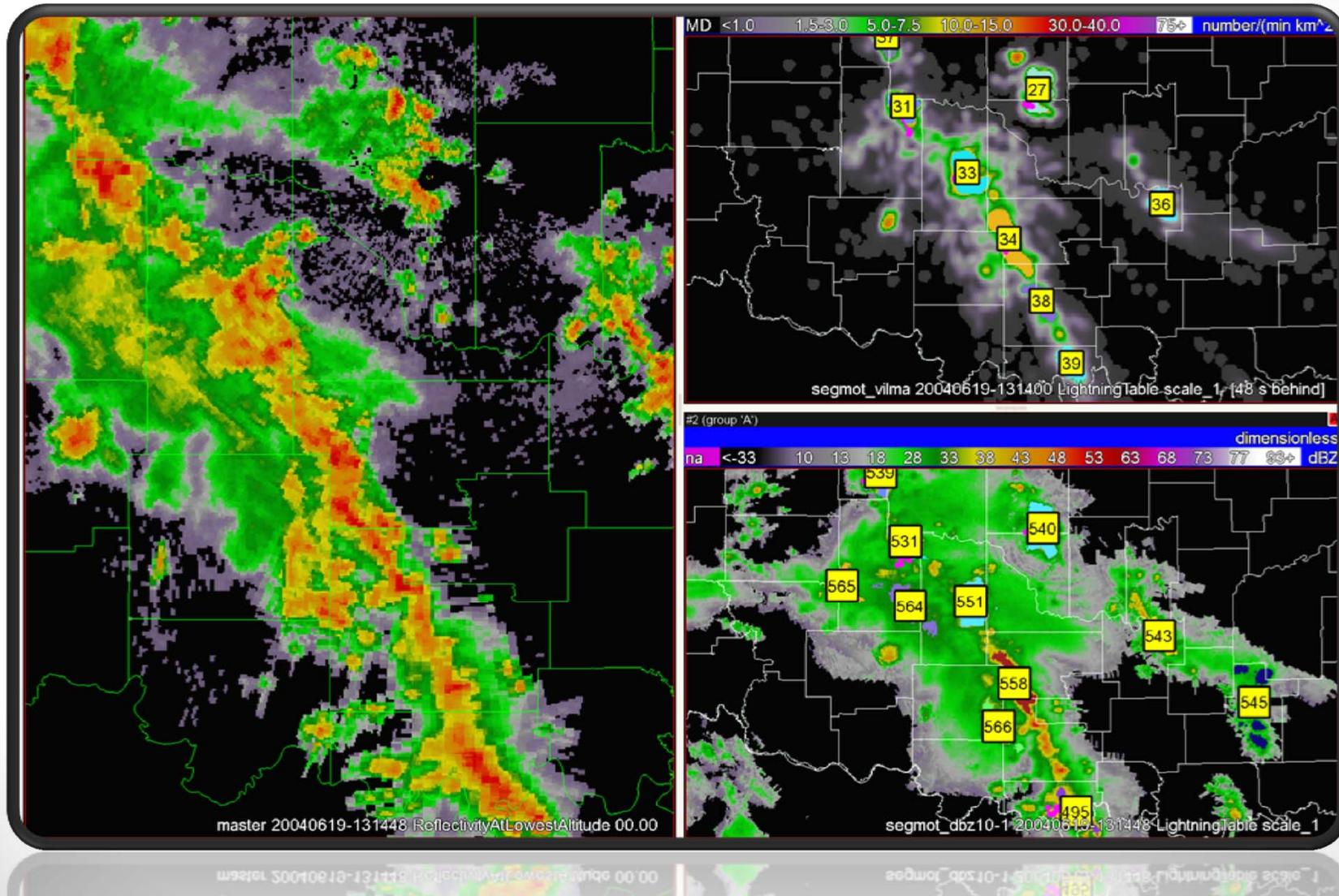


# Storm tracking & typing for lightning observations

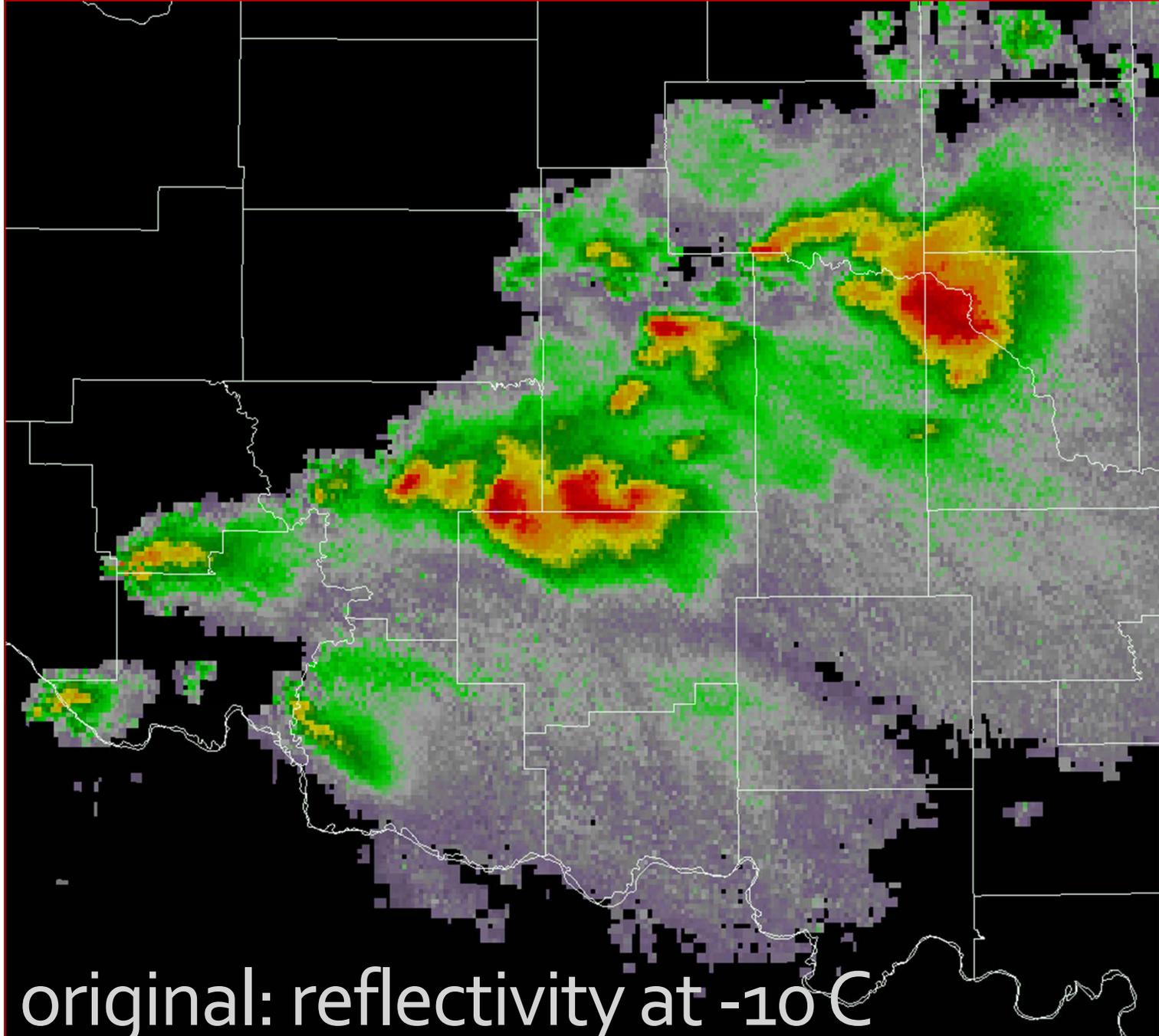
Kristin Calhoun, Don MacGorman, Ben Herzog



# Storm tracking: Segmotion / k-means

- Identifies **segments** (or storm cells/clusters) of image & estimates **motion**
- Extracts properties of each cell
  - Size of cell (# of pixels)
  - Pull data from all grids, including radar, lightning, and derived properties such as maximum expected size of hail (MESH)
- Moves grid based on motion field
- Tracking: **Lightning** vs. **Reflectivity** vs. Hybrid
- Want a relatively stable area, without drops or mismatches
- Past track given by centroid of area, if loses section or adds will change centroid location and can account for difference in track

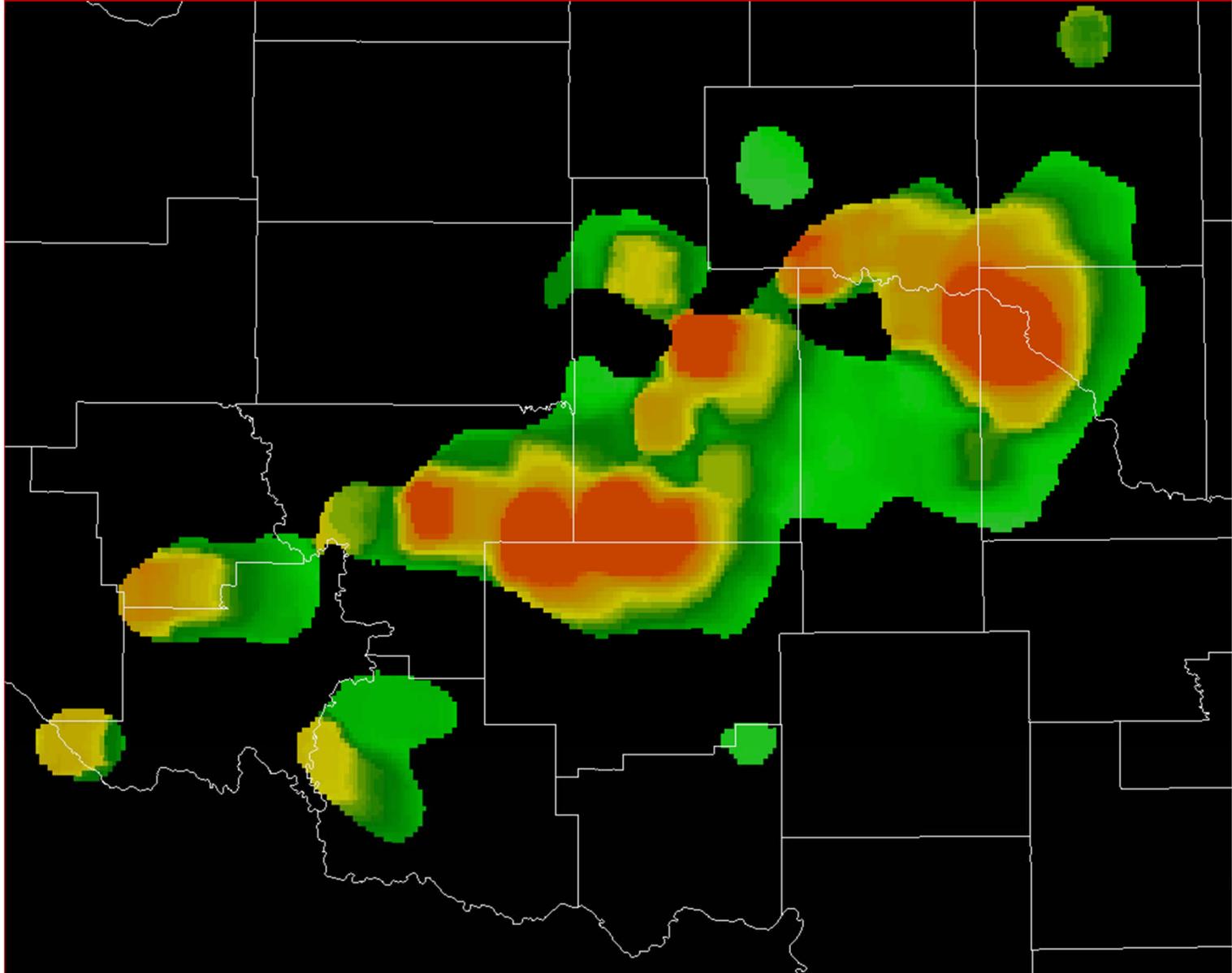
na <-33 -10 10 13 18 28 33 38 43 48 53 63 68 73 77 93+ dBZ



original: reflectivity at -10 C

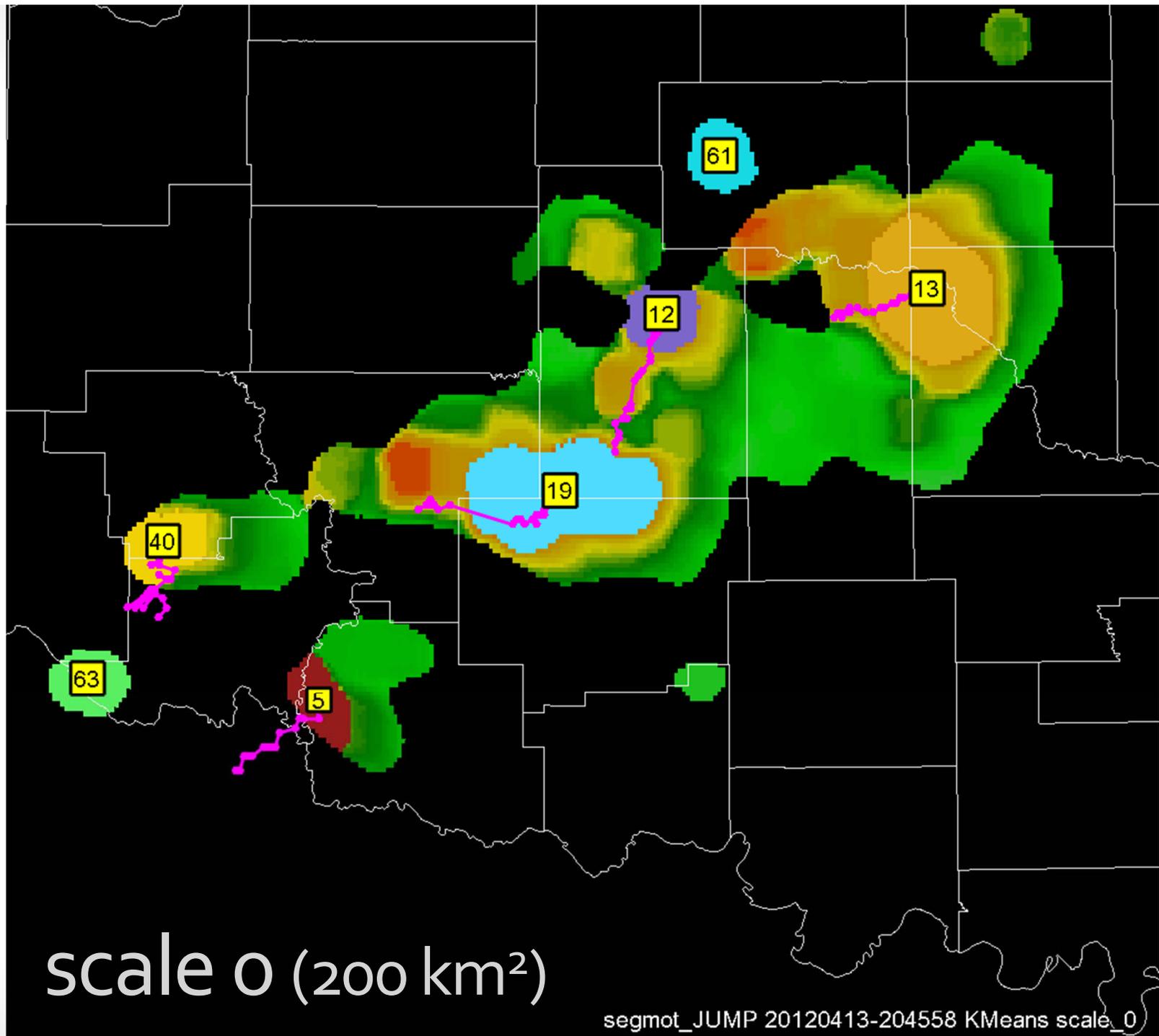
multi 20120413-204558 Reflectivity\_-10C 00.00

na <-33 -10 10 13 18 28 33 38 43 48 53 63 68 73 77 93+ dBZ



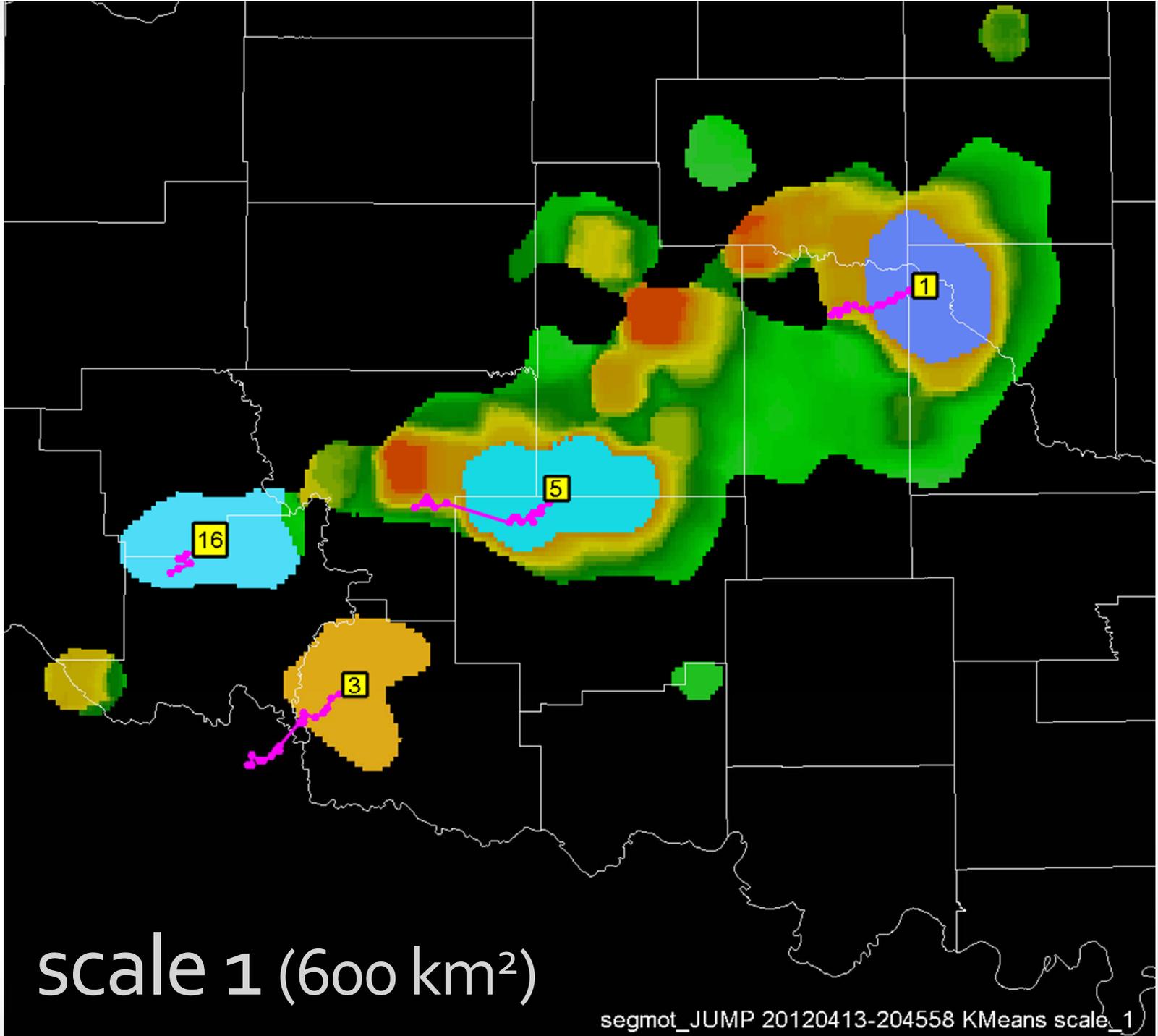
thresholds & median filter applied

smoothed 20120413-204558 Reflectivity\_-10C\_smoothed 00.00



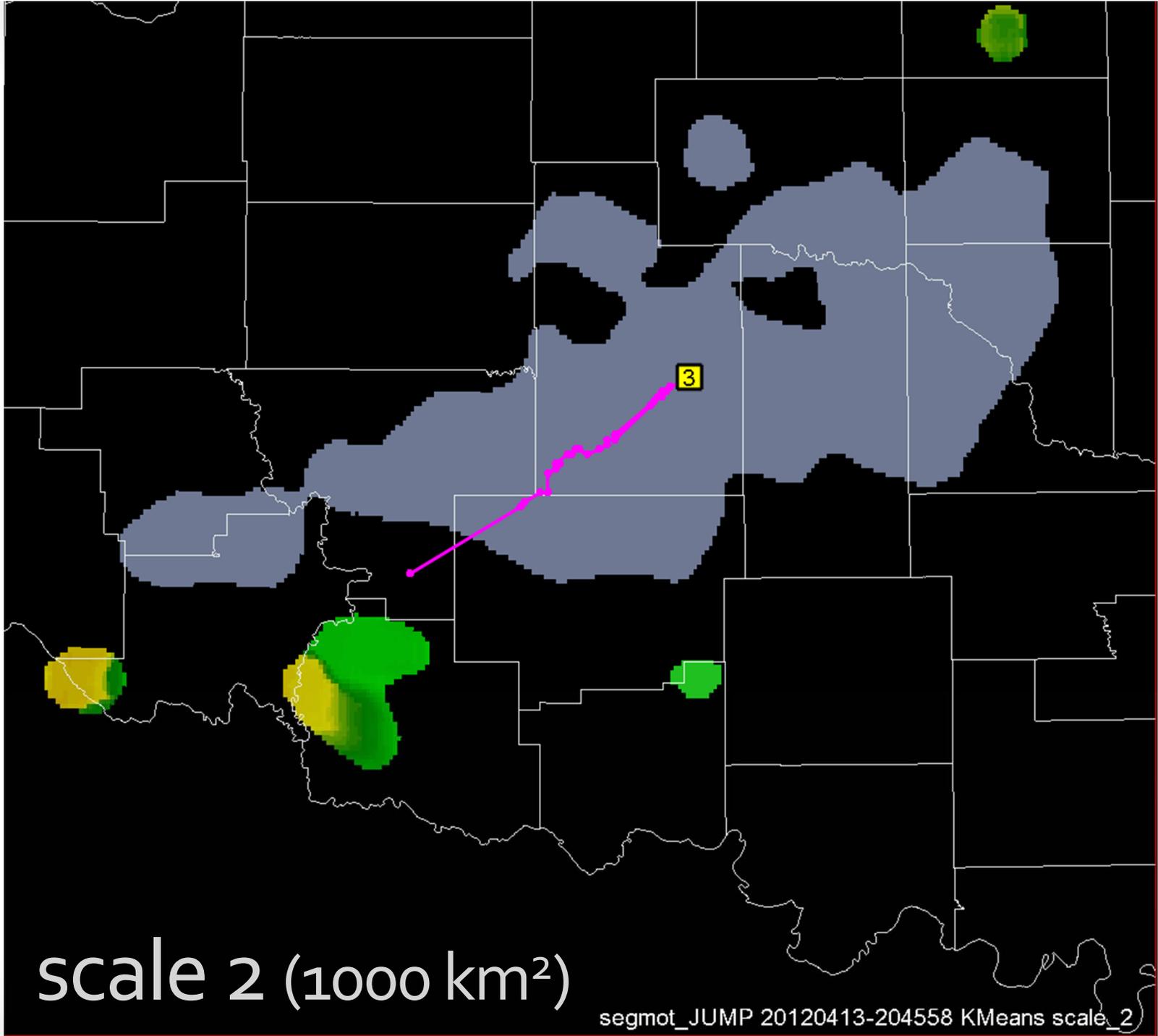
scale 0 (200 km<sup>2</sup>)

segmot\_JUMP 20120413-204558 KMeans scale\_0



scale 1 (600 km<sup>2</sup>)

segmot\_JUMP 20120413-204558 KMeans scale\_1



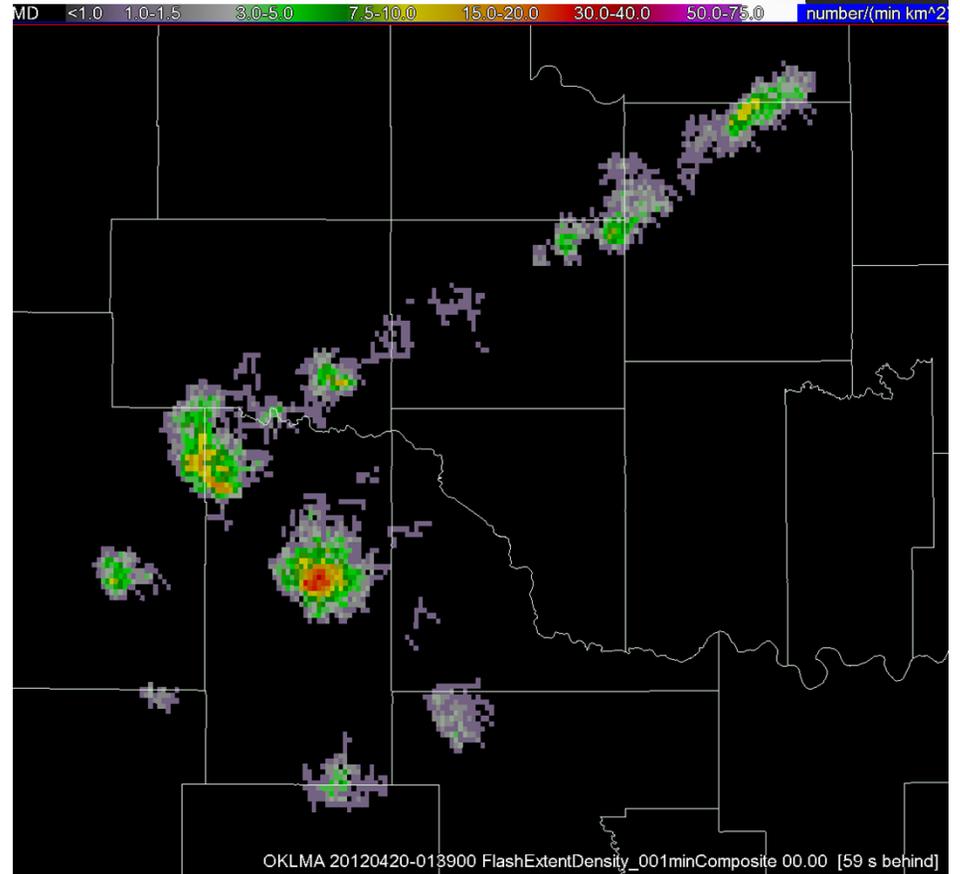
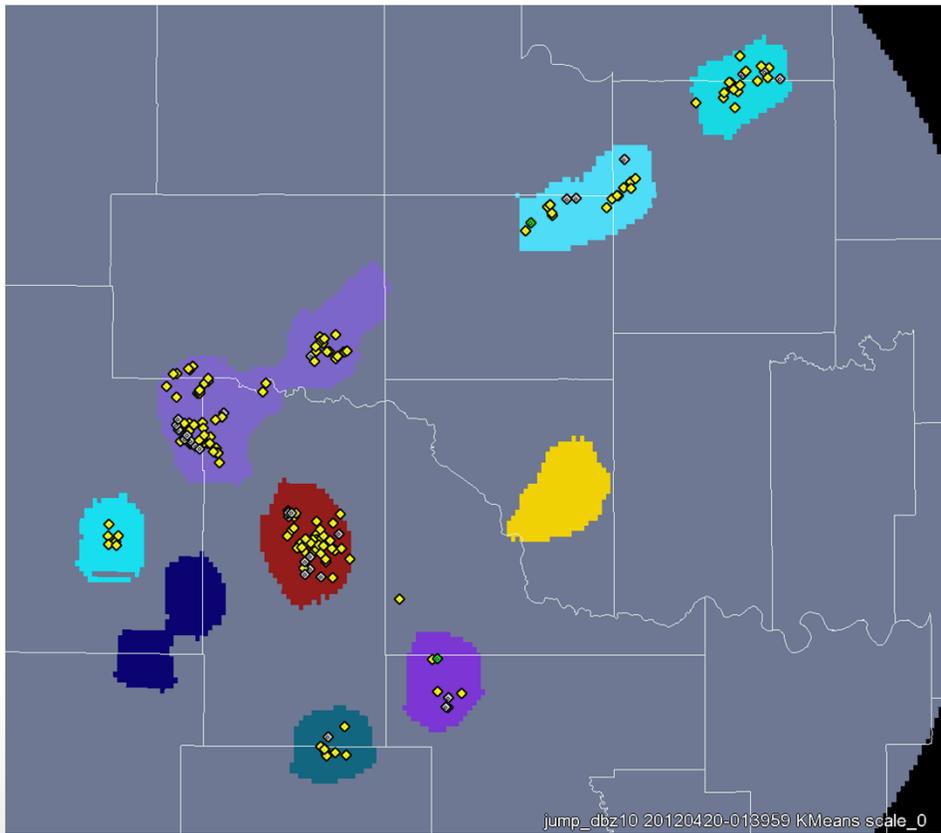
scale 2 (1000 km<sup>2</sup>)

segmot\_JUMP 20120413-204558 KMeans scale\_2

# Flash Extent Density vs Flash Rate vs Flashes per unit area?

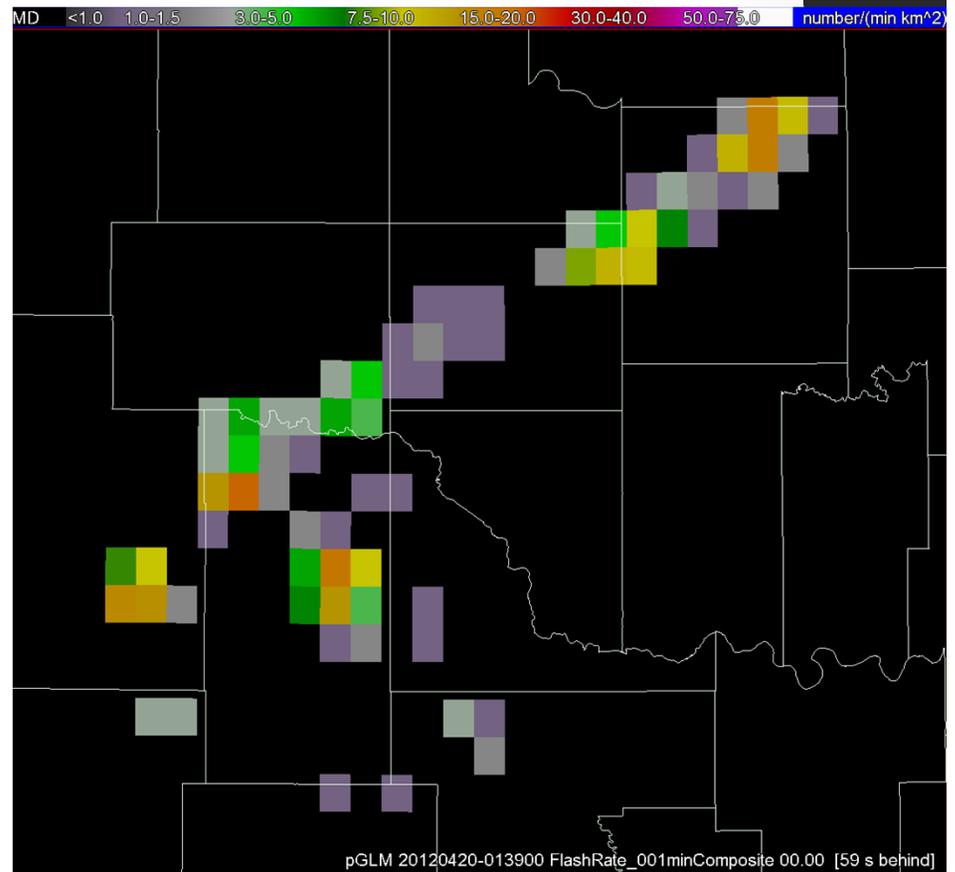
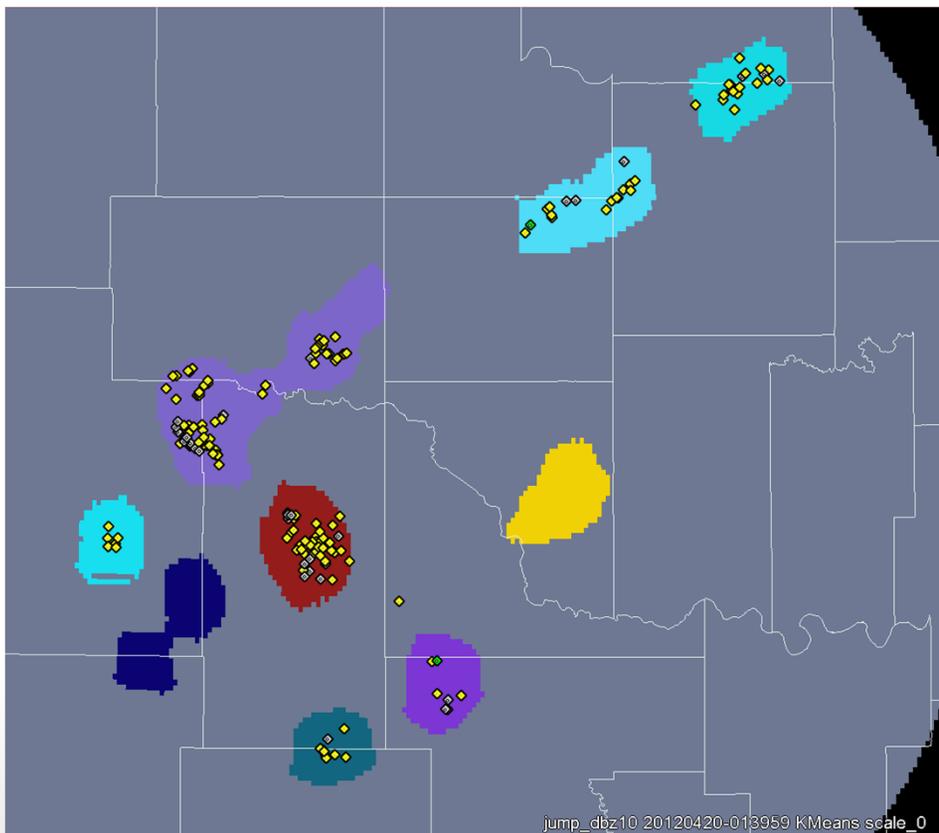
- For assimilation:
  - # of flash initiations (single point: lat / lon)
  - # of flashes traversing a grid cell,
  - or some measure of the summed density/duration of flashes at a particular grid cell?

# Flash Extent Density vs Flash Rate vs Flashes per unit area?



# Flash Extent Density vs Flash Rate

- GLM scale

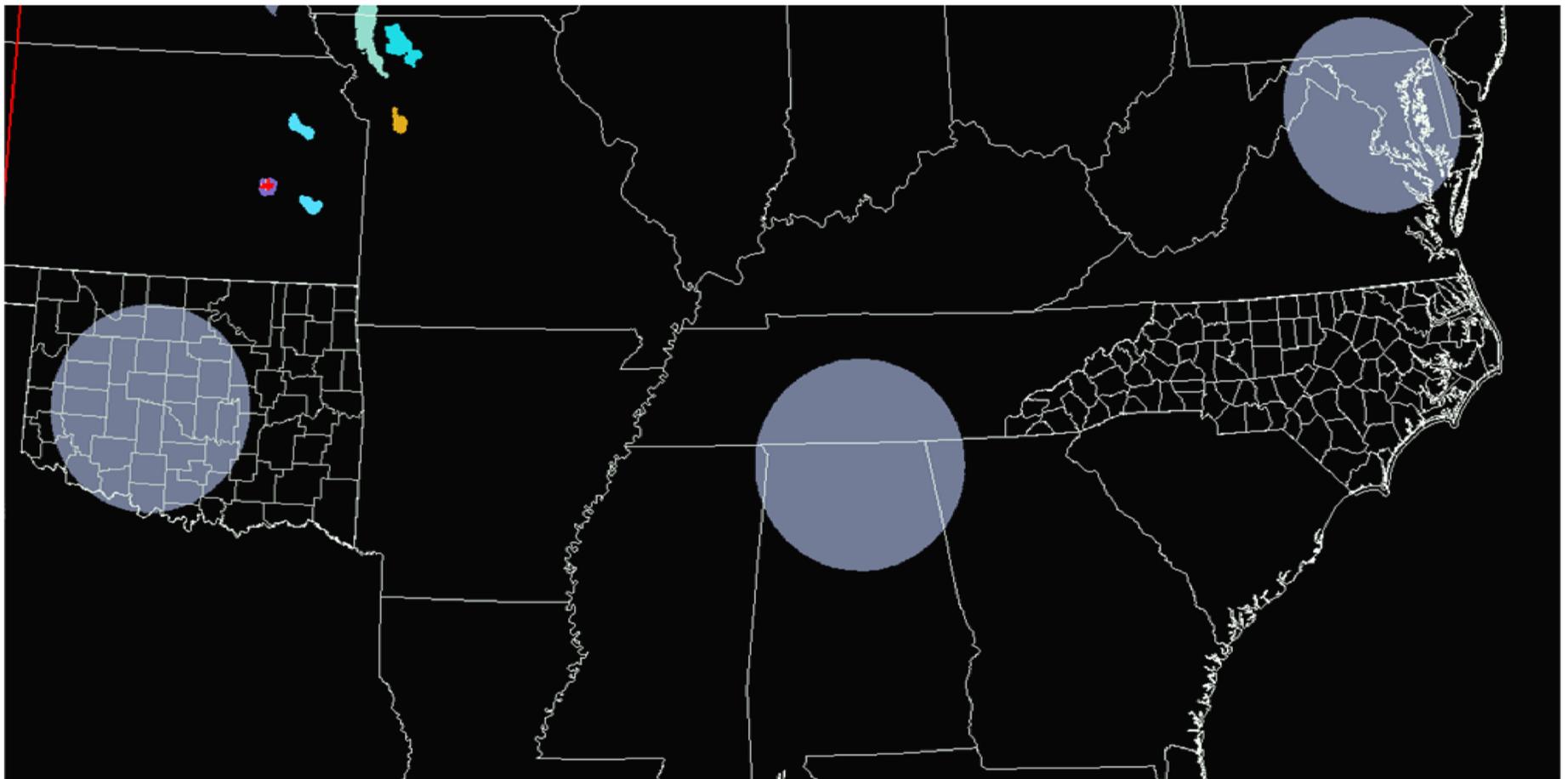


# Flash Extent Density vs Flash Rate vs Flashes per unit area?

- For assimilation:
  - # of flash initiations,
  - # of flashes traversing a grid cell,
  - or some measure of the summed density/duration of flashes at a particular grid cell?
- For observations / lightning jump:
  - # of flashes per cell,
  - the max density of flashes in a cell,
  - or the # of flashes per unit area of a cell
- Are the answers to these questions different for different types of storms or at different resolutions/spatial scales?
- How does this translate to pGLM and ultimately GLM?

6 years of data (2007-2012)

3 domains (OKLMA, NALMA, DCLMA)



# Speed tests!

## active weather week over 3 LMA domains

On NSSL machine idealized for real-time processing:

- 21 single radars, processing: ~31 hrs/each
- 3 LMA domains, processing: ~29 hrs/each
- Multi-radar/sensor merger & storm tracking: ~155 hrs



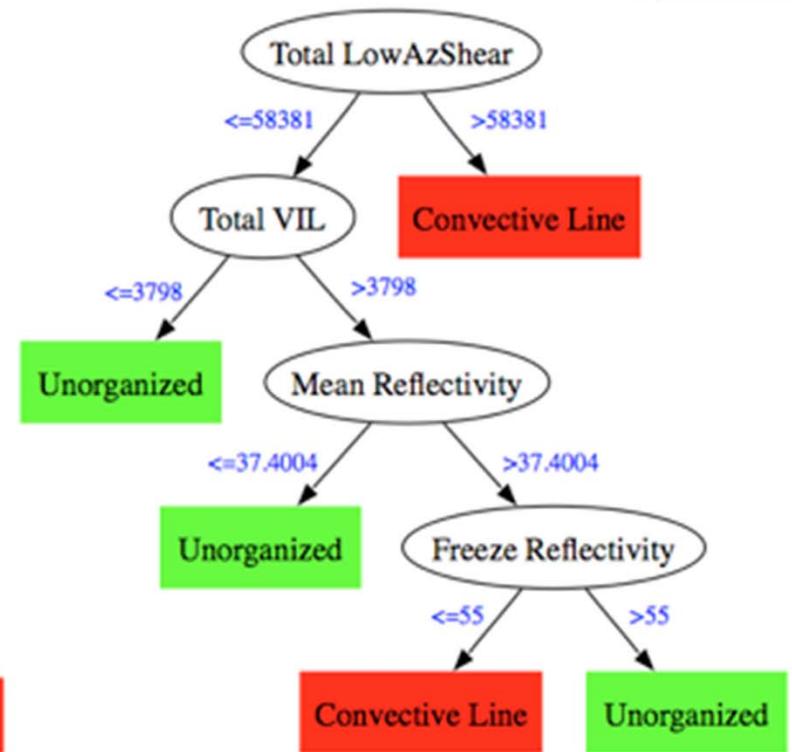
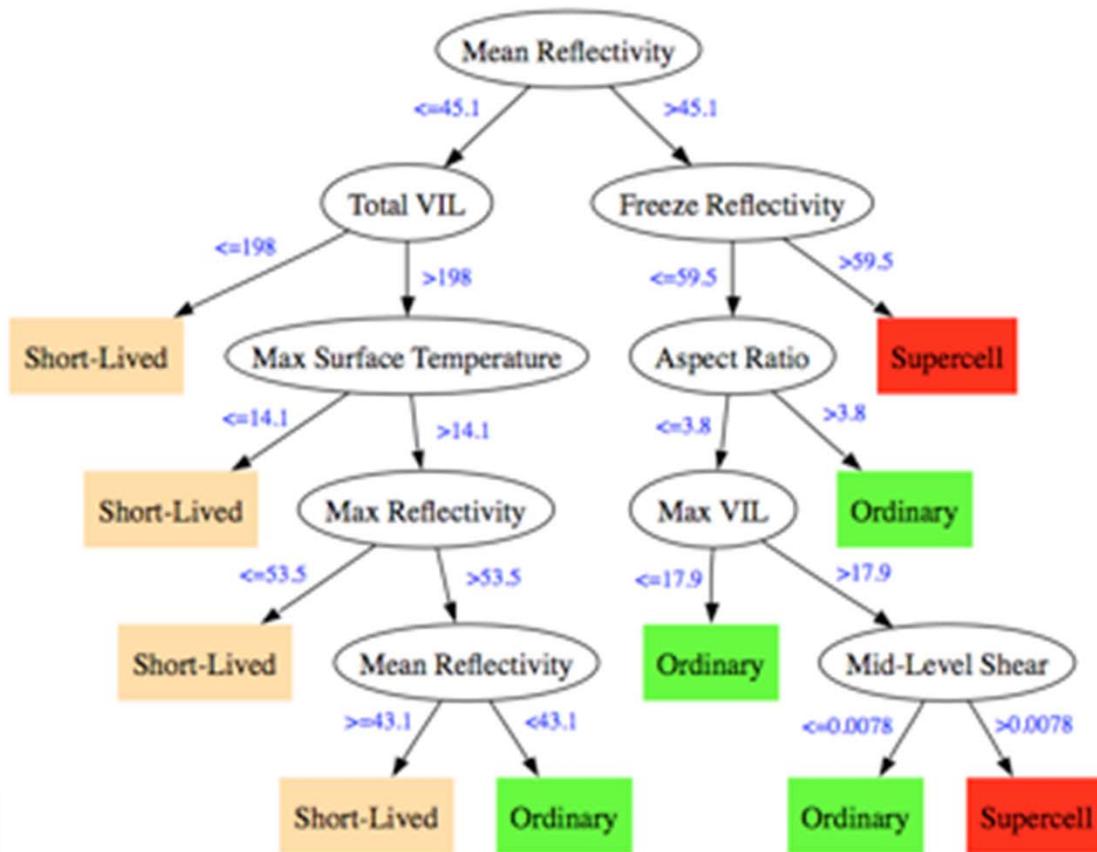
Can run in parallel

Onto supercomputing:

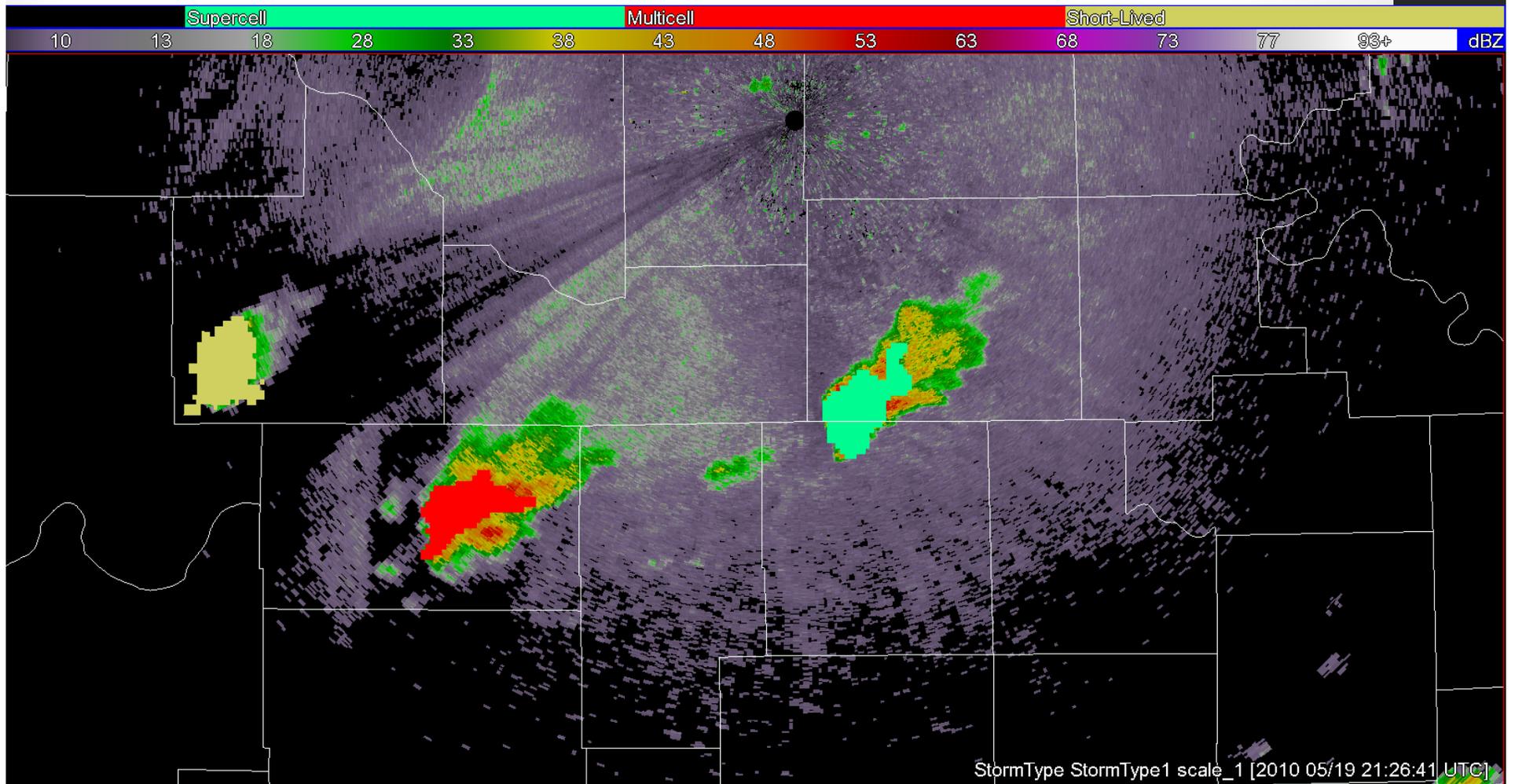
- ~67% faster + more parallel computing opportunities!
- Run multiple weeks at the same time
- Optimizing WDSS2 for supercomputing

# Storm typing

- Decision tree: based on training set from number of years across the CONUS (Hobson et al., 2012)

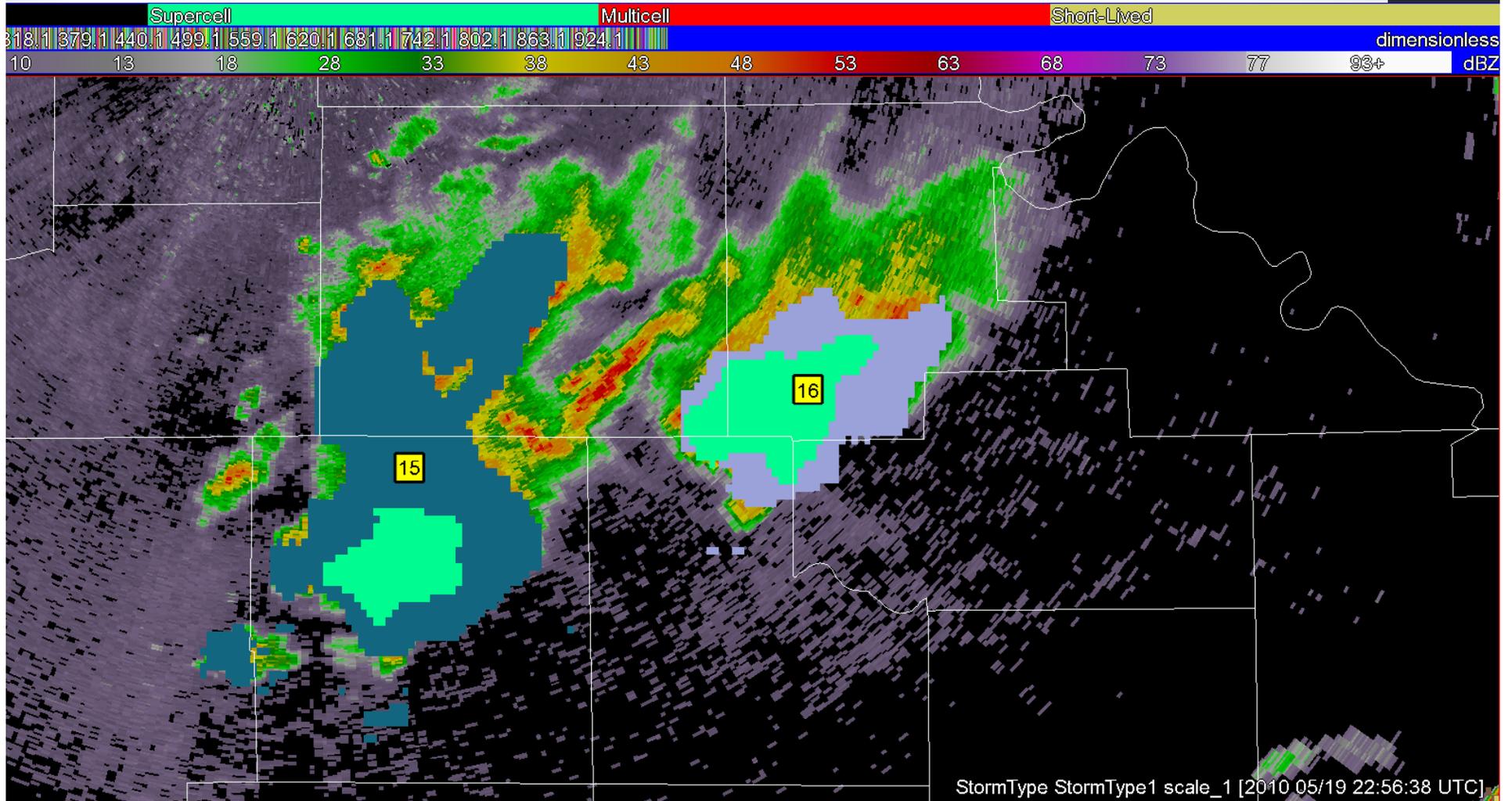


# Storm typing: 19 May 2010, NW OK



short-lived, multi-cell, supercell

# Storm typing: 19 May 2010, NW OK



a bit later: 2 **supercell** storms

# Applying results to Data Assimilation:

- 3DVAR framework – real-time in the Hazardous Weather Testbed every 5 min (w/Jidong Gao)
- Parallel work by Ted Mansell, Blake Allen, and Alex Fierro utilizing EnKF and pGLM flash density

