

# Cell Tracking Algorithm (R3)

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# Objectives:

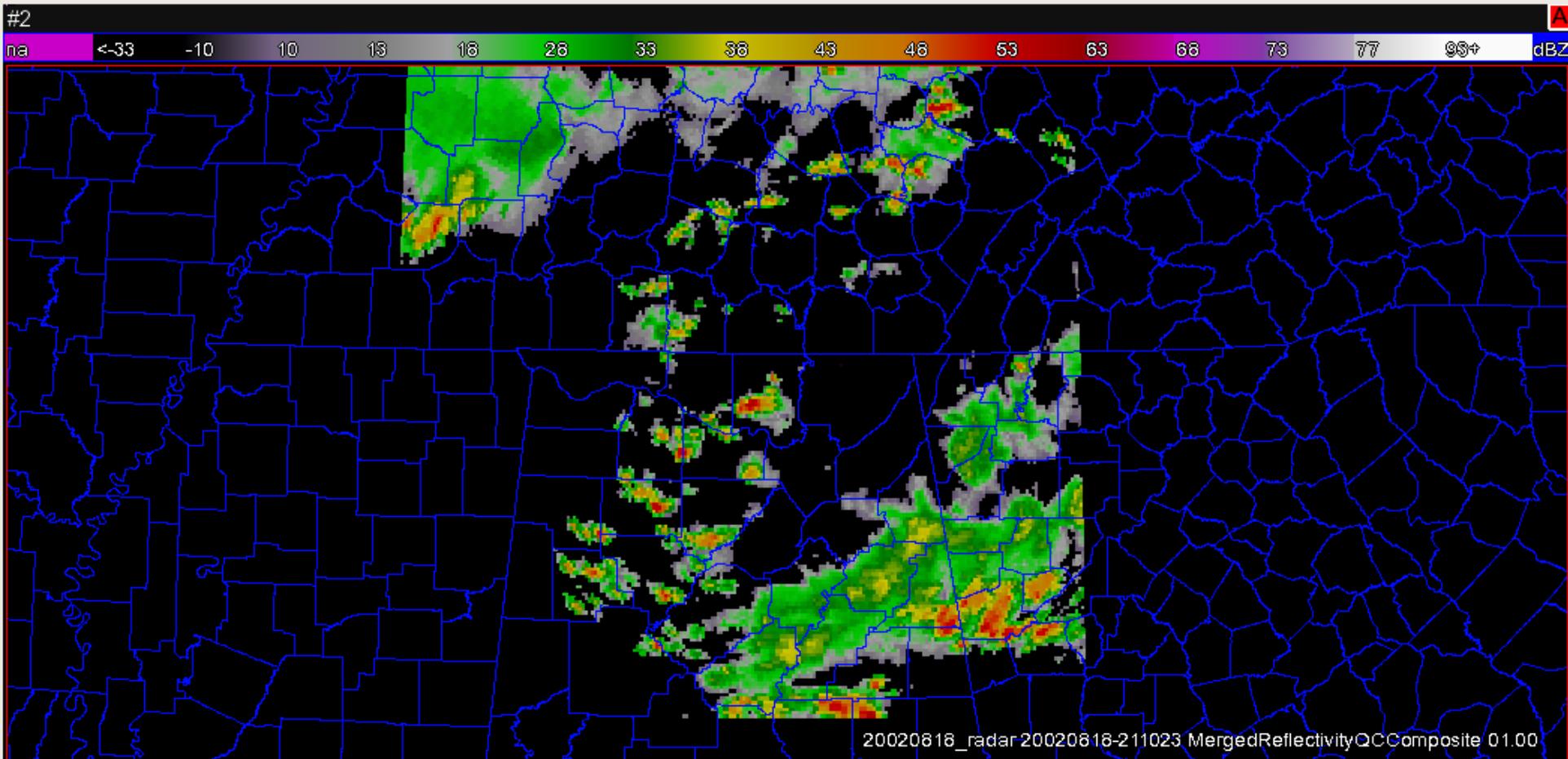
Fully automated tracking of thunderstorms, so lightning statistics can be trended

Cell Tracker is to be the “home” for Lightning Jump Algorithm - LJA depends on time history of flashes in the tracked cell

Primary interest in scale of a few GLM pixels (100's km<sup>2</sup>), appropriate for NWS severe wx warnings

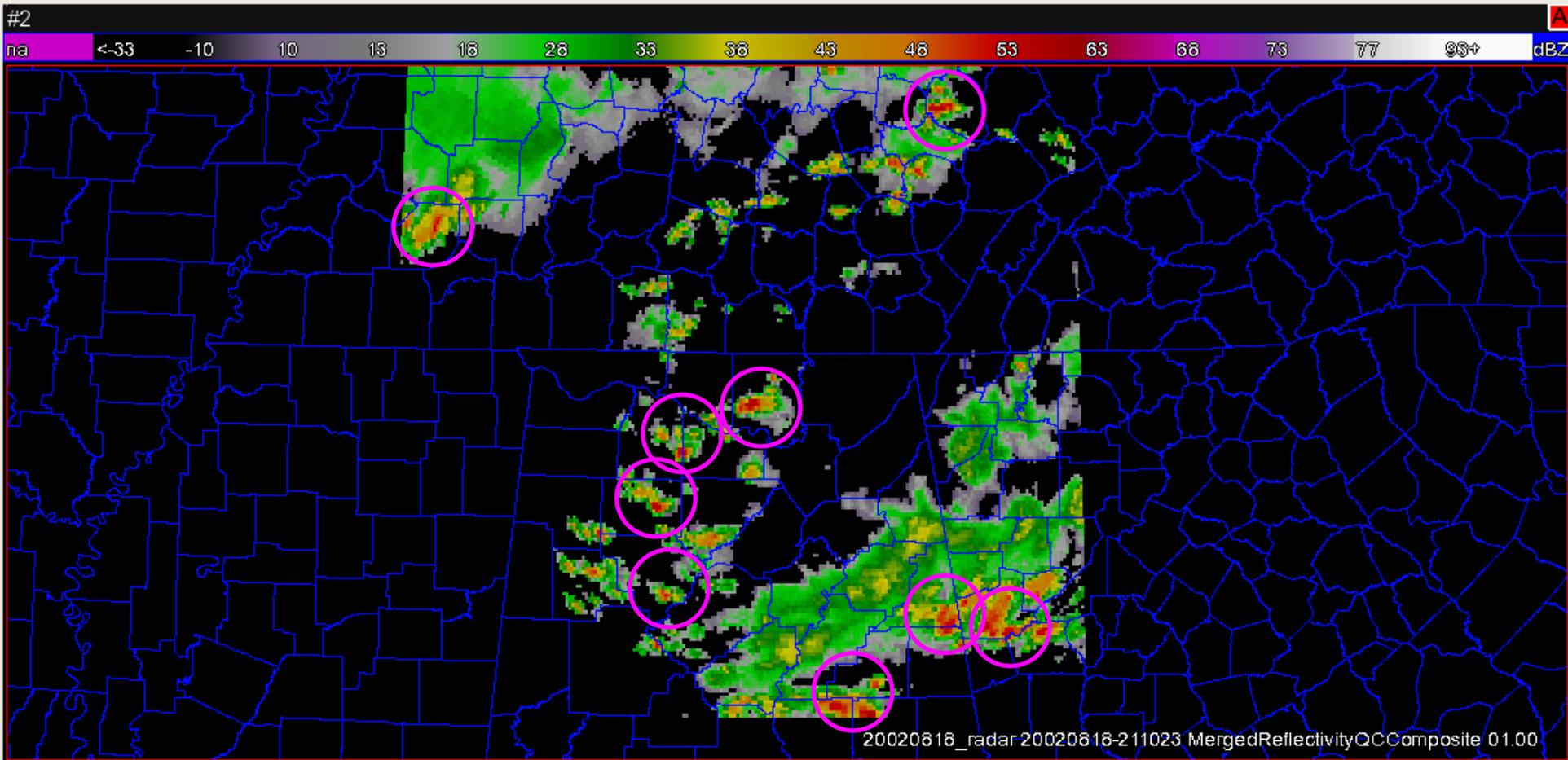
Also interested in tracking larger features (e.g. lines) that are hazard to aviation, outdoor events

# 1st step: Cell ID



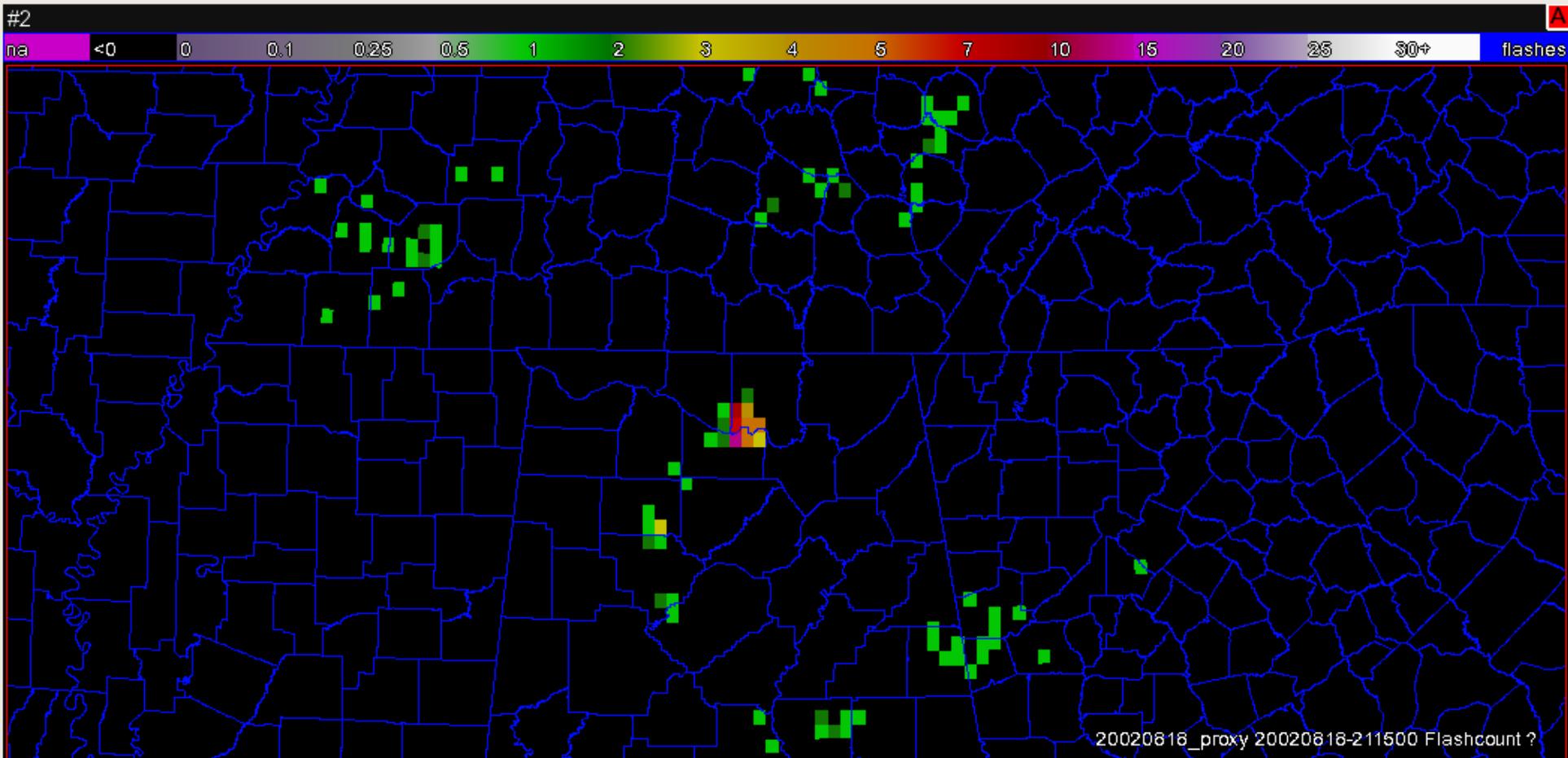
Most users familiar with using radar reflectivity

# 1st step: Cell ID



Pretty easy for a human (subjective cell ID)

# Cell ID from GLM



High flash rate storms easy to pick out subjectively

Low flash rate storms poorly depicted

# Approach:

Using WDSSII w2segmotionII (Lakshmanan et al. 2009; Lakshmanan and Smith 2010; *acknowledgment to Lak, he has been helpful with getting this running*)

Try to make optimal use of available inputs (depends on location, time)

Track GLM flashes by themselves

Track combination of GLM + ABI info

Track combination of GLM + Radar (where available)

Working with LMA-based GLM proxy flashes from Bateman and Mach

# w2segmotionII

Robust product primarily used with radar data, but general enough to apply to other fields

No need for us to re-invent a wheel

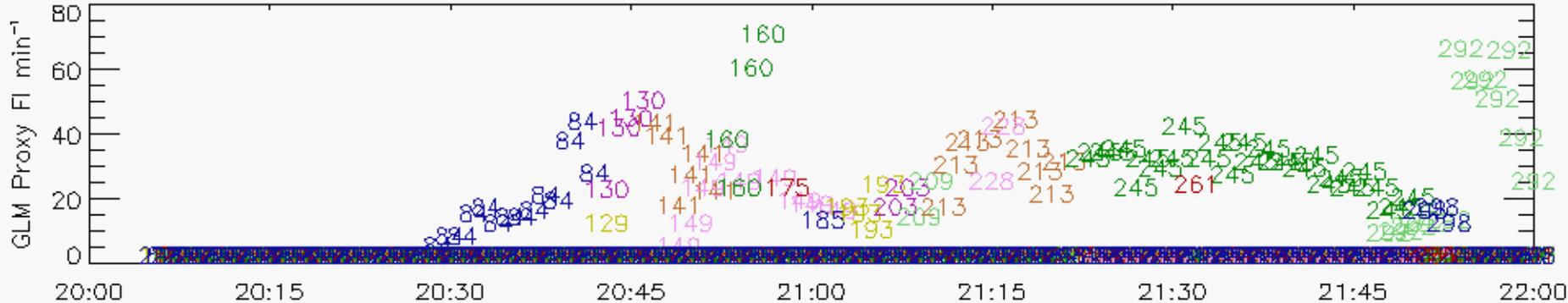
Searches for local maxima in the tracked field

Adds pixels surrounding the local max until the “cell” has exceeded a minimum size (enhanced watershed method)

We set different sizes, to simultaneously track thunderstorm cells and larger mesoscale features

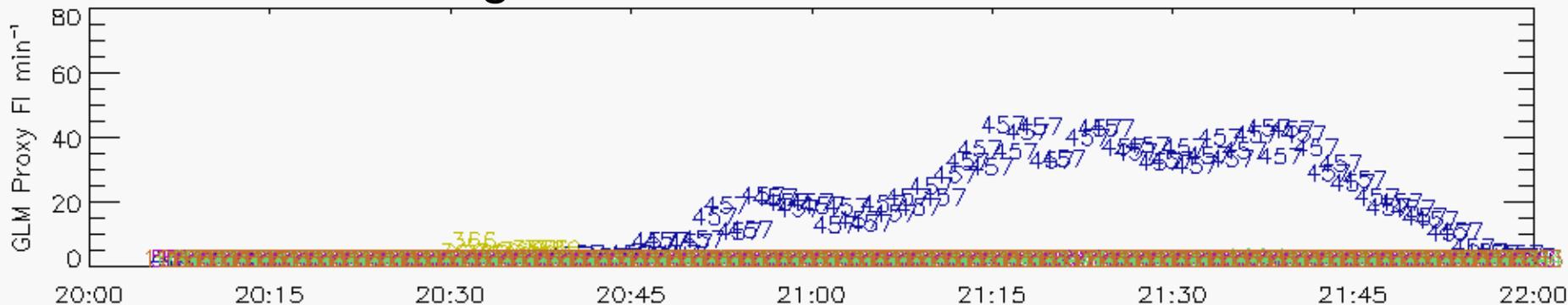
Many options available; trying to find “best” settings and best fields to track

# Flash rate time series



Top: A bad cell track --> user has to piece together a time series from multiple cell IDs

Bottom: A good cell track --> automatic generation of time series from a single cell ID



# Tracked fields

Two fields currently being tested:

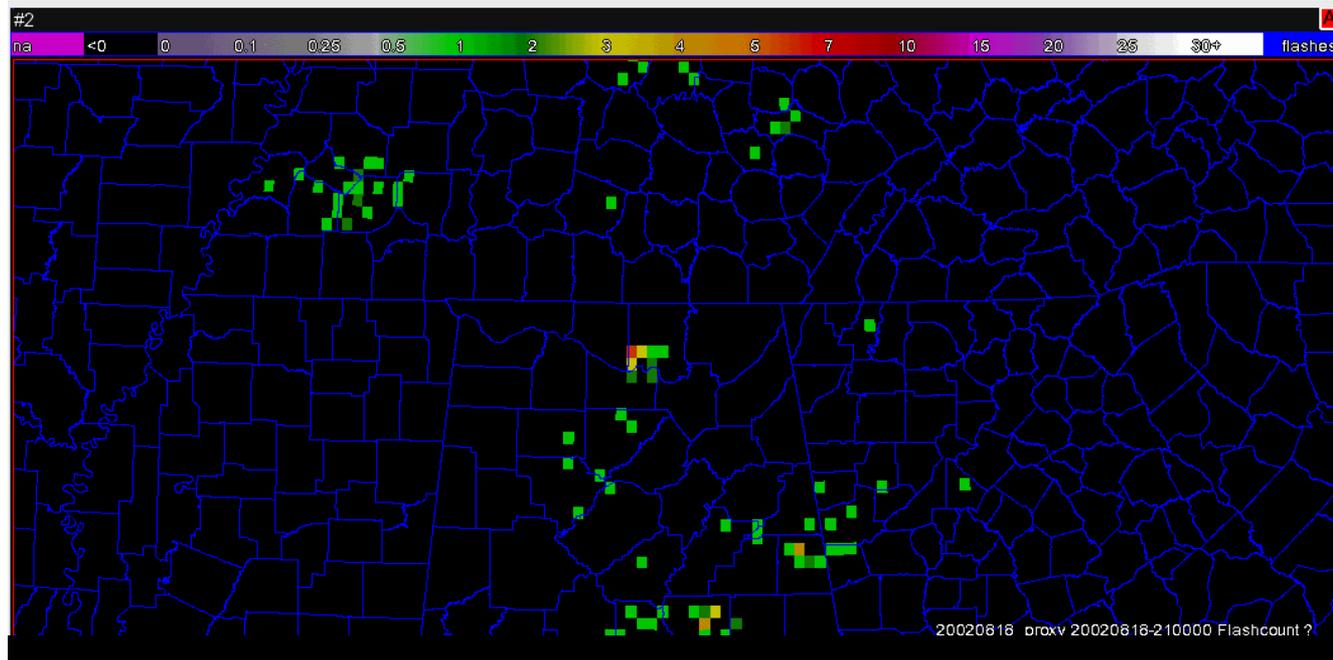
- 5-minute Flash Counts, updated every 1-minute
- “VIL-FRD”: A combination of 5-minute Flash Count and radar-derived VIL, weighting high flash counts more heavily:

Scale both VIL and Flash Count to range between 0-100, then take the one with larger value

$$\text{VIL} = 100 * ( \text{VIL} < 45 ) / 45$$

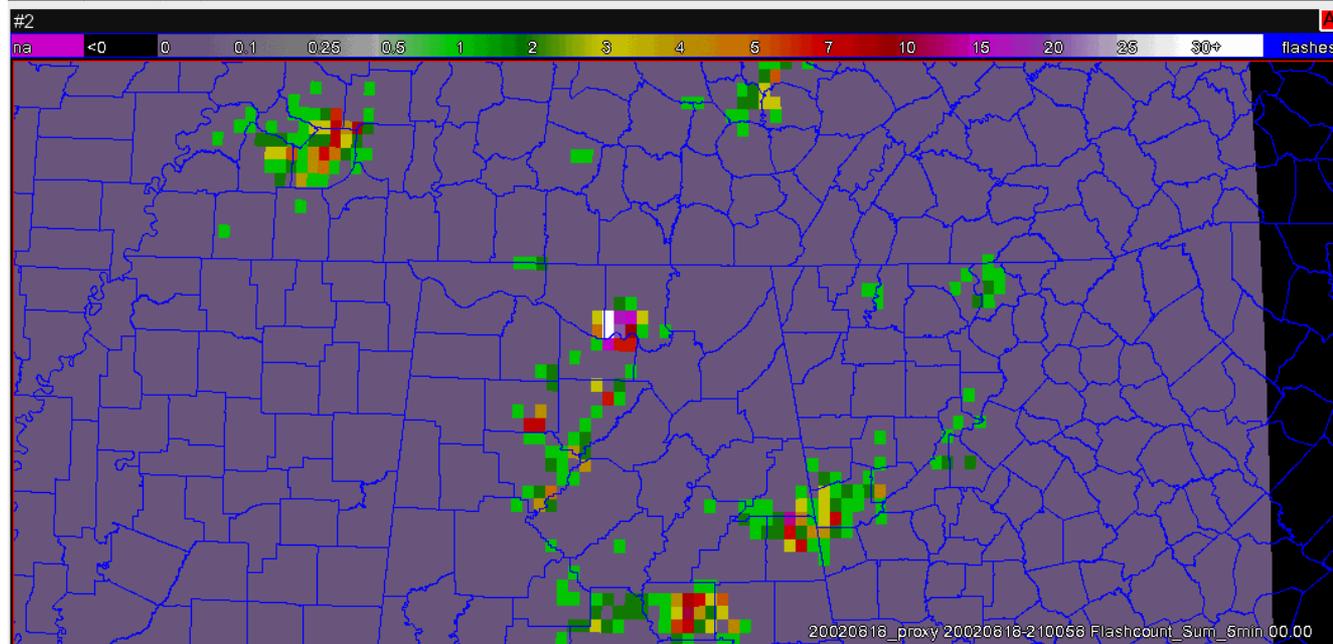
$$\text{Flash Count} = 100 * \text{sqrt}( ( \text{Flash Count} < 45 ) / 45 )$$

**Top:  
1-minute Flash  
Counts**



**Bottom:  
5-minute Flash  
Counts,  
updated every  
minute**

*Accumulating a few  
minutes of flashes  
allows more  
consistent tracking*

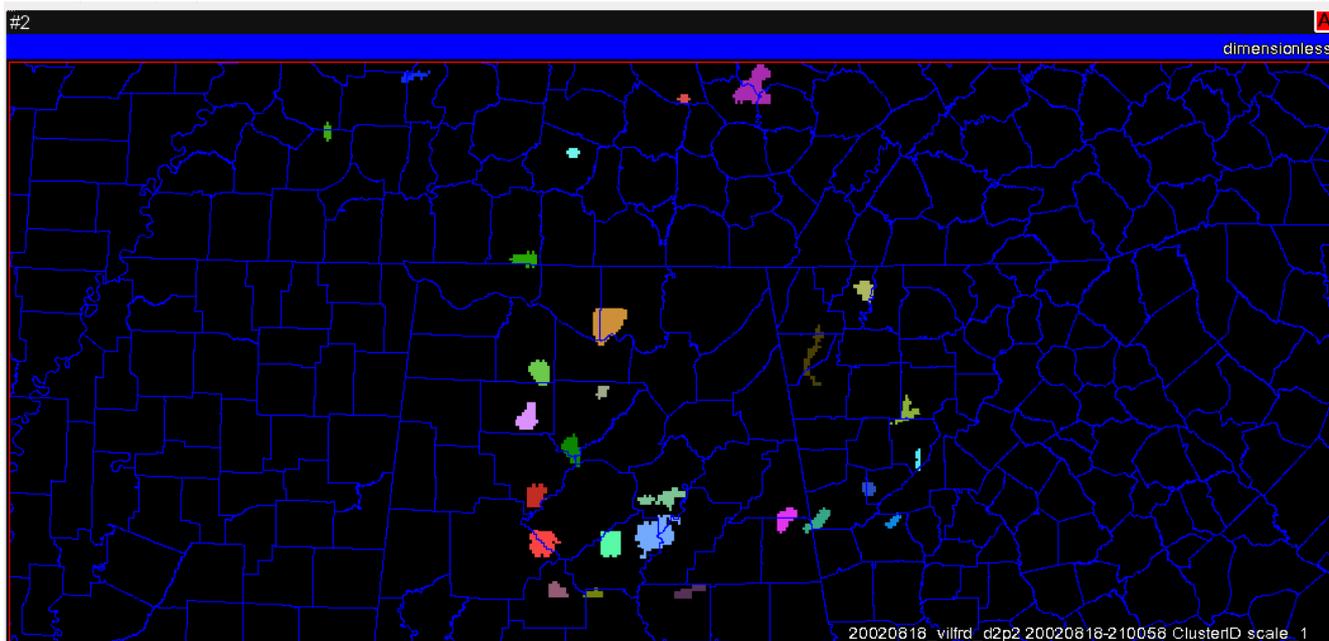
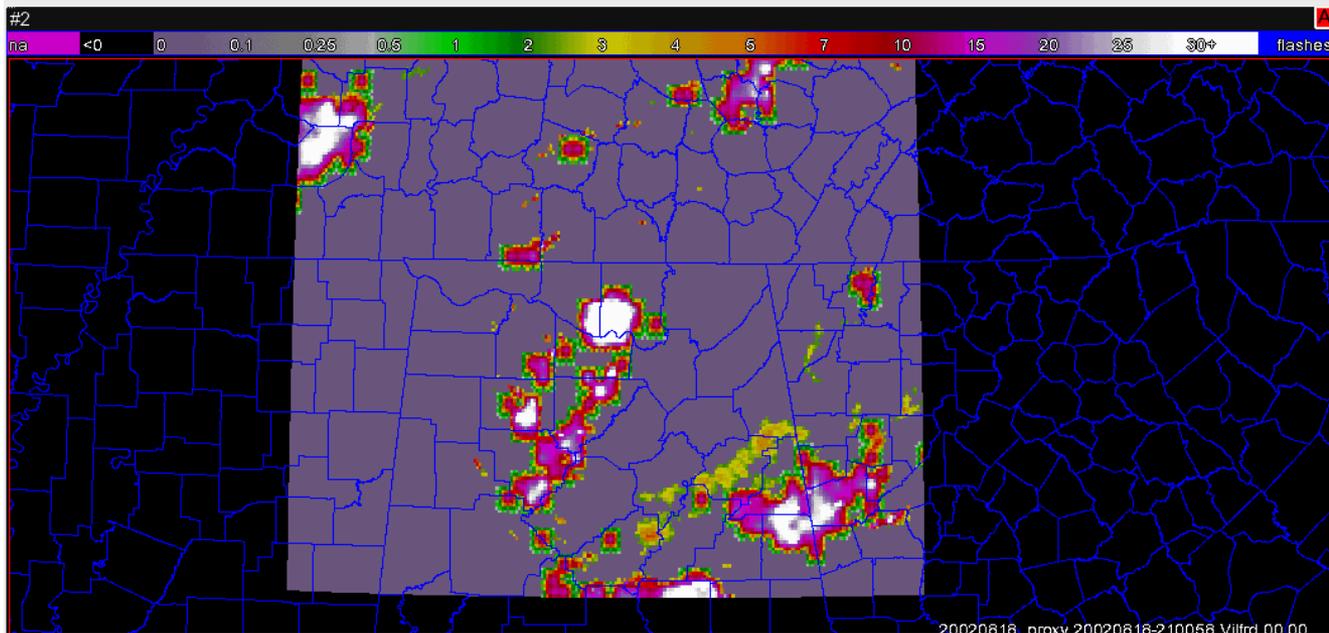


# Combined VIL - Flashcount field tracked

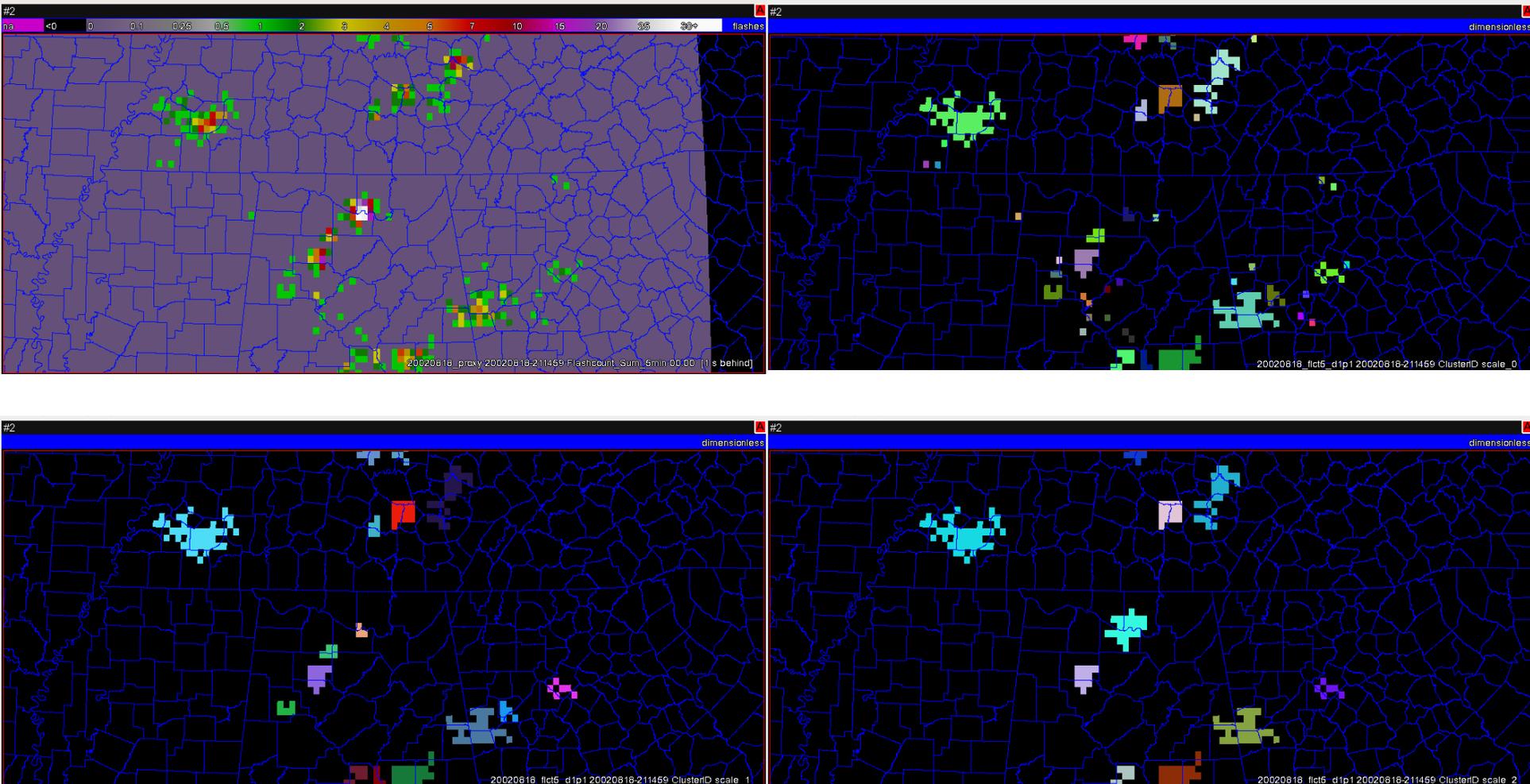
Bottom:  
Intermediate  
scale cells,  
aimed toward  
something  
appropriate for  
NWS warnings

*Works well for some  
cells (HSV), not  
others*

*Small, short lived  
cells probably not  
important, but  
distracting*



# Lots of ways cells can be defined, with different settings

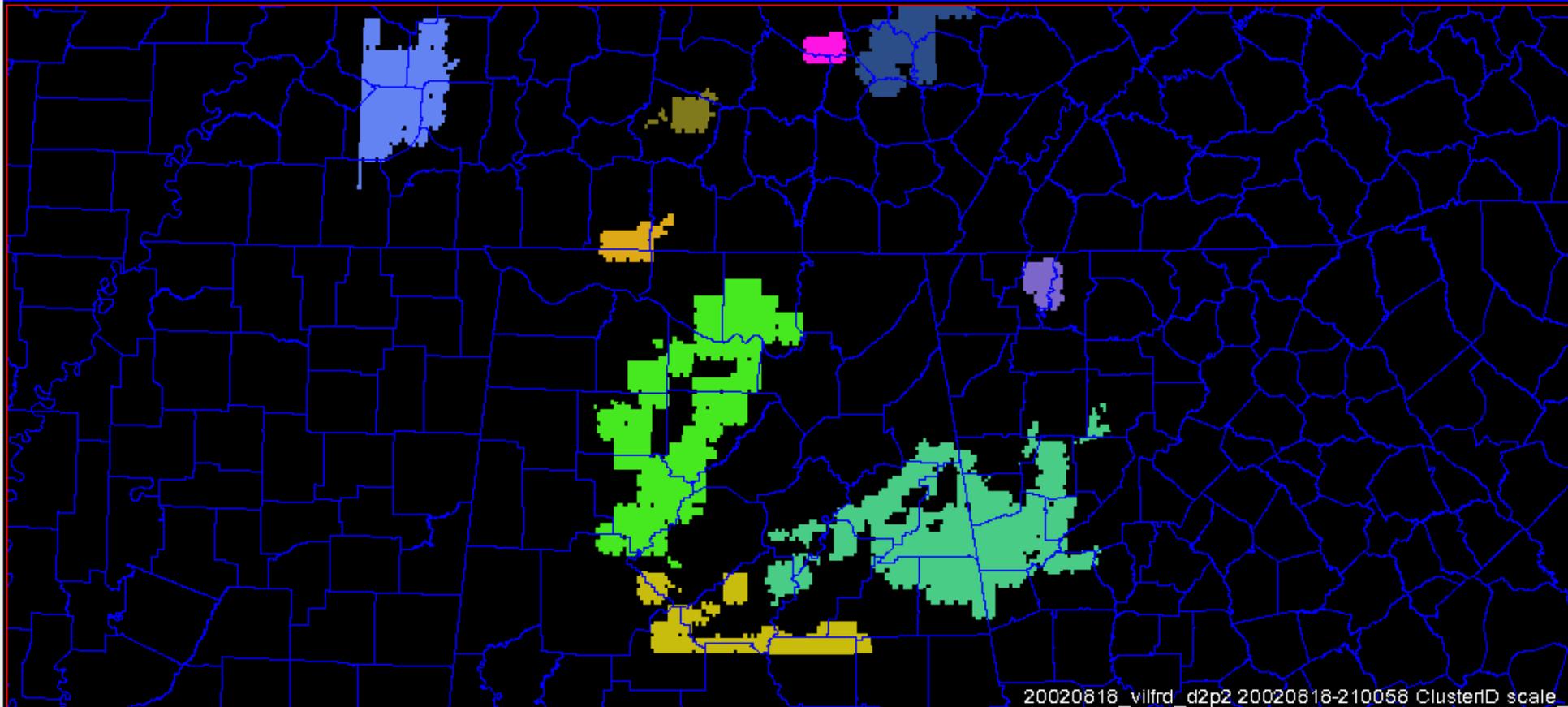


24 different versions of cell ID, all at the same valid time

# Tracking larger scale storm complexes

#2

dimension



*Pick out the large blobs that aircraft should divert around, for example*

# Summary

Using w2segmotionII (WDSII) to define / track cells

Lots of options being tested

Some options good for particular cases, but trying to decide which work best across-the-board

Tracked fields:

- 5-minute flash counts

- Combination 5-min flash count + VIL from radar

- Combination 5-min flash count + ABI field (*suggestions wanted*)

# Summary

Different spatial scales tracked simultaneously, appropriate for NWS warnings (small scale) or aviation (large scale)

Statistics generated for each cell (total flash count, max pixel flash count, time tendencies...)

To get total flash count right, need to adjust w2segmotion to include “*foothills*” around the cell

Since cells will have different sizes, affected by pixel geometry, maybe sum up the flashes for the top few (~5?) GLM pixels in each cell

