Comparison of GLM with LMA Lightning Detection

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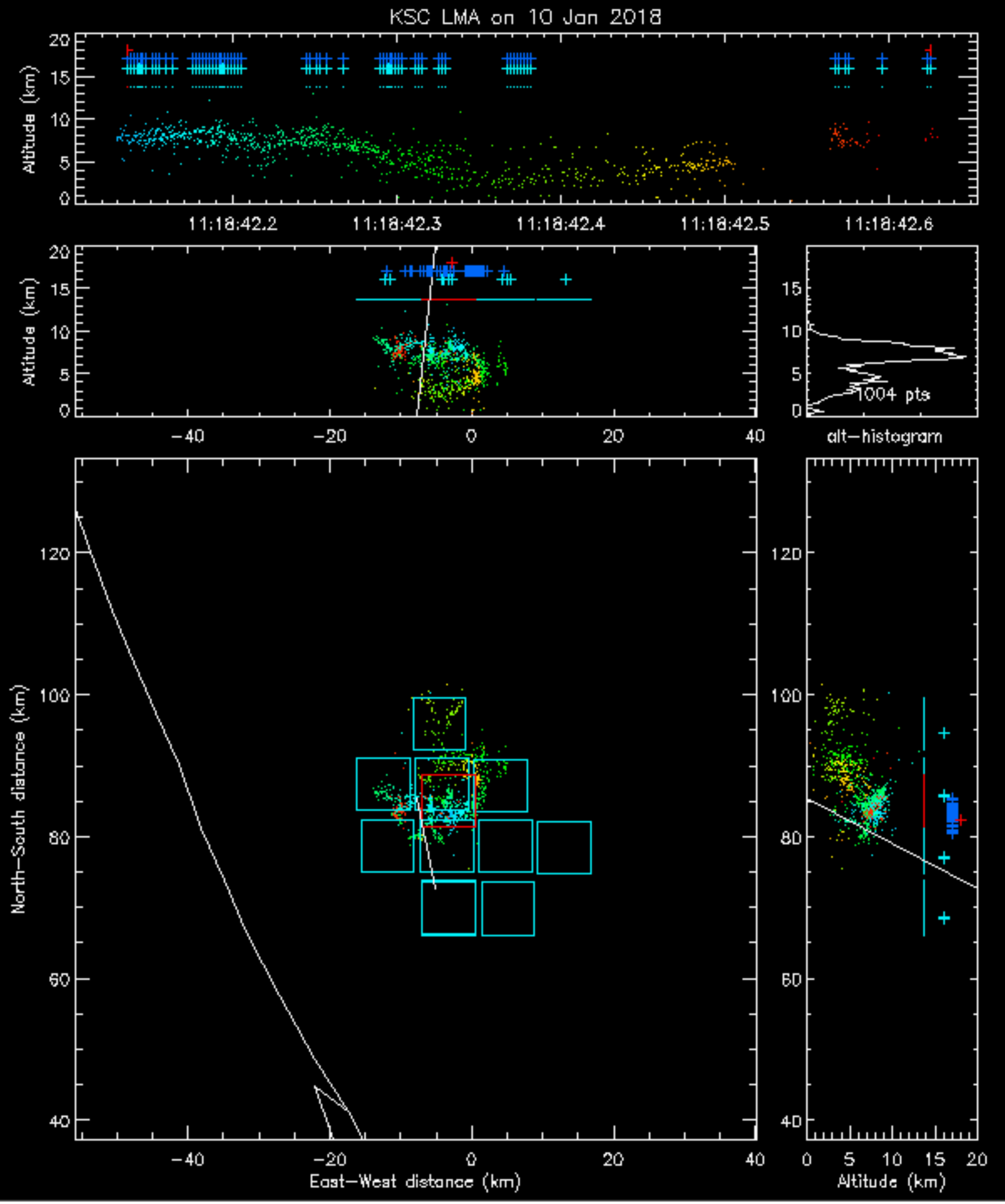
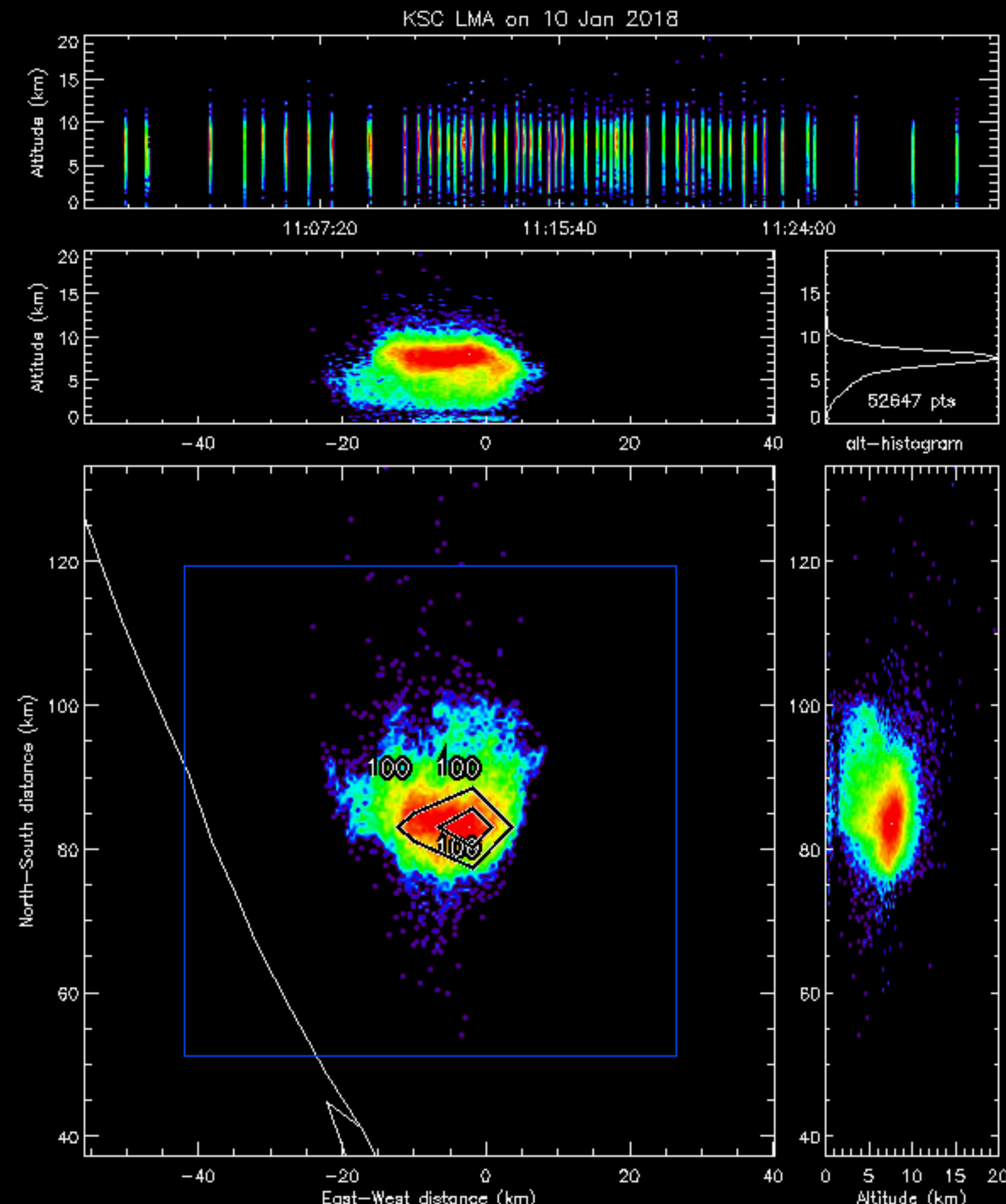
Does GLM detect each LMA flash

- The GLM and LMA flashes must overlap in time
- The center of each flash must be within 15 km
- In this example we would have complete detection even if either GLM or LMA divided this flash into two
- This flash was on January 10 2018 off the Florida coast near Kennedy Space center



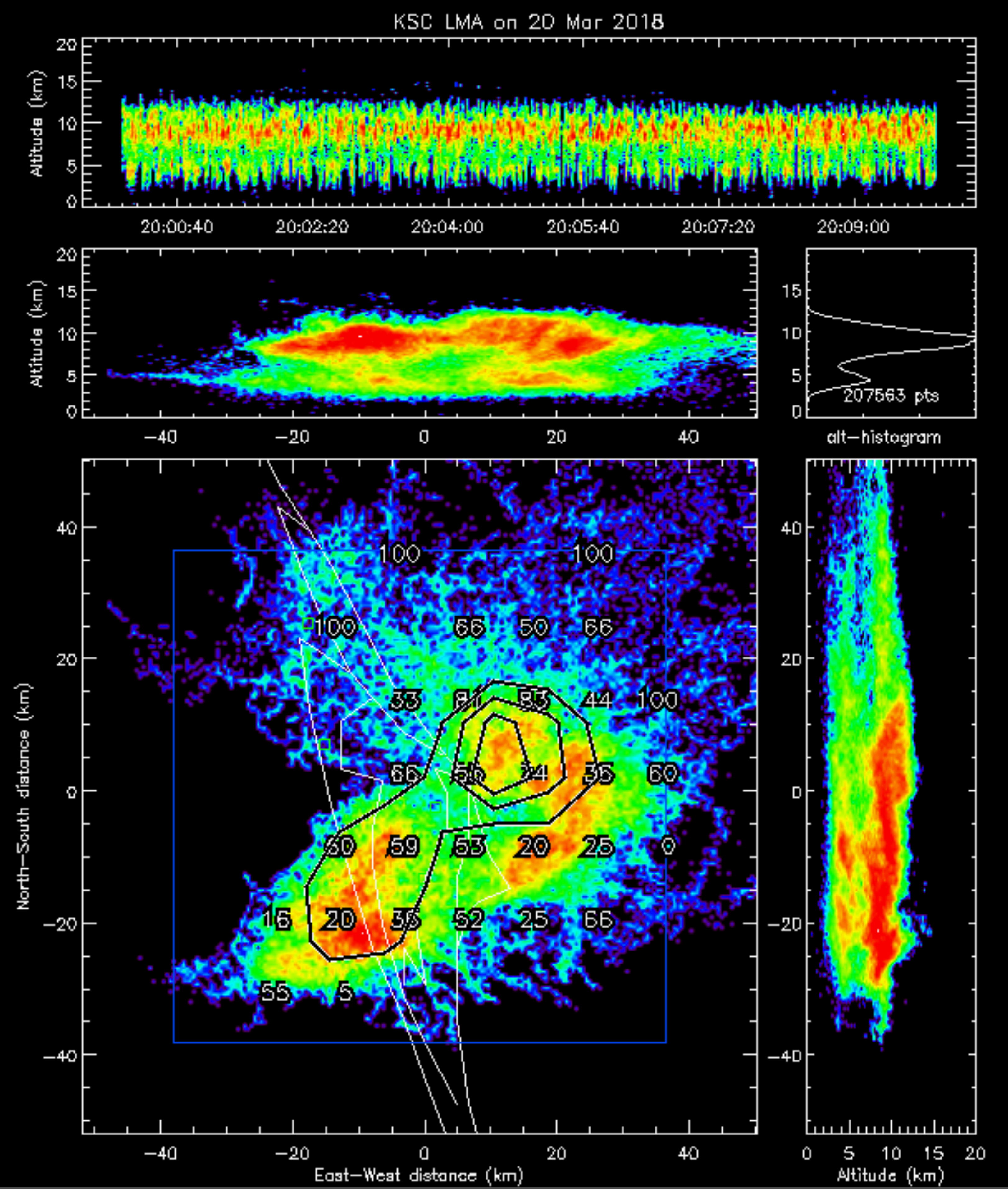
A Small Storm

- 30 minutes of a small storm
- Every LMA flash with more than 10 points was detected for 100% detection efficiency
- The detection efficience for big LMA flashes is shown for 0.1 degree squares that have more than 2 LMA flashes
- LMA sources are show as log-density in color
- Contour shows GLM flash density
- Typically small storms have at least 80% DE



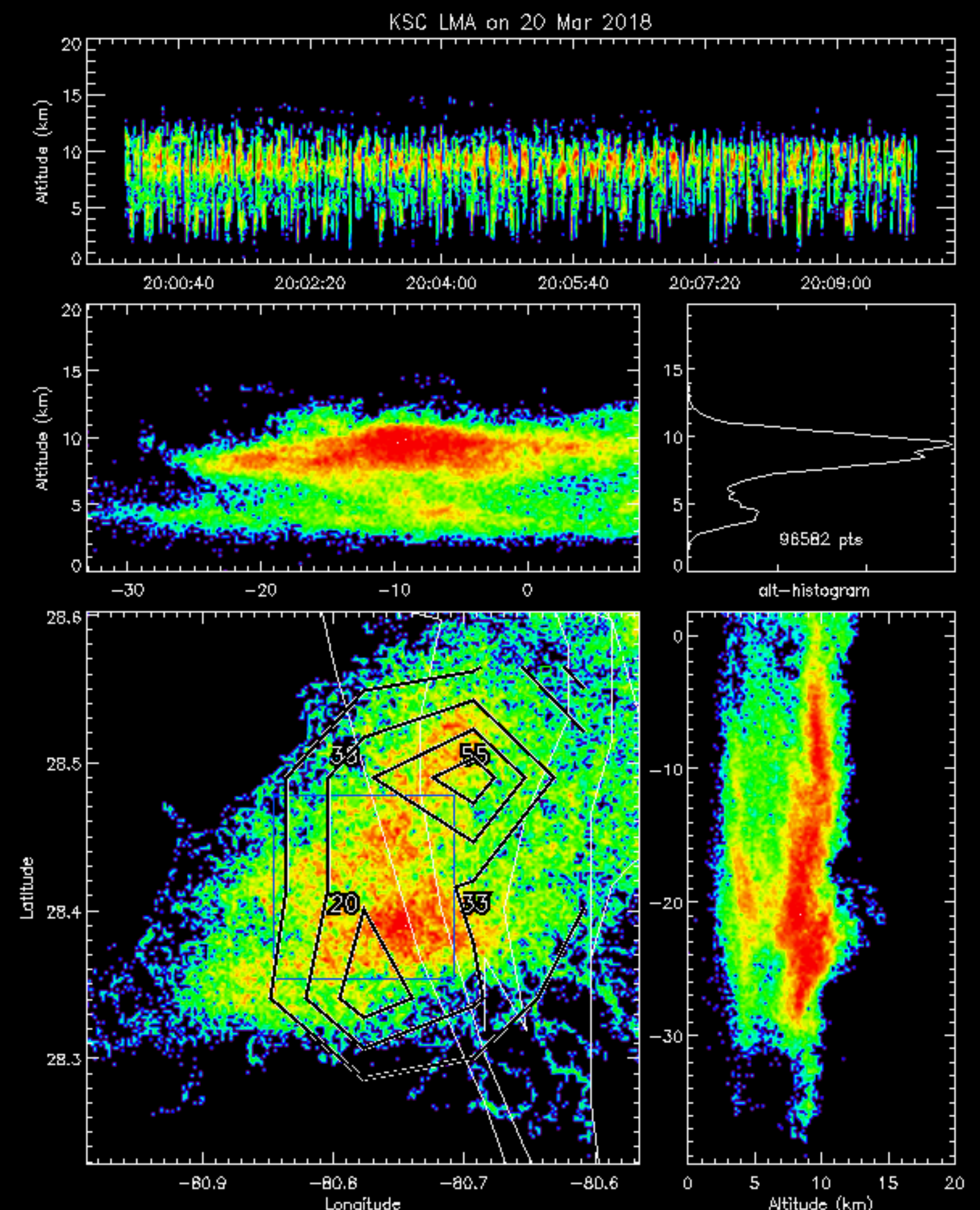
Big Florida Storm

- Last year we saw low detection efficiencies in a massive Colorado storm system
- We wanted to see if changes to GLM processing had changed this
- We looked at other big storms in several LMAs
- This large storm is near the KSC LMA
- The detection efficiencies are as low as 16% in the southern part of the storm



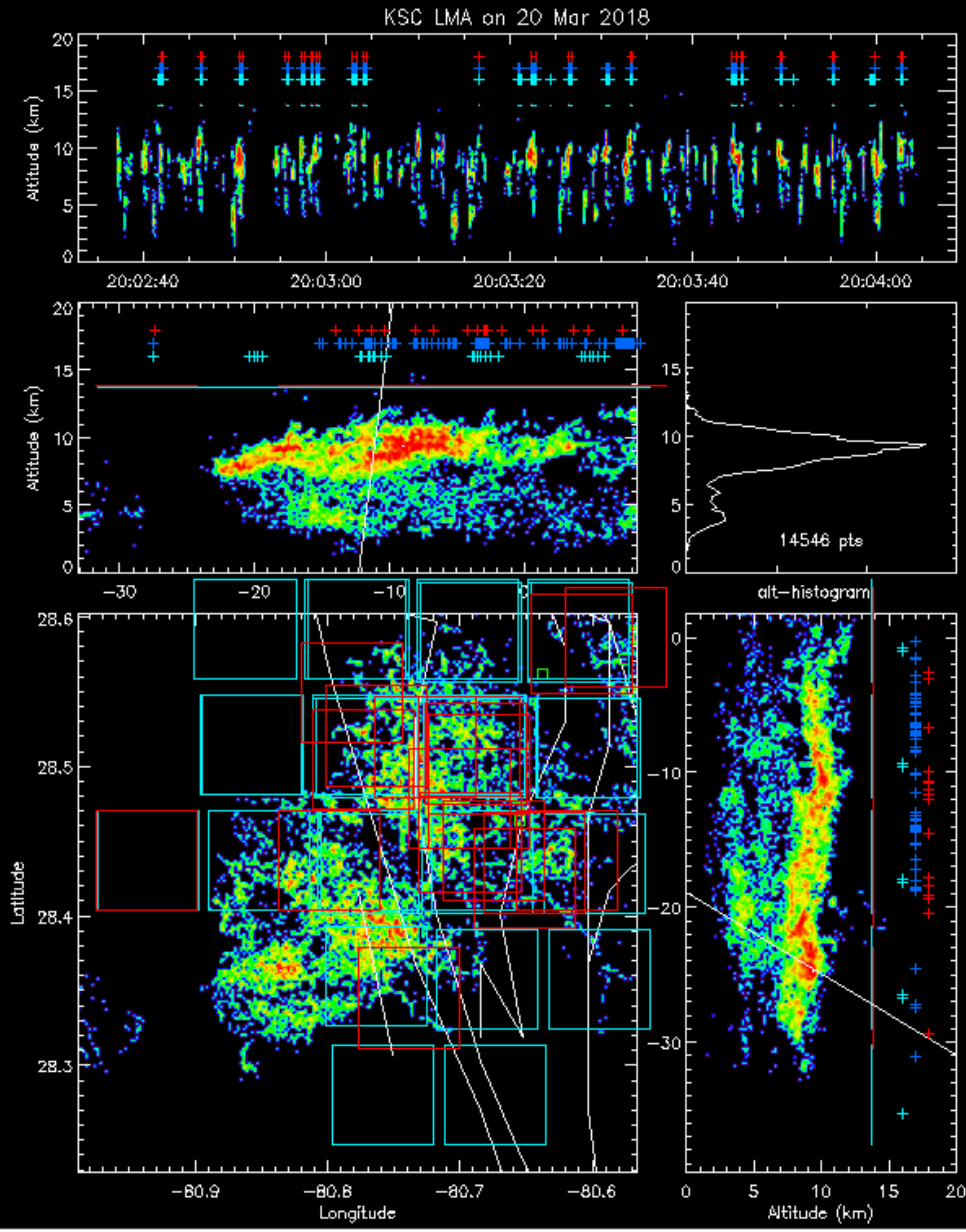
Zoom in to Southern Cornner

- Low DEs
- peak of LMA and GLM flashes are in different places



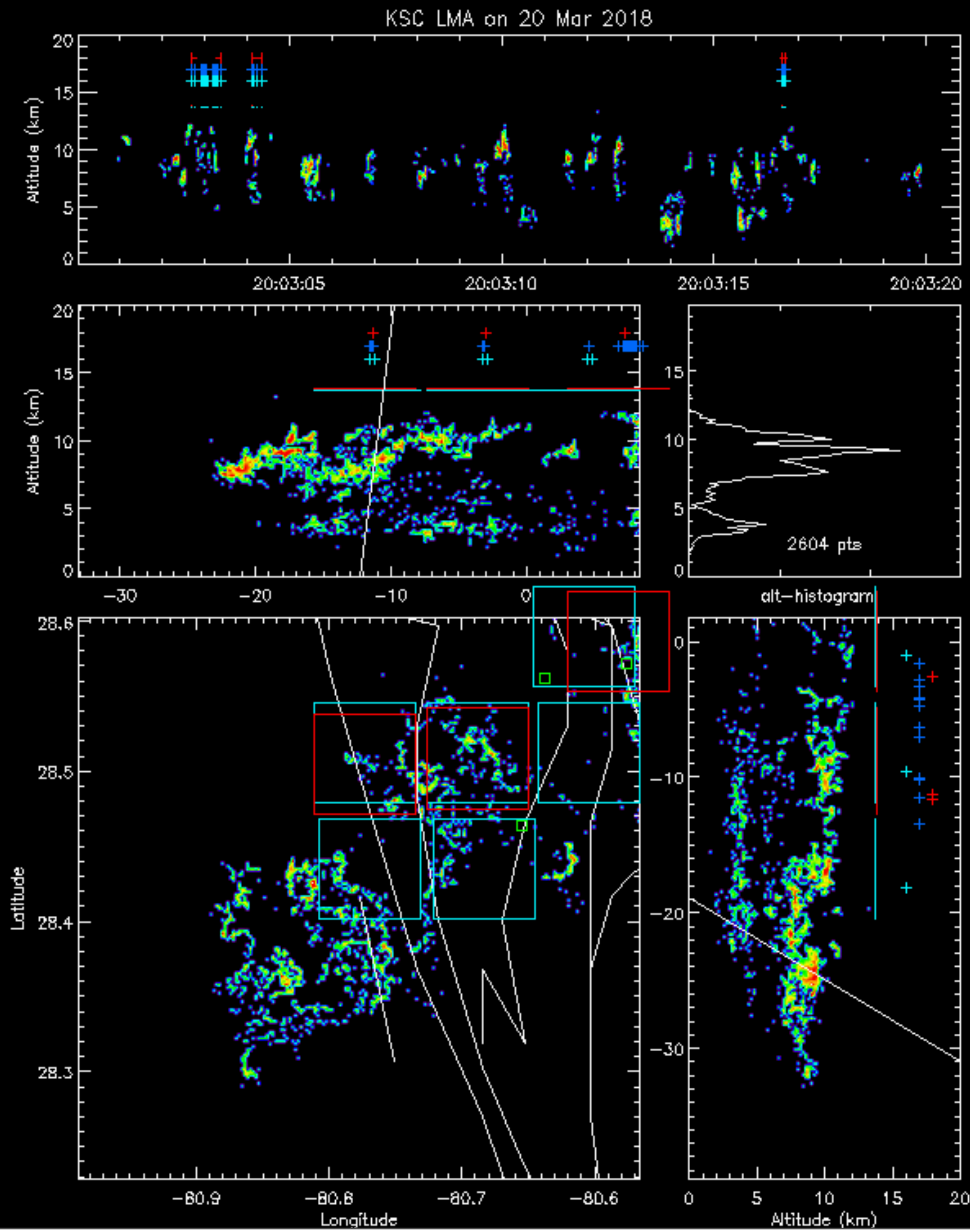
Zoom in in time

- Look at individual flashes and see many are missed
- Only a few flashes in the southern part are detected by GLM



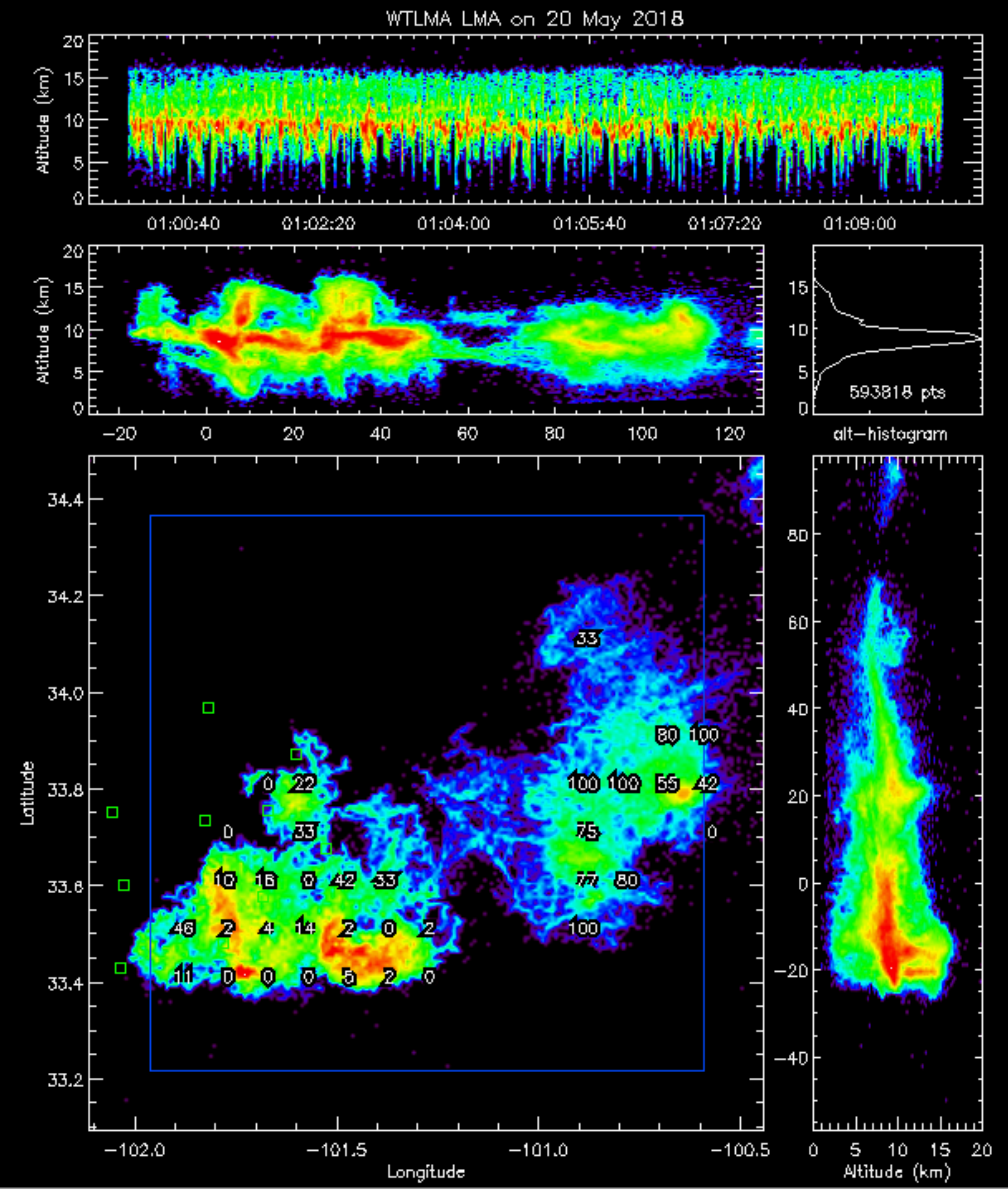
Zoom in More

- Many big flashes are missed
- The flashes detected are at high altitudes
- But many high altitude flashes are missed
- The very low detection rate for GLM is real
- The light from the flashes is not escaping from the cloud
- WHY?



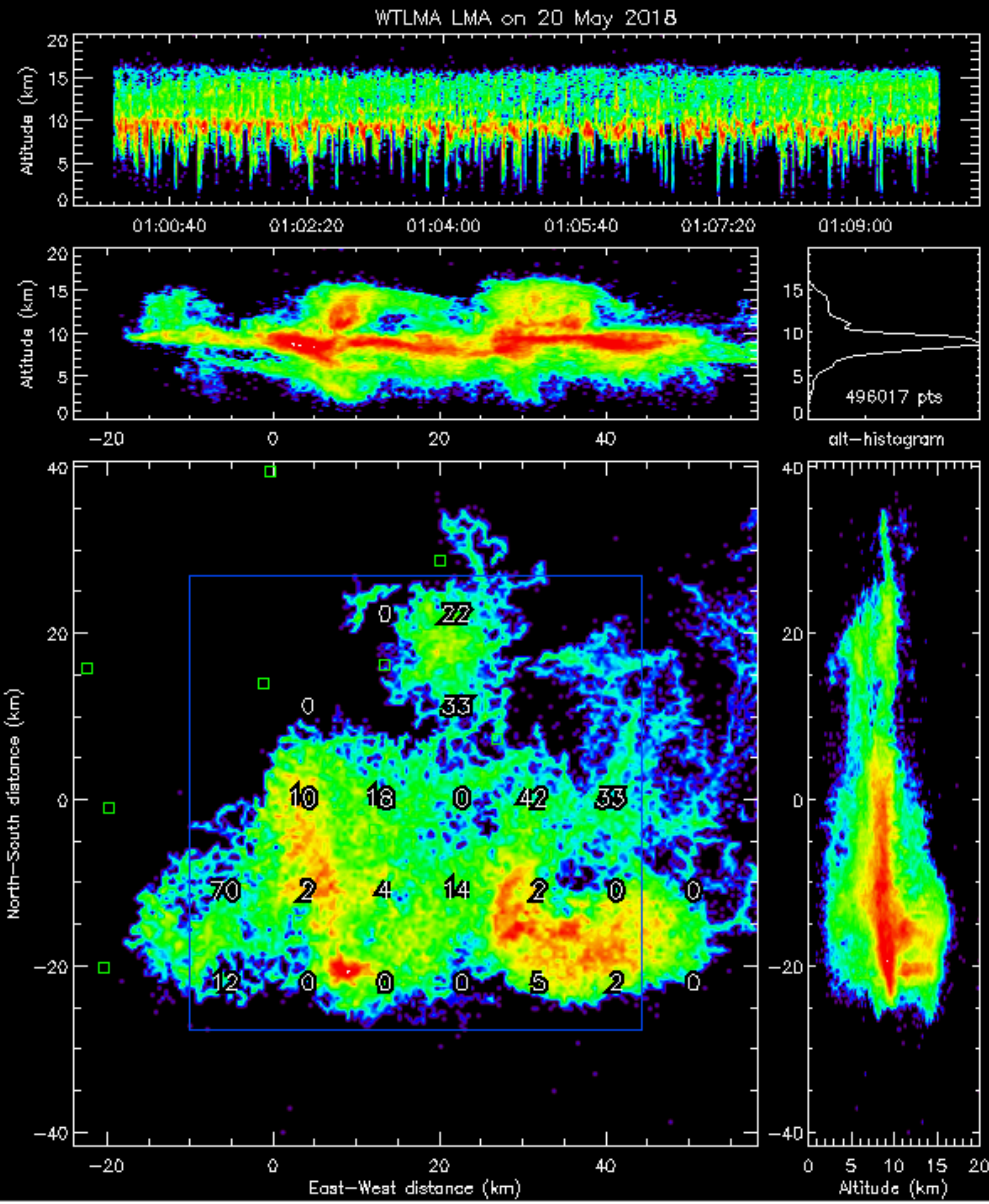
Storm from the West-Texas LMA

- This was a large slow moving Supercell with very large hail
- We have looked at large storms in Colorado, West Texas, Oklahoma, Alabama, and Florida and found low DE (less than 50%) in all locations
- This has the lowest DE of the small number we sampled
- The southern edge of this stotm has 100s of large LMA flashes with less than 1% detected by GLM



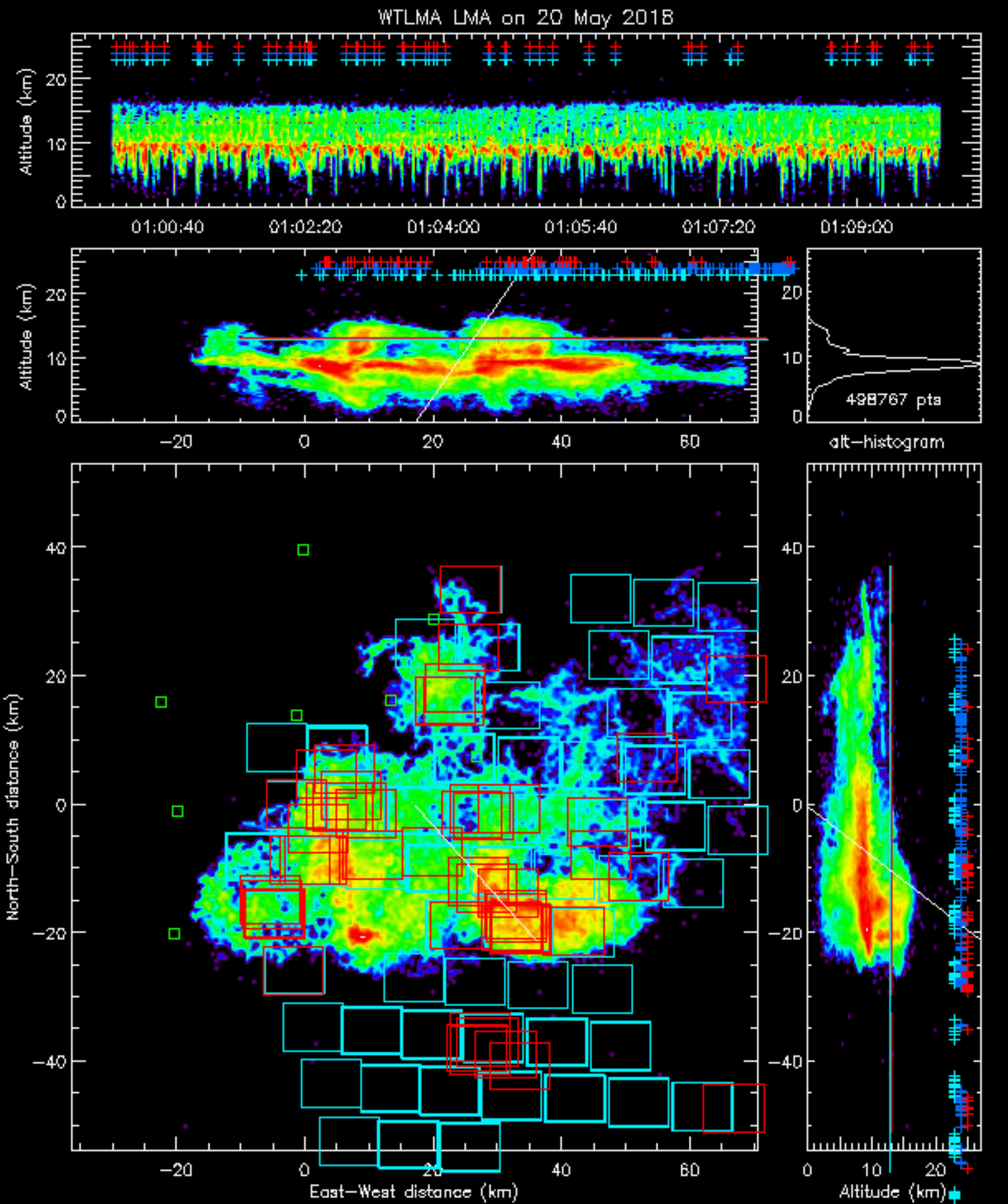
WTLMA Supercell

- Lowest DE in region with very deep lightning activity



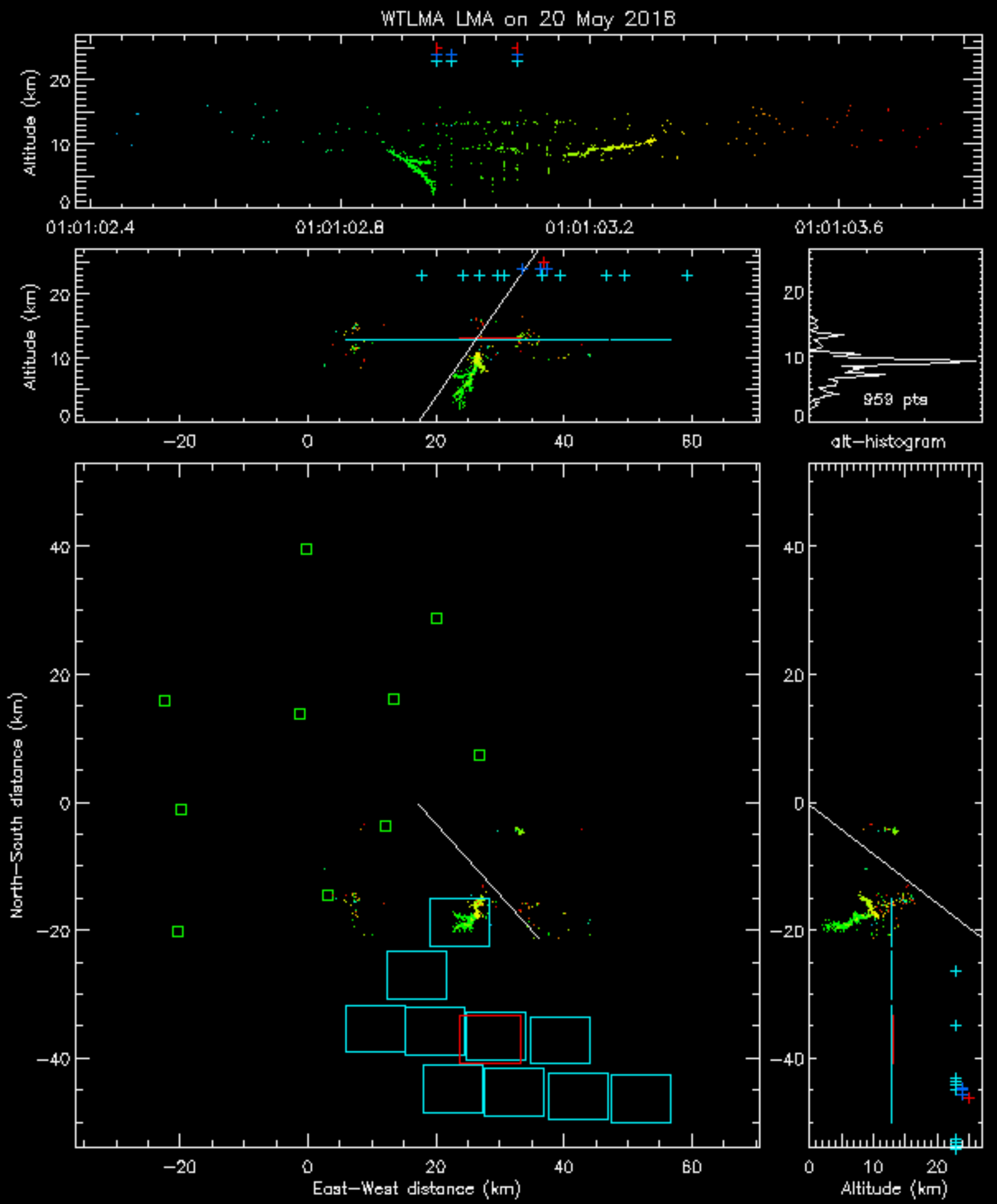
Add GLM Data

- 10 minutes of data
- Region of high LMA sources show no GLM events
- Cloud tops well above model offsets GLM E and S
- Gaps seen in GLM time series
- GLM detections 10-20 km south of storm



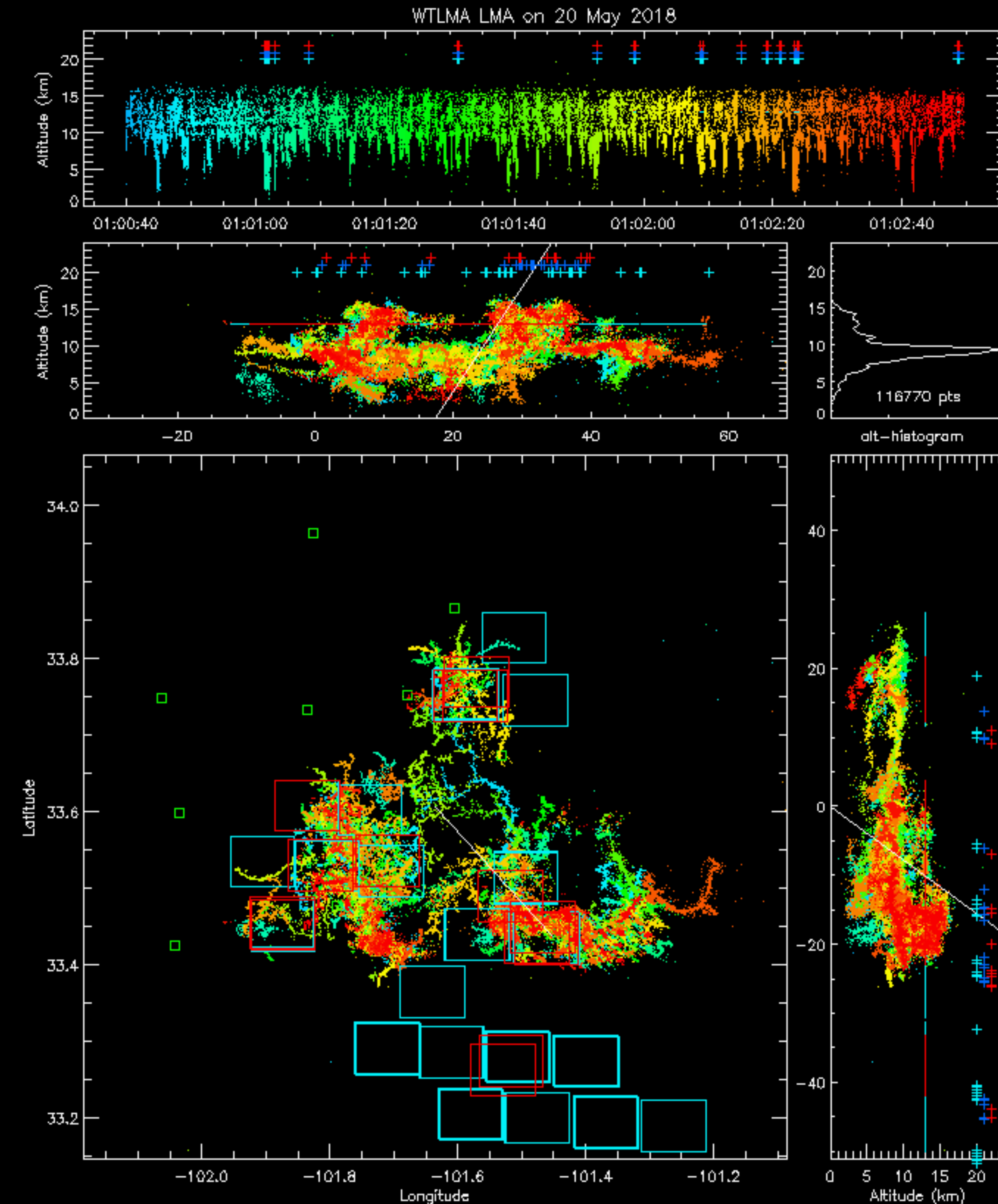
A single flash detected south of storm

- Light from flash is seen where it might have lit up the ground



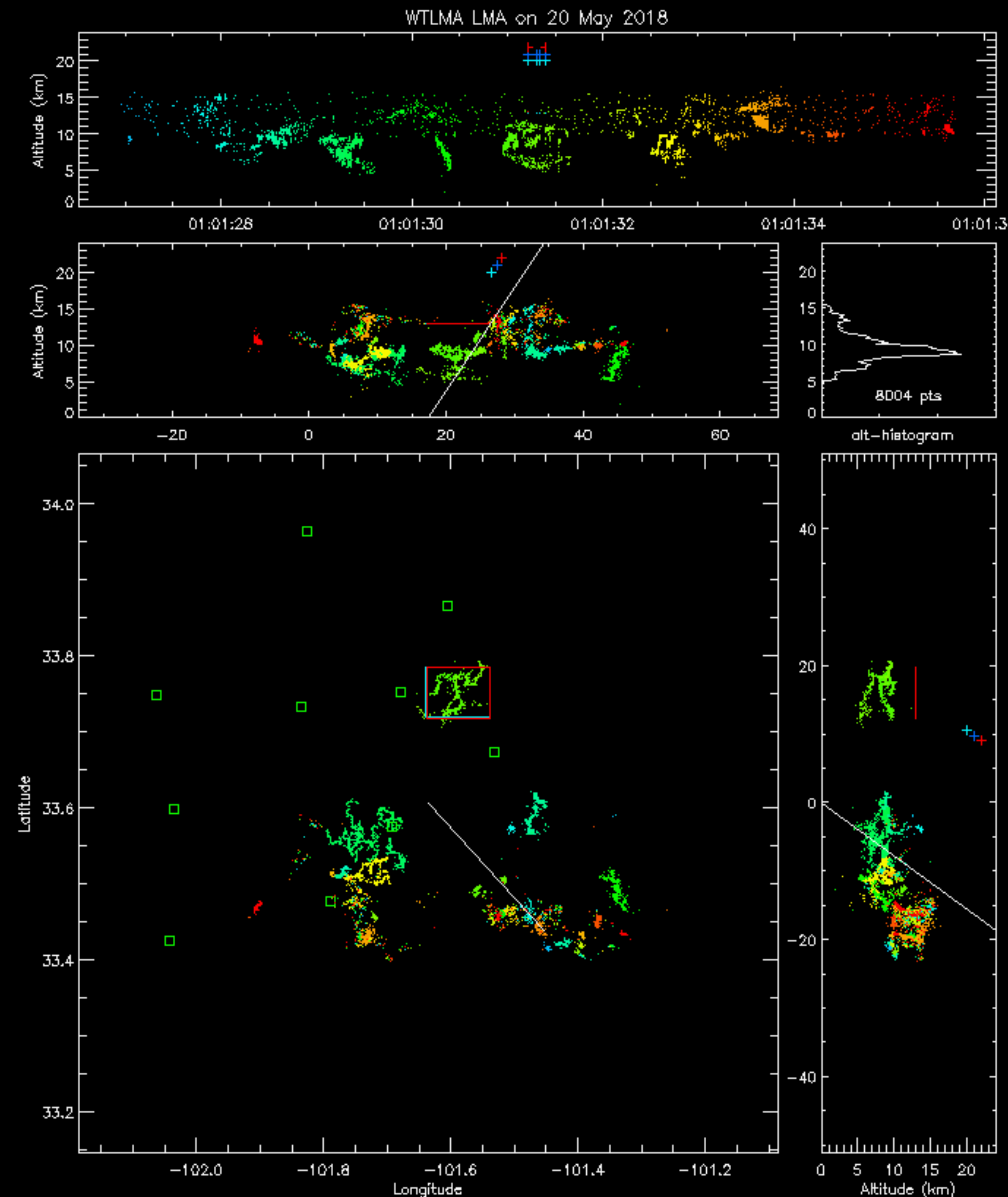
Zoom in more

- Two minutes of data
- About 10 GLM flashes
- 100's of LMA big flashes



Zoom in more

- 8 seconds of data
- one GLM flash



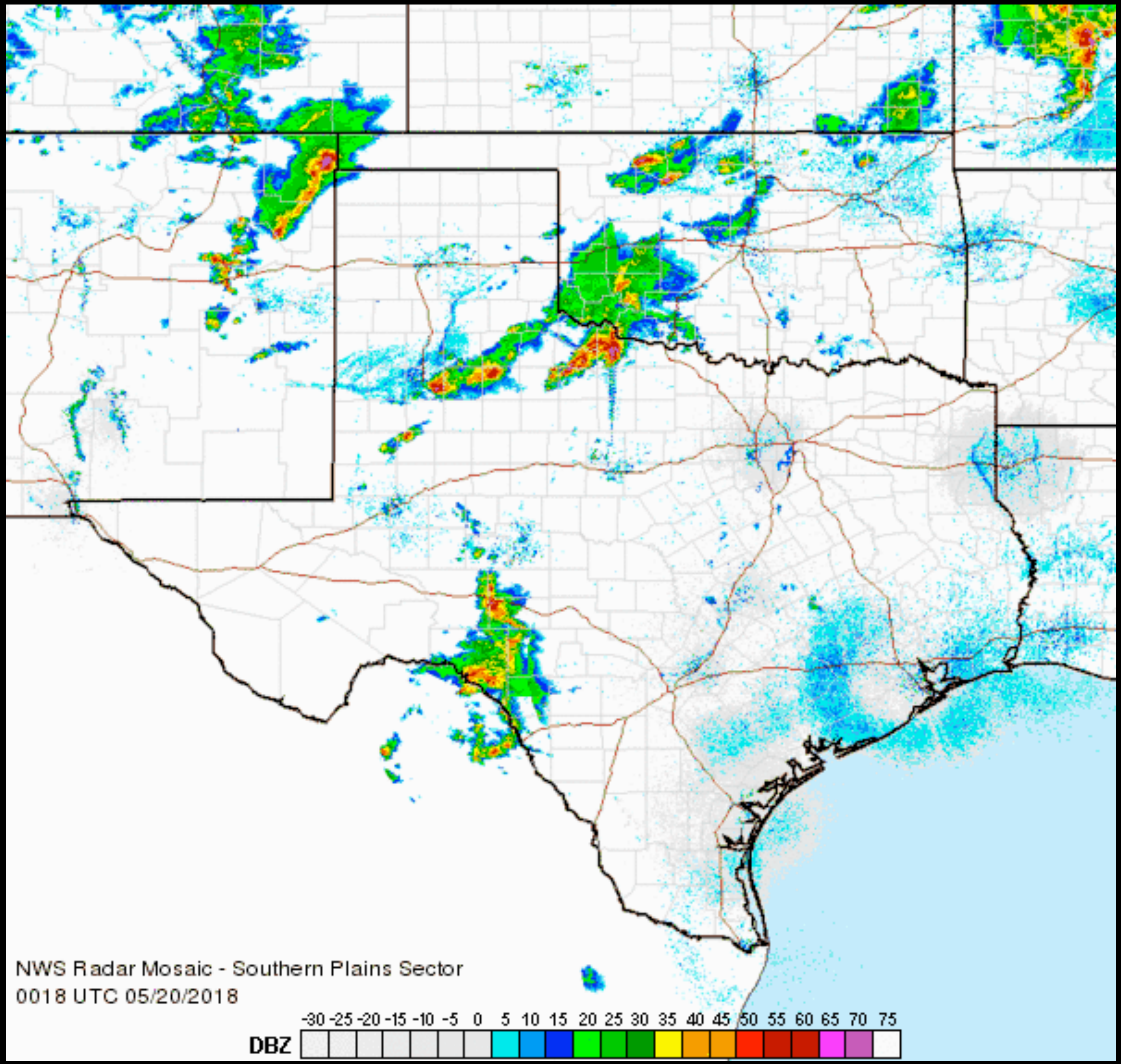
Giant Hail

- The storm was full of liquid water and ice - big hail, graupel, ice crystals
- Water and Ice absorb small amounts of red light
- Something in these greatly reduces the light getting to GLM even from lightning high in the cloud

Severe Thunderstorms Drop Giant Hail and Heavy Rain
19 May 2018

Large hail that fell in southwest Lubbock Saturday evening (19 May 2018). The picture is courtesy of Robert Barritt.

A nearly stationary boundary joined forces with a passing upper level disturbance, approaching cold front, and returning Gulf of Mexico moisture to spark widespread strong and severe thunderstorms over the South Plains region Saturday evening and overnight (19 May 2018). The most intense storms generated giant hail and very heavy rainfall.

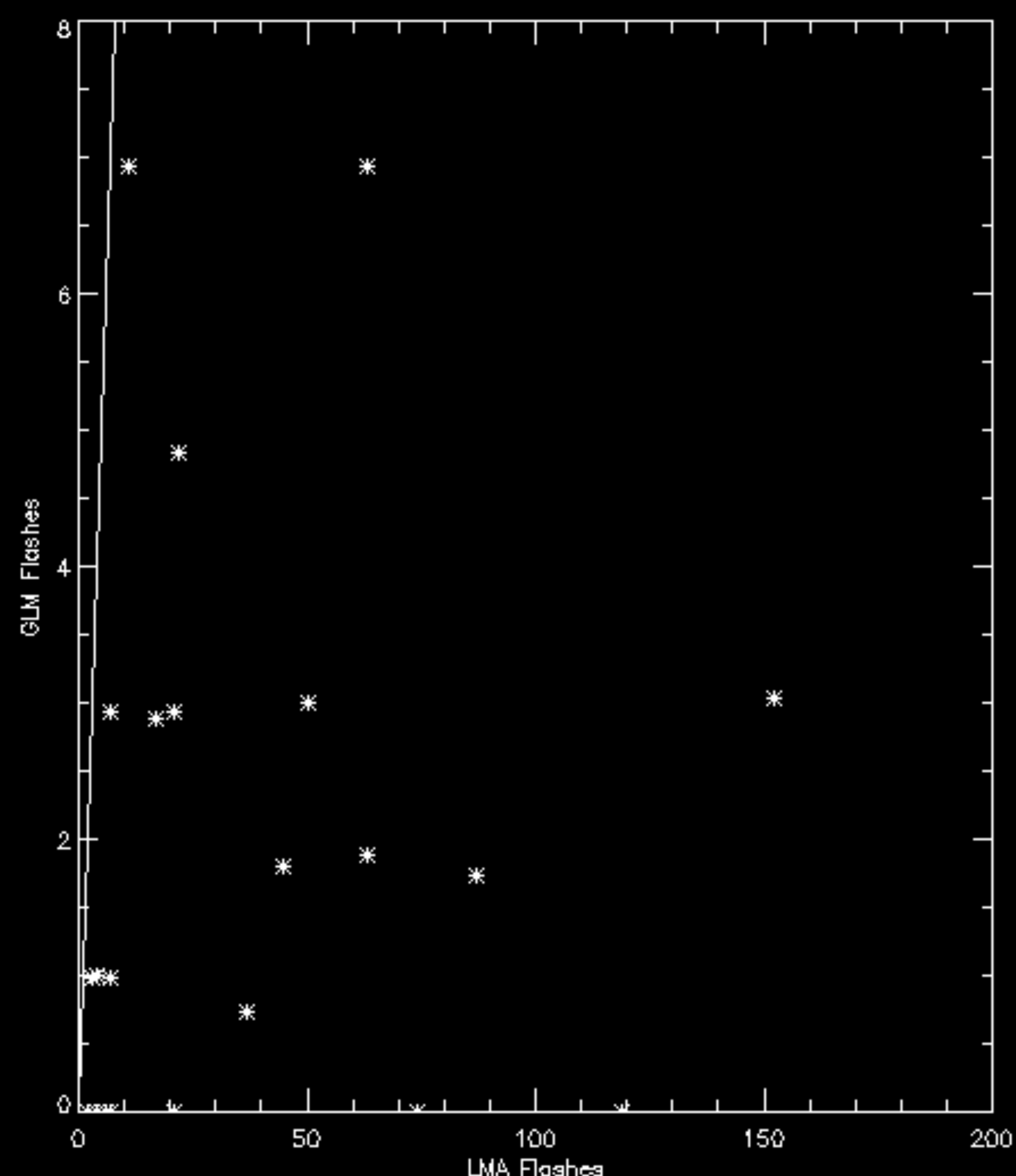

NWS Radar Mosaic - Southern Plains Sector
0018 UTC 05/20/2018
DBZ
-30 -25 -20 -15 -10 -5 0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75

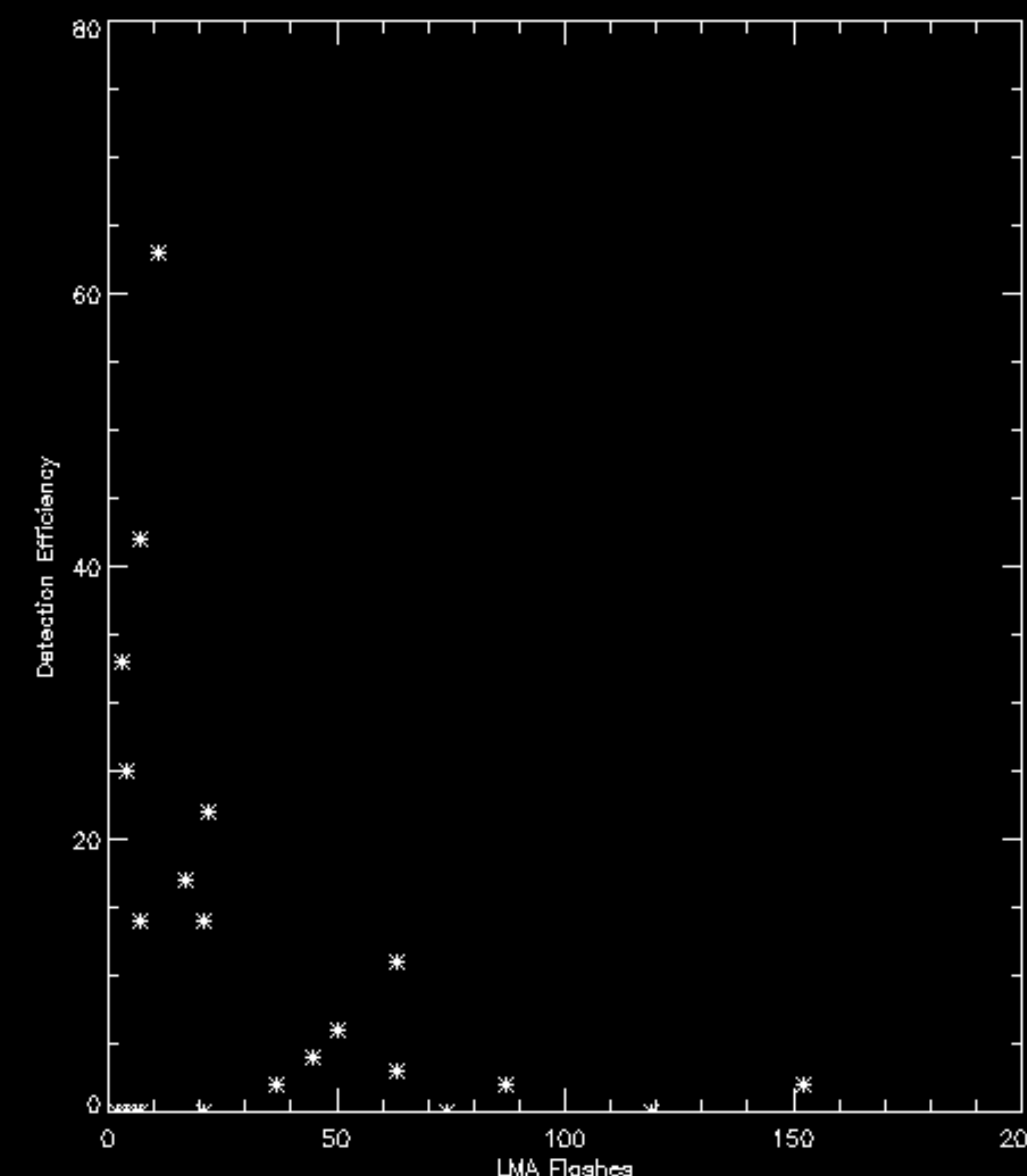
Conclusions

- We find that lightning in super cell and other massive storms are poorly seen by GLM.
- This indicates that as severe weather increases in thunderstorms lightning detected by GLM decreases.
- This implies that GLM data can be misleading if used to help issue severe weather alerts.

Flash Density for LMA and GLM

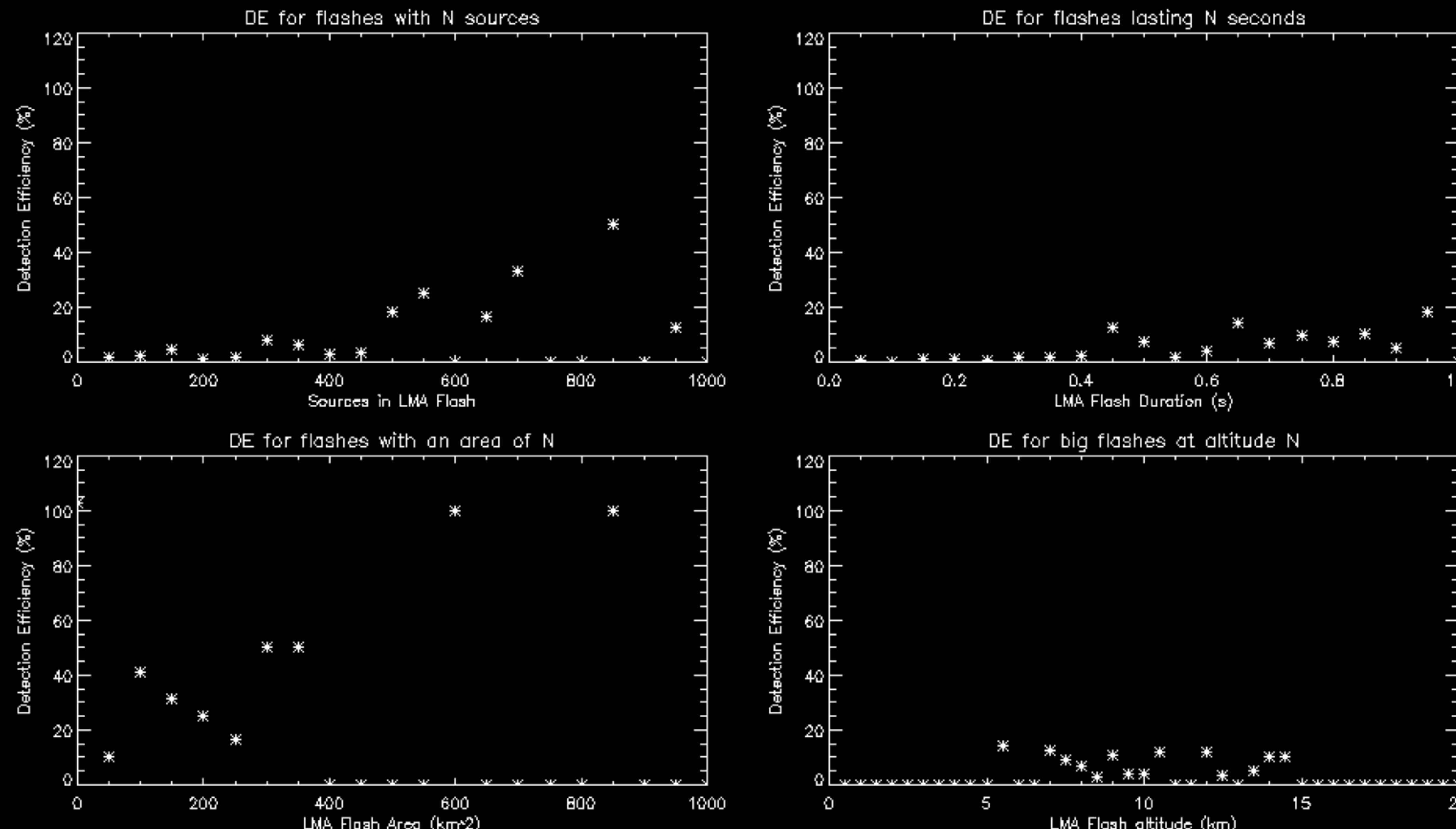
- Flash density on grid
- Only count big LMA Flashes
- grid is 0.1 degrees latitude and longitud





How DE changes

- DE is slightly better with more than 500 sources
- Duration has little effect
- Poor DE at all altitudes



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