



TEXAS TECH UNIVERSITY™



# Operational Trials of Total Lightning Data and Training at NWS Lubbock Forecast Office

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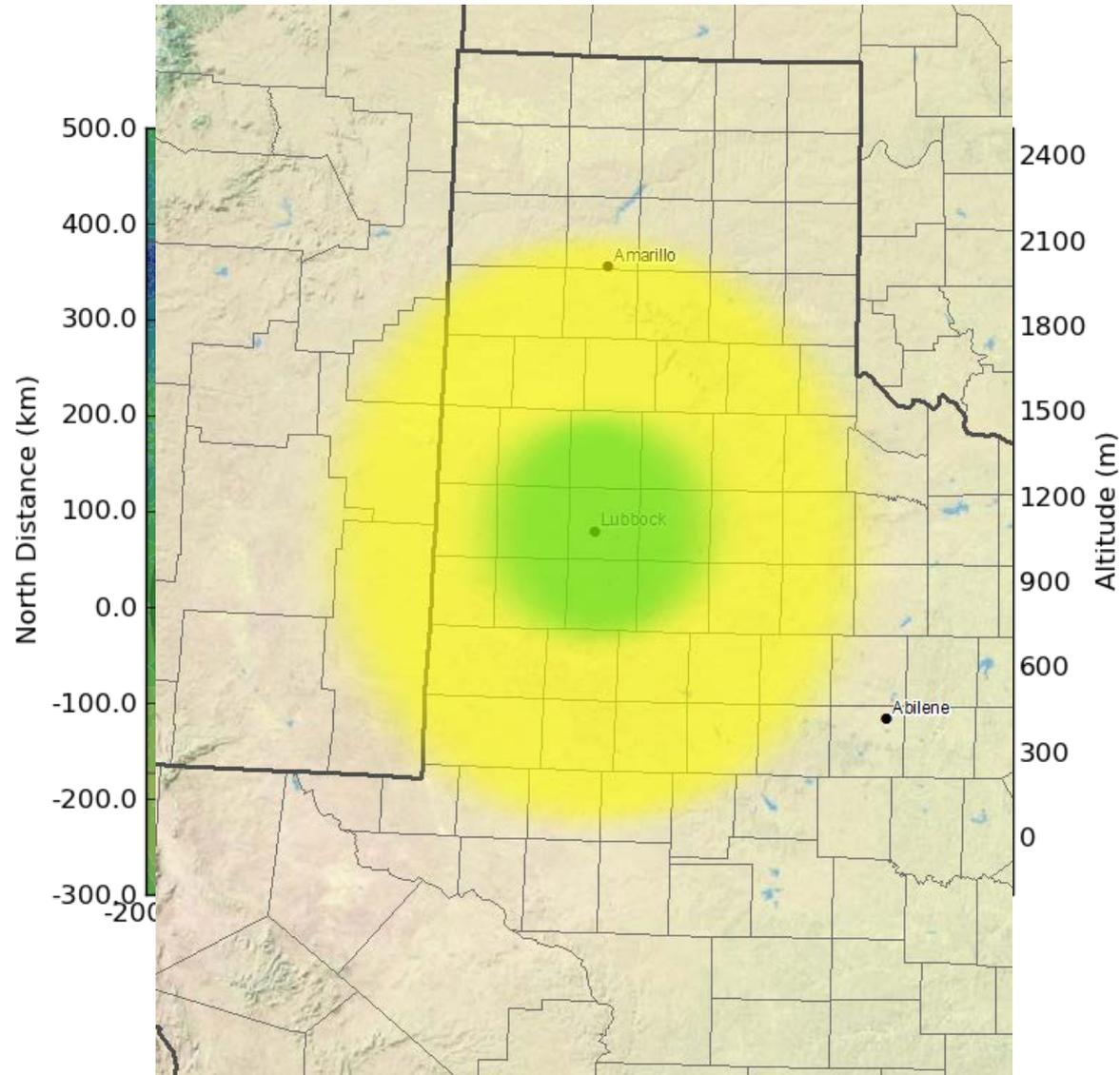
*93<sup>rd</sup> AMS Annual Meeting*

# WEST TEXAS LMA (WTLMA)



## WTLMA network went live late 2011

- 2D mapping across West Texas into OK
- Useful for MCS, frontal passage or long-track supercell events
- 3D mapping ~150km diameter (*green*)
- 2D mapping ~400km diameter (*yellow*)

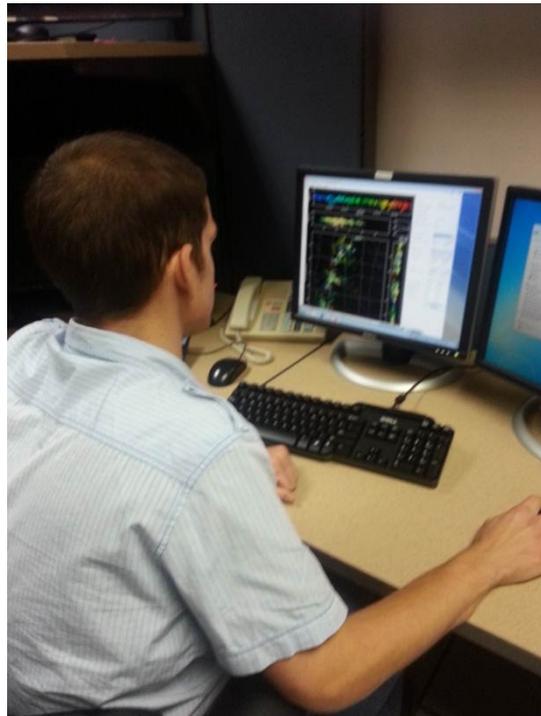




## WTLMA TO WFO LBB

# WTLMA data introduced to WFO Lubbock operations in April 2012

- Real-time data flow with 1s latency from flash to display
- Use of NM Tech LiveLMA Java software for display



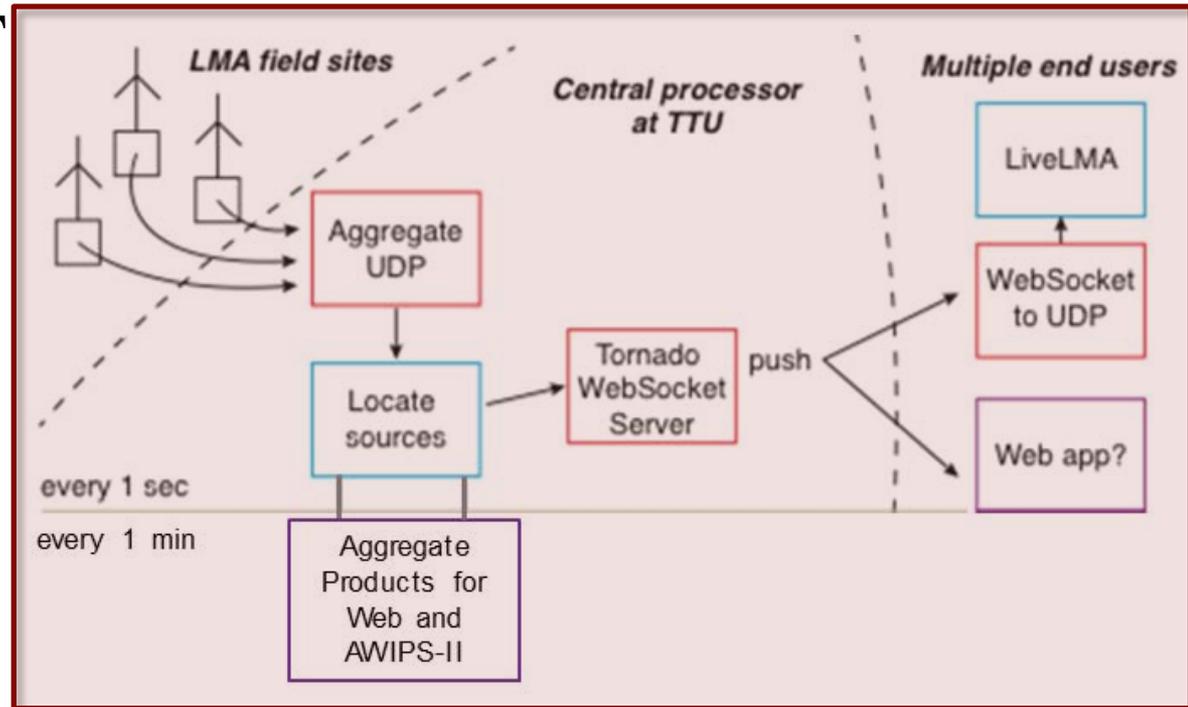
*General Forecaster  
Jonathan Guseman utilizes  
the NM Tech LiveLMA  
Software to analyze  
real-time lightning data  
in a squall line*



## DATA FLOW TO WFO LBB

Linux-based SOCAT utility configured to receive WebView packets from TTU

- Data multicast to any local WFO pc



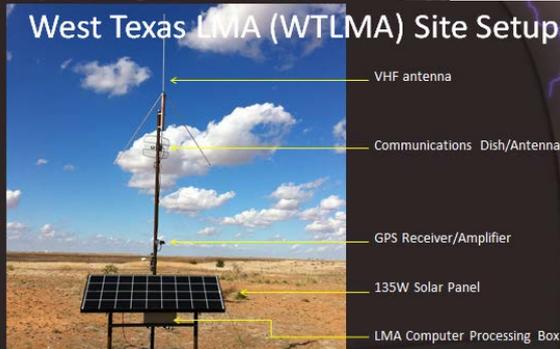
- *Advantage to set-up: single stream of data can be shared by multiple users without taxing local network resources*



## Storm Electrification

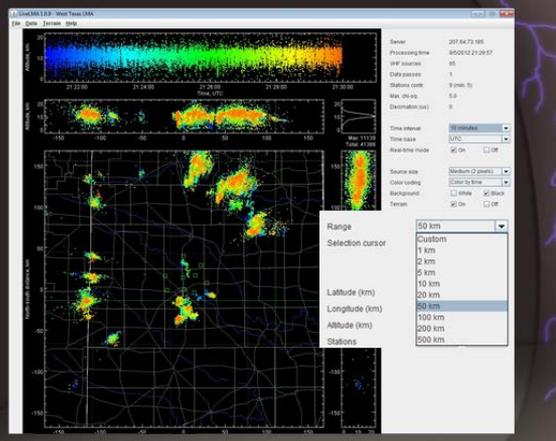
- Precipitation-based mechanisms
  - Two hydrometeors collide, rebound
  - No coalescence can occur
- Inductive
  - Requires pre-existing electric field
  - Must to tra

### West Texas LMA (WTLMA) Site Setup



## 2 COMET training modules developed

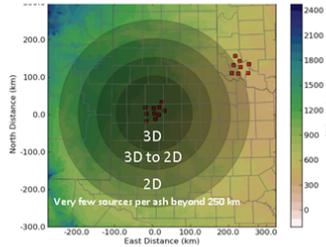
- Module 1: Storm electrification & charge structure
  - *Basic electrification principles*
  - *Latest research on storm charge structure*
- Module 2: LMA hardware & data format
  - *LMA site set-up*
  - *LMA/NLDN comparison*
  - *GUI introduction*
  - *Product explanation*





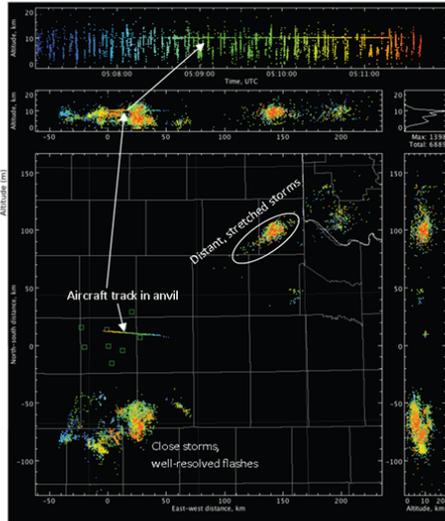
# QUICK REFERENCE SHEET

WTLMA Coverage Area  
Max range—240 km  
Best within 100-150 km of LBB



- In 2D coverage, also expect:
- Increasingly large altitude errors
  - Increasing minimum detectable altitude: earth curvature

Time interval	2 minutes	
Time base	UTC	
Real-time mode	<input checked="" type="checkbox"/> On	<input type="checkbox"/> Off
Source size	Medium (2 pixels)	
Color coding	Color by time	
Background	<input type="checkbox"/> White	<input checked="" type="checkbox"/> Black
Terrain	<input checked="" type="checkbox"/> On	<input type="checkbox"/> Off
Range	Custom	
Selection cursor	<input checked="" type="checkbox"/> On	<input type="checkbox"/> Off
	Min	Max
Latitude (km)	-282.8	282.8
Longitude (km)	-282.8	282.8
Altitude (km)	0.0	20.0
Stations	6	9
Chi-squared	0.0	5.0
	<< Station mask	
	Redraw	



Time/height	histogram
E-W projection	N-S projection
Plan view	

Colors:  
cool = earlier  
warm = later

Log-density: good for showing cellular features  
Source plots: good for seeing channel structure

Mouse scrollwheel allows you to zoom in and out  
Right click + hold pans  
Left click + drag allows area/time selections in any projection

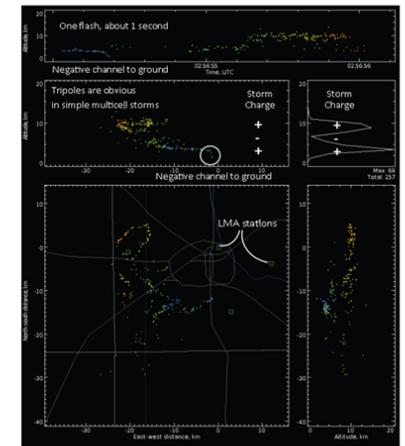
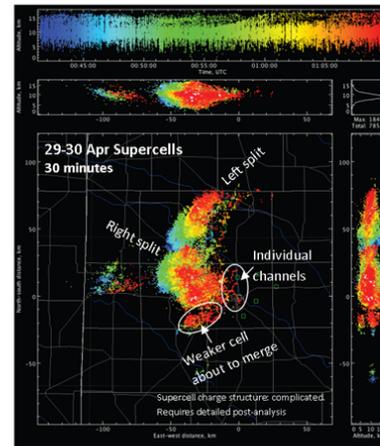
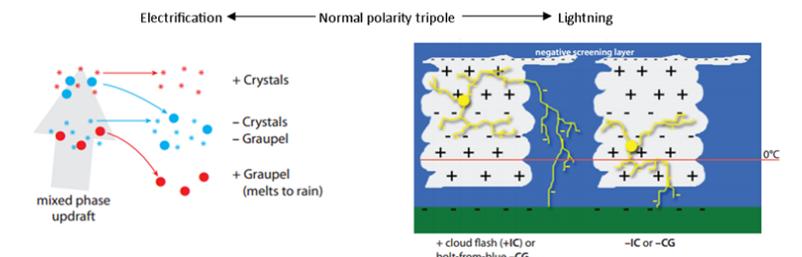
Minimum stations:  
Use 5 (short range)  
or 6 (long range) click  
Redraw to see change

**Rules of thumb:**  
More, smaller flashes in stronger updrafts

Fewer, larger flashes in anvils or stratiform regions

Tropical multicell: about 1 flash per minute  
Supercell: >1 flash per second

Electrification occurs in updraft mixed phase region (~-15C) -> crystal-graupel charge separation occurs -> larger graupel (net - charge) precipitates below smaller crystals (net + charge) -> km-scale charge regions  
Intensifying updraft means liquid water condenses at greater rate which produces more graupel. More graupel colliding with ice leads to more charge generation and separation. The result is an increase in electrical field within and beneath cloud.



LMA detects VHF point sources made by lightning channel steps.  
A CG's channel to ground is a tiny fraction of points detected.  
Negative channels make more points, and +CGs are nearly invisible to the LMA because positive leaders move less impulsively



# FORECASTER FEEDBACK ON TRAINING

- Training stimulated interest in lightning
- 75% of forecasters were more likely to include total lightning data in their warning decision process
- If a module 3 were to be developed in the future, possible topics may include:
  - *LP vs. HP storms*
  - *Winter weather*
  - *Cases utilized in operations/decision support*
  - *LiveLMA playback of specific cases (expand on advantages & disadvantages)*



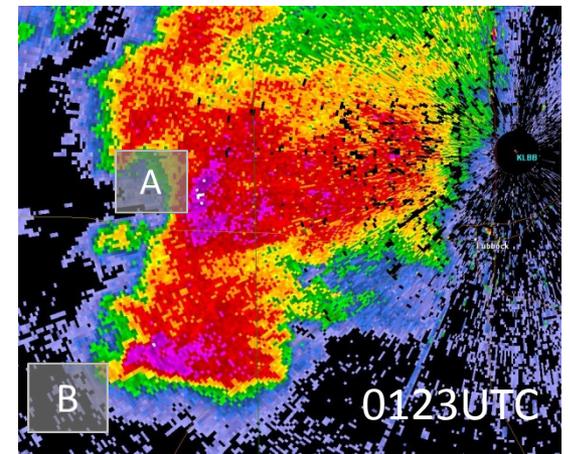
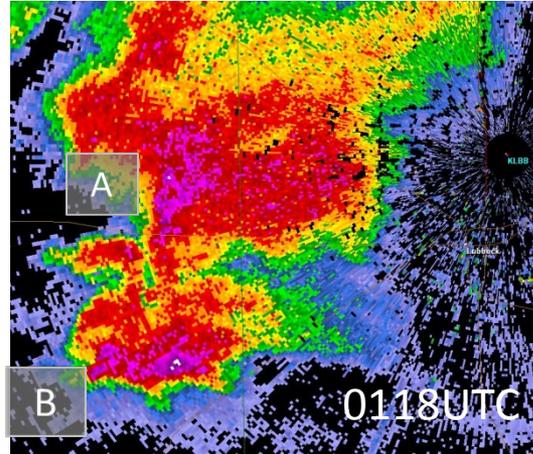
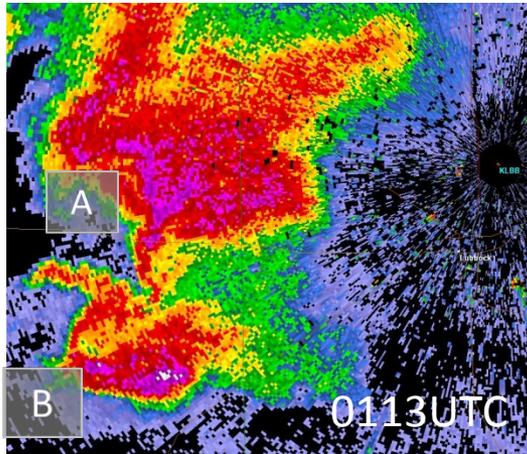
## OPERATIONAL USE

29 April 2012:

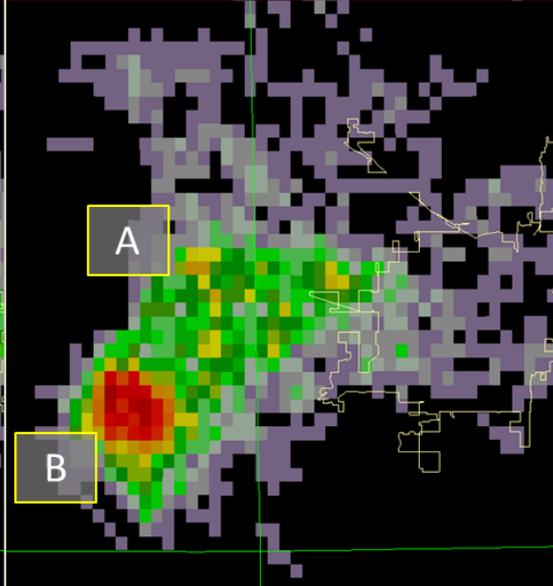
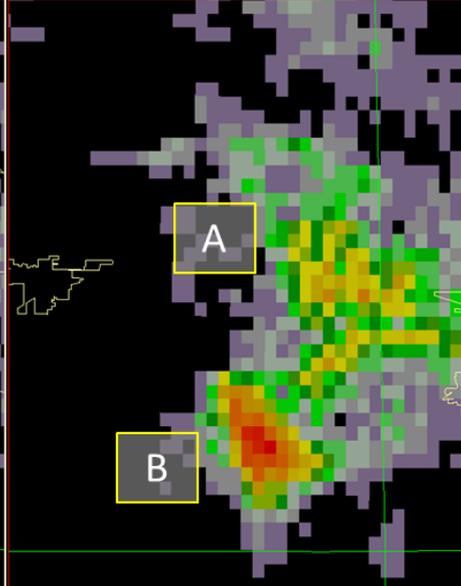
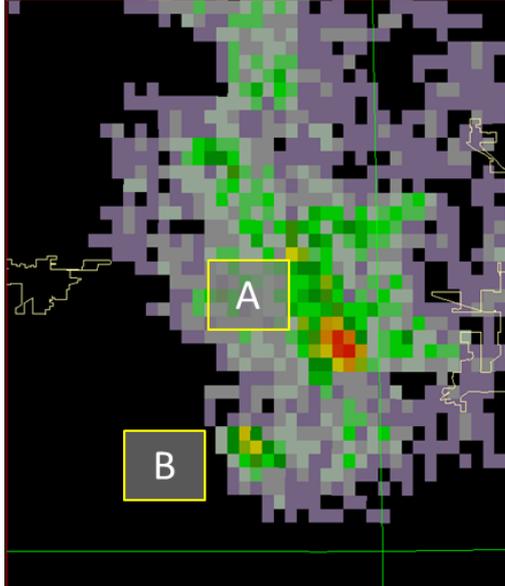
- Large hail event
- Intensification of lightning activity prior to heaviest activity



29 APRIL 2012



MD <1.0 1.0-1.5 3.0-5.0 7.5-10.0 15.0-20.0 30.0-40.0 50.0-75.0 nu



0114 UTC

0118 UTC

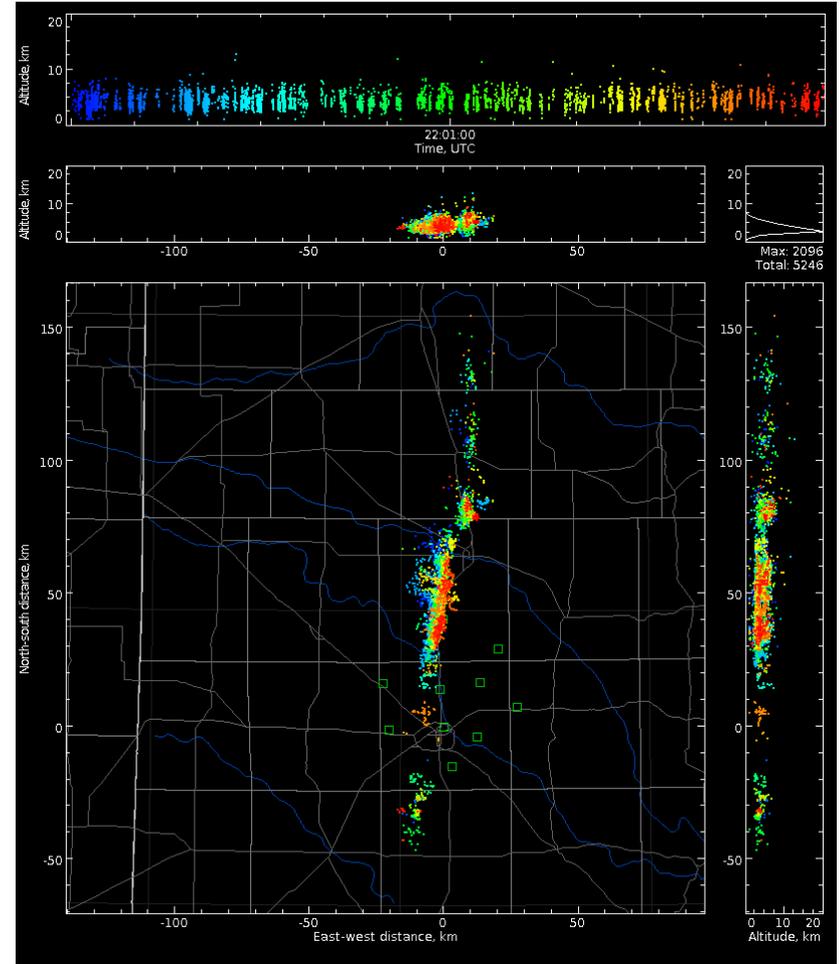
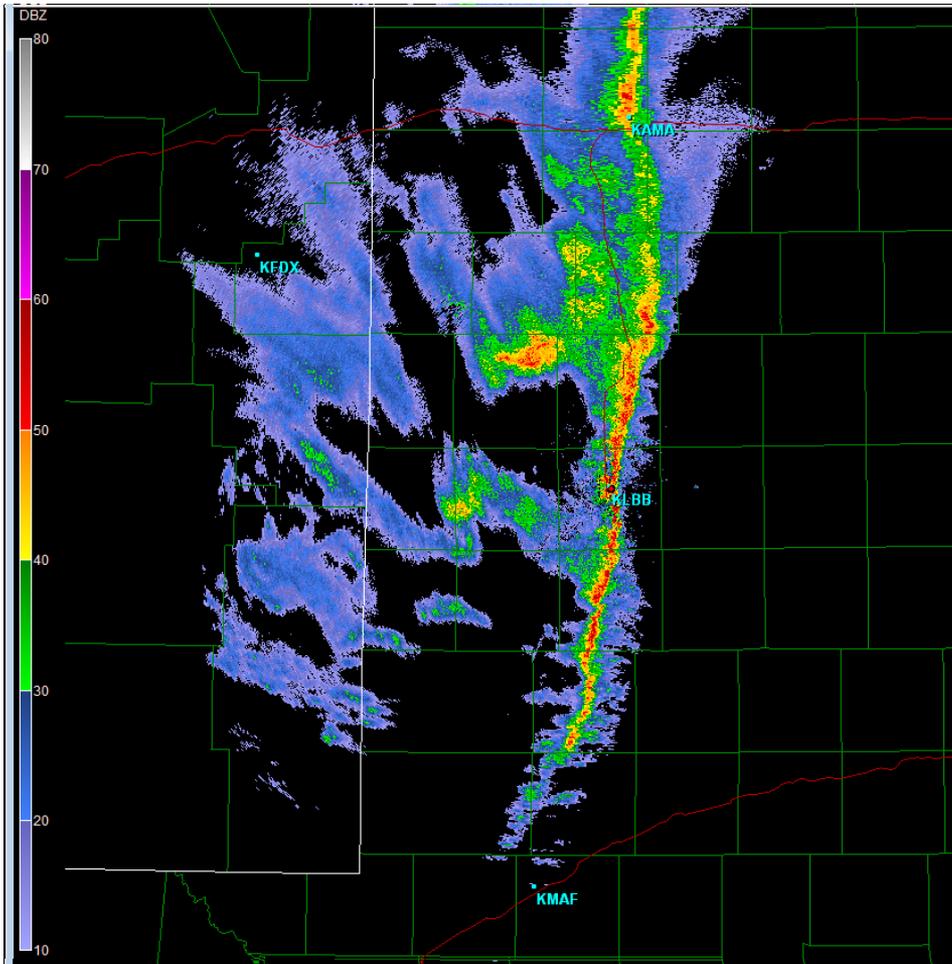
0121 UTC



## 14 December 2012:

- Squall line along fast moving front
- Through CWA ~4 hours
- Total lightning data helped forecasters concentrate on most intense portions of line
- LMA saved valuable time in analyzing a quick moving event
  - *FAR 0.17*
  - *POD 0.79*
  - *83.3% Warning Verification*

14 DECEMBER 2012





## Other uses:

- April 9 – City of Lubbock Fire Training Conference
- April 11 – Hockley County early flash
- June 4 – data ingest failure; supplement warning operations at backup office
- Caprock Canyon State Park
- Post city pool
- FedEx at Lubbock International Airport

# POTENTIAL OPERATIONAL USES



- Lightning desk during large outbreaks
  - *Increased situational awareness*
  - *Provide decision support for large outdoor events*
- Post-analysis of cases to recognize common trends
  - *Could lead to increased warning time as LMA data “fills the gaps” between radar volume scans*



*“Real-time total lightning information has become a fundamental data set during convective situations. It provides insight into updraft tendencies between traditional radar volume scans and is an effective tool for overall situation awareness. The information allows us to better inform decision makers about lightning threats for outdoor venues.”*

- Steven Cobb – SOO WFO Lubbock





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