Pantex

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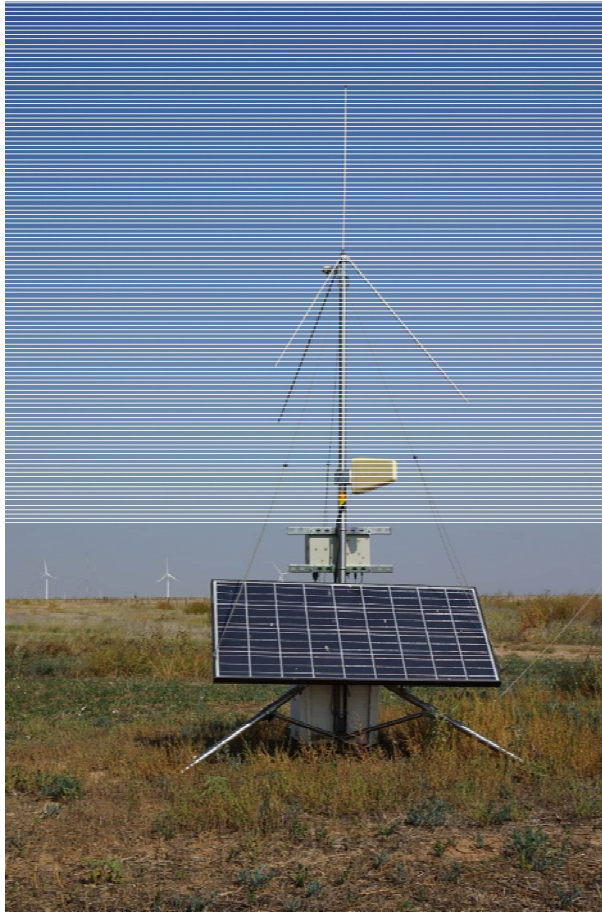
The Pantex Lightning Mapping Array (LMA)

Steve Kersh
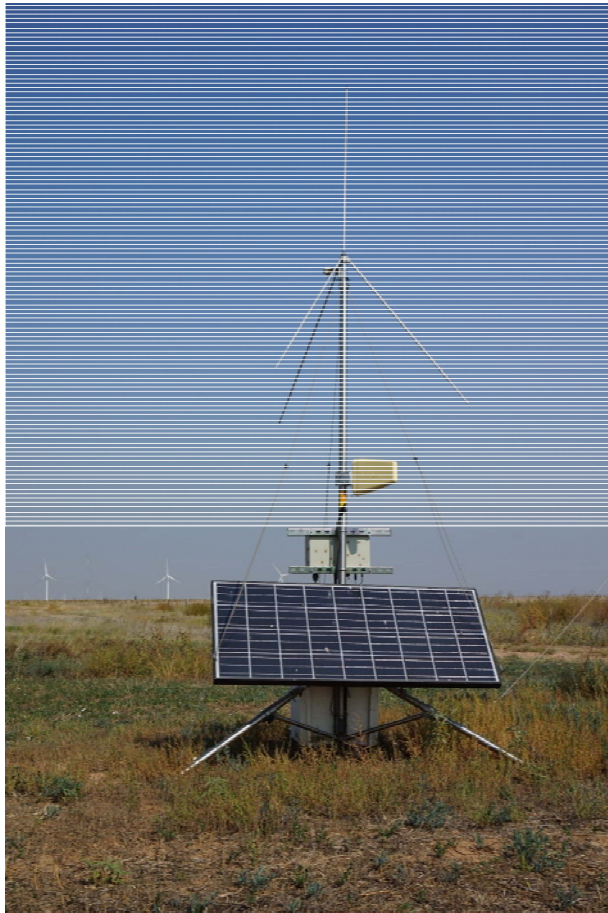*Meteorologist – Electromagnetics Group, Facility Engineering*

April 14, 2021

The Pantex Lightning Mapping Array

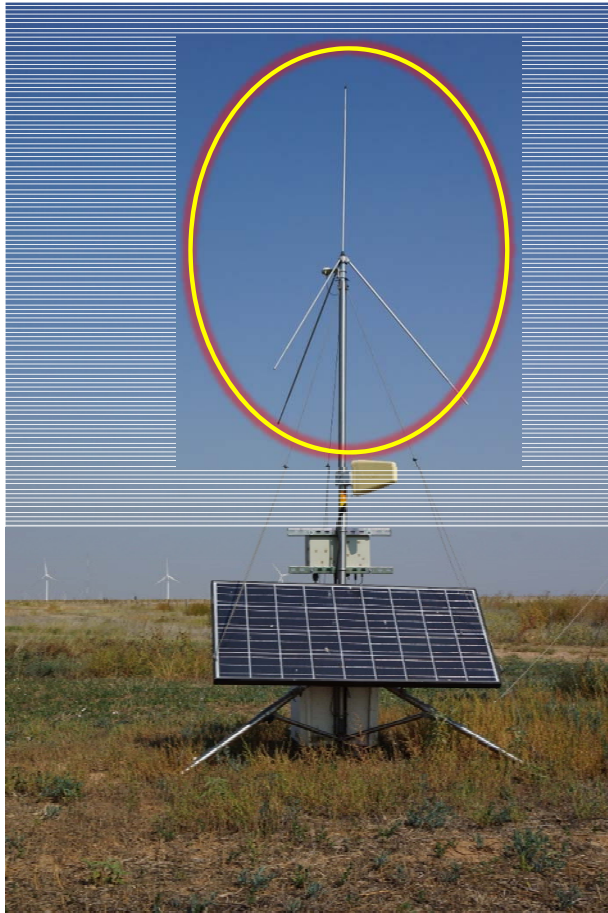The Pantex LMA located east of the John C. Drummond Center (JCDC)

The Pantex Lightning Mapping Array

The LMA is made up of three main parts.

1) Data collection
2) Communication
3) Power & processing
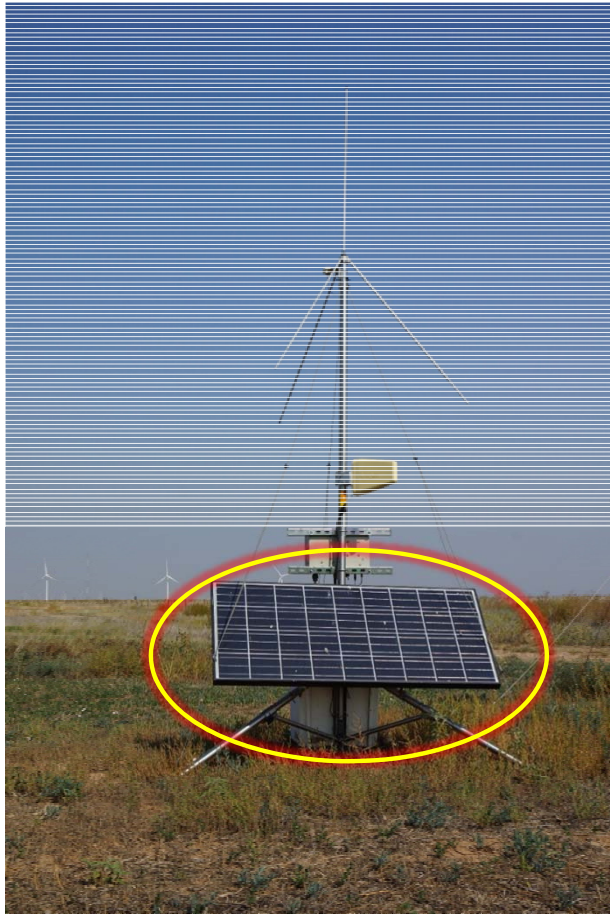
The Pantex Lightning Mapping Array

The antenna is located at the top of the LMA and is the way the device "listens" for static discharges that are occurring inside clouds.

The LMA can pick up the smallest static discharge ongoing inside developing thunderstorms that could be the precursor to a future cloud-to-cloud or cloud-to-ground lightning strike.

Research done at Pantex in 2020 of 20 different storms from February through November showed an average lead time of around 20 minutes from when "source densities" were detected inside developing thunderstorms over the Texas Panhandle to when the first cloud-to-cloud or cloud-to-ground lightning strike occurred.

The Pantex Lightning Mapping Array

Power for the Pantex LMA is through the solar panel, located on the front of the device. The boxes below the solar panel house the processing unit and the battery, which is connected to the solar panel.

The Pantex Lightning Mapping Array
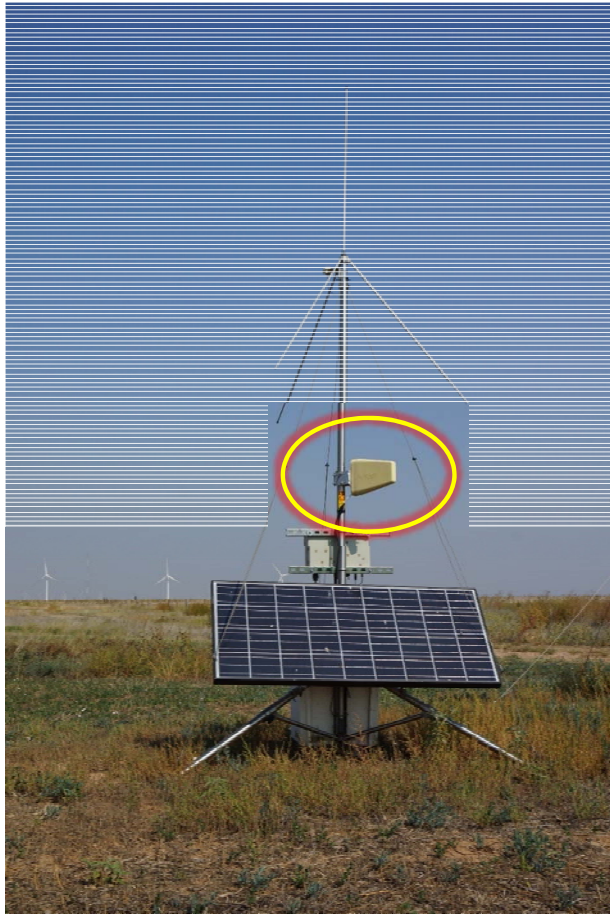
Communication occurs via the Yagi antenna that is connected to the mast. This cellular antenna sends the data from each LMA to the network hub at LMA Tech, who houses the data from Pantex's network of sensors.

This data is then displayed on Pantex's LMA website

www.pntx.lmatech.net:443/pntxlma

How The Pantex LMA Works

As clouds develop vertically and continue to push higher and higher into the atmosphere, the water droplets freeze and become graupel. The graupel collides with each other, helping to produce "static discharges" inside the cloud, which can be precursors to a cloud-to-cloud or cloud-to-ground lightning strike.

How The Pantex LMA Works

These "static discharges" can be "heard" by listening to an AM radio station (or tuning between AM radio stations) when thunderstorms are present or ongoing. Not all of the "static" that you hear on the AM radio are lightning strikes, most are static discharges coming from the clouds!

The Pantex Lightning Mapping Array
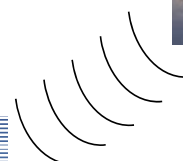
So, in essence, the Pantex LMA sits and "listens" for those static discharges and if there are a lot of them in a small, confined area (called a source density), it displays those on the Pantex LMA map.

How The Pantex LMA Works
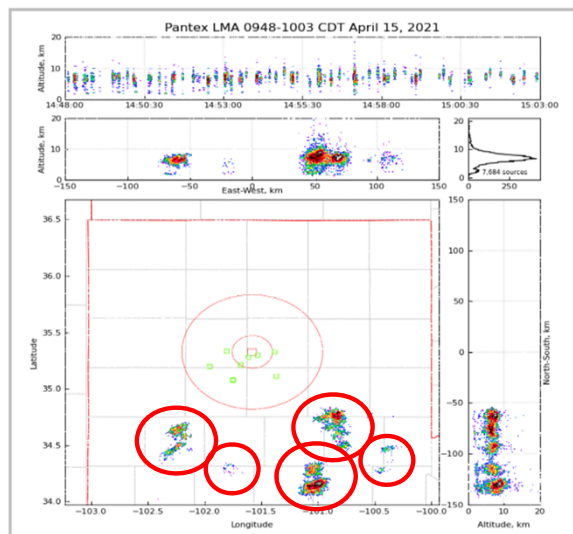
Here's what the "source densities" look like when plotted on the Pantex LMA map. When this snapshot was taken on the morning of April 15, 2021, we had an area of showers and thunderstorms over the southern Texas Panhandle. The "brighter colors" of red, yellow and white indicate very high source density areas.

How The Pantex LMA Works
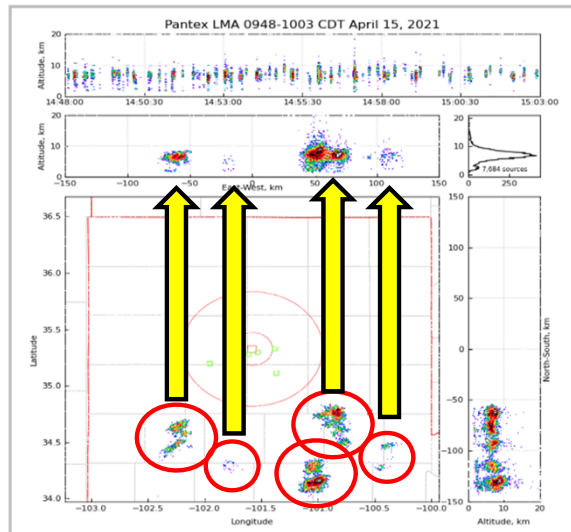
The source densities can be seen on a vertical scale as well, which lies just above the LMA map. The altitude scale is in kilometers, but will show you the height of the static discharges coming from the clouds.
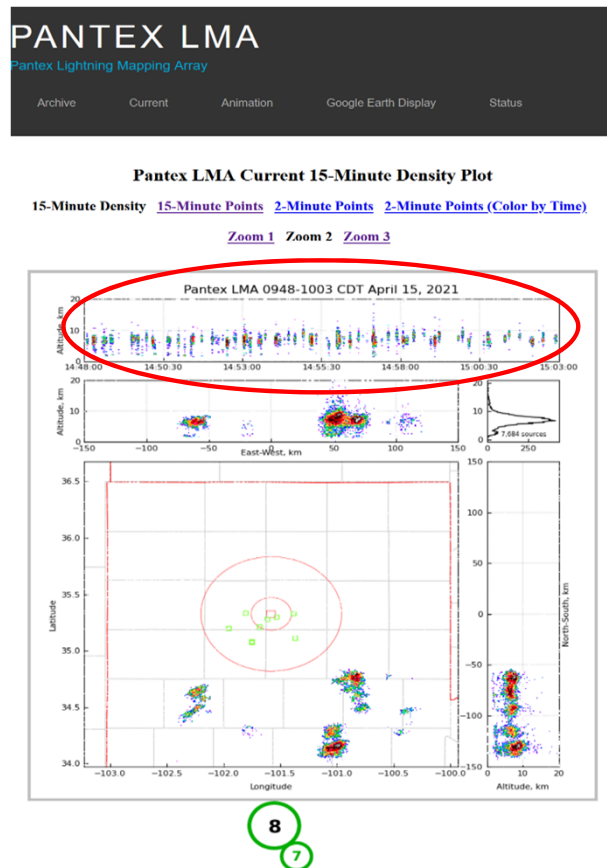
How The Pantex LMA Works
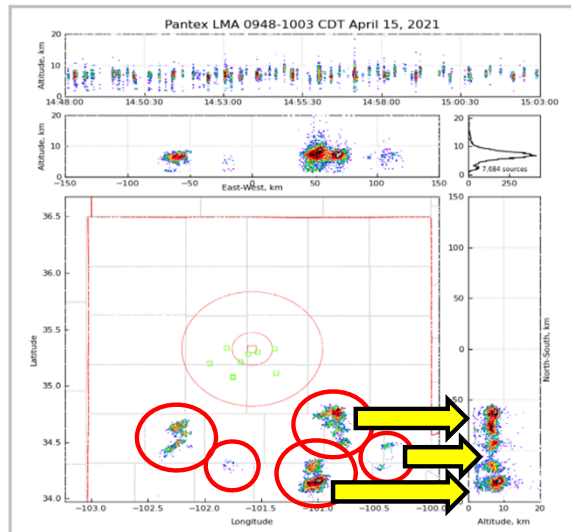
The source densities can be seen on a horizontal scale, which lies to the right of the LMA map. It shows how far away from Pantex the storms are located, in kilometers.

How The Pantex LMA Works

The scale just below the time, date and year of the data is the horizontal time scale. As source densities occur, this scale shows how many occurred and at what time. The oldest data is on the left with the newest data on the right.
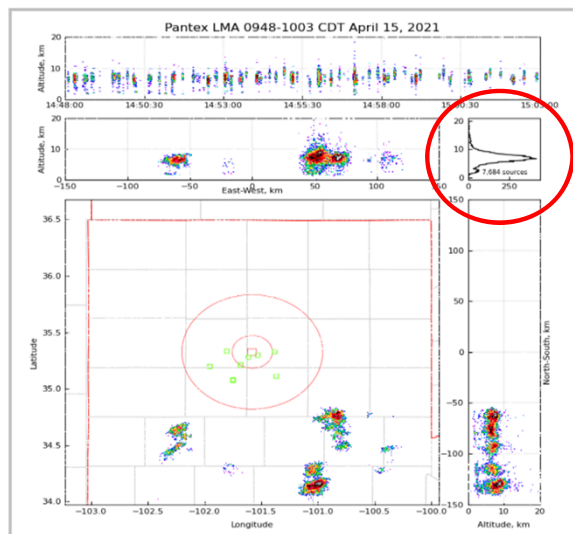
How The Pantex LMA Works

Lastly, the graph circled in red shows how many source densities were detected by the LMA over the last 15 minutes.

On this particular map, over 7,000 source densities were detected over the last 15 minutes!
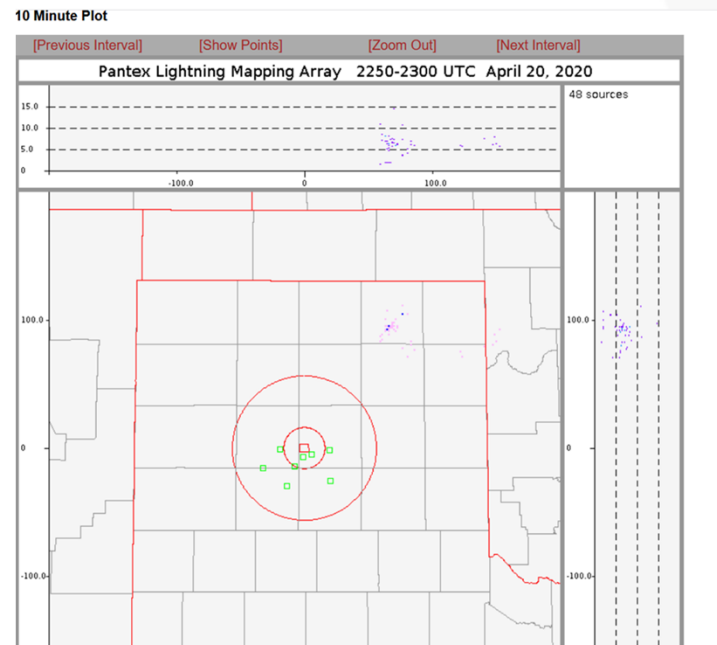
2020 Pantex LMA Research

At 5:52pm CDT, on April 20, 2020, we had a thunderstorm developing just north of River Road HS. The storm developed in the mid-levels of the atmosphere and was showing up on KFDX and KLBB WSR-88D radars.
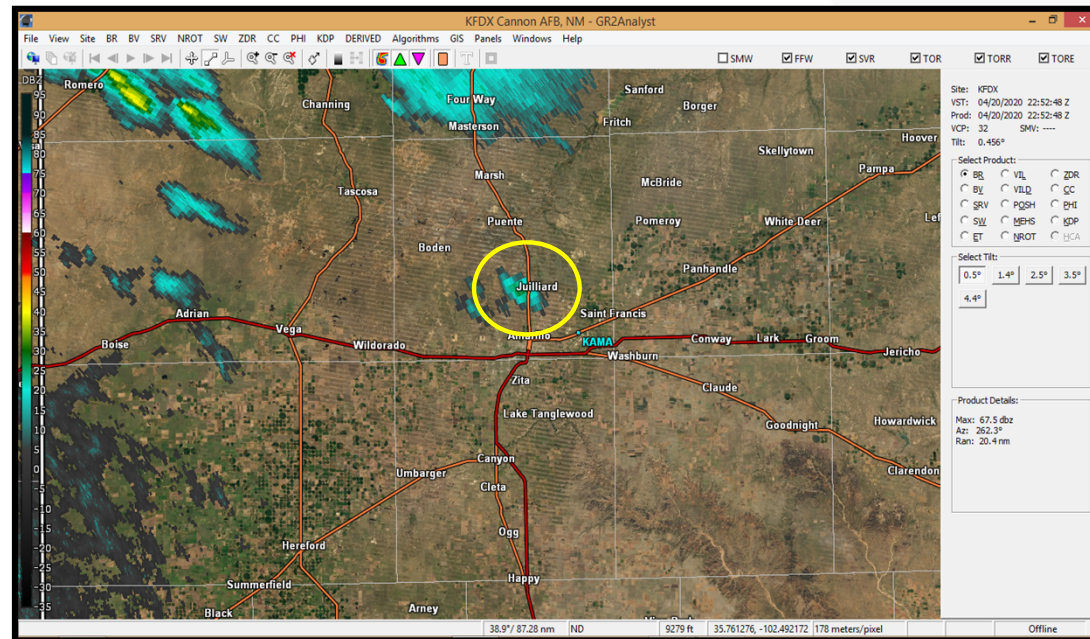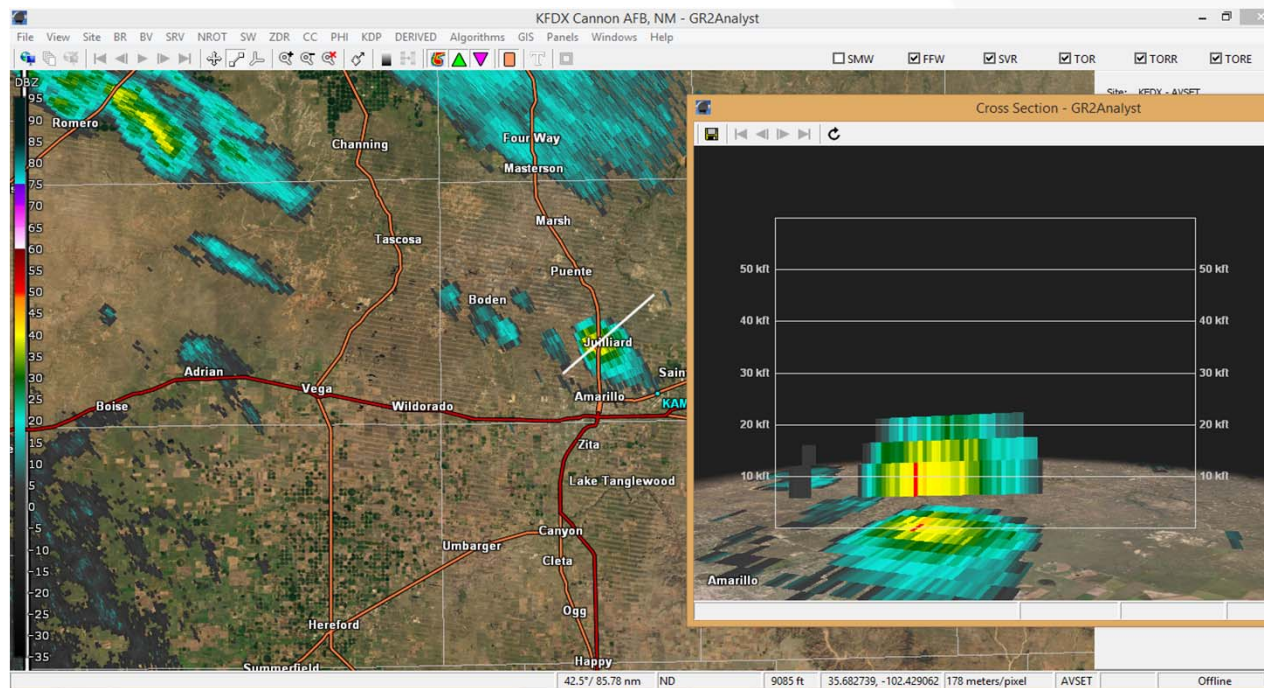
2020 Pantex LMA Research

The Pantex LMA, during this time, was not showing any source densities with the storm north of Amarillo. It did detect some source densities with ongoing thunderstorms south of Perryton, in southern Ochiltree County.
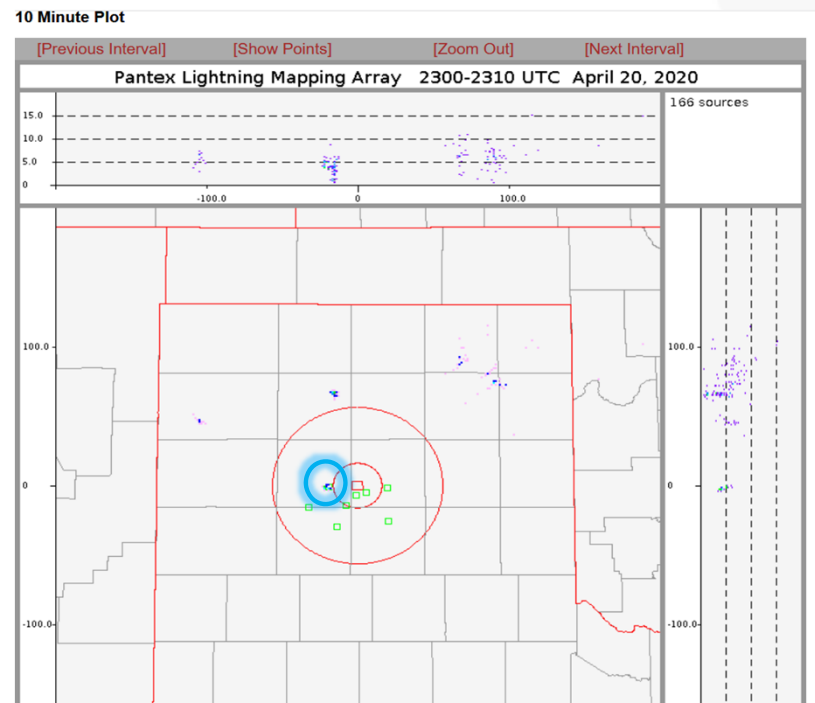
2020 Pantex LMA Research

Just 18 minutes later, around 6:10pm, the storm continues to rapidly develop north of Amarillo. This picture is from the KFDX WSR-88D.

2020 Pantex LMA Research

The Pantex LMA starts detecting "source densities" north of Amarillo at exactly 6:06pm.

First "Cloud-to-cloud" Lightning Strikes Occur At 6:24pm

Lightning Event List					
Date/Time	**Latitude**	**Longitude**	**Amps**	**Distance**	**Bearing (°)**
Apr 20, 2020 6:24:45 PM CDT	35.2883	-101.6984	-13653 amps	7.2666 miles	249.9462
Apr 20, 2020 6:24:45 PM CDT	35.2856	-101.6971	-3570 amps	7.2630 miles	248.3934
Apr 20, 2020 6:24:45 PM CDT	35.2863	-101.6961	-6123 amps	7.1934 miles	248.5638

First "Cloud-to-cloud" Lightning Strikes Occur At 6:24pm
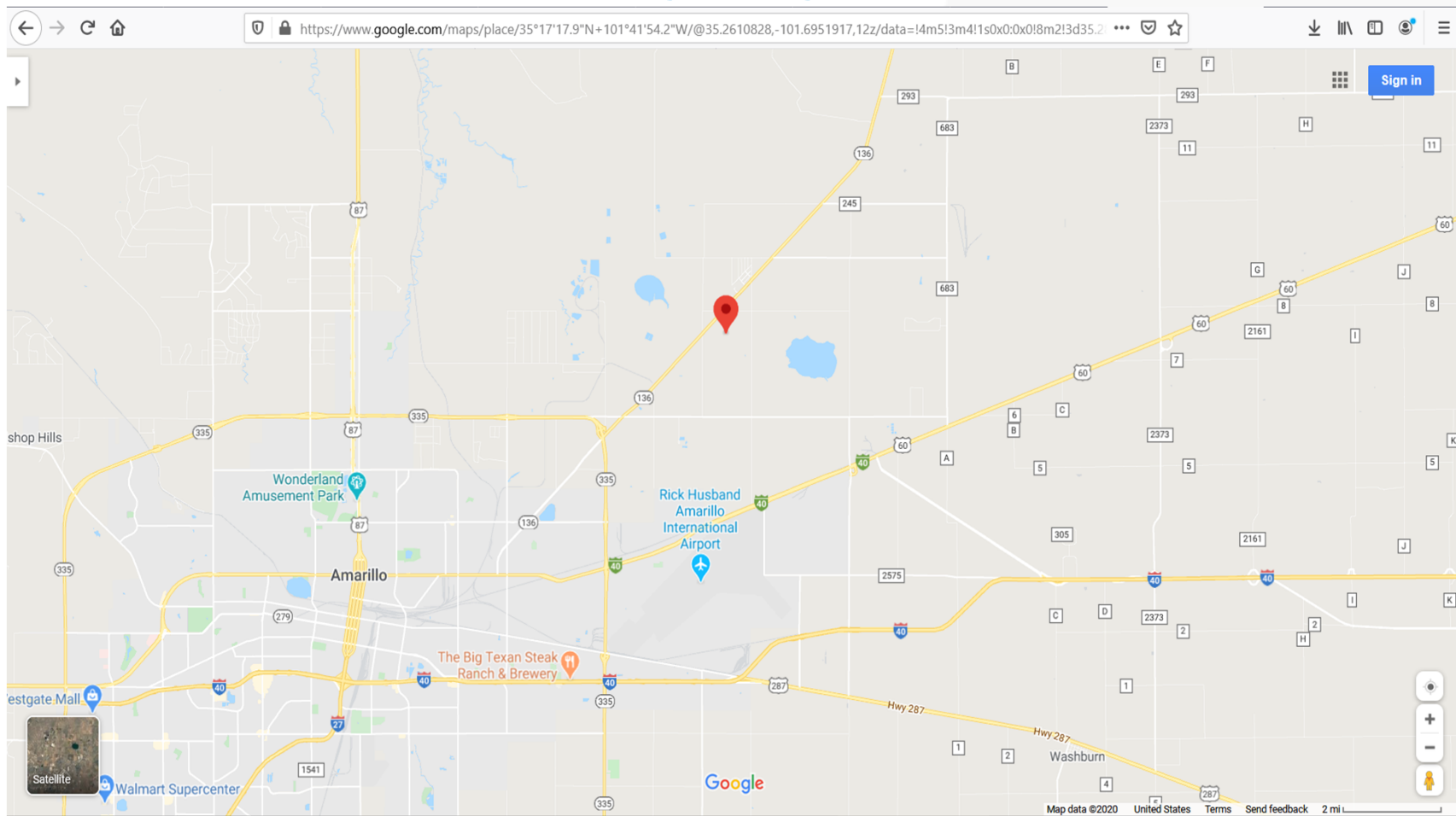
First "Cloud-to-Ground" Lightning Strike Occurs At 7:01pm

Lightning Event List

Date/Time	Latitude	Longitude	Amps	Distance	Bearing (°)
Apr 20, 2020 7:01:50 PM CDT	35.3062	-101.4846	-17464 amps	5.3790 miles	103.4711

# First "Cloud-to-Ground" Lightning Strike Occurs At 7:01pm
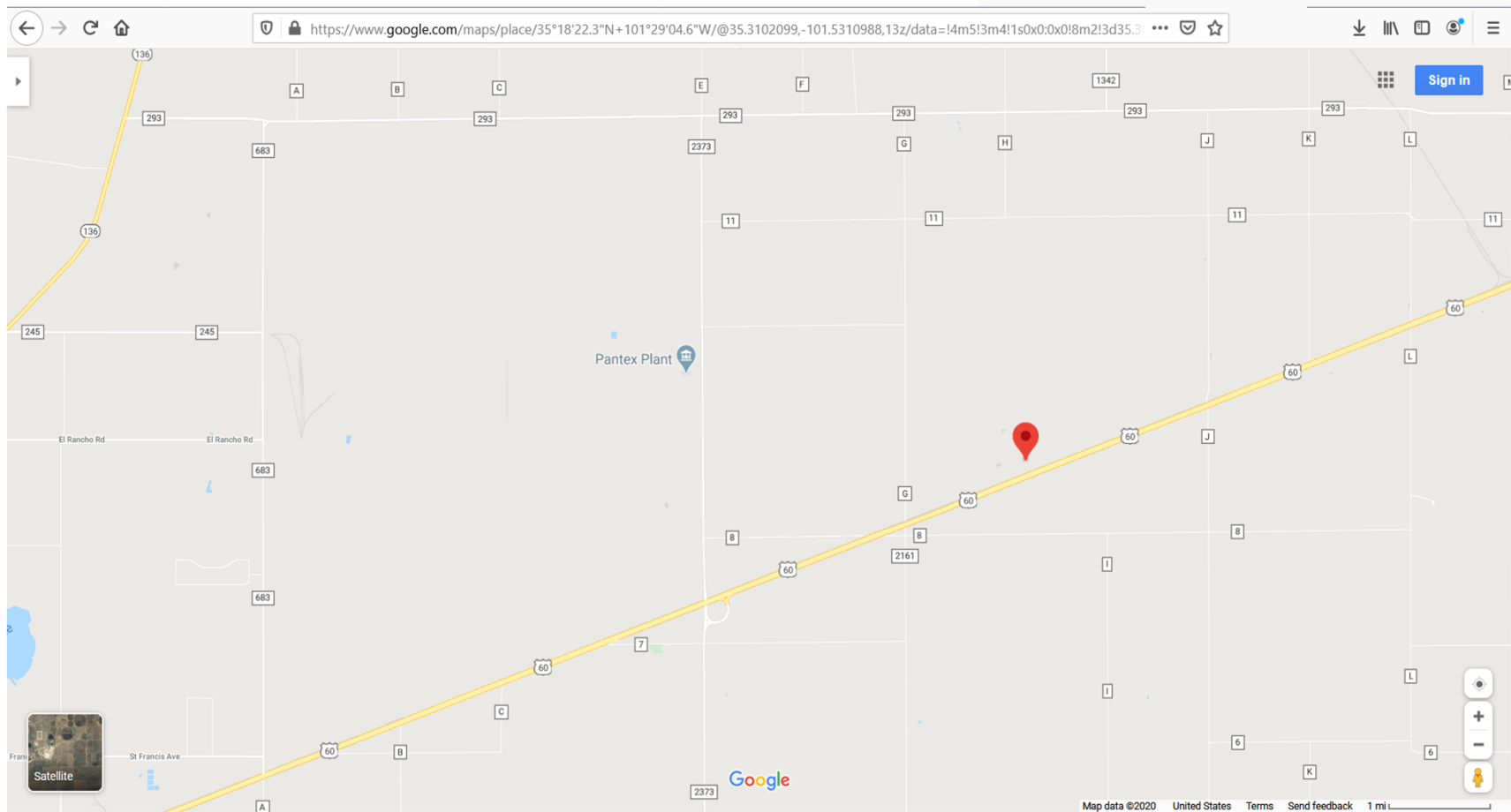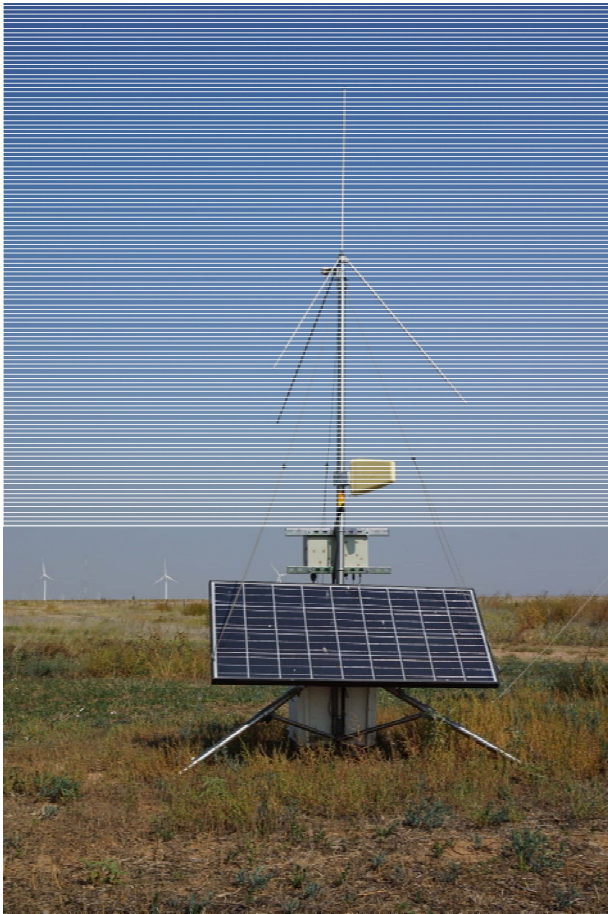
Timeline for April 20, 2020 Storm Event

Storm Detected by Pantex LMA

First Intra-Cloud Lightning

First Cloud-to-Ground

17:55 · 18:00 · 18:05 · 18:10 · 18:15 · 18:20 · 18:25 · 18:30 · 18:35 · 18:40 · 18:45 · 18:50 · 18:55 · 19:00

18 Minutes

37 Minutes
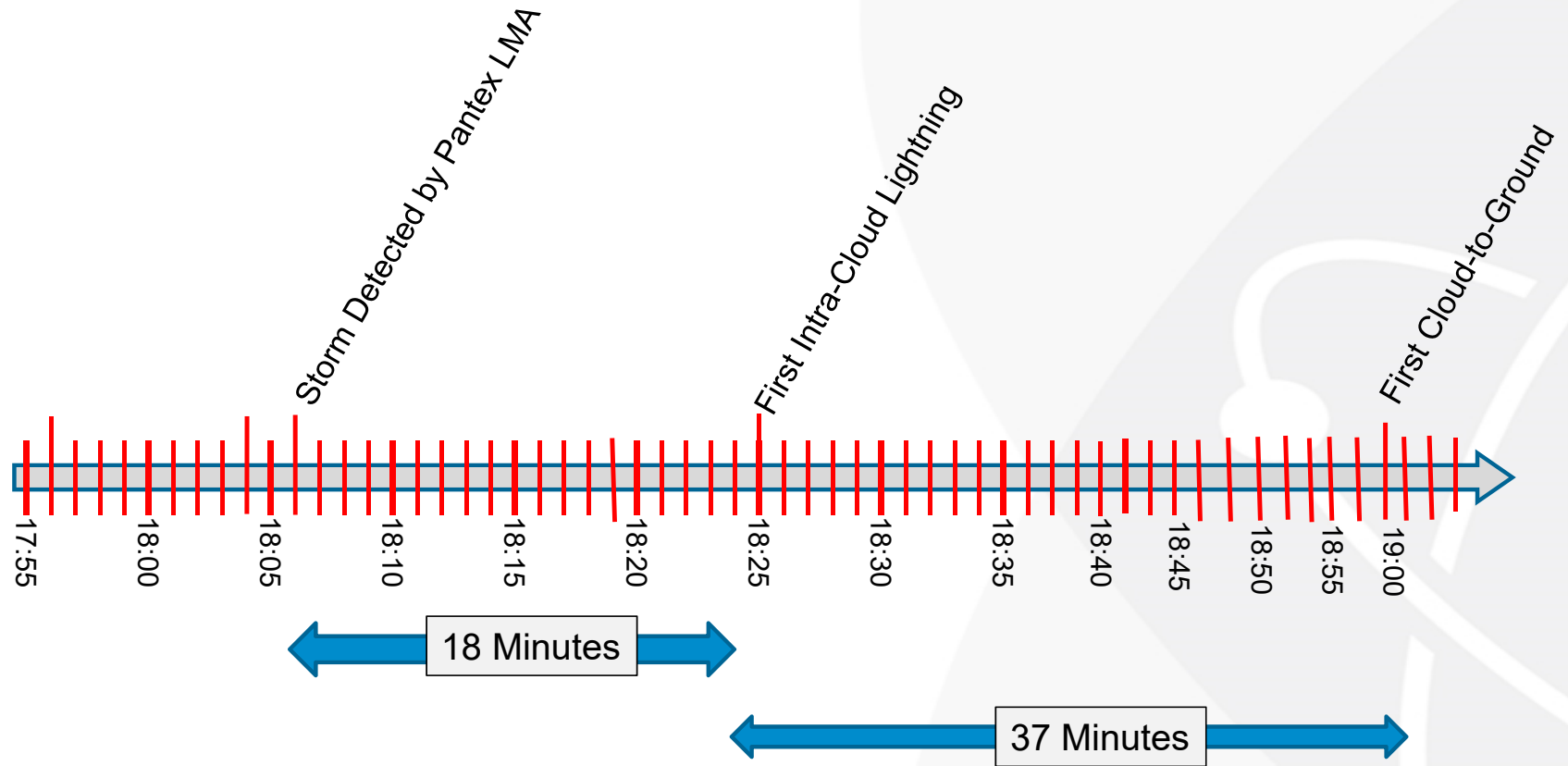
In Conclusion

The Pantex LMA is an extremely helpful meteorological tool that can detect developing thunderstorms before they even produce their first cloud-to-cloud or cloud-to-ground lightning strike.
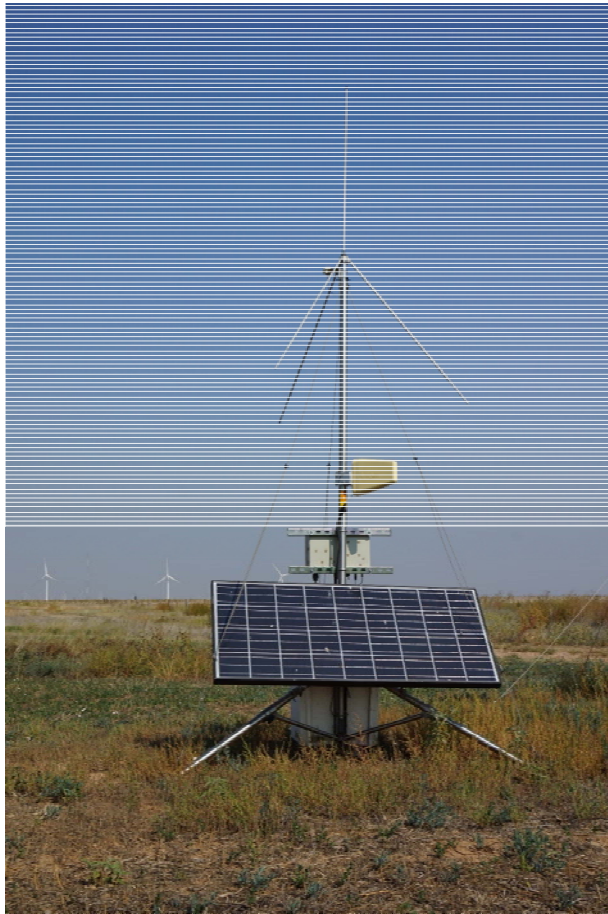
In Conclusion

The Pantex LMA will continue to grow and expand and provide even better resolution of data, higher accuracy and redundancy.

In Conclusion

Pantex is proud to be one of only 3 existing LMA networks in the State of Texas (Texas Tech & Houston/Texas A&M)

In Conclusion
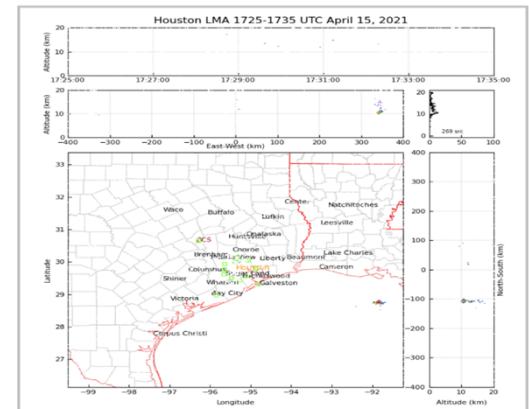
Pantex & TTU Combined LMA Network

In fact, on September 2, 2021, Pantex and Texas Tech "merged" their LMA networks, creating one "super LMA network" that covers all of West Texas!
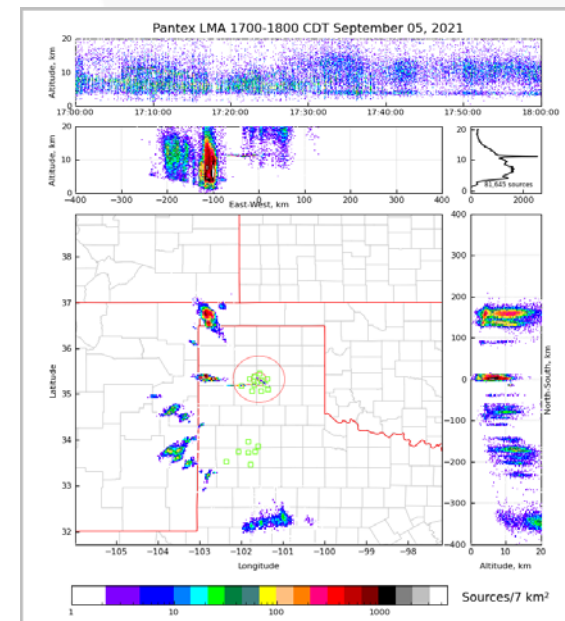
Pantex LMA Data By Itself

In Conclusion
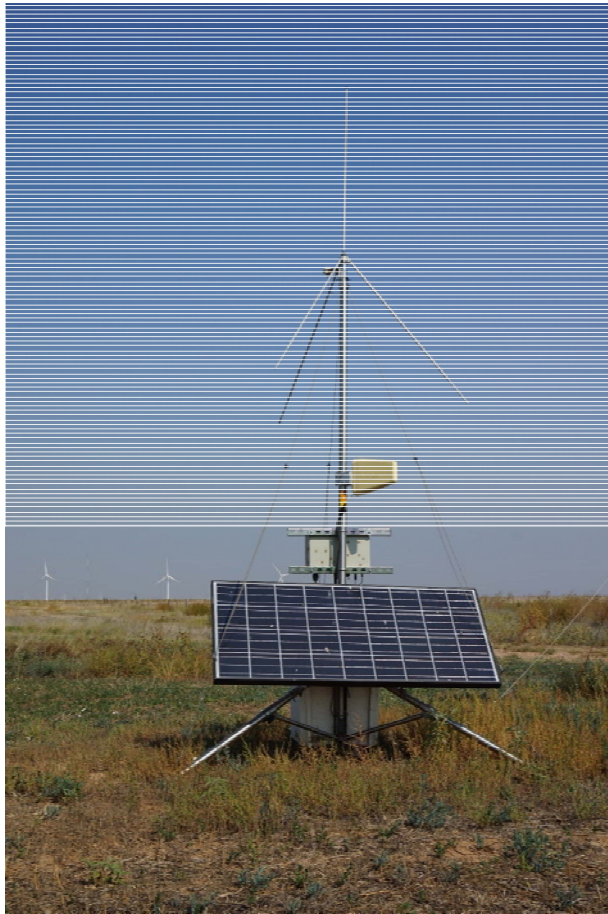
Pantex will continue to support research into lightning and lightning safety with the goal of keeping not just Pantexans safe, but all who live in the Texas Panhandle as well.

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