



# Panel Discussion of Induced Seismicity

Alexandros Savvaidis, PhD

TexNet PI and Manager, CISR Seismology Research Lead  
Bureau of Economic Geology, University of Texas at Austin

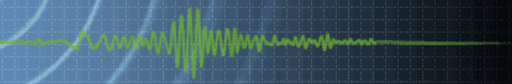


RISC October 20th, 2021

Remote meeting



# Executive Summary

- TexNet Seismic Network
- Seismic Station Monitoring Tool
- Seismicity Overview



MENU

Earthquake Hazards Program

← Latest Earthquakes

Overview

Interactive Map

Regional Information

Felt Report - Tell Us!

Technical

Origin

Waveforms

Download Event KML

View Nearby Seismicity

Earthquakes

Hazards

Data & Products

Learn


Monitoring

Research


Search...  
SEARCH

## M 3.3 – 50 km SSW of Whites City, New Mexico

2021-10-21 17:56:08 (UTC) | 31.763°N 104.601°W | 4.7 km depth

[Interactive Map](#)  


Contributed by TX.<sup>1</sup>

[Regional Information](#)  


Contributed by TX.<sup>1</sup>

[Felt Report - Tell Us!](#)  

0 0 0 0 0 0

Responses

Contribute to citizen science. Please [tell us](#) about your experience.

Citizen Scientist Contributions

[Origin](#)  

Review Status  
REVIEWED

Magnitude  
3.3 ml

Depth  
4.7 km

Time  
2021-10-21 17:56:08 UTC

Contributed by TX.<sup>1</sup>

[View Nearby Seismicity](#)  

Time Range  
± Three Weeks

Search Radius  
250.0 km

Magnitude Range  
≥ 1.0

ANSS Comcat

### For More Information

- [Impact Summary](#)
- [Technical Summary](#)

### Contributors

1. [Texas Seismological Network \(TexNet\)](#)
2. [USGS National Earthquake Information Center, PDE](#)

### Additional Information

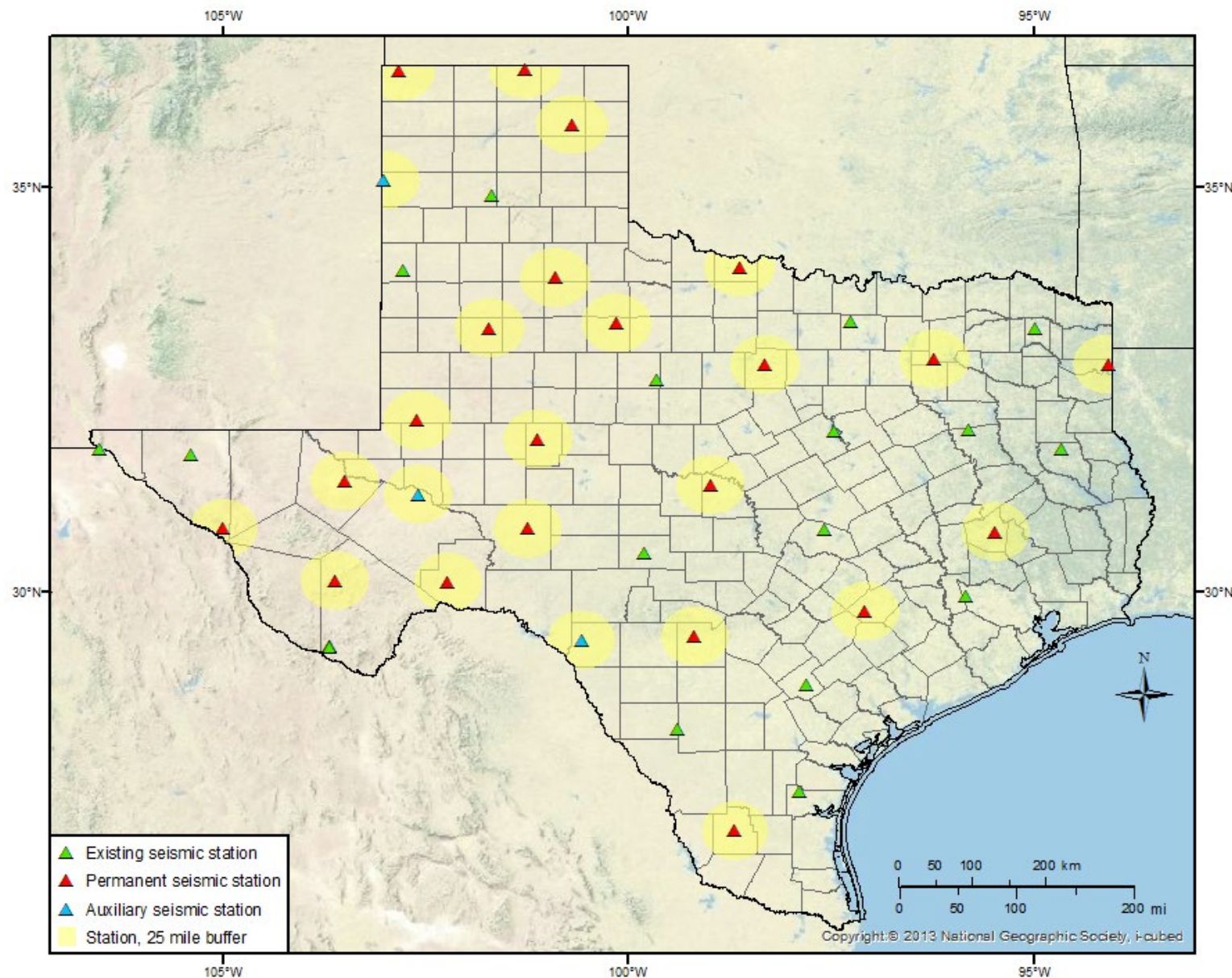
- [ANSS Comprehensive Earthquake Catalog \(ComCat\) Documentation](#)
- [Technical terms used on event pages](#)

# TexNet Plan (SSA meeting Reno, April 2016)

In 2016 18 Existing Seismic Stations in Texas

## TexNet Plan of 2016

- Fill in the gaps
- Add 22 additional stations, providing a backbone of 40+ stations, considering auxiliary sites
- Add portable stations as needed



(Savvaidis et al., 2019; SRL)

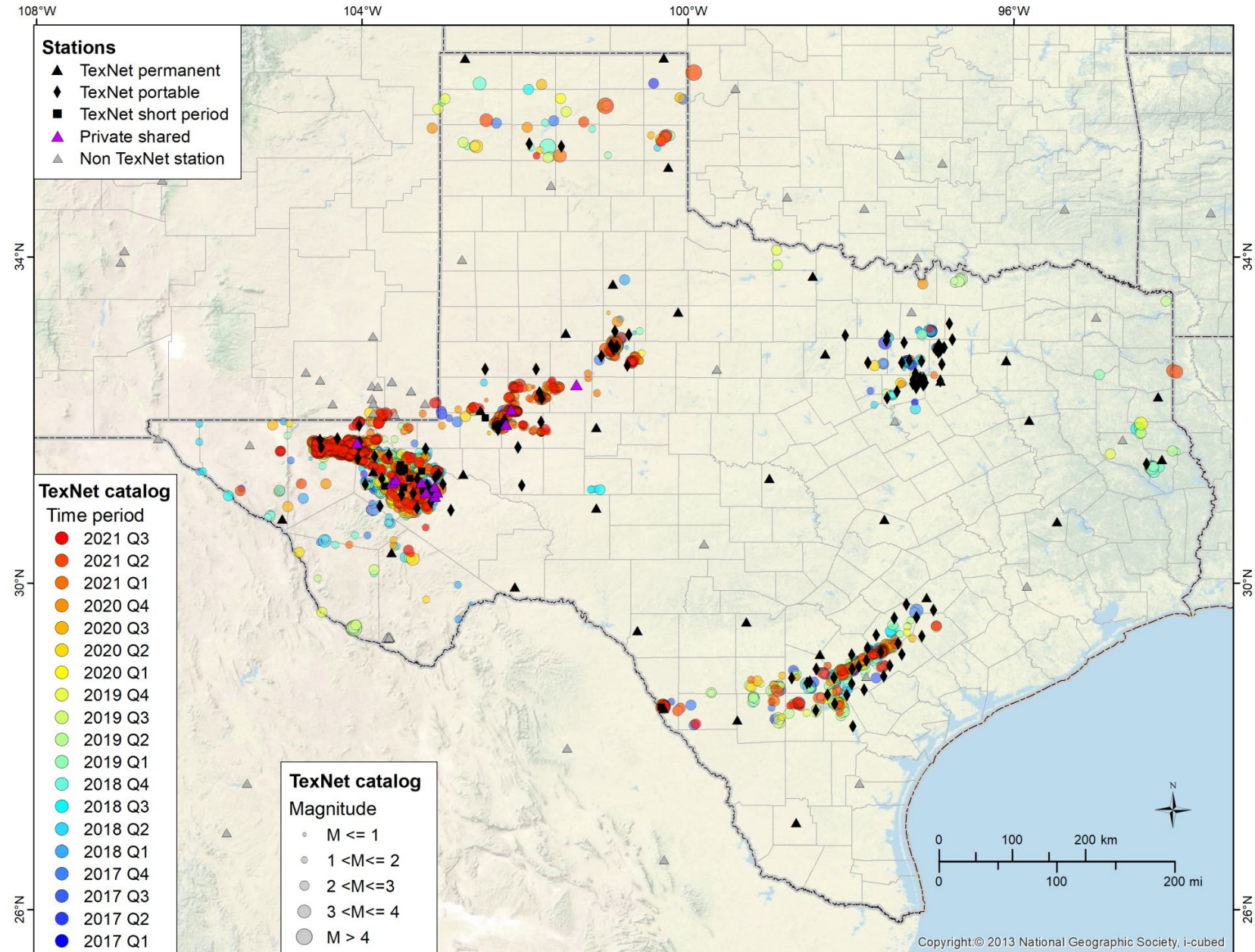


# Seismic Stations Deployment 2021

- 41 Stations in the Delaware Basin
- 15 Stations in Midland Basin
- 31 Stations in DFW Basin
- 35 Stations in Eagle Ford and South Texas
- 7 Stations in Snyder
- 5 Stations in Panhandle
- +20 Stations along the whole State to create an evenly spaced grid of seismic instruments

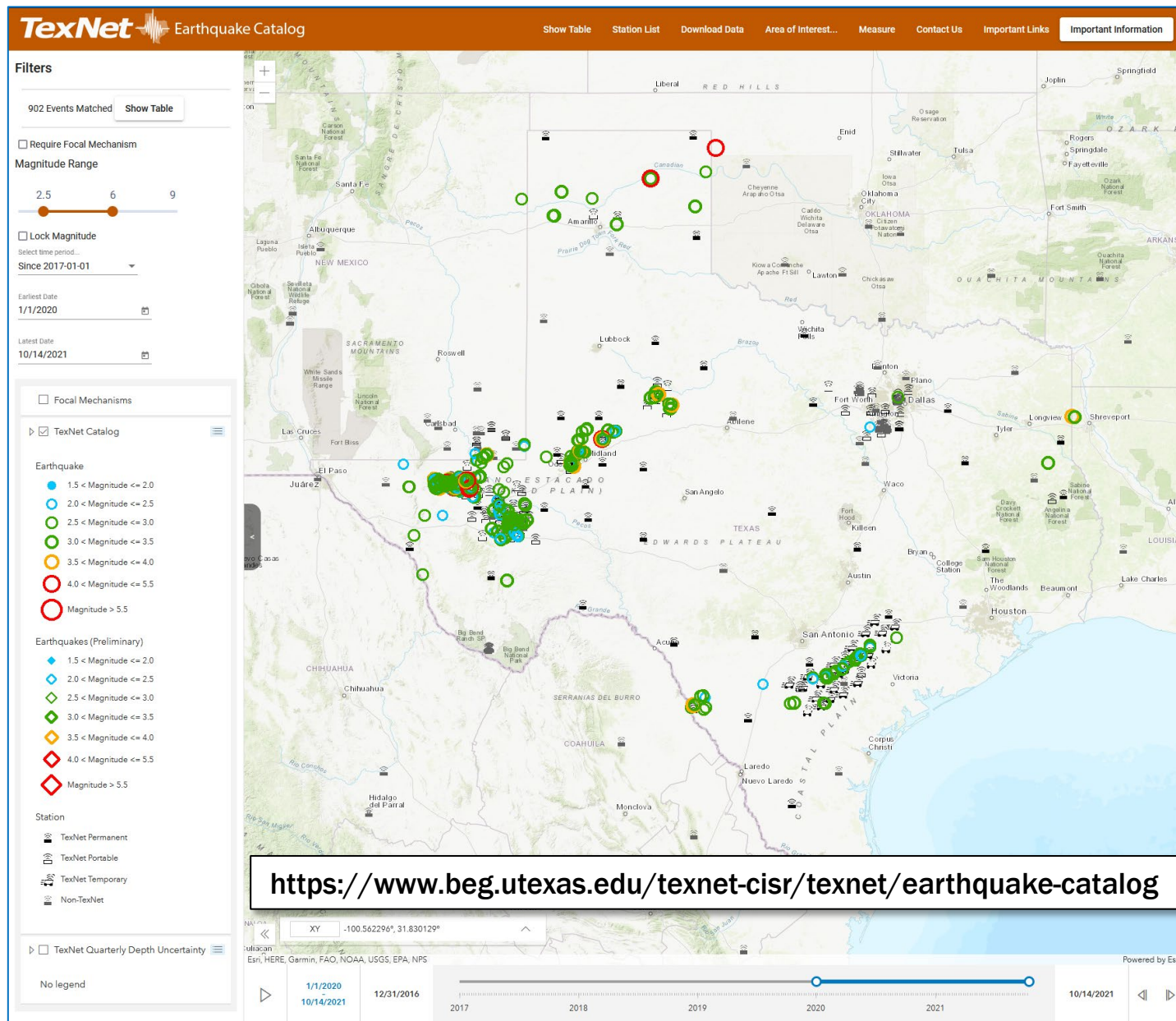
Q1 2016: 18 Stations

Q3 2021: >150 real time stations



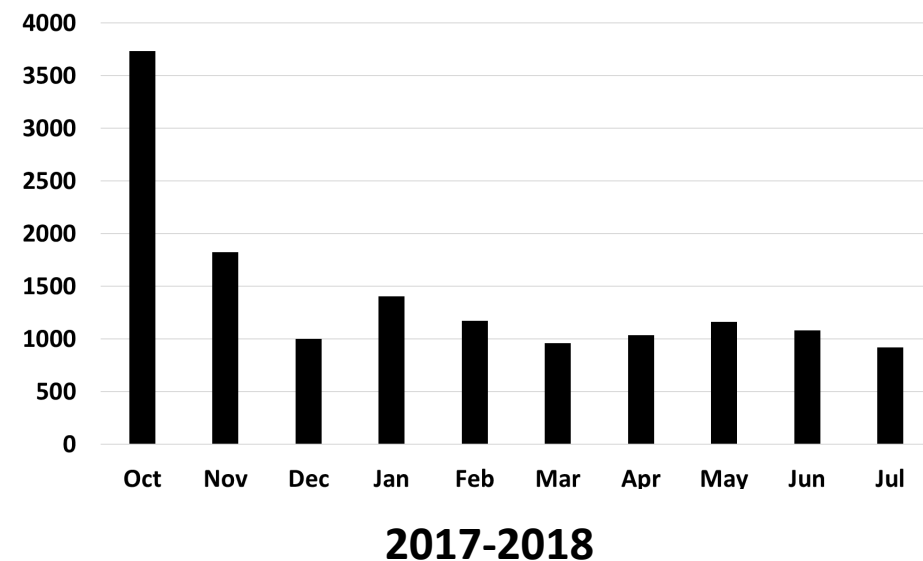
(Savvaidis et al., 2019; SRL)

# TexNet Earthquake Catalog



- Provide a video of seismicity with time
- Show Focal Mechanisms
- Show Quarterly Depth Uncertainty
- Show Quarterly Mc (Magnitude of Completeness)

Unique Users of the TexNet Earthquake Catalog





# TexNet Seismic Station Monitoring Tool

Collaboration between TexNet,  
Saltwater Disposal Operators  
and Texas Railroad Commission:

Provide availability of  
earthquake data from the  
operators that follow the  
incentive to dispose high  
volumes while operating a  
seismic station and providing  
data to TexNet.

<https://monitor.texnet.beg.utexas.edu/>

The screenshot displays the 'TexNet Stations Monitor' web application. The browser address bar shows the URL <https://monitor.texnet.beg.utexas.edu>. The page title is 'TexNet System Status Monitor'. A 'Sort By' dropdown menu is set to 'Name'. A time filter bar at the top allows selection of monitoring intervals: < 1 min, 1 min - 10 min, 10 min - 30 min, 30 min - 1 hour, 1 hour - 2 hours, 2 hours - 6 hours, 6 hours - 1 day, 1 day - 2 days, 2 days - 3 days, 3 days - 4 days, 4 days - 5 days, and > 5 days. The main content area is organized by network, with expandable sections for 'Network: 2T', 'Network: 40', 'Network: 4T', and 'Network: TX'. Each network section contains a grid of station status cards. Each card displays the station ID, location, and a table of channel names and their current status (all are 'Current').

Station ID	Location	Channel Name	Latency
DB02	00	.HHN	Current
		.HHE	Current
		.HHZ	Current
DB03	00	.HHZ	Current
		.HHE	Current
		.HHN	Current
DB04	00	.HHN	Current
		.HHE	Current
		.HHZ	Current
LWM1	0K	OK.HHZ	Current
		OK.HHN	Current
		OK.HHE	Current
LWM2	0K	OK.HHZ	Current
		OK.HHN	Current
		OK.HHE	Current
MBBB1	00	00.HHE	Current
		00.HHN	Current
		00.HHZ	Current
MID01	00	.HHN	Current
		.HHE	Current
		.HHZ	Current
OP01	00	00.HHZ	Current
		00.HHN	Current
		00.HHE	Current
PR01	00	00.HHZ	Current
		00.HHE	Current
		00.HHN	Current
WB01	00	00.HHZ	Current
		00.HHN	Current
		00.HHE	Current

At the bottom of the page, there is a 'Last Update:' label.

# Seismological Setting of M3.0+ Seismicity in Texas

Seismicity is natural and due to injection above basement

Seismicity caused by EOR incl. CO<sub>2</sub>

Seismicity most likely caused by injection above basement

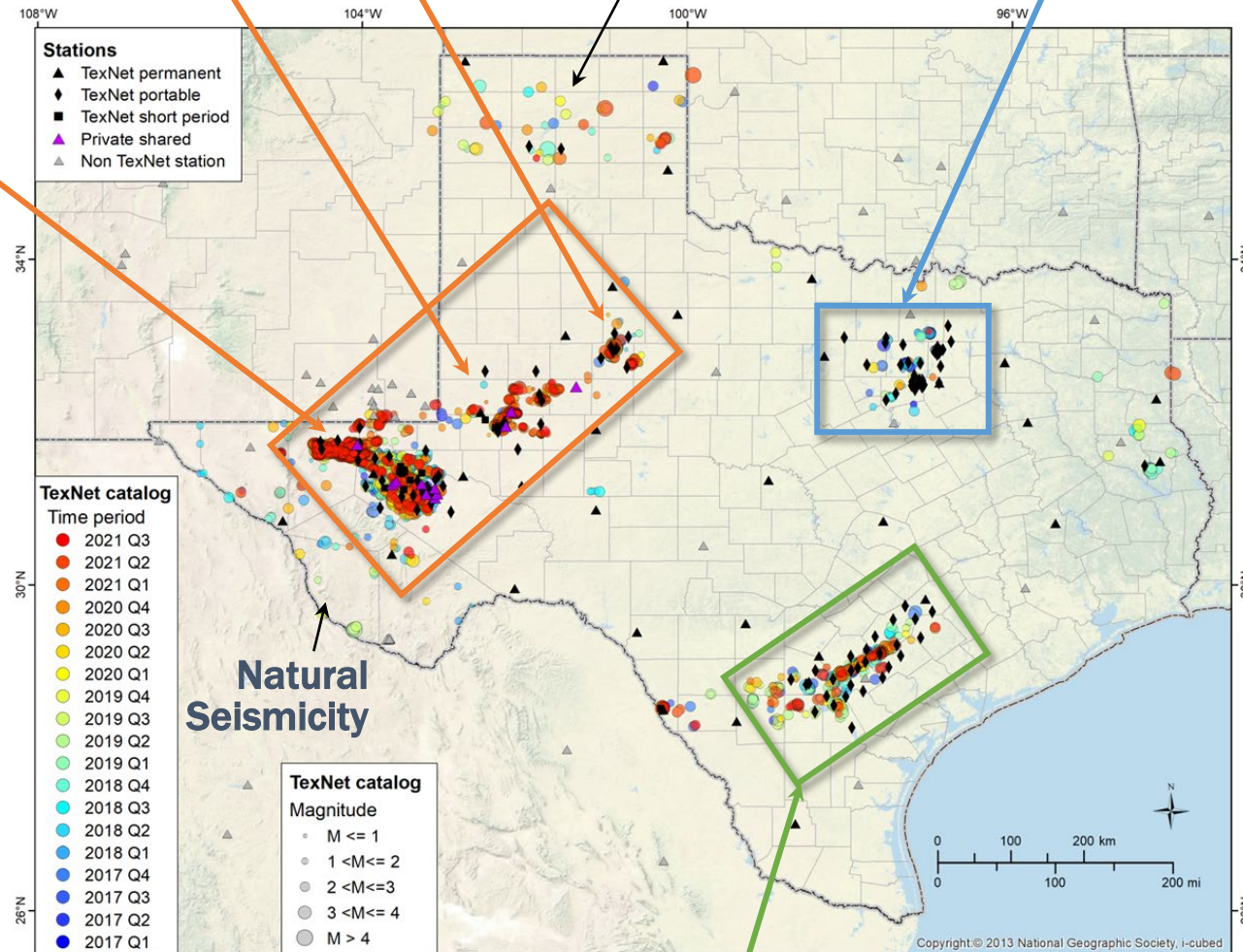
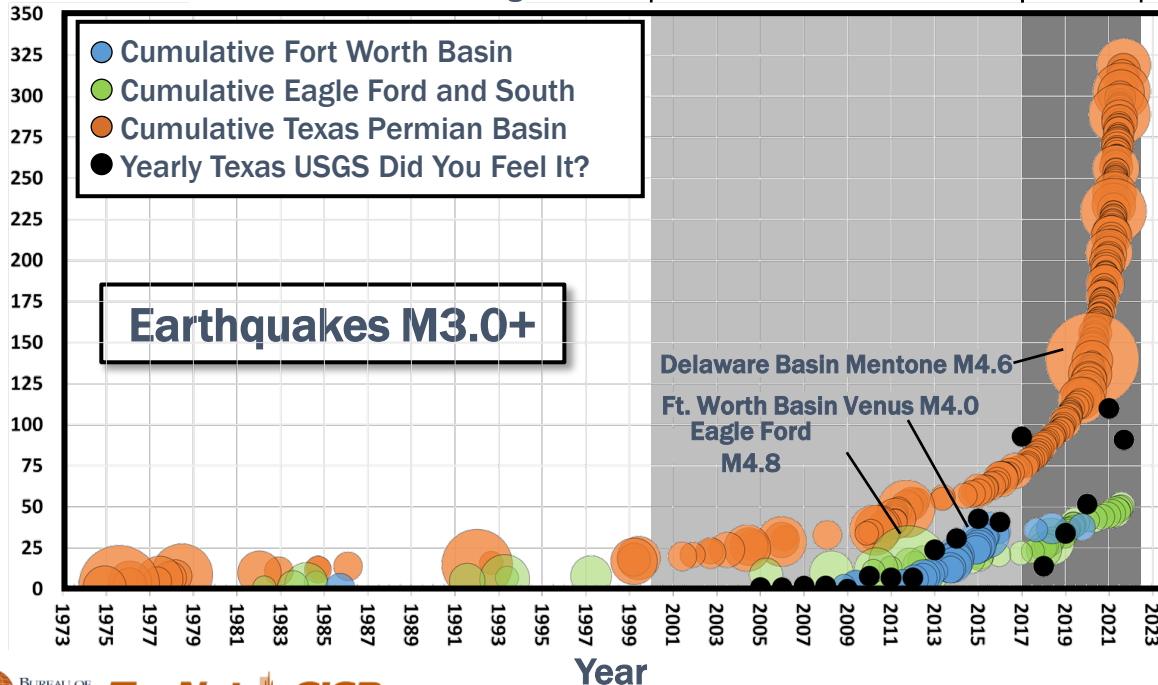
Seismicity caused by injection above basement

Seismicity in a Complex Basin caused by deep injection, shallow injection, hydraulic fracturing

~uniform regional detectability ~M3.0+

TexNet

instrumental monitoring

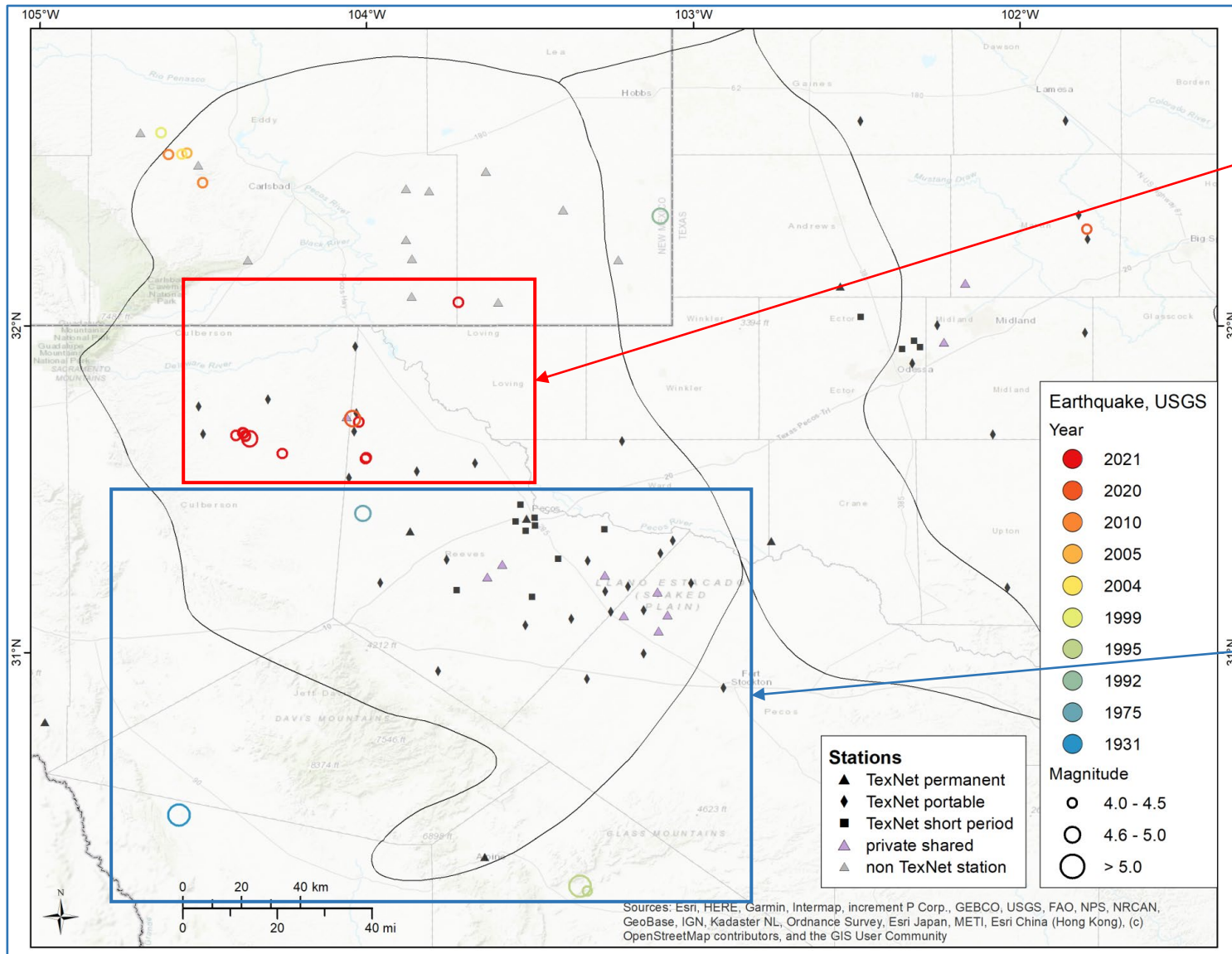


Seismicity caused by hydraulic fracturing

# Historical Seismicity M $\geq$ 4.0 Permian Basin

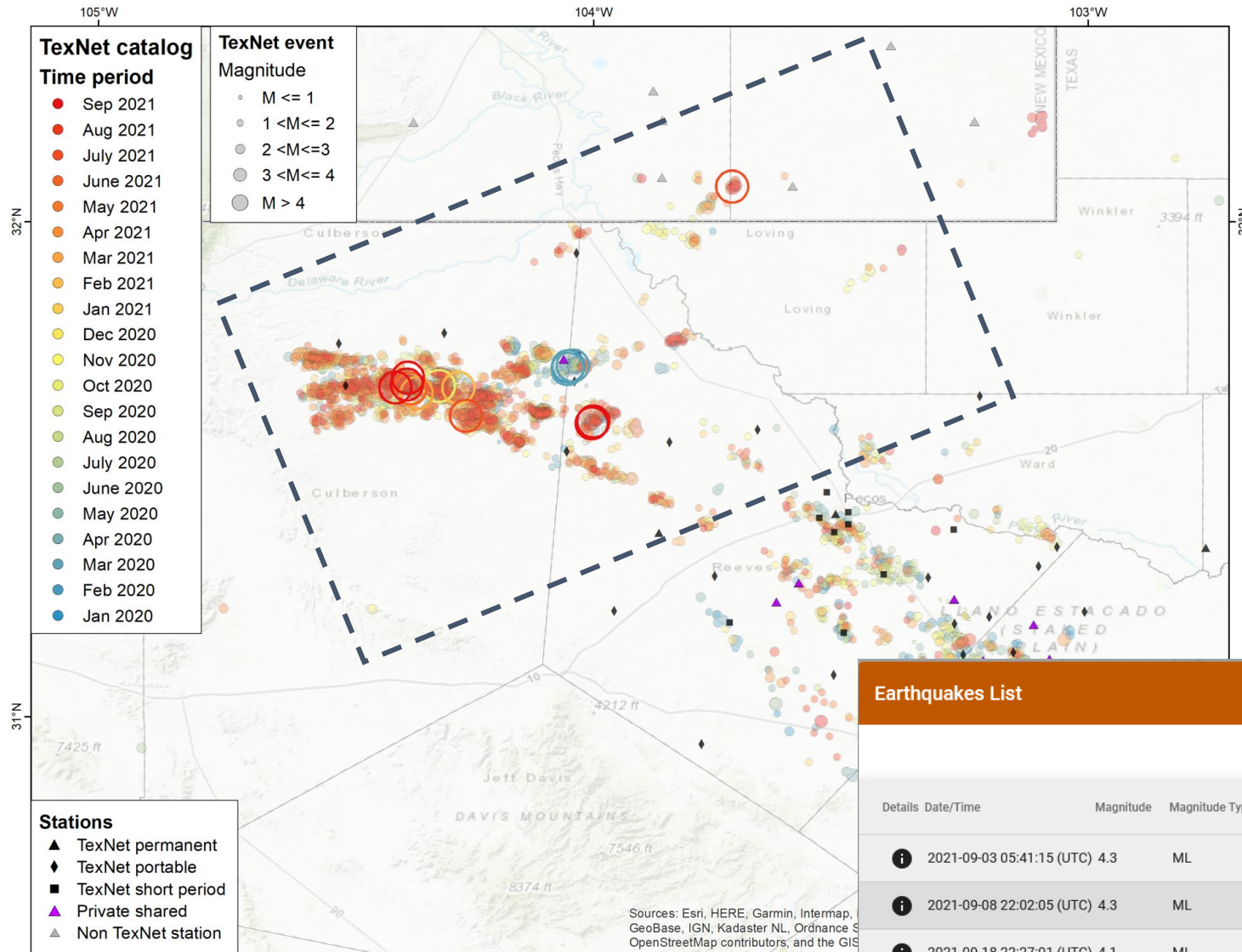
- September 2021, Increase of seismicity in the Delaware basin (West Texas and Border with New Mexico)

- Seismicity of 1931 to 2016 (from north to south)
  - 1975-08-01 (M4.8)
  - 1931-08-16 (M5.8)
  - 1995-04-14 (M5.7)
  - 1995-04-15 (M4.0)





# Recent Seismicity Delaware Basin

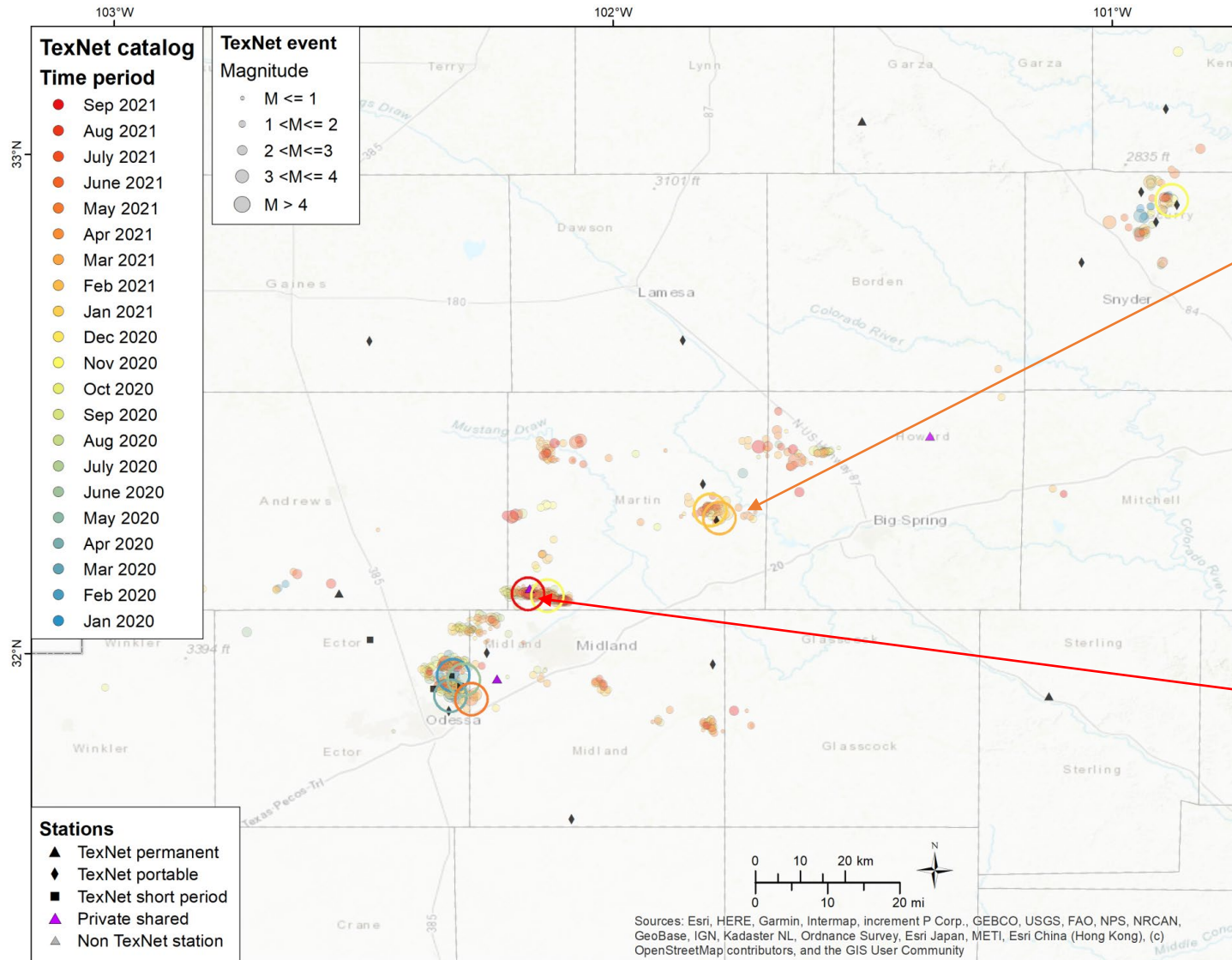


- Colored rings are  $M \geq 4.0$  events
- Increase of seismicity in the Delaware basin (West Texas and Border with New Mexico)
- Current rate 5 earthquakes of  $M \geq 4.0$  in one month

## Earthquakes List

Items per page: 20 1 - 5 of 5 < >												
Details	Date/Time	Magnitude	Magnitude Type	Region Name	County Name	Latitude	Latitude Error	Longitude	Longitude Error	Depth (MSL)	Depth (Surface)	Depth Uncertainty
i	2021-09-03 05:41:15 (UTC)	4.3	ML	Western Texas	CULBERSON	31.6653	0.9	-104.4002	0.9	6.8	8.0	1.7
i	2021-09-08 22:02:05 (UTC)	4.3	ML	Western Texas	CULBERSON	31.6717	0.6	-104.3774	0.6	6.1	7.3	1.0
i	2021-09-18 22:27:01 (UTC)	4.1	ML	Western Texas	REEVES	31.5968	0.5	-104.0008	0.5	7.3	8.3	1.2
i	2021-09-23 07:52:06 (UTC)	4.3	ML	Western Texas	REEVES	31.5931	0.5	-104.0034	0.5	8.8	9.8	0.9
i	2021-09-29 07:22:08 (UTC)	4.2	ML	Western Texas	CULBERSON	31.6726	0.6	-104.3795	0.6	6.1	7.3	1.2

# Recent Seismicity Midland Basin



- Colored rings are  $M \geq 3.5$  events
- One earthquake of  $M \geq 4.0$
- No increase on  $M \geq 4.0$  seismicity
- Most recent  $M \geq 3.5$  event

Earthquake Details	
Event ID	texnet2021mek
Origin Time	2021-09-07 03:05:37 (UTC)
Latitude	32.119
Longitude	-102.171
Local Magnitude	3.7
Moment Magnitude	
Depth, Relative to MSL (km)	7.1
Depth, Relative to Surface (km)	8.0
Mode	ML

Event Details Zoom to

- High interest from the public



# Questions?

[alexandros.savvaidis@beg.utexas.edu](mailto:alexandros.savvaidis@beg.utexas.edu)

