



Texas Magnetometer Network Update

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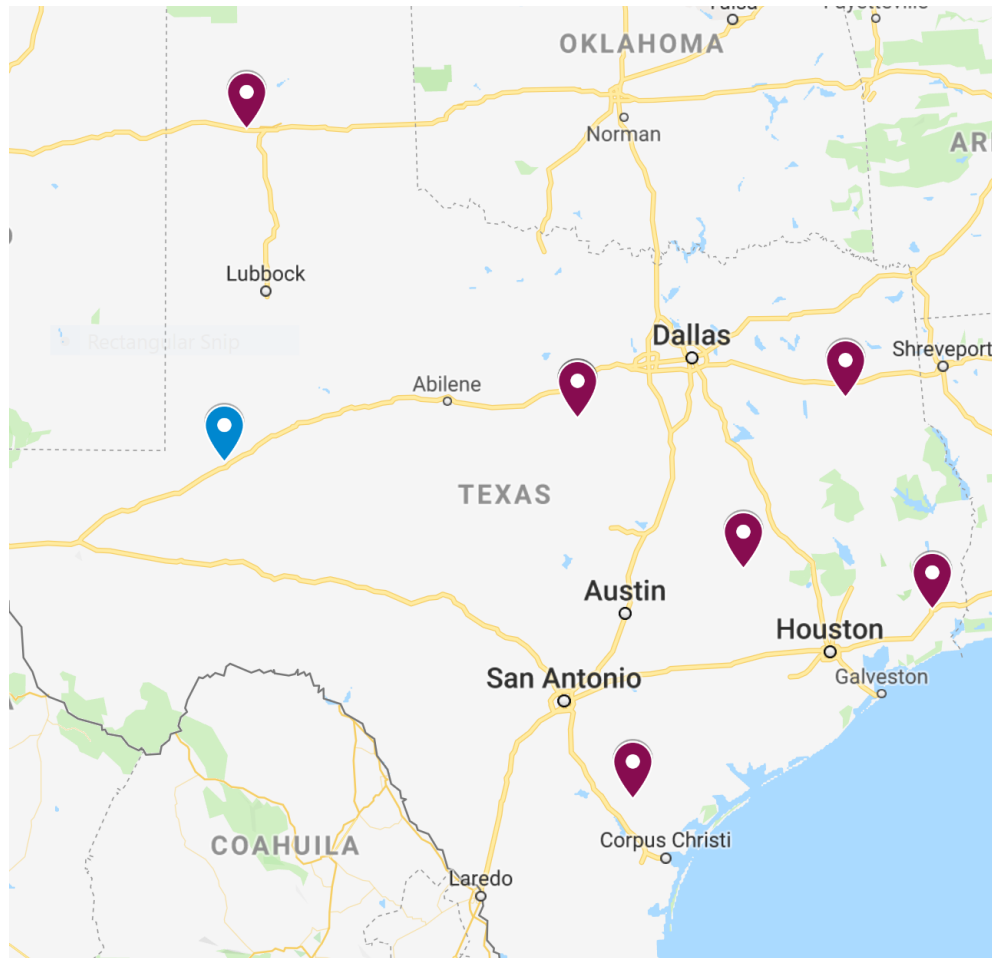
ERCOT PGDTF Meeting
March 3rd, 2020

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Texas Magnetometer Network



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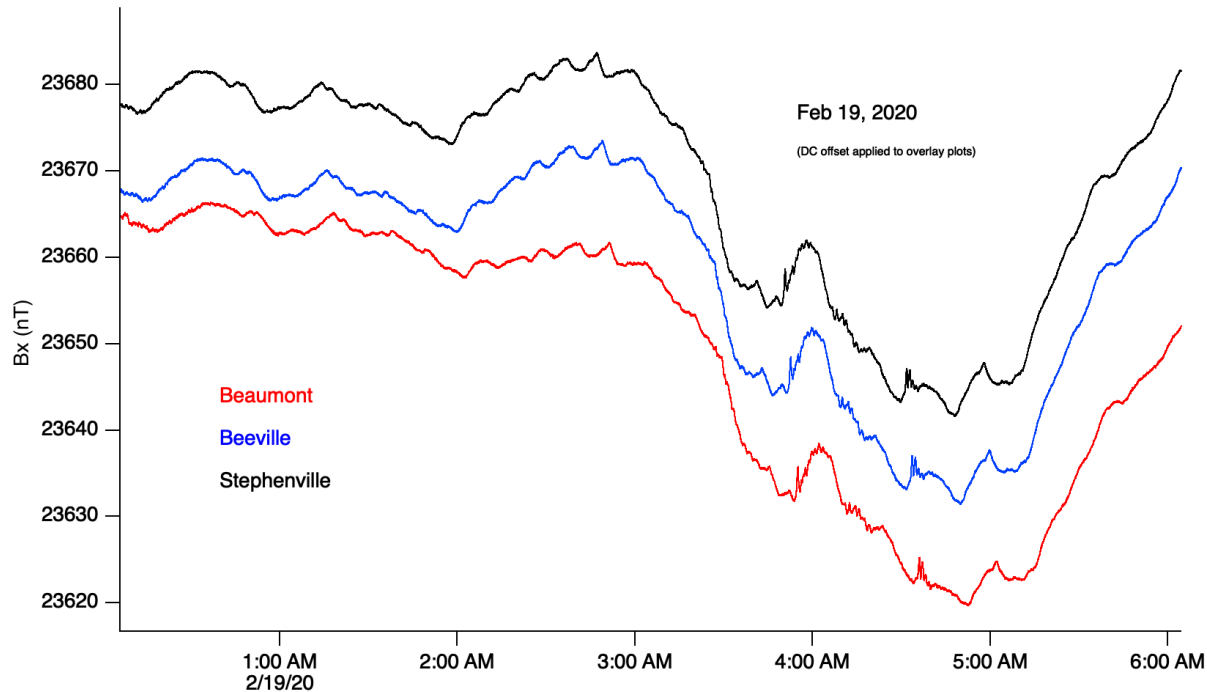


- 6 magnetometers installed by Texas A&M and Computational Physics Inc. (CPI)
 - **Completed** Dec 2019
 - Building on the results of our NSF project design
- Locations
 - 5 Texas A&M AgriLife Research sites (Amarillo, Beaumont, Beeville, Overton, Stephenville)
 - 1 local on RELLIS Campus (Bryan, TX)

Texas Magnetometer Network



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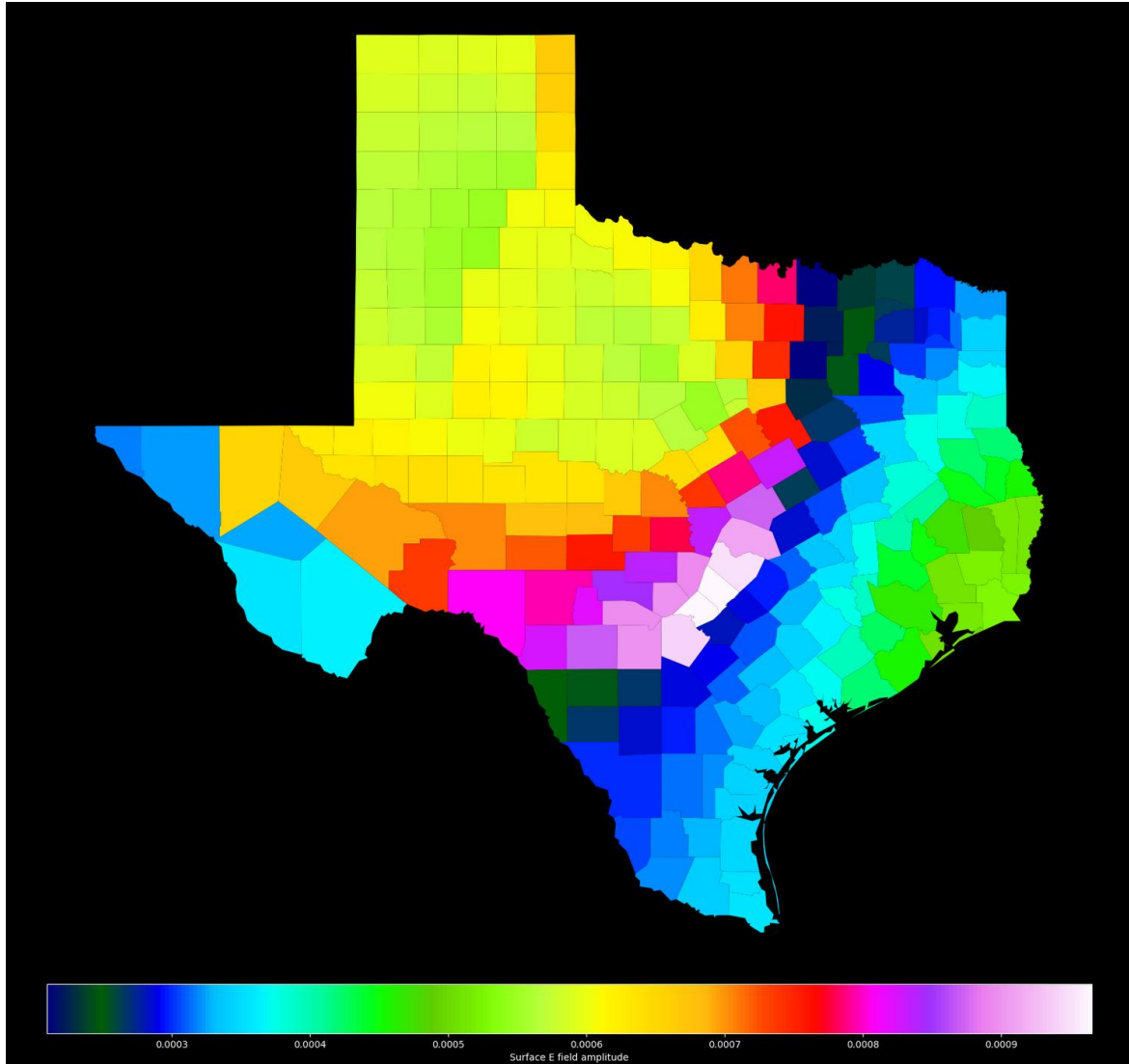
B data from last week, G1 (minor) event

- Consulted with utilities on locations; near GIC monitors
- Network will provide data in real-time directly to TAMU
 - TAMU can provide it to utilities and other entities under partnerships
- Ongoing work
 - Electric field calculations
 - Data access and analytics platform/dashboard
 - Real-time GIC visualization

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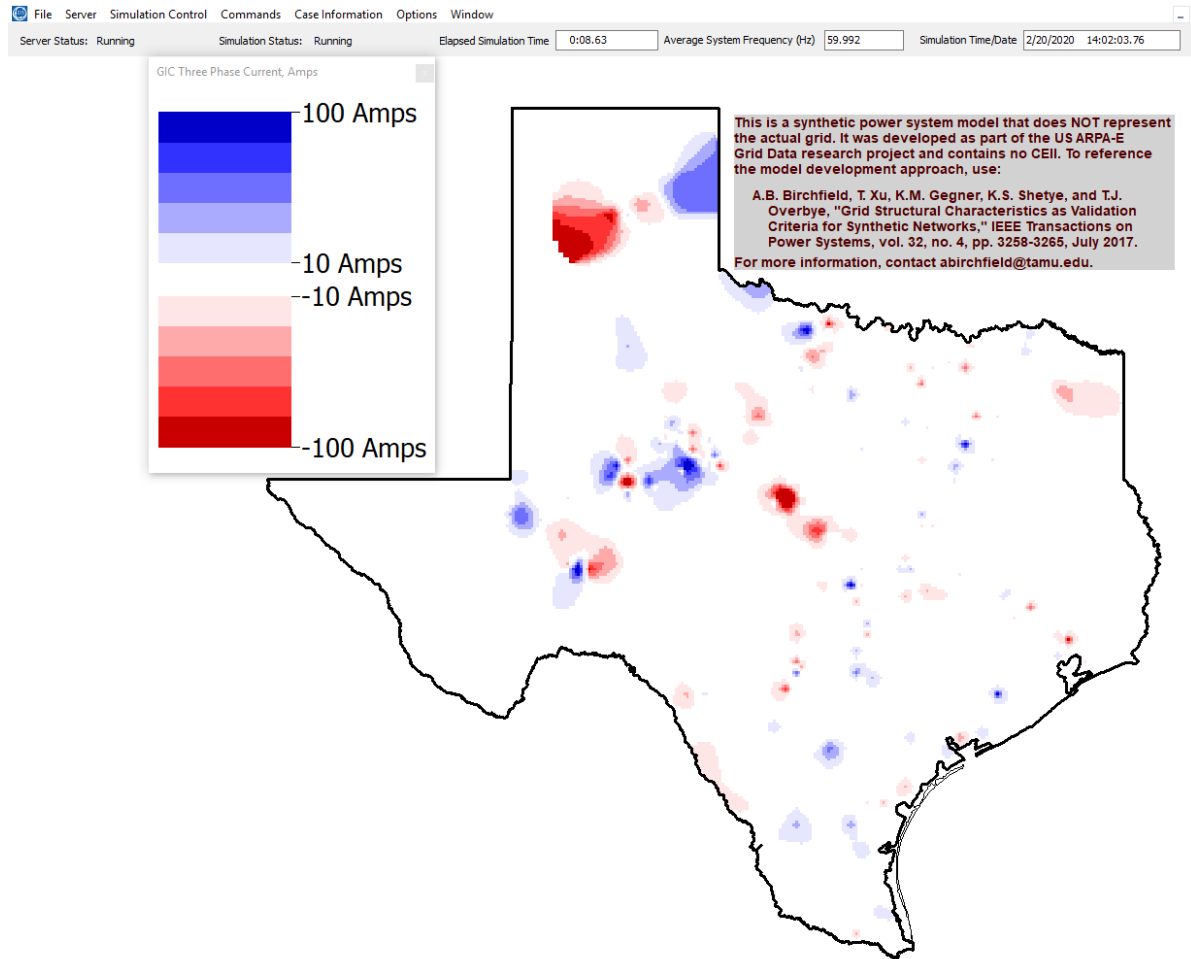


- **Real-time** electric field data, calculated from all the mags
 - Under development
 - 1 min resolution
 - Grid format (.B3D binary format)
 - Using NERC TPL-007 conductivity model
 - Values scaled in the figure here to highlight variation (non-event day)

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• Real-time GIC Visualization

- Under development
- Example shown using synthetic Texas grid (2000 buses)
 - Note: E field magnified for illustration
- Electric field data is read from the web server every minute into the power system simulation server for GIC analysis and visualization
 - Currently doing a GIC simulation
 - Can extend this to a GIC estimation problem where some GIC neutral measurements are available, and the remaining transformer GICs are estimated along E field estimation improvement

RELLIS Control Room Lab



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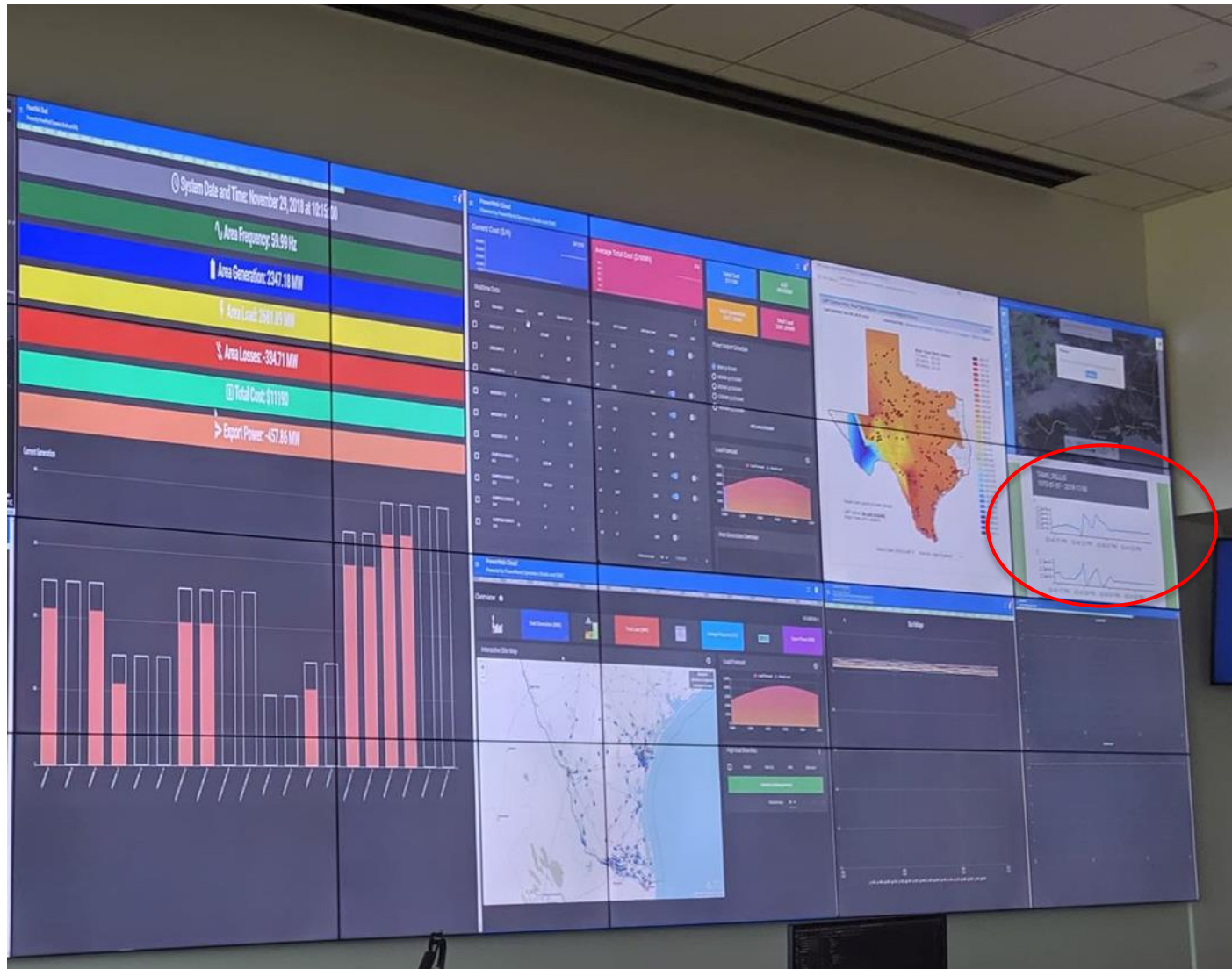


- Power Grid Operations Research and Education
- Give users (students and industry participants) the experience of operating the grid in advanced scenarios such as GMDs
 - Testbed equipped with EMS, DMS, and other industry grade tools
 - Hands on experience; and R&D of monitoring, visualization and control applications

RELLIS Control Room Lab



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- Power Grid Operations Research and education
- One of our Industry Day demos from November 2019, showing magnetometer data flowing into our Control Center Lab
 - Integration of mag data in real-time applications and control room environment

Magnetometer Setup



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Connect through
wireless access
points for secure
communication



Beaumont



Boulder: Validation Site

Beeville

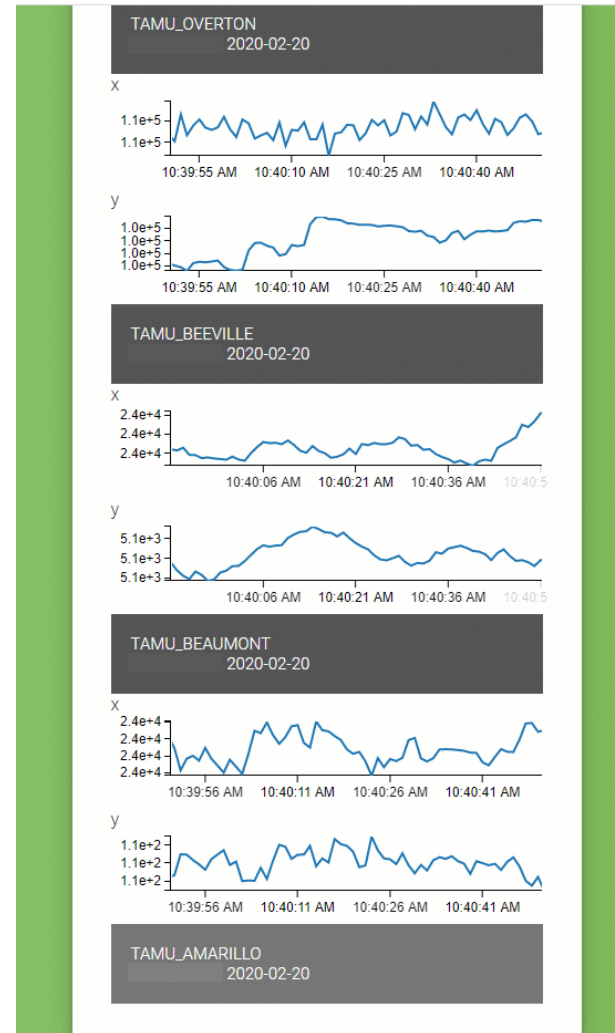


Autonomous
operation
(low power,
solar panels)

Magnetometer Network Features



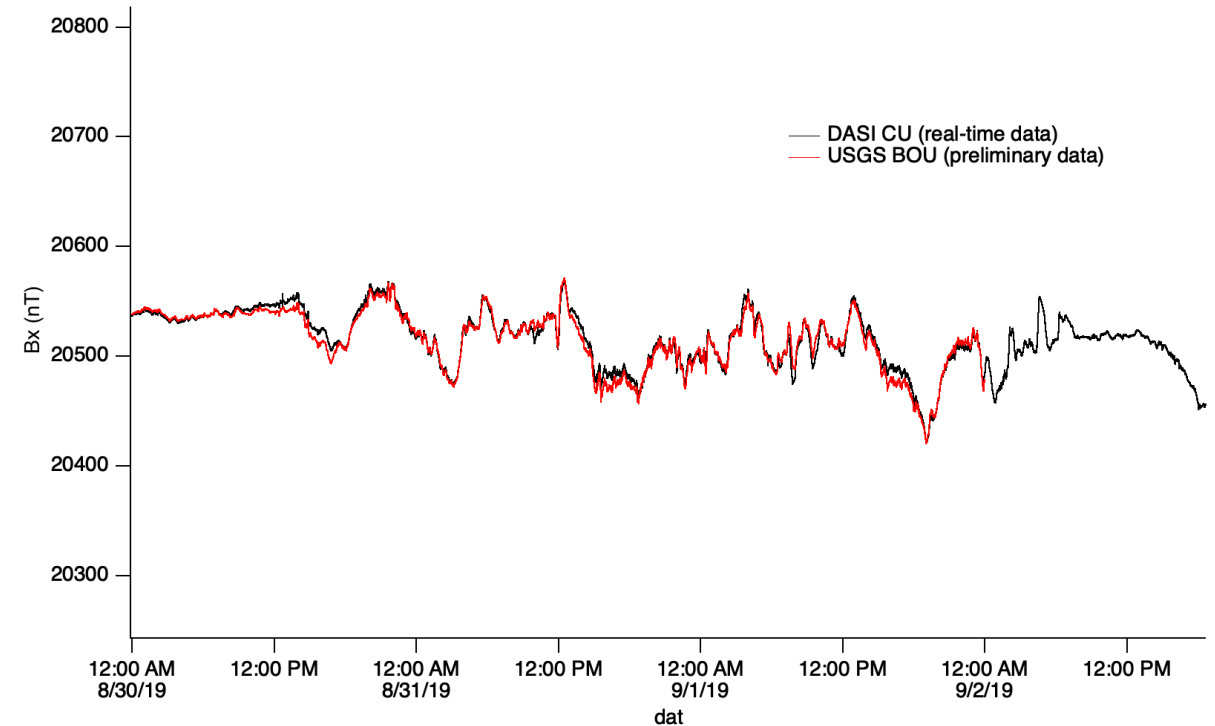
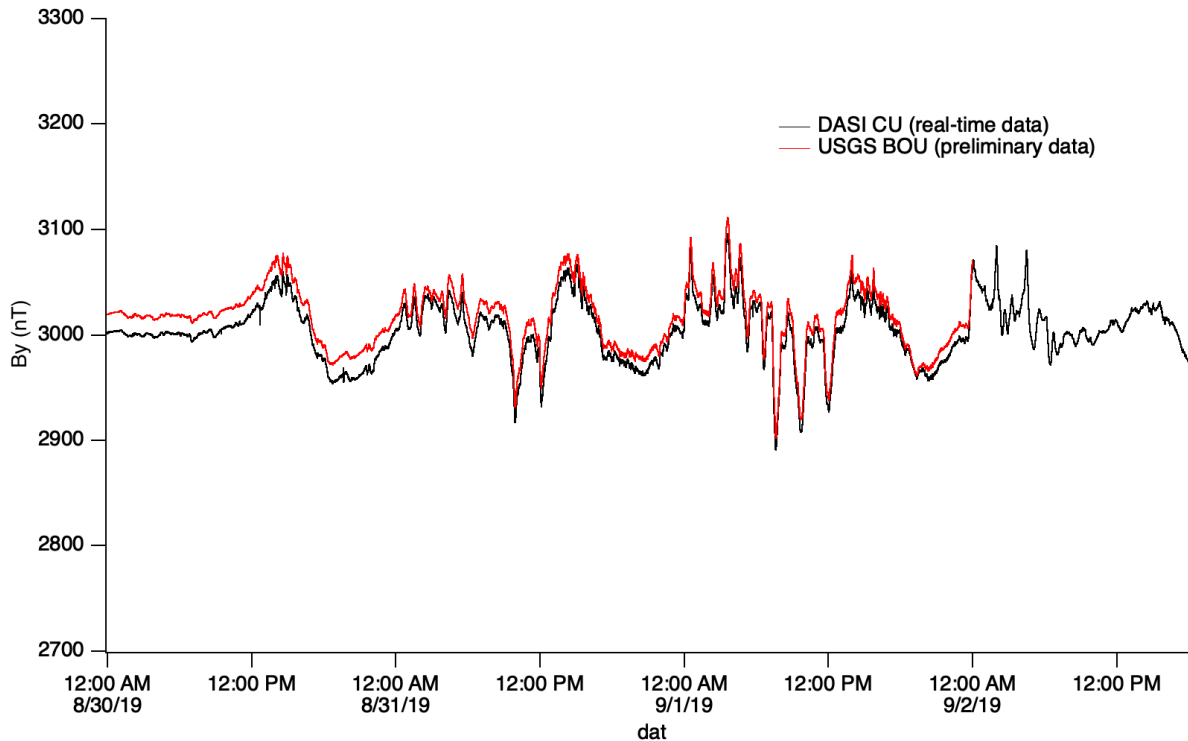
- Real-time data delivery (fraction of a second latency)
 - 1-sec resolution
- Web-based data download in .csv format
- Real-time temperature correction
- Low-noise magnetic field measurements



Real-time data stream from day of NERC meeting

Note:
Preliminary prototype of interface to access data

Magnetometer Data Validation

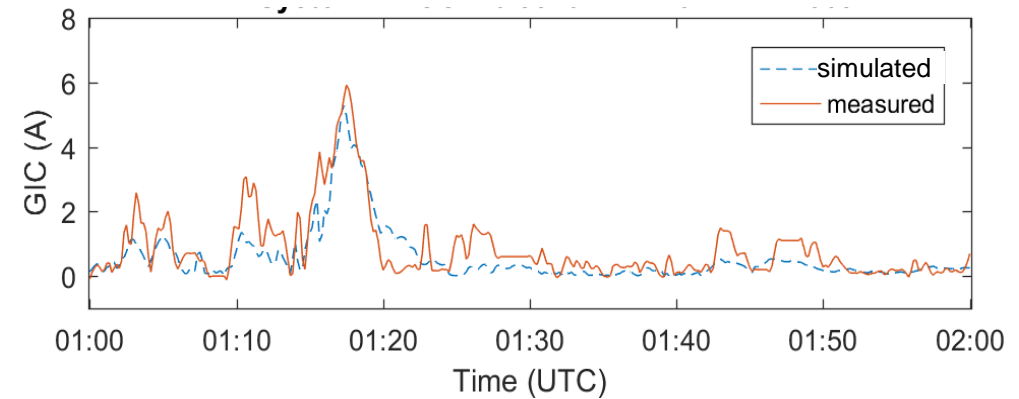
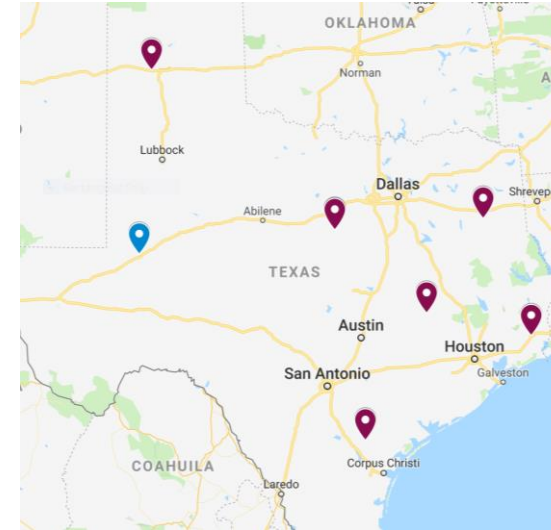


- Plots: Jenn Gannon
- Test installation of TAMU equipment in CU Boulder
- Comparison with USGS BOU (i.e. observatory quality) B data
- Has been testing for seven months, real time data transmission, 0% data loss over wireless connection

Moving Forward



- We plan to harness the data from the mags in Texas and the SHM network for research studies
 - E.g., research on uses/benefits of closely spaced magnetometers
- Collaboration
 - TPL-007 is requiring magnetic field (and GIC) monitoring; can work with utilities to provide magnetic field data
 - We can use GIC neutral data from utilities with mag data to 1) develop ground conductivity transfer functions 2) validate other models and parameters such as substation grounding, etc.



validation

- Every mag needs a (NERC Compliance Registry Number) NCRID – who will provide this or apply for this?
 - Also who will be the reporting entity?
- How often would you (ERCOT and/or utilities) like to receive data? Annually, after every event, real time?
 - We can work with individual entities with different requests
- Is there any interest in electric field data?
 - Offline or real-time or both?
- We are keen on partnering for research particularly for GMD model validation, and real-time monitoring and visualization.
 - Leverage our Control Center Lab to develop and demo applications

Other News – GMD Short Course



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- First offered in April 2019 at the brand new Smart Grids Control Center at RELLIS
- Next one in Fall 2020
- Details at <https://epg.engr.tamu.edu/electric-grid-impacts-of-geomagnetic-disturbances/>



Last GMD course full! (24 participants, mostly industry, national labs, etc.)

Instructors



Thank You!



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Questions?
Access to Data?
Short Course?

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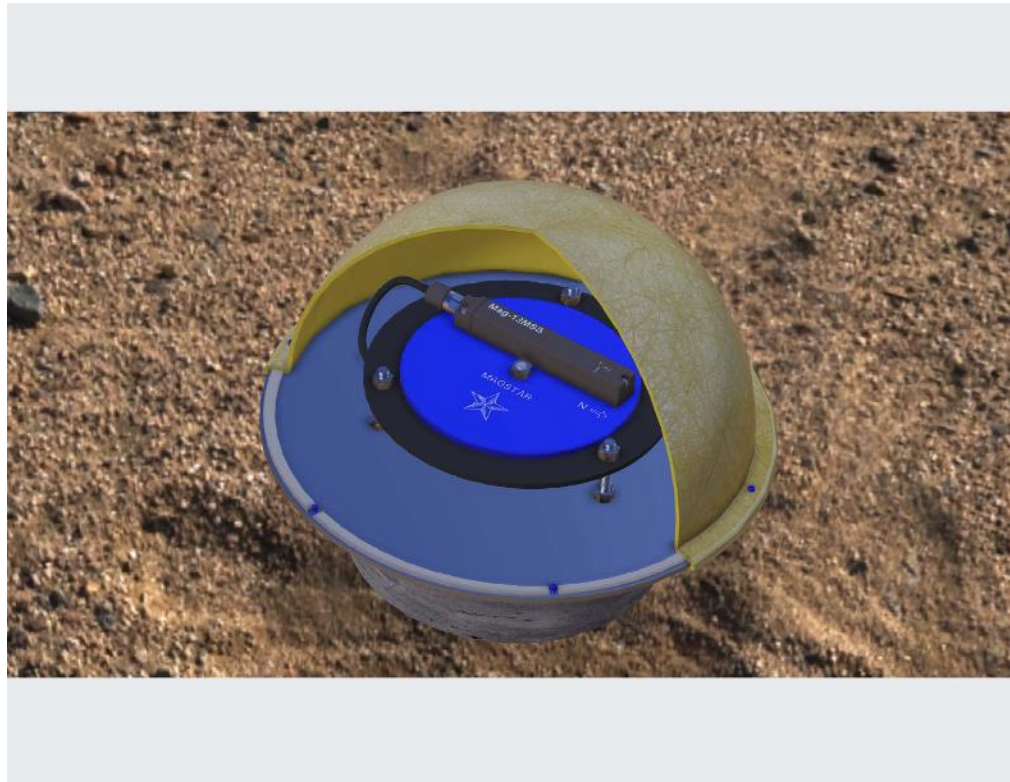


BACKUP SLIDES

Real-time monitoring is key to understanding what's happening locally



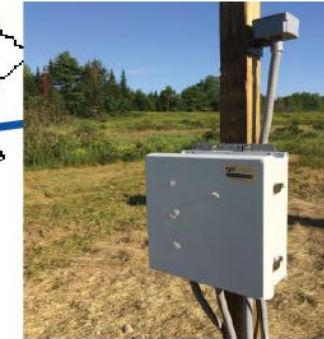
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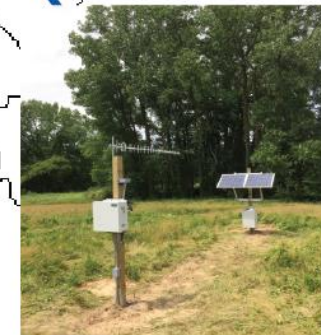
- Site placement is important!
 - ⇒ No metal, current-carrying wires, fences, buildings, roads, i.e. as magnetically quiet as possible
 - ⇒ Off substation grounding mat
 - ⇒ Ideally within 200 miles of substation
- Measure 1-second cadence
 - ⇒ Fluxgate mags
 - ⇒ Actually measure higher, and average to 1 second
- Align with geographic north!
- Store all of the information! (Needed to calculate E)

SHM: Space Hazard Monitors

Our earlier work while at UIUC



Key outcome of our recently concluded project:
NSF EAR #1520864



These are already in place

Motivating Factors

- Improve understanding of Texas geophysics for GIC hazard analysis
- There is a high degree of uncertainty in available conductivity models for Texas
- There are no models built specifically for Texas; this limits our understanding of how GIC hazard varies between locations

