

Update on a Semi-Airborne Controlled Source Electromagnetic Survey at Kemper CarbonSAFE

NETL, Colorado School of Mines, DIAS Geophysical

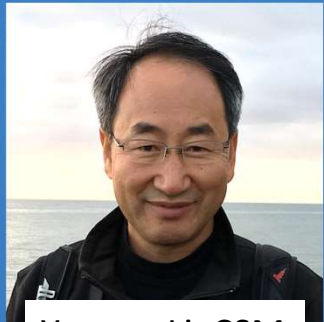


Rick Hammack

Research Geologist/Geological and Environmental Sciences



Colton Kohnke, NETL



Yaoguo Li, CSM



2023 Carbon Management Review Meeting
Pittsburgh, PA , August 31, 2023



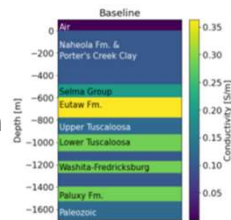
Ryan Olson, DIAS

Project Background

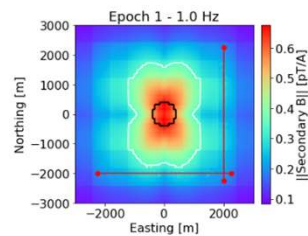
- Brief project history:

2010
Geotech
Presentation
at AGU

2020 Selected
Kemper
CarbonSAFE
site



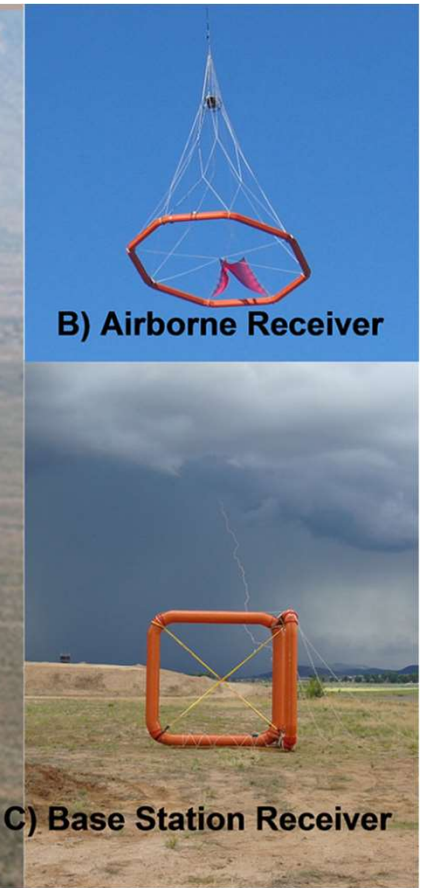
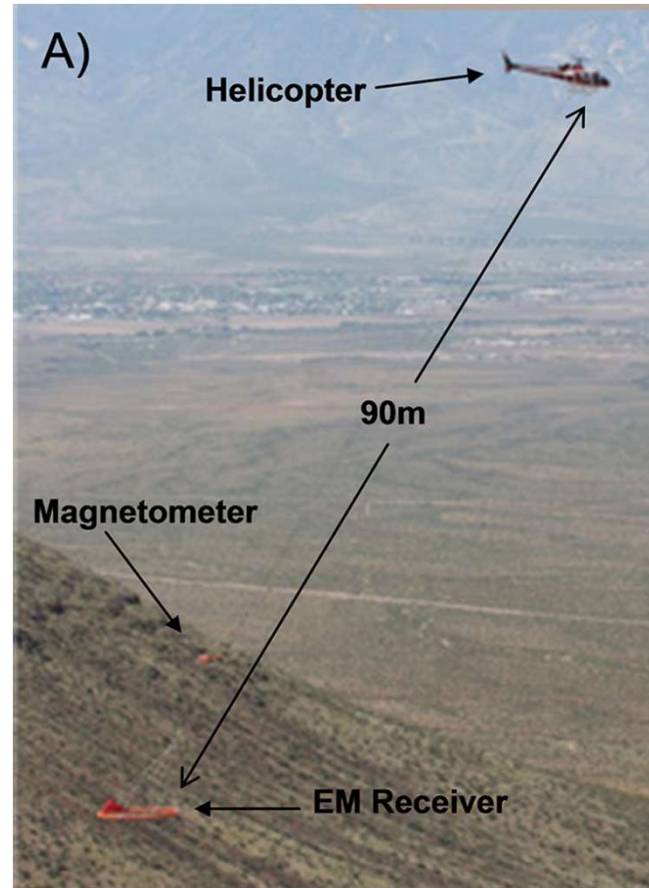
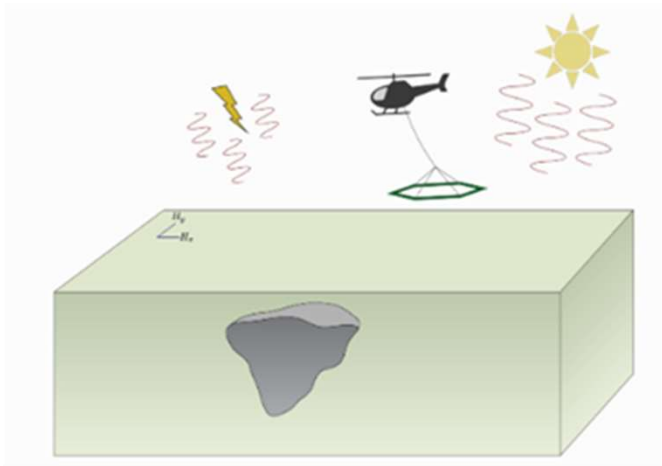
2021 Forward
Model MT and
CSEM response to
CO₂ injection at
Kemper



2023 Baseline
CSEM and MT
surveys at
Kemper

2-5 years CSEM
and MT surveys
during CO₂
injection

Approach – Geotech's ZTEM



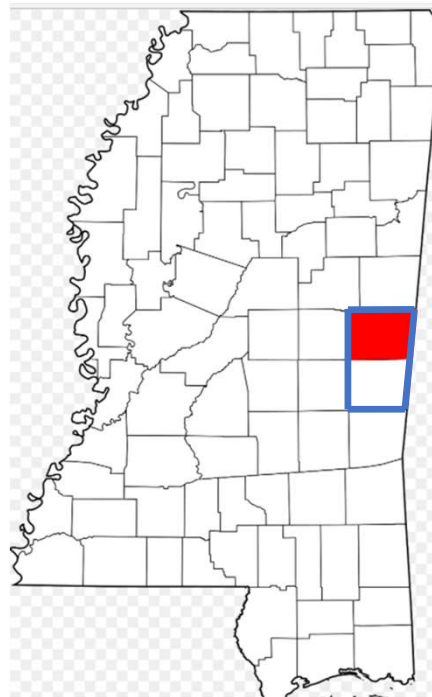
Approach – DIAS QAMT

3C Low-Temperature SQUID Magnetometer

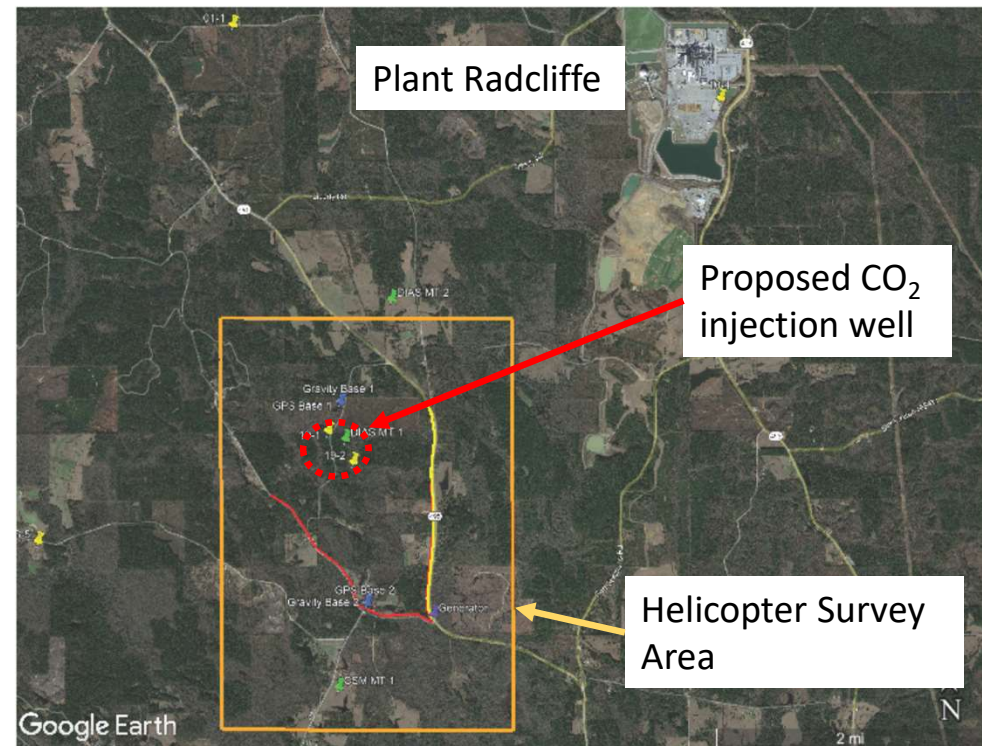


Project Background-Location

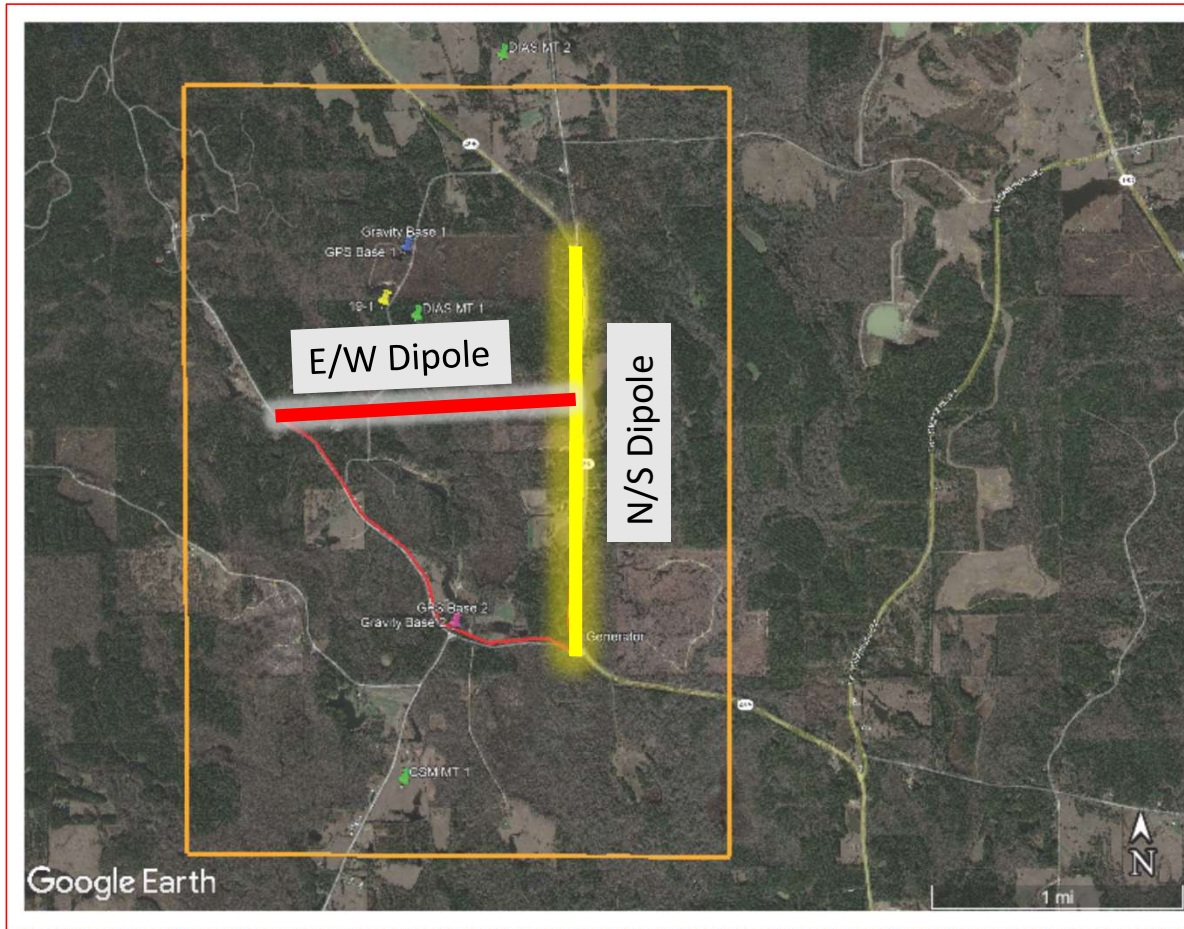
Kemper (red) and Lauderdale
Counties (white), Mississippi



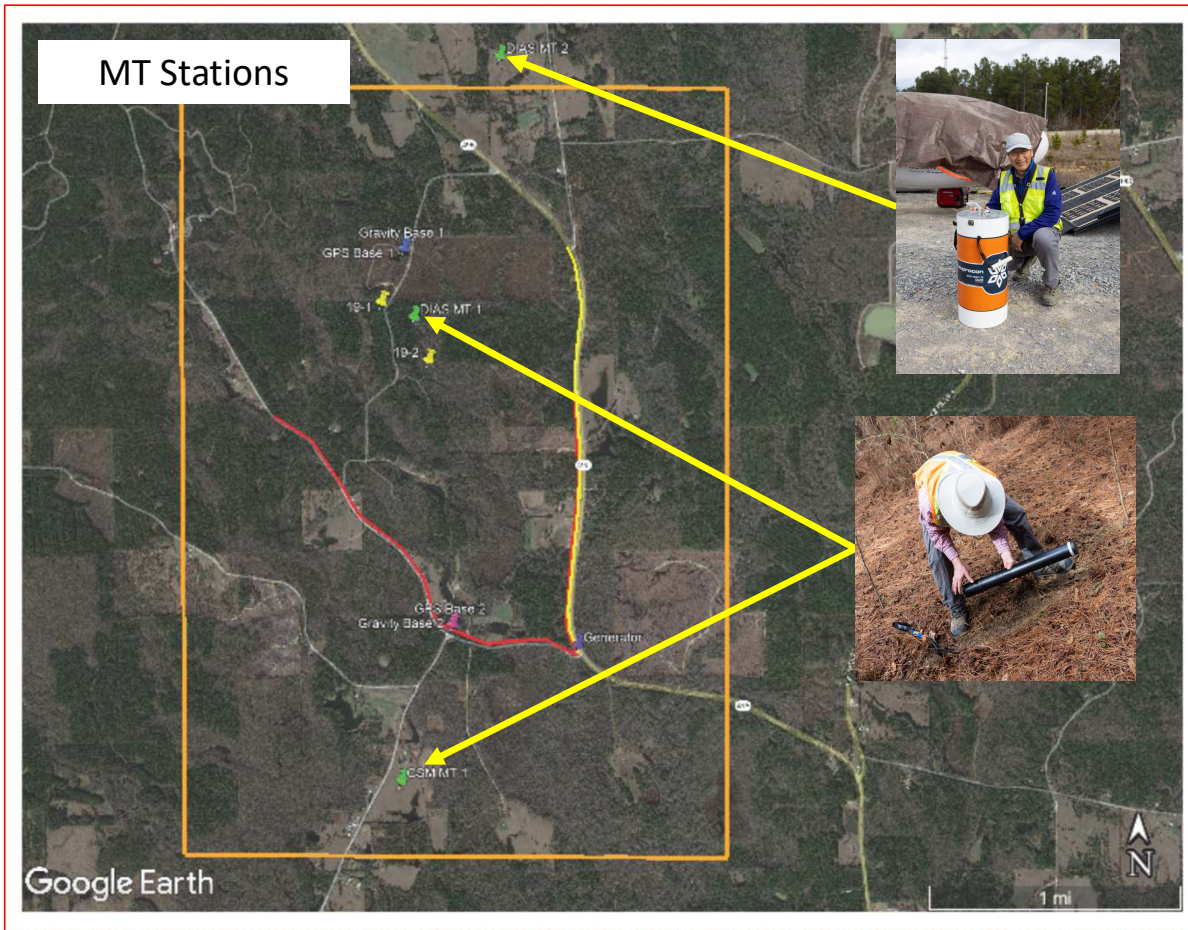
Mississippi



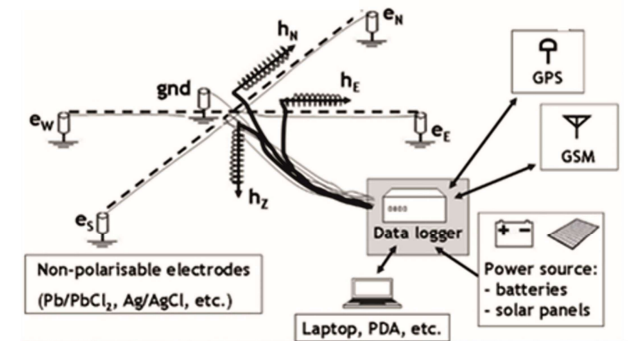
Crossed Dipole Transmitters



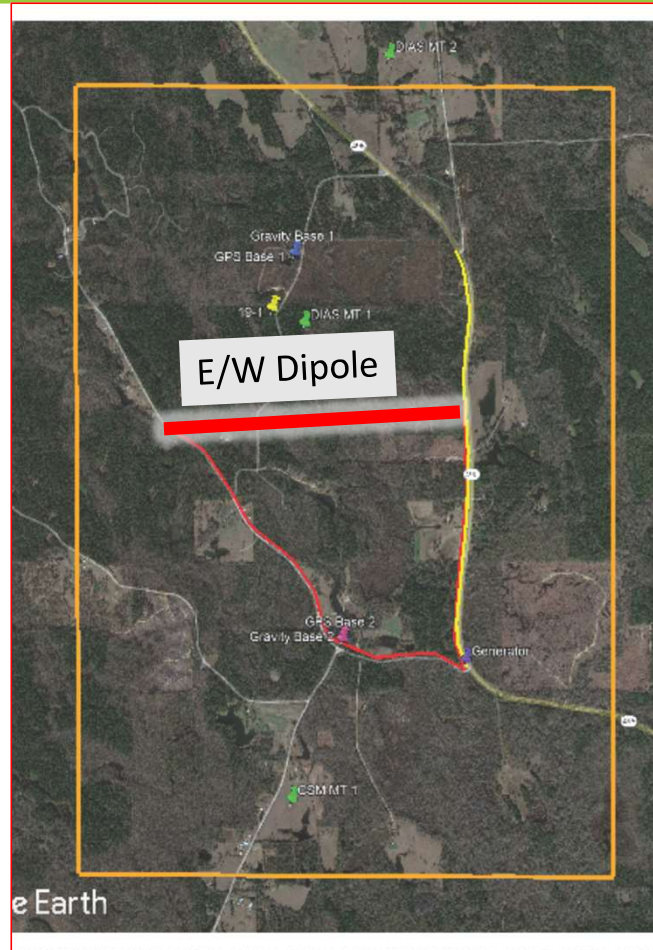
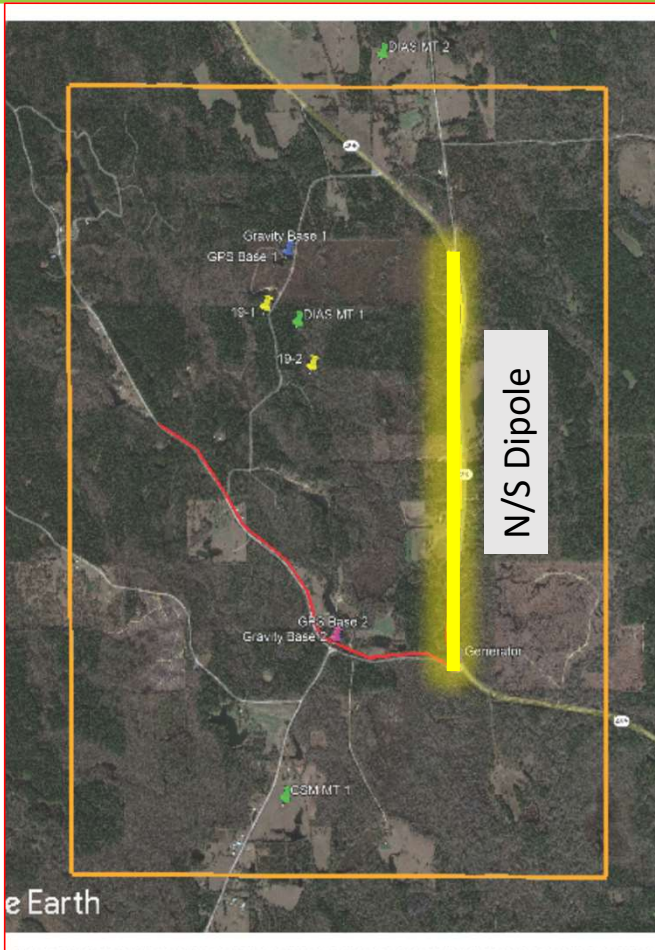
Magnetotelluric (MT) Stations



MT Stations



Baseline MT and CSEM Surveys



Natural Fields Survey (MT or ZTEM)

- Flight Line Direction – N/S
- Flight Line Spacing – 300 m
- No Tie Lines

CSEM Survey 1 – N/S Dipole

- Flight Line Direction – N/S
- Flight Line Spacing – 75 m
- No Tie Lines

CSEM Survey 2 – E/W Dipole

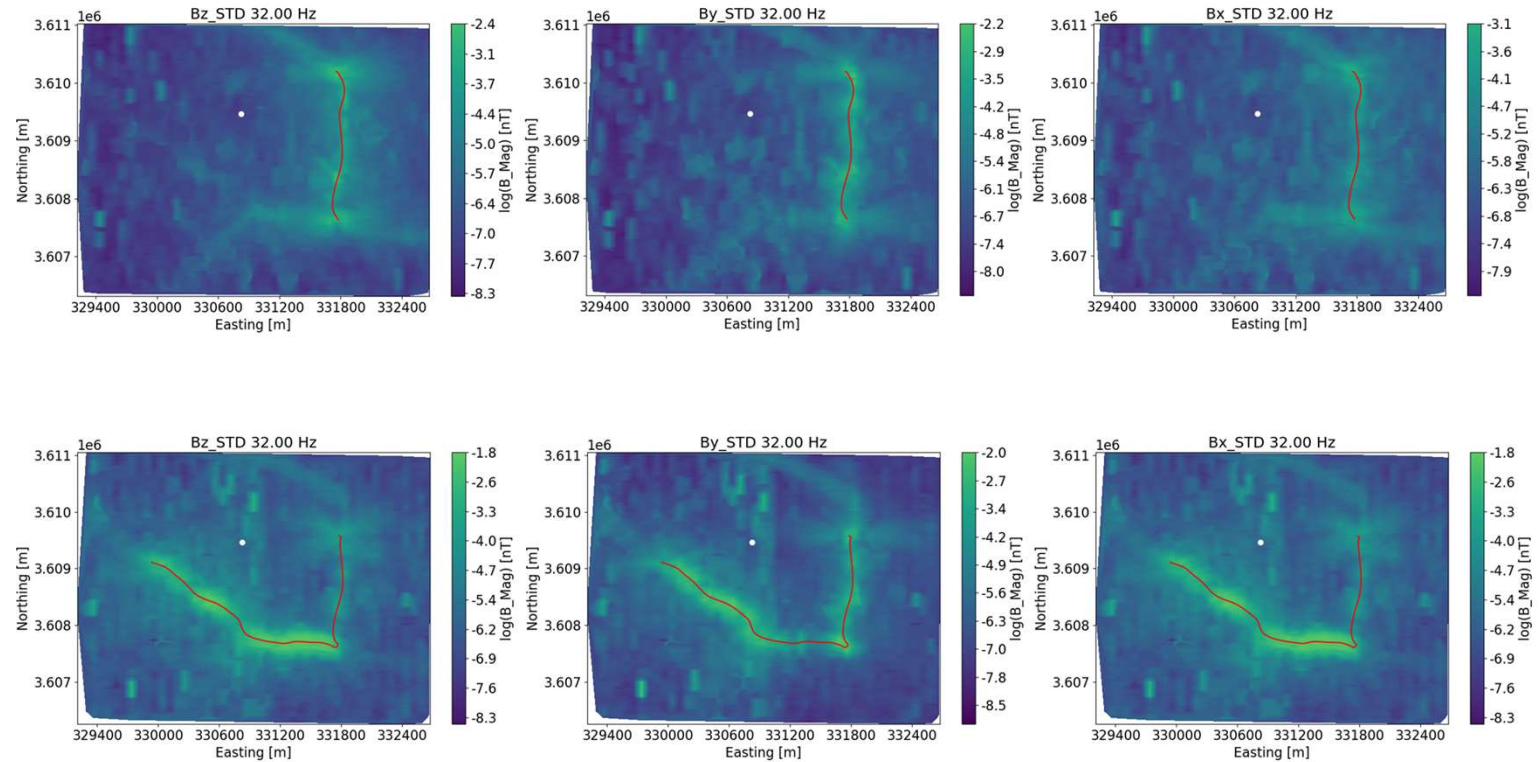
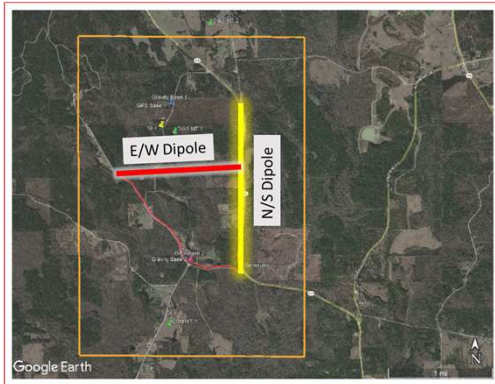
- Flight Line Direction – N/S
- Flight Line Spacing – 75 m
- No Tie Lines



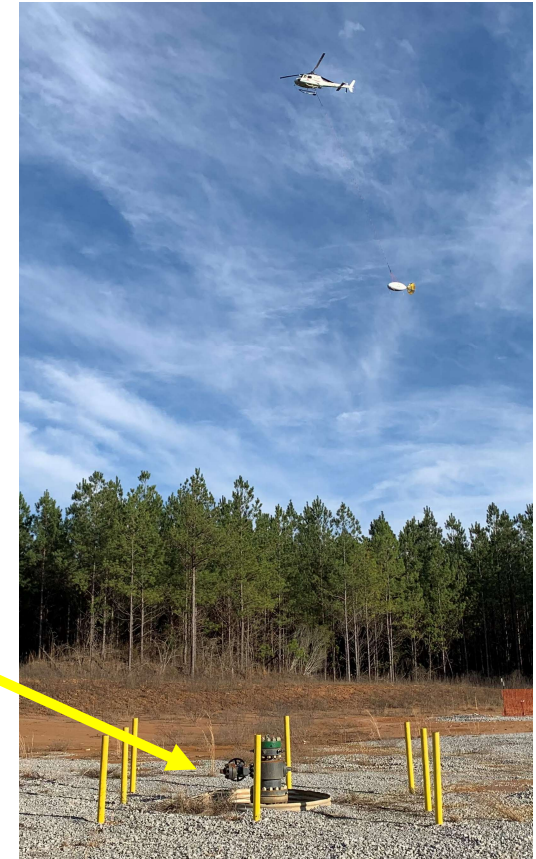
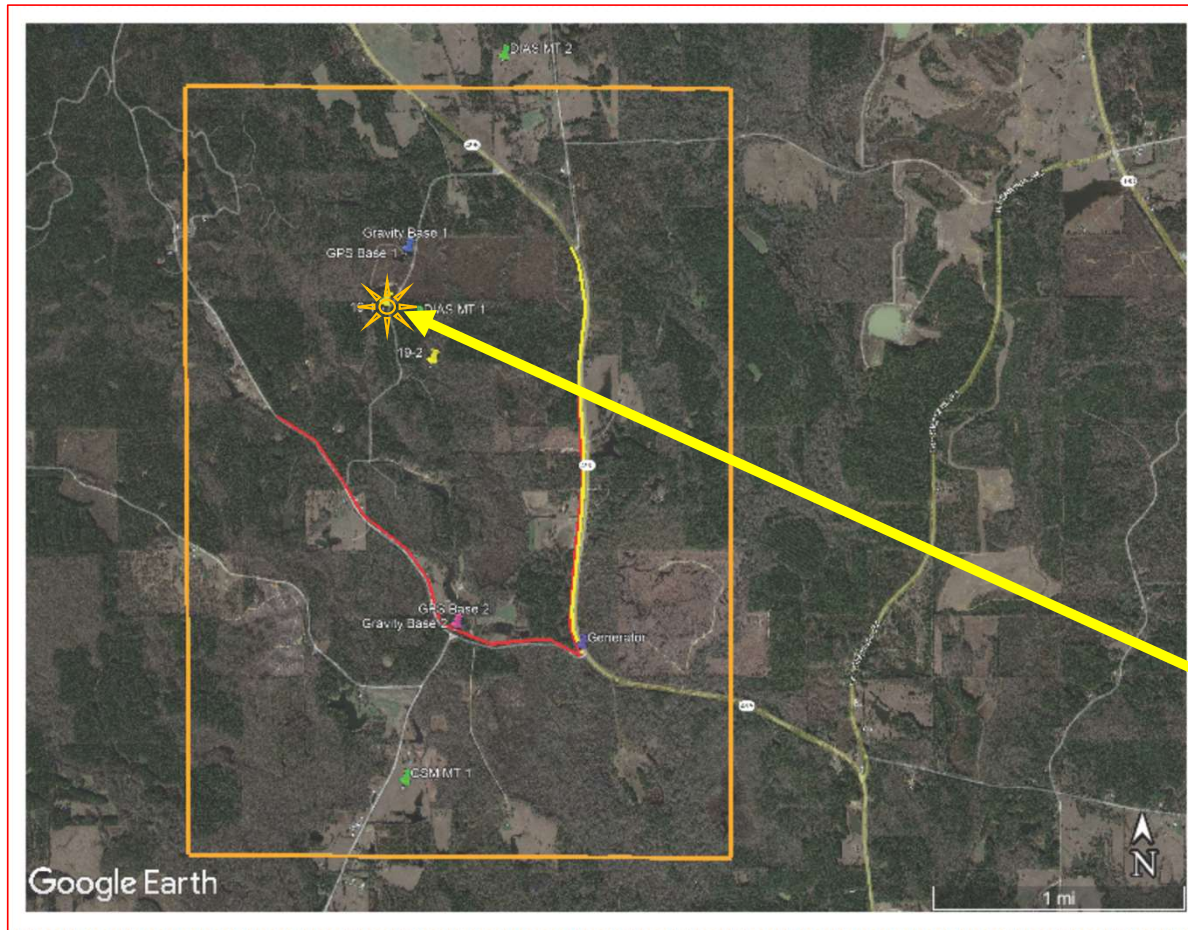
U.S. DEPARTMENT OF
ENERGY

9/5/2023

Results - Noise Survey (Transmitters on)



Next Steps – Compare CSEM to MT to Well Log



Project Summary



- **Forward Modeling** indicated that the injected CO₂ plume at Kemper CarbonSAFE can be mapped using a sensitive magnetometer on aircraft
 - Magnetotellurics (MT) – excellent for detecting CO₂/brine interface (Tipper)
 - Controlled Source Electromagnetics (CSEM) – Will not detect the CO₂ plume in early stages of injection but will detect plume in later stages and post injection.
- **Baseline Survey** found that the electromagnetic noise at the proposed CO₂ injection site would not prevent airborne MT and CSEM from detecting the CO₂ plume boundaries.

Importance to Advancing DOE Program Goals



Plume Monitoring During and Post Injection

- Lowers CO₂ plume monitoring cost
- Complementary to 4D seismic
- Lessens impact on residents and landowners
- Possibility of autonomous aircraft surveys
- On-the-fly data processing/interpretation
- AI informed surveys



Baseline MT and CSEM Surveys

