

Study Site

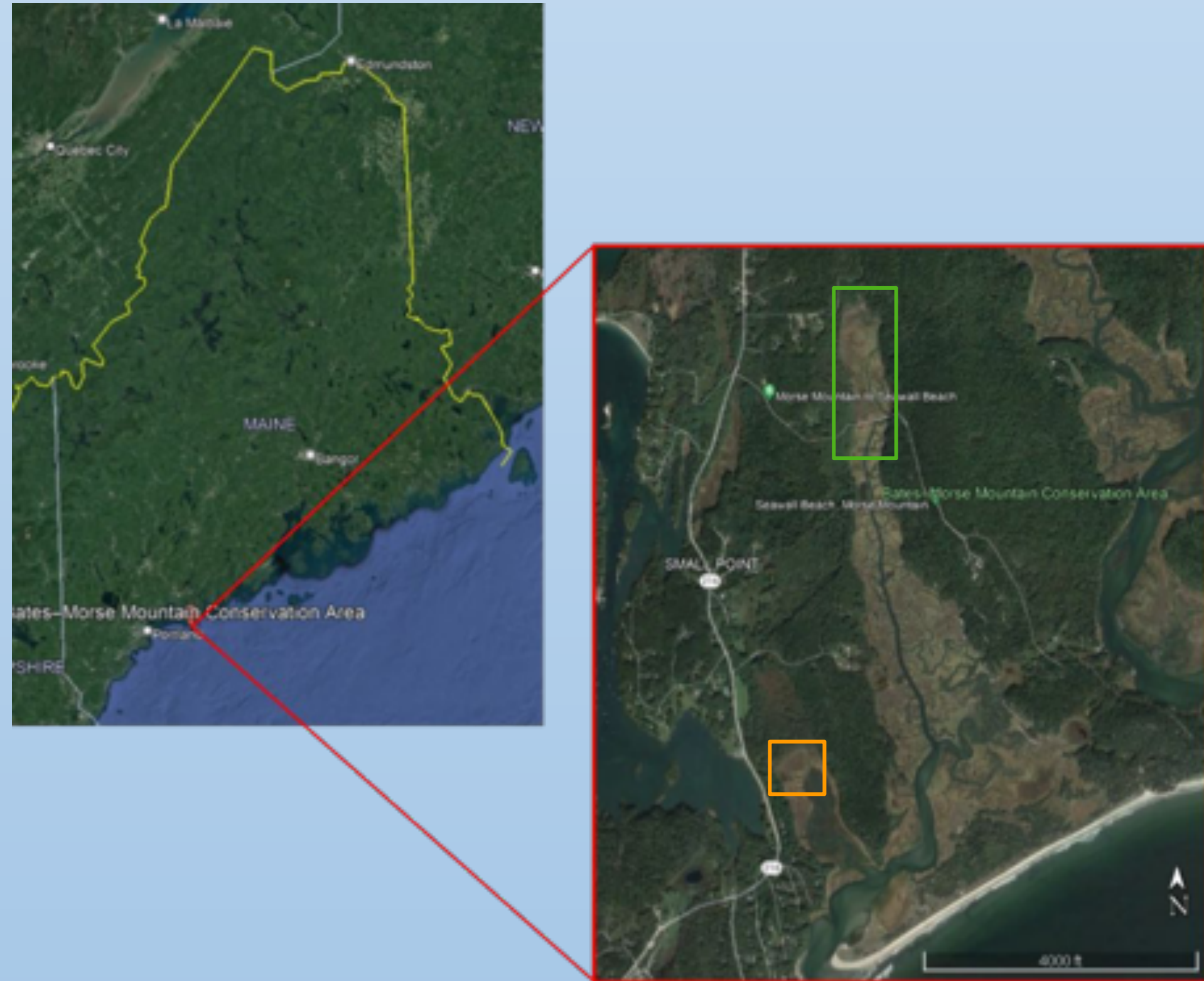


Figure 1. The study areas are in Sprague Marsh, located in the Bates-Morse Mountain Conservation Area, in Phippsburg.

Purpose

Salt marshes are fragile ecosystems that have the potential to mitigate climate change through carbon sequestration. These marshes are an important tool for meeting carbon targets as highlighted in Maine Won't Wait. Little is known about the impact of historical farming practices or of tidal restrictions on carbon sequestration and stocks in salt marshes. This study combines historical data, field observation, and geochemical analyses of sediment cores to assess the variability in carbon density in areas of historical farming. Additionally, greenhouse gas flux data are measured across a tidal restriction.



Figure 2. Sprague River salt marsh from the ground.

Methods



Figure 3. LICOR-7810 greenhouse gas flux analyzer (on right) with SMART chamber and collar (on left), setup for a 24 hour data collection

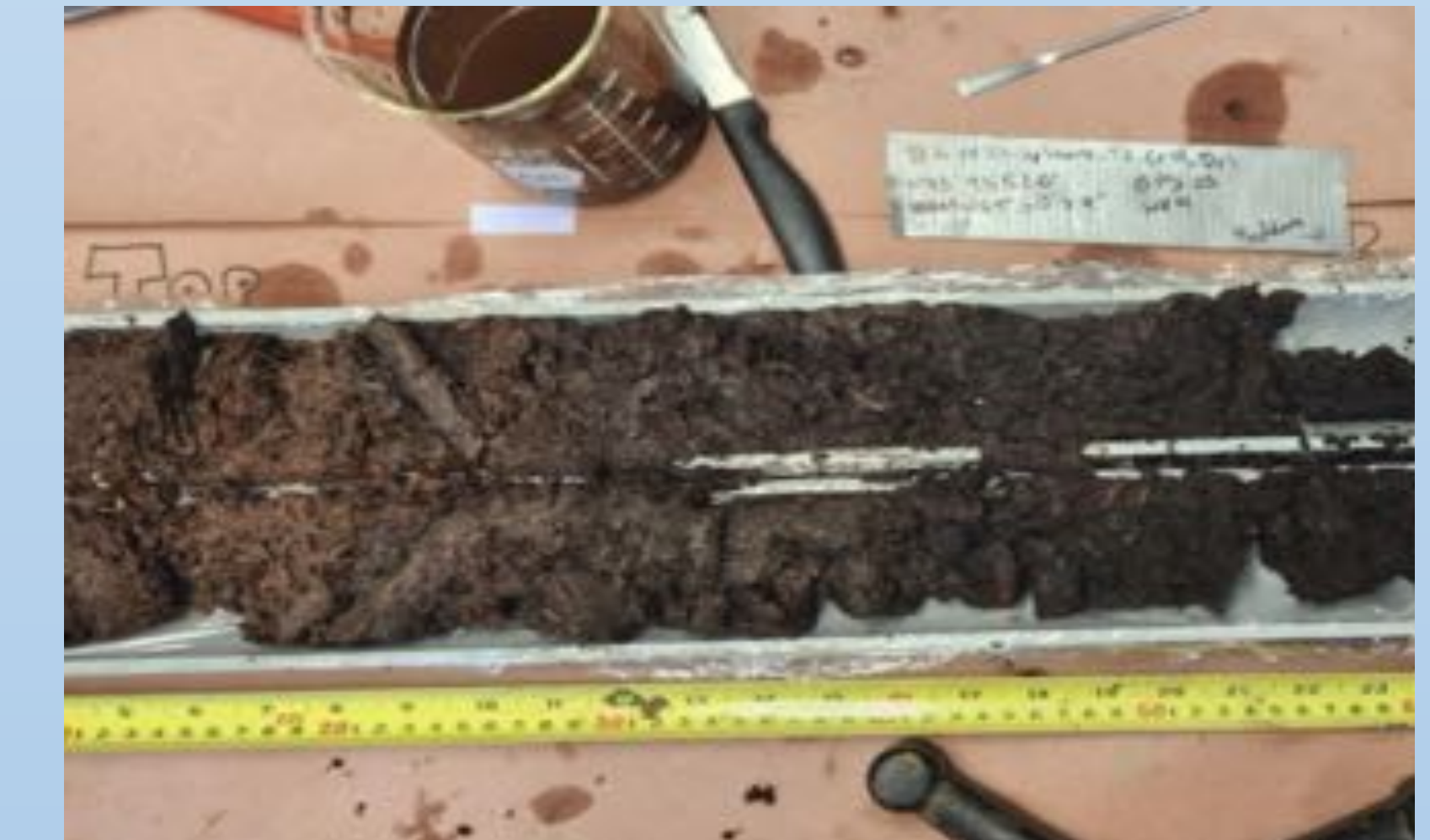


Figure 4. A sediment core of Sprague Marsh, split in half, being described and subsampled for geochemical analysis

Gas fluxes were taken at nine collars below the causeway (tidal restriction) and seven collars above the causeway. Marsh Cores were taken on two transects, one in a section of subsided marsh and one moving from the marsh into the adjacent forest. Cores were subsampled in the Bates Environmental Geochemistry Lab where Loss on Ignition (LOI) was conducted and they were processed through a Isotope Ratio Mass Spectrometer

Maine Won't Wait

This work will increase our understanding of Maine's blue carbon stocks and methods to increase salt marsh productivity as a natural climate solution in line with our climate action plan, Maine Won't Wait. Strategy E of the plan is to "...Promote Natural Climate Solutions and Increase Carbon Sequestration" and it specifically references blue carbon as a tool to aid the state in reaching carbon neutrality. By better understanding how much carbon is sequestered in Salt Marshes and what ways historical structures are hindering this processes we can better account for Blue Carbon in Maine and develop new methods of restoration.

Future Work

More repetitions of the greenhouse gas data needs to be collected to confirm the observations we have so far. Additional cores from Sprague and other marshes will help develop a more complex understanding of how carbon density changes. Sedimentation rates will be determined for carbon sequestration rates. Ultimately this can be used to develop a more comprehensive carbon stock for Maine salt marshes.

Acknowledgements

Special thanks to the Maine Climate Science Information Exchange for funding a summer internship during which these data were collected. Additional funding was provided through grants to B. Johnson from Maine Sea Grant and and the Maine Community Foundation. This work couldn't have been done without the caretakers at Bates-Morse Mountain Conservation Area and Shortridge Coastal Center.

References

Colarusso, P., et al. (2023). The Blue Carbon Reservoirs from Maine to Long Island, NY. EPA Region 1.

Results



Figure 5. Core locations in Sprague Marsh

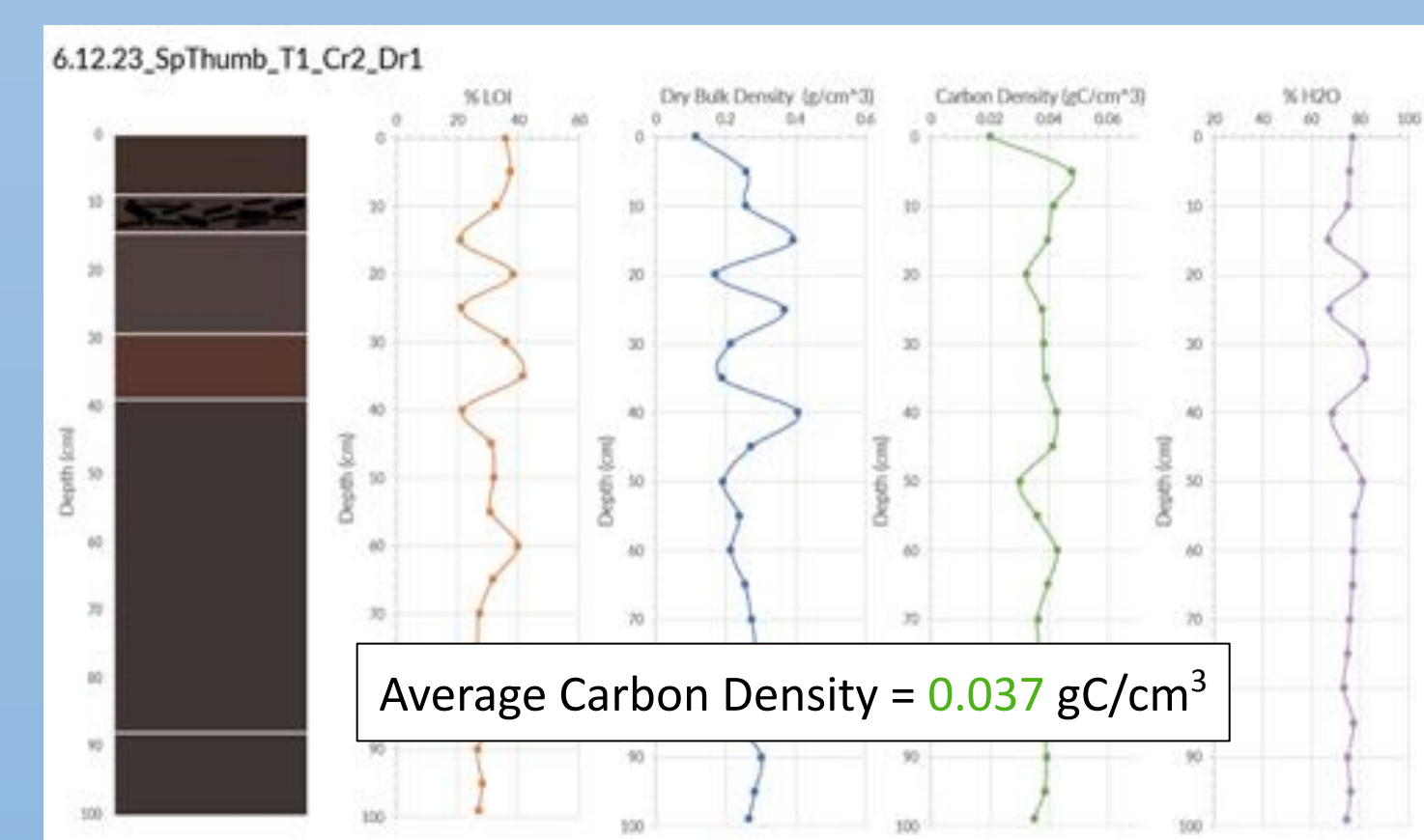


Figure 6.

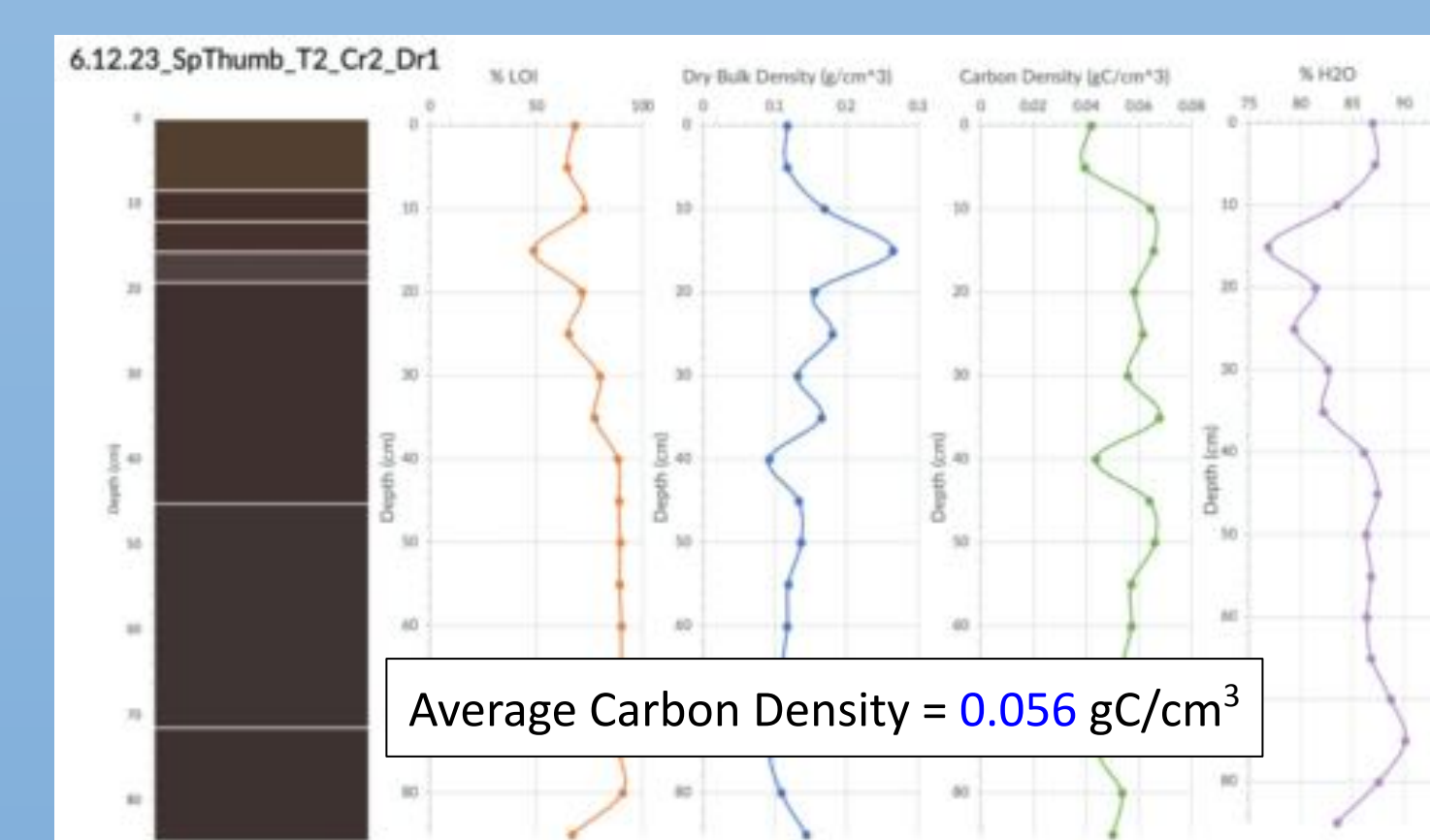


Figure 7.

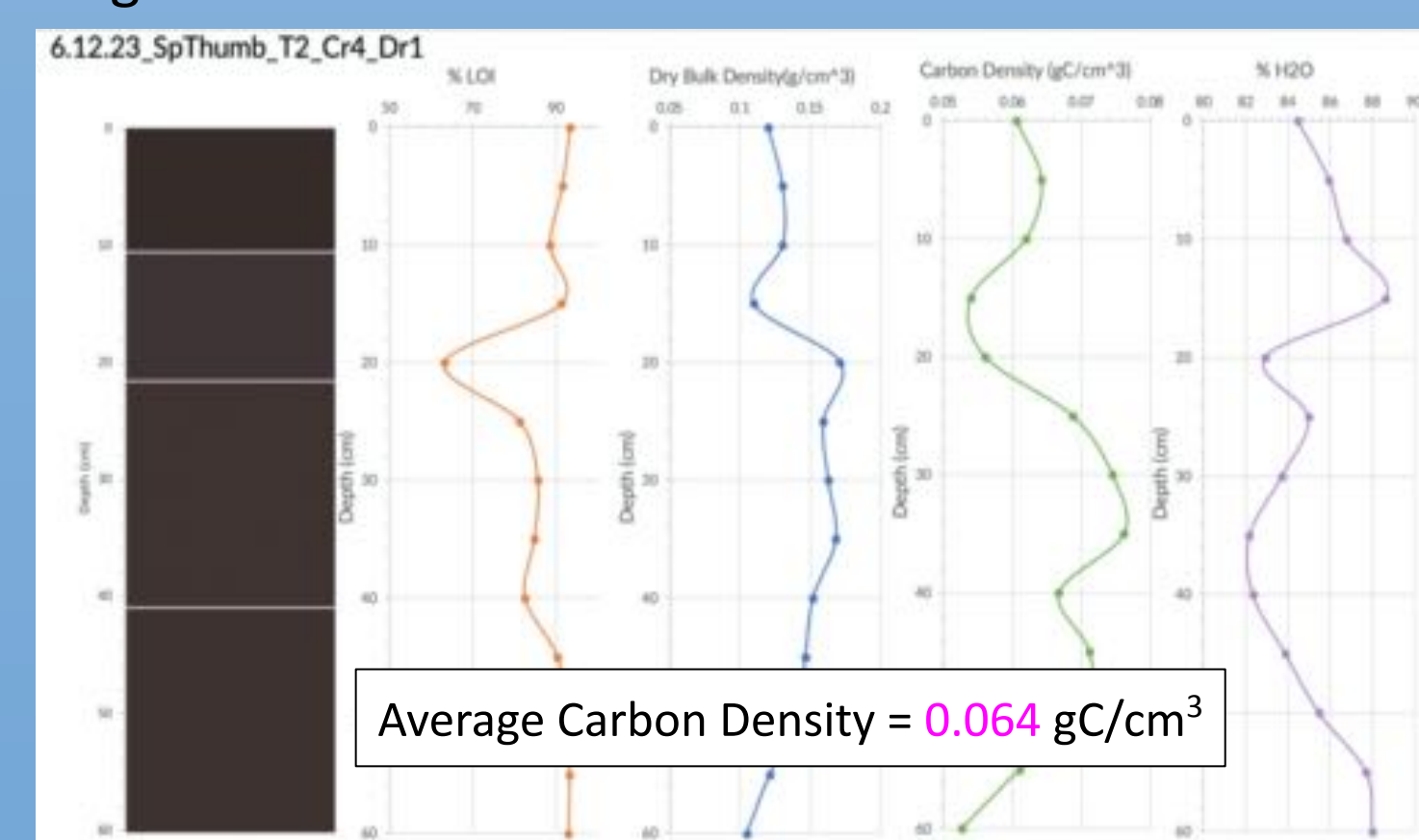


Figure 8.



Figure 10. Collar locations in Sprague Marsh



Figure 11.

In general, methane emissions below the restriction were lower than the emissions above the restriction. Salinity has been used as a proxy for methane emissions, however this did not appear to be true for all of the locations we tested at Sprague Marsh.

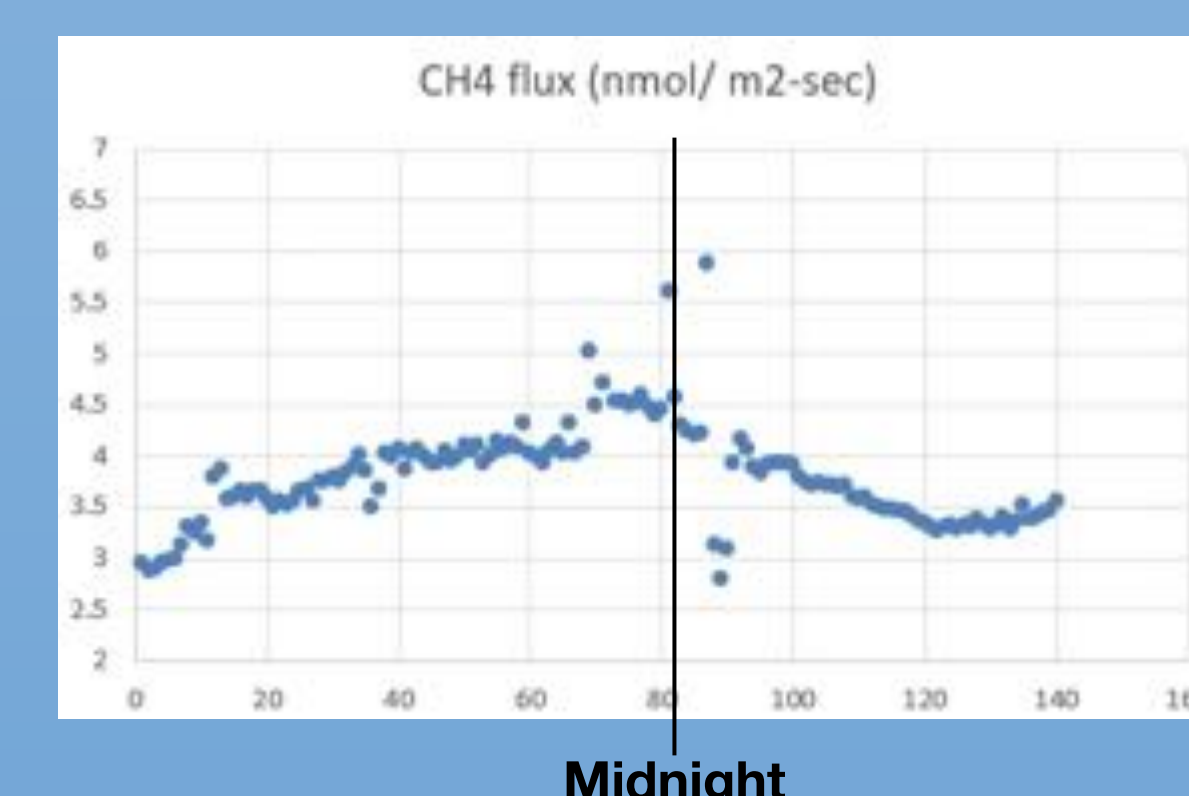
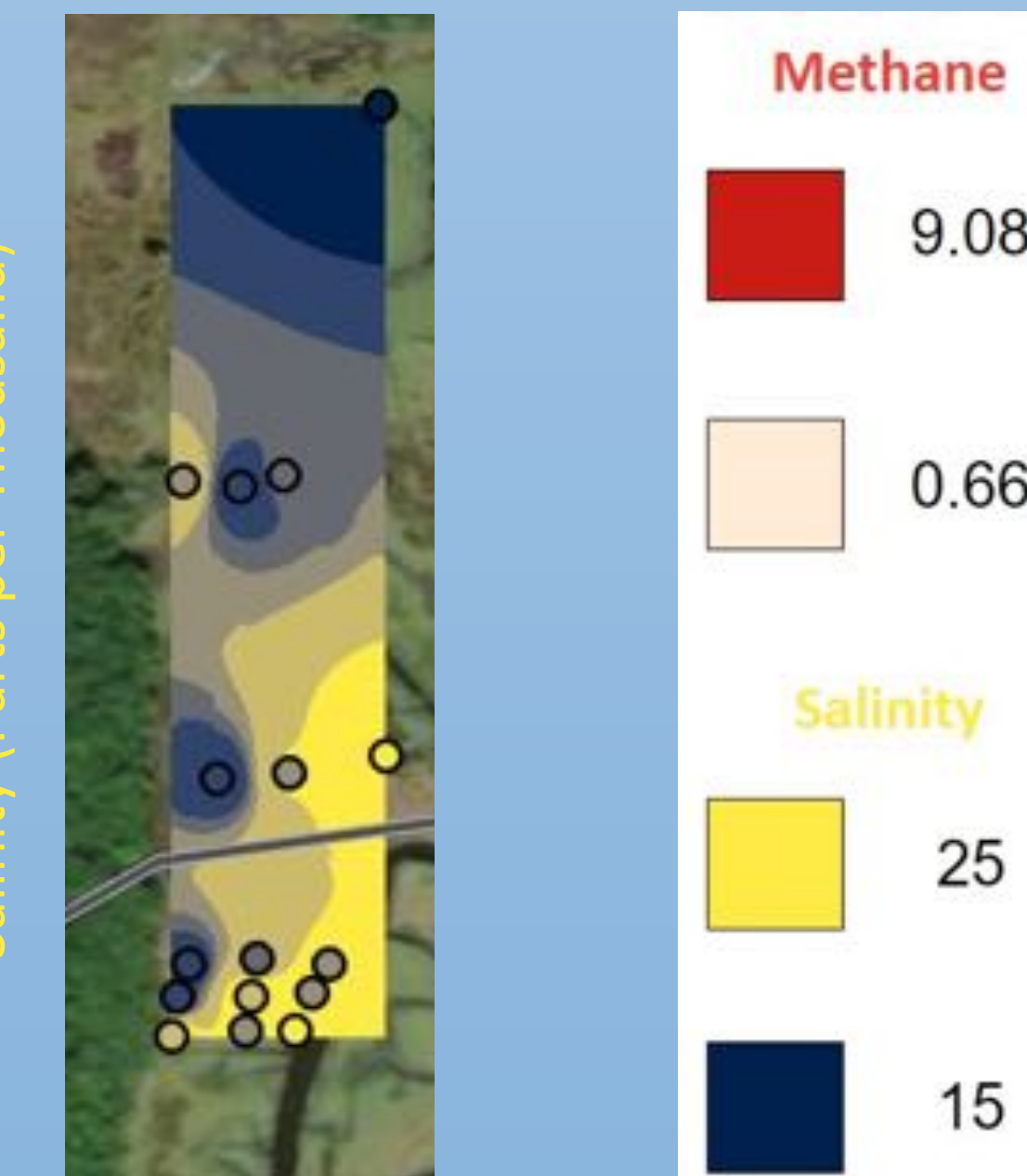


Figure 12. Graph of methane soil flux at a single location over a 24 hour period

Methane soil flux is lowest in the early morning and highest at night. We Sampled mid-day suggesting that we did not get peak emissions data. More work is needed to understand the nature of this variation.

Data Source	Carbon Density (g/cm ³)	Stock (Mg C)	Reference
Avg 115 cores in New England	0.035	1344	Colarusso et al., 2023
Core T1, C2	0.037	1421	This study
Core T2, C2	0.056	2150	This study
Core T2, C4	0.064	2458	This study
Avg 8 cores, this study	0.044	1690	This study

Figure 9.

The cores from Sprague Marsh show variation in the carbon density even within the same marsh. This complicates the calculation of carbon stocks because using the regional average may not be an accurate representation.