Atmospheric Winter-Time Convection in the Gulf of Maine

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Introduction

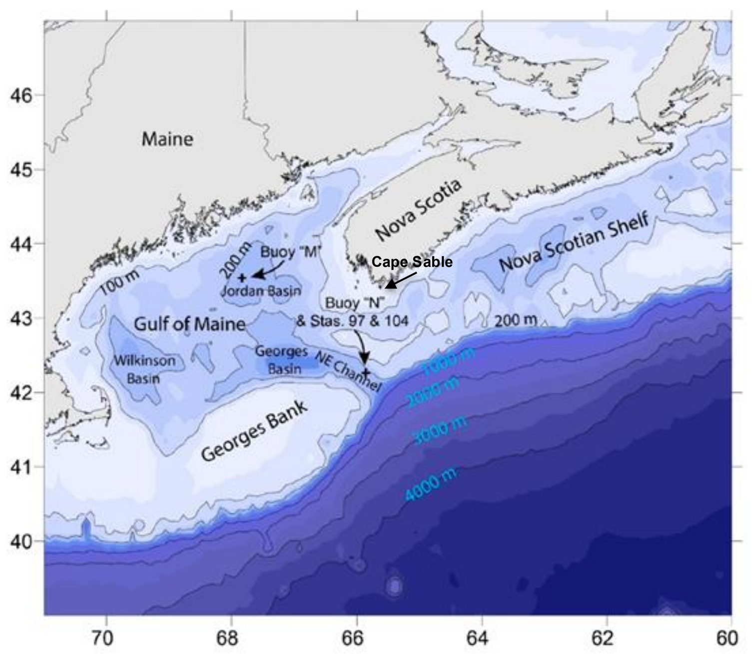
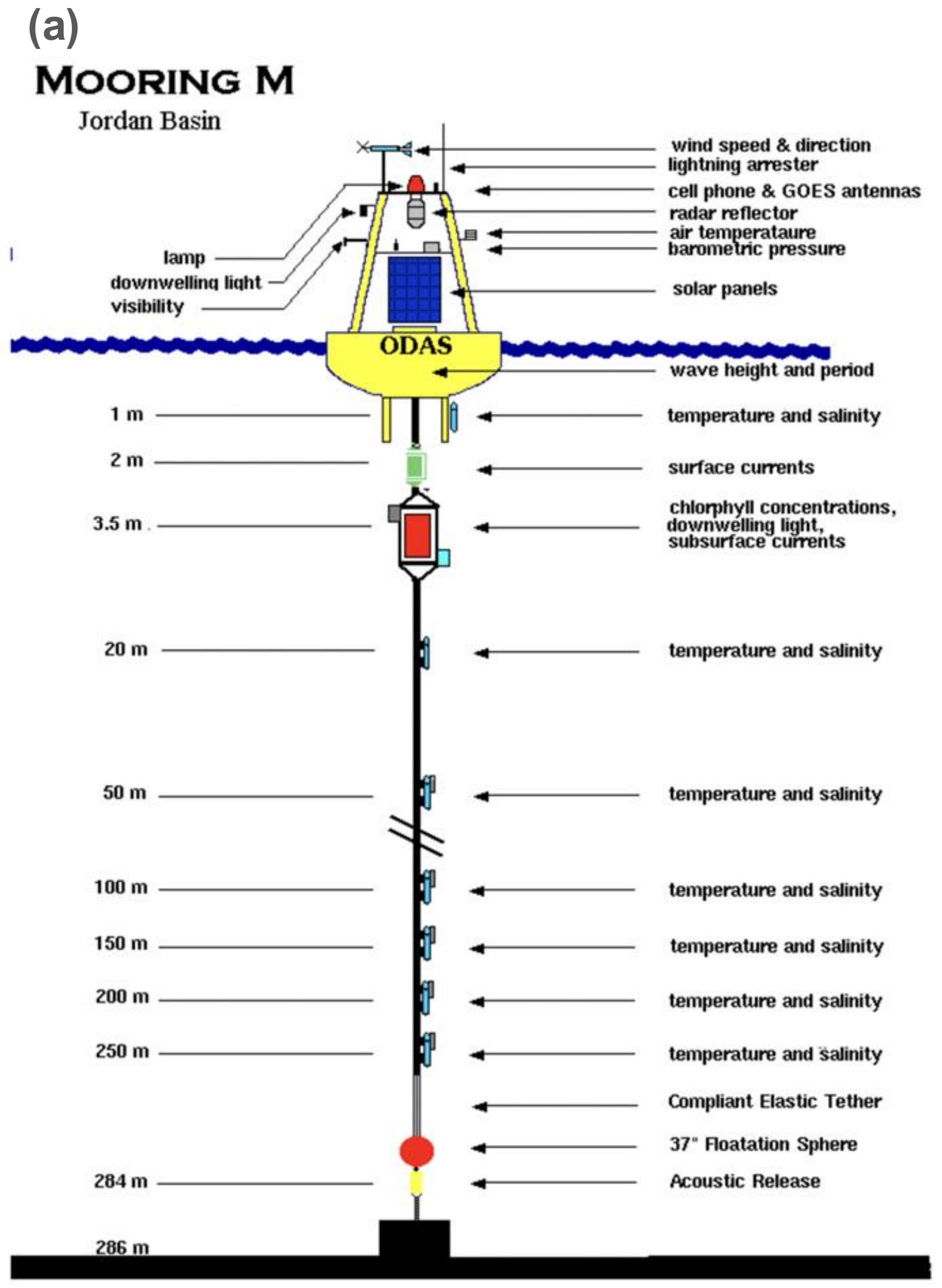


Figure 1. Map of the GoM region depicting the location of Buoy M in the Jordan Basin and surrounding bathymetric features, where the x-axis are longitudinal values and the y-axis are latitudinal values (Townsend et al., 2023).

- The Gulf of Maine (GoM) presents highly biologically productive ecosystems of significant economic importance (Townsend et al., 2023).
- The GoM is sourced with cold/fresh waters at the surface around Cape Sable and the Northeast Channel, while warm/salty waters enter the GoM through the Northeast Channel below 50 - 75m (Townsend et al., 2015).
- The Jordan Basin serves as a reservoir of nutrients from slope waters, where localized upwelling allows nutrients to be distributed throughout the GoM (Townsend et al., 2015).
- **The purpose of this study is to bridge the knowledge gap in how local atmospheric forcing affects the temporal variability of hydrographic properties and nutrient concentrations on monthly to interannual timescales.**

Data and Methods

(a)



- NERACOOS moored BuoyM equipped with temperature and salinity (2003-2025) and nitrate (2013-2025) in the Jordan Basin (Figures 1 and 2)
- Temperature and salinity measurements: MicroCATs (SBE37-IM)
- Nitrate measurements: SUNA V2
- SUNA measurements were removed when concentrations dropped below detection limits (0.3 μM), assuming sensor failures
- Data was averaged on monthly and yearly window sizes, where gaps in data were linearly interpolated (Figure 3)

(b)

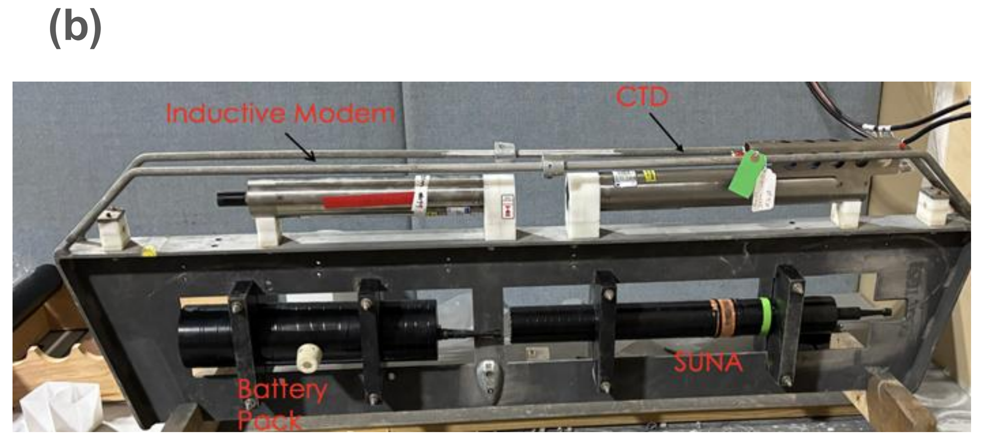


Figure 2. (a) Diagram of the NERACOOS Buoy M and it's payload in the Jordan Basin (UMaine Physical Oceanography Group, 2003), (b) temperature and salinity rails have been modified to accommodate the SUNA (Submersible Ultraviolet Nitrate Analyzer) with their own battery pack. When all devices are connected, the inductive modem transmits data up the cable for real time data transmission.

Results

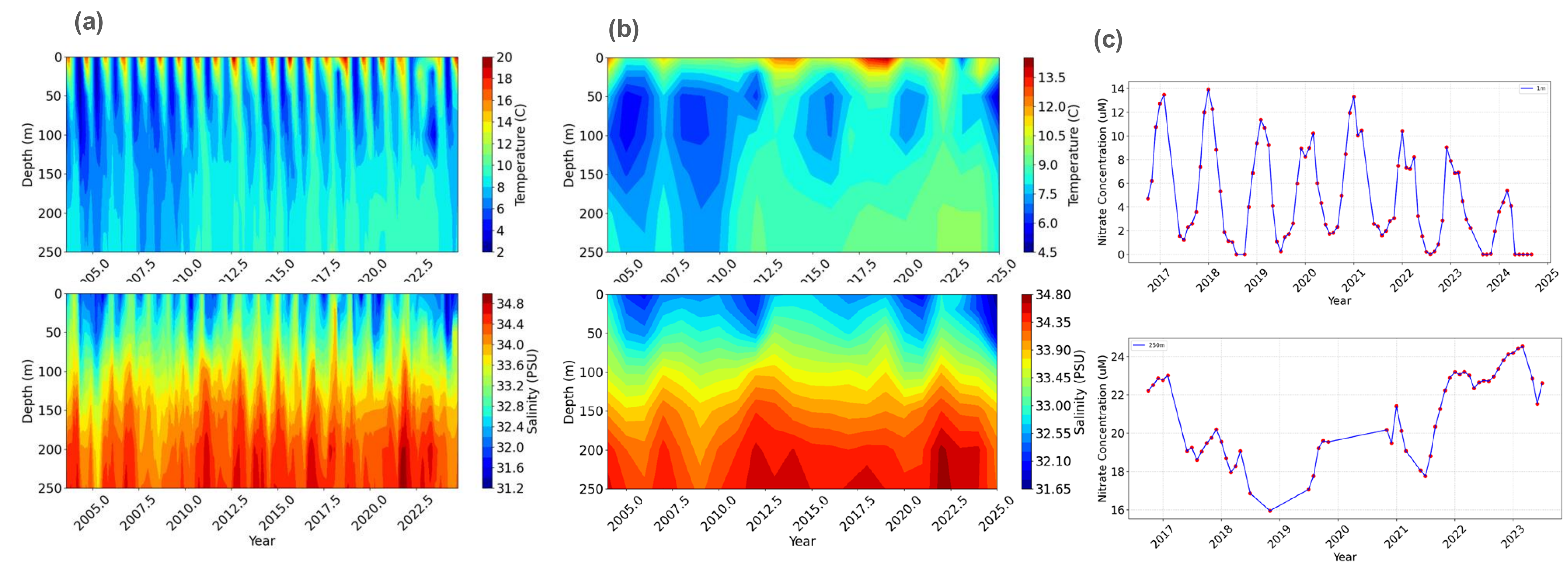


Figure 3. Visual data representation of hydrographic properties and nitrate variability measured from Buoy M in the Jordan Basin. Hovmoller diagrams of **(a)** monthly and **(b)** annual averages for temperature (top panels) and salinity (bottom panels). **(c)** Monthly running averages of nitrate concentrations near the surface (1 m) and ocean bottom (250 m). **It seems wintertime convective mixing is driving mixing at depth. Where warm salty waters are trapped at depth when wintertime convective mixing isn't as prevalent. Seemingly leading to accumulation of nitrate concentrations at depth and a depletion at the surface.**

Take Home Messages

- Temperature and salinity were dominated by seasonal cycles
- Strength of seasonality changes changes yearly, where the strength of the wintertime convection seems to dictate interannual variability of temperature and salinity properties. Convection observed to become weaker over the years, leading to warmer and saltier waters at depths below 150m.
- Due to reduced vertical mixing, nitrate seems to be increasing at depth and decreasing at the surface
- This study is in its early stages.. Our next steps are to collect atmospheric data in order to run a Price-Weller-Pinkel (PWP) model to test if wintertime convective mixing is the driving factor for the variability of data in the GoM.

Acknowledgements

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References

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