14 years on the Halifax Line: Assessing trends and variability using ship-based observations and autonomous vehicles

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1. The Atlantic Zone Monitoring Program

- Ship-based ocean monitoring program

- Implemented by Fisheries and Oceans Canada (DFO) in 1998

- >20 lines on the Scotian Shelf, in the Gulf of St. Lawrence, and around Newfoundland and Labrador

-13 stations on the Halifax Line (HL)

- Biogeochemical measurements made from discrete water samples, alongside a CTD on a rosette

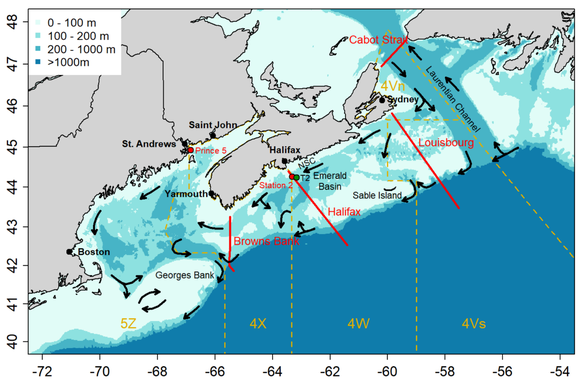

Figure 1: Select Atlantic Zone Monitoring Program lines. The Nova Scotia Current (NSC) is shown adjacent the coast (Hebert et al., 2024).

2. Gliders & data availability

- Autonomous underwater vehicles

- Dive and ascend by changing their buoyancy

- Speed ~30 cm/s, angle +/- 20° from horizontal

- Maximum depth: 650 m or 10 m off the bottom

- Glider types: Teledyne Slocum, Alseamar SeaExplorer

Photos: Teledyne (L) and Alseamar (R)

- Return trip on the HL ~550 km, ~3 weeks, 1000-2000 profiles

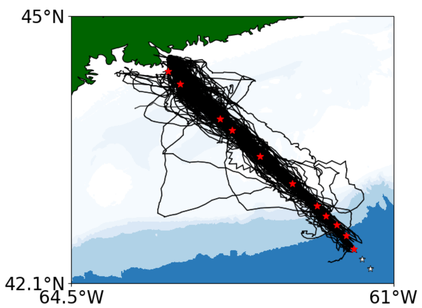

Figure 2: Glider tracks along the Halifax Line. The Atlantic Zone Monitoring Program stations are indicated in red and the Atlantic Zone Offshore Monitoring Program stations are indicated in white.

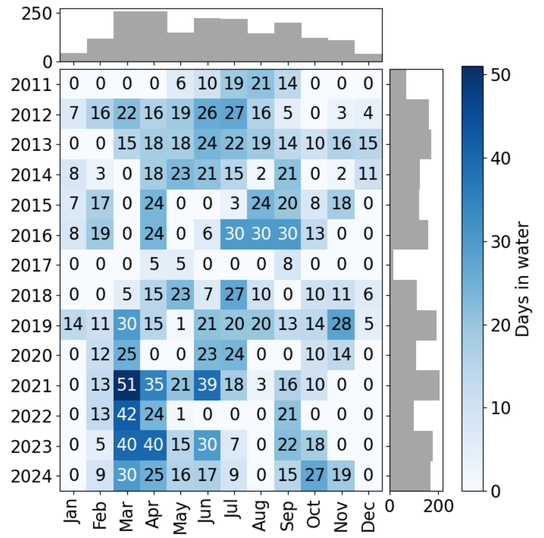

Figure 3: Glider days in water for the Ocean Tracking Network and Fisheries and Oceans Canada.

3. AZMP climatologies

- Used one profile per station, per season, per year

- Averaged profiles over 2011-2024 to match glider data availability

- Smoothed cross-sections using Barnes averaging

- Computed distance along the HL as the geodesic distance from Halifax Harbour (-63.4572° W, 44.5824° N)

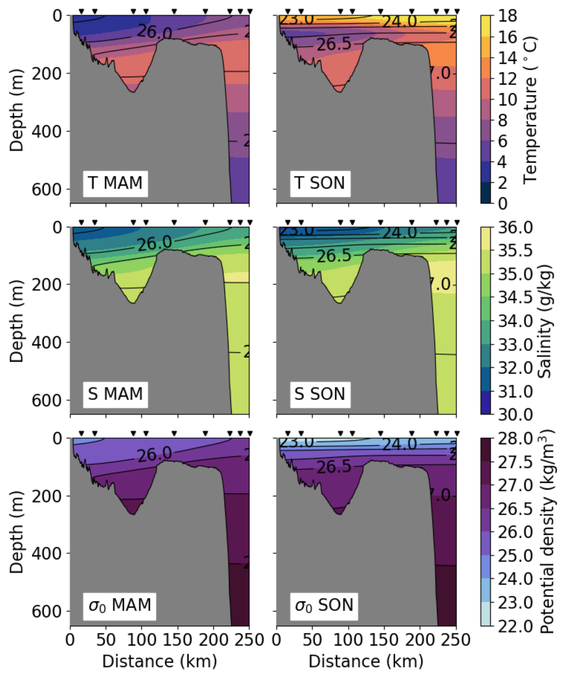

Figure 4: Spring (March-May) and fall (September-November) climatologies for 2011-2024 for temperature, salinity, and potential density along the Halifax Line using profile CTD data from the Atlantic Zone Monitoring Program.

4. Glider climatologies (preliminary)

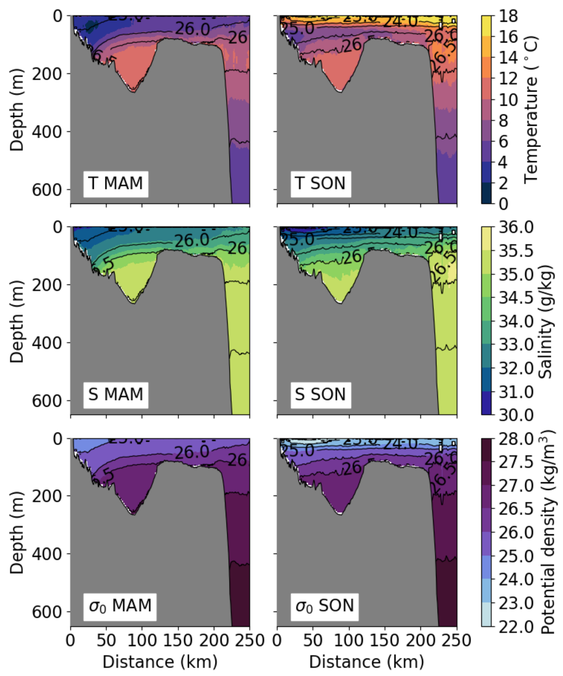

Figure 5: Same as Figure 4 but using glider data from the Ocean Tracking Network and Fisheries and Oceans Canada.

- No quality control

- Binned profiles to average time/ position of each profile

- Binned transects to a 1 m x 2 km grid

Spring: 2 layers
- Cold, fresh water from the NSC (Cabot Strait subsurface water)
- Warm slope water (Dever et al., 2016)

Fall: 3 layers
- Solar-heated surface layer
- Cold Intermediate Layer (CIL)
- Warm slope water

5. What's next?

- Complete glider CTD sensor processing and data quality control
- Explore options to publish processed glider dataset
- Formally compare AZMP and glider climatologies
- Produce glider time series to look for trends
- Compute depth-averaged currents to estimate transport and St. Lawrence River discharge

References

Dever, M., Hebert, D., Greenan, B.J.W., Sheng, J., and Smith., P.C. 2016. Hydrography and Coastal Circulation along the Halifax Line and the Connections with the Gulf of St. Lawrence. Atmosphere-Ocean, 54:3, 199-217. DOI: 10.1080/07055900.2016.1189397

Hebert, D., Layton, C., Brickman, D., and Galbraith, P.S. 2024. Physical Oceanographic Conditions on the Scotian Shelf and in the Gulf of Maine during 2023. Can. Tech. Rep. Hydrogr. Ocean Sci. 380: vi + 71 p.

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