Physical Oceanographic Conditions on the Scotian Shelf and in the Gulf of Maine during 2025

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2026

Canadian Technical Report of Hydrography and Ocean Sciences 421

Fisheries and Oceans Canada Pêches et Océans Canada

Canada

Canadian Technical Report of Hydrography and Ocean Sciences

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PHYSICAL OCEANOGRAPHIC CONDITIONS ON THE SCOTIAN SHELF AND IN THE GULF OF MAINE DURING 2025

by

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Cat. No. Fs97-18/421E-PDF ISBN 978-0-662-03951-8 ISSN 1488-5417
https://doi.org/10.60825/pfp0-tx20

Correct citation for this publication:

Layton, C., Brickman, D., Greenan, B., Galbraith, P.S., and Shaw, J.-L. 2026. Physical Oceanographic Conditions on the Scotian Shelf and in the Gulf of Maine during 2025. Can. Tech. Rep. Hydrogr. Ocean Sci. 421: vi + 93 p. https://doi.org/10.60825/pfp0-tx20

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Layton, C., Brickman, D., Greenan, B., Galbraith, P.S., and Shaw, J.-L. 2026. Physical Oceanographic Conditions on the Scotian Shelf and in the Gulf of Maine during 2025. Can. Tech. Rep. Hydrogr. Ocean Sci. 421: vi + 93 p. https://doi.org/10.60825/pfp0-tx20

The physical oceanographic conditions on the Scotian Shelf and in the Gulf of Maine observed in 2025 are presented. Sea-surface temperature remained above normal for most of the shelf but were cooler than the previous three years except for the eastern portion. At near-coastal stations, Prince 5 and Station 2, bottom temperature continued on a cooling trend from the early 2020s time series records. Bottom temperatures across the shelf were above normal from 2012 to 2022, but the last three years were normal to below normal for the central and western parts of the shelf. The departure from the above normal conditions suggests advection of Labrador Current waters onto the shelf.

RÉSUMÉ

Layton, C., Brickman, D., Greenan, B., Galbraith, P.S., and Shaw, J.-L. 2026. Physical Oceanographic Conditions on the Scotian Shelf and in the Gulf of Maine during 2025. Can. Tech. Rep. Hydrogr. Ocean Sci. 421: vi + 93 p. https://doi.org/10.60825/pfp0-tx20

Les conditions océanographiques physiques observées sur le plateau néo-écossais et dans le golfe du Maine en 2025 sont présentées. La température de la surface de la mer est demeurée au-dessus de la normale sur la majeure partie du plateau, mais elle était plus fraîche que les trois années précédentes, sauf dans la partie est. Dans les stations près de la côte, Prince 5 et Station 2, la température au fond s'est maintenue sur une tendance de refroidissement par rapport aux enregistrements de la série chronologique du début des années 2020. Les températures au fond dans l'ensemble du plateau ont été supérieures à la normale de 2012 à 2022, mais elles ont été normales à inférieures à la normale les trois dernières années dans les parties centrale et ouest du plateau. L'écart par rapport aux conditions supérieures à la normale semble indiquer une advection des eaux du courant du Labrador sur le plateau.

1 INTRODUCTION

This document discusses meteorological and physical oceanographic trends and variability during 2025 on the Scotian Shelf, Bay of Fundy, and the Gulf of Maine (Figure 1), from observations and numerical model results. It provides an update for the 2024 report (Layton et al. 2025), and it complements similar reviews of the conditions in the Gulf of St. Lawrence and the Newfoundland-Labrador regions for the Atlantic Zone Monitoring Program (AZMP) (Coyne et al. 2025; Galbraith et al. 2025b). These reports together serve as a basis for a zonal summary (Galbraith et al. 2025a).

Environmental conditions are compared by anomalies, which are deviations from the long-term mean, or by normalized anomalies, the anomaly divided by the long-term standard deviation (SD). The long-term means and SDs are calculated, when possible, over the 30-year reference period defined as years 1991 to 2020. The use of normalized anomalies and the same base period allow for direct comparisson among site variables. Throughout the document, normalized anomalies within +/-0.5SD are considered near normal and are depicted with the color white. Values greater than +0.5SD are referred to as above normal, depicted with increasing darker shades of red, and values less than -0.5SD are below normal depicted with increasing darker shades of blue.

Temperature and salinity conditions on the Scotian Shelf, in the Bay of Fundy and Gulf of Maine regions, are determined by many processes: heat transfer between the ocean and atmosphere; inflow from the Gulf of St. Lawrence supplemented by flow from the Newfoundland Shelf; exchange with offshore slope waters; local mixing; freshwater runoff; direct precipitation; and melting of sea-ice. The Nova Scotia Current (NSC) is the dominant inflow, originating in the Gulf of St. Lawrence and entering the region through Cabot Strait (Figure 1). This current, whose path is strongly affected by topography, has a general southwestward drift over the Scotian Shelf and continues into the Gulf of Maine where it contributes to the counter-clockwise mean circulation. Mixing with offshore waters from the continental slope also modifies the water-mass properties of shelf waters. These offshore waters are generally of two types: Warm Slope Water, with temperatures in the range of 8–12°C and salinities from 34.7–35.5; and Labrador Slope Water, with temperatures from 4–8°C and salinities from 34.3–35 (Gatien 1976). Shelf-water properties have large seasonal cycles, along- and across-shelf gradients, and vary with depth (Petrie et al. 1996).

2 METEOROLOGICAL OBSERVATIONS

2.1 NORTH ATLANTIC OSCILLATION INDEX

The North Atlantic Oscillation (NAO) index was originally defined as the difference in sea-level atmospheric pressures between the Azores and Iceland (Rogers 1984), and is a measure of the strength of the westerly winds over the Northwest Atlantic. It represents the dominant, large-scale meteorological forcing over the North Atlantic Ocean. The NAO index is based on a Rotated Principal Component Analysis (Barnston and Livezey 1987) applied to the monthly-standardized 500 mb height anomalies (Hurrell et al. 2003). Two versions of the winter NAO are presented. The first is the December to March average of the monthly timeseries from the National Oceanic and Atmospheric Administration (NOAA). The second is the Hurrell principal component based index for months December to March from the National Center for Atmospheric Research (NCAR).

A high NAO index corresponds to an increased pressure difference between the Icelandic Low and the Azores High. Strong northwest winds, cold air and sea temperatures, and heavy ice in the Labrador Sea and on the Newfoundland shelf areas, are usually associated with a high positive NAO index (Colbourne et al. 1994; Drinkwater 1996). The opposite response typically occurs during years with a negative NAO index.

The NAO has been shown to strongly affect bottom temperature distributions throughout the region from the Labrador Shelf to the Gulf of Maine (Petrie 2007). The response is bimodal, the product of direct and advective effects, with positive (negative) NAO generally corresponding to colder (warmer) than normal bottom temperatures over the Labrador-Newfoundland Shelf, the Gulf of St. Lawrence, and the Eastern Scotian Shelf, and warmer (colder) than normal conditions on the Central and Western Scotian Shelf and in the Gulf of Maine.

In 2025, the winter (December to March) NOAA NAO index was positive, +0.65, and the Hurrell NAO index was positive, +0.37 (Figure 2A). The lower panels of Figure 2 show the sea-level atmospheric pressure conditions during the winter of 2025 compared to the 1991 – 2020 mean. The 2025 Icelandic low pressure cell was in a similar location when compared to the seasonal mean. Meanwhile, the 2025 Azores high pressure cell was more south compared to the seasonal mean.

2.2 AIR TEMPERATURES

Surface air temperature anomalies maps relative to the 1991–2020 means for the North Atlantic region are available from the U.S. National Oceanic and Atmospheric Administration's interactive website. In 2025, the annual anomalies were ±0.5°C over the Gulf of Maine and most of the Scotian Shelf except south of Cape Breton where the anomaly was positive, 0.5 to 1.0°C (Figure 3). The seasonal anomaly of these regions ranged between -1°C to 0.5° during the winter and summer, -0.5°C to 1° for spring, and were ±0.5°C in the western region and up to +1.5°C in the eastern region for fall (Figure 4).

Monthly air temperature anomalies for 2024 and 2025 relative to their 1991–2020 means at six sites in the Scotian Shelf/Gulf of Maine region are shown in Figure 5. Monthly mean-temperature data for Canadian sites are from Environment and Climate Change Canada's Adjusted Homogenized Canadian Climate Data (AHCCD) where available (Vincent et al. 2020). In cases where no data were available, observed monthly mean values from the Canadian Climate Summaries (CCS) at the Environment and Climate Change Canada website were used. Monthly means from the Monthly Climatic Data for the World (Menne et al. 2018) were used for Boston. Monthly air temperatures ranged between below normal to above normal throughout the year with months August (with the exception of Sydney) and December below normal and months March and October above normal at all six sites. The magnitude of the annual average anomalies for 2025 were smaller than observed for 2024 .

In 2025, the mean annual air temperature anomalies relative to 1991–2020 climatology varied for all sites, with anomalies ranging from -0.3°C (-0.4 SD) for Saint John to +0.6°C (+0.8 SD) for Sydney (Table 1). The time series of annual anomalies indicates that all sites have increasing temperatures over the long-term with decadal-scale variability superimposed (Figure 6). Over decadal and shorter periods, there are times when there is no trend or a decreasing trend in the temperature, but overall, the linear trend from 1900 to present is positive (Table 1).

The air temperature anomalies for the six Scotian Shelf and Gulf of Maine sites are summarized in Figure 7 as a composite sum that illustrates two points. Firstly, for most years the anomalies have the same sign; that is, the stacked bars coincide. Since 1900, for the 114 years when all sites were operating, 98 had five or more stations with the annual anomalies having the same signs; for 90 years, all six stations had anomalies with the same sign. This indicates that the spatial scale of the air temperature patterns is greater than the largest spacing between sites. Previous analyses yielded an e-folding decorrelation scale of 1800 km (Petrie et al. 2009).

2.3 WIND

Hourly wind data for Sable Island (1953-present) were downloaded from the historical climate data archive at the Environment and Climate Change Canada website. For the 1991 – 2020 climatology reference period, the winter, defined as December, January, and February, has a mean wind speed of 8.4m/s (4.0 SD) with winds most frequently from 280°T (Figure 8). For 2025, the mean was 8.5m/s (3.9 SD) and most frequently from 280°T, with an average direction from the west (273°T). In the spring, defined as months March, April, and May, the climatology mean wind speed is 7.1m/s (3.6 SD) and most frequent direction is 230°T. For 2025, the mean was 7.4m/s (3.1 SD) and most frequently from 240°T, with an average direction from the southwest (223°T). In the summer, defined as months June, July, and August, the climatology mean wind speed is 5.0m/s (2.4 SD) and most frequent direction is 230°T. For 2025, the mean was 5.3m/s (2.6 SD) and most frequently from 220°T, with an average direction from the southwest (213°T). Finally, in the fall, defined as months September, October, November, the climatology mean wind speed is 6.9m/s (3.5 SD) and most frequent direction is 270°T. For 2025, the mean was 6.8m/s (3.5 SD) and most frequently from 250°T, with an average direction from the west (285°T). Overall, the annual mean wind speed for all seasons were similar to the climatology reference period and the most frequent direction of the wind was within 20° of the climatology. Winter has the highest mean wind speed and summer has the lowest, with both seasons having a more dominant frequent direction than seasons spring and fall. The highest observed wind speed and the highest percentage of wind speeds exceeding Beaufort number 8 (i.e. Gale) in 2025 occurred during the winter (Figure 9).

Physical forcing mechanisms, one being wind driven coastal upwelling, can play a role in bloom dynamics (Greenan et al. 2002, 2004, 2008). In particular, the along-shore wind stress component can be an indicator of favourable upwelling (positive value) and downwelling (negative value) conditions. Daily wind speed and wind stress, components of along- (60°T) and across-shore (150°T) were computed assuming neutral conditions following Smith (1988) (Figure 10). For 2025, the along-shore wind stress component is primarily positive, with greater positive values from January to mid-April and November to December indicating that these periods are upwelling favourable.There are five events where the along-shore wind stress component is very high (> 0.5 Pa), with the strongest event occurring in mid-February.

3 REMOTELY-SENSED SEA SURFACE TEMPERATURE (SST)

The satellite-based sea surface temperature product is derived from a blend of Pathfinder version 5.3 (4 km resolution for 1982 to 1985 and sparsely to 2020; Casey et al. (2010)), Maurice Lamontagne Institute (MLI; 1.1 km resolution for 1985 to 2013; Larouche and Galbraith (2016)) with the NOAA STAR CoastWatch Advanced Clear-Sky Processor for Ocean (ACSPO) L3S-LEO-Daily "super-collated" v2.81 product (0.02 degree resolution for 2000 to current; Jonasson et al. (2022)). Details of the regional calibration are found in Galbraith et al. (2025b). Because the SST blend is different than in previous reports, certain previously reported records have changed although the geospatial patterns remain similar.

Monthly and annual temperature anomalies relative to the 1991–2020 climatology are calculated for seven subareas based on the NAFO divisions in the Scotian Shelf/Gulf of Maine region (Figure 11). In 2025, monthly sea surface temperatures (SST) were below to above normal throughout the year with months May, June, and July above normal at all NAFO divisions and below normal to normal for the month of December. From the central Scotian Shelf (4W) to the Gulf of Maine (5Ze), conditions were below normal to normal from January to April. (Figure 12). Annual anomalies were calculated from monthly-averaged temperatures for the seven subareas (Table 2 and Figure 13). The annual anomalies during 2025 ranged from -0.0°C (-0.0 SD) in 5Ze to +0.9°C (+1.4 SD) in 4XSS. SST remained above normal from 2024 at all NAFO divisions with the exception of 5Ze. The last five years were consistently above normal for both 4Vn and 4Vs, but 2025 was cooler than the previous four years. NAFO divisions 4W, 4X Scotian Shelf, 4X eastern Gulf of Maine and Bay of Fundy, and 5Y remained above normal, with 4X Scotian Shelf warmer than last year, 4W and 4X eastern Gulf of Maine and Bay of Fundy similar to last year, and 5Y continuing on a cooling trend, which began in year 2023. Division 5Ze remained normal. A regime shift algorithm to detect a step change using mean levels was applied to the annual time-series (Rodionov 2004). Over the length of the record, the temperature has three distinct periods in all regions, a relatively cooler period from 1982 to 1993, near the climatological mean from 1994 to 2011, and a relatively warmer period from 2012 to present. However, since 2021, for regions 4Vn and 4Vs, it suggests that these regions are in an even warmer period.

4 COASTAL TEMPERATURES AND SALINITIES

Coastal near-surface temperatures have been collected at Halifax (Nova Scotia) and St. Andrews (New Brunswick) since the 1920s (Figure 14). In 2025, the SST anomaly relative to the 1991 – 2020 mean for Halifax was +1.3°C (+2.1 SD), an increase of +0.7°C from 2024. St. Andrews was +0.5°C (+0.7 SD)(2022 was the record high), a decrease of -0.6°C from 2024.

Temperature and salinity measurements through the water column have been sampled monthly for the most part since 1924 at Prince 5, at the entrance to the Bay of Fundy (Figure 1). It is the longest continuously operating hydrographic monitoring site in eastern Canada. Its waters are generally well-mixed from the surface to the bottom (90 m), except in the spring. In 2025, no measurements were collected in January, Feburary, and December because the vessel was not available due to its annual refit.

The 2025 annual cycle at Prince 5 shows normal to above normal temperature throughout the year with the entire water column above normal for October (Figure 15). There were no monthly time series records for 2025. The average upper ocean temperatures (0-50m), were normal to above normal. Bottom (90m) temperatures were normal, with the exception of October which was above normal. Salinity ranged from below to above normal throughout the water column, with small anomalies and no temporal pattern. The average upper ocean salinity (0-50m) was normal with the exception of below normal conditions in May. Bottom salinity conditions ranged from normal to weakly above normal throughout the year until August and then was slightly below normal in October. The vertical structure and time evolution of the density anomaly was similar to salinity, but the entire water column in October was below normal. The average upper ocean density conditions ranged from below normal to above normal throughout the year with the largest magnitude anomaly occurring in May when densities were below normal. Bottom density transitioned from above normal to below normal throughout the year, but note the lack of available near bottom data.

The annual upper ocean temperature anomaly for 2025 at Prince 5 was +0.30°C (+0.50 SD) (2021 was the record high) (Figure 16). Temperatures have continued to decrease from the series record high in 2021 and a similar trend is observed at the bottom where the temperature anomaly was +0.10°C (+0.10 SD) (2012 was the record high). The 2025 upper ocean salinity anomaly was +0.00 (+0.10 SD) and the stratification (i.e. density) anomaly was +0.10kg/m^3 (+1.40 SD).

As an indication of the upper ocean conditions, two variables, stratification index and mixed-layer depth, are examined for annual variability. The stratification index (SI) is the density difference between 50 m and 5 m. The mixed-layer depth (MLD) is the depth at which the density at 5m is exceeded by 0.03 kg/m^3.

In 2025, the SI at Prince 5 was near normal for most of the year, with March and May above normal and October below normal (Figure 17). The MLD was shallower to near normal with the exception of October and November which was thicker than normal.

The 2025 temperature, salinity, and density fields at Halifax 2, located at the mouth of Halifax harbour (Figure 1), are shown in Figure 18. From January to May, temperatures in the top 60m were primarily near normal then from June to November were primarily above normal with a monthly series record high in September at 25m and in October from the surface to 15m. Below 60m, temperatures ranged from below normal to normal with monthly series record lows in January from 140m to the bottom. The mean temperature in the top 50m was near normal with June and September to November above normal. The bottom temperature ranged from below normal to normal. Throughout the year, salinity primarily ranged from below normal to normal with the exception of some depth bins in the upper 50m for June, September, October, and November. Monthly series record lows occured in January from 125m to the bottom, and at the bottom in June. Upper ocean salinity conditions (0-50m) ranged from below normal to normal with the exception of October. Bottom salinity ranged from below normal to normal with the exception of April. Density primarily ranged from below normal to normal with no vertical or temporal pattern. Monthly series record lows occured in January from 125m to the bottom, same as salinity, and one isolated record at 45m in November. Upper ocean density (0-50m) ranged from below normal to normal. Bottom density varied from below to above normal with no temporal pattern.

The 2025 annual upper ocean temperature anomaly at Halifax 2 was +0.70°C (+1.00 SD) (2012 was the record high) (Figure 19). The bottom temperature anomaly was -1.20°C (-1.10 SD). The upper ocean salinity anomaly was -0.00 (-0.20 SD) (2000 was the record high) and the stratification anomaly was +0.10kg/m^3 (+0.70 SD) (2023 was the record high). The SI ranged from normal to above normal with the exception of November. The MLD ranged from normal to above normal with the exception of October (Figure 20). The annual mean bottom conditions from the T2 mooring, which is roughly 12 km east of Halifax 2 and 15m deeper, is compared to the Halifax 2 bottom timeseries (Figure 21). Overall, there is strong coherence between the two timeseries with warmer and saltier waters at the mooring.

5 STANDARD SECTIONS

The Maritimes region AZMP core lines, Cabot Strait, Louisbourg, Halifax, and Browns Bank were sampled in the spring of 2025 (Figure 22). In addition, the following ancillary lines were occupied: the Laurentian Channel Mouth to support modelling efforts and monitor water masses entering the Gulf of St. Lawrence, St. Anns Bank and The Gully to continue Marine Protected Area monitoring, Sable Island Bank to support research on the ecosystem impacts of grey seals, and the Northeast Channel, Yarmouth, and Portsmouth lines as part of the collaborative agreement with Northeastern Regional Association of Coastal Ocean Observing Systems (NERACOOS) (Beazley et al. 2025b).

During the spring of 2025, temperature anomalies along Cabot Strait were within $\pm$1°C with the exception of sub-surface positive anomalies, up to 2°C, between 100 and 200m, across the entire strait (Figure 23). For the Louisbourg line from the coast to the shelfbreak, the temperature anomaly was within $\pm$1°C, salinity anomaly within $\pm$0.5, and density anomaly within $\pm$0.5kg/m^3. However, beyond the shelfbreak the temperature anomaly had a subsurface minimum as large at -5°C centered around 100 m depth. The temperature anomaly was largest at the last station on the Louisbourg Line (LL9). A fresh salinity anomaly coincides with the subsurface cold temperature anomaly in the slope water suggesting that the source of this anomalous water mass is an increase in the amount of Labrador Current water flowing westward around the tail of the Grand Banks. (Figure 24). Along the Halifax line, conditions on the shelf were similar to Louisbourg , but with subsurface temperature anomaly (up to 2°C warmer) and salinity (up to 1 unit saltier) over Emerald Bank at 125km and Western Bank at 175km (Figure 25). In the slope region of the Halifax Line (beyond HL6), a cold anomaly is observed in the upper 300 m with an anomaly at large at -4°C at 50 m depth. This also corresponds with a negative salinity anomaly which is consistent with the observation on the outer part of the Lousbourg Line. On Browns Bank, Figure 26, anomaly values could not be calculated since sampling is outside of the reference climatology seasonal date range (Layton 2025).

The Maritimes region AZMP core lines, Cabot Strait, Louisbourg, Halifax, and Browns Bank were sampled in fall 2025 (Figure 27). In addition, the Laurentian Channel Mouth, St. Anns Bank, The Gully, Northeast Channel, Yarmouth, and Portsmouth lines were occupied to support the same objectives as listed above. Additional coastal stations, those parallel to the coastline near Halifax line, were occupied within the Eastern Shore Islands Area of Interest to support eDNA research (Beazley et al. 2025a).

During the fall of 2025, the eastern side of Cabot Strait had positive temperature anomalies (up to 4°C) in the top 100m and negative temperature anomalies (up to 2°C) between 100 and 200m (Figure 28). For the remainder of the water column the temperature anomaly was within ±1°C, salinity anomaly within ±0.5, and density anomaly within ±0.5kg/m^3. For the Louisbourg line, temperature anomalies were positive (up to 4°C) in the top 50m for all stations beyond LL3 of the transect and for the depicted depths to the end of the line (Figure 29). Along the shelf, there was a small subsurface positive temperature anomaly (up to 3 °C) centered at 50 m near the coast. For the remainder of the water column the temperature anomaly was within ±1°C, salinity anomaly within ±0.5, and density anomaly within ±0.5kg/m^3. At the shelfbreak, the temperature anomaly was negative (up to 3°C) for depths between 100 and 300m. Further offshore (at LL9), the positive surface anomaly extended to 300m and this resulted in a strong horizontal gradient in temperature below 100m. The salinity along the Louisbourg Line was within ±0.5 for most of the section except for small areas at the shelfbreak and offshore where the temperature anomalies were observed. For the Halifax line, from the surface to 50m, the temperature anomaly was positive (up to 6°C) from the beginning of the line to the end of Emerald Basin (Figure 30). Subsurface temperature anomalies were primarily negative (up to 6°C) for the remainder of the depicted water column, however, the surface temperature was within ±1°C from HL5 to the end of the line. If monitoring was solely dependent on satellite sea surface temperature in this case, it would appear the the Scotian Shelf conditions were positive (>1°C) inshore and neutral (±1°C) offshore, but this would miss a dominant subsurface signal of relatively cold and fresh water below 50m. A negative salinity anomaly of within ±0.5 extends from HL1 across Emerald Basin centered at about 100 m depth. THe negative anomaly of up to 2 is observed over Western Bank and extends toward the surface in the offshore stations. For the Browns Bank line, near surface to 50m temperature anomalies were positive (up to 6°C warmer) across the entire transect, and consequently, density anomalies were negative (up to 1kg/m^3) along the shelf (Figure 31). The subsurface temperature field (below 50m) was similar in structure to that observed on the Halifax Line with cold anomalies across the shelf and with the coldest being over the bank at the edge of the shelf at BBL7. The salinity anomalies were small with a negative anomaly observed over Browns Bank and this was also observed in the density anomaly field.

The Appendix contains lines in the Maritimes region conducted by Maurice Lamontagne Institute for Cabot Strait in spring (Figure A.1), summer (Figure A.2), and fall (Figure A.3). For both spring and fall Maritimes AZMP missions, additional lines were sampled. This includes St. Anns Bank during the spring (Figure A.4) and fall (Figure A.5), Laurentian Channel Mouth in the spring (Figure A.6) and fall (Figure A.7), The Gully in the spring (Figure A.8) and in the fall (Figure A.9), Sable Island Bank in the spring (Figure A.10), Northeast Channel in the spring (Figure A.11) and fall (Figure A.12), Yarmouth in the spring (Figure A.13) and fall (Figure A.14), and Portsmouth in the spring (Figure A.15) and fall (Figure A.16). If there exists a sufficient number of historical occupations of the sections at the same time of year, anomaly sections are also shown. While these data are not discussed in detail, the data are used in other analyses presented in this document.

6 GLIDER OPERATIONS ON THE HALIFAX LINE

In 2018, glider operations were started along the Halifax Line as an enhancement to the normally tri-annual vessel based sections. The glider data provides higher temporal and spatial coverage than the vessel-based sampling, but only down to a maximum depth of 650m (Figure 32). For ease of analysis, the glider data are temporally averaged to hourly and vertically binned to 1m. On regular missions, the glider attempts to follow the Halifax Line from approximately HL2 to HL7. Currents can, however, affect the actual trajectory of the glider (Figure 33, red box). For 2024 and 2025, the glider trajectories were well within the 15nm limit, but larger deviations were observed in earlier years and can explain some of the gaps in Figure 32. Battery upgrades were completed for the entire fleet in year 2022. This has allowed for more consistent coverage out to HL7, with one mission in 2025 covering beyond HL7 (Figure 32).

Station 2 (HL2) is sampled throughout the year from a small vessel and provides the highest temporal resolution of the Halifax Line stations (Figure 34). Glider data is consistent with the ship based measurements and fills in the gaps when vessel sampling is unavailable. In addition, the variability in temperature, salinity, and chlorophyll fluorescence is shown for a few of the Halifax Line stations over the 2024 – 2025 period (Figure 35). This is only a small fraction of the data available for analysis. At HL3, HL4, HL5 and HL6, the glider sampling was sufficient to resolve the seasonal cycle of temperature, salinity, and chlorophyll (Figure 35).

7 SCOTIAN SHELF AND GULF OF MAINE TEMPERATURES

Drinkwater and Trites (1987) tabulated monthly mean temperatures and salinities from available bottle data for 35 areas on the Scotian Shelf and in the eastern Gulf of Maine that generally corresponded to topographic features such as banks and basins. Petrie et al. (1996) updated their report using these same areas and all available hydrographic data. A time series of annual mean and filtered (five-year running means) temperature anomalies at selected depths for six areas (Figure 36) is presented (Figure 37). The Cabot Strait temperatures represent a mix of Labrador Current Water and Warm Slope Water entering the Gulf of St. Lawrence along the Laurentian Channel (e.g. Gilbert et al. 2005); the Misaine Bank series characterizes the colder near-bottom temperatures on the Eastern Scotian Shelf, mainly influenced by either inshore Labrador Current water or cold intermediate layer water from the Gulf of St. Lawrence (Dever et al. 2016); the deep Emerald Basin temperature anomalies represent the slope-water intrusions onto the Shelf that are subsequently trapped in the inner deep basins (note the large anomaly “events” in the Emerald Basin panel of Figure 37C, for example, around 1980, 1998, and 2007, indicative of pulses of colder Labrador Slope Water); the Lurcher Shoal observations define the ocean climate in the southwest Scotian Shelf and the shallow waters entering the Gulf of Maine via the Nova Scotia Current; lastly, the Georges Basin series represents the slope waters entering the Gulf of Maine through the Northeast Channel. Annual anomalies are based on the averages of monthly anomalies; however, observations may not be available for all months in each area.

In 2025, the annual anomaly was +0.8°C (+1.3 SD) for Cabot Strait at 200-300 m (2022 was the record high; 2024 anomaly was 0.5°C) . For the shallow Misaine Bank on the eastern Scotian

Shelf, the annual anomaly was +0.5°C (+0.8 SD) at 100 m (2022 was the record high; 2024 anomaly was 0.3°C) . For the deep basins on the central Scotian Shelf and Gulf of Maine, the 2025 anomalies were -0.3°C (-0.4 SD) for Emerald Basin at 250 m (2019 was the record high; 2024 anomaly was -0.3°C) and -0.5°C (-0.8 SD) for Georges Basin at 200 m (2018 was the record high; 2024 anomaly was -0.4°C) . For the shallow banks in western Nova Scotia, the anomalies were -0.4°C (-0.6 SD) for Eastern Georges Bank at 50 m (2024 anomaly was 0.0°C) and +0.7°C (+0.7 SD) for Lurcher Shoals at 50 m (2012 was the record high; 2024 anomaly was 1.0°C). Over the length of the timeseries, temperature patterns at all areas are in general agreement. For the two relatively near-shore and shallow areas, Misaine Bank and Lurcher Shoal, from approximately the mid to late 1960s to the mid 1980s, temperatures were above and near the climatological mean, respectively, from the mid 1980s to 2010 temperatures were below normal, and from 2011 to present have been above normal. For the deeper and off-shore areas, Cabot Strait, Emerald Basin, Georges Basin, and Eastern Georges Bank, temperatures were relatively below normal from 1970 to 2010, and have been above normal since 2011. The annual mean Labrador Current transport index on the Scotian Shelf can have an effect on the deep basin water masses, with a relatively higher transport indicating increased transport of relatively cooler and fresher waters at depth (Han et al. 2014; Coyne et al. 2025). In 2023, the transport shifted from generally below normal to above normal, aligning with the decrease of the temperature anomaly in the central and western Scotian Shelf regions (Galbraith et al. 2025a).

8 TEMPERATURES DURING THE ECOSYSTEM TRAWL SURVEYS

In the Maritimes Region, Fisheries and Oceans Canada (DFO), conducts two trawl surveys each year. During winter, the survey covers Georges Bank, the Bay of Fundy, and the western Scotian Shelf. The deep-water boundary of the survey is marked roughly by the 200 m isobath. The broadest spatial temperature and salinity coverage of the Scotian Shelf is obtained during the summer trawl survey, which covers the Scotian Shelf from Cabot Strait to the Bay of Fundy. The deep-water boundary of this survey is also marked roughly by the 200 m isobath along the shelf break.

The temperatures from each survey were interpolated onto a 0.2°-by-0.2° latitude-longitude grid using an objective analysis procedure known as Barnes interpolation (Koch et al. 1983). The Barnes method requires four input parameters, the x and y radii of the weighted ellipse, defined as xr and yr, where x and y are relative to east and north respectively, the grid focussing parameter γ, and the number of iterations. For the winter survey, xr = 0.71, yr = 0.52, γ = 0.47, and 3 iterations was used. For the summer survey, xr = 0.81, yr = 0.58, , γ = 0.53, and 3 iterations was used. Temperatures were optimally estimated at the standard depths (e.g., 0 m, 10 m, 20 m, etc.) and for near the bottom. Only the near-bottom temperatures are presented here.

8.1 WINTER SURVEY

The winter survey took place from 01 March to 30 March 2025. A total of 120 Conductivity-Temperature-Depth (CTD) stations were sampled (Figure 38). Sampling was mainly on Georges

Bank (NAFO Division 5Ze) and Georges Basin (along the boundary between NAFO Division 5Ze and 4X), with additional sampling in the Bay of Fundy and western Scotian Shelf (NAFO Division 4X). Additional data from the NOAA National Marine Fisheries Service (NMFS) Northeast Fisheries Center (NEFSC) was used to increase coverage on the western portion of the grid. A total of 158 CTD stations were used, which were sampled between 15 February to 30 April 2025. Bottom temperature anomaly throughout most of the sampled region ranged from 0.5°C to -2.0°C (Figure 39).

8.2 SUMMER SURVEY

The summer survey took place from 30 June to 05 August 2025. A total of 182 CTD stations were sampled (Figure 40). The survey covered part of Cabot Strait, the entirety of the Scotian Shelf (NAFO Divisions 4Vn, 4Vs, 4W, and 4X) to the mouth of the Bay of Fundy (northwest portion of NAFO Division 4X), and part of Eastern Georges Bank (NAFO Division 5Ze). The near-bottom temperature anomalies for 2025 were generally positive (mostly up to 1°C) for NAFO division 4Vn, negative on the outer shelf portion of 4Vs and generally positive for the remainder of the division. Bottom temperature anomaly was mostly negative (greater than -4°C) in 4W except for the shallow area around Sable Island which was up to 2.5°C above the climatology, and was positive for the near coastal regions of the western Scotian Shelf portion of 4X with the shelfbreak area observed to be negative (Figure 41). The anomaly for July varied for the NAFO Divisions sampled on the Scotian Shelf in 2025: +0.7°C (+0.8 SD) for 4Vn (2020 was the record high), -0.2°C (-0.2 SD) for 4Vs (2015 was the record high), -1.2°C (-1.2 SD) for 4W (2022 was the record high) and -0.4°C (-0.5 SD) for 4X (2012 was the record high) (Figure 42). All regions show elevated bottom temperatures from approximately year 2010 to 2022. In 2023, with the exception of 4Vn which remained above normal, all divisions went from above normal to normal. In 2024 and 2025, conditions ranged from normal to below normal for all divisions across the shelf except for 4Vn.

The volume of the Cold Intermediate Layer (CIL) in the summer, defined as waters with temperatures less than 4°C, was estimated from Barnes interpolated data using the full depth CTD profiles for the region, from Cabot Strait to Cape Sable, collected during the summer ecosystem survey (Figure 43). For years where grid coverage is less than 70%, a blended CIL volume is used. It uses the measured CIL for the region where data was collected. Where data wasn't collected, the CIL is calculated from the climatology that is adjusted using the mean minimum temperature (for additional details see Hebert et al. (2023)). There is considerable interannual variation in the volume of the CIL from 1998 until 2009 (Figure 43). In 2025, the CIL volume was near normal (Figure 43). The low-frequency variability of the area-weighted average minimum temperature mirrors the variability in the CIL volume. In 2025, the minimum temperature was above normal, and has been for the previous four years. This has been trending upward since the early 1990s.

9 DENSITY STRATIFICATION

Stratification of the near-surface layer influences physical, chemical and biological processes in the ocean such as the extent of vertical mixing, the ocean's response to wind forcing, the timing of the spring bloom, vertical nutrient fluxes, and plankton distribution. Under increased stratification, there is a tendency for more primary production to be recycled within the upper mixed layer and hence less production in the deeper layers. The variability in stratification was examined by calculating the density (sigma-t) difference between the near-surface (0 or 5m depending on data availability) and 50 m water depth. The density differences were based on monthly mean density profiles calculated for several hydrographic areas on the Scotian Shelf (see Figure 44) as defined by Petrie et al. (1996). The long-term, monthly mean density gradients for 1991 – 2020 were estimated; these were subtracted from the individual monthly values to obtain monthly anomalies. Annual anomalies for each area were estimated by averaging all available monthly anomalies within a calendar year. These estimates could be biased if, in a particular year, most data were collected in months when stratification was weak, while in another year sampling was in months when stratification was strong. However, initial results using normalized monthly anomalies obtained by dividing the anomalies by their monthly SDs were qualitatively similar to the plots presented here. The Scotian Shelf-wide average annual anomalies and their five-year running means were then calculated for an area-weighted combination of subareas 4–23 on the Scotian Shelf. A stratification of 0.01 (kg m^{-3})/m represents a difference of 0.5 kg m^{-3} over 50 m.

The dominant feature is the period from about 1950 to 1990 with generally below-average stratification in contrast to the past 25 years that are characterized by above normal values (Figure 45). Since 1948, there has been an increase in the mean stratification on the Scotian Shelf, resulting in a change in the 0–50 m density difference of 0.78 kg m^{-3} per century. It should be noted the change over time is not linear but could consist of two periods of constant stratification with a jump around 1990. This change in mean stratification is due mainly to a decrease in the surface density, composed equally of warming and freshening (Figure 46). Stratification in 2025 was near normal (Figure 45). Examining the 2025 stratification anomaly for areas 4-23 on the Scotian Shelf show that the overall normal anomaly is due to an area-average of below normal to normal values on the eastern Scotian Shelf and along the shelf break with most of the western Scotian Shelf above normal (Figure 44).

10 SEA LEVEL

Sea level is a primary variable in the Global Ocean Observing System. Relative sea level is measured with respect to a fixed reference point on land. Consequently, relative sea level consists of two major components: one due to changes in the global mean sea level and a second caused by sinking or rising of the land. In Atlantic Canada, Glacial Isostatic Adjustment (GIA) is causing the area roughly south (north) of the Chaleur Bay to sink (rise) in response to glacial retreat; this results in an apparent rise (fall) of sea level.

Relative sea level at Yarmouth (1966-2025), Halifax [1] (1920-2025), and North Sydney (1970-

[1]The historical station in Halifax failed in early-2014. The nearby tidal station at Bedford Institute of

2025) are plotted as monthly means and as a filtered series using a five-year running mean filter (Figure 47). The linear trend of the monthly mean data has a positive slope of +40.7 cm/century (Yarmouth), +34.9 cm/century (Halifax), and +43.9 cm/century (North Sydney). Relative sea level changes over two periods, 1981–2010 and 1991–2020, shows that sea level rise is increasing with time. An interesting feature of the data is the long-term variation that has occurred since the 1920s (Figure 48). The residual sea-level data for the common period 1970-2025 shows that the variability has a large spatial structure given the coherence between the three sites.

11 RESULTS FROM A NUMERICAL SIMULATION MODEL

Currents and transports are derived from the GLORYS12 reanalysis product (Jean-Michel et al. 2021). GLORYS12 is a global eddy-resolving physical ocean and sea ice reanalysis at 1/12°, approximately 10km, horizontal resolution which assimilates ocean data from 1993-NOW, where NOW is typically two months behind realtime. The reanalysis is based on the Copernicus Marine Environment Monitoring Service (CMEMS) NEMO ocean model platform (Madec et al. 2008). The model has 50 z-levels in the vertical (22 in the top 100 m), and partial cells in the bottom layer to adapt to the bathymetry. Surface forcing is derived from the European Centre for Medium-Range Weather Forecast (ECMWF) ERA-Interim reanalysis (Dee et al. 2011). The model has no tidal forcing, and includes a representation of the world's major river systems. Monthly GLORYS12 data is downloaded on a region spanning from 73°W to 43°W and 38°N to 62°N.

Some calculations intended to help interpret data collected by the AZMP are presented. Results are presented in terms of standardized anomalies to facilitate comparison to other AZMP analyses. The reader is cautioned that the results outlined below are not measurements, and simulations and improvements in the model may lead to changes in them.

11.1 VARIATION IN TRANSPORTS IN THE SCOTIAN SHELF/GULF OF MAINE REGION

The general circulation on the shelf seas of the Maritimes Region of Canada can be characterized as a general northeast-to-southwest flow from the Strait of Belle Isle, through Cabot Strait, and along the Scotian Shelf toward the Gulf of Maine (Figure 49). Part of the water that flows out of the Gulf of St. Lawrence through the western side of Cabot Strait follows the Nova Scotia coastline as the Nova Scotia Current, which ultimately flows into the Gulf of Maine. Another part follows the shelf break and contributes to the Gulf of Maine inflow at the Northeast Channel. Variations in these currents may influence the distribution of various fish and invertebrate larvae from the southern Gulf of St. Lawrence westward to the Gulf of Maine. As well, the currents that stream past Cape Sable Island and through Northeast Channel bring on-shelf and off-shelf water properties into the Gulf of Maine, and the partitioning of the transports is potentially important to processes occurring in the Gulf of Maine.

Monthly mean transports for the 1993–2025 period were extracted from the model simulation for

Oceanography in Dartmouth, Nova Scotia, was used since 2014. For the common operating period, there was no significant difference in the two tide gauges.

four Maritime sections: Cabot Strait (CS), Halifax (HFX), Cape Sable Island/Browns Bank (CSI) and Northeast Channel (NEC) (Figure 49). From these data, standardized anomaly plots (based on a 1991–2020 averaging period) were constructed to illustrate transport variability. The results for the near-shore regions at CS, HFX, and CSI, the shelf break at HFX, and the inflow at NEC are displayed in Figure 50. Here, nearshore is taken as the subsection between the coastline and 30 km, 80 km, and the 100 m isobath for CS, HFX, and CSI respectively. From the inflows through the CSI and NEC sections in the Gulf of Maine (GoM), the inflow ratio CSI/(CSI + NEC) was computed (see below). Note that for all sections except NEC, positive transport denotes a flow direction through CS towards the GoM. For NEC, positive transport denotes flow into the GoM.

Transport variability on the Scotian Shelf shows a fairly coherent pattern of annual anomalies for CS, HFX (near-shore and shelf-break), and CSI (Figure 51). On a monthly basis, on average, the near-shore series (CS, HFX near-shore, and CSI) and the transport into the GoM at NEC exhibit a seasonal cycle with mid-to-late-year transport minima, while the shelf-break transport along the Halifax section shows no clear seasonality (Figure 50, although note interannual variability).

For a qualitative comparison with the numerical model transport estimates, the monthly transport of the Nova Scotia Current off Halifax was calculated using bottom-mounted Acoustic Doppler Current Profilers (ADCP). Work by Dever (2017) showed a high correlation ($r^2 = 0.87$) between the depth-integrated current and the total transport at the mooring location T2 located 12 km east of Station 2 (Figure 1 and Figure 49). Transport anomalies are based on the mean for each month using all data available for that month. Red anomalies denote an increase in transport toward the Gulf of Maine, while blue anomalies indicate decreased transport[2]. The data (Figure 52) show significant intra-and-inter annual variability, with generally weaker transport to the southwest from 2008-2016 (see bottom row of plot), followed by generally stronger transport from 2016 onward, with 2023 showing anomalously strong southwestward transport. For most of year 2024, transport was normal with the exception of February and July which were below normal and June, August, and November were above normal, followed by normal to above normal conditions for year 2025 with above normal transports estimated for six of the ten months where data was available. The overall trend is reasonably simulated by the model (Figure 51), although differences exist (see HFX nearshore panel of Figure 50). Notably, the positive anomalies late in 2023 are captured by the model.

The fraction of transport into the Gulf of Maine through the Cape Sable Island section (GoM inflow ratio of Figure 53) exhibits a seasonal cycle with a minimum during the summer months. Averaged annual, the model predicts that about one third of the transport into the Gulf of Maine enters through the CSI section (Figure 51, bottom row). Inter-annually the GoM inflow ratio was slightly above normal from 1993–2067 mostly neutral from 2007–2015, negative from 2016–2020, becoming neutral to positive from 2021 onward. From the model simulation, the general warming trend from roughly 2005-2020, seen in many data series(e.g. Figure 13), is evident as increased transport into the GoM at NEC and a reduced GoM inflow ratio.

An overall annual composite transport index was computed (Figure 54) by summing the standardized anomalies (Figure 51) for five of the six transport variables (the inflow through NEC was omitted as this metric is not independent of the GoM inflow ratio). If one considers this summation as a measure of the onshelf flow-through in the system from the southern Gulf of St.

[2]These anomalies are based on a different averaging period than used for the model simulations.

Lawrence to the Gulf of Maine, it is found that the GLORYS12 reanalysis shows mostly positive but variable anomalies from 1993–2011, followed by strong negative anomalies with positive trend from 2012 onward.

12 MARINE HEAT WAVES

Marine heatwaves (MHWs) are prolonged, anomalously warm ocean events or, quantitatively, by temperatures exceeding the 90th percentile of temperatures for that day of year during at least 5 consecutive days (Hobday et al. 2016; Oliver et al. 2021). Conversely, marine cold spells (MCSs) are when temperatures are less than the 10th percentile during at least 5 consecutive days. MHWs are commonly discussed in terms of intensity (I), i.e., the difference between temperature and the daily climatology. Single events are then summarized using four standard metrics: duration (D), average intensity (I_{mean}), maximum intensity (I_{max}), and integrated intensity (I_{cum}). These metrics were calculated using code implementations of Hobday et al. (2016). Following Hobday et al. (2018), MHWs and MCSs with I_{max} values greater than 1, 2, 3, and 4 times the difference between the associated percentiles and the climatology are respectively referred to as moderate, strong, severe and extreme events.

Time-series can have temporal variability. For example, sea surface temperature has higher variability in summer and lower variability in winter, which results in a seasonal bias: summer and winter moderate thresholds correspond to different intensity values. To facilitate comparison of events, a normalized intensity index, denoted c, is calculated for each day (using that day's percentile threshold) and examined over all days of the year that meet MHW/MCS criteria. This normalized intensity is a continuous equivalent to the Hobday et al. (2018) category system. Event metrics for individual years are aggregated into annual metrics (sum of durations, $\sum D$; annual maximum of the normalized intensity, $\hat{c}_{max}$; annually integrated normalized intensity, $\sum c_{cum}$; and the event count).

12.1 REMOTELY-SENSED SEA SURFACE TEMPERATURE

The 90th percentile thresholds are calculated using the standard 1991 to 2020 climatology period of the daily averages over each subarea based on the satellite SST NAFO divisions in the Scotian Shelf/Gulf of Maine region (Figure 11).

Although there was more than twice the long-term average MHW count during 2025, all these events were categorized as moderate (Figure 55 and 56). The most intense event occurred during the fall in the 4X SS region, and by itself, cumulated more intensity (c_{cum} = 105 days) than the interannual average because of its long duration (69 days) in moderate conditions close to its peak intensity (c_{max} = 1.8). Overall as was the case in 2024, most metrics in most regions were below the high values measured during the 2021 to 2023 period. In the period following 2020, all areas have experienced at least two MHWs each year. Conditions did not meet the MCS criteria in 2025.

12.2 NEAR COASTAL BOTTOM TEMPERATURE

The near coastal time-series from the T2 mooring began late in year 2008. For time-series that have less than 30 years of data, following the WMO climatology construction guidelines, it is suggested that the climatology reference period ends on a complete decade (WMO 2017; Schlegel et al. 2019). The 90th and 10th percentile thresholds are calculated using a 2009 to 2020 climatology reference period of the daily average.

In 2024, conditions did not meet the MHW criteria, but did meet the MCS criteria for seven events (Figure 57). Of those events, two reached the extreme threshold (c_{max} = -4.0), one in the winter season from March 3rd to March 15th, with the extreme conditions being met for 2days. The second event spanned over the spring into the fall seasons from June 22nd to December 28th, with extreme conditions being met for 2days (Figure 58). The integrated intensity was highest for the second extreme event due to the span of 190 days. Data for 2025 were available for the first nine months from the mooring recovered on the fall AZMP mission. This year was similar to the previous year where conditions did not meet the MHW criteria, but did for the MCS criteria with seven events. One event reached the extreme criteria (c_{max} = -4.0), with four others meeting the severe criteria (c_{max} = -3.0). The extreme event occured during the winter season from January 9th to 20th, with extreme conditions met for 1day. The event with the highest integrated intensity was one of the severe events which spanned over the spring into the fall seasons from June 10th to October 6th, due to its duration of 119 days. This event is anticipated to be longer than reported here as the end date is the end of the shown timeseries.

13 SUMMARY

In 2025, the North Atlantic Oscillation NOAA index was above normal (+0.65 , +0.97 SD) and the NAO Hurrell index was above normal (+0.37 , +0.33 SD). The analysis of satellite data indicates that sea-surface temperatures remained above normal at all NAFO divisions with the exception 5Ze which was normal. The last four years were consistently above normal for both 4Vn and 4Vs. Divisions 4W, 4X SS, 4X eGoM+BoF, and 5Y remained above normal, but were cooler than the previous three years. There were twice as many MHW events compared to the climatology, but all events were categorized as moderate. At the high frequency fixed station, Prince 5, the 0-50m average temperature and the bottom temperature (90m) were both normal and continued on a cooling trend from the time series record high in 2021 and second record high in 2022, respectively. At Station 2, the bottom temperature remained below normal, which is in agreement with nearby moored measurements that indicated frequent MCS events throughout the year. During the spring AZMP mission, temperatures off the shelf were up to 6°C cooler and salinity primarily one unit fresher than normal on the Louisbourg line and up to 4°C cooler and up to 1.5 units fresher on the Halifax Line. During the fall AZMP mission, temperatures were up to 2°C cooler and 0.5 units fresher on the Louisbourg line and up to 6°C cooler and up to 2 units fresher on the Halifax line. The persistence of these relatively cooler and fresher conditions suggests the source of these waters are from an increase of Labrador Current water flowing westward along the tail of the Grand Banks.

In 2025, 6 of 22 temperature variables that were able to be measured were more than 1 SD above their normal values (Figure 59). Of these, 1 was more than 2 SD above normal. There were no record highs in 2025. One other series was the third highest. Composite indicies of these temperature records, Figure 60, indicate that near surface temperatures remained above normal, but cooler than previous years. Mid-depth records were normal. Bottom composite anomalies were normal, the lowest since year 2010.

14 ACKNOWLEDGEMENTS

The authors would like to recognize, and extend their gratitude, to all those who are involved in acquisition of CTD data used in this report:

- Station 2 monitoring: Maddison Proudfoot, Mandi Newhook, Kristen Wilson, multiple support science staff, and the crew of CCGS Sigma-t.
- Prince 5 monitoring: Fred Page, Jack Fife, multiple support science staff, and the officers and crew of CCGS Viola M. Davidson.
- Glider Halifax line monitoring: Clark Richards, Melany Belzile (Program Coordinator), Chris Beck, Chantelle Layton, Laura Boehner, Matthew Lawson, Hana Hourston, and the crew of CCGS Sigma-t.
- Winter ecosystem survey: Ryan Martin and Jamie Emberley for facilitating hydrographic sampling during the survey, Maddison Proudfoot for technical expertise, multiple support science staff, and the officers and crew of CCGS Capt. Jacques Cartier.
- Spring AZMP survey: Lindsay Beazley (Chief Scientist), Adam Hartling, Chris Beck, Chris Gordon, Melanie Hardy, and the officers and crew of RV Endeavor.
- Summer ecosystem survey: Ryan Martin and Jamie Emberley for facilitating hydrographic sampling during the survey, Maddison Proudfoot for technical expertise, multiple support science staff, and the officers and crew of CCGS Capt. Jacques Cartier.
- Fall AZMP survey: Lindsay Beazley (Chief Scientist), Katie Warman, Patrick Upson, and the officers and crew of RRS James Cook.

The authors are also grateful for the following data, and the agency or people, who make it possible for it to be provided:

- NAO, sea-level atmospheric pressure, global surface air temperature : National Oceanic and Atmospheric Administration.
- NAO : National Science Foundation National Center for Atmospheric Research.
- Air temperature: Environment and Climate Change Canada, National Oceanic and Atmospheric Administration (Boston).
- Remotely-sensed sea surface temperature: Peter Galbraith.
- Halifax in-situ sea surface temperature: Katie Thistle and Shawn Roach.

- St. Andrews in-situ sea surface temperature: Fred Page and Jack Fife.
- Sea level: Canadian Hydrographic Survey.
- Nova scotia current mooring: Jay Barthelotte, Matthew Lawson, Katie Warman, Adam Hartling, Mike Vining, the officers and crew of RRS Discovery, and the officers and crew of RRS James Cook.
- Numerical model transport results: Adam Drozdowski.

They also thank Justine McMillan and Li Zhai for reviewing and providing insightful comments which improved the document.

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15 TABLES

Table 1. The 2025 annual mean air temperature anomaly and normalized anomaly (relative to the 1991-2020 climatology), the climatology mean and SD, and the linear trends with the 95% confidence limits for the Scotian Shelf and Gulf of Maine.

	Annual Anomaly		1991-2020 Climatology		Linear trend (95% confidence limits)
Site	**Observed (℃)**	**Normalized (SD)**	**Mean (℃)**	**SD**	**℃/100years**
Sydney	+0.6	+0.8	+6.44	+0.72	+1.3°C (+1.0°C, +1.7°C)
Sable Island	+0.3	+0.5	+8.33	+0.67	+1.4°C (+1.1°C, +1.7°C)
Halifax	+0.2	+0.3	+7.15	+0.70	+2.0°C (+1.7°C, +2.4°C)
Yarmouth	+0.2	+0.3	+7.68	+0.70	+1.3°C (+1.0°C, +1.6°C)
Saint John	–0.3	–0.4	+5.70	+0.76	+1.3°C (+1.0°C, +1.7°C)
Boston	+0.3	+0.5	+10.90	+0.71	+2.6°C (+2.3°C, +2.9°C)

Table 2. The 2025 SST anomalies and long-term statistics.

	Annual Anomaly		1991-2020 Climatology	
NAFO Zone	**Observed (℃)**	**Normalized (SD)**	**Mean (℃)**	**SD**
4Vn	+0.9	+1.7	+6.88	+0.52
4Vs	+0.8	+1.3	+8.01	+0.61
4W	+0.6	+0.9	+9.06	+0.63
4XSS	+0.9	+1.4	+8.71	+0.63
4XeGoM+BoF	+0.5	+0.7	+8.51	+0.72
5Y	+0.3	+0.6	+9.98	+0.61
5Ze	–0.0	–0.0	+11.56	+0.67

Table 3. The 2025 summer ecosystem trawl survey bottom temperature anomalies and long-term statistics.

	Annual Anomaly		1991-2020 Climatology	
NAFO Zone	**Observed (℃)**	**Normalized (SD)**	**Mean (℃)**	**SD**
4Vn	+0.7	+0.8	+3.88	+0.83
4Vs	-0.2	-0.2	+3.43	+0.89
4W	-1.2	-1.2	+6.76	+0.99
4X	-0.4	-0.5	+7.84	+0.93
4XSS	-0.5	-0.5	+7.06	+1.06
4XeGoM BoF	+0.1	+0.1	+8.22	+0.92

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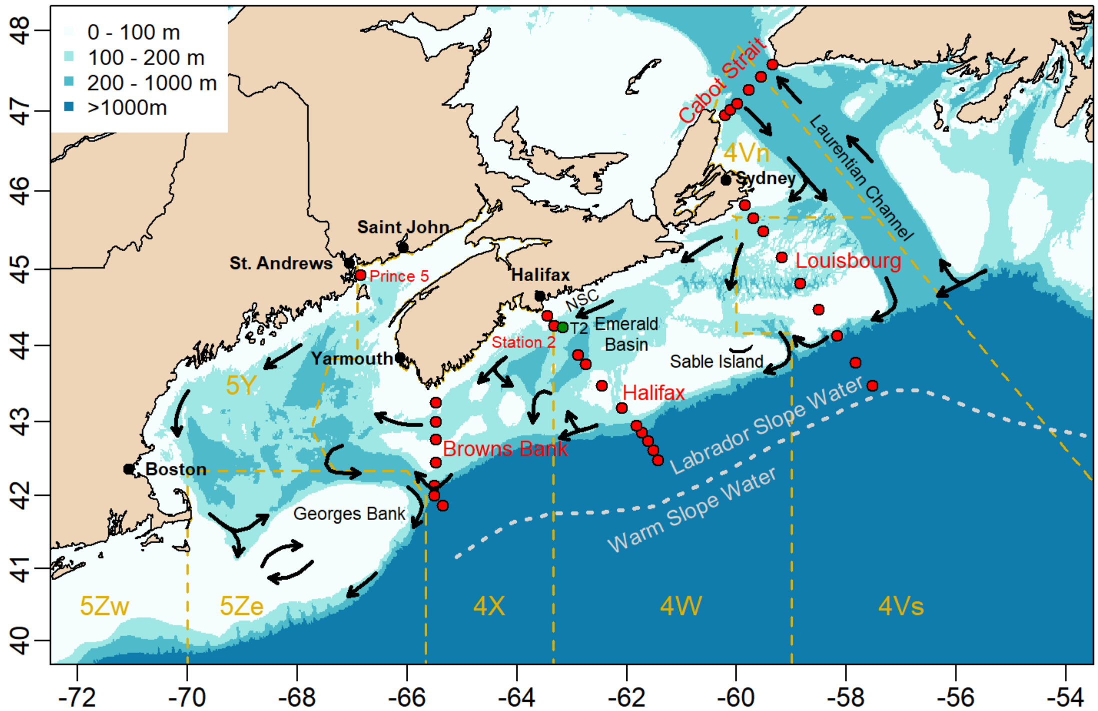

Figure 1. Map of the Scotian Shelf and the Gulf of Maine showing high frequency sampled hydrographic stations Station 2 and Prince 5 (red circles) near Halifax and St.Andrews respectively, core AZMP lines (red dots), Nova Scotia Current mooring, T2, (green dot) near Halifax, weather stations (black dots) and topographic features. The Nova Scotia Current (NSC) is shown. The dashed yellow lines indicate the boundaries of the Northwest Atlantic Fisheries Organization Divisions.

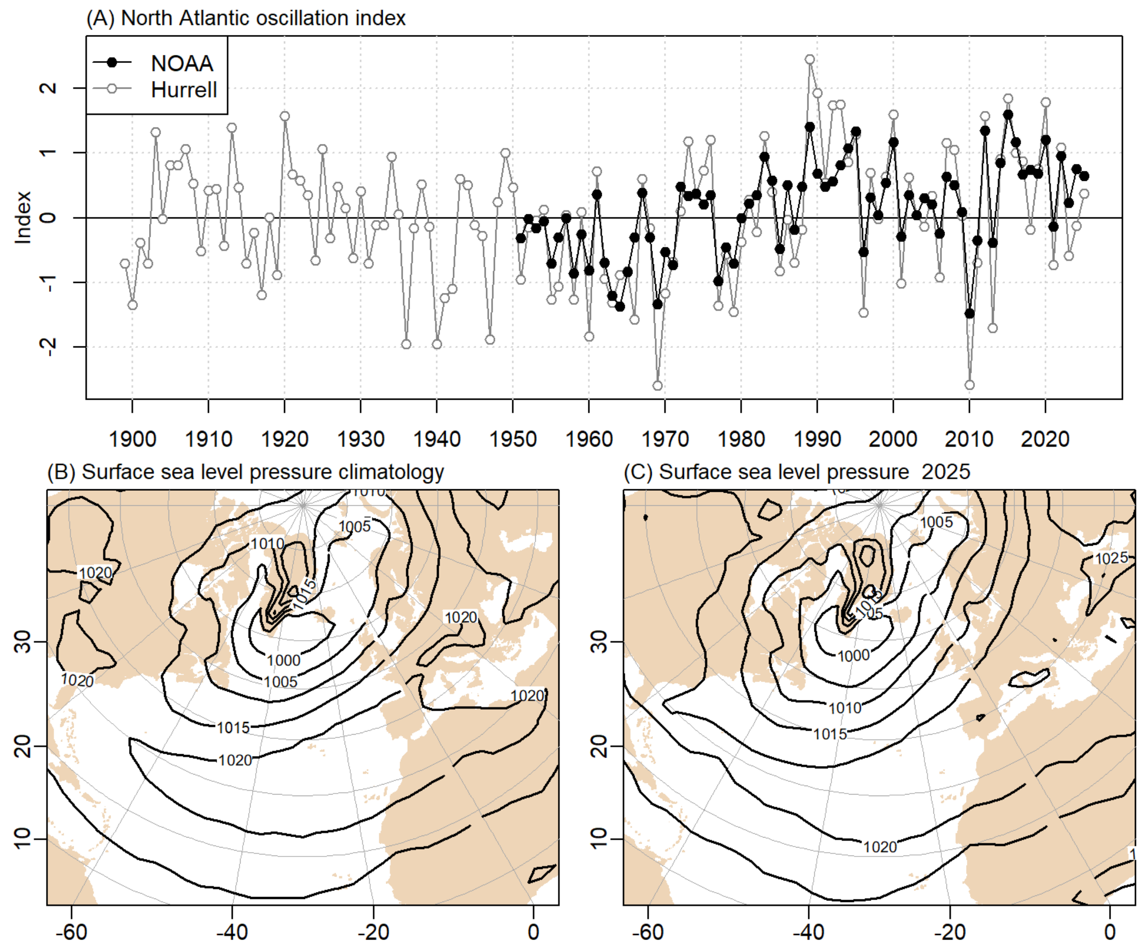

Figure 2. (A) The North Atlantic Oscillation (NAO) index, defined as the winter (December, January, February, March), monthly time series mean from NOAA and the principal component based index from Hurrell. (B) The 1991-2020 December – March mean and (C) December 2024 – March 2025 mean sea-level atmospheric pressure over the North Atlantic. (Data provided by the NOAA/ESRL Physical Sciences Division, Boulder, Colorado.)

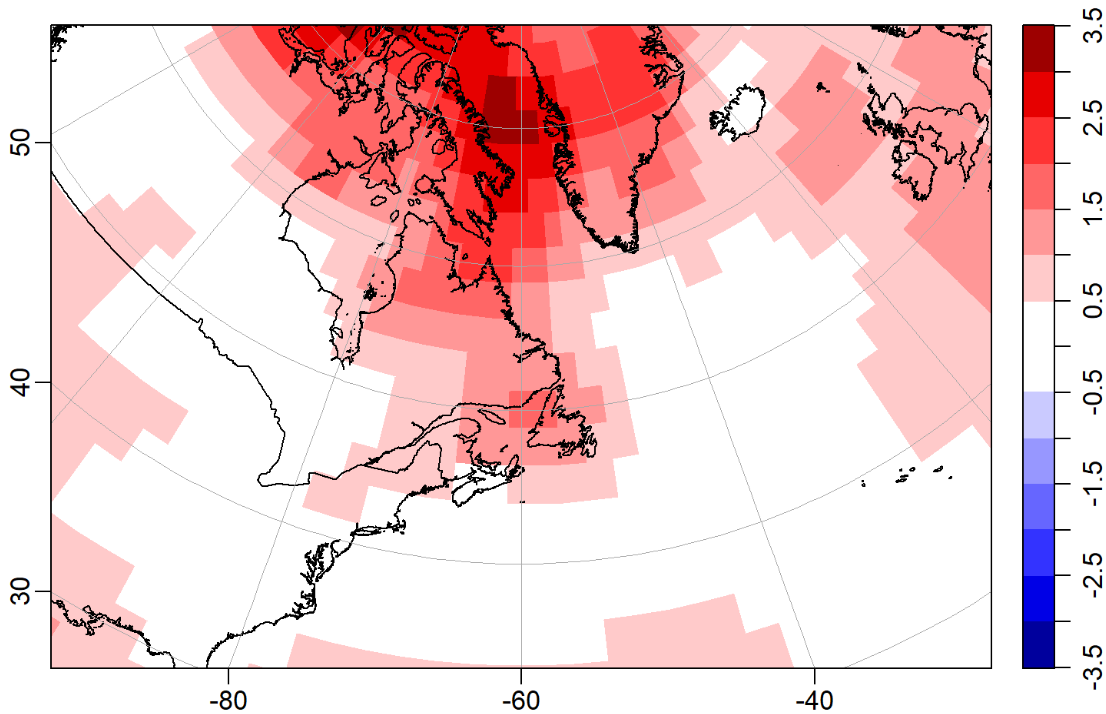

Figure 3. Annual air temperature anomalies (°C) over the Northwest Atlantic relative to the 1991-2020 mean; data were obtained from NOAA Internet site (accessed 26 January 2026).

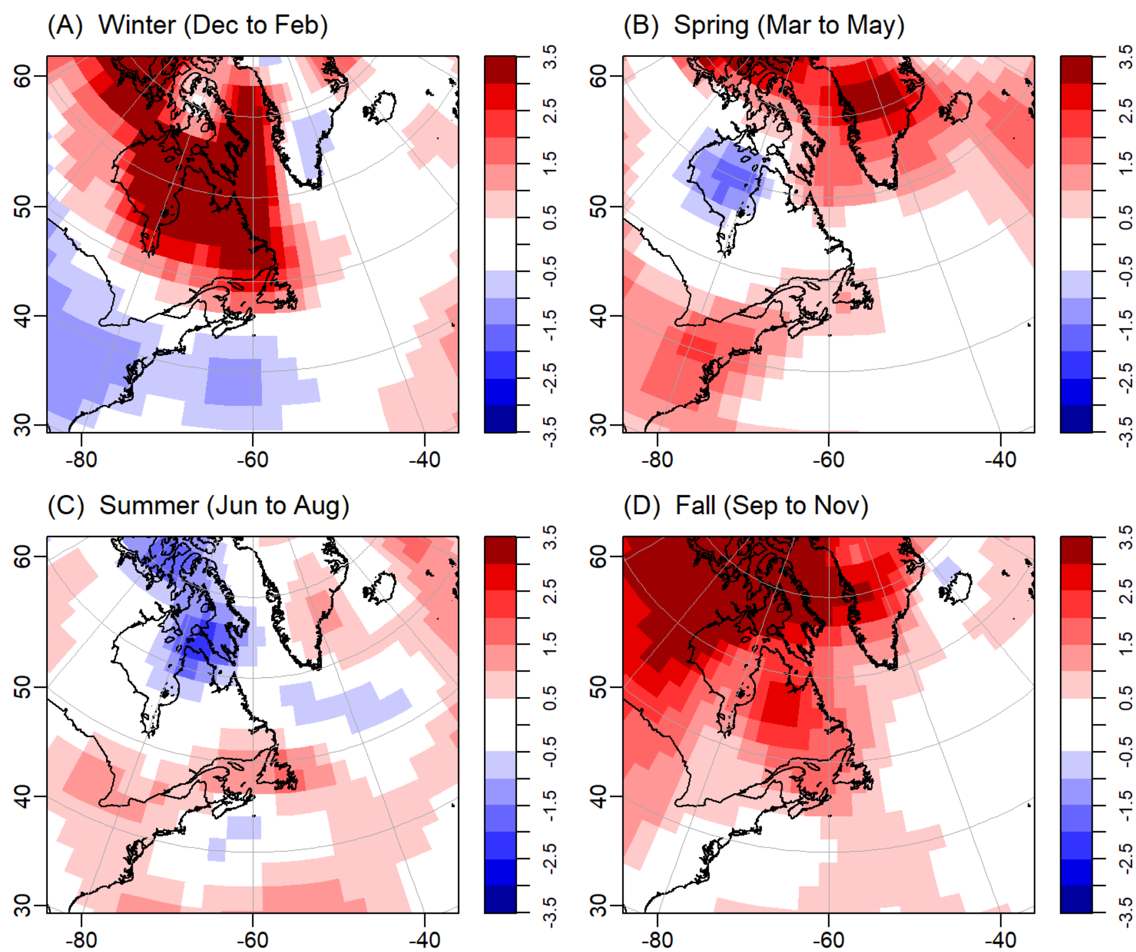

Figure 4. Seasonal air temperature anomalies (°C) over the Northwest Atlantic relative to the 1991-2020 means; data were obtained from NOAA Internet site (accessed 26 January 2026).

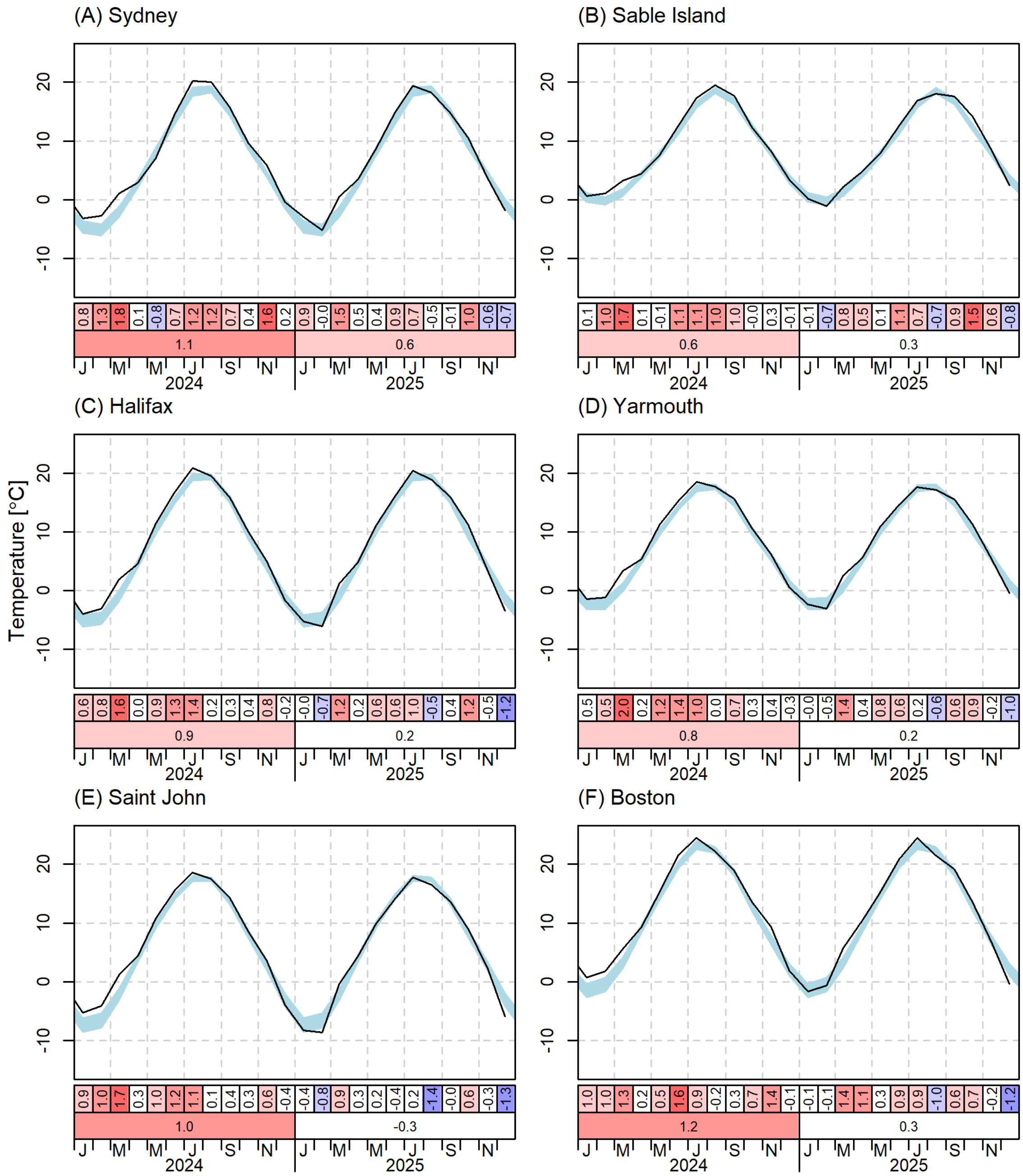

Figure 5. Monthly air temperature (°C), denoted by the thin black line, at selected sites in the Scotian Shelf/Gulf of Maine region for 2024 and 2025. See Figure 1 for locations. The blue area represents the 1991-2020 climatological monthly mean ± 0.5 SD. The scorecards are colour-coded according to the normalized anomalies based on the 1991-2020 climatologies for each month (top row) and for the year (bottom row).

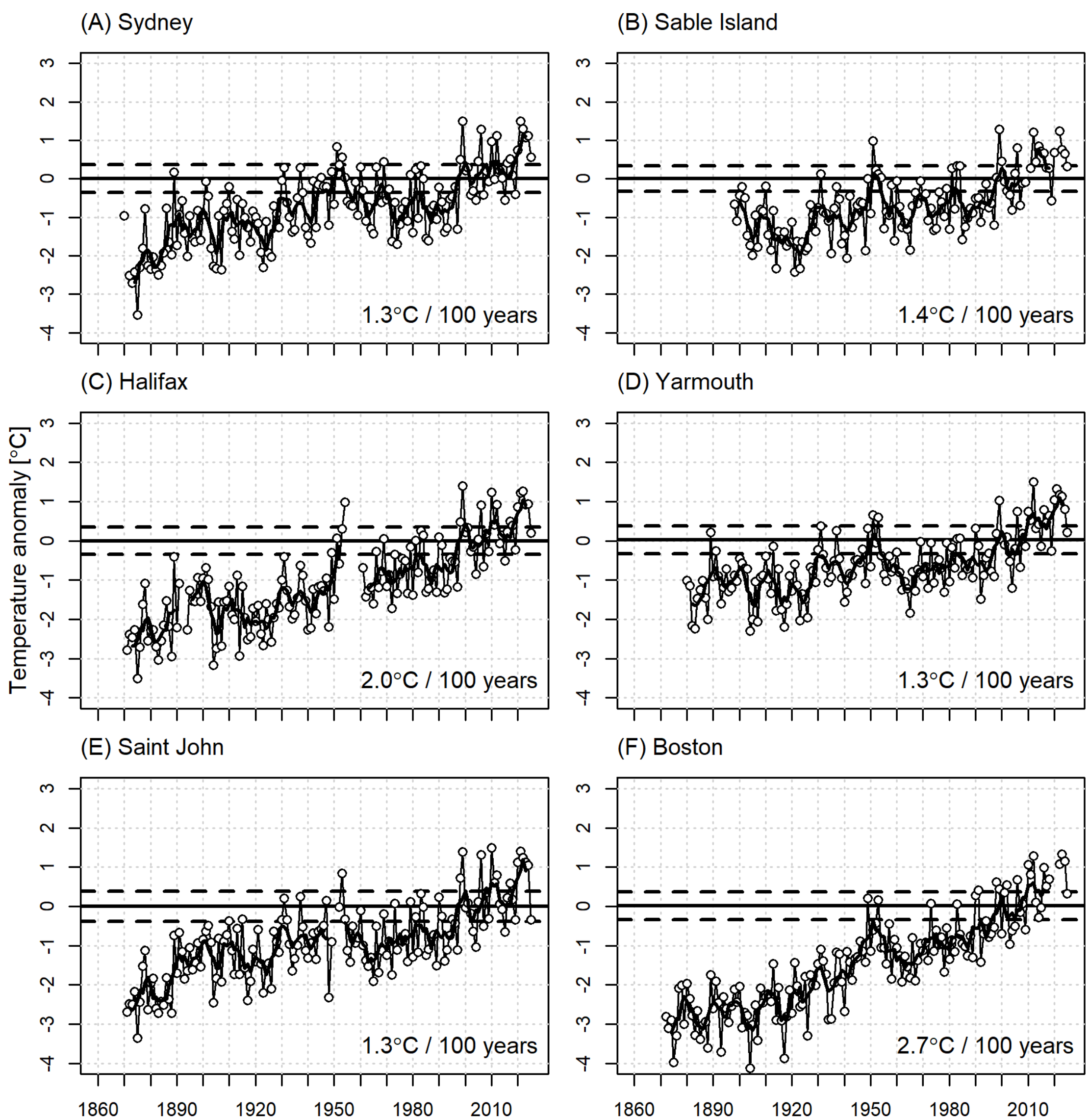

Figure 6. Annual air temperature anomalies in °C (circles connected by thin black line) and five-year running means (thick solid line) at selected sites in Scotian Shelf/Gulf of Maine region (years 1870 to 2025). Horizontal dashed thick lines represent plus or minus 0.5 SD for the 1991-2020 period. Linear trends for 1900–present are shown.

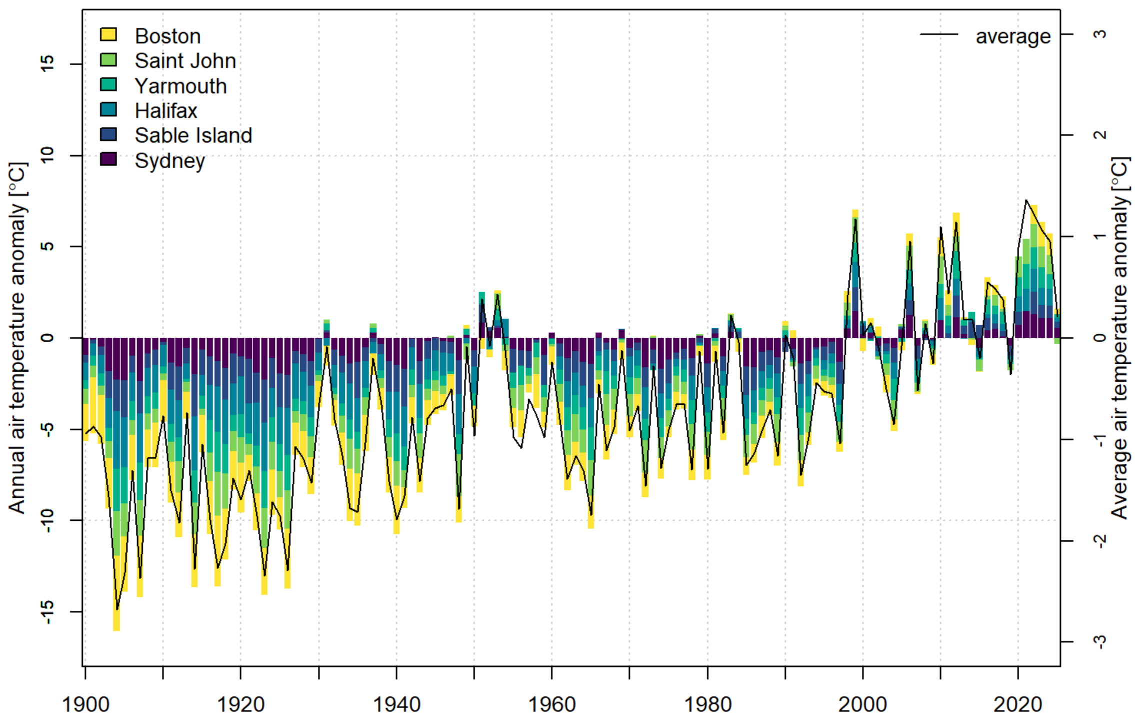

Figure 7. The contributions of the annual air temperature anomaly for selected sites in Scotian Shelf/Gulf of Maine shown as a stacked bar chart. Anomalies referenced to 1991-2020.

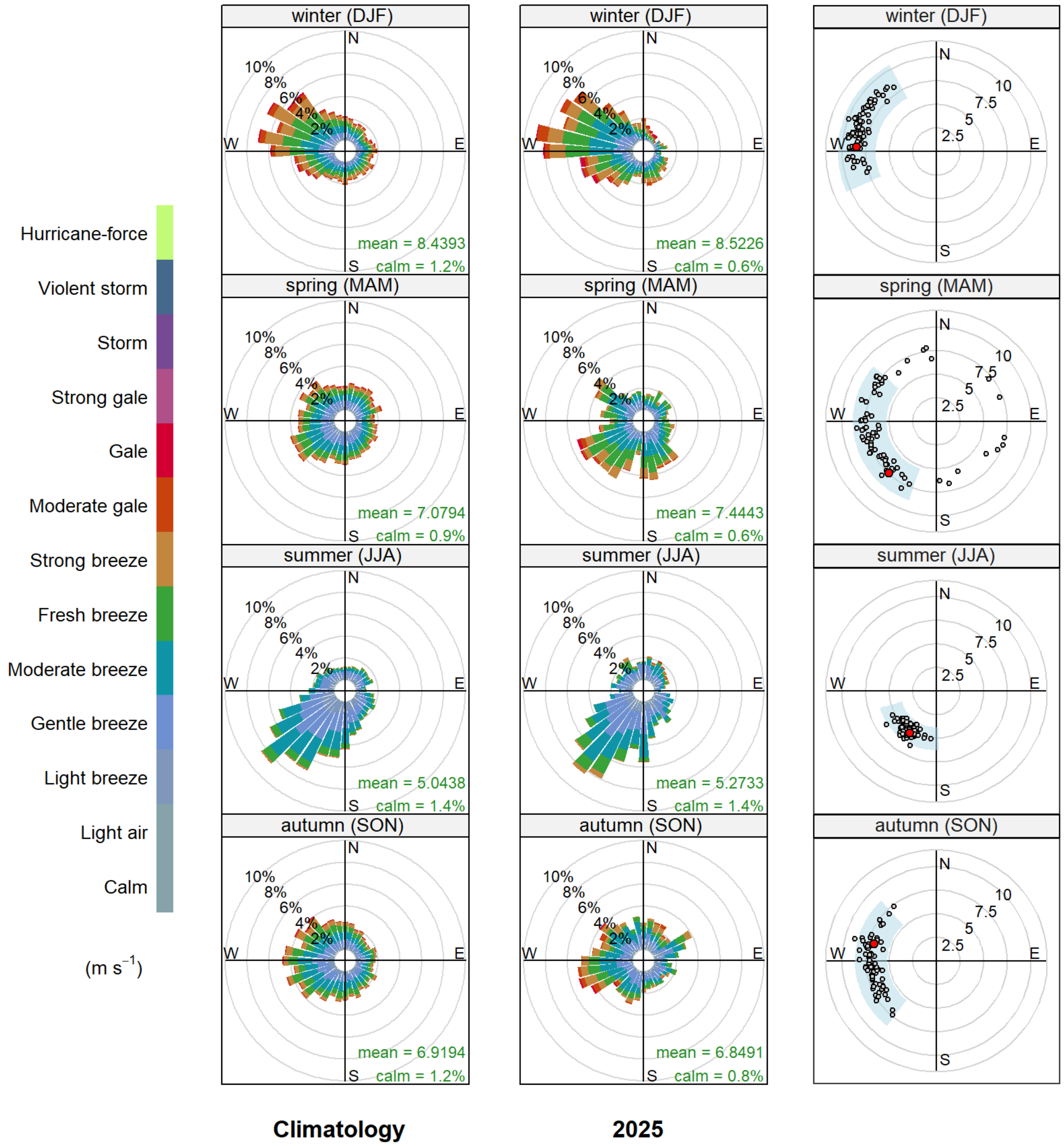

Figure 8. Proportional counts of hourly wind speed data, showing the direction the wind is coming from (meteorological convention), from Sable Island for the 1991 to 2020 climatology reference period (left column) and for year 2025 (middle column), for each season, winter (December, January, February (DJF)), spring (March, April, and May (MAM)), summer (June, July, and August (JJA)), and autumn (September, October, and November (SON)). Wind rose paddles are shown for every 10 degrees and are colour coded by the Beaufort wind scale. The percentage of calm winds, defined as a wind speed of 0 m/s, is provided in the lower right corner. Annual mean speed (m/s) and direction for each season (right column). The current year is indicated by a red dot, and all previous years are indicated by a grey dot. The blue shaded area is +/-0.5SD of the 1991 to 2020 climatology reference period for direction and speed.

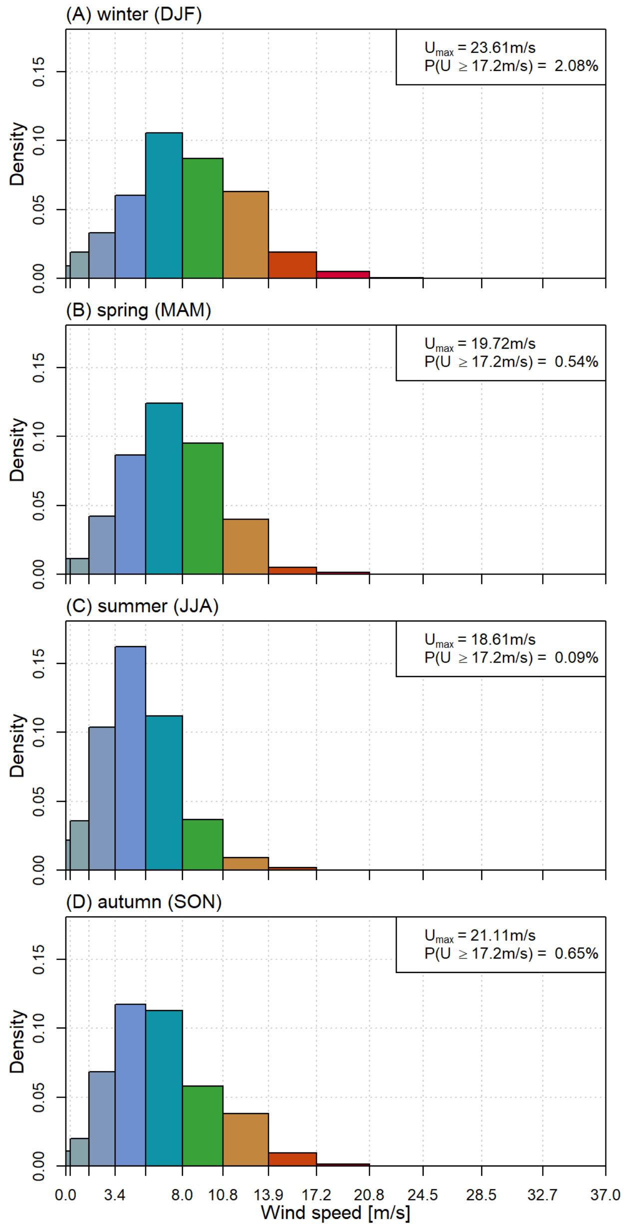

Figure 9. Seasonal probability density histograms of the hourly wind speed from Sable Island for year 2025. Histogram breaks follow the Beaufort scale, reiterated by the color coding as done in Figure 8. The maximum wind speed (U_{max}) observed during the season, and the percentage of wind speed observations greater 17.2m/s ($P(U \geq 17.2m/s)$), associated with Beaufort scale Gale-force winds, is provided in the top right corner.

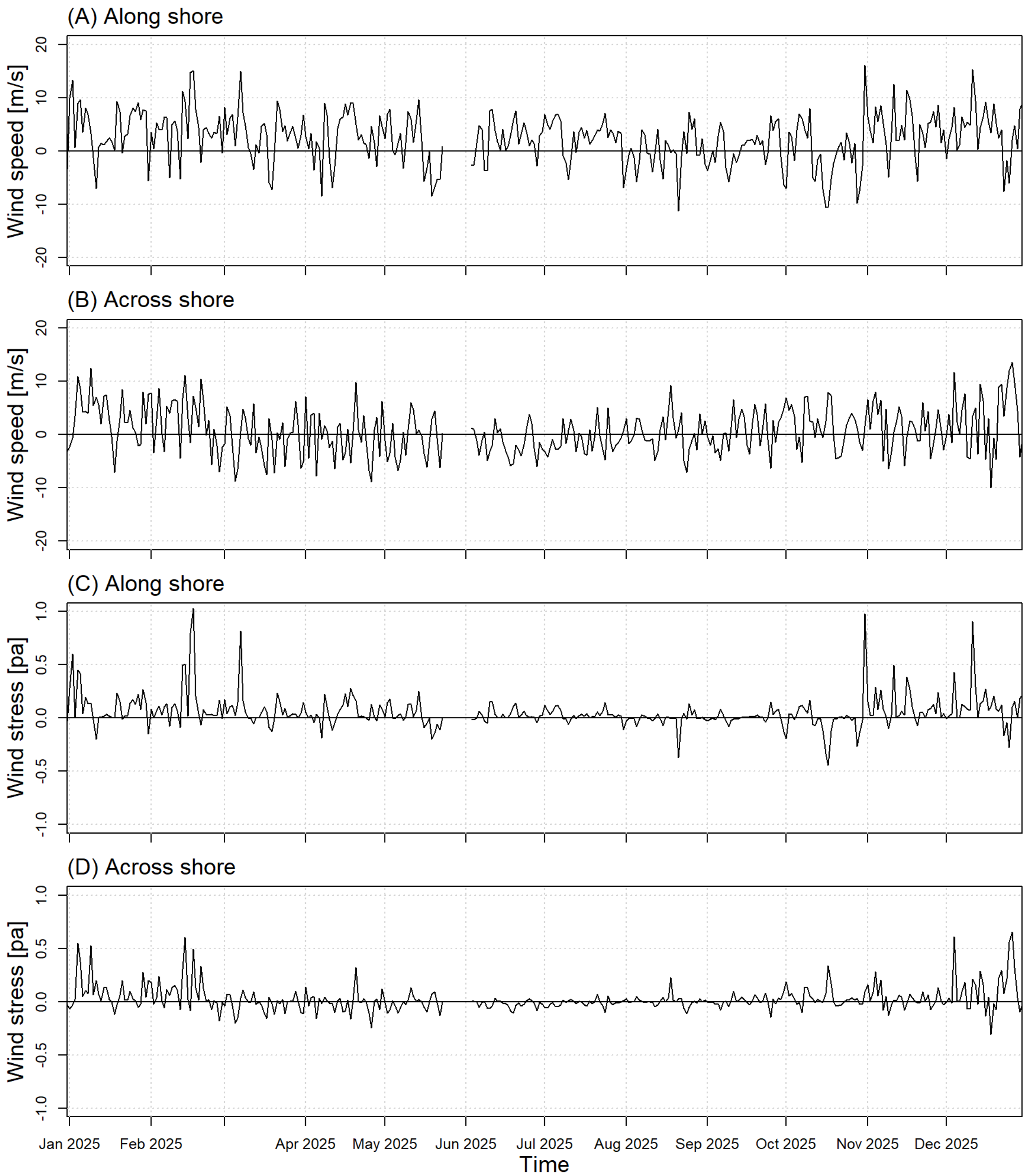

Figure 10. Sable Island along- (60°T) and across-shore (150°T) wind speed and wind stress components for 2025.

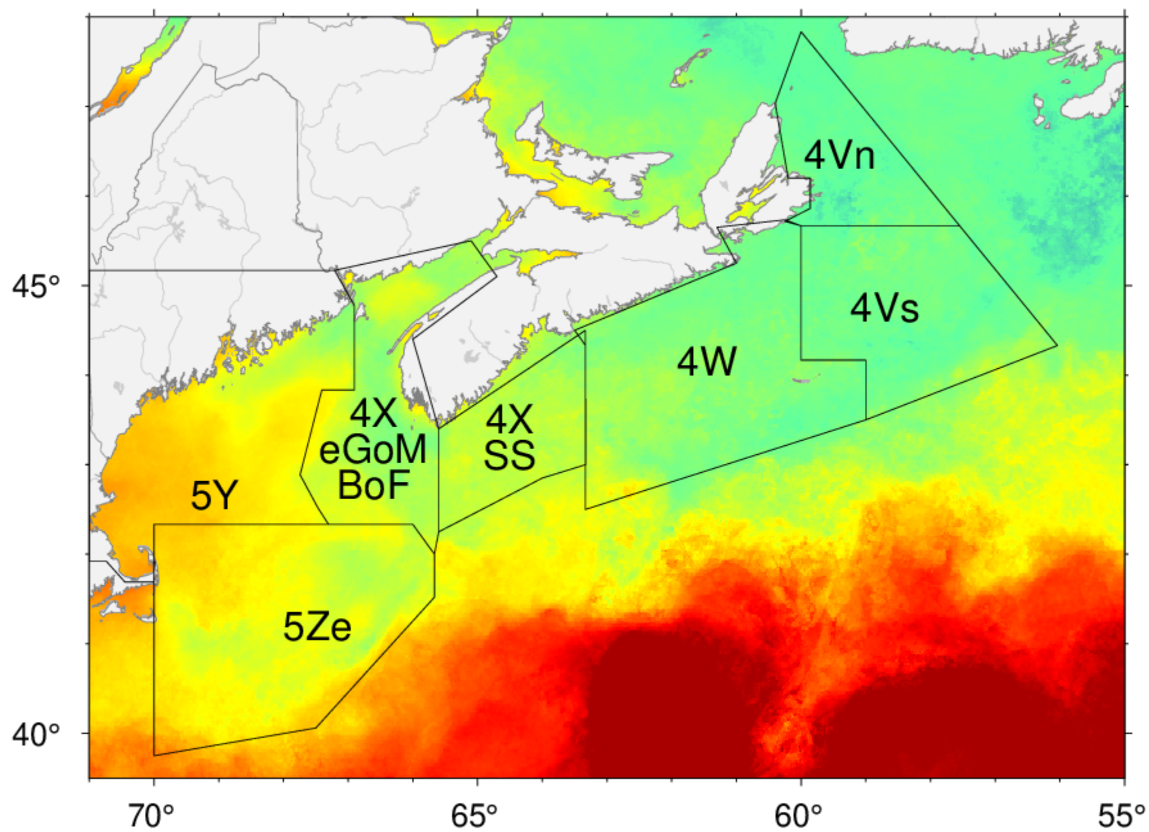

Figure 11. Scotian Shelf/Gulf of Maine NAFO divisions (4Vn, 4Vs, 4W, 4X SS, 4X eGoM-BoF, 5Y and 5Ze) used for extraction of sea surface temperature.

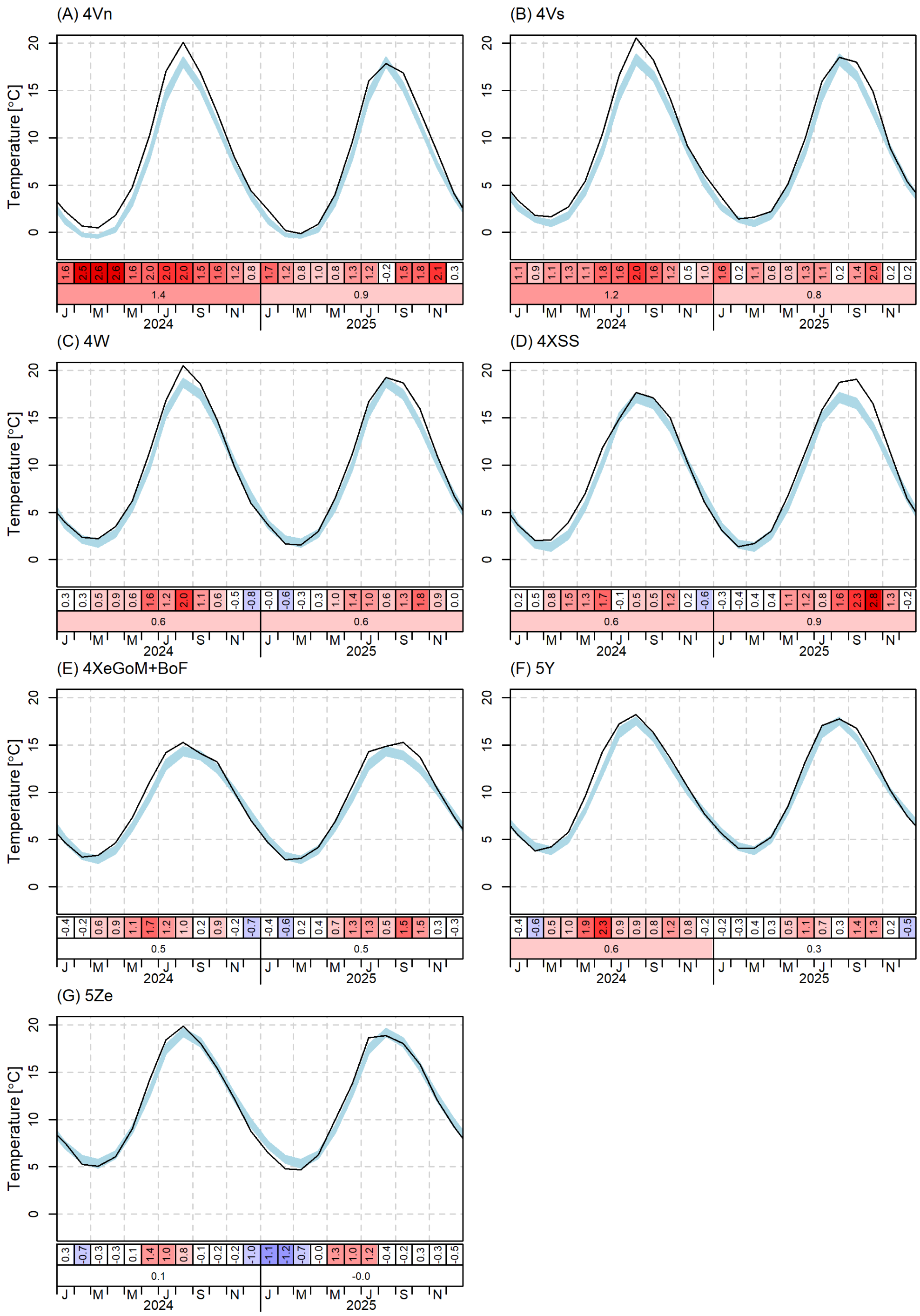

Figure 12. Satellite sea-surface temperature monthly averages (black line) over the seven regions of the Scotian Shelf and Gulf of Maine. The blue area represents the 1991-2020 climatological monthly mean ± 0.5 SD. The scorecards are colour-coded according to the normalized anomalies based on the 1991-2020 climatologies for each month (top row) or for the year (bottom row).

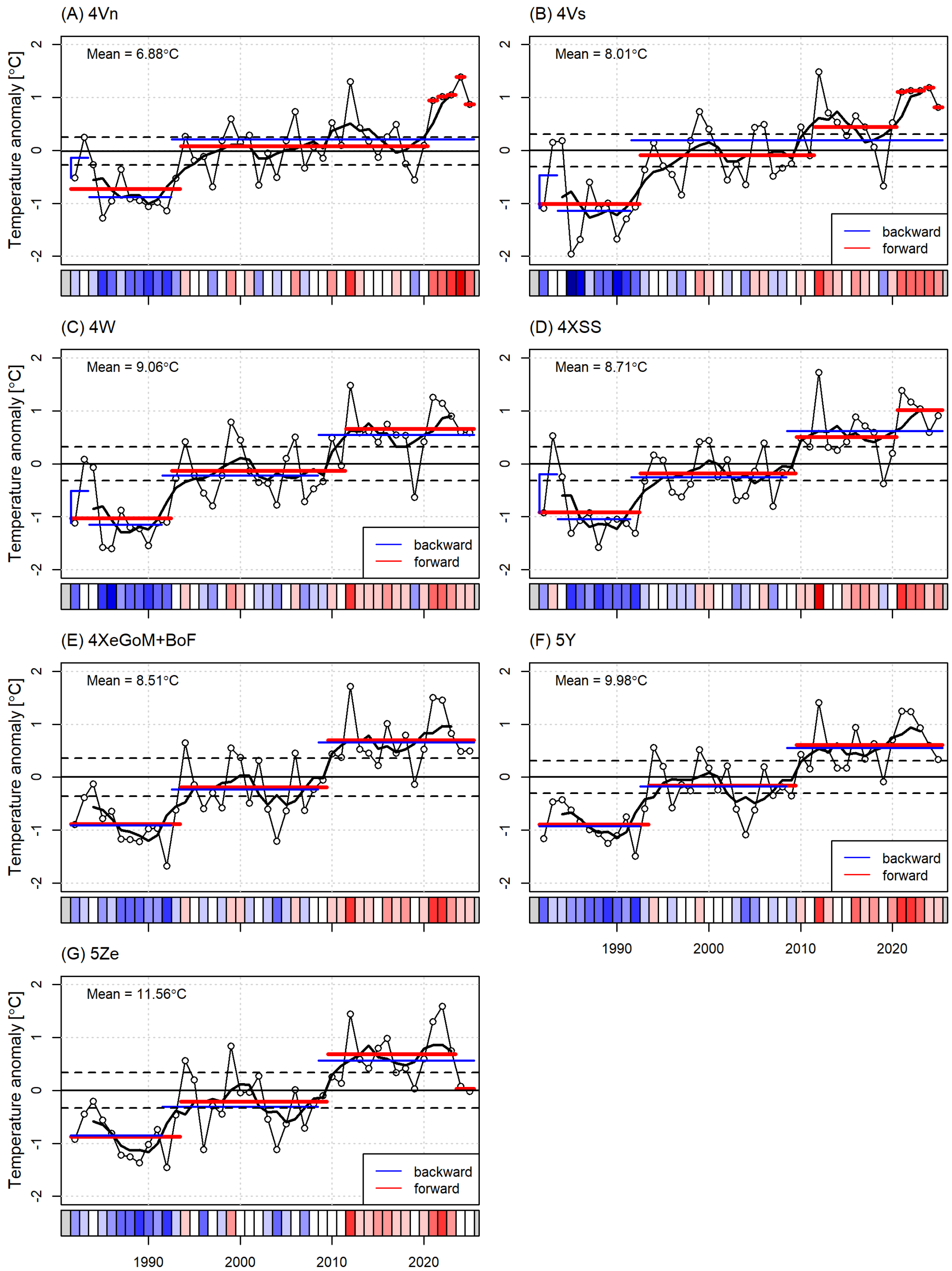

Figure 13. The annual satellite sea-surface temperature anomaly (thin solid line with circles) derived from monthly means and the five-year running means (thick black line) for the seven regions on the Scotian Shelf and Gulf of Maine (Figure 11). Horizontal dashed lines represent ±0.5 SD of the 1991-2020 climatology reference period. Regime shift analysis results from running the method forwards and backwards on the time series depicted by the red and blue horizontal lines, respectively. The scorecard below each timeseries plot is colour coded based on the normalized anomalies, with blue indicating below normal, white indicating normal, and red above normal.

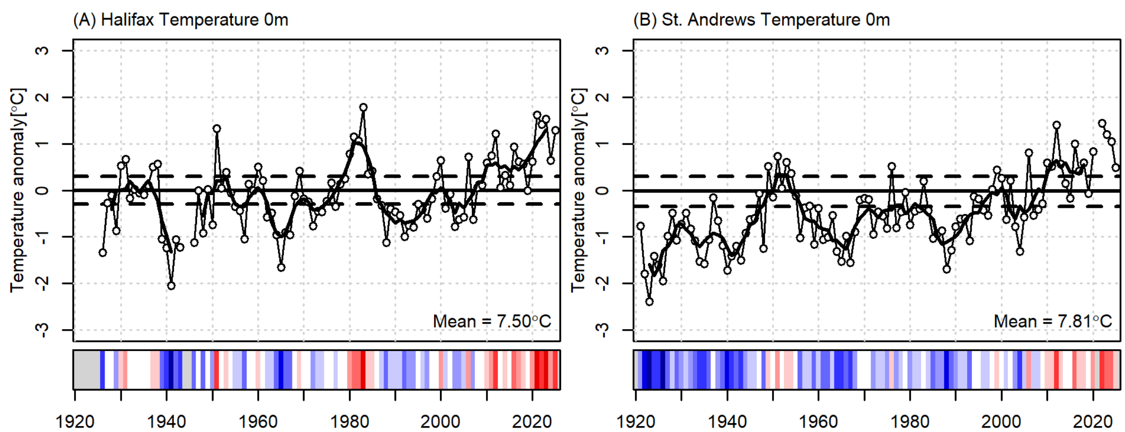

Figure 14. The annual surface-temperature anomalies with respect to the 1991–2020 climatology (thin solid line with circles) and their five-year running means (thick black line) for (A) Halifax Harbour and (B) St. Andrews. Horizontal dashed lines represent the mean ±0.5 SD. The scorecard below each timeseries plot is colour coded based on the normalized anomalies, with blue indicating below normal, white indicating normal, and red above normal.

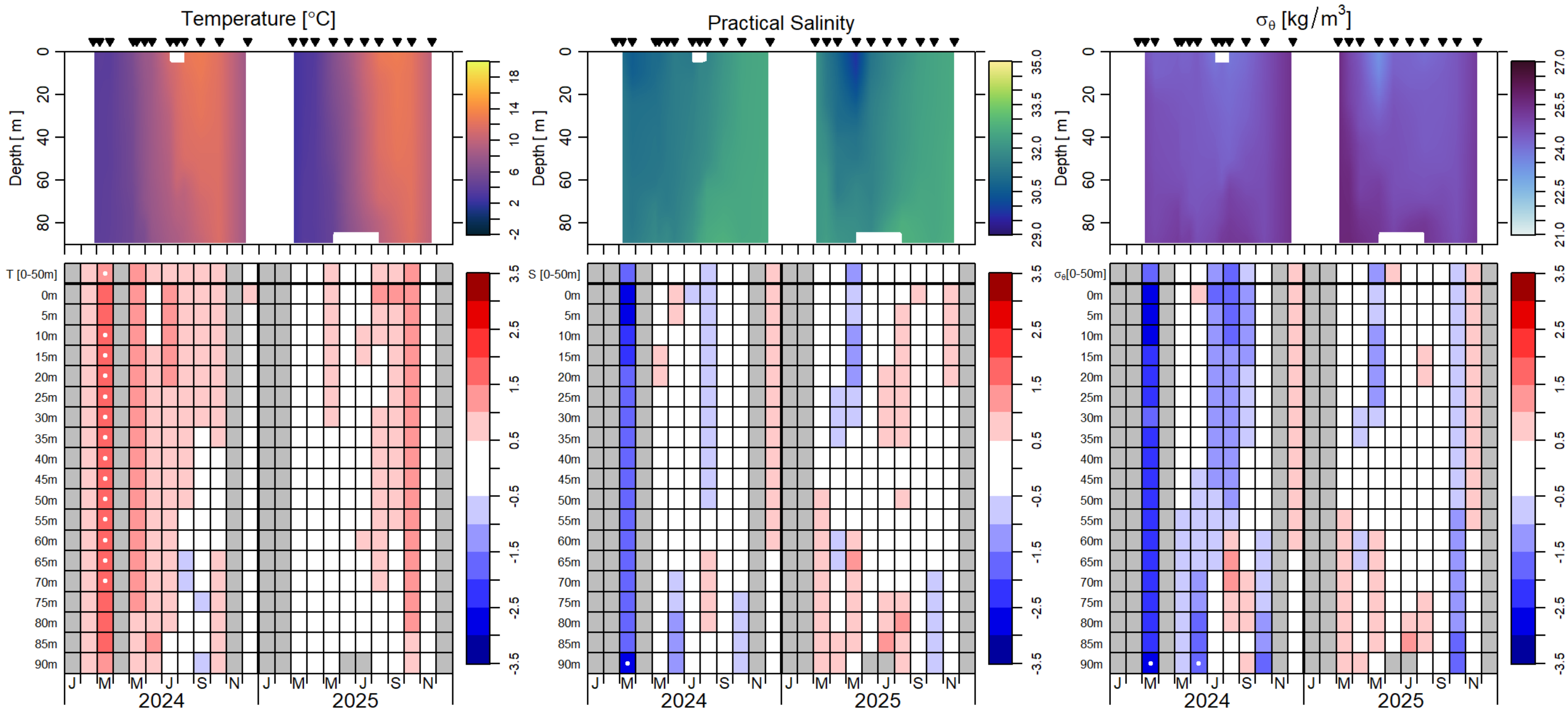

Figure 15. Prince 5 2024-2025 temperature (top left), salinity (top center), and density (top right), triangles indicate periods of sampling. Scorecard tables with 0-50m mean values (T [0-50m], S [0-50m], σ_θ [0-50m]), and depth bin monthly normalized anomalies with respect to the 1991–2020 climatology (bottom panels). White dots indicate monthly time series record low or highs for each depth bin.

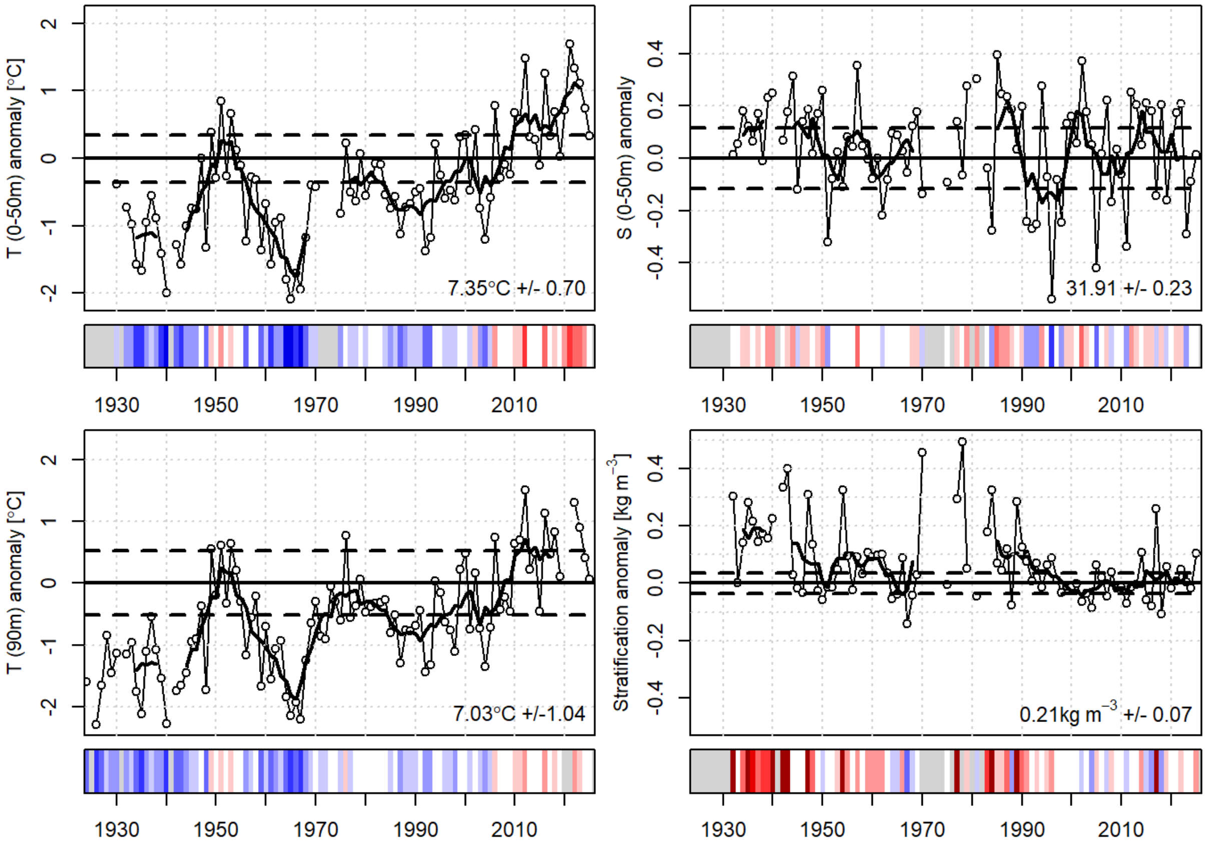

Figure 16. Prince 5 annual anomaly time series (circles connected by a thin black line) of temperature (top left) and salinity (top right) averaged from 0 to 50m, the bottom temperature (bottom left), and the stratification (bottom right) which is the density difference between 0 and 50m with the five-year running mean (thick solid line). Horizontal dashed lines represent the mean ±0.5 SD for the 1991-2020 period. Scorecards below each timeseries plot are colour coded based on the normalized anomalies, with blue indicating below normal, white indicating normal, and red above normal.

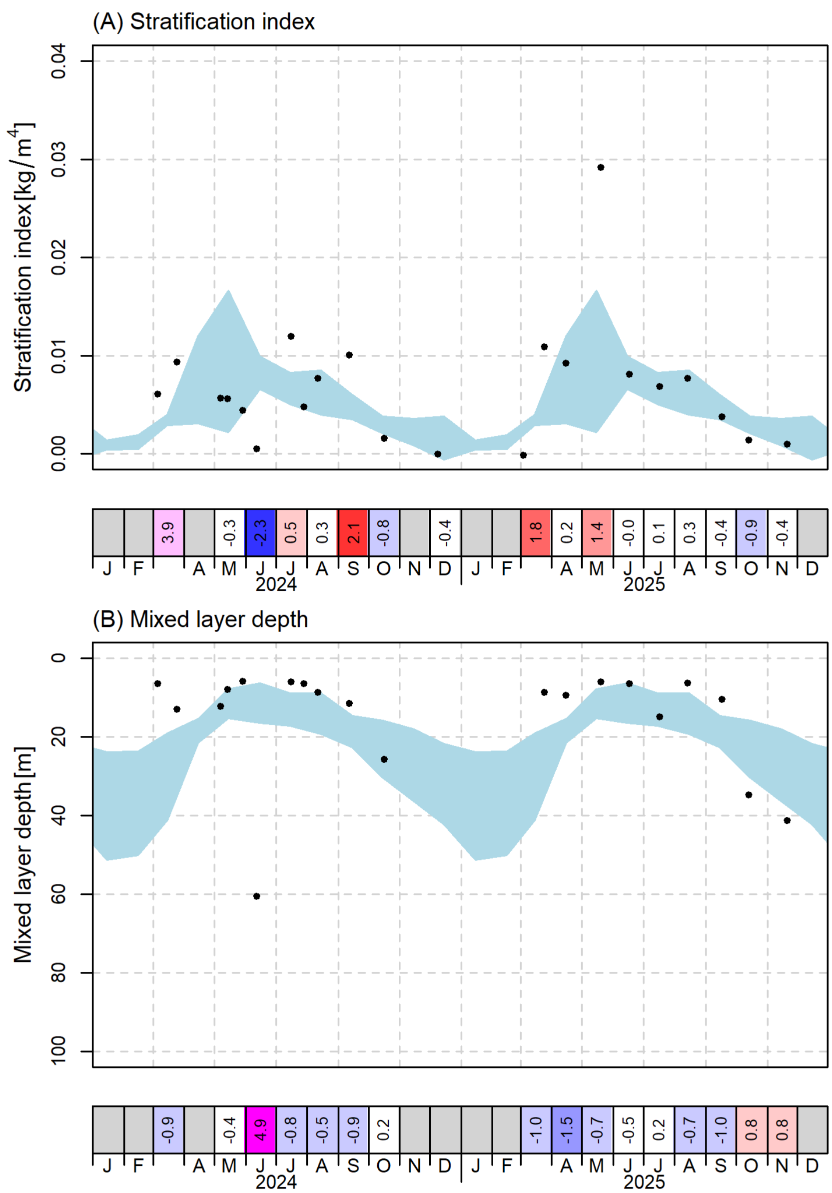

Figure 17. The 2024– 2025 annual cycle of stratification index (top panel) and mixed layer depth (lower panel) for Prince 5. The shaded area is the 1991–2020 climatological mean ± 0.5 standard deviations. The dots represent individual calculations. The normalized anomalies with respect to 1991–2020 monthly means are shown below each figure.

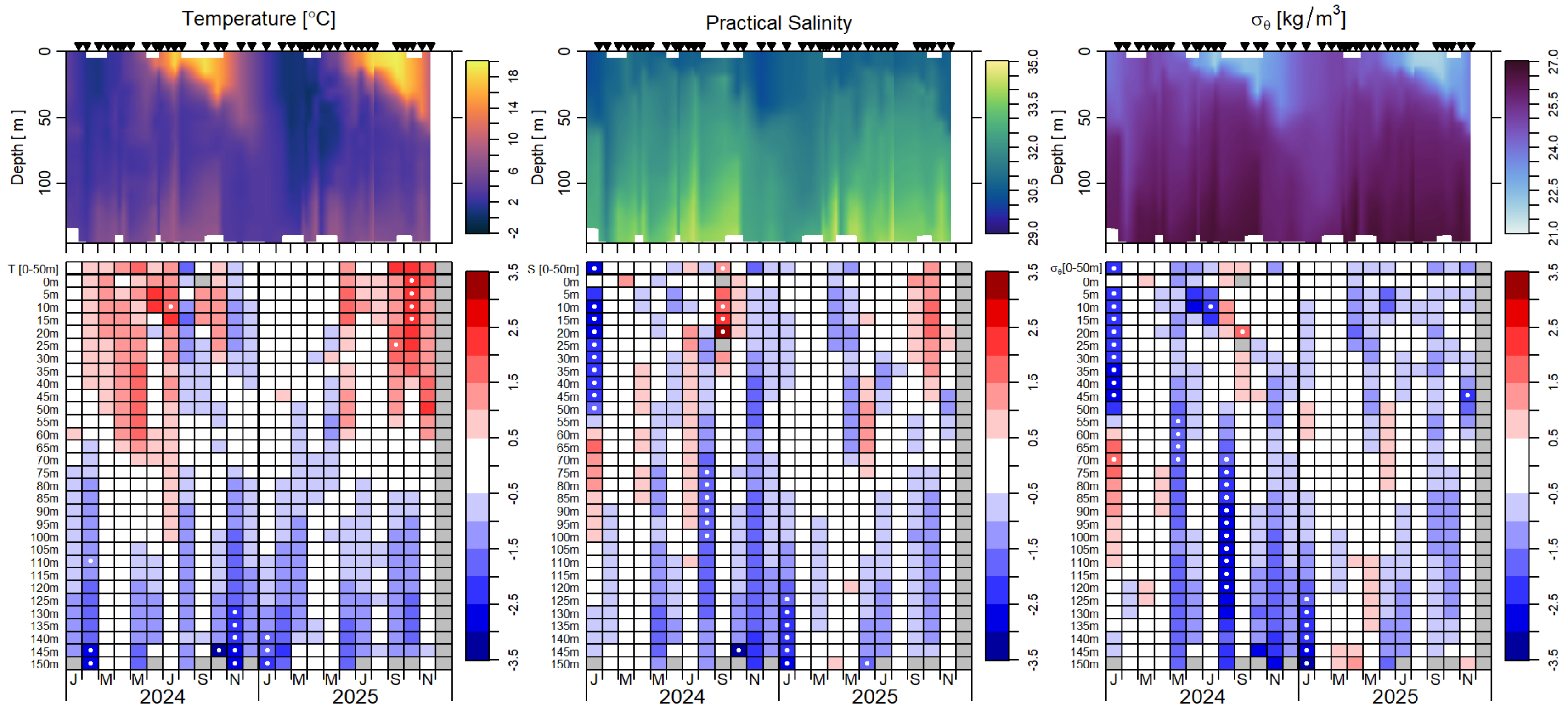

Figure 18. Halifax station 2 2024-2025 temperature (top left), salinity (top center), and density (top right), triangles indicate periods of sampling. Scorecard tables with 0-50m mean values (T [0-50m], S [0-50m], σ_θ [0-50m]), and depth bin monthly normalized anomalies with respect to the 1991–2020 climatology (bottom panels). White dots indicate monthly time series record low or highs for each depth bin.

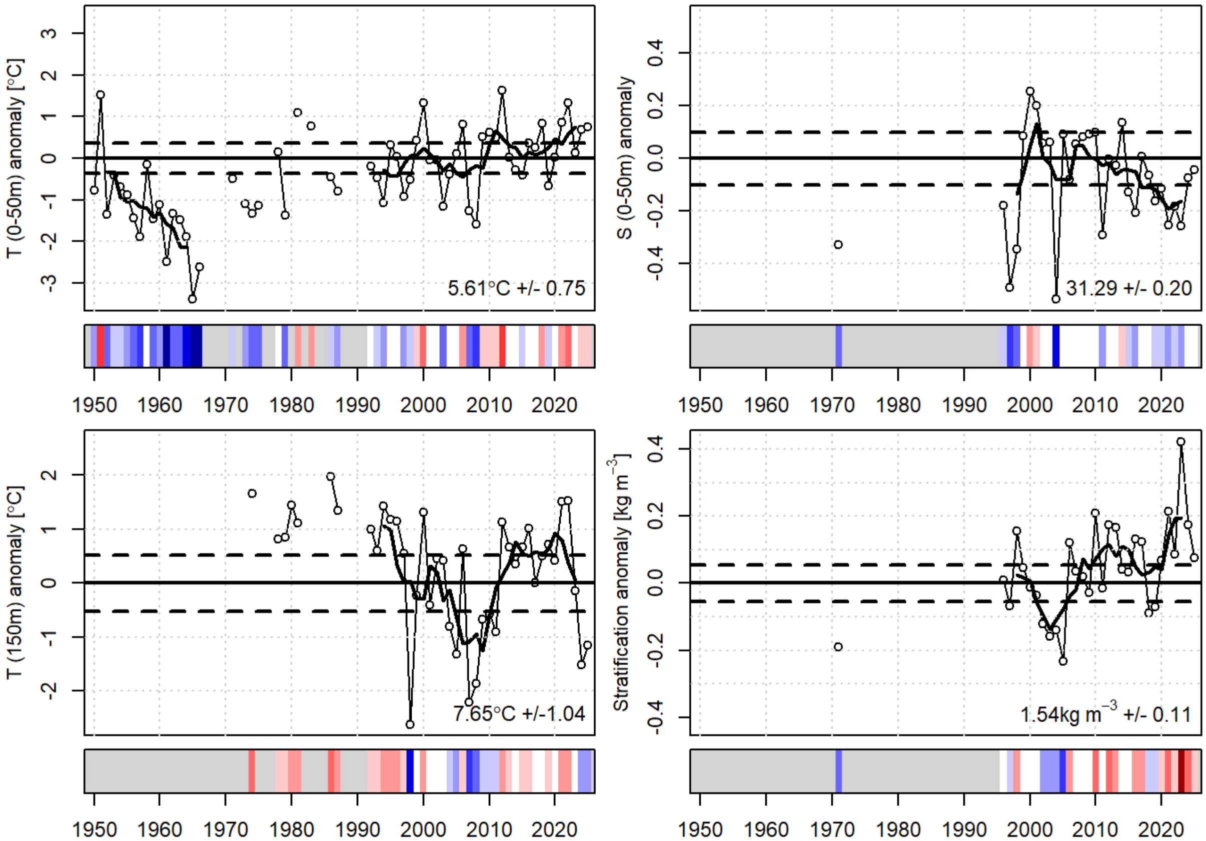

Figure 19. Halifax station 2 annual anomaly time series of temperature (top left) and salinity (top right) averaged from 0 to 50m, the bottom temperature (bottom left), and the stratification (bottom right) which is the density difference between 0 and 50m. Horizontal dashed thick lines represent the mean ± 0.5 SD for the 1991-2020 period. Scorecards below each time series plot are colour coded based on the normalized anomalies, with blue indicating below normal, white indicating normal, and red above normal.

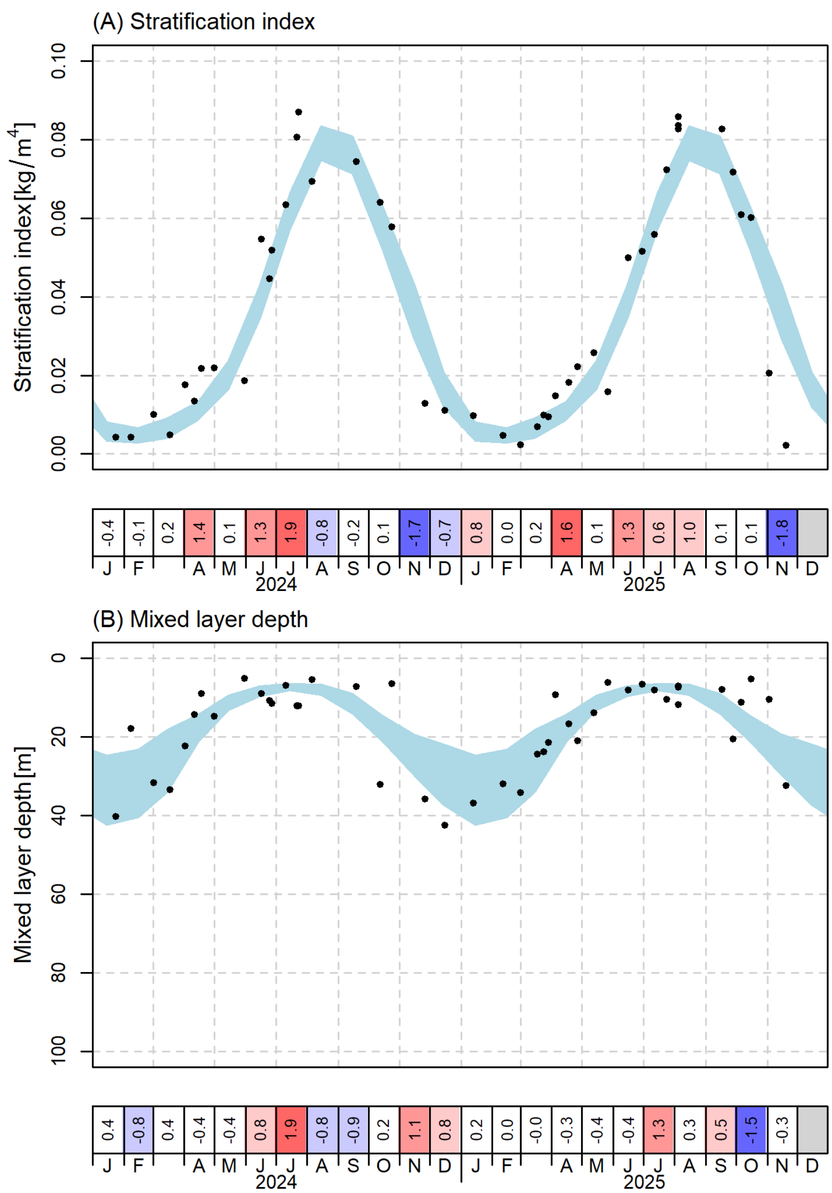

Figure 20. The 2024– 2025 annual cycle of stratification index (top panel) and mixed layer depth (lower panel) for Halifax station 2. The shaded area is the 1991–2020 climatological mean +/-0.5 standard deviations. The dots represent individual calculations. The normalized anomalies with respect to 1991–2020 monthly means are shown below each figure.

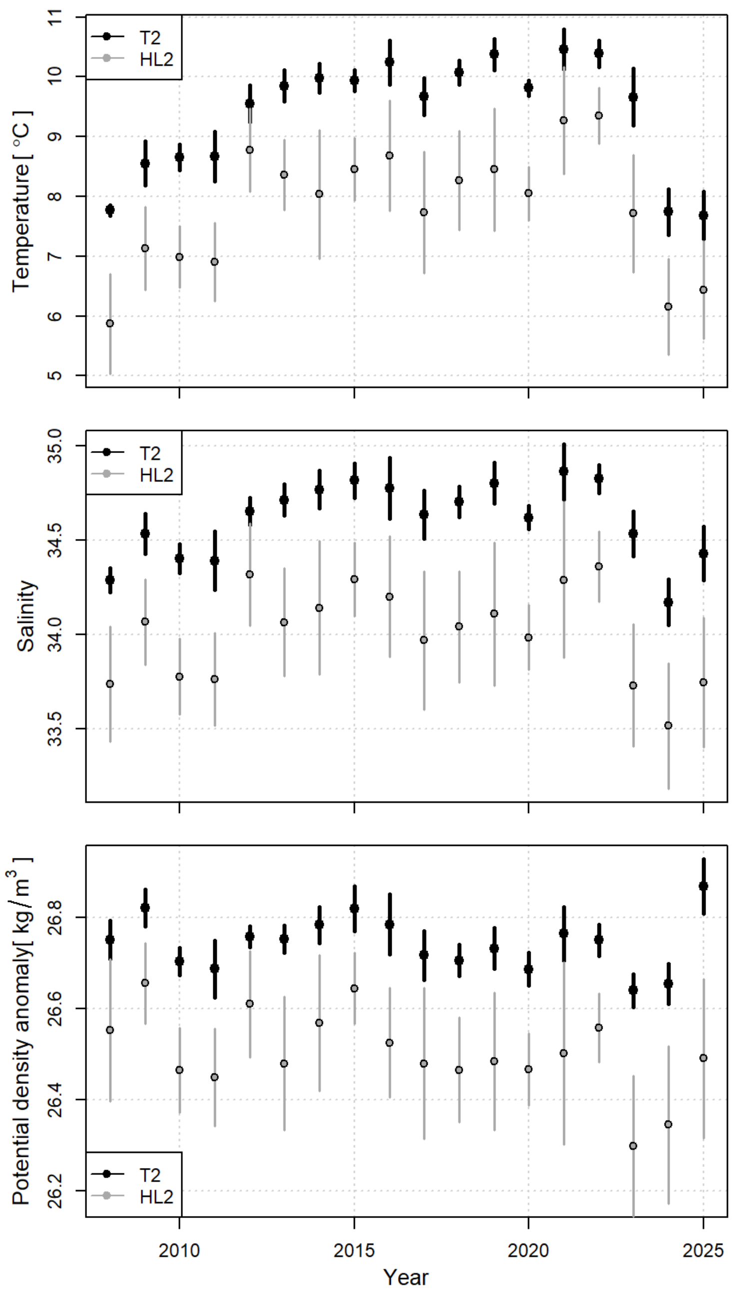

Figure 21. A comparison of the T2 and Halifax 2 near-bottom annual time series of temperature (top) and salinity (middle), and density (bottom) with vertical lines from each point representing +/- 0.5SD.

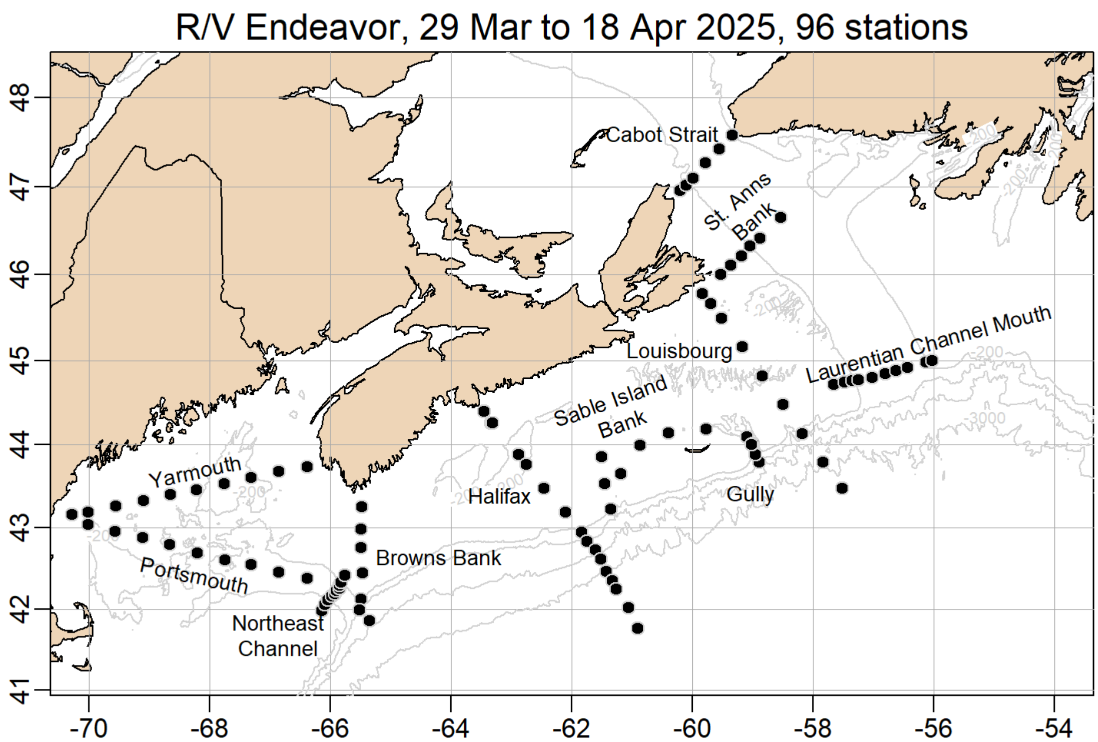

Figure 22. The 2025 sampling of the Scotian Shelf/Gulf of Maine for the spring AZMP survey. The black dots represent sampling locations along both AZMP core and ancillary lines as well as sampling within Marine Protected Areas such as the Gully and St. Anns Bank.

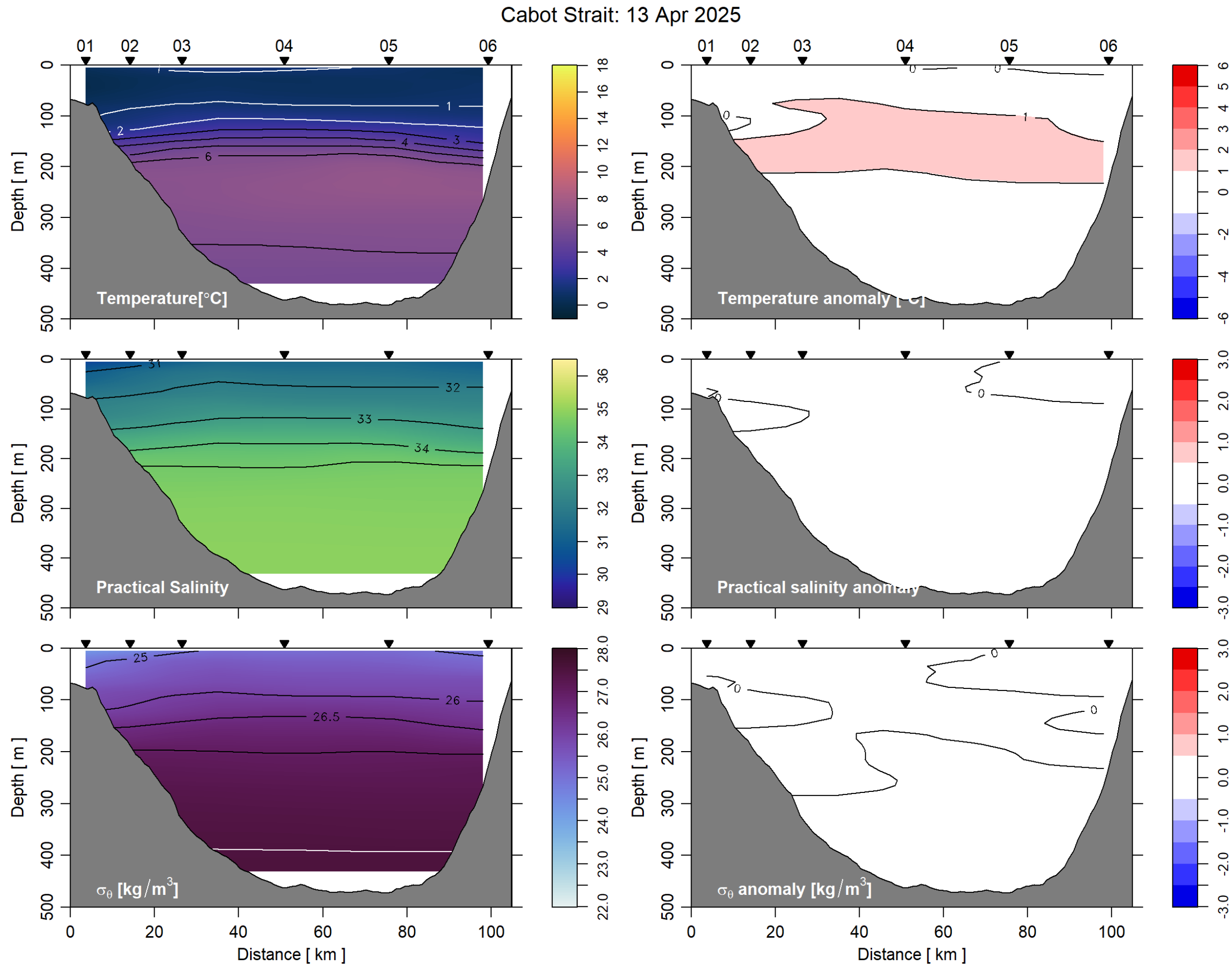

Figure 23. The 2025 sampling of the Cabot Strait line for spring. Temperature (top panel), salinity (middle panel), and density (lower panel) and their anomalies with respect to the 1991–2020 climatology (right panels). Triangles indicate locations of sampling and station numbers are labelled above.

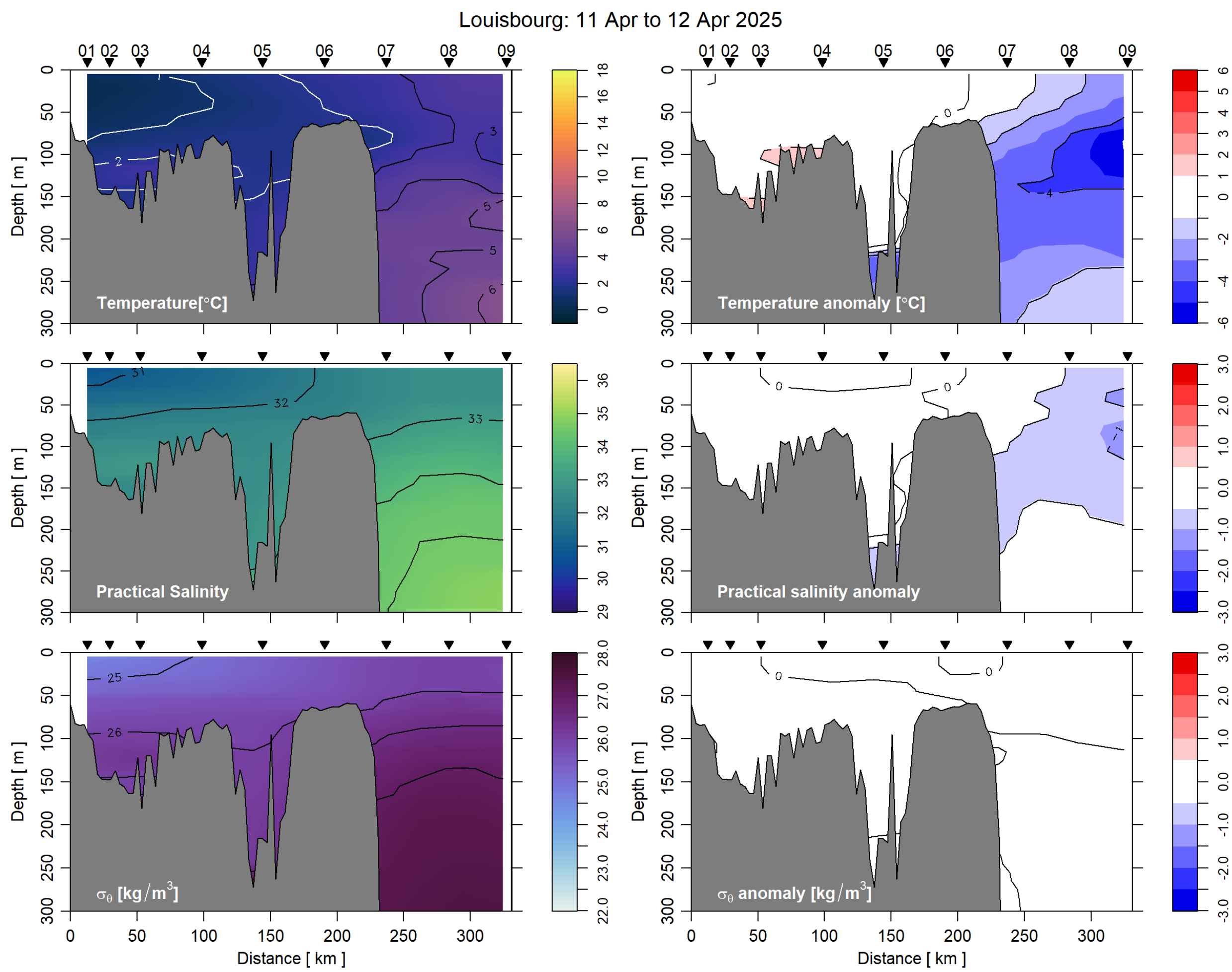

Figure 24. The 2025 sampling of the Louisbourg line for spring. Temperature (top panel), salinity (middle panel), and density (lower panel) and their anomalies with respect to the 1991–2020 climatology (right panels). Triangles indicate locations of sampling and station numbers are labelled above.

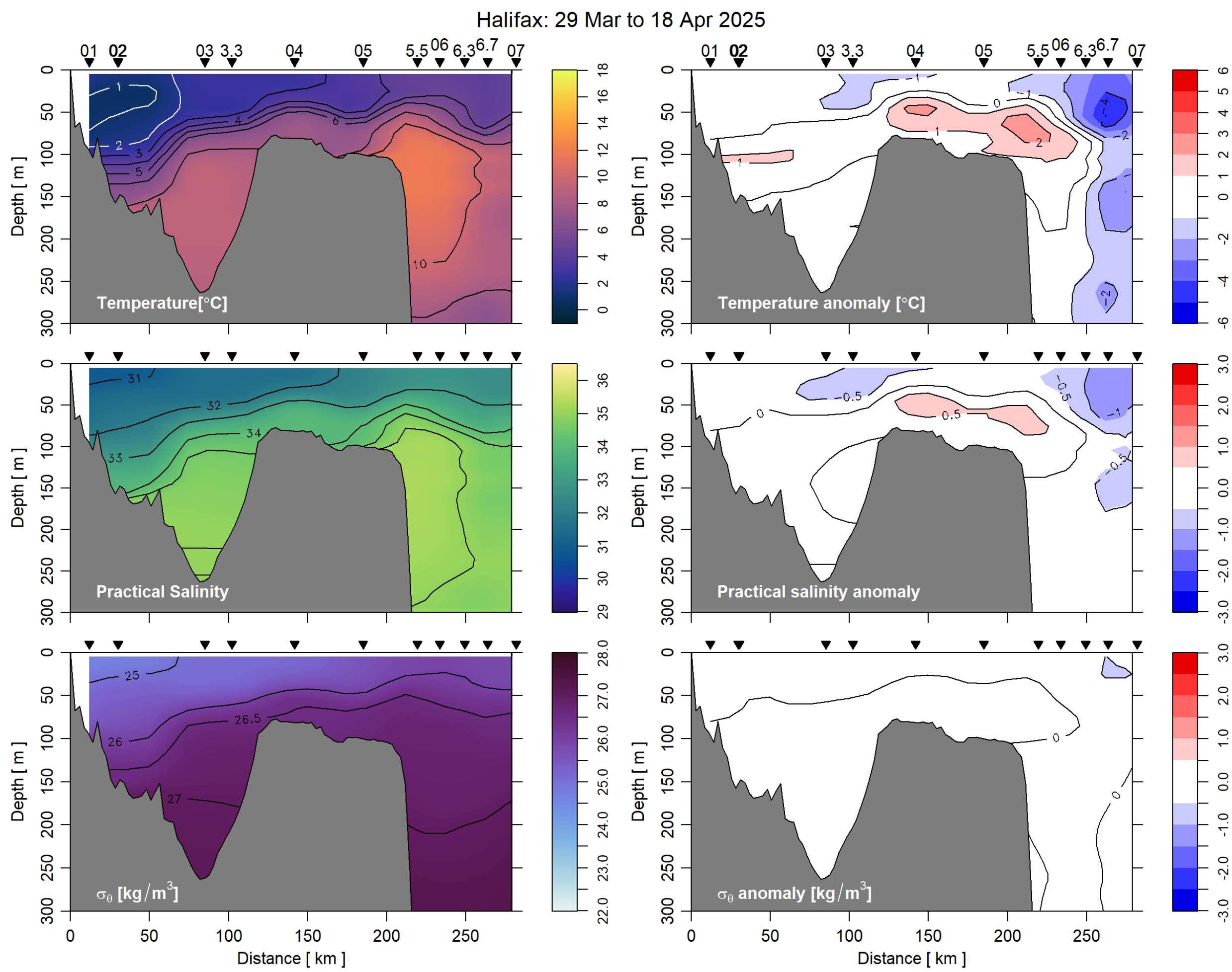

Figure 25. The 2025 sampling of the Halifax line for spring. Temperature (top panel), salinity (middle panel), and density (lower panel) and their anomalies with respect to the 1991–2020 climatology (right panels). Triangles indicate locations of sampling and station numbers are labelled above.

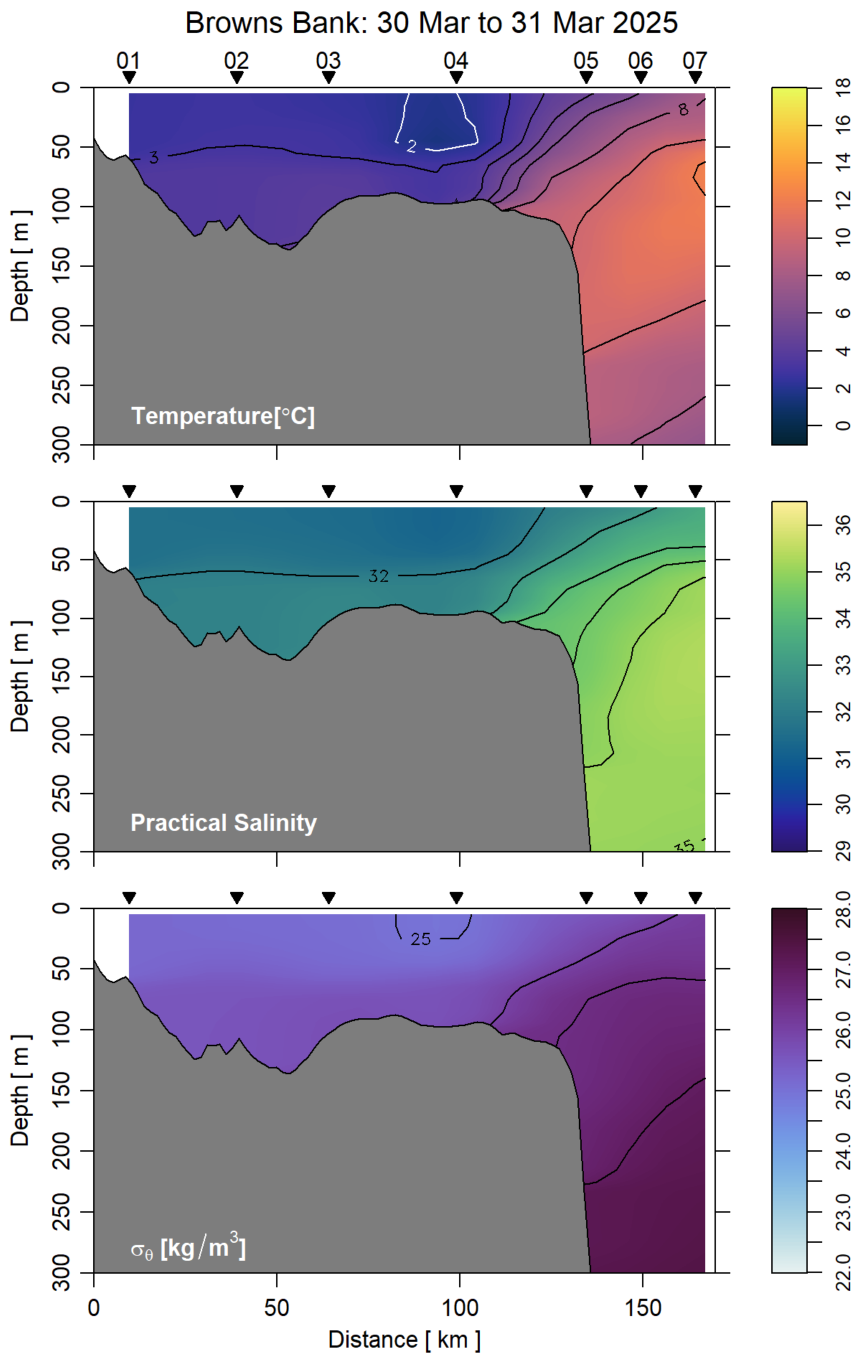

Figure 26. The 2025 sampling of the Browns Bank line for spring. Temperature (top panel), salinity (middle panel), and density (lower panel). Triangles indicate locations of sampling and station numbers are labelled above.

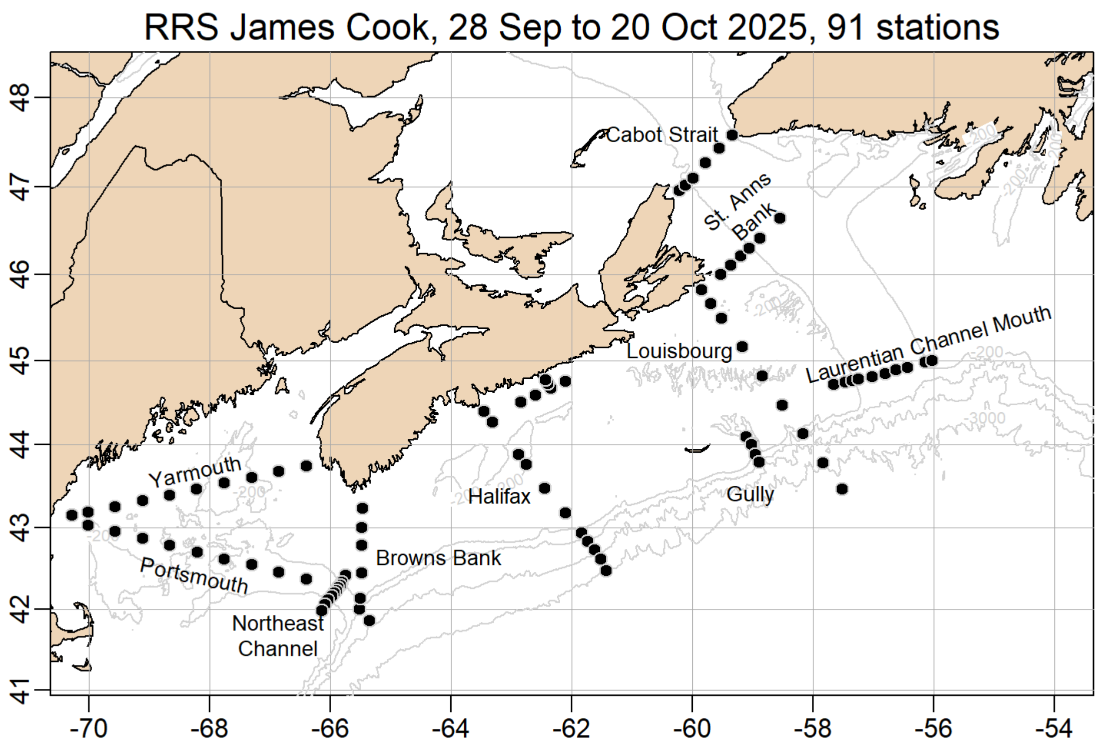

Figure 27. The 2025 sampling of the Scotian Shelf/Gulf of Maine for the fall AZMP survey. The black dots represent sampling locations along both AZMP core and ancillary lines as well as sampling within Marine Protected Areas such as the Gully and St. Anns Bank.

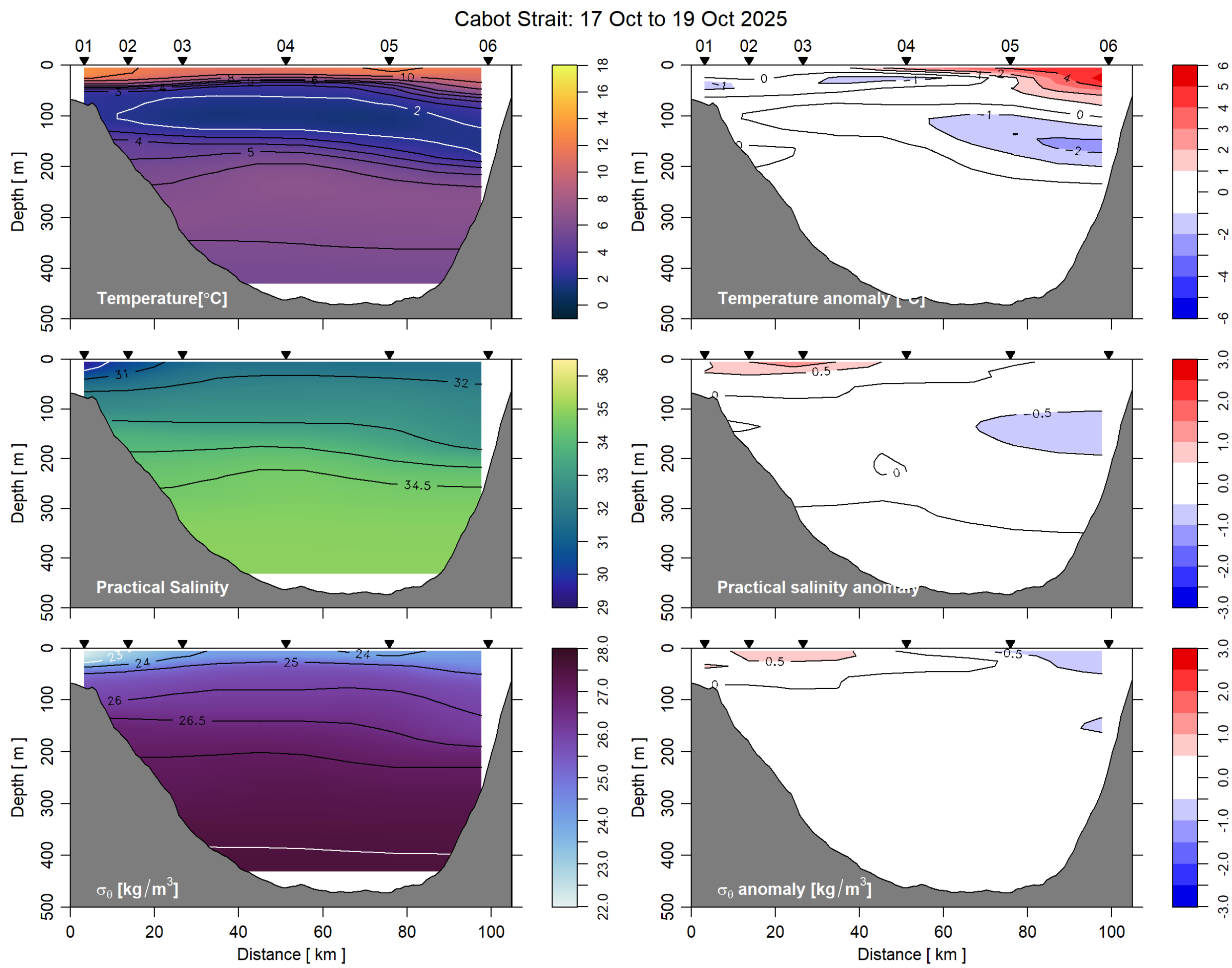

Figure 28. The 2025 sampling of the Cabot Strait line for fall. Temperature (top panel), salinity (middle panel), and density (lower panel) and their anomalies with respect to the 1991–2020 climatology (right panels). Triangles indicate locations of sampling and station numbers are labelled above.

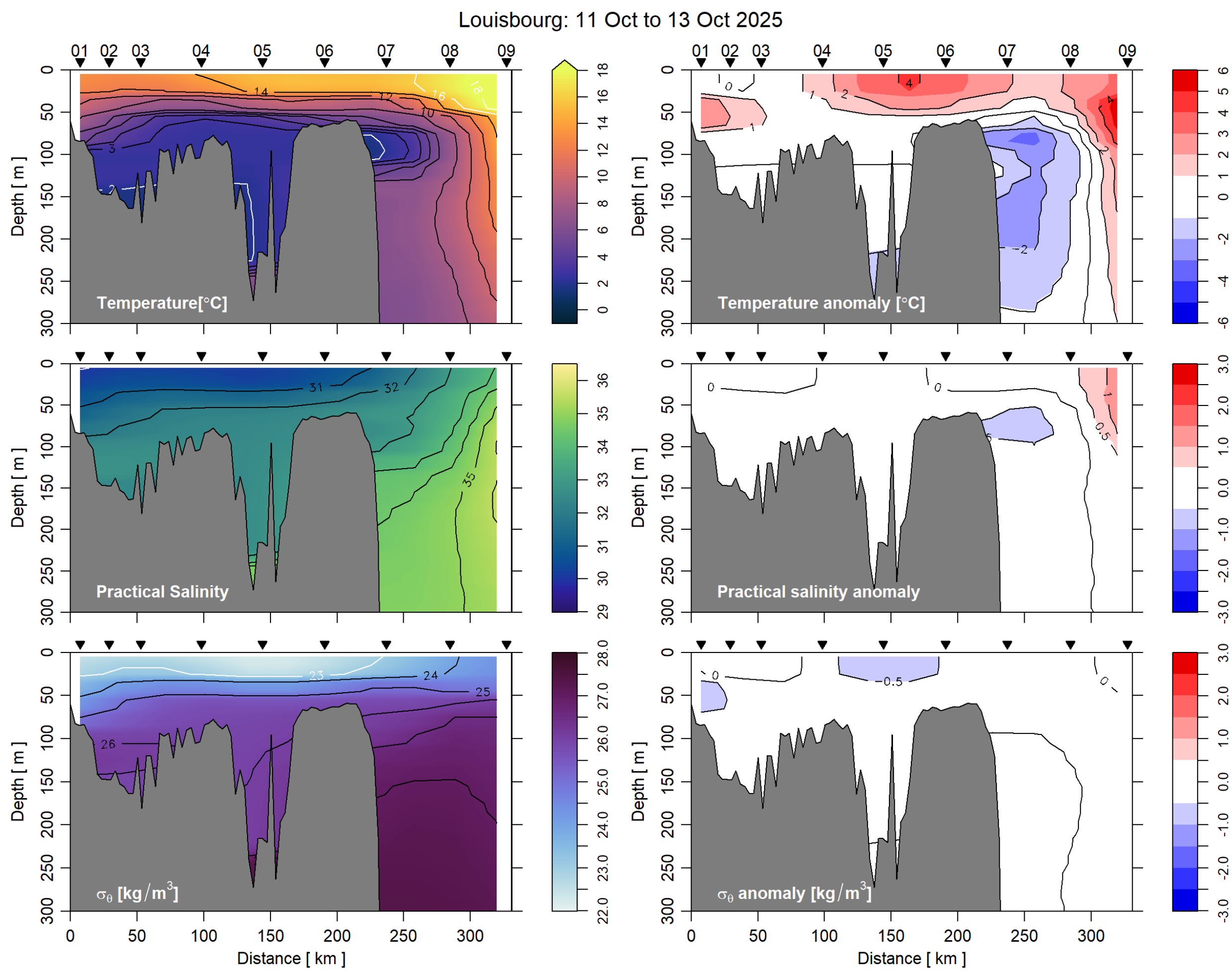

Figure 29. The 2025 sampling of the Louisbourg line for fall. Temperature (top panel), salinity (middle panel), and density (lower panel) and their anomalies with respect to the 1991–2020 climatology (right panels). Triangles indicate locations of sampling and station numbers are labelled above.

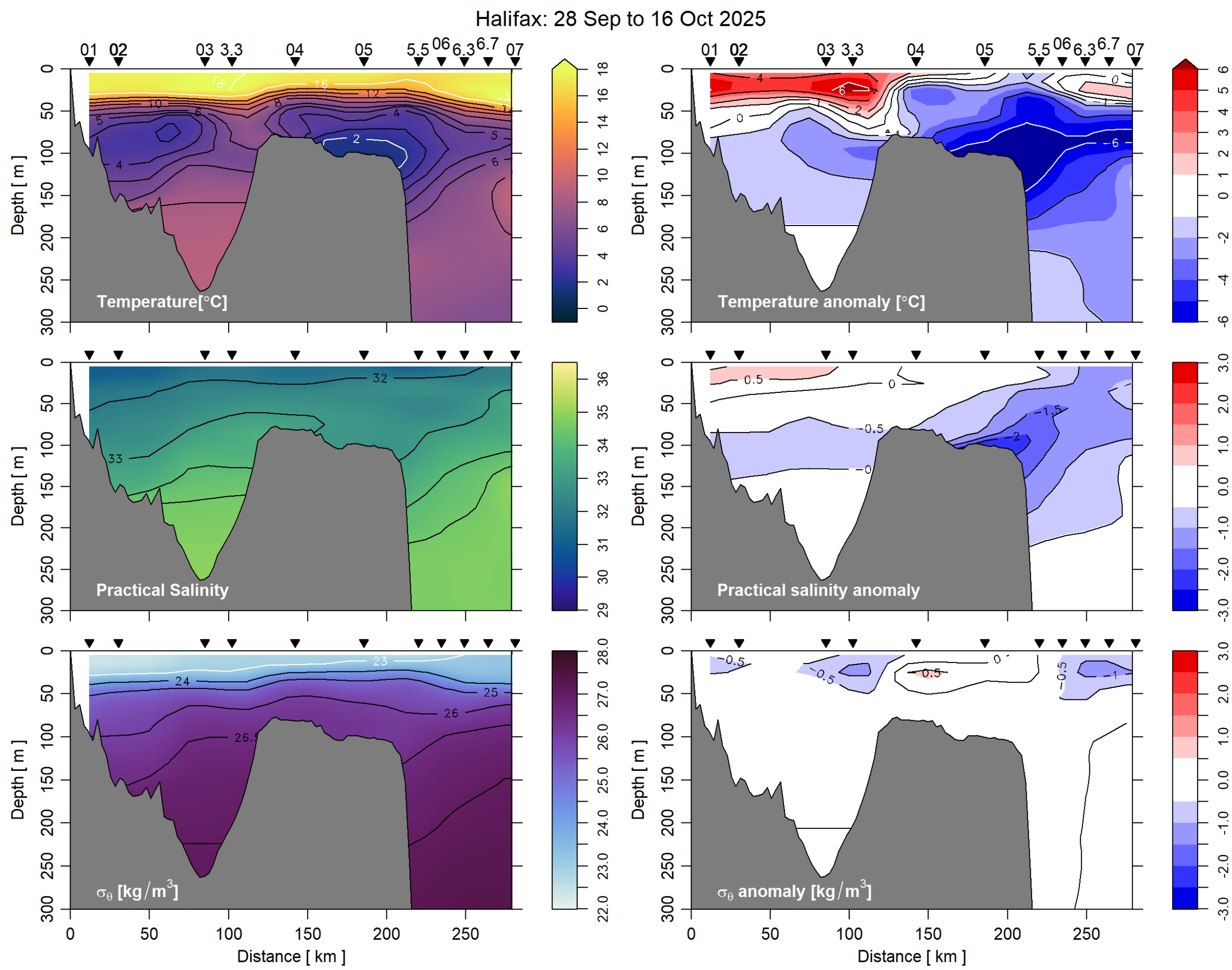

Figure 30. The 2025 sampling of the Halifax line for fall. Temperature (top panel), salinity (middle panel), and density (lower panel) and their anomalies with respect to the 1991–2020 climatology (right panels). Triangles indicate locations of sampling and station numbers are labelled above.

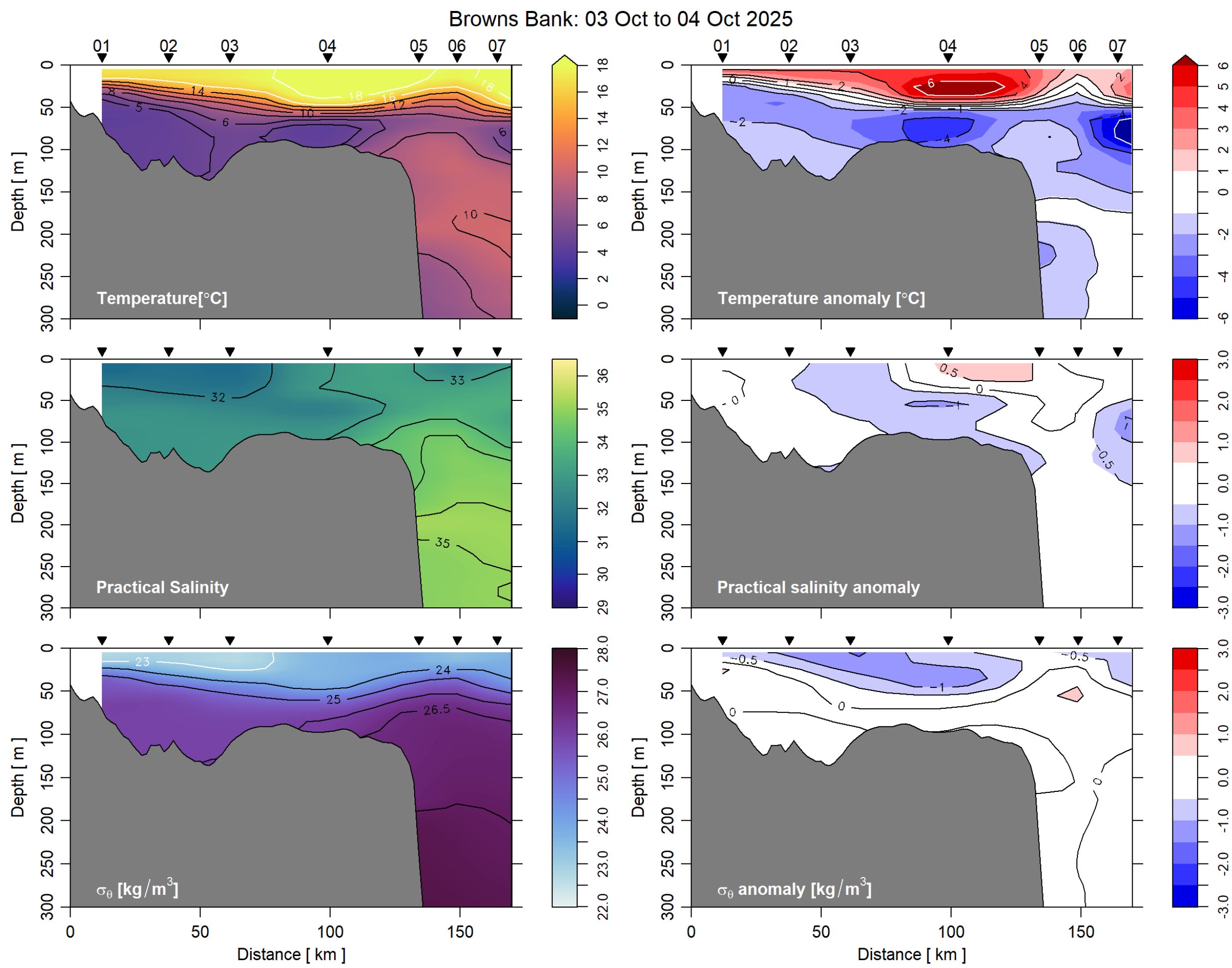

Figure 31. The 2025 sampling of the Browns Bank line for fall. Temperature (top panel), salinity (middle panel), and density (lower panel) and their anomalies with respect to the 1991–2020 climatology (right panels). Triangles indicate locations of sampling and station numbers are labelled above.

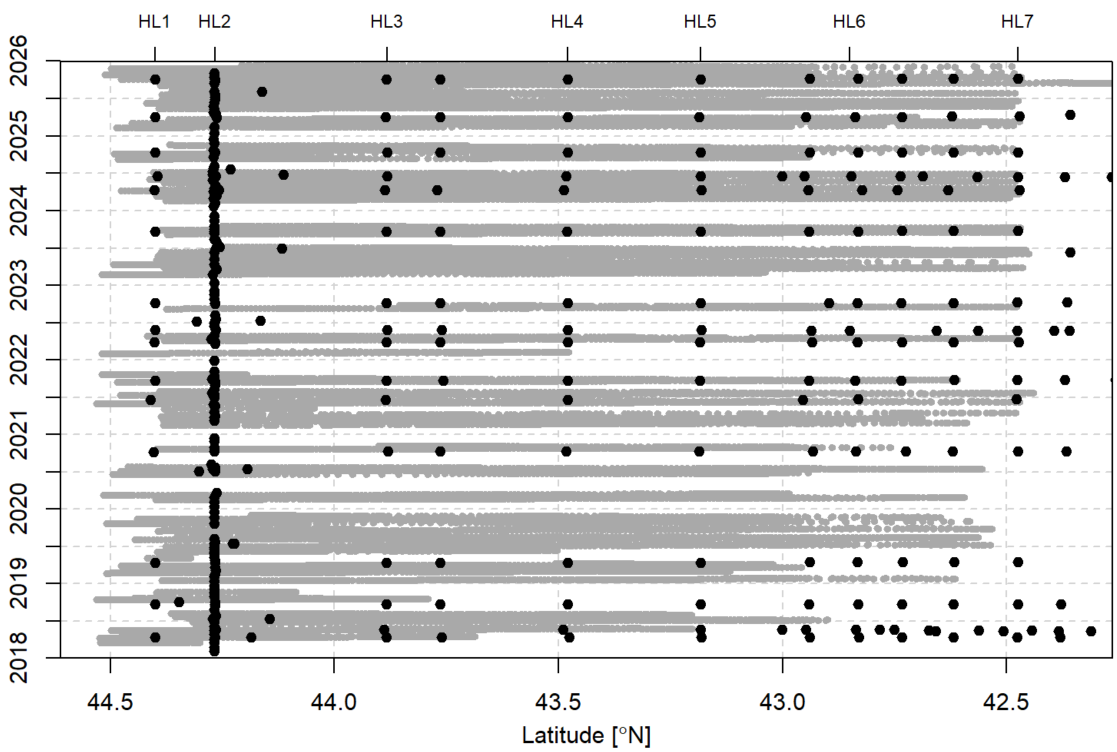

Figure 32. Hodograph of sampling on the Halifax line for 2018-2025. Black dots represent the sampling by a vessel. Grey dots represent sampling by the gliders.

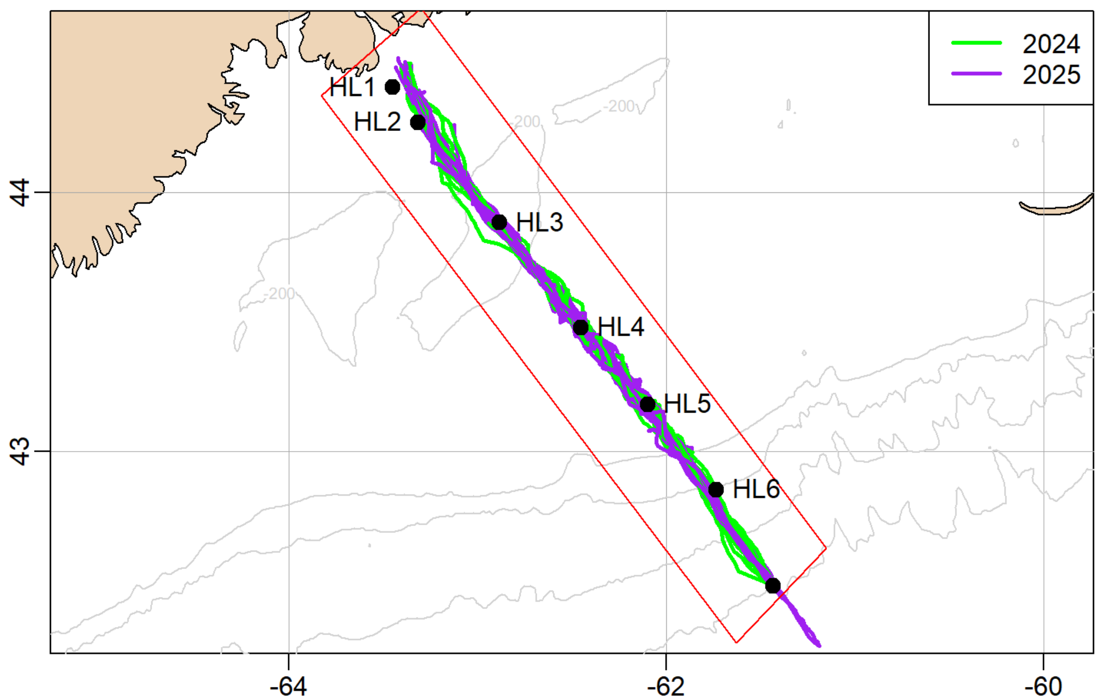

Figure 33. Glider trajectories on the Halifax line (HL) for 2024 and 2025. Locations of the HL stations are shown by the black dots. Red box shows the limitations applied to glider data to be considered on HL, and corresponds to 15nm.

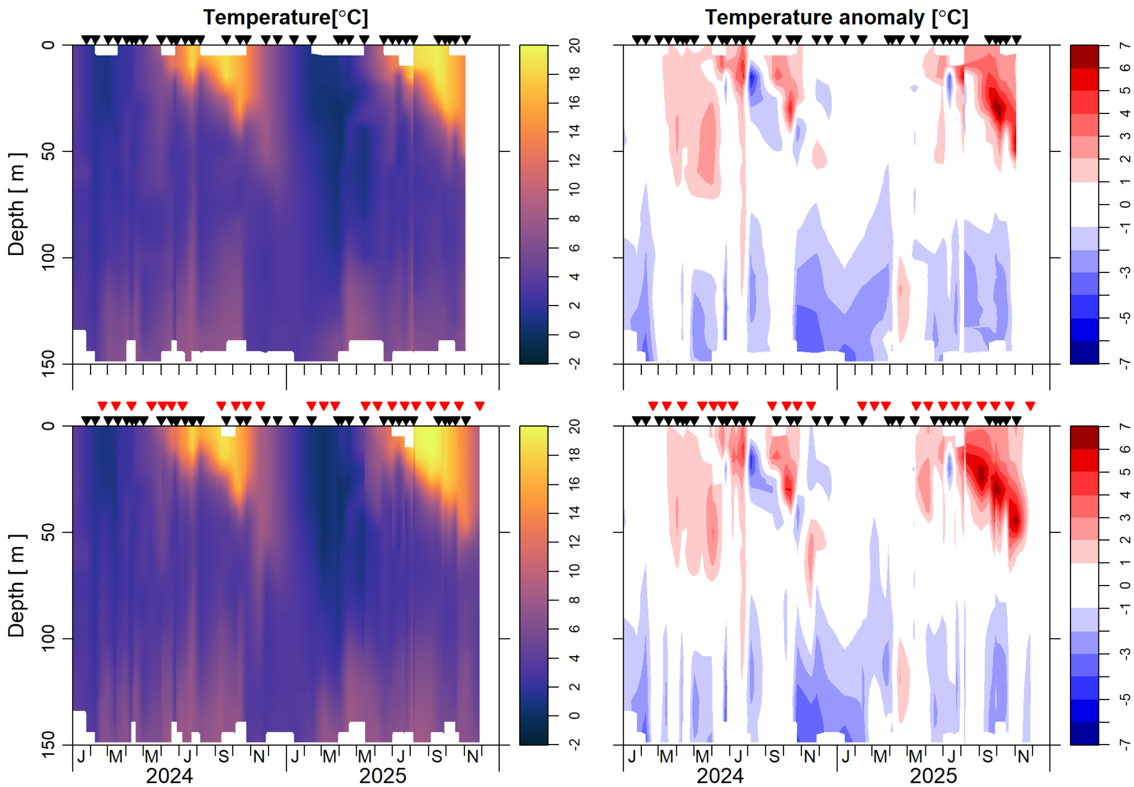

Figure 34. Top panels for temperature (left) and temperature anomaly (right) with standard vessel sampling at Station 2. Bottom panels include the additional glider data that has been averaged hourly. Times of vessel sampling (black triangles) and glider sampling (red triangles) are shown for each panel.

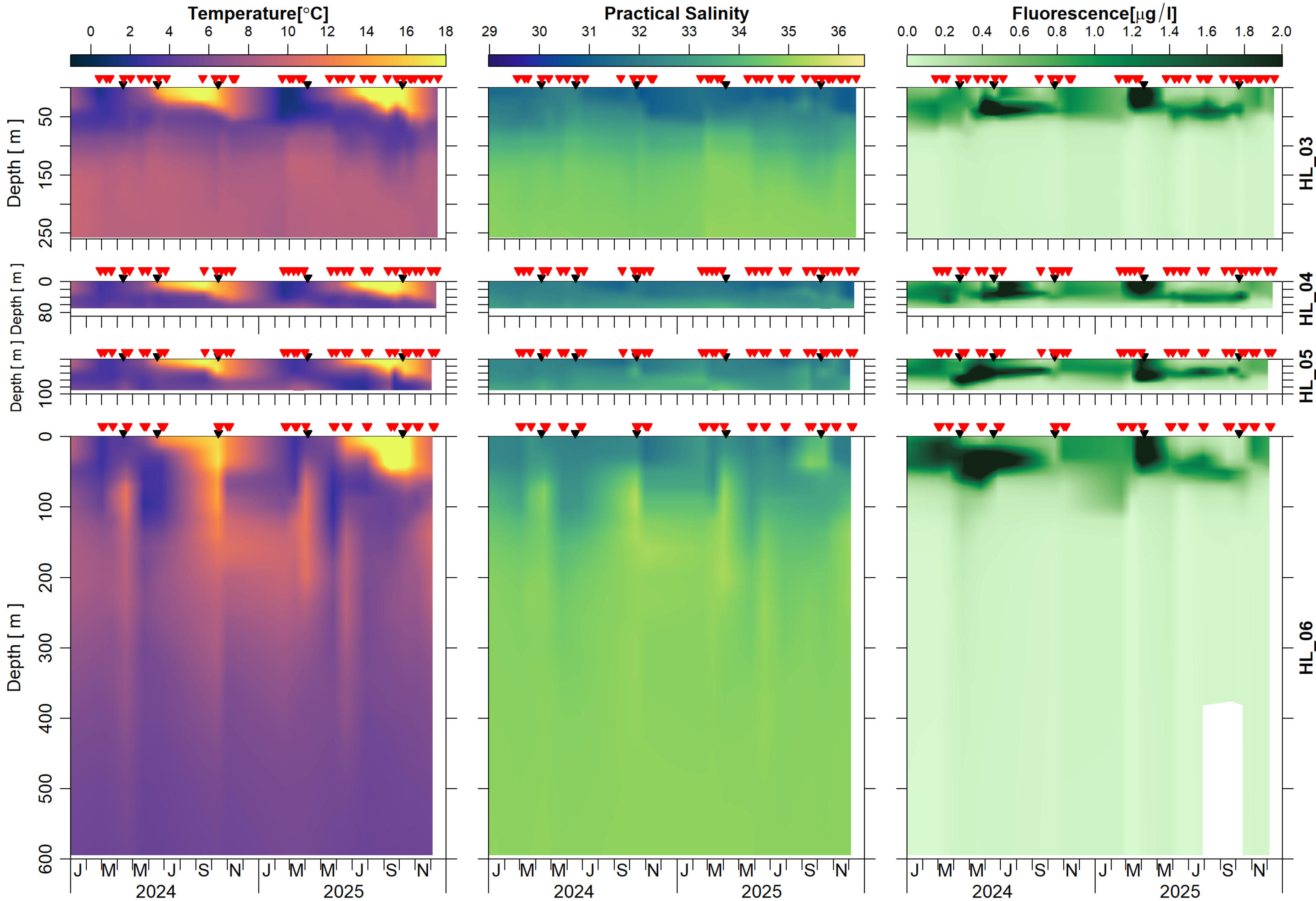

Figure 35. Temperature (left), salinity (middle), and chlorophyll fluorescence (right) for the standard hydrographic stations on the Halifax Line: HL3 (top panel), HL4 (second panel from the top), HL5 (third panel from the top), and HL6 (bottom panel). Times of vessel sampling (black triangles) and glider sampling (red triangles) are shown for each panel.

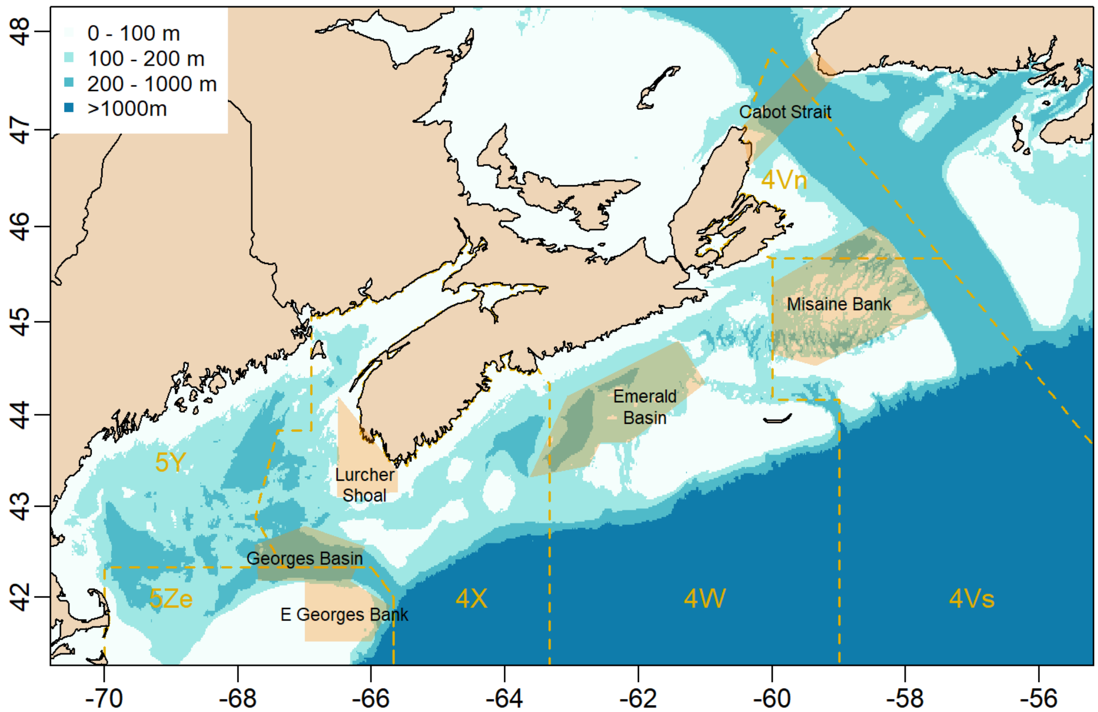

Figure 36. Areas on the Scotian Shelf and eastern Gulf of Maine depicting the different water masses: Cabot Strait; Misaine Bank; Emerald Basin; Lurcher Shoals; Georges Basin; and Eastern Georges Bank.

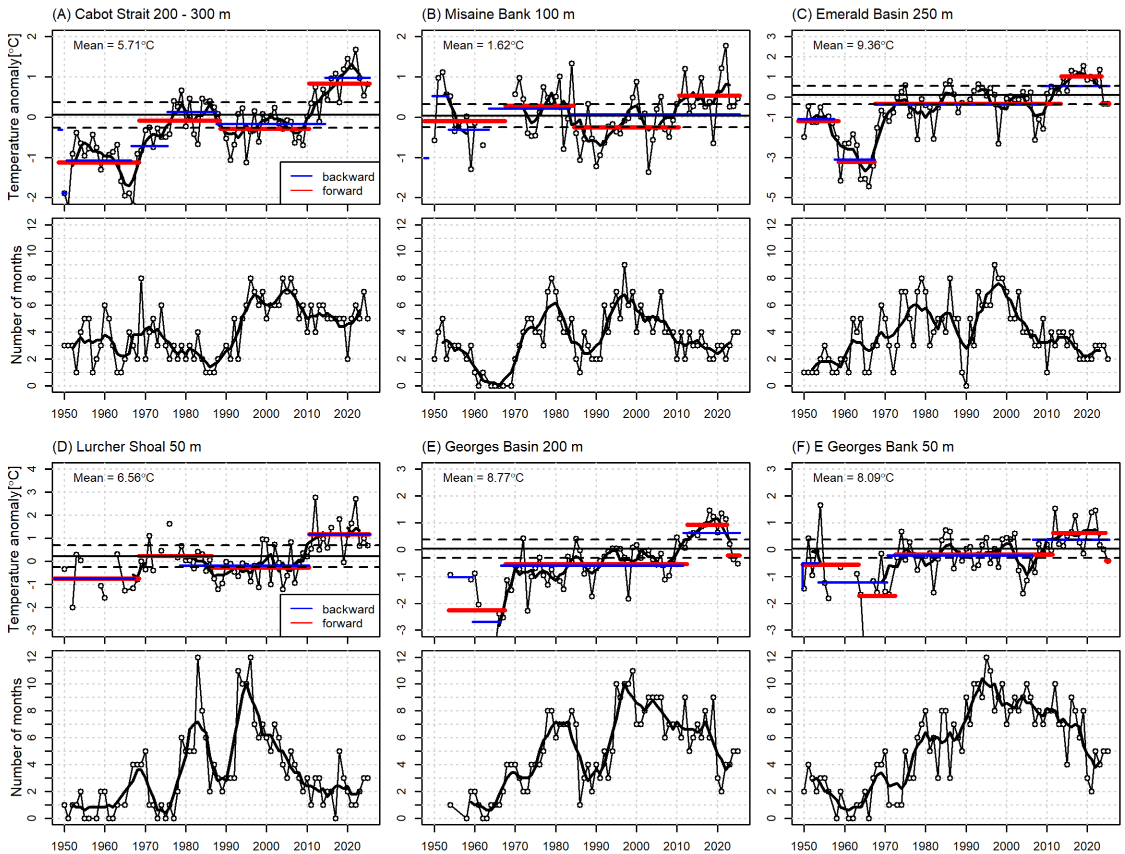

Figure 37. The annual mean temperature anomaly time series (line with circles) and the five-year-running-mean anomalies (thick solid line) on the Scotian Shelf and in the Gulf of Maine at: (A) Cabot Strait at 200–300 m, (B) Misaine Bank at 100 m, (C) Emerald Basin at 250 m, (D) Lurcher Shoal at 50 m, (E) Georges Basin at 200 m, and (F) Eastern Georges Bank at 50 m (see Figure 36 for locations of regions). Horizontal dashed lines represent the mean ±0.5 SD for the 1991-2020 period. Regime shift analysis results from running the method forwards and backwards on the time series depicted by the red and blue horizontal lines, respectively. Note that the y-axis range is different for each panel. Below each time series panel is the number of months (line with circles) that went into the annual calculation with the five-year-running-mean (thick solid line) overlaid.

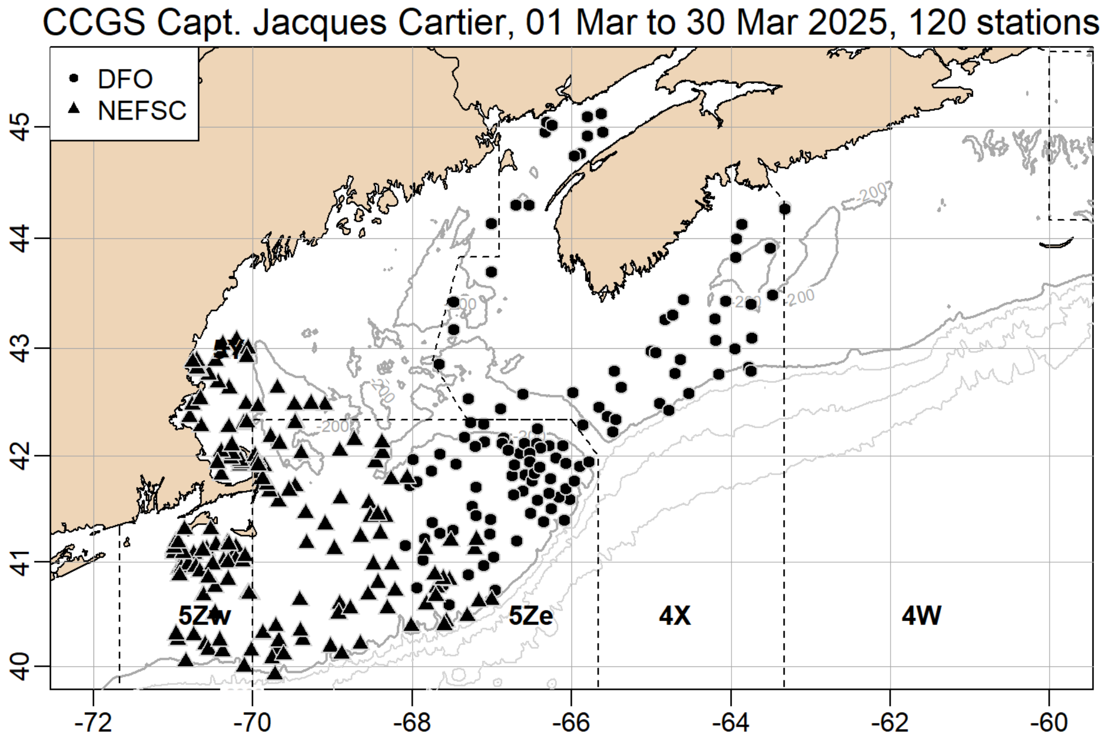

Figure 38. Locations of CTD sampling during the 2025 winter ecosystem trawl survey. The 200 m isobath is shown as a darker line. NAFO Divisions 4W, 4X, 5Ze, 5Y, and 5Zw are shown.

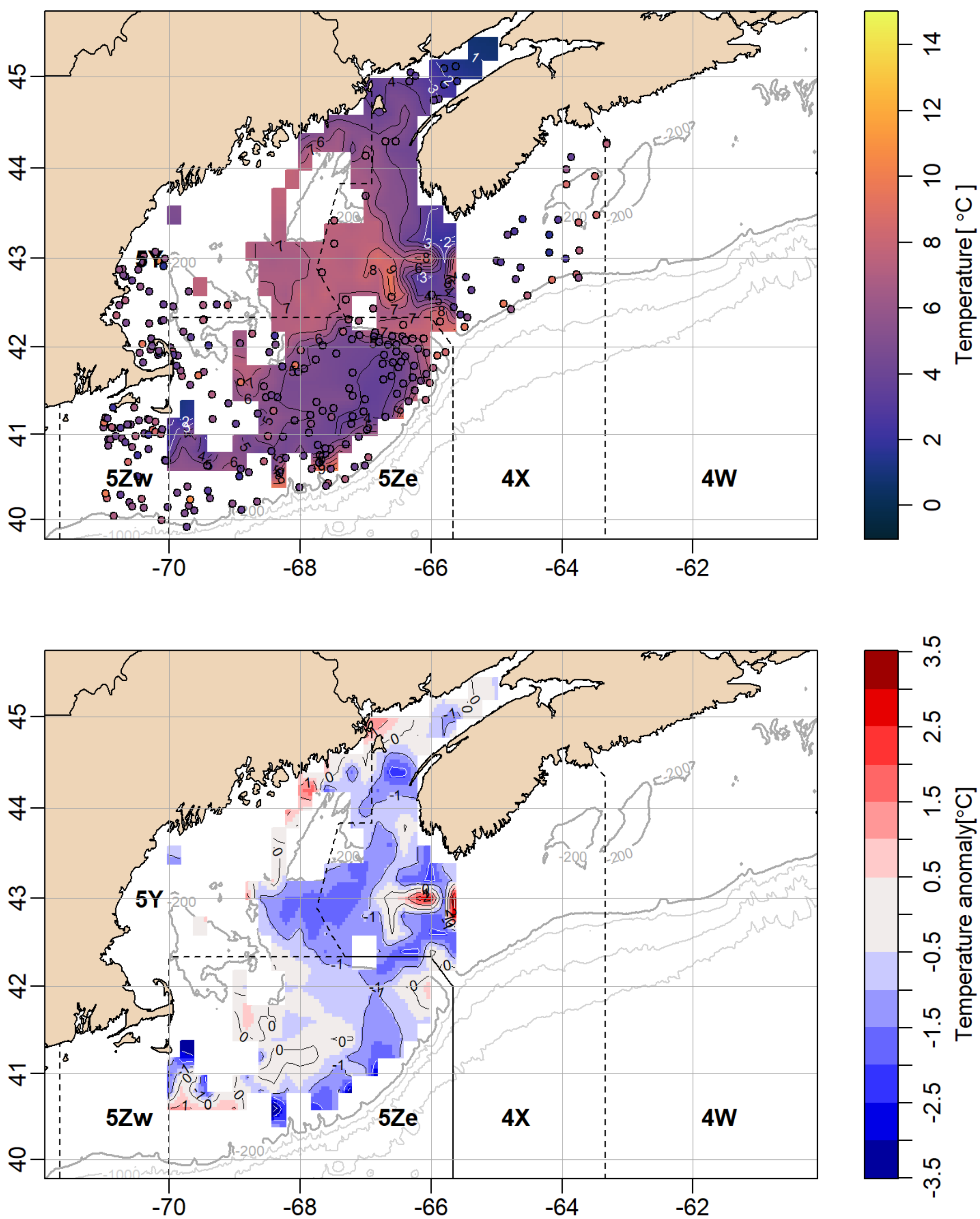

Figure 39. Winter bottom-temperature (upper panel) and anomaly (lower panel; relative to 1991–2020) maps for 2025. NAFO Divisions 4W, 4X, 5Ze, 5Y, and 5Zw are shown.

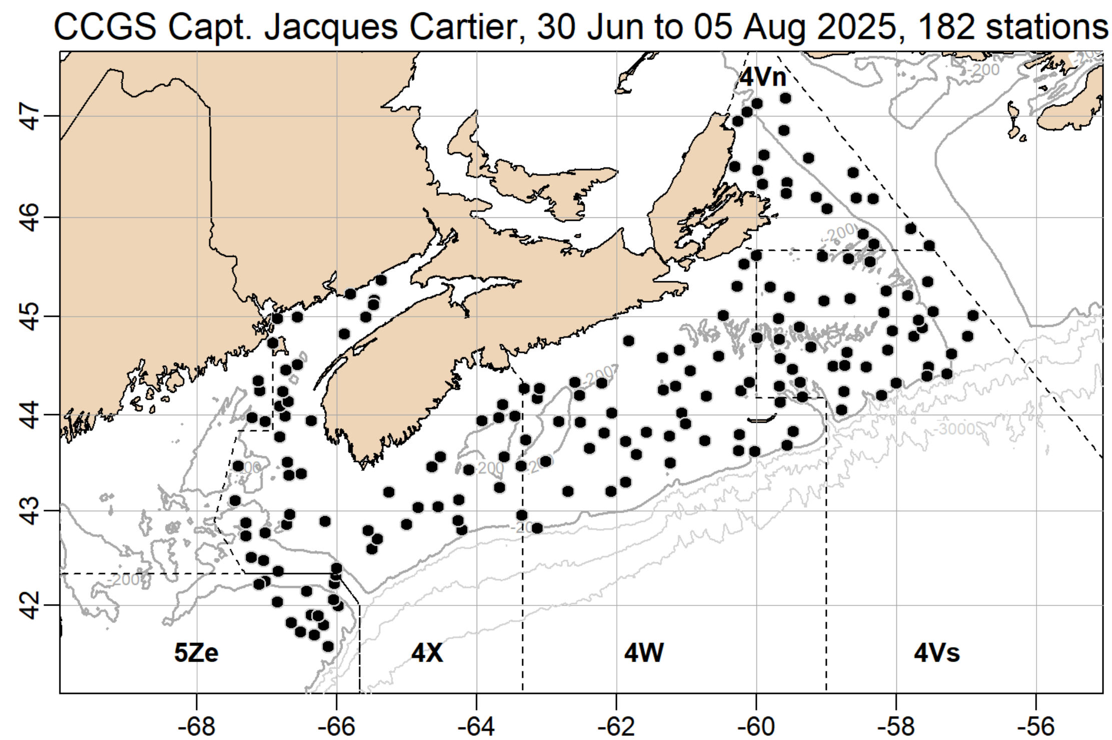

Figure 40. Locations of CTD sampling during the 2025 summer ecosystem trawl survey. The 200 m isobath is shown as a darker line. NAFO Divisions 4Vn, 4Vs, 4W, 4X, 5Ze, and 5Y, are shown.

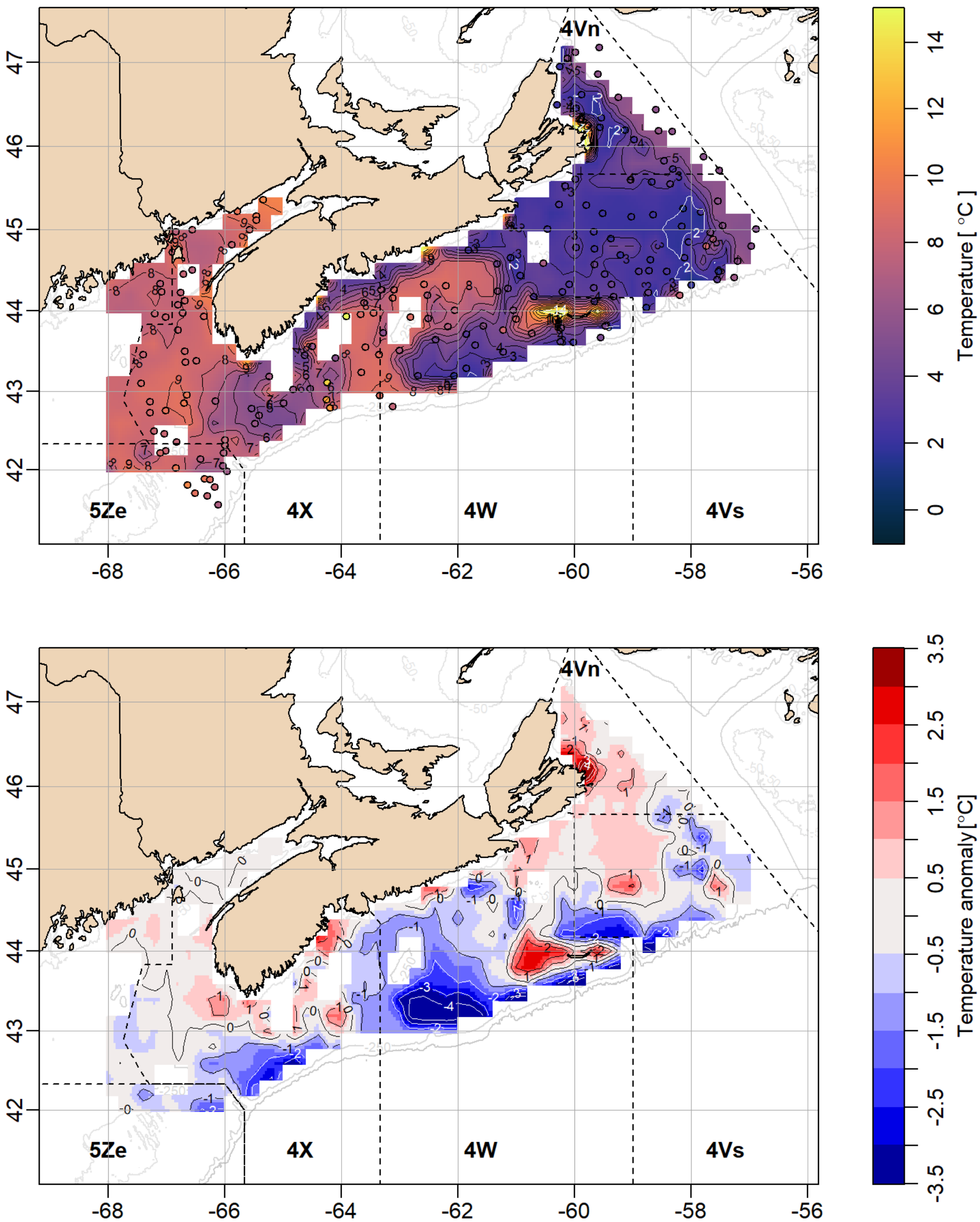

Figure 41. Summer bottom-temperature (upper panel) and anomaly (lower panel; relative to 1991–2020) maps for 2025. NAFO Divisions 4Vn, 4Vs, 4W, 4X, 5Ze, and 5Y are shown.

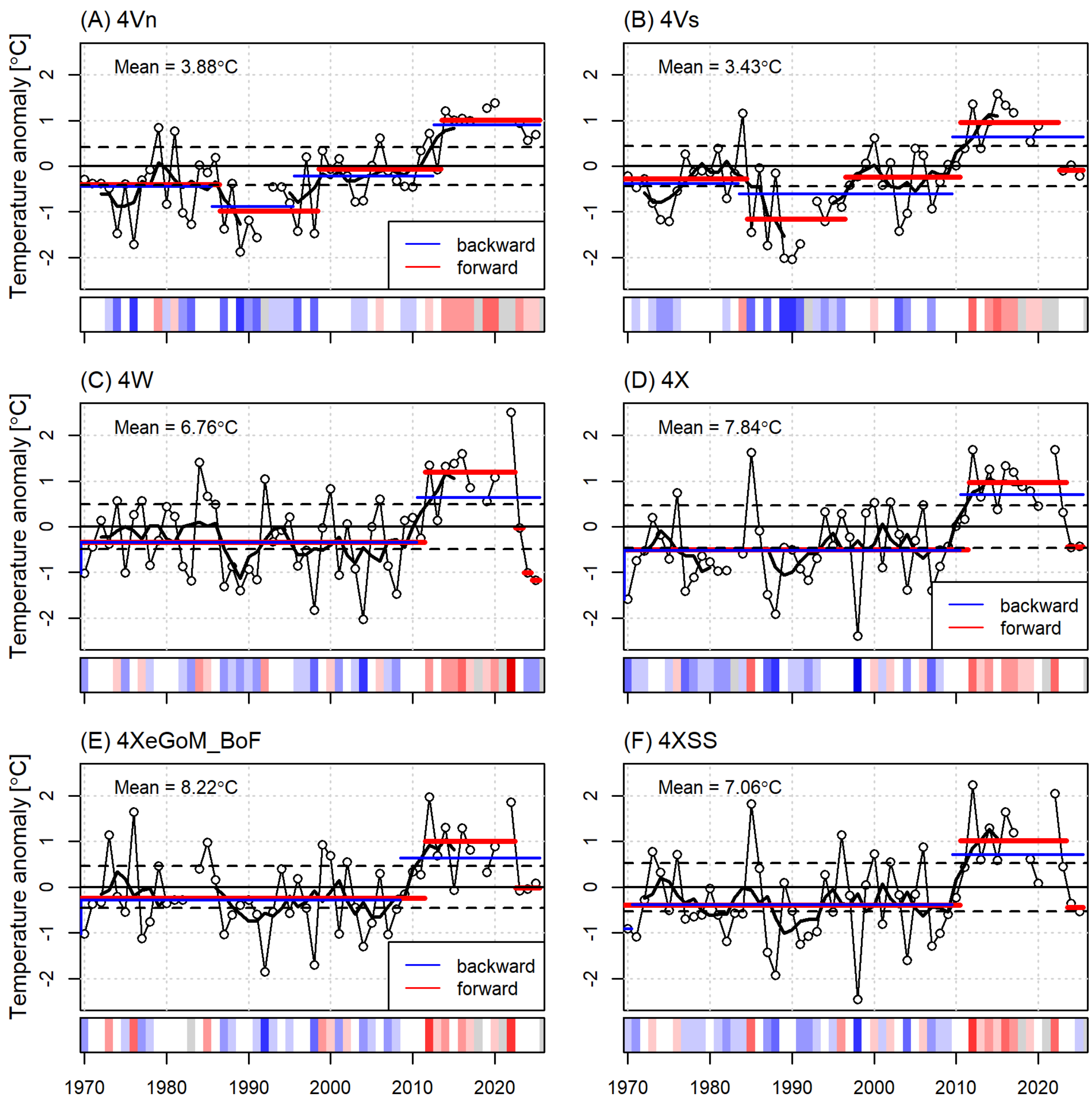

Figure 42. Time series of July bottom temperature anomalies (thin lines with circles) and five year running mean filtered series (thick line) for NAFO Divisions: 4Vn, 4Vs, 4W, 4X, and 4X separated into two regions; the eastern Gulf of Maine/Bay of Fundy(eGoMBoF) and the Scotian Shelf (SS). The solid horizontal line is the 1991-2020 mean and dashed lines represent ±0.5 SD. Regime shift analysis results from running the method forwards and backwards on the time series depicted by the red and blue horizontal lines, respectively. Scorecards below each timeseries plot are colour codedbased on the normalized anomalies, with blue indicating below normal, white indicating normal, and red above normal.

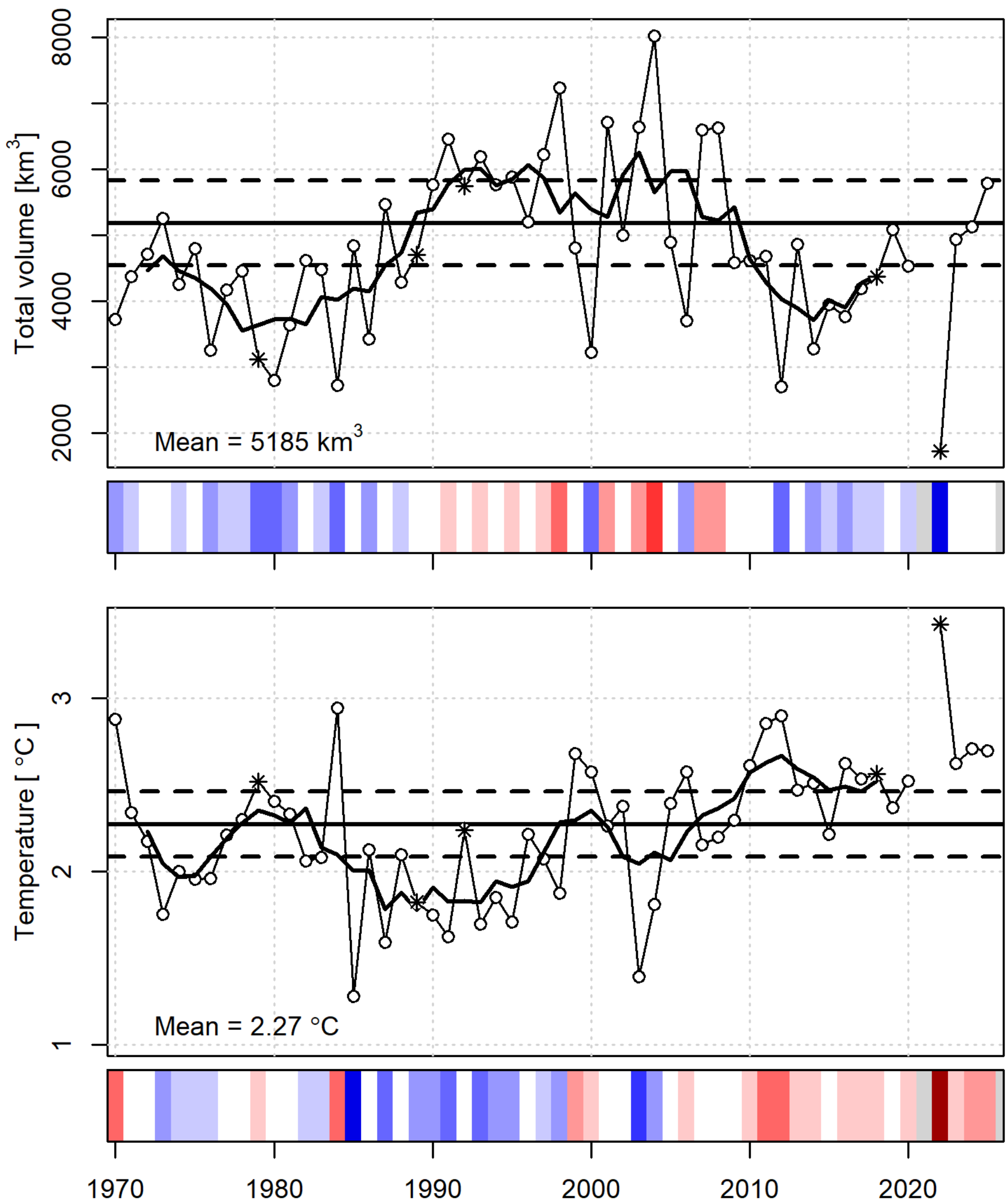

Figure 43. Time series of the Cold Intermediate Layer (CIL; defined as waters with temperature < 4°C) volume (circles connected by a thin black line) on the Scotian Shelf based on the DFO ecosystem summer trawl survey (top panel) with the five-year running mean (thick solid line). When grid coverage is less than 70%, a blended CIL calculation is used, indicated by an asterisk. The area-weighted average minimum temperature (circles connected by a thin black line) in the CIL(bottom panel) with the five-year running mean (thick solid line). The solid horizontal lines are the 1991–2020 means and dashed lines represent ±0.5 SD. Scorecards below each timeseries plot are colour coded based on the normalized anomalies, with blue indicating below normal, white indicating normal, and red above normal.

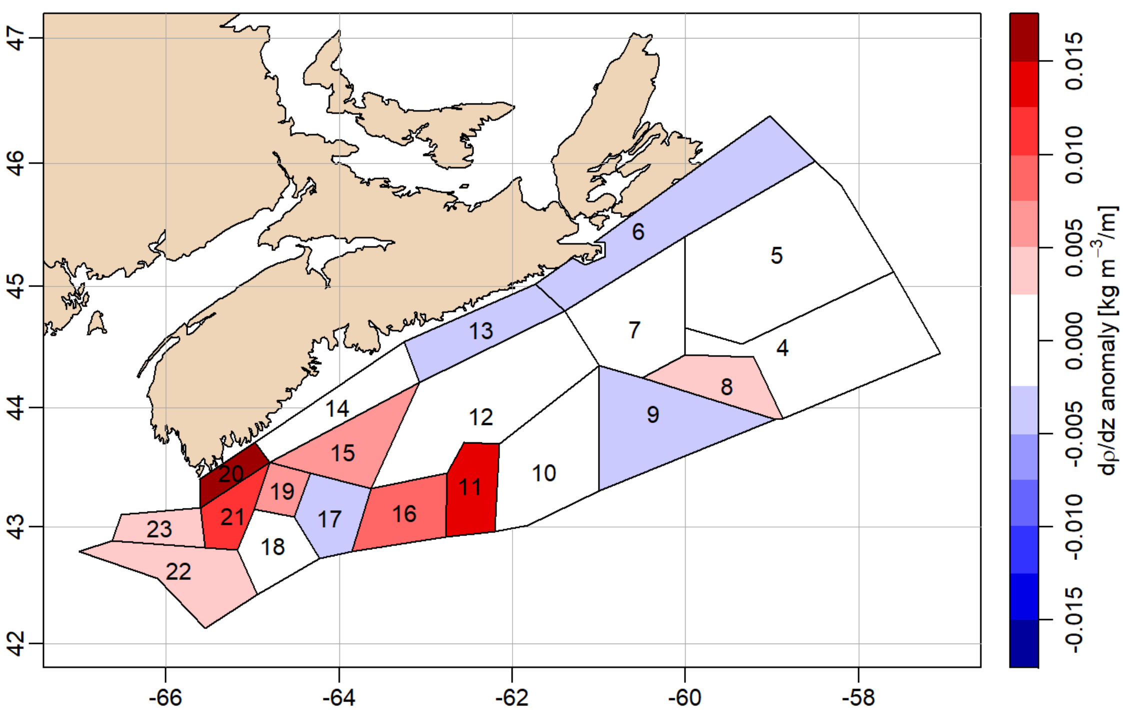

Figure 44. Stratification annual anomaly over the Scotian Shelf for 2025. The different areas were defined by Petrie et al. (1996).

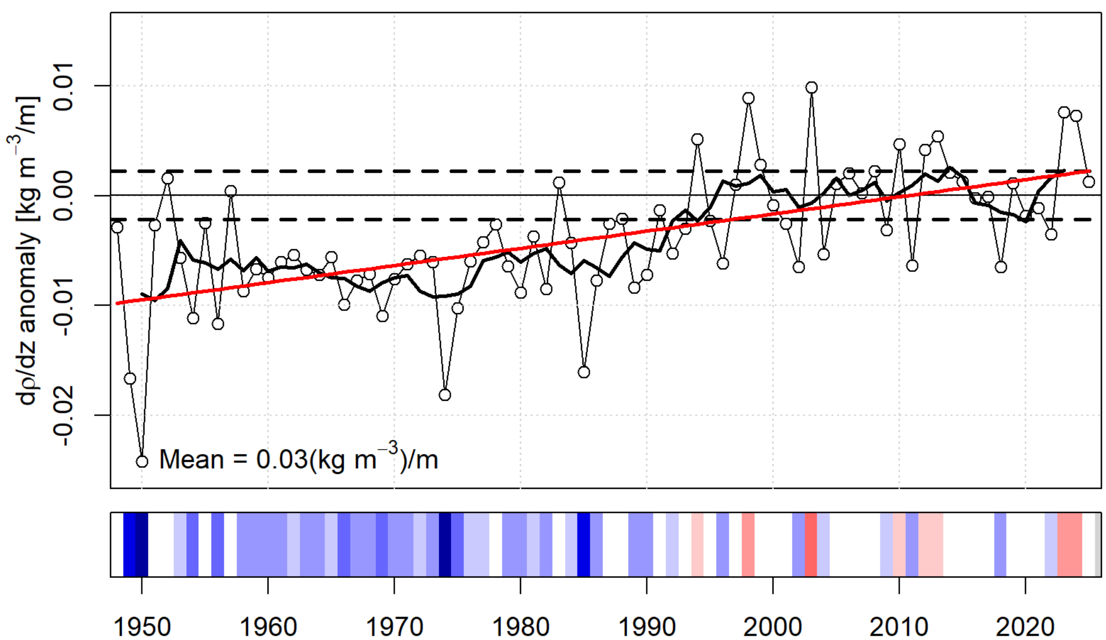

Figure 45. Stratification index (0–50 m density gradient) mean annual anomaly (black line with circles) and five-year running mean (black thick solid line) averaged over the Scotian Shelf. The reference period is 1991-2020. The linear trend (red line) shows a change in the 0–50 m density difference of 0.78 kg m^{-3} per century. The scorecard below the timeseries plot is colour coded based on the normalized anomalies, with blue indicating below normal, white indicating normal, and red above normal.

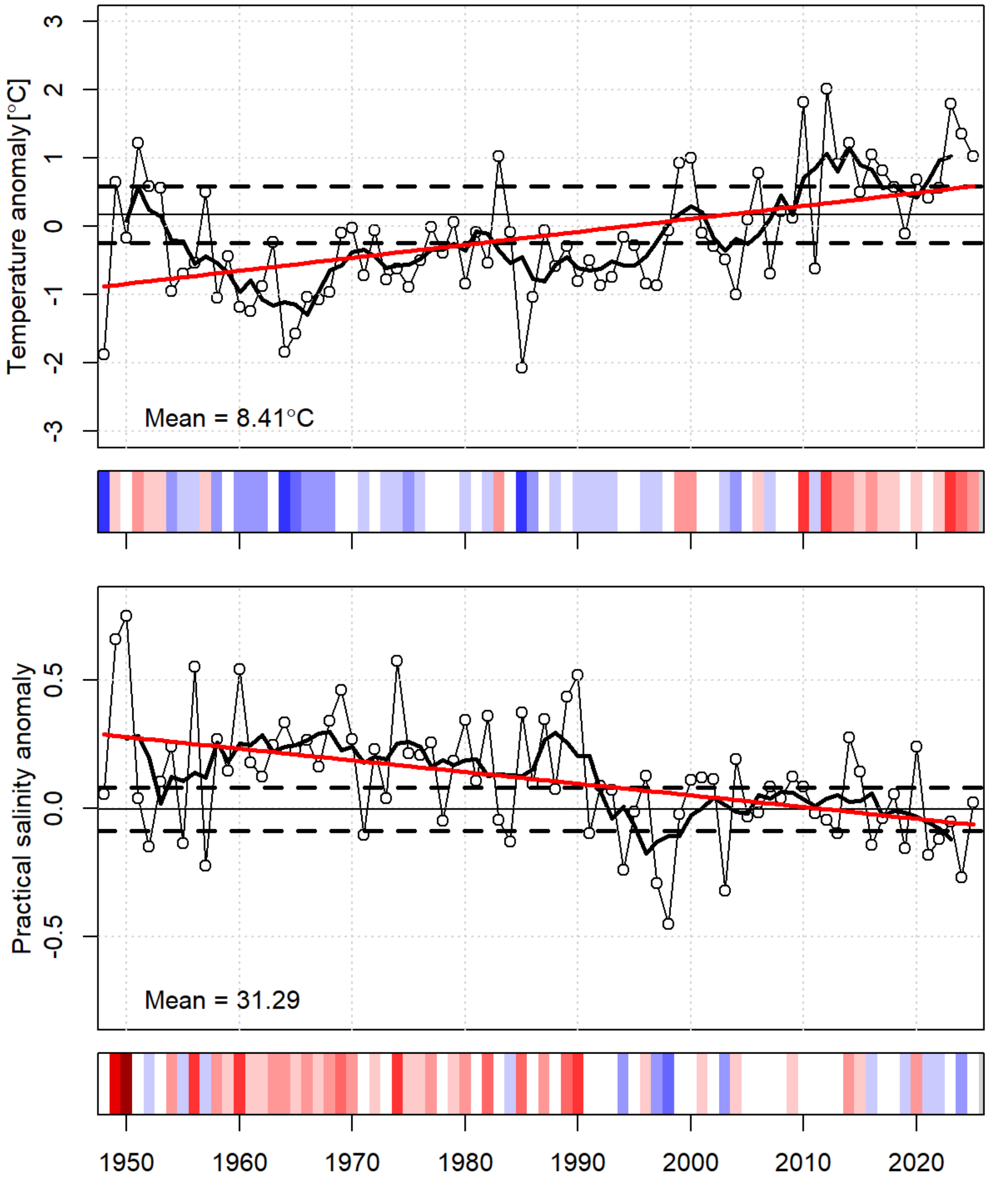

Figure 46. The mean-annual-surface-temperature (top panel) and salinity (lower panel) anomalies (black line with circles) and five-year running mean (black thick solid line) averaged over the Scotian Shelf. The linear trend (red line) shows a warming of 0.95°C and a freshening of 0.46 over a 100-year period. The scorecard below each timeseries plot are colour coded based on the normalized anomalies, with blue indicating below normal, white indicating normal, and red above normal.

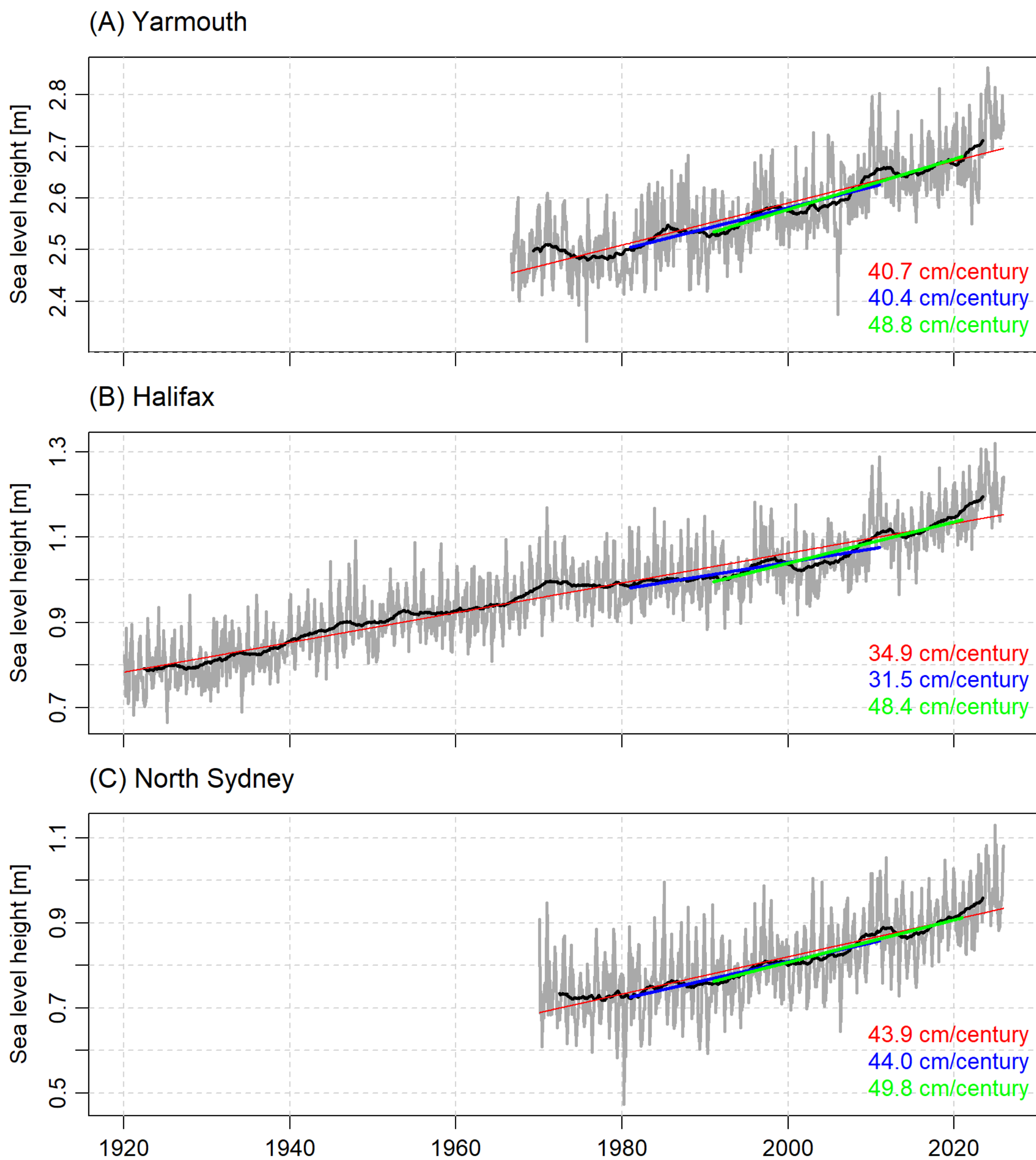

Figure 47. The time series of the monthly means (grey line) and a five-year running mean (black line) of the relative sea-level elevations at Yarmouth (top panel), Halifax (middle panel), and North Sydney (bottom panel), along with the linear trend (red line) over the observation period, over 1981–2010 (blue line) and over 1991–2020 (green line).

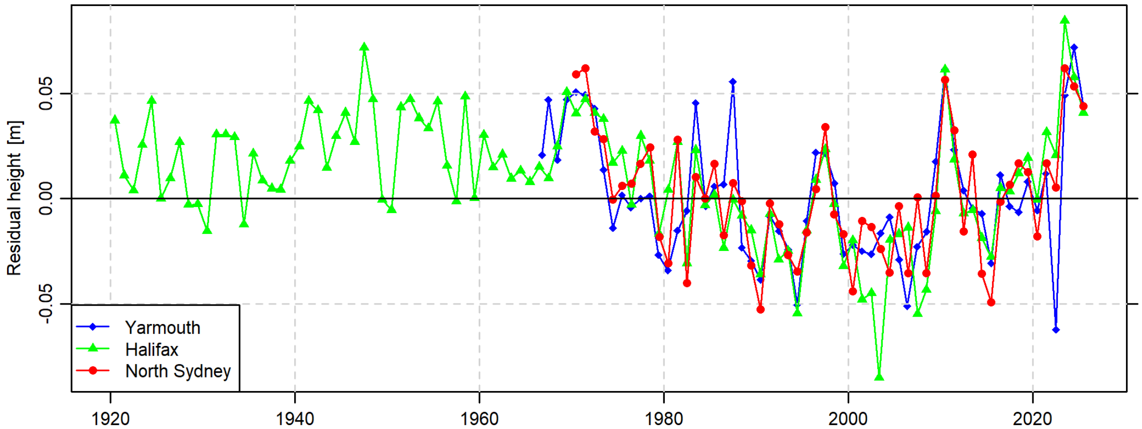

Figure 48. Residual relative sea level (annual observed values minus linear trend based on the 1970— 2025 period) for Yarmouth (blue line with diamonds), Halifax (green line with triangles), and North Sydney (red line with circles). (Data provided by the Canadian Hydrographic Service).

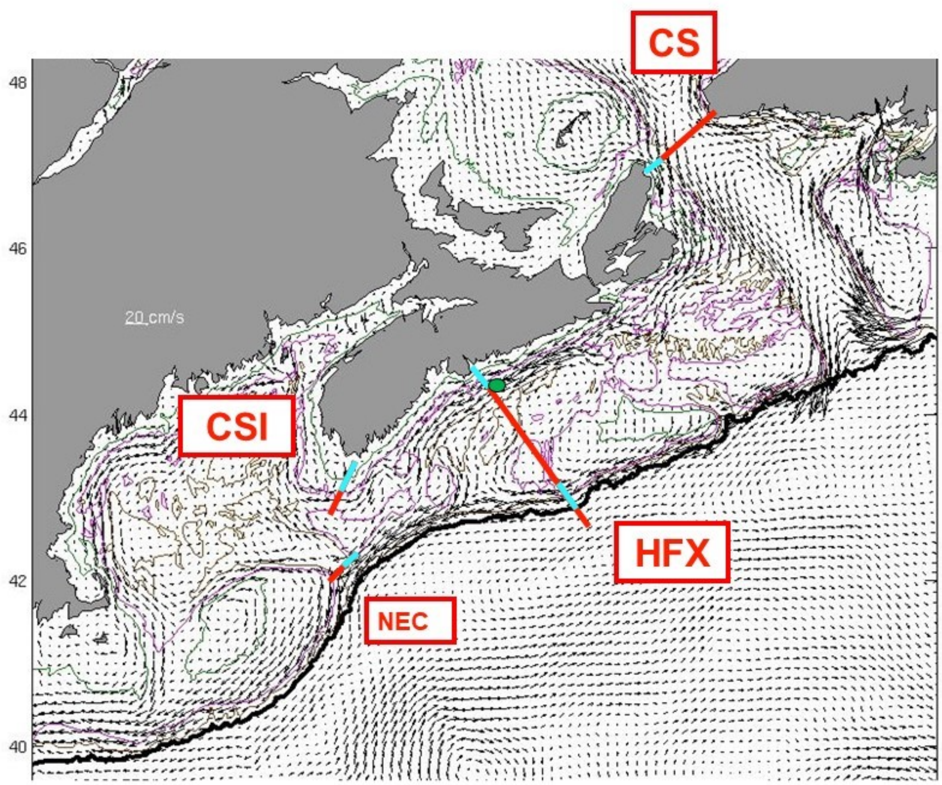

Figure 49. Climatological-annual and depth-averaged circulation illustrating the principal flow pathways from the southern Gulf of St. Lawrence to the Gulf of Maine and the subsections where transport calculations were made (cyan). CS = Cabot Strait; HFX = Halifax; CSI = Cape Sable Island/Browns Bank; NEC = Northeast Channel. Green circle shows the location off T2.

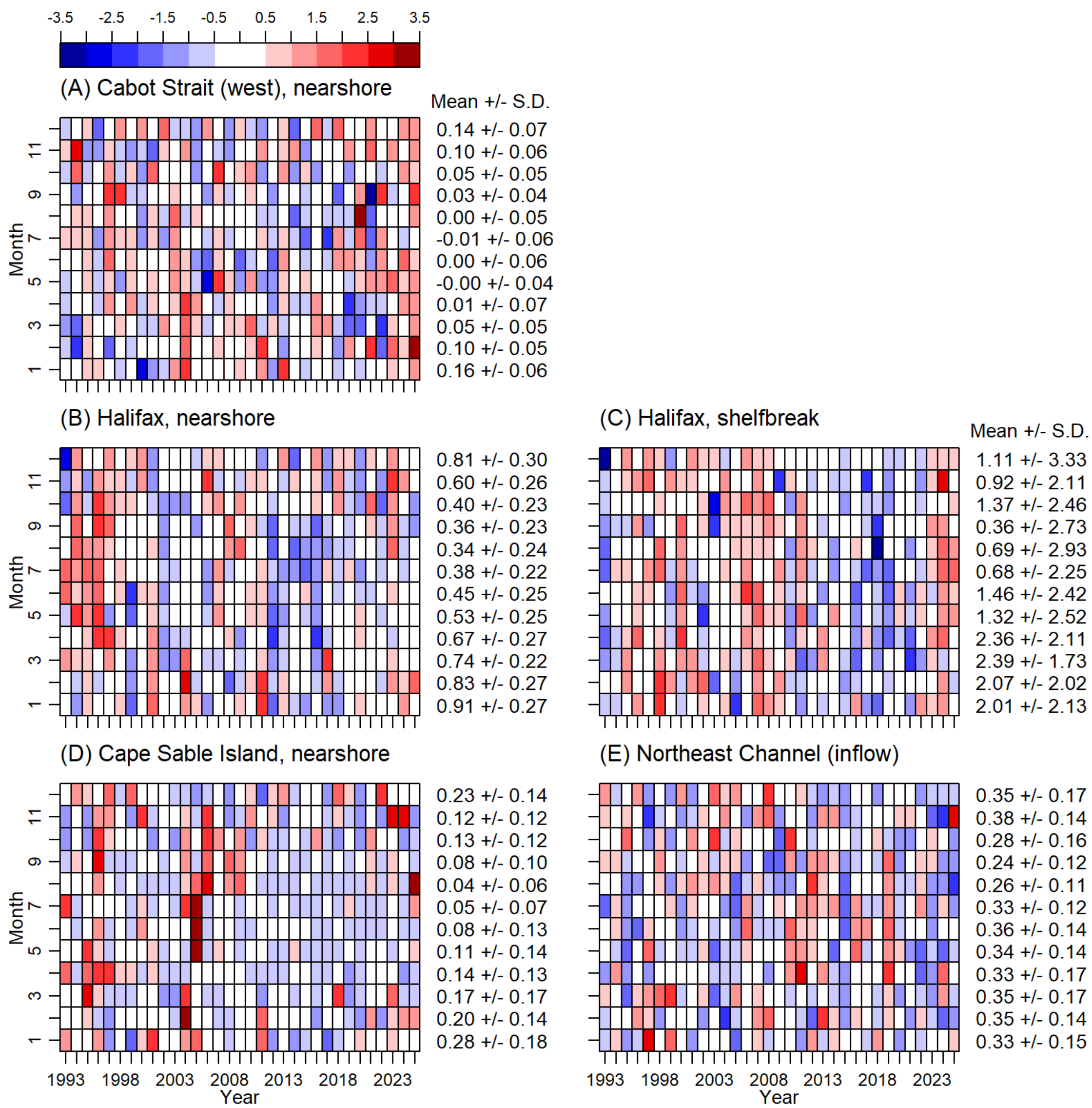

Figure 50. Normalized anomalies of the monthly transport relative to the 1991-2020 climatology for four Maritime sections: (A) Cabot Strait (CS) west nearshore; Halifax (HFX) (B) nearshore and (C) shelf break; (D) Cape Sable Island (CSI) nearshore; and (E) the Northeast Channel (NEC). Numbers to the right are climatology monthly means and standard deviations in Sverdrups (1 Sv = $10^6 m^3 s^{-1}$).

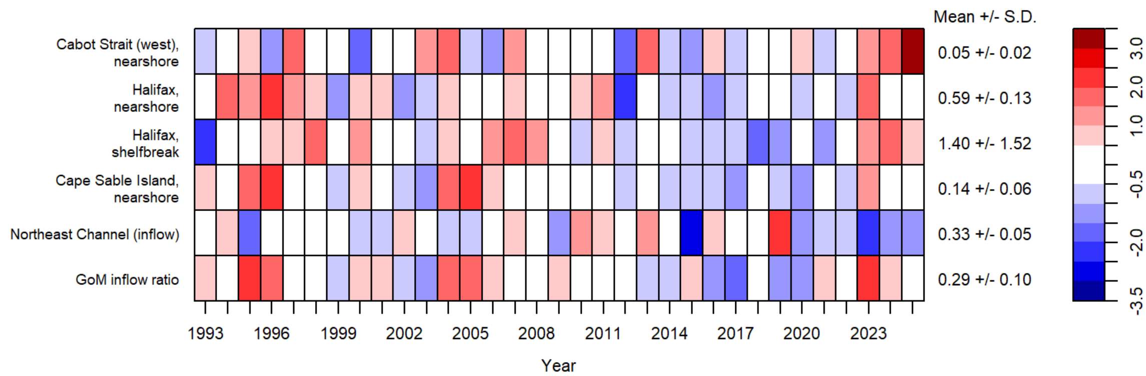

Figure 51. Normalized annual anomalies for the monthly values shown in Figure 50 and Figure 53. Numbers to the right are climatological (1991-2020) annual means and standard deviations (in Sverdrups).

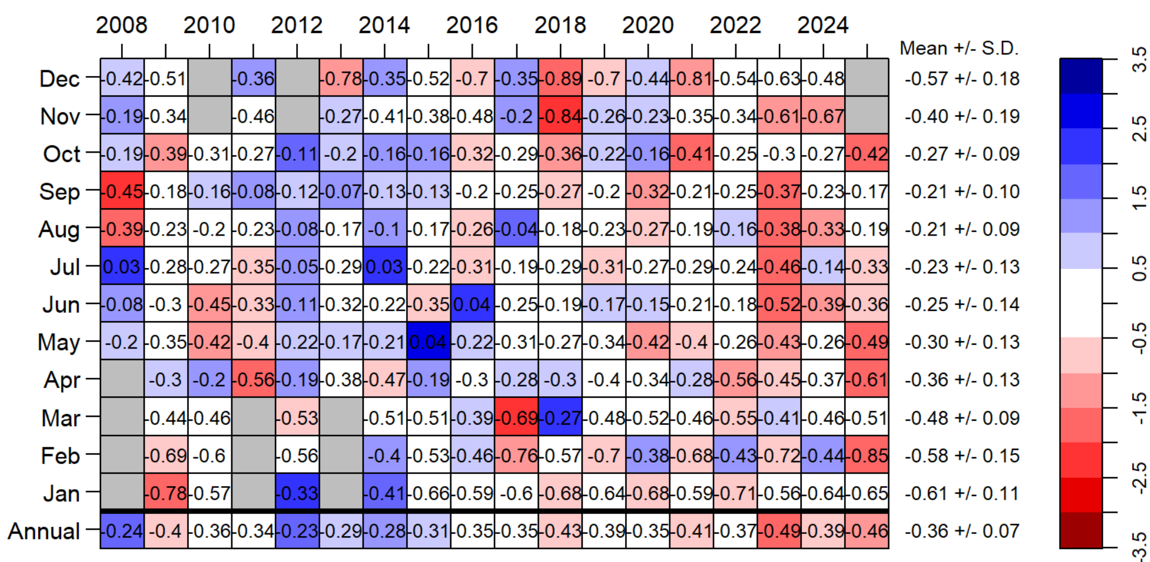

Figure 52. Monthly transport (Sv) for the Nova Scotia Current south of Halifax from ADCP measurements. Negative transports are to the southwest. The monthly transports are colour-coded for whether they are above, less southwestward (blue), or below, stronger southwestward (red), than the monthly average for the observation period (numbers to the right) by more than one-half standard deviation.

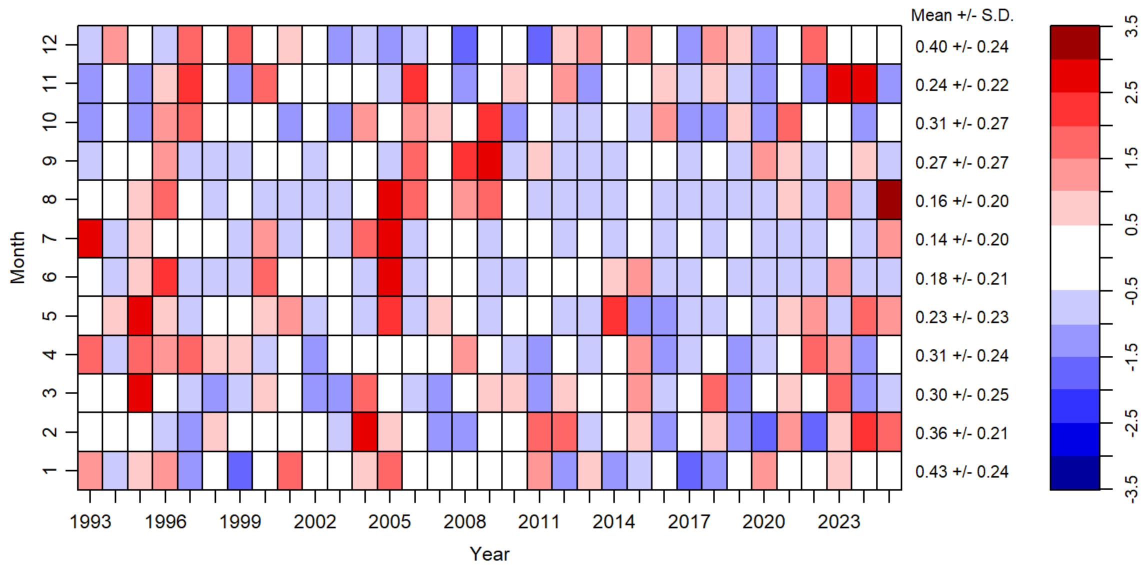

Figure 53. Normalized anomalies of the Gulf of Maine inflow ratio. Numbers to the right are 1991-2020 climatological monthly means and standard deviations.

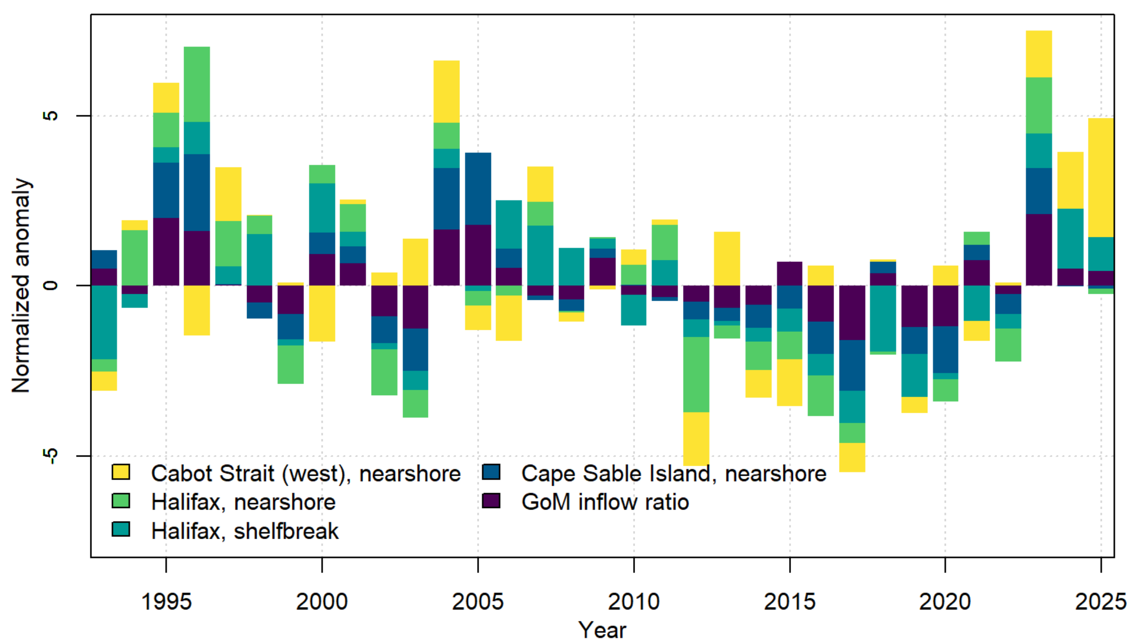

Figure 54. Sum of normalized transport anomalies for the variables in Figure 51.

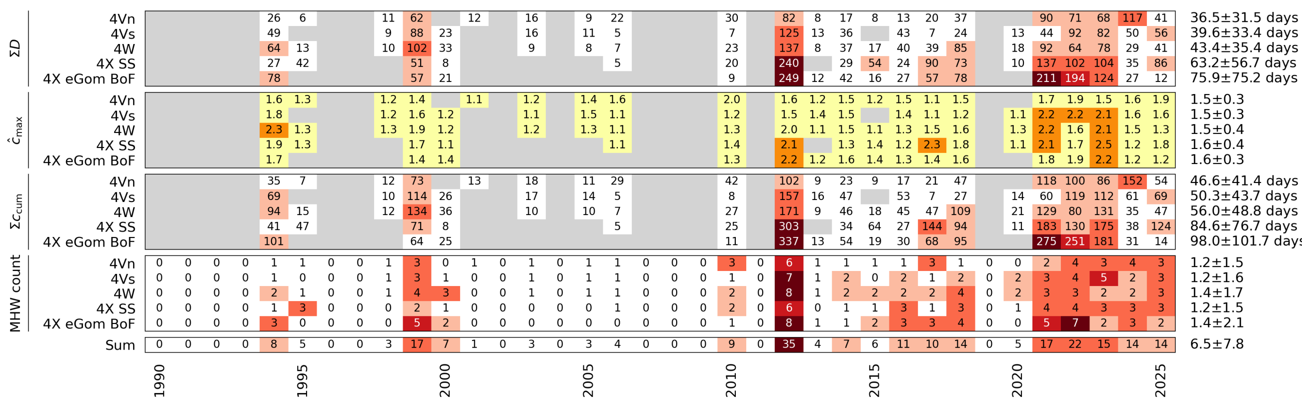

Figure 55. Aggregated satellite SST MHW metrics by region. From top to bottom are shown $\sum D$, $\hat{c}_{max}$, $\sum c_{cum}$, and the number of MHW events. Boxes are colour-coded according to their values. Gray shading indicates that no data are available for the metric for the year. To emphasize larger events, values up to the mean of each panel are coloured white and shades of red darken with increasing values by one standard deviation for each shade. The $\hat{c}_{max}$ panel is colour-coded to the corresponding MHW category: yellow (moderate), orange (strong), burgundy (severe) or purple (extreme). The mean and standard deviation are shown to the right for each station.

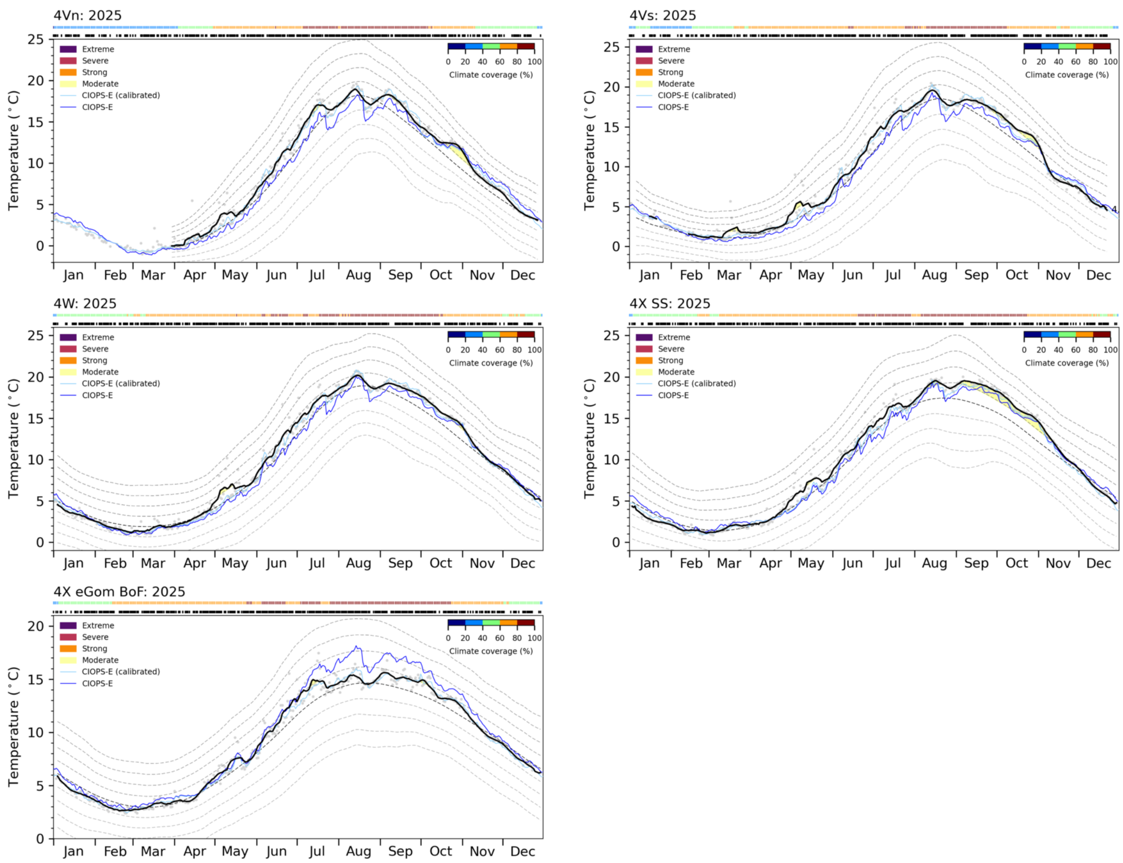

Figure 56. Satellite SST time series (solid black) for each NAFO division during 2025. The thresholds for MHW and MCS categories are shown (dashed gray lines) on each side of the climatology (dashed black line). When temperature exceeds MHW or MCS thresholds, the area between the thresholds and the time series is coloured according to the corresponding MHW or MCS category as detailed in the upper left corner. Coloured tick marks above the graph show the daily percentage of available data on which to base the thresholds over the climate reference period, with colours matching the scale in upper right corner.

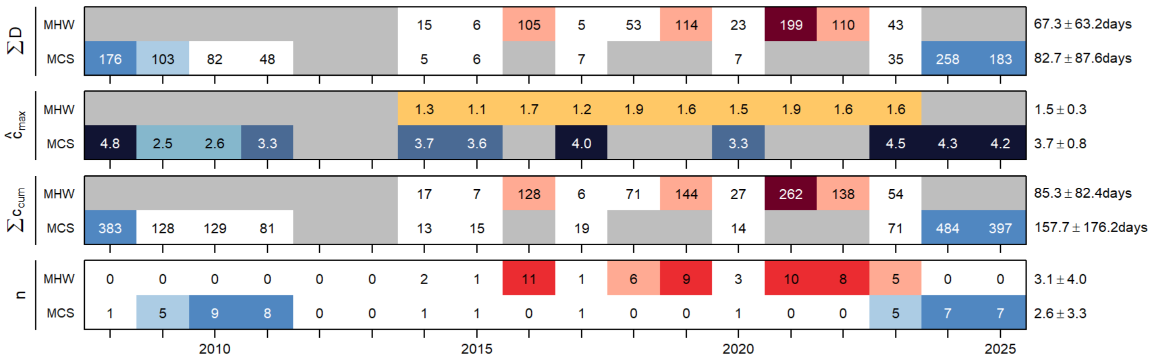

Figure 57. Aggregated NSCM bottom temperature metrics by MHW and MCS. From top to bottom are shown $\sum D$, $\hat{c}_{max}$, $\sum c_{cum}$, and the number of events, n. Boxes are colour-coded according to their values. To emphasize larger events, values up to the mean of each panel are coloured white and shades of red/blue darken with increasing values by one standard deviation for each shade. The $\hat{c}_{max}$ panel is colour-coded to the corresponding MHW/MCS category. The mean and standard deviation are shown to the right.

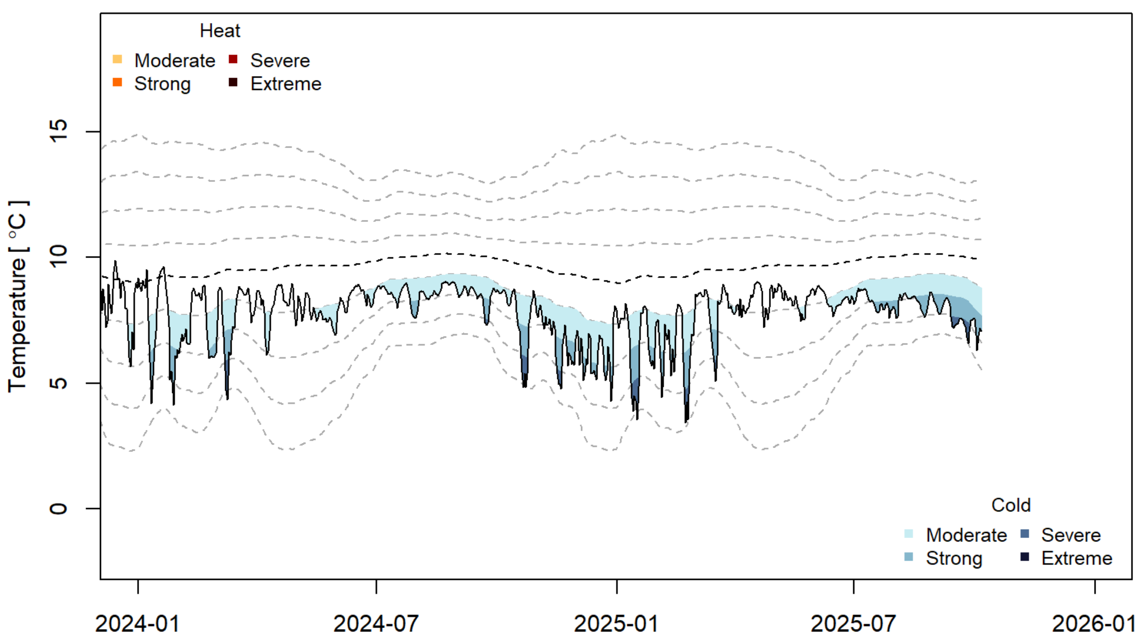

Figure 58. The T2 mooring bottom temperature time series (solid black). The thresholds for MHW and MCS categories are shown (dashed gray lines) on each side of the climatology (dashed black line). When temperature exceeds a MHW or MCS threshold, the area between the thresholds and the timeseries is coloured according to the corresponding category.

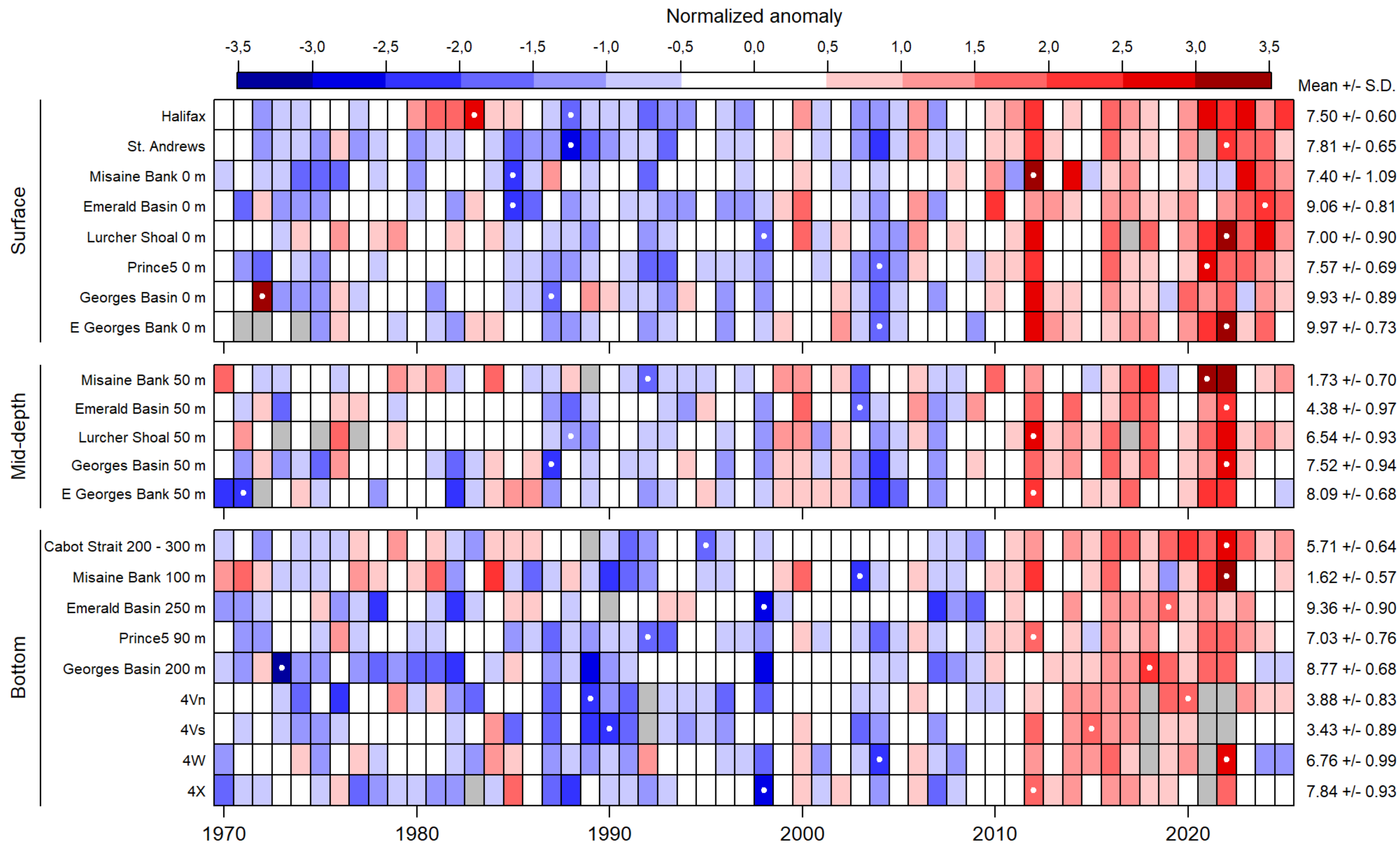

Figure 59. Normalized annual anomalies of temperatures surface, mid-depth, and bottom for the Scotian Shelf/Gulf of Maine region. These anomalies are based on the 1991–2020 means divided by the standard deviation. Blue colours indicate below-normal anomalies. Red colours indicate above-normal anomalies. White dots represent record minimum and maximum years for each parameter. Gray represents lack of data.

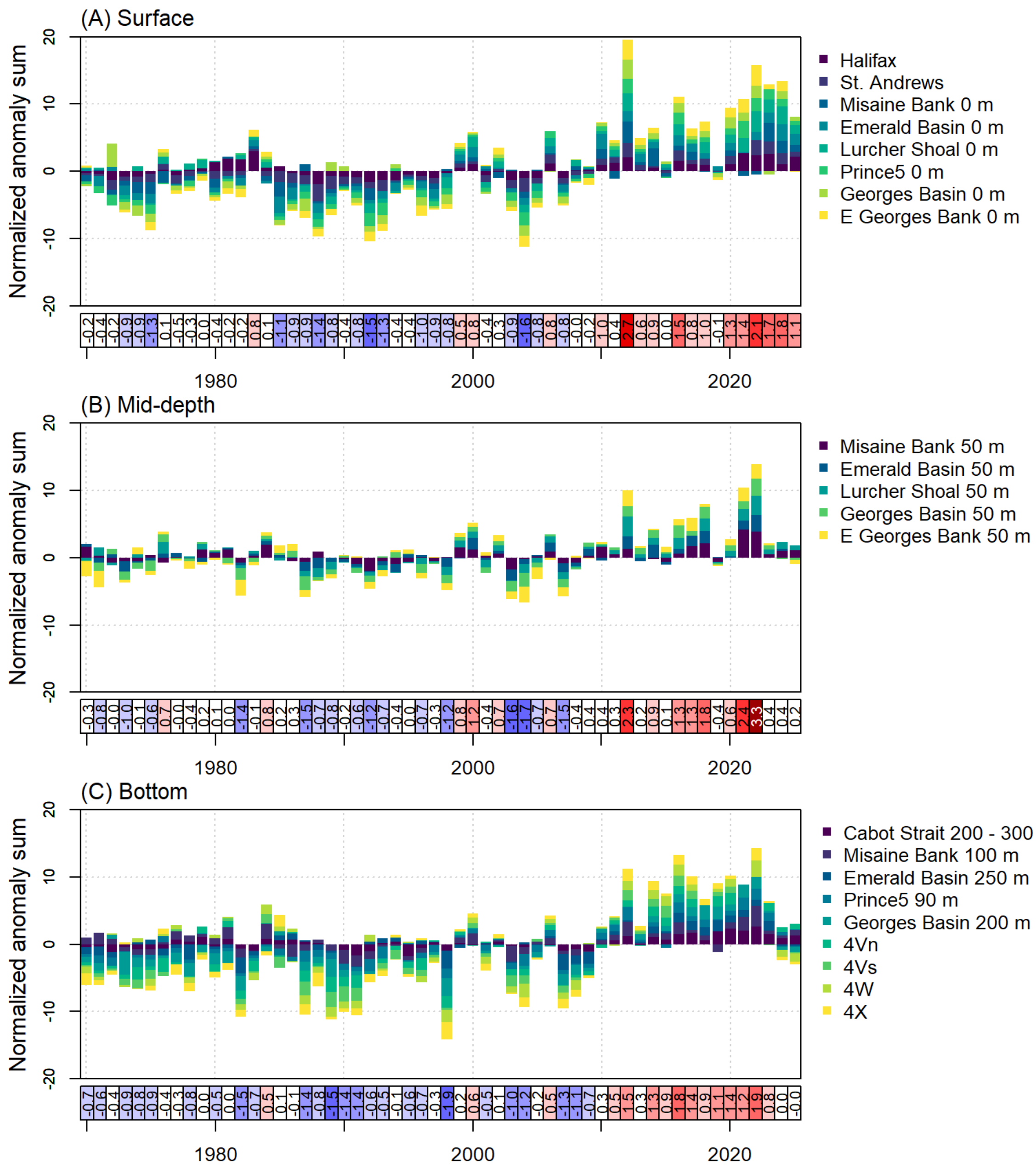

Figure 60. Composite indicies from variables represented in Figure 59 by summing the normalized anomaly for temperatures measured at the surface (top), mid-depth (middle), and bottom (bottom). Values above the zero line are positive anomalies and below are negative anomalies. Scorecard values below each panels are re-normalized to the 1991 to 2020 climatology period. Blue colours indicate below-normal anomalies, white colours indicate normal anomalies, and red colours indicate above-normal anomalies.

APPENDIX A ANCILLARY SECTIONS

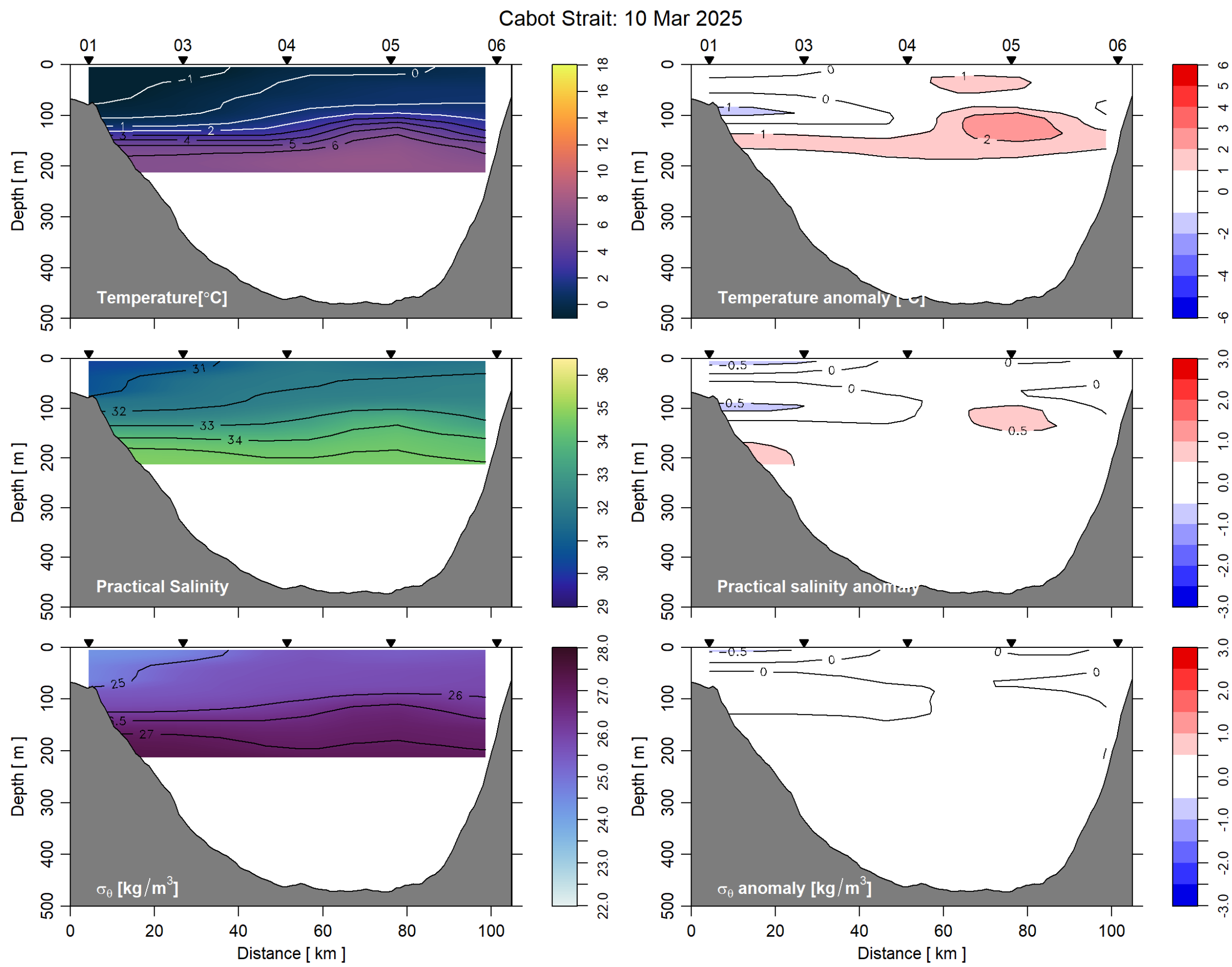

Figure A.1. The spring 2025 sampling of the Cabot Strait line collected by Quebec Region AZMP. Temperature (top panel), salinity (middle panel), and density (lower panel) and their anomalies with respect to 1991–2020 monthly means (right panels). Triangles indicate locations of sampling and station numbers are labelled above.

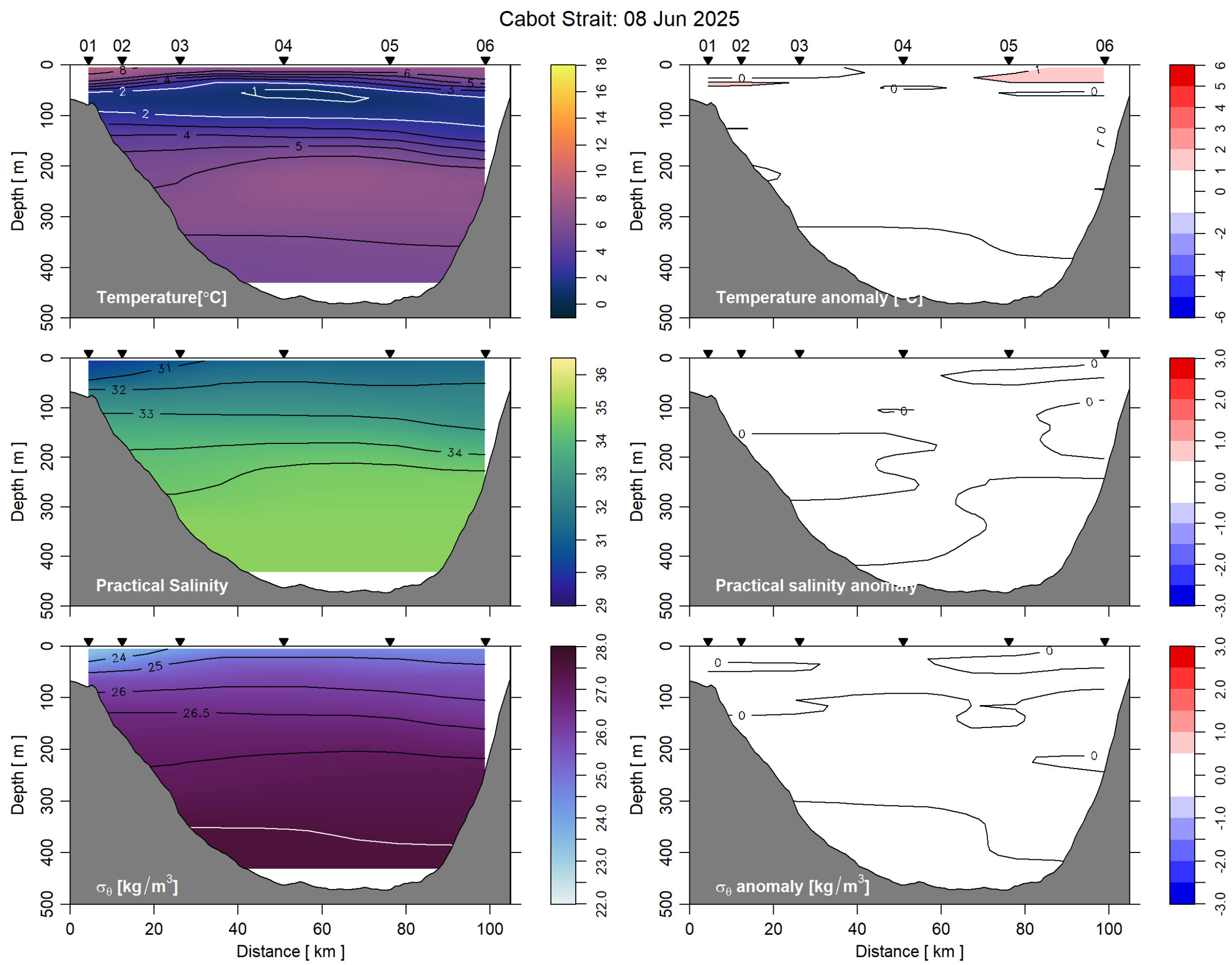

Figure A.2. The summer 2025 sampling of the Cabot Strait line collected by Quebec Region AZMP. Temperature (top panel), salinity (middle panel), and density (lower panel) and their anomalies with respect to 1991–2020 monthly means (right panels). Triangles indicate locations of sampling and station numbers are labelled above.

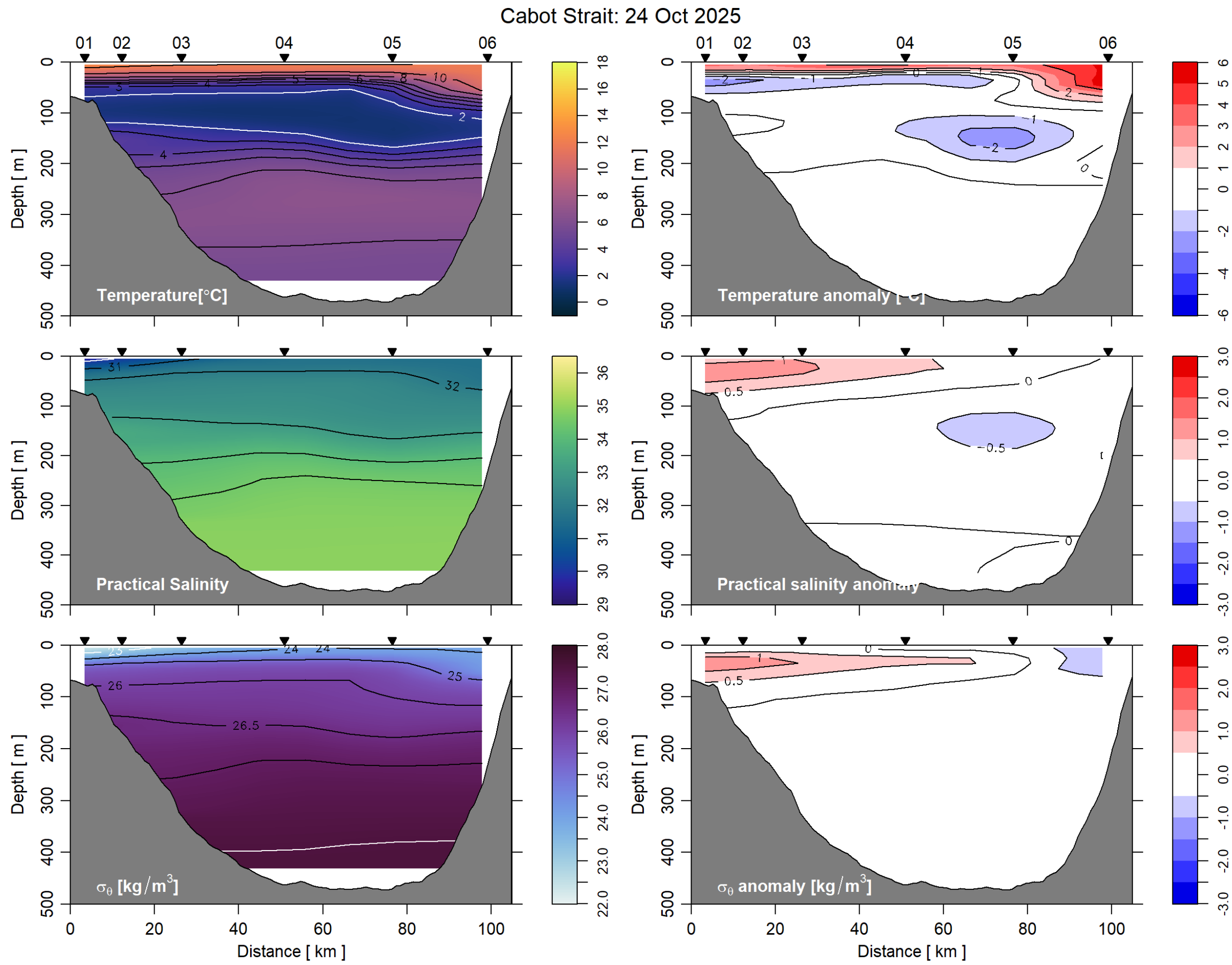

Figure A.3. The fall 2025 sampling of the Cabot Strait line collected by Quebec Region AZMP. Temperature (top panel), salinity (middle panel), and density (lower panel) and their anomalies with respect to 1991–2020 monthly means (right panels). Triangles indicate locations of sampling and station numbers are labelled above.

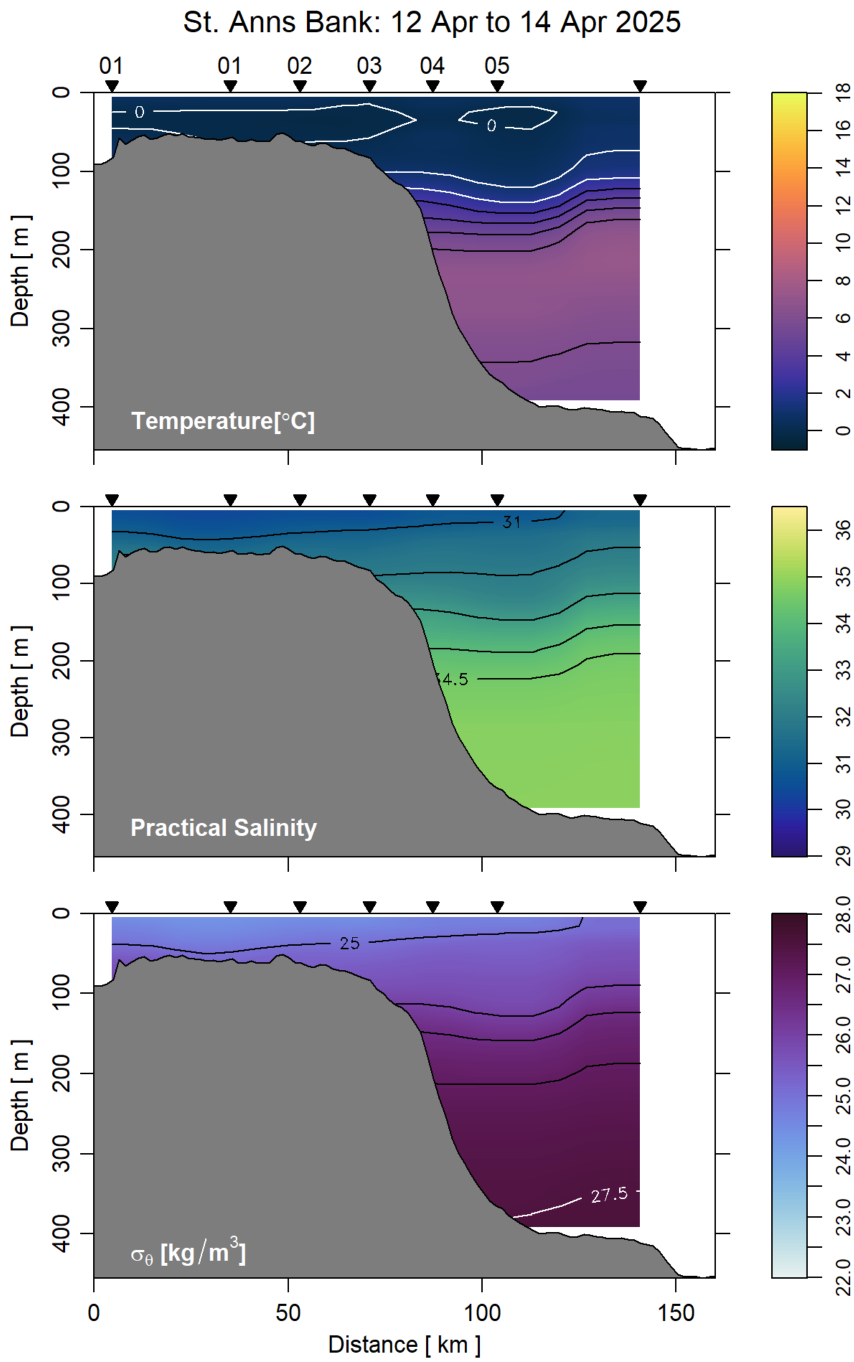

Figure A.4. The spring 2025 sampling of the St. Anns Bank line collected by Maritimes AZMP. Temperature (top panel), salinity (middle panel), and density (lower panel). Triangles indicate locations of sampling and station numbers are labelled above.

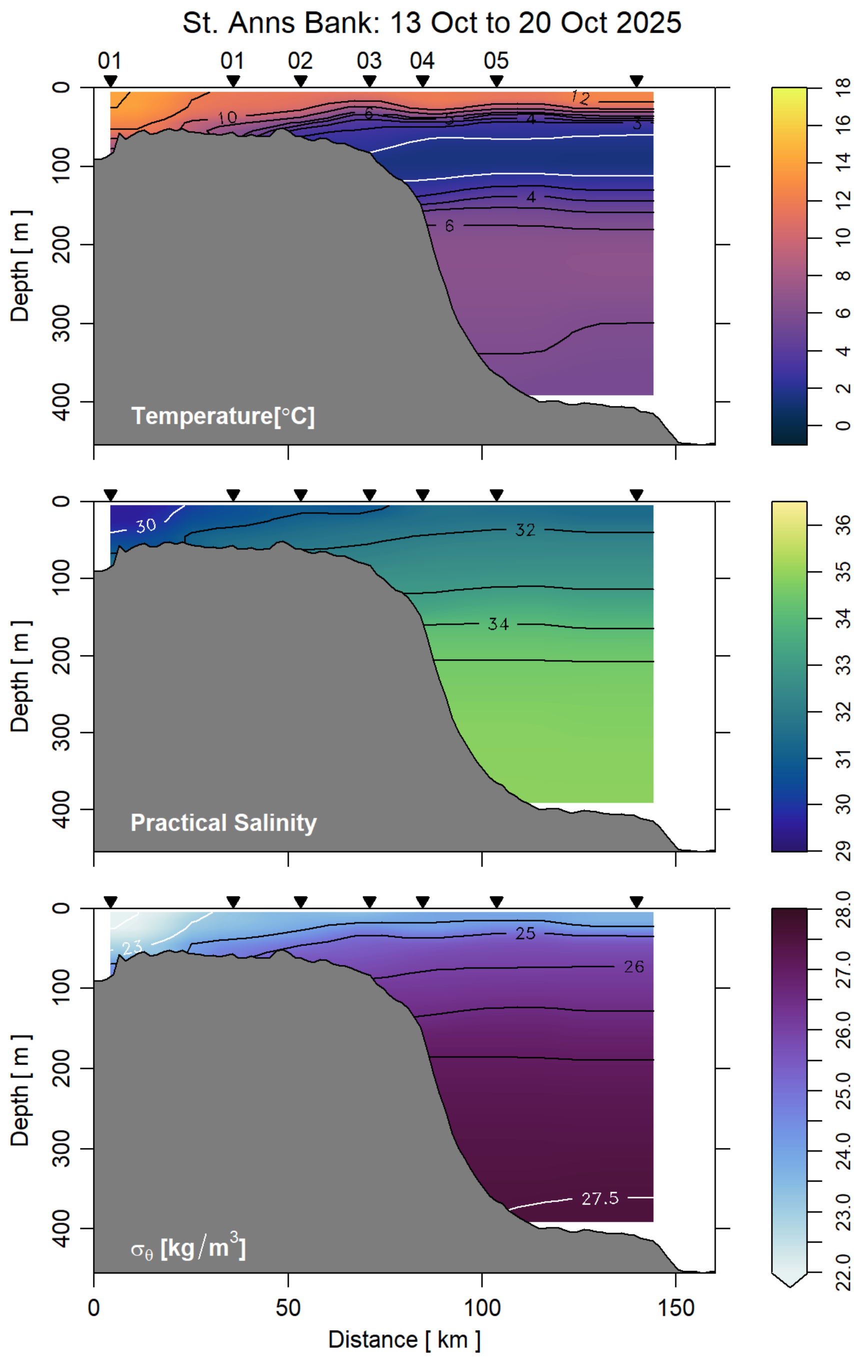

Figure A.5. The fall 2025 sampling of the St. Anns Bank section collected by Maritimes AZMP. Temperature (top panel), salinity (middle panel), and density (lower panel). Triangles indicate locations of sampling and station numbers are labelled above.

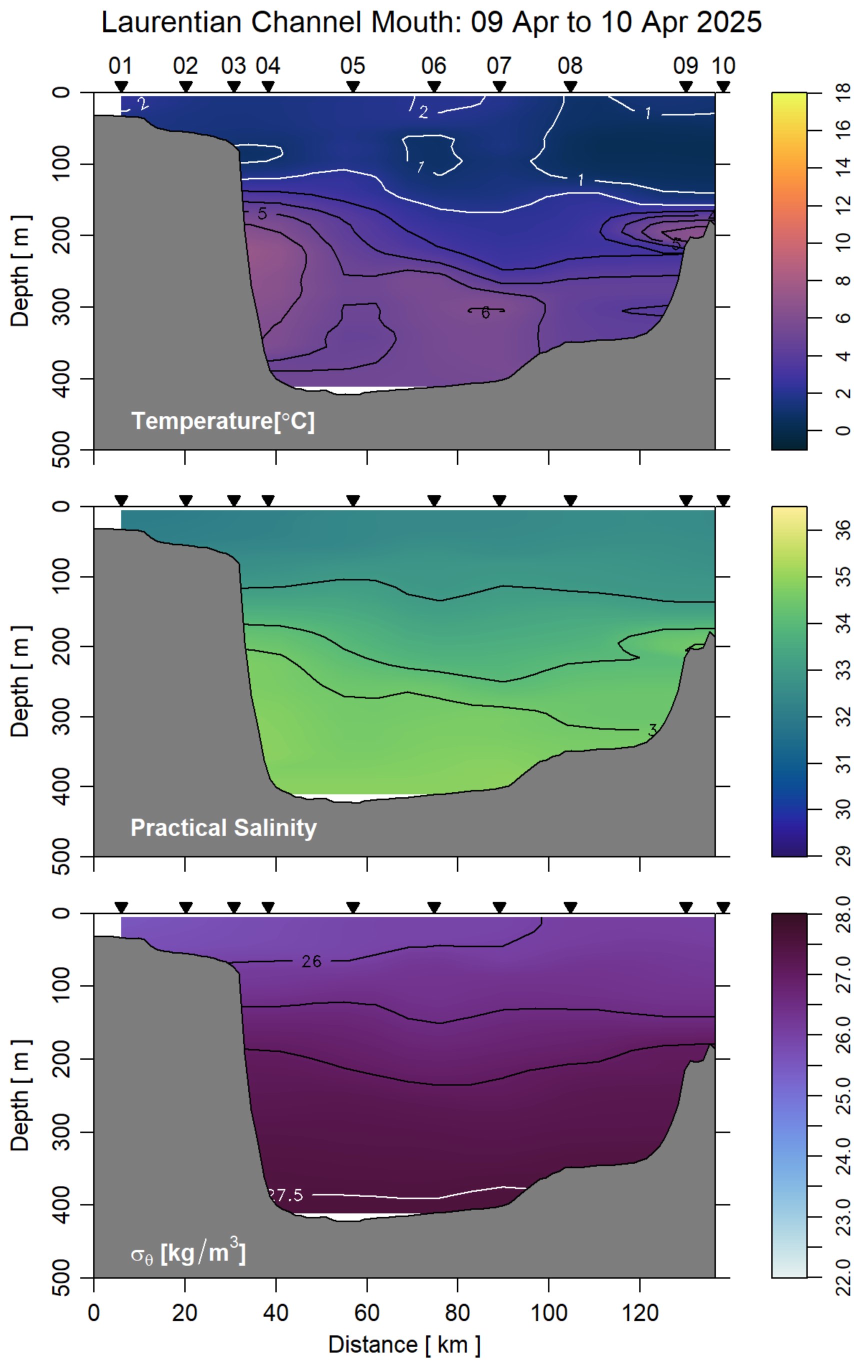

Figure A.6. The spring 2025 sampling of the Laurentian Channel Mouth line collected by Maritimes AZMP. Temperature (top panel), salinity (middle panel), and density (lower panel). Triangles indicate locations of sampling and station numbers are labelled above.

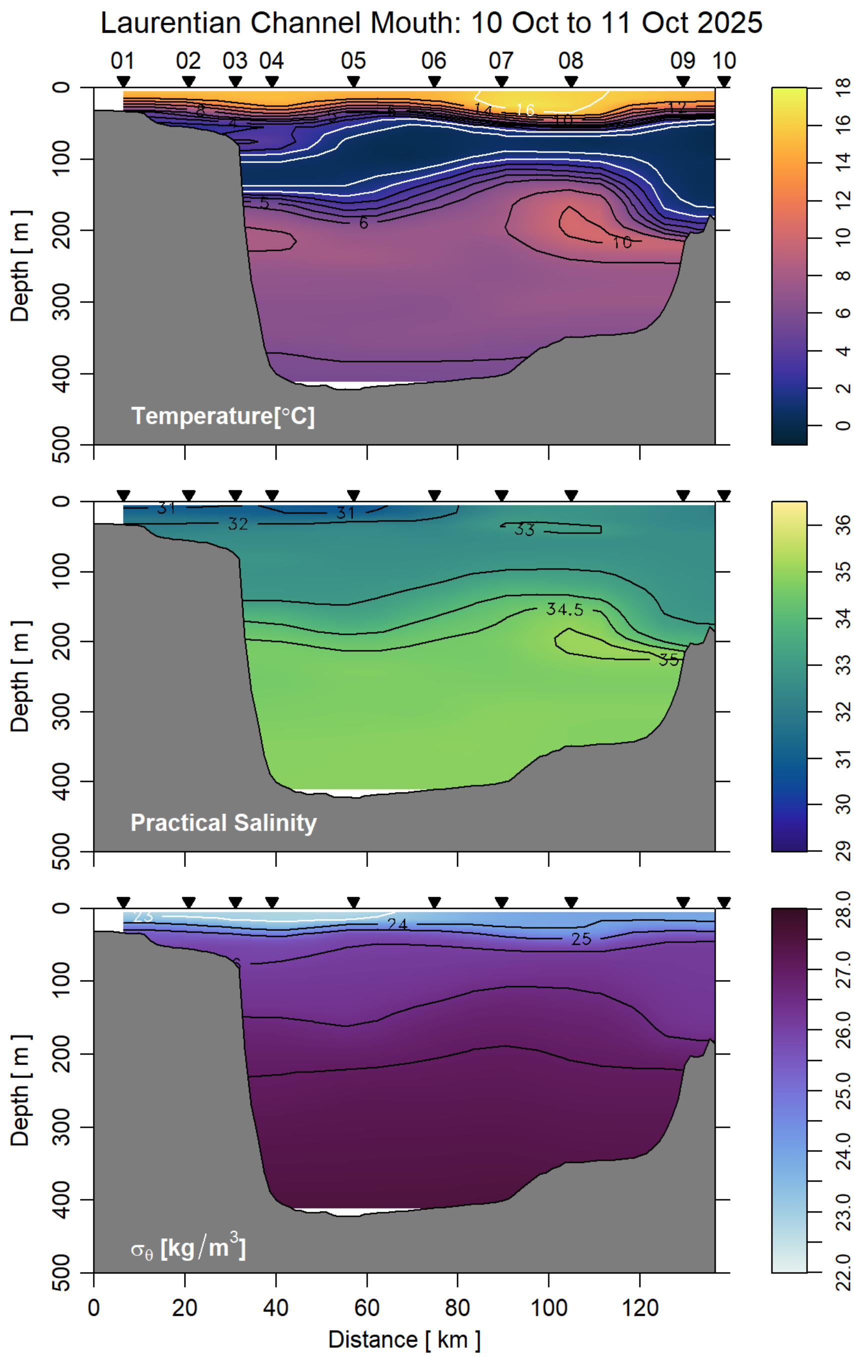

Figure A.7. The fall 2025 sampling of the Laurentian Channel Mouth section collected by Maritimes AZMP. Temperature (top panel), salinity (middle panel), and density (lower panel). Triangles indicate locations of sampling and station numbers are labelled above.

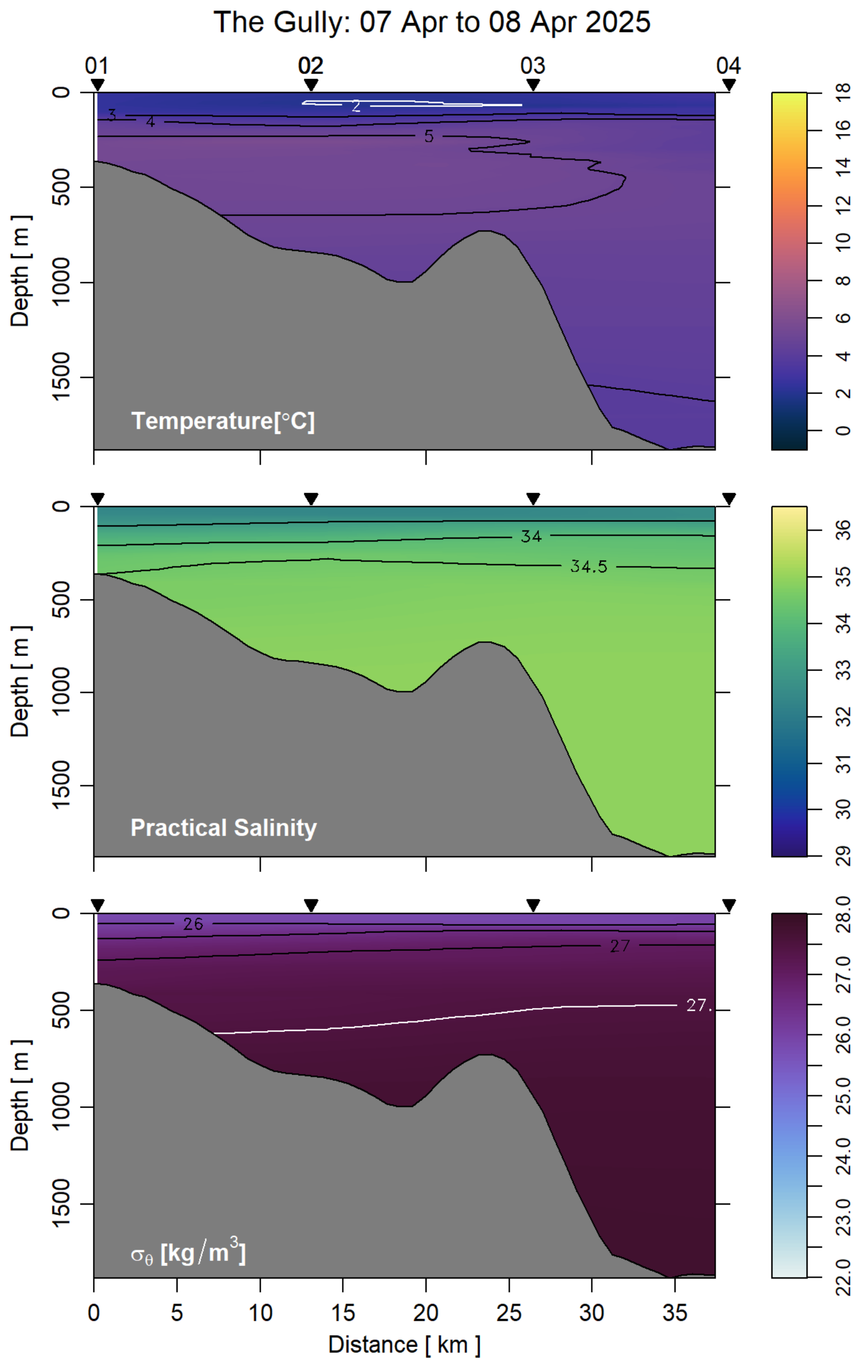

Figure A.8. The spring 2025 sampling of The Gully line collected by Maritimes AZMP. Temperature (top panel), salinity (middle panel), and density (lower panel). Triangles indicate locations of sampling and station numbers are labelled above.

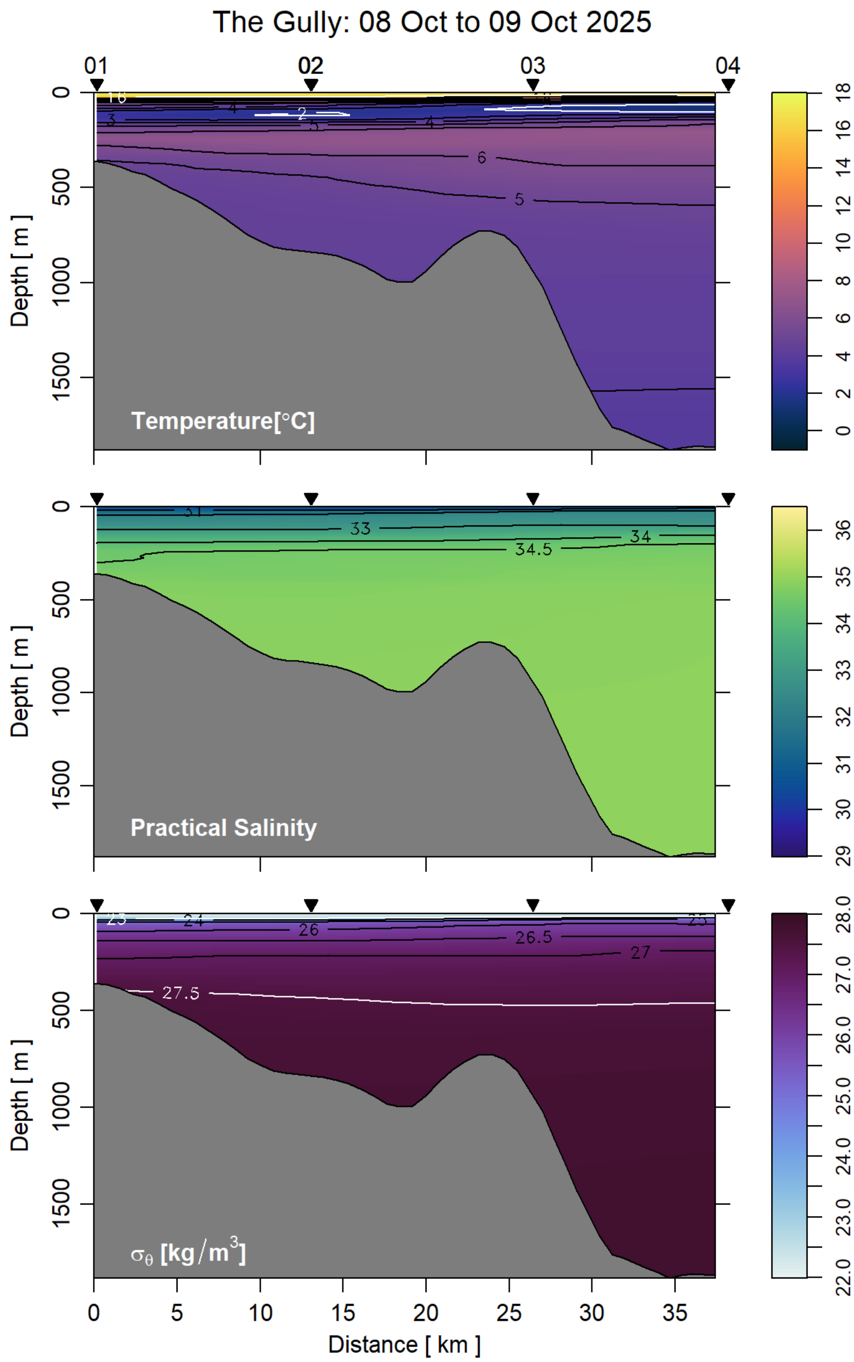

Figure A.9. The fall 2025 sampling of The Gully line collected by Maritimes AZMP. Temperature (top panel), salinity (middle panel), and density (lower panel). Triangles indicate locations of sampling and station numbers are labelled above.

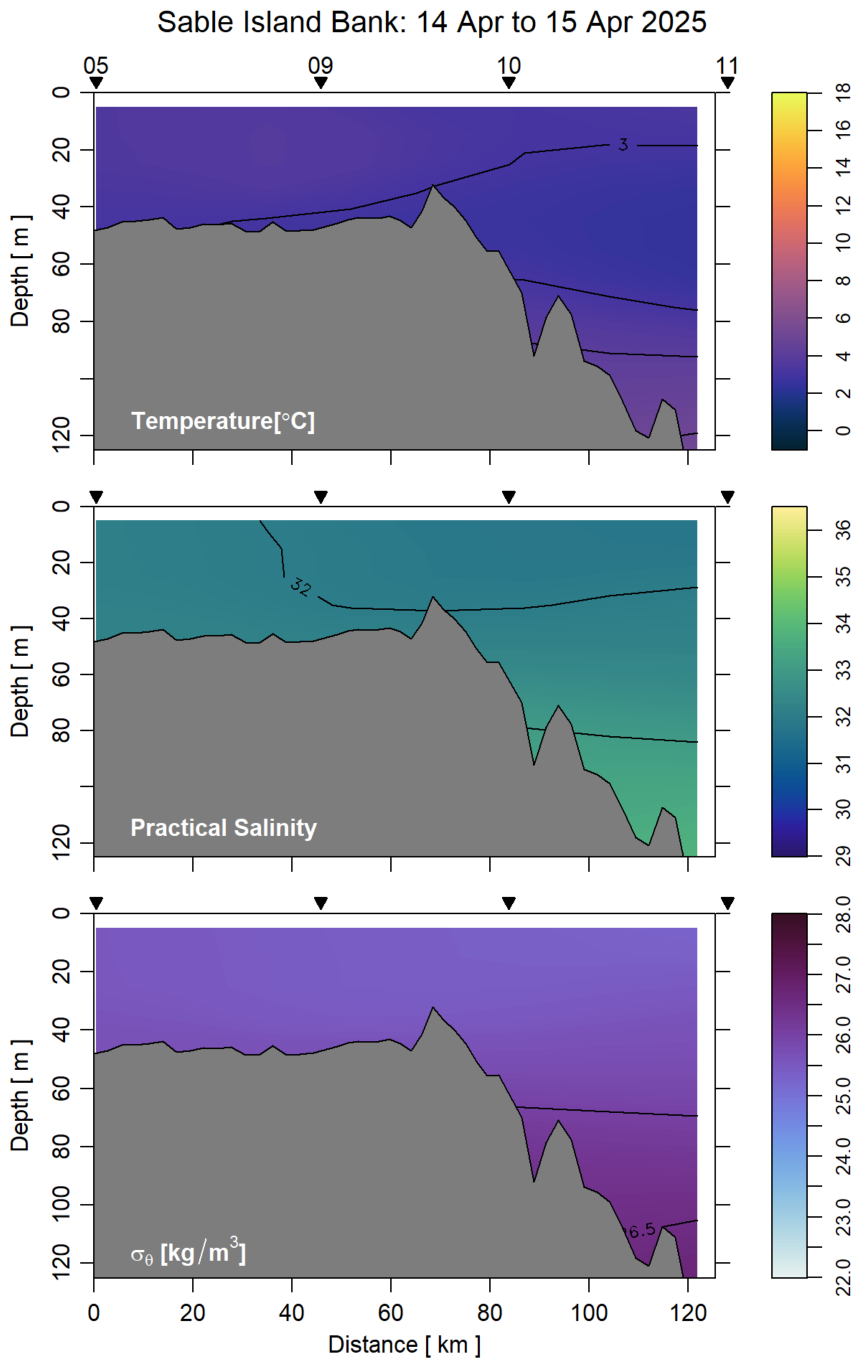

Figure A.10. The spring 2025 sampling of Sable Island Bank (west-east) collected by Maritimes AZMP. Temperature (top panel), salinity (middle panel), and density (lower panel). Triangles indicate locations of sampling and station numbers are labelled above.

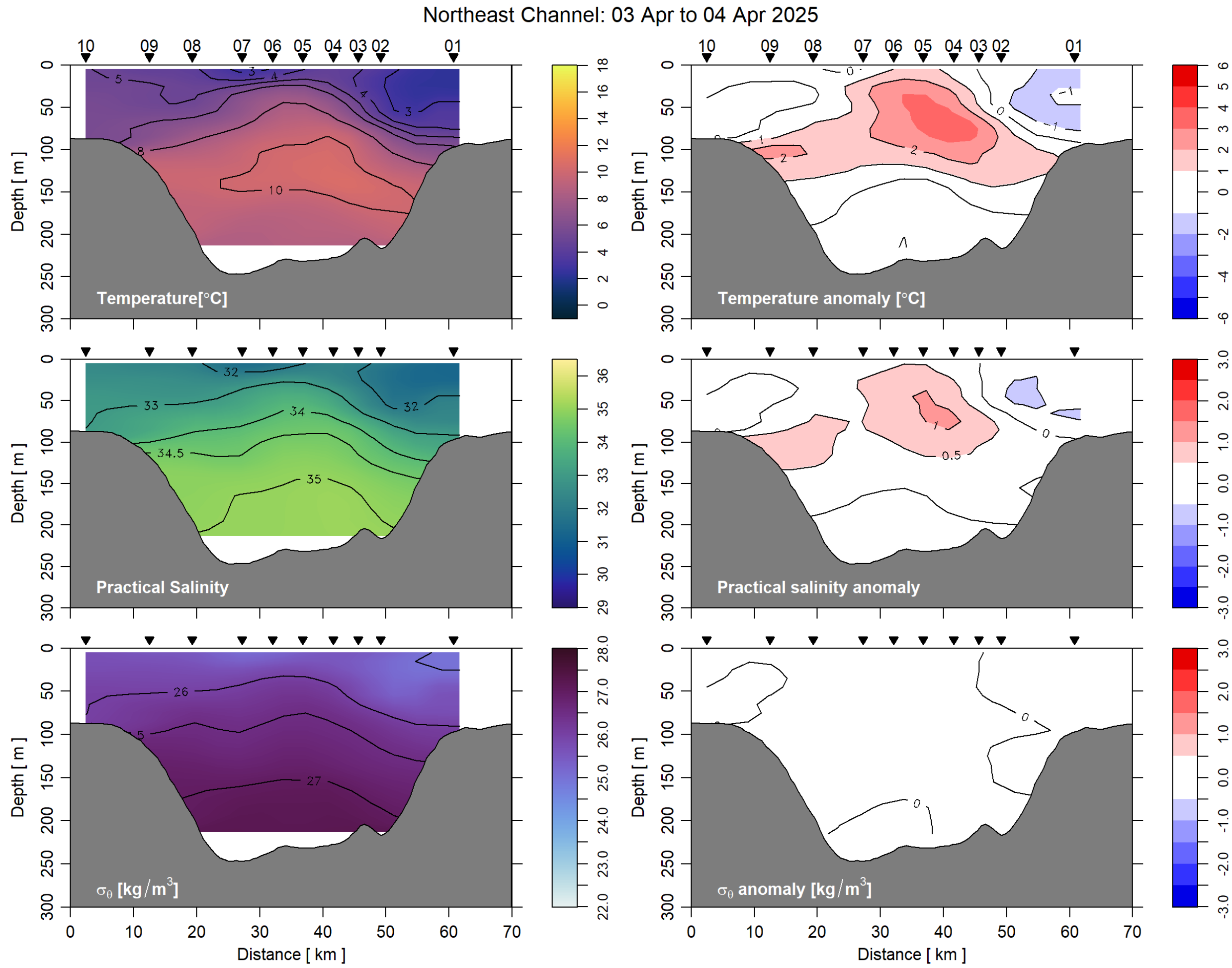

Figure A.11. The spring 2025 sampling of the Northeast Channel line collected by Maritimes AZMP. Temperature (top panel), salinity (middle panel), and density (lower panel)and their anomalies with respect to 1991–2020 monthly means (right panels). Triangles indicate locations of sampling and station numbers are labelled above.

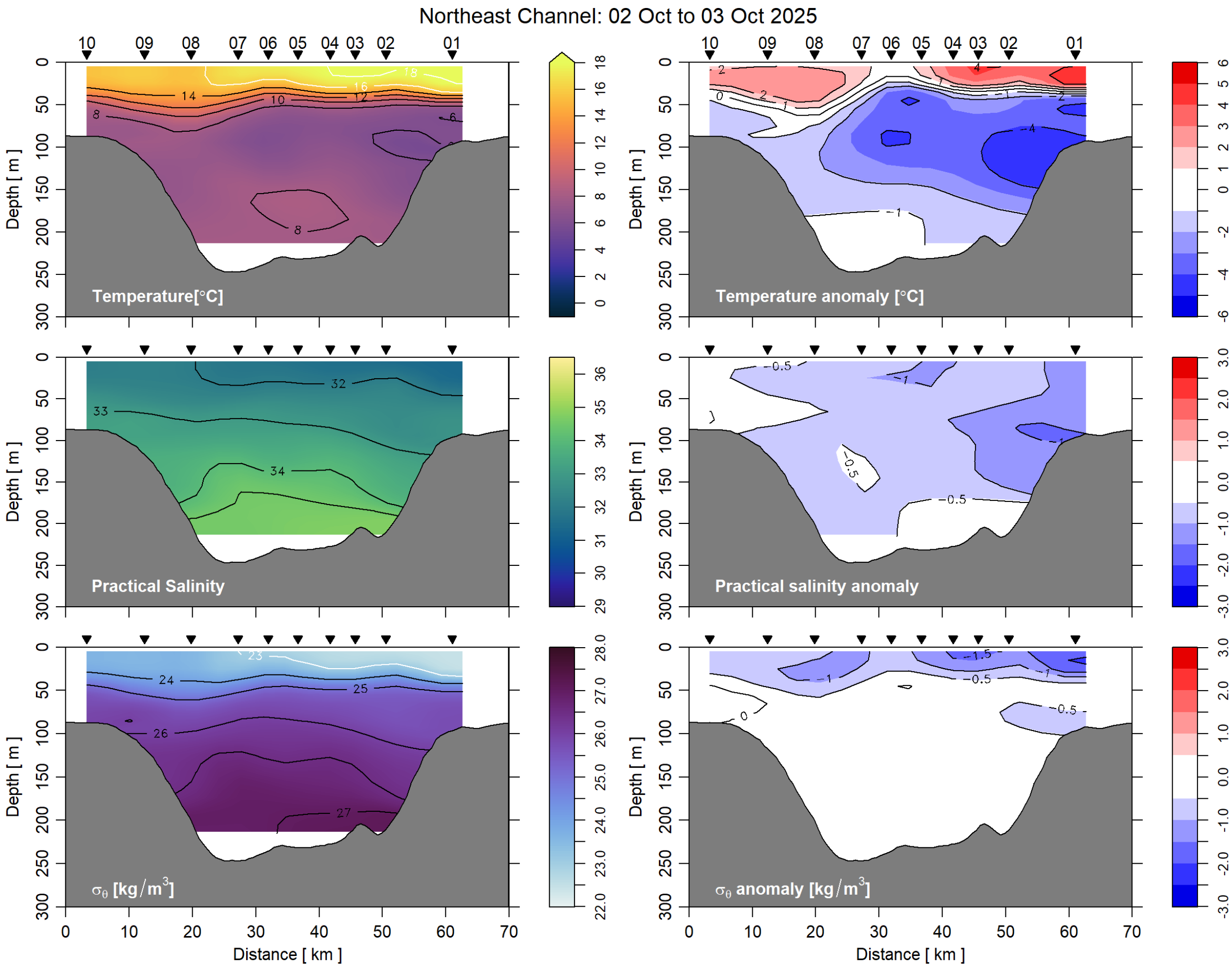

Figure A.12. The fall 2025 sampling of the Northeast Channel line collected by Maritimes AZMP. Temperature (top panel), salinity (middle panel), and density (lower panel)and their anomalies with respect to 1991–2020 monthly means (right panels). Triangles indicate locations of sampling and station numbers are labelled above.

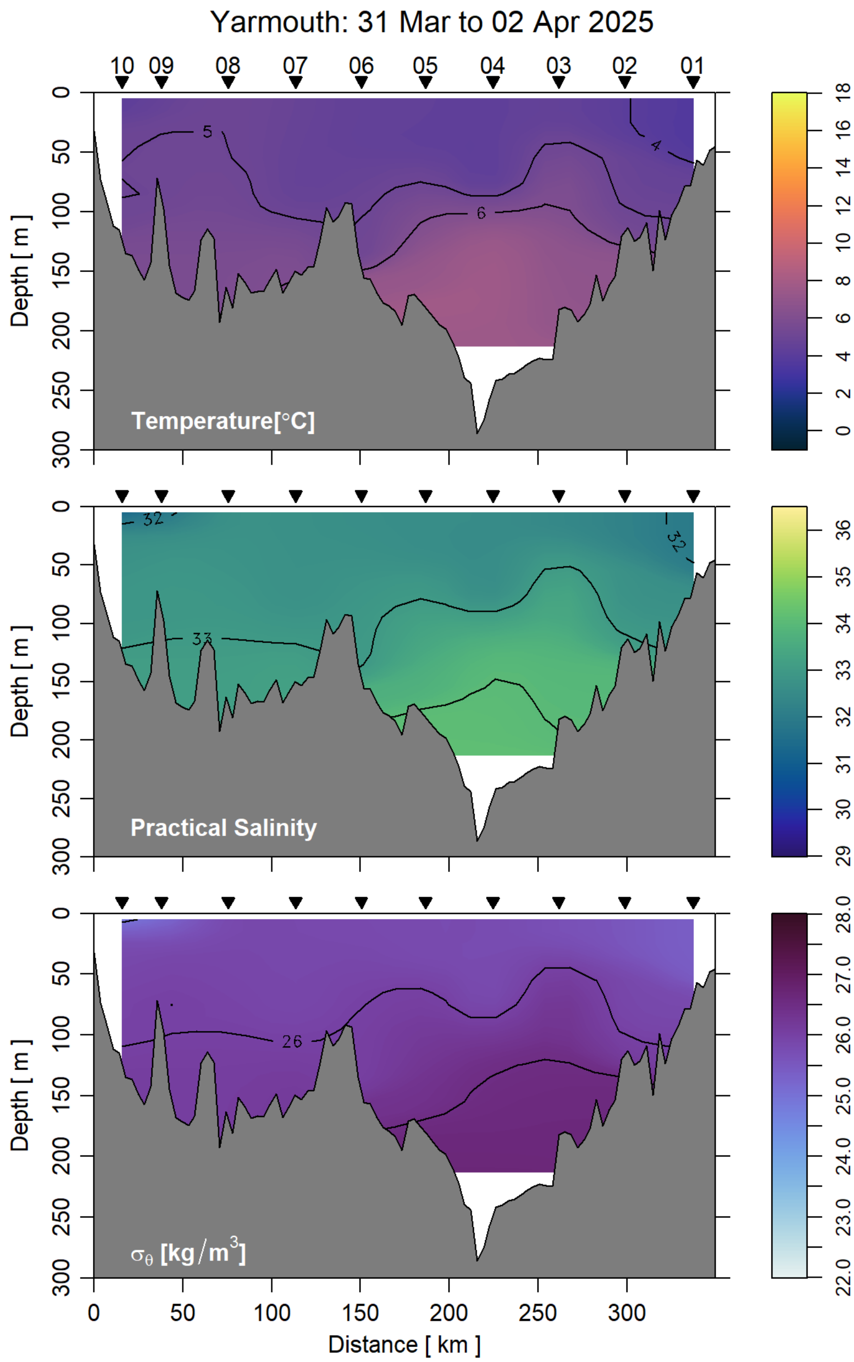

Figure A.13. The spring 2025 sampling of the Yarmouth line collected by Maritimes AZMP. Temperature (top panel), salinity (middle panel), and density (lower panel). Triangles indicate locations of sampling and station numbers are labelled above.

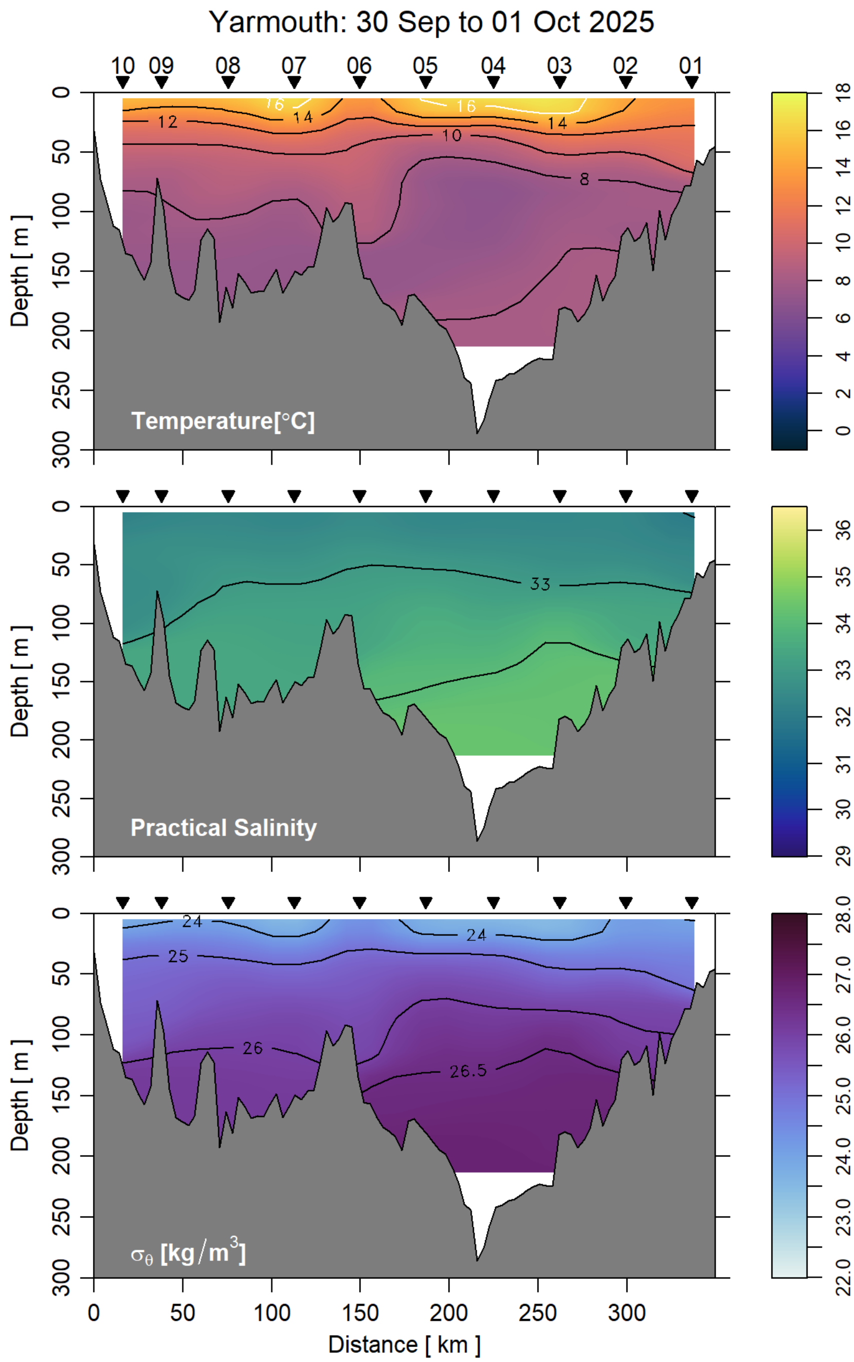

Figure A.14. The fall 2025 sampling of the Yarmouth line collected by Maritimes AZMP. Temperature (top panel), salinity (middle panel), and density (lower panel). Triangles indicate locations of sampling and station numbers are labelled above.

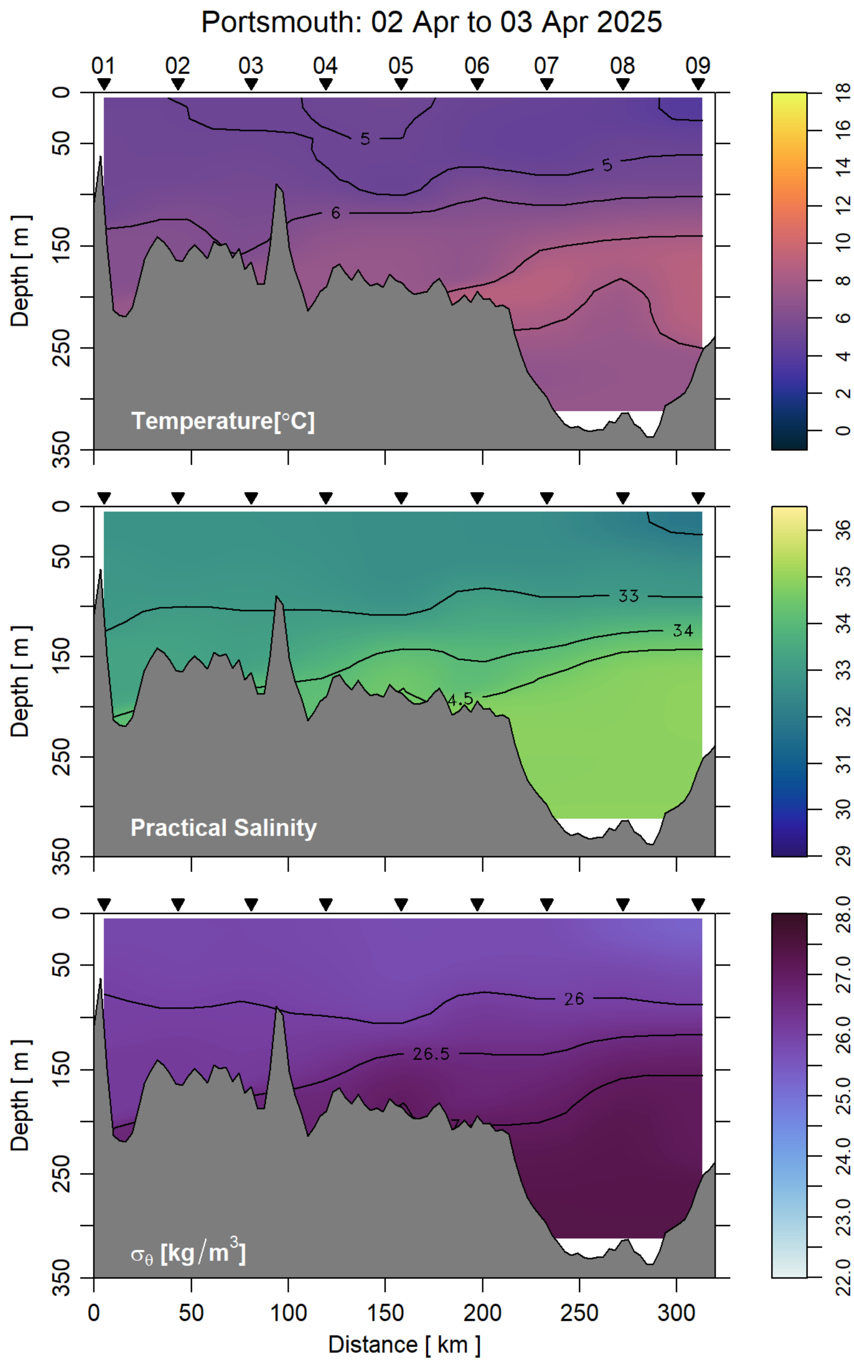

Figure A.15. The spring 2025 sampling of the Portsmouth line collected by Maritimes AZMP. Temperature (top panel), salinity (middle panel), and density (lower panel). Triangles indicate locations of sampling and station numbers are labelled above.

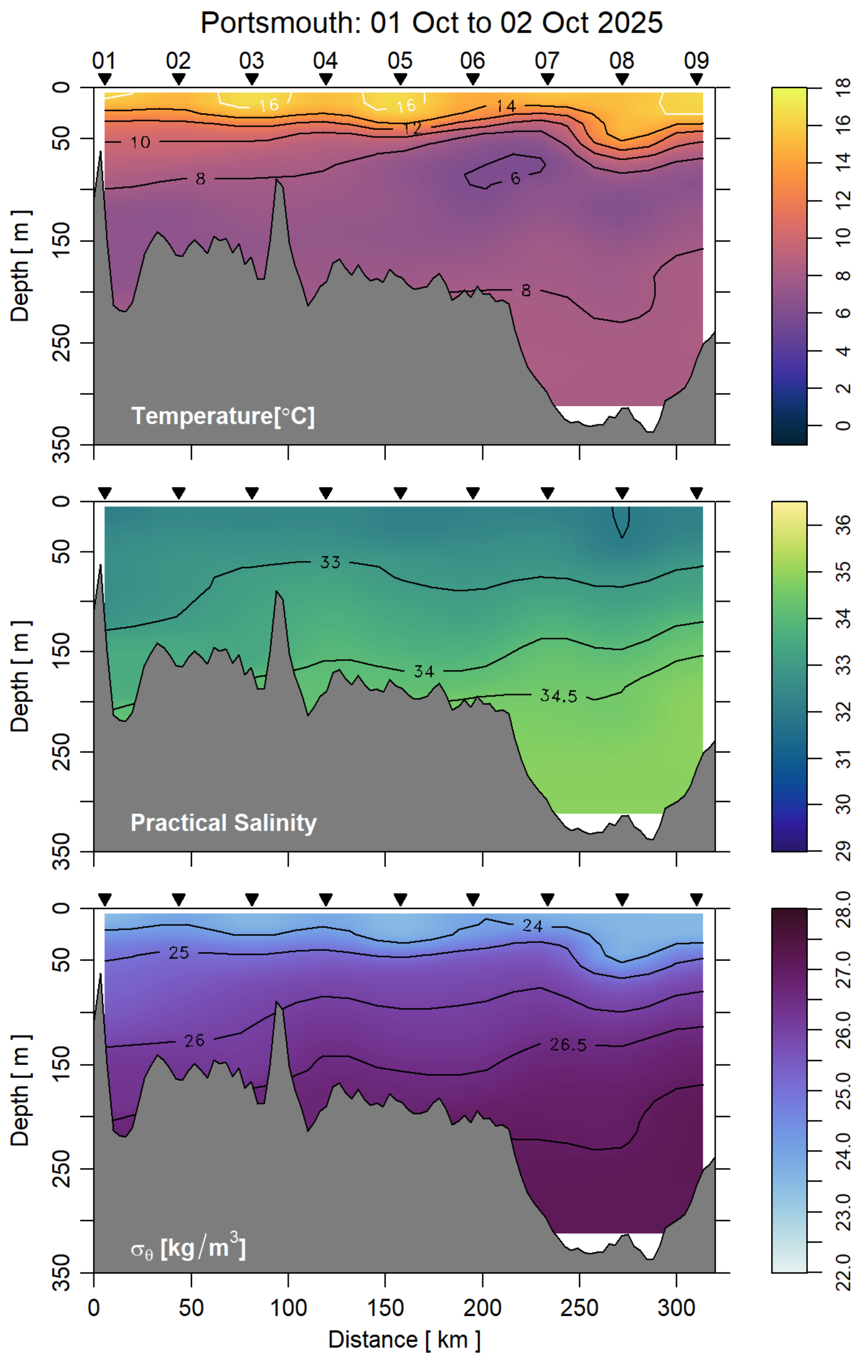

Figure A.16. The fall 2025 sampling of the Portsmouth line collected by Maritimes AZMP. Temperature (top panel), salinity (middle panel), and density (lower panel). Triangles indicate locations of sampling and station numbers are labelled above.