CDOGS 2026

Conference of Dalhousie Oceanography Graduate Students

Friday March 27, 2026
09:00 - 17:00, McInnes Room, Student Union Building
Dalhousie University, Halifax, Nova Scotia

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An assessment of mean conditions, trends, and variability on the central Scotian Shelf using ship-based observations and autonomous vehicles

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The Scotian Shelf and Slope are located at the confluence of the Labrador Current and the Gulf Stream in the Northwest Atlantic Ocean and provide essential habitat for commercially important species. Primary production in this dynamic region depends directly on the nutrient levels within and the relative contributions of the different water masses present. Mean conditions, trends, and variability of water masses along a 550 km transect of the central Scotian Shelf (CSS) are determined using 29 years of biannual ship-based observations and 15 years of monthly observations from underwater gliders. Seasonal glider-derived climatologies for the period 2011-2025 illustrate a transition from a two-layer vertical structure in the spring to a three-layer structure in the fall, which also appears in the ship-based climatologies. Mean water mass temperature and salinity are computed from repeat upstream profiles and projected into temperature-salinity space to use as mixing triangle endmembers for the CSS. Time series of endmember properties show high interannual variability in Cabot Strait subsurface (CBSs) water and Warm Slope Water (WSW), medium variability in Inshore Labrador Current (InLC) water and Cabot Strait-Cold Intermediate Layer (CBS-CIL) water, and low variability in Labrador Slope Water (LSW). Mixing lines are observed year-round in the glider data between the CBSs and WSW, as well as between the WSW and LSW, while mixing between the CBS-CIL and WSW is not apparent. Future work will evaluate mean conditions and trends in Nova Scotia Current transport from glider-derived estimates of alongshore current velocities.

Oceanographic Data Quality Control - A task for the bots?

Emily O'Grady

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Artificial intelligence (AI) is transforming workflows across academia and industry. As these tools become more prevalent, it is important for subject-matter-experts to identify workflows where AI can make contributions which increase efficiency while minimizing risk. The task of data quality control requires an advanced skillset and knowledge base but is often tedious and time-consuming. I argue this is a task which is well suited to AI integration, and give an overview of current projects which are working to develop AI-backed QC strategies including machine-learning algorithms and agentic platforms. Oceanographic data, collected at a never-before-seen scale through autonomous platforms, is often at risk of loss due to data quality issues, which can prevent it from being incorporated into scientific analyses, or may introduce bias or uncertainty. Some current machine learning solutions include, SalaciaML, which is a QC algorithm used as a secondary check to increase the efficiency of classic statistical quality control tests; and CoTeDe, which presents a broader framework for ocean data QC through a python package. The international Argo program has also explored multiple integrations of machine learning into their advanced and standardized quality control systems. I will present my proposed master's thesis; QSEA (Quality-control with Smart Explainable Agents) an agentic platform that facilitates the use of various globally-developed machine learning algorithms, and provides an interactive interface through a python dash app to allow subject-matter-experts to verify quality control decisions.

Effects of Remotely Generated Coastal Trapped Waves in Extreme Coastal flooding in the Bohai Sea in October 2024

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Record-breaking coastal flooding occurred in the Bohai Sea on 21 October 2024 in the calm weather condition, which was not forecasted accurately in time. In this study, hydrodynamics in the Bohai Sea and adjacent waters during this flooding event are examined using a nested-grid ocean circulation model based on the Regional Ocean Modeling System. Analysis of model results demonstrates that this widespread flooding was caused by three major drivers including (a) remotely generated coastal trapped waves (CTWs), (b) large spring tides, and (c) elevated background sea level associated with large-scale circulation over the northwestern Pacific. The CTWs were generated by atmospheric forcing over the Yellow Sea, Korea Strait, and Sea of Japan. The Complex Empirical Orthogonal Function (CEOF) analysis is used to examine the main characteristics of these CTWs, which propagated from the Korean shelf to Bohai Sea and then to the Chinese shelf. Our findings highlight the importance of trans-basin dynamics in coastal flood forecasting.

Detecting and Analyzing Kauai Beacon Acoustic Transmissions on Ocean Networks Canada Hydrophones

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Acoustic tomography can be used to remotely monitor basin-scale ocean properties. In 2023 the Kauai Beacon (KB) began transmitting an acoustic signal six times daily, every fourth day across the north Pacific from the Hawaiian Island of Kauai. The signal has been detected off the continental United States and near Wake Island at approximately 4000 km range. Bottom mounted Ocean Networks Canada (ONC) hydrophones, off the British Columbia coast, have received the signal at a distance of 4100 km, providing an opportunity to study long-range propagation in the northeast Pacific Ocean. The signal is detected using a matched filter to extract the maximum-length sequence encoded transmission from the below the ocean's background noise. Of the five ONC sensor locations, the signal was only detected on the Barkley Canyon hydrophones and shows a single arrival peak. Observed trends in travel time, signal-to-noise ratio, and receive level, coincide with seasonal changes. The travel time variations can be analyzed to give the sound speed and temperature of the ocean integrated over the acoustic ray paths. Observations of travel time and receive level were compared to a raytracing model (BELLHOP) and a range-dependent Parabolic Equation (RAM-PE) propagation model respectively. The results show that increased sea surface temperatures decreased the width of the Sound Fixing And Ranging (SOFAR) acoustic channel. Under these conditions, the acoustic rays experienced warmer temperatures and longer travel times as they concentrate around the slow sound speed of the SOFAR channel. This study establishes methods of acoustically monitoring ocean conditions in the northeast Pacific using existing infrastructure.

Localization and Source Level Estimation of Blue Whale Calls in the Gulf of St. Lawrence

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Since 2019, gliders equipped with hydrophones have been deployed each summer in the Honguedo Strait shipping lane between Gaspé and Anticosti Island to detect North Atlantic right whales and support vessel mitigation measures. These gliders also record calls from other species, including the endangered Northwest Atlantic blue whale. Understanding how loud whale calls are is important for modelling how sound travels through the ocean and improving our ability to locate whales, which can help reduce ship strikes. However, the loudness of blue whale calls and how far they can be detected in the Gulf of St. Lawrence remain largely unknown. In this study, we analyzed 79 blue whale "Arch" calls that were recorded simultaneously by an underwater glider and four ocean bottom seismometers. By comparing the arrival times of the calls at different stations and using an ocean-acoustic model, we estimated the whale's location and the source level of its vocalizations. Our results suggest that these calls can be detected by a glider at distances of up to 150 km when it is positioned within the sound channel. The measured acoustic features of Arch calls suggest propagation similarities to song-type vocalizations. These findings have ecological implications and can inform management strategies in an area heavily used by both whales and vessels.

Underwater Movement of Bowhead Whales

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Understanding and quantifying feeding behavior of marine animals is a complicated and difficult endeavor. To date, Bowhead whale (*Balaena mysticetus*) behavior in the East Canadian Arctic has been studied to this day with satellite-linked time-depth recorders that log horizontal and vertical movements of individuals. Feeding efforts are inferred using dive shapes, but this has never been confirmed. However, in variable environments. To determine what characterizes feeding efforts, we used inertial sensing tags to record the 3D movement of whales. Customizable Animal Tracking Solutions (CATS) tags were attached to bowheads in Cumberland Sound, NU, using suction-cups and dermal attachments. CATS tags include high-resolution triaxial sensors (Accelerometer, magnetometer, gyroscope), time-depth recorder (TDR), GPS, pressure rated forward-facing camera and hydrophone. Using a mixed-model we found that the bowhead whale feeding is characterized by slow velocity and changes in the average speed, body position and time of day. By using the kinematic signature we can better identify feeding behavior and determine how whales would respond to climate change.

North Atlantic Right Whale Energy Intake in a Summer Foraging Habitat

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Climate-driven changes in summertime foraging habitats have led North Atlantic right whales (*Eubalaena glacialis*) to feed at higher latitudes in the Gulf of St. Lawrence. The energetic profitability of prey fields in this habitat remains poorly understood because most sampling has not been in close proximity to feeding whales. We quantified the energy density of prey layers targeted by feeding whales in the Shediac Valley in July and estimated daily net energy intake. Whale behaviour and feeding depth were determined using suction-cup attached, camera equipped inertial-sensing biologging tags. Vertically resolved Optical Plankton Counter measurements were combined with net-derived species composition and bulk calorimetric measurements to estimate prey-layer energy density. Energy density observations were analyzed using a Bayesian hierarchical latent mixture model to distinguish background conditions from whale-targeted high-density prey layers while accounting for sampling uncertainty. Energy intake was estimated by integrating prey-layer energy density with whale-specific filtration rates, baleen filtration efficiency, and digestive efficiency. Prey layers associated with feeding whales were dominated by late-stage Calanus finmarchicus and exhibited energy densities 12 times higher than background conditions (417 vs 34 kJ m^{-3}). Under mid-range feeding effort (10 h d^{-1}) and energetic conditions (50% background, 50% whale-targeted), mean daily energy intake was 5,225 MJ d^{-1} for yearlings, 11,252 MJ d^{-1} for juveniles, and 16,293 MJ d^{-1} for adults, compared to their respective daily energy requirements of 956 MJ d^{-1}, 1,370 MJ d^{-1}, and 2,046 MJ d^{-1}. Energy intake exceeded daily energetic requirements across all age classes, indicating that sustained access to dense prey layers should be sufficient to support lipid accumulation and reproductive activity. These findings demonstrate that energetically profitable foraging conditions occur within the Gulf of St. Lawrence and highlight the importance of fine-scale, co-located prey sampling for assessing habitat quality and energetic constraints in right whales.

Dear Diary... Unveiling the daily behaviour budget of North Atlantic right whales using high-resolution biologging tags

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Despite the immense number of studies published on and surveys of North Atlantic right whales (*Eubalaena glacialis*), we still know relatively little about the behaviour of the species. Quantifying a species' activity budget is important to understanding its ecology, quantify energetic expenditure and create effective protective legislation. Biologging tags equipped with high-resolution tri-axial, kinematic sensors with synchronised camera footage, allow us to advance our understanding of behaviour and measure different activity states. We deployed high-resolution CATs (www.cats.is) tags onto right whales in the Shediac Valley, Gulf of St. Lawrence during July 2023-2025 (duration 10.8 hrs $\pm$ 10.1 SD; n = 26). To identify behavioural states (subsurface sleep, logging, surface active groups and travel), we applied a series of kinematic thresholds, including fluking effort (rad min^{-1}), unidirectional heading, and roll rate (rad min^{-1}). We applied these thresholds, interpolated and validated to construct activity budgets for the duration of the tag deployment of each right whale. We then pooled these data into daylight classifications (day, twilight, night), age classification (yearling, juvenile, adult) and tidal state (flood, slack, ebb). We found that individuals across all age classes and daylight classifications spent most of their time feeding (86 $\pm$ 22.4 SD %) during our study period. Feeding was observed near the surface at (0-15 m) at night and at depth (40-60 m) during day. The proportion of time spent feeding increased with age from yearling ($<$ 2 years old; 92.4% $\pm$ 4.8 S.E.) to adult ($>$ 8 years old; 82.9% $\pm$ 3.5 S.E). We also found an inverse trend in resting time, with adults spending the most time subsurface sleeping (7.7 $\pm$ 2.6 SE %). Interestingly, we found whales allocated a greater proportion of time resting during twilight relative to day and night, likely caused by the disaggregation of the prey layer during diel vertical migration close to sunrise and sunset.

Synthetic aperture sonar mapping of a nearshore benthic habitat

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High-resolution synthetic aperture sonar (SAS) imagery can be segmented down to a fine-scale as seafloor features can be clearly delineated. This is useful for making detailed thematic maps of categorical seafloor characteristics such as morphological or substrate classes. SAS has been increasingly applied for commercial purposes such as seabed mining and offshore construction, but less so for mapping biological features of the benthic habitat. Deep learning methods have been shown to effectively segment SAS imagery. However, such neural network models require large labelled datasets to be trained effectively in a supervised fashion. Obtaining an appropriate labelled dataset for model training is resource-intensive and is a primary challenge slowing the wider adoption of deep learning methods to segment SAS data for seafloor thematic map production. To address challenges arising from scarce labelled datasets, we performed unsupervised feature extraction and segmentation of SAS data collected over a nearshore area on the Scotian Shelf using self-supervised neural networks. A seafloor video dataset recorded over a limited number of locations with differing substrate and faunal communities were used to reclassify the segmented clusters into maps of substrate classes and biophysical habitat (benthoscape) classes. Different models were built to process various data modes available from the SAS sensor, including intensity, bathymetry, coherence, and the complex-valued SAS imagery. Segmentation outputs from including different data types in the modelling were compared qualitatively and quantitatively.

Spatial resolution and predictor selection shape modelled lobster habitat and marine refuge alignment

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Fishing exclusion zones have been established in the southern Gulf of St. Lawrence since 1999 by Fisheries and Oceans Canada to mitigate habitat degradation from scallop dragging and to protect juvenile American Lobster (*Homarus americanus*) habitat. However, the extent to which these marine refuges (MRs) encompass suitable benthic habitat for lobster remains uncertain. This study uses multiresolution habitat modelling to assess the influence of data resolution and predictor selection on the spatial alignment of modelled predictions with existing MRs. Two habitat suitability models were developed using adult lobster presence records derived from 113 drop-camera surveys (2023–2024) to predict occurrence probability in the Northumberland Strait: a regional broadscale model (100 m resolution) using bathymetry and bathymetric derivatives, and a local finescale model (10 m resolution) that additionally incorporated multibeam backscatter. Binary suitability maps were generated and compared with the spatial distribution of MRs. The broadscale model predicted substantially larger areas of suitable habitat and indicated that 47% of suitable lobster habitat occurs within MRs, while 1,645 km^2 remains unprotected. Spatial comparison of the binary models showed moderate agreement (77.8%), with most disagreement occurring where the broadscale model predicted suitability that the finescale model did not support. The broadscale model also classified a much larger proportion of MR area as suitable habitat, indicating overprediction within protected zones. When suitability estimates were compared across modelled substrate classes, predicted occurrence probabilities were highest on hard substrates in both models, but the finescale model more clearly constrained suitability to heterogeneous seafloor habitats and reduced predictions across soft sediments. These results demonstrate that spatial resolution and predictor selection strongly influence modelled habitat patterns and estimates of MR–habitat alignment, with implications for habitat mapping and marine spatial management in the Gulf of St. Lawrence.

Boulders as habitat islands in a conservation area in the Gulf of St Lawrence

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In the Gulf of St. Lawrence (GSL), conservation areas (termed Other Effective area-based Conservation Measures - OECMs), have been established for cold-water sponges. Previous research has noted that sponge abundance in these OECMs generally correlated positively with the percent cover of boulders present in an OECM's benthoscape class (a broad seafloor classification scheme based on biophysical characteristics) and that other taxa appeared to be exclusive to either boulders or the substrate surrounding the boulders (referred to as the "matrix"). According to island biogeography theory, communities on habitat islands follow specific distribution patterns and tend to differ from matrix communities, and the contrast between the matrix and the island influences these island community patterns. I tested the hypothesis that boulders in Parent Bank, an OECM in the GSL, follow species distribution patterns typically associated with island biogeography. Species richness increased as a function of boulder size in one of four benthoscape classes and in Parent Bank as a whole. Evenness did not increase logarithmically as a function of boulder size. The surrounding habitat matrix, defined using previously assigned benthoscape classes, did not appear to influence richness or evenness on boulders. There was no evidence of non-random co-occurrence or nestedness in boulder communities. Together these results suggest that these boulders do not act as habitat islands. However, boulder communities differed significantly from matrix communities within each benthoscape. Sponges were consistently identified as important indicator species on boulders, suggesting that these geological features are of great importance to the efficacy of Parent Bank as a sponge conservation area.

A Very Lazy Submarine Spring

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Plumes are ubiquitous in nature. A plume is called lazy if it has reduced momentum relative to its buoyancy (i.e. it is slow). The seepage of subterranean water directly into the ocean, termed Submarine Groundwater Discharge (SGD), can often fit this description. SGD is an important source of freshwater and land-based tracers to the coastal ocean. Despite the freshwater volume flux of SGD dominating over rivers locally in some locations, the impact on coastal oceanography from SGD has received much less attention than rivers. Concentrated sources of SGD, referred to as submarine springs, form small-scale (O(1) m or less) plumes that accelerate upward under the action of their own buoyancy. Here, we present an investigation of a submarine spring in western Japan that exhibits lazy plume behaviour. The 1 m deep spring is characterized by high-resolution (5 cm) downward-looking Acoustic Doppler Current Profiler measurements of along-axis vertical velocity. We apply theoretical descriptions of lazy plumes to our observations to infer the volume, momentum, and buoyancy fluxes of the spring. It is found that lazy plume theory describes the observations well and that the freshwater content of the discharging water is unexpectedly low, comprising only 2 % by volume.

POSTER: Characterizing background zooplankton assemblages in current and potential foraging habitat for North Atlantic Right Whales using in situ imaging

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The North Atlantic Right Whale (Eubalaena glacialis; NARW) is an endangered species of baleen whale distributed along the eastern coast of North America. Between 2015 and 2017, NARW shifted their distribution from the Gulf of Maine into the Gulf of St. Lawrence (GSL), tracking a spatial distribution of their primary prey, Calanus spp. copepods. This rapid expansion into new waters led to elevated mortality from vessel strikes and entanglement in fishing gear. Therefore, identifying and characterizing previously unknown potential habitats and seasonal use will allow for the creation of protective policies and predictions of future distributional shifts, ultimately increasing the recovery potential for NARW.

Sporadic acoustic presence and prey abundance estimates indicated that the northeastern GSL could be a potential foraging area for NARW throughout a northward expansion. To evaluate this potential, an Underwater Vision Profiler 6 – High Frequency (UVP6-HF) in-situ imaging sensor was utilized to characterize zooplankton communities in a known NARW foraging habitat in the southwestern GSL, Shediac Valley, and a potential future foraging habitat in the northeastern GSL, Lark Harbour, Newfoundland. Further, background oceanographic conditions were determined using a Conductivity, Temperature and Depth (CTD) profiler and the energetic density of the zooplankton community was determined using oxygen bomb calorimetry.

Results indicate that (1) areas sampled off the western coast of Newfoundland may not currently constitute suitable foraging habitat for NARW, as the background zooplankton assemblages did not maintain the densities likely required for foraging; (2) zooplankton community composition exhibited consistent seasonal variability in the Lark Harbour/TBB region in comparison to the Bonne Bay fjord; and (3) pronounced spatial differences were observed, with the Lark Harbour/TBB region exhibiting higher Calanus spp. biovolume and corresponding energetic density compared to the Bonne Bay fjord. However, this study was spatially constrained to a small area off the western coast of Newfoundland, and further investigation is required for definite inference.

As climate-driven shifts in prey distribution and whale foraging areas are expected to become increasingly common under ongoing anthropogenic climate change, pre-defining potential habitats will be essential for proactive conservation and management of NARW.

POSTER: Spectral Signatures: Improving Cyanobacterial Detection in Aquatic Systems Through Three-Channel Fluorometry

Cora Johnson , Hugh MacIntyre

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Cyanobacteria are a key component of the phytoplankton community from oligotrophic ocean basins to freshwater lakes used as reservoirs and recreational areas. However, their abundance is commonly underestimated in these systems. As many cyanobacteria can be toxic, this is a significant concern. Traditionally, phytoplankton are monitored using fluorometers targeting the ubiquitous pigment chlorophyll-a. These excite fluorescence with blue light (typically 430-470nm) and detect chlorophyll-a's red fluorescence emission (peak at c.685nm). However, this approach does not differentiate between phytoplankton groups and tends to underestimate cyanobacteria, which have phycobilins (phycocyanin and phycoerythrin) that absorb and emit maximally at green and orange wavelengths. Using a three-channel fluorometer, the *tridente* (RBR, Ottawa, ON), targeting chlorophyll-a (Chl-a, 470nm/695nm Ex/Em), phycocyanin (PC, 590nm/654nm Ex/Em), and phycoerythin (PE, 525nm/600nm Ex/Em) should allow for better estimates of abundance. It should allow discrimination between cyanobacteria and the unrelated (and non-toxic) cryptophytes, which also possess phycobilin's but in very different photosynthetic structures. The spectral signatures of select PC- and PE- rich cyanobacteria (*Phormidium persicinum*, *Pseudanabaena sp.*, *Scytonema sp.*, *Rubidibacter lacunae*) and cryptophytes (*Proteomonas sulcata*, *Rhodomonas salina*, *Chroomonas mesostigmatica_cf*) were compared using the *tridente*. A test of the signatures with ANOSIM, a multivariate analog of Analysis of Variance, shows that the instrument can reliably detect and discriminate between the cyanobacteria and cryptophytes. Multichannel fluorescence is a promising technology for improving the monitoring of both the abundance and composition of the phytoplankton at meaningful timescales and with minimal human effort.

POSTER: Building an OpenCTD: Assessing a cost-effective instrument's capabilities for physical oceanography.

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Conductivity, Temperature, and Depth (CTD) instruments are a common oceanographic tool which are often used to obtain measurements of temperature and salinity profiles with depth. CTDs are prohibitively expensive, which can make oceanography inaccessible for many. The OpenCTD, developed by Andrew Thaler and Oceanography for Everyone offers a cost-effective alternative. It is built using parts that are mostly available at local hardware and technology stores and allows anyone to build a CTD for a relatively low cost. To investigate the OpenCTD's capabilities for oceanographic research, I explored the components and built and tested one following the instructions from Oceanography For Everyone. It was straight forward to build and going through the construction process taught me a lot about how CTDs work, how sensors are connected, programmed and calibrated, and how to build something useful for science using the tools I have available. I plan to assess the quality of the OpenCTD's physical oceanographic measurements by calibrating and testing it in laboratory and field settings in comparison to a commercial CTD. I hope to build more OpenCTDs with longer battery life which can be deployed together on a mooring for longer term data collection, and also to experiment with adding different sensors to collect different types of data. The OpenCTD bridges the gap between manufacturer and researcher, empowering ocean-observers to learn how to build, calibrate, modify, and operate the instrument they require for their specific needs.

POSTER: Using Stable Isotopes of Nitrate to Quantify Nitrification in a Coastal Fjord

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Nutrient concentrations in coastal bays have increased worldwide over recent decades due to anthropogenic inputs such as wastewater discharge. These elevated nutrient levels may be driving increased microbial activity, including nitrification and denitrification. As a result, the production of nitrous oxide (N_2O), an intermediate of denitrification and a byproduct of nitrification, may also be increasing. N_2O is a potent greenhouse gas with a global warming potential of approximately 300 times that of CO_2. Therefore, it is important to better understand the link between nutrient inputs and greenhouse gas production.

Our study site, the Bedford Basin (BB), is a coastal fjord located between Halifax and Dartmouth, Nova Scotia. The BB is eutrophied year-round due to wastewater inputs and has surface waters that are supersaturated with N_2O. To quantify how much wastewater is contributing to this atmospheric source of N_2O, the absolute rates of nitrification must be determined.

To do so, an inverse numerical model was developed using data from the Bedford Basin Monitoring Program, a weekly timeseries of oceanographic collected by The Bedford Institute of Oceanography since 1992. This timeseries contains CTD sensor data and analyzes various parameters, including NO_3^- isotopes (δ15N and δ18O), oxygen, nutrient, and N_2O measurements.

Model-data comparisons highlight sensitivity of inferred nitrification rates to ammonium pool dynamics, episodic mixing, and sedimentary fluxes, indicating that improved constraints on these processes are required to accurately estimate the absolute rates of nitrification.

POSTER: Isotope fractionation during nitrate assimilation by phytoplankton

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Phytoplankton plays an important role in nitrogen cycling and carbon sequestration. *Phaeocystis spp.* is a dominant group of phytoplankton in the Labrador Sea. Measuring isotope fractionation during nitrate assimilation provides an understanding of how *Phaeocystis* utilizes nitrogen. However, not much is known about the extent to which their assimilation of nitrogen fractionates. Consequently, the primary objective of this project is to measure nitrogen and oxygen isotope fractionation of nitrate during assimilation by a culture of *Phaeocystis pouchetii.* To achieve this, I maintained a phytoplankton culture of *Phaeocystis pouchetii* that was originally collected from the Lincoln Sea in the Arctic Ocean. The first stage of the project involved determining the growth rate of the culture, which provided a foundation for subsequent experiments. I monitored nitrogen assimilation and growth of the culture by tracking fluorescence as a proxy for biomass, alongside samples of dissolved nitrate over time. I analyzed samples to determine the isotope ratios of nitrogen and oxygen in nitrate and how this changed through the course of nitrate consumption. Initial nitrate concentrations were varied to assess how nutrient availability influences isotope fractionation during assimilation. Preliminary results showed a higher isotope fractionation rate than was expected. This could mean *Phaeocystis* has a higher impact on the isotope signatures of nitrate than originally expected. These findings will help us interpret the biogeochemistry of the ocean through isotope field samples of the water column and sediments. Furthermore, it could be used to further understand how *Phaeocystis* blooms in the Labrador Sea, Arctic and Northwest Atlantic impact nitrogen cycling and carbon storage.

POSTER: Bio-Receptivity of Phytoplankton-Enriched Concrete: A Material that Couples Wastewater Remediation to Carbon Capture and Sequestration

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Climate change causes larger storms, rising sea levels, and habitat loss, driving an increased need for coastal armoring and reef restoration. Seawalls and Artificial Aquatic Habitats are normally made of concrete, however, concrete production accounts for approximately 8% of anthropogenic greenhouse gas emissions (Monteiro et al., 2017). To avoid a positive feedback loop, the concrete industry must be decarbonized. We have formulated a concrete mixture enriched with an algal admixture – Phycocrete – that sequesters the CO2 captured during growth without decreasing the strength of the material. The alga is an extremophilic isolate from Nova Scotia and is grown in a medium of amended tertiary-treated municipal wastewater. To assess the marine applications of this material, we compared the bio-receptivity of pucks made of Phycocrete to control pucks made of regular concrete. Seventy-two pucks were submersed for five weeks at a shallow water mooring in Mahone Bay, Nova Scotia, and sampled weekly to assess biofilm growth. Biomass accumulation on the pucks was measured using extracted chlorophyll a and spectral reflectance. Physiological status was interrogated using variable fluorescence. We measured vigorous periphyton growth on the pucks over time, with chlorophyll concentrations reaching an average concentration of 7.49 ± 0.86 mg/m^2 after one month. Importantly, through a nested ANOSIM, we determined there was a significant increase in the biofilm over time (p lt 0.001) but no significant difference in biomass accumulation or periphyton photo-physiology between regular concrete and Phycocrete within sampling intervals ($p = 0.48$). This preliminary experiment suggests that Phycocrete could be used in marine applications – including Artificial Aquatic Habitats and seawalls – to couple wastewater remediation, carbon capture, and sustainable building.

POSTER: Numerical Study of Circulation and Sea Ice Over the Labrador Sea and Adjacent Coastal Waters

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The Labrador Sea is an important basin in the Northwest Atlantic where ocean circulation, stratification, and sea ice variability interact to shape the regional hydrographic structure. During winter, strong atmospheric cooling can destabilize the water column and drive open-ocean convection, allowing dense surface waters to sink and mix with deeper layers. This process leads to the formation of Labrador Sea Water (LSW), an intermediate water mass that contributes to large-scale ocean circulation. Although convection is an important process, Labrador Sea variability is also influenced by mesoscale circulation, with boundary currents and eddies playing a role in stratification and water-mass formation throughout the basin. Representing these interacting processes remains challenging in ocean general circulation models (OGCMs), as coarse-resolution models often struggle to accurately capture the dynamics that regulate variability in the region. To address these challenges, this study analyzes a three-year simulation generated using a coupled Regional Ocean Modelling System and Community Ice CodE (ROMS–CICE). The parent model simulates ocean circulation and sea-ice interactions across the Northwest Atlantic, providing estimates of temperature, salinity, and sea ice concentration in the Labrador Sea. Model output is evaluated against observational estimates to assess the model's ability to reproduce the seasonal hydrographic structure and variability of the region. To better resolve regional ocean and sea ice dynamics, a higher-resolution child model will be nested within the parent domain. Nested-grid modelling allows mesoscale features to be represented more realistically while maintaining manageable computational costs. By improving the representation of these processes, this study aims to provide a more accurate depiction of the hydrodynamics in the Labrador Sea and adjacent coastal waters and its role in regional variability.

Effects of Light, Temperature, and Growth Rate on the Transcriptome of *Synechococcus*

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A key goal of biological oceanography is to describe the variability and distribution of species throughout the ocean. Biological oceanography however is a chronically under sampled field. This paired with the highly dynamic nature of the ocean makes it difficult to piece together a full picture through a scattered mosaic of research cruises. For this reason, highly sensitive and data rich methods of measurement are especially powerful. Transcriptomics has the potential to quantify species-specific physiological parameters of in situ populations, such as growth rate, carbon content, nutrient limitation, and light and temperature stress. For this to become a reality, transcriptomic lab studies are required to determine how gene expression shifts with each of these conditions. Here we utilize quantitative transcriptomics to analyze patterns in gene expression of cultured *Synechococcus* as light and temperature are varied. Through this, we hope to define benchmarks for predicting growth, carbon content, and light and temperature stressors of *Synechococcus*.

Using quantitative metabarcoding to evaluate zooplankton community composition in the Labrador Sea

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The Labrador Sea is an important region of the Northwest Atlantic where unique oceanographic processes create the biological carbon pump (BCP). Deep Winter convection, reaching depths of up to 2300 m, replenishes surface nutrients, while seasonal stratification following sea-ice melt initiates intense spring phytoplankton blooms. These blooms have been historically dominated by diatoms but are being increasingly influenced by *Phaeocystis* and other taxa, driving primary production and carbon export. As phytoplankton biomass accumulates and grazing pressure increases, zooplankton convert this production into energy-rich lipids and rapidly sinking particulate organic carbon, linking surface productivity to deep ocean carbon sequestration. Mesozooplankton (0.2–20 mm) play a central role in the BCP through faecal pellet production and diel vertical migration, enhancing carbon flux. Community composition and biomass determine the magnitude and efficiency of carbon export, yet taxonomic resolution remains limited using traditional morphological approaches. To address this, we applied a metabarcoding framework to characterize zooplankton communities and quantify methodological biases. Zooplankton samples from 2022 and 2024 were size-fractionated, freeze-dried, homogenized, and DNA extractions were performed. A synthetic spike-in (2.5% of total DNA) was incorporated into the 18s rRNA barcode to enable quantitative assessment of sequencing performance. Mock communities composed of equal DNA contributions from 18 representative taxa were constructed to evaluate amplification bias. Libraries targeting the COI and 18S rRNA V4 barcodes were prepared and sequenced on an Illumina NextSeq PE300 platform (50,000 reads per sample per barcode). This integrative approach enables high-resolution assessment of zooplankton community structure and methodological bias, providing improved understanding of community composition and carbon export potential in the Labrador Sea. Understanding these dynamics is essential for predicting how climate-driven shifts in plankton communities may alter the efficiency of the Northwest Atlantic biological carbon pump.

Stable Preformed pCO2 and pH in the Cold Intermediate Layer of the Gulf and Lower St. Lawrence Estuary over Two Decades of Rising Atmospheric CO_2

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The upper layers of the ocean are typically expected to track rising atmospheric CO_2 as a result of air-sea gas exchange, leading to progressive acidification of surface and recently ventilated subsurface waters. Atmospheric CO_2 has increased by 40 μatm between 2003 and 2023 (380 to 420 μatm). Here we assess whether this atmospheric increase has propagated into the Cold Intermediate Layer (CIL) of the Gulf and Lower St. Lawrence Estuary, a winter-formed water mass that persists beneath summer stratification at depths down to 150 m. Using a harmonized 20-year (2003-2023) biogeochemical dataset, we reconstruct a time-series of preformed carbonate chemistry of the CIL to assess how anthropogenic CO2 has propagated into this seasonally-ventilated water mass. Preformed dissolved inorganic carbon (DIC_0) and total alkalinity (TA_0) were calculated by removing the imprint of microbial remineralization using apparent oxygen utilization (AOU). Preformed pCO_2 was then computed for the CIL ($50-150$ m) at the inferred ventilation temperature (Tvent = Tmin). Surprisingly, preformed pCO_2 in the CIL remained stable at 395-405 μatm with no detectable trend over two decades. Similarly, DIC_0, TA_0, and pH exhibited no secular increase. This stability occurs alongside a previously documented 1°C warming of the winter mixed layer. The absence of an increasing preformed CO_2 signal suggests that winter-time ventilation is insufficient to allow the CIL to track the atmospheric CO_2 increase. We hypothesize that this decoupling may reflect (i) incomplete winter air-sea equilibration during CIL formation and (ii) the influence of preconditioned, relatively poorly-ventilated Arctic-derived source waters entering through the Strait of Belle Isle from the Labrador Current. The results indicate that renewal timescales, source-water pathways, and restricted air-sea exchange can delay or modulate transmission of anthropogenic CO_2 into some shallow water masses found in seasonally ventilated marginal seas. Such dynamics have implications for predicting subsurface acidification and for evaluating the regional effectiveness of deliberate marine carbon dioxide removal.

A quantitative comparison of physical supply and biological uptake of new nitrogen in the Arctic Ocean

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Nitrogen constrains biomass across the Arctic Ocean, with nitrate (NO_3) supply to the surface waters fueling new primary production and net carbon drawdown. In this Review, we explore the physical mechanisms driving NO_3 fluxes to the euphotic zone across the Arctic Ocean and how biological processes respond. The volume and inflow depth of Atlantic and Pacific Ocean waters, together with sea ice and halocline dynamics, govern internal physical mixing of NO3. Respectively, these inflows supply 34 ± 5 kmol NO_3 s^{-1} and 9 ± 1 kmol NO3 s^{-1}, spreading at mid-depth. NO_3 from below the euphotic zone is mixed upwards via several mechanisms. Overall, NO_3 fluxes associated with diffusive and turbulent mixing, submesoscale fronts, and cyclonic mesoscale eddies are relatively low (on the order of 0.1-0.7 mmol m^{-2} d^{-1}) but cover a large area, with peaks associated with wind events or individual strong eddies. By comparison, upwelling-driven fluxes are much stronger (on the order of 1 mmol m^{-2} d^{-1}) but are more localized. Near inertial and tidal mixing over the Arctic Ocean's complex bathymetry drive perhaps the strongest NO_3 fluxes, for example reaching 4.5 mmol m^{-2} d^{-1} in the Barents Sea. Comparing these fluxes with observed biological NO_3 uptake rates indicates that the internal physical supply of NO_3 only limits primary productivity in 9 of 17 of the cases considered. Thereafter, light limitation and lagged growth responses can result in excess NO_3 remaining in the surface waters. Future research should prioritize linking NO_3 supply and uptake at corresponding spatiotemporal scales.

Characterizing Anthropogenic Nutrient Sources to a Eutrophic Urban Fjord

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The Bedford Basin (BB) is a eutrophic urban fjord located in Halifax, NS, Canada. Anthropogenic nutrient loading from multiple wastewater treatment facilities and the Sackville River makes the basin a source of nitrous oxide (N_2O), a potent greenhouse gas, to the atmosphere.

Nutrient concentrations at the wastewater outfalls were observed to be 10 to 100 times larger than other regions of the BB. Outfalls with consistently high ammonium concentration showed N_2O saturation levels between 200-1200%. While the surface water of the BB is normally supersaturated with N_2O, outfalls with high ammonium concentrations in the surface water act as a localized hotspot for increased N_2O outgassing, comparatively to other regions. The effectiveness of the outfall diffuser pipes and physical mixing play a major role in diluting the concentration of ammonium after input which can prevent elevated saturation levels of N_2O.

Timeseries datasets of nutrients, natural abundance stable isotopes of nitrogen and oxygen in nitrate, and N_2O concentrations at these sources have been collected. We aim to quantify the impact that the addition of these nutrients have on primary production, hypoxia and N_2O production in the basin.

Exchanging knowledge in Nain, Nunatsiavut: a full circle collaboration

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My project focuses on carbon storage in Arctic and subarctic sediments with the Nunatsiavut Government as an important partner. For the past 4 years, our lab group has been steaming along their coastline to collect sediment samples to better understand the regional biogeochemistry. As my first chapter nears completion, it was important to return these findings Nunatsiavut. With support from the OFI Knowledge Mobilization Fund, I travelled to Nain in January to present what we learned from their fjords to their government and people. The visit was designed as a two-way knowledge exchange, emphasizing discussion rather than one-directional scientific communication. This experience challenged me to expand my communication skills beyond traditional academic approaches and to engage with people in conversations about mud that felt accessible and meaningful. In this talk I will reflect on some of the activities that helped communicate our research findings more effectively and other lessons I learned from visiting a northern community. What do mediation, an artist, sourdough bread and mud have in common? You're about to find out.