EEB313H Proposal (Naveen David, Silas Peters)

Phytoplankton are integral players in the global carbon cycle and nutrient cycle, contributing nutrients to many marine life (Falkowski, 2012). Zooplankton are integral for aquatic food chains and can be important bioindicators for changes in marine ecosystems (US EPA, 2013). Thus, understanding how these taxa are responding to climate change and subsequent ocean acidification is integral to understanding how these changes may then impact the rest of the marine ecosystems.

Our project aims to understand how ocean acidification affects plankton by examining the historical effects of acidification on plankton abundance and modelling this into the future to predict how abundance may change. Our hypothesis is that ocean acidification will affect plankton abundance and community composition. Certain plankton are more susceptible to acidification than others (Ex – Spisla et al., 2021). Thus, we predict that as acidification increases, sensitive plankton taxa will decrease in abundance. We also predict that changes in abundance will worsen over time, and as we project these abundances into the future, the change will be more drastic as ocean acidification continues. Along with understanding how ocean acidification is affecting plankton currently, we also aim to use our current data to project plankton abundance into the future.

To do this investigation, we will be using two datasets. The first dataset, CPR plankton abundance in the WN Atlantic 1958 – 2021, is the result of continuous long-term monitoring across the last 90 years. Plankton are identified to various taxonomic levels. Sampling for this dataset was outlined in Richardson et al (2006). Essentially, plankton is collected using a Continuous Plankton Recorder which is towed behind ships at approximately a depth of 7 m. Samples are split into 10 nautical miles of tow. Phytoplankton colour is noted, the number of phytoplankton present on the filters is estimated, zooplankton under 2 mm are counted from 1/50 of the filter and estimated for the rest of the sample, and zooplankton over 2 mm in length are removed and identified (Richarson et al, 2006**)**. In the data set, the plankton abundance is shown by taxa, which is identified by an accepted ID (a unique CPR identifier). Thus, we will be using the columns of id_# and the rows, which represent abundance.

The second dataset is from continuous recording of ocean chemistry parameters from 1983 to 2013. This dataset was collected by the Icelandic Marine Research Institute in the North Atlantic and accessed through NOAA (Ólafsson, Jón (2016)). Data collection was done through sensors on moored buoys in the ocean. The dataset contains information on partial pressure of carbon dioxide (pCO2), which would be expected to increase as atmospheric CO2 increases. While the dataset does not contain information on pH, it can be expected that pH increases with pCO2.

References

Falkowski, P. (2012). Ocean Science: The power of plankton. *Nature*, *483*(7387), S17–S20. https://doi.org/10.1038/483S17a

Spisla, C., Taucher, J., Bach, L. T., Haunost, M., Boxhammer, T., King, A. L., Jenkins, B. D., Wallace, J. R., Ludwig, A., Meyer, J., Stange, P., Minutolo, F., Lohbeck, K. T., Nauendorf, A., Kalter, V., Lischka, S., Sswat, M., Dörner, I., Ismar-Rebitz, S. M. H., … Riebesell, U. (2021). Extreme Levels of Ocean Acidification Restructure the Plankton Community and Biogeochemistry of a Temperate Coastal Ecosystem: A Mesocosm Study. *Frontiers in Marine Science*, *7*. https://doi.org/10.3389/fmars.2020.611157

Richardson, A. J., Walne, A. W., John, A. W. G., Jonas, T. D., Lindley, J. A., Sims, D. W., Stevens, D., & Witt, M. (2006). Using continuous plankton recorder data. *Progress in Oceanography*, *68*(1), 27–74. https://doi.org/10.1016/j.pocean.2005.09.011

US EPA, O. (2013, November 21). *Indicators: Zooplankton* [Overviews and Factsheets]. https://www.epa.gov/national-aquatic-resource-surveys/indicators-zooplankton

Partial pressure (or fugacity) of carbon dioxide, dissolved inorganic carbon, temperature, salinity and other variables collected from discrete sample and profile observations using CTD, bottle and other instruments from ARNI FRIDRIKSSON and BJARNI SAEMUNDSSON in the North Atlantic Ocean from 1983-03-05 to 2013-11-13 (NCEI Accession 0149098). NOAA National Centers for Environmental Information. Dataset. https://doi.org/10.3334/cdiac/otg.carina_irmingersea_v2. Accessed 15 Oct 2024.