Finding the baseline: Relating environmental seasonality in a sub-Arctic coastal region to species distributions and life histories

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The marine environment is anything but uniform. It exhibits considerable variability over space and time. The lack of comprehensive data on variability in the inorganic carbon system in coastal regions limits understanding of a) the movement of inorganic carbon among Earth's spheres and b) the implications of CO_2 induced ocean acidification.

In this study we characterize the temporal (seasonal) and spatial environmental variability in a sub-Arctic bay in Iceland, Breiðafjörður. Data on temperature, salinity, nutrients, chlorophyll *a* and the inorganic carbon system (pCO_2 and DIC) was collected on 20 sampling surveys conducted from April 2010 through May 2011. Other parameters of the inorganic carbon system were calculated (i.e. pH, calcium carbonate saturation states (Ω), etc).

There was significant seasonality observed in temperature, nutrients, chlorophyll *a* and the inorganic carbon system. Temperatures ranged from -0.8°C in winter to 14°C in summer. Over the summer, new production was limited through nitrate depletion but in winter, phytoplankton biomass was negligible. Breiðafjörður was a net sink of atmospheric CO_2 at a rate of 1.8 ± 0.2 mol C m^{-2} y^{-1} with surface pCO_2 ranging from 212 to 417 µatm from summer to winter. Surface seawater pH_T ranged from 8.02 to 8.27 and $\Omega_{aragonite}$ ranged from 1.5 to 3, from winter to summer respectively.

We relate species distributions and life histories to the environmental variability, paying particular attention to taxa (e.g. calcifyers) and life-stages (generally early life-stages) that are considered sensitive to ocean warming and/or ocean acidification. This approach allows for a holistic view of coastal systems. However, this work also highlights important knowledge gaps that limit our understanding of how ocean warming and ocean acidification will affect coastal ecosystems in the future.