Ocean Acidification Impacts in the Western Arctic Ocean

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U.S. DEPARTMENT OF COMMERCE

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Arctic Seawater CO_2-carbonate chemistry

$$CO_{2atm} + H_2O = [CO_2^*]_{sea} = HCO_3^-] + [H^+] = [CO_3^{2-}] + [H^+] \quad (1)$$

Observed and calculated seawater CO_2-carbonate chemistry

Dissolved inorganic carbon (DIC)

- DIC = $[HCO_3^-] + [CO_3^{2-}] + [CO_2^*]$

Total Alkalinity (TA)

- TA = $[HCO_3^-] + 2[CO_3^{2-}] + [B(OH)^-] + [OH^-] - [H^-]$

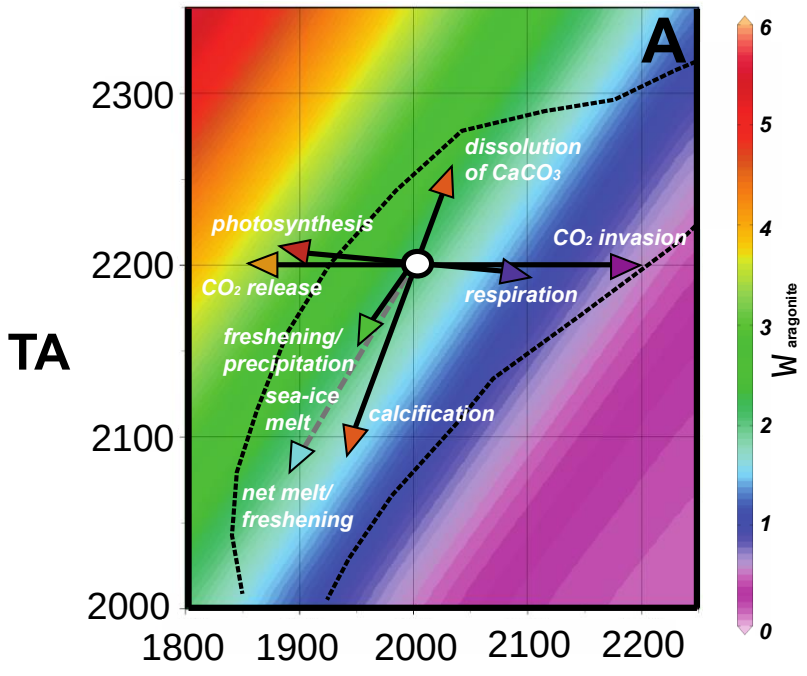
Partial pressure of CO_2

- pCO_2 or fCO_2

pH

- $-\log_{10}[H^+]$

Physico-biogeochemical processes (e.g., sea-ice melt, production, air-sea fluxes) impacting $CaCO_3$ saturation states and OA



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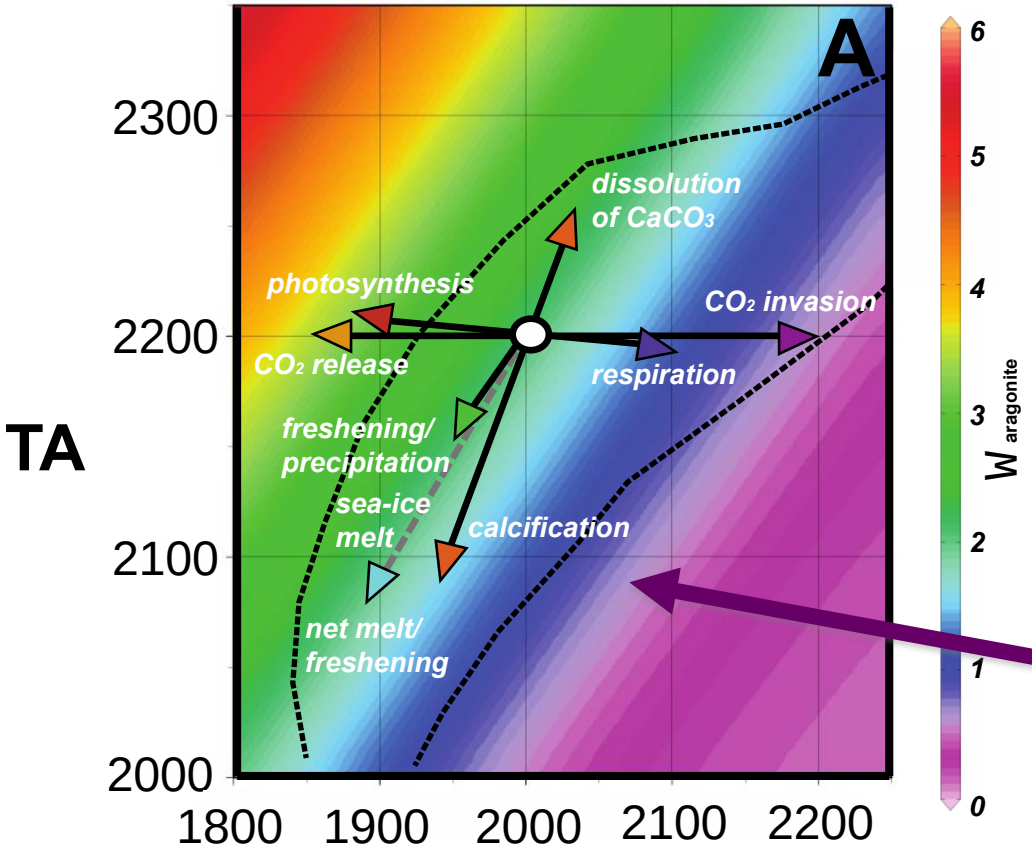
Ocean Acidification (OA) Impacts

5. A new assessment of the impact of ocean acidification (OA) on the bottom waters of the eastern East Siberian Sea and western Chukchi Sea shelves will be made, and their potential impact on benthic calcifying organisms.



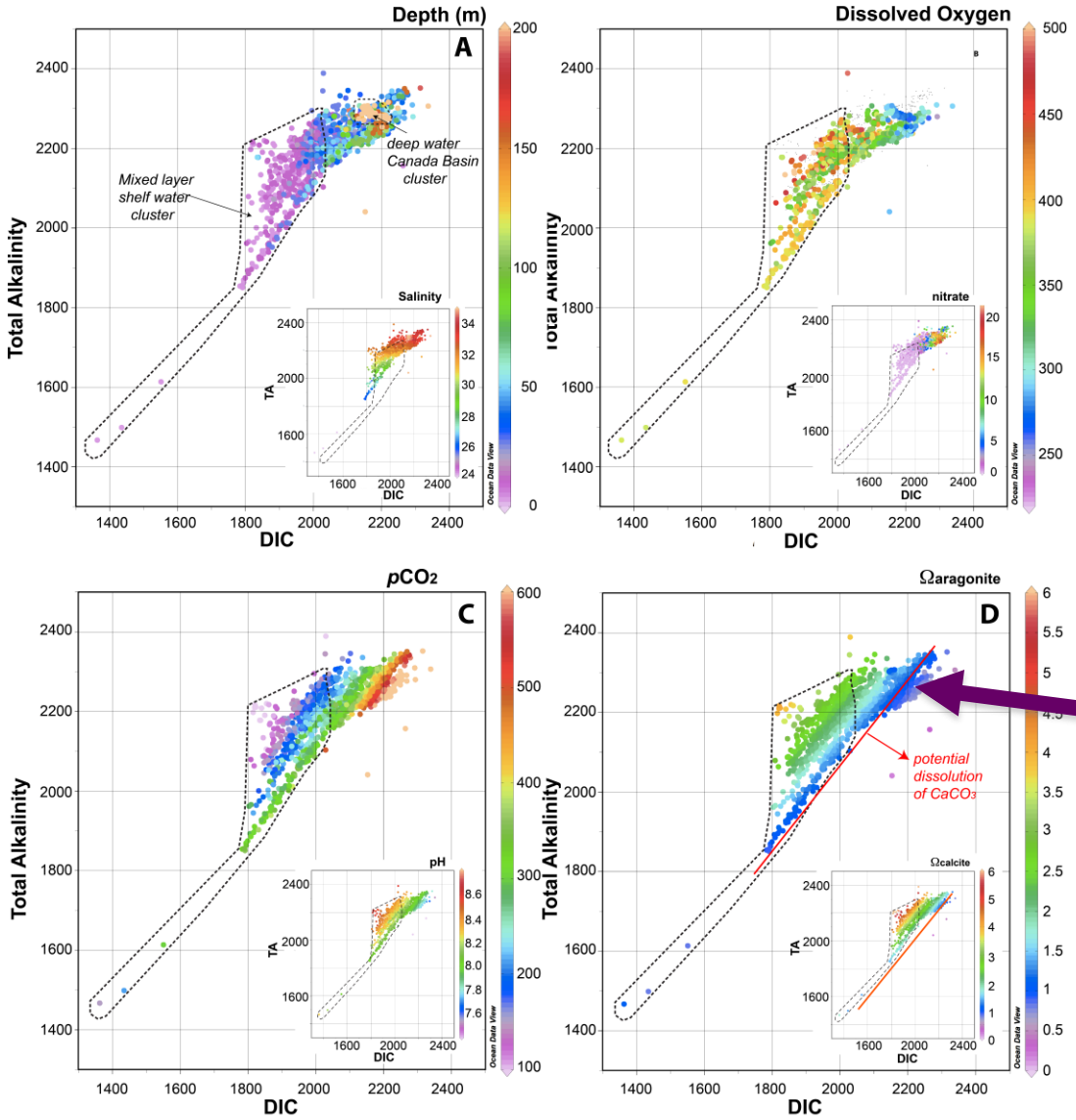
Physico-biogeochemical processes impacting $CaCO_3$ saturation states (i.e., $\Omega_{aragonite}$ less than one facilitates dissolution)

Potential dissolution of $CaCO_3$ (blue and purple colours in next slides)

Dotted line denotes envelope of RUSALCA data

Western Arctic Inorganic Carbon

RUSALCA and ICESCAPE Distributions

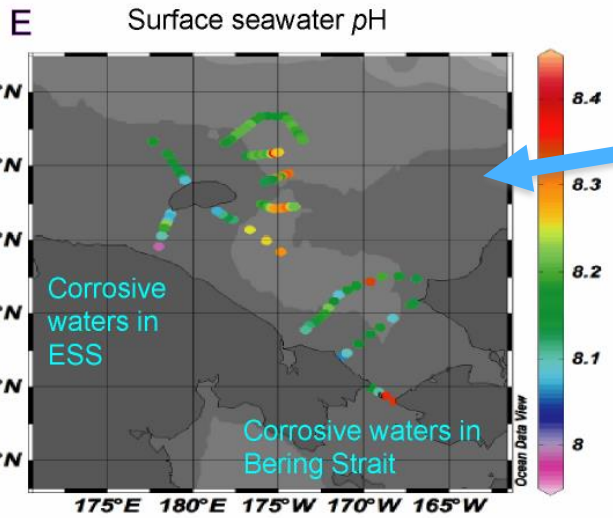


Potential dissolution of $CaCO_3$ (blue and purple colours)

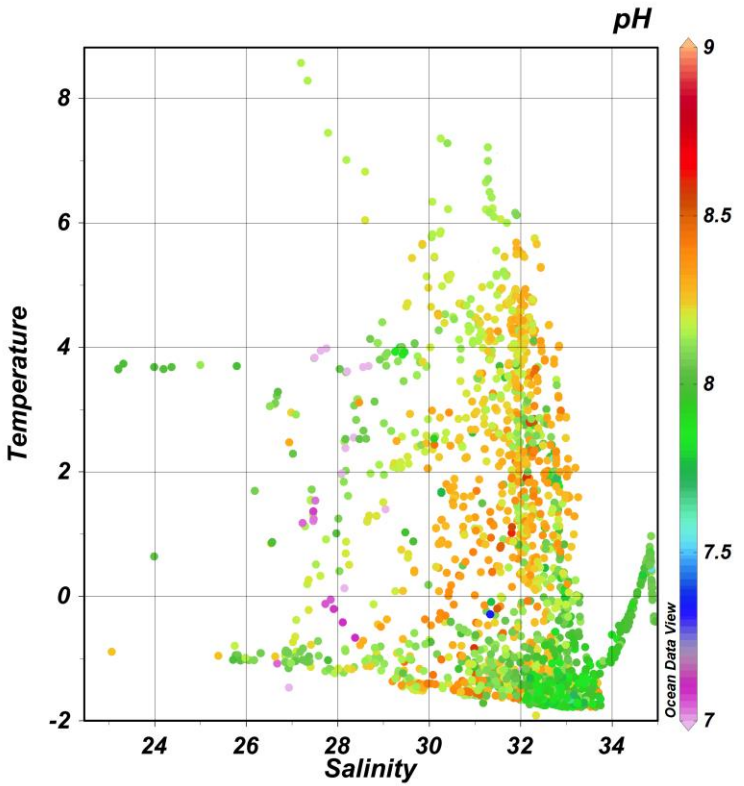
N.R. Bates, RUSALCA 2014

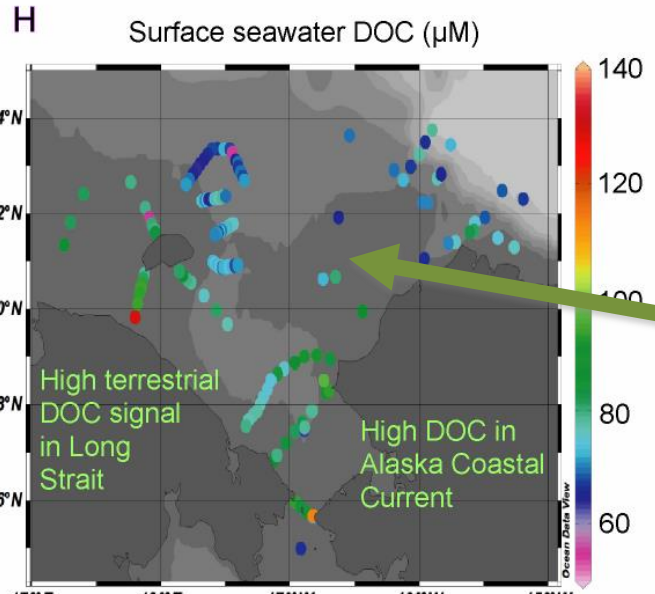
Hypothesis testing, data synthesis and interpretation

4. Assessment of the Impact of Ocean Acidification in the western Arctic Ocean



areas of low seawater pH





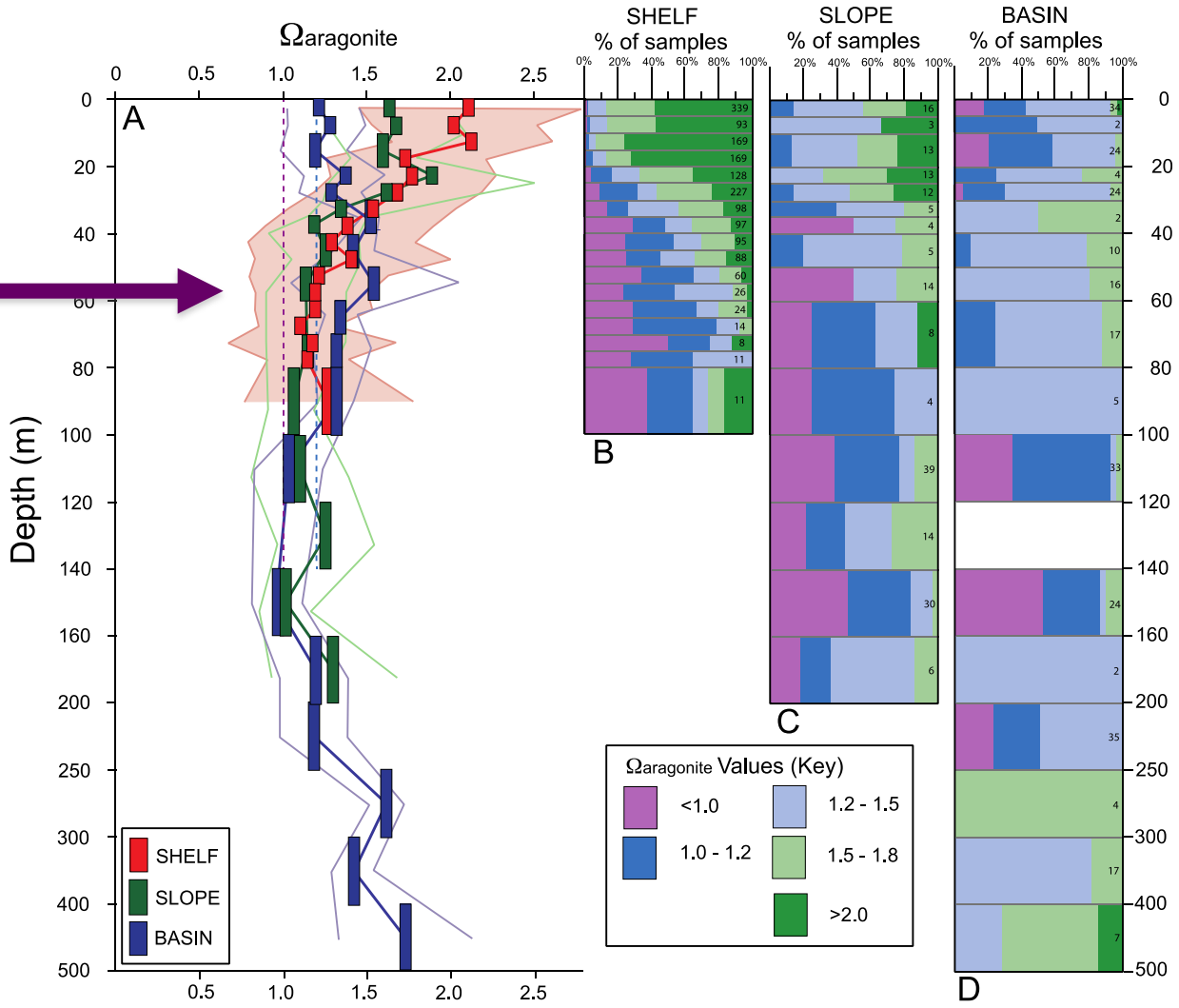
areas of higher DOC content

Hypothesis testing, data synthesis and interpretation

4. Assessment of the Impact of Ocean Acidification in the western Arctic Ocean

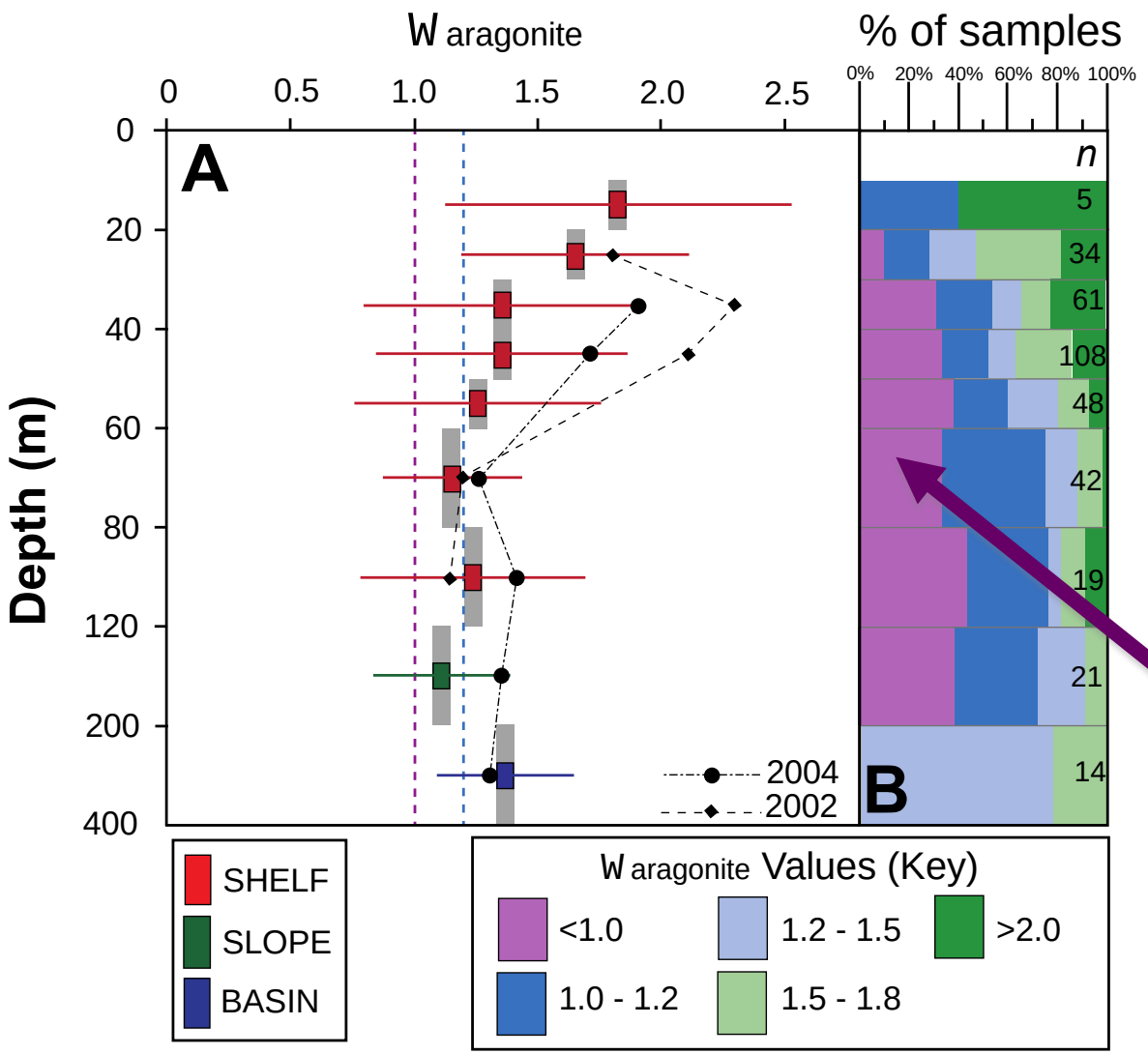
Arctic highly vulnerable to OA

Areas of low seawater saturation state for $CaCO_3$ minerals. Much of the Chukchi Sea benthos exposed to bottom waters that are corrosive to $CaCO_3$ during summertime.



RUSALCA data combined with 2010/2011 ICESCAPE data

Western Arctic OA Impacts



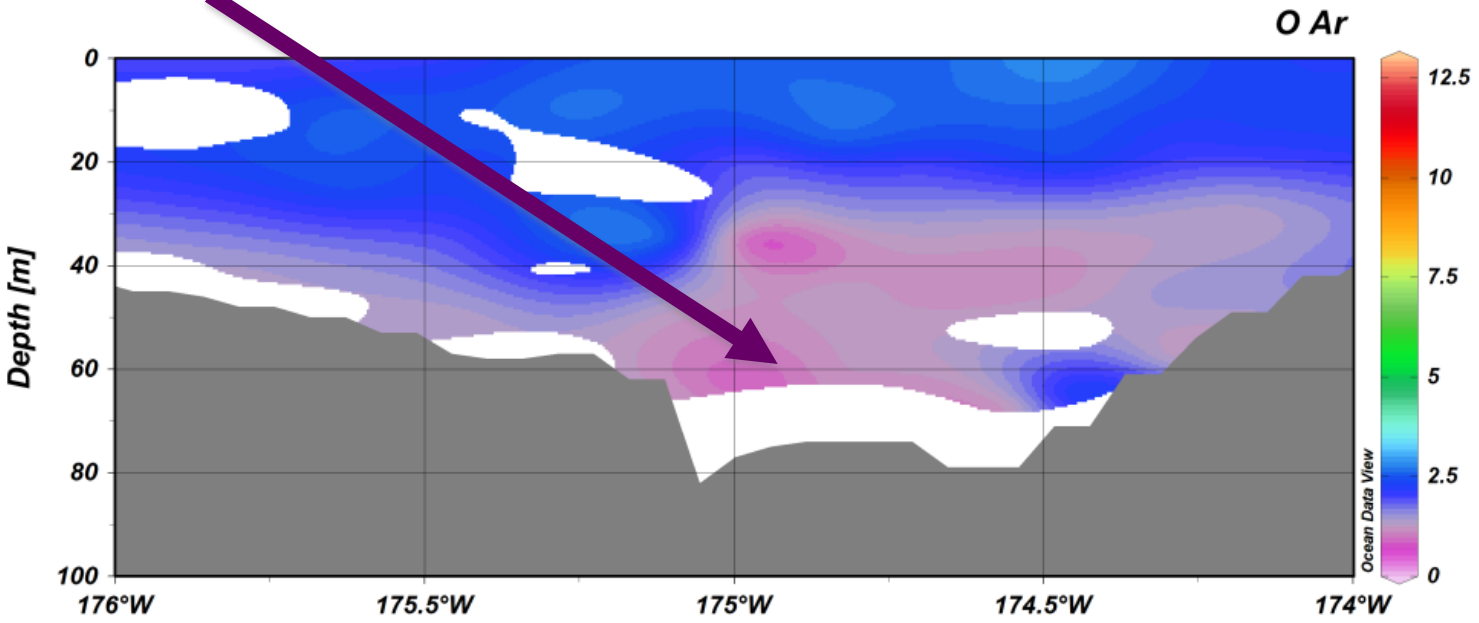
Areas of low seawater saturation state for $CaCO_3$ minerals. At least 40% of the Chukchi Sea benthos is exposed to bottom waters that are corrosive to $CaCO_3$ during summertime

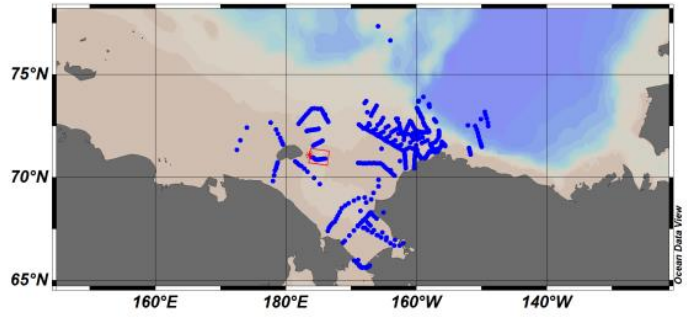
Hypothesis testing, data synthesis and interpretation

4. Assessment of the Impact of Ocean Acidification in the western Arctic Ocean

Outflow of corrosive bottom waters through Herald Valley

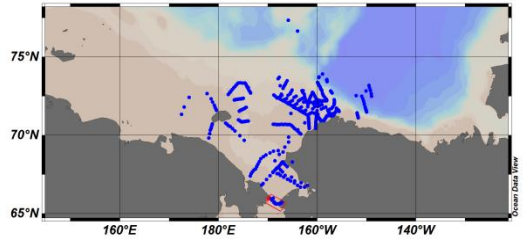
Chukchi Sea and ESS highly vulnerable to OA

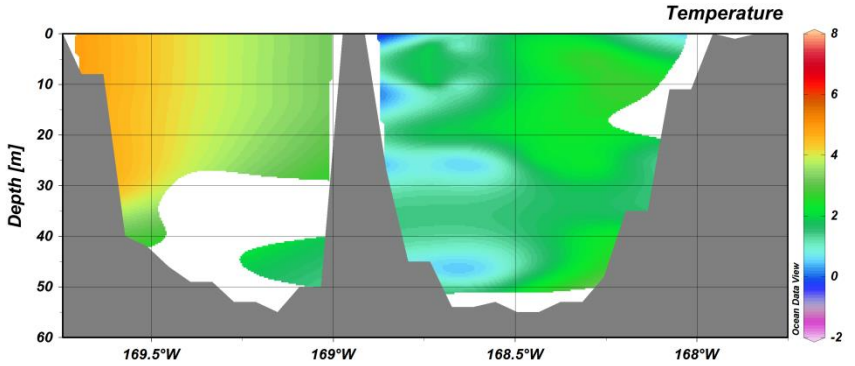


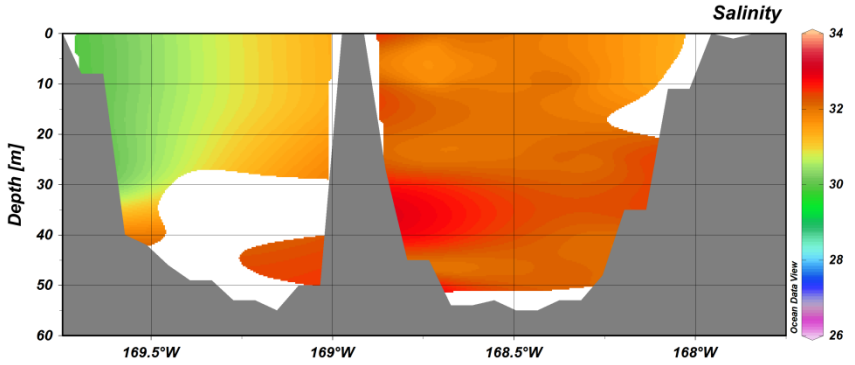


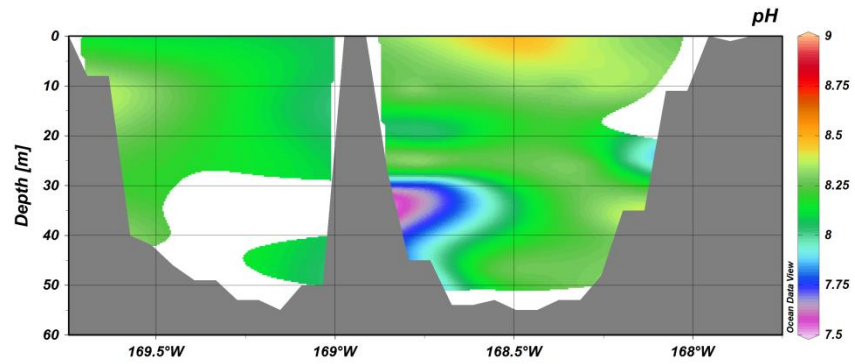
Bering Strait OA

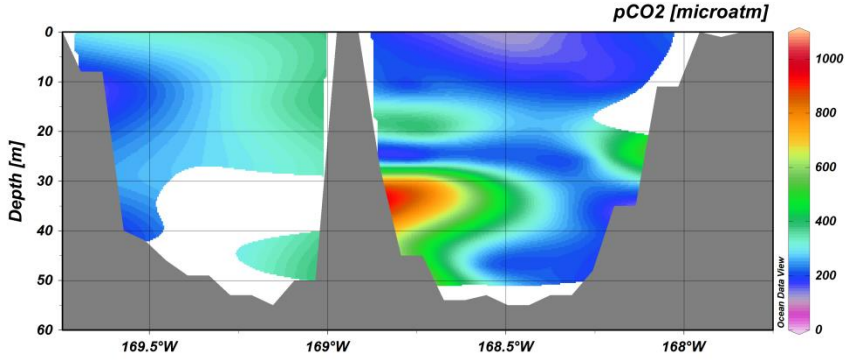
Sections of data combining 2009 RUSALCA and 2010/2011 ICESCAPE

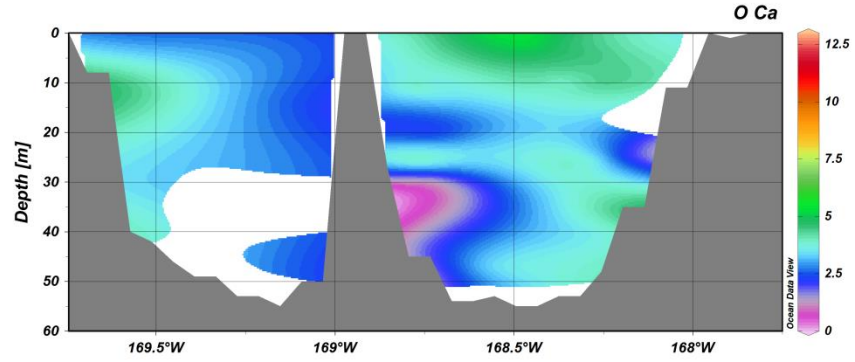


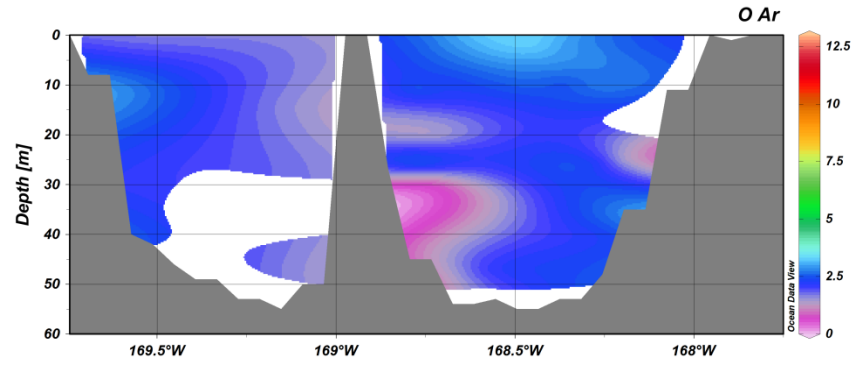








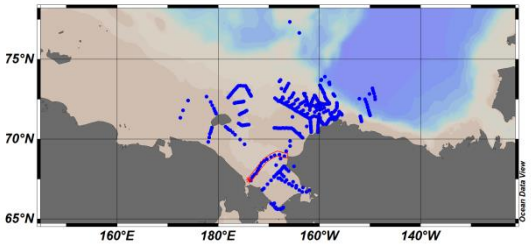


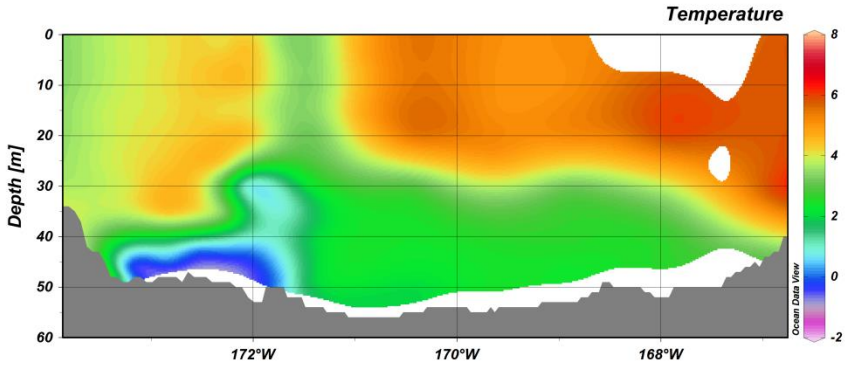


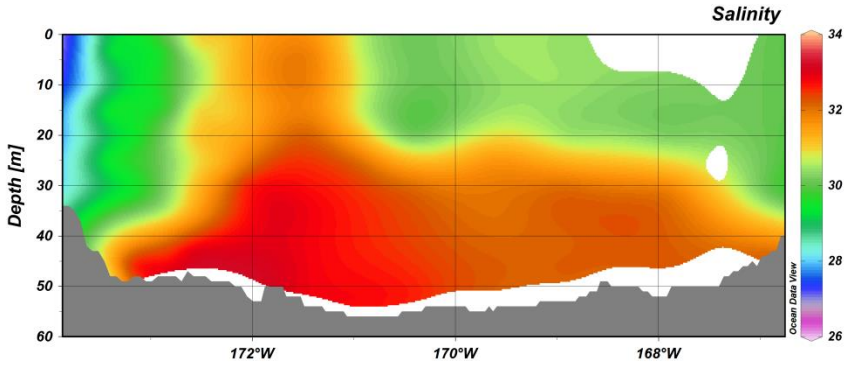
RUSALCA data combined with 2010/2011 ICESCAPE data

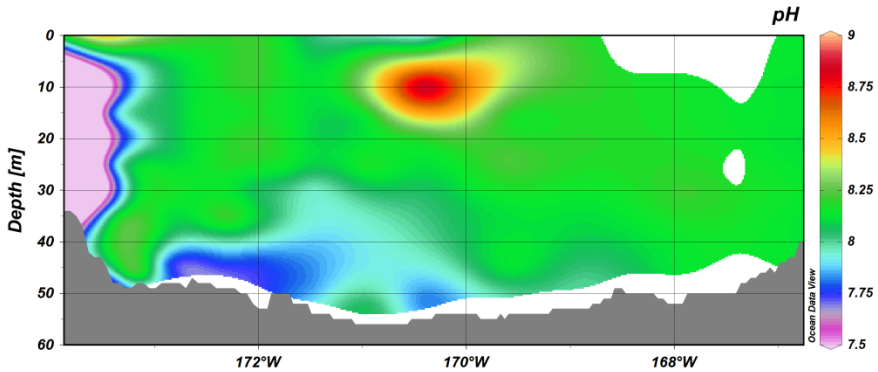
Alyatki to Cape Lisburne

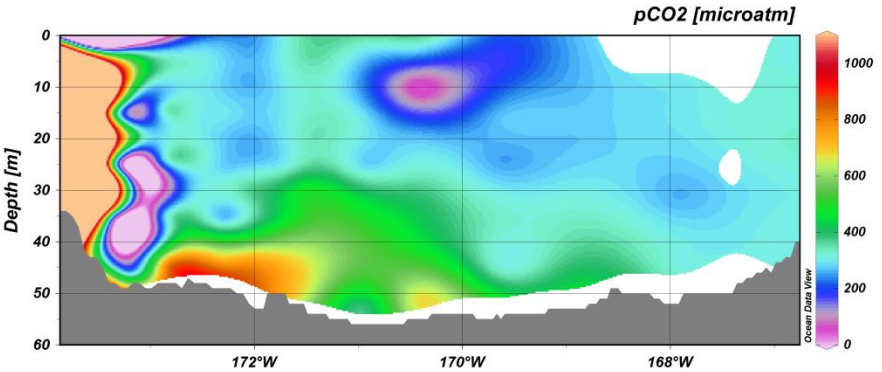
Sections of data combining 2009 RUSALCA and 2010/2011 ICESCAPE

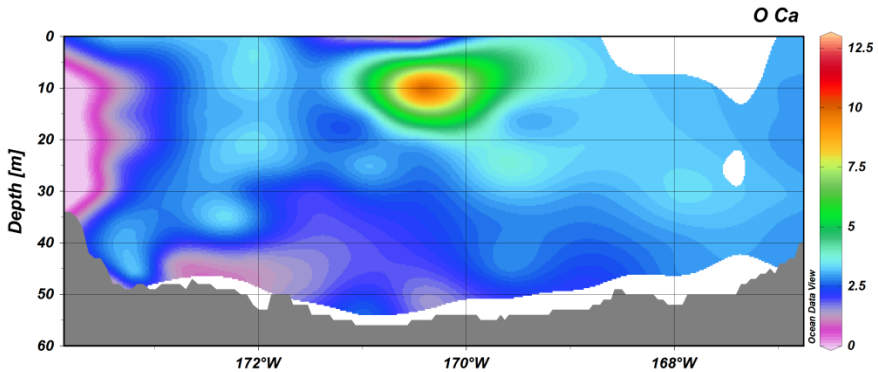


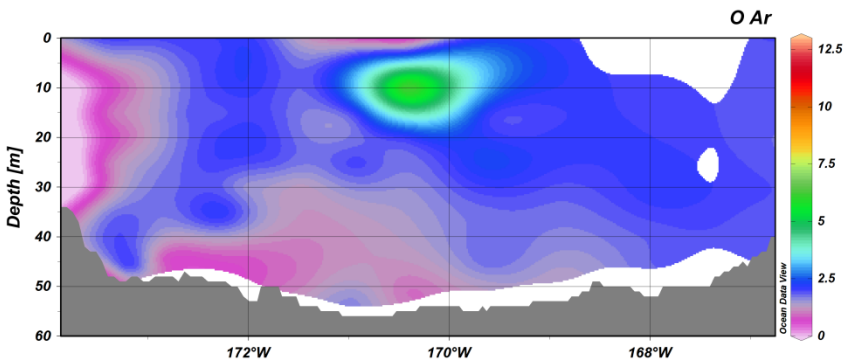








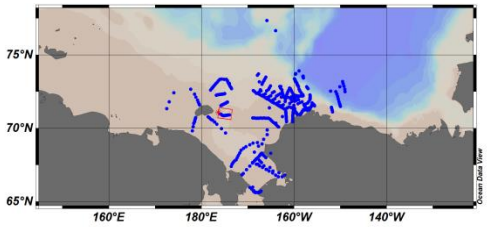


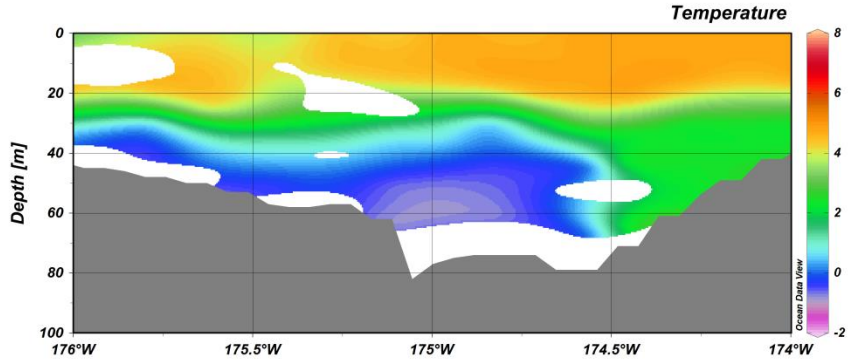


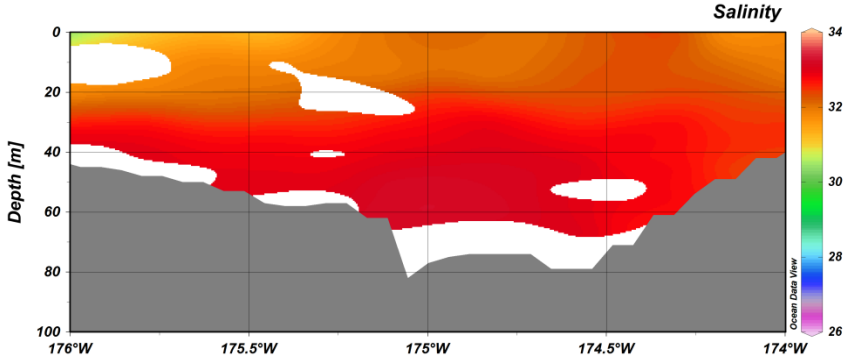
RUSALCA data combined with 2010/2011 ICESCAPE data

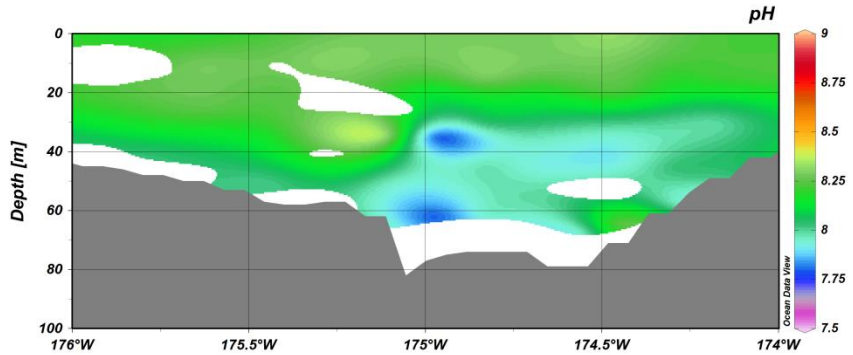
Herald Valley

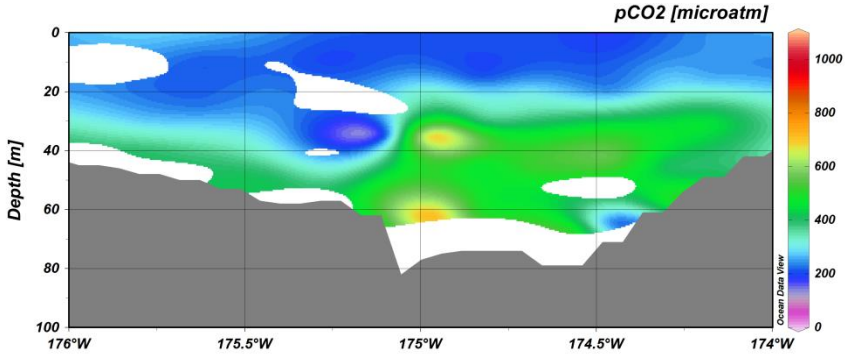
Sections of data combining 2009 RUSALCA and 2010/2011 ICESCAPE

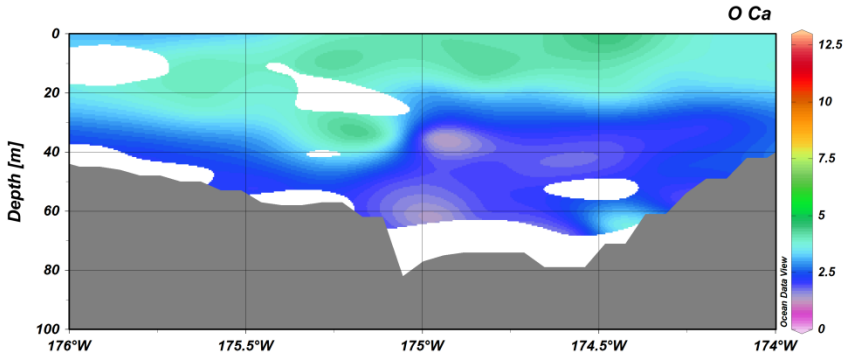


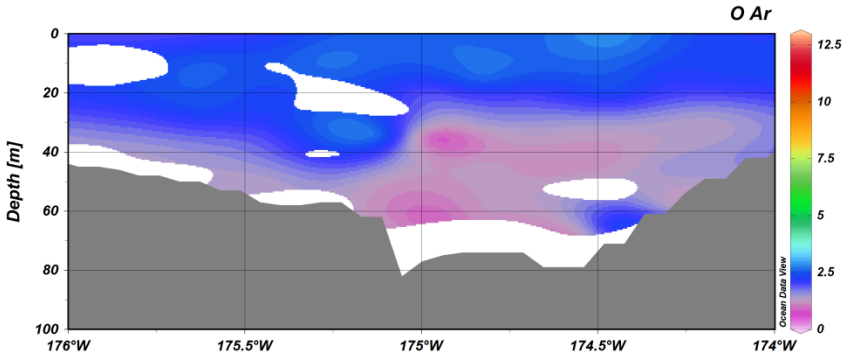








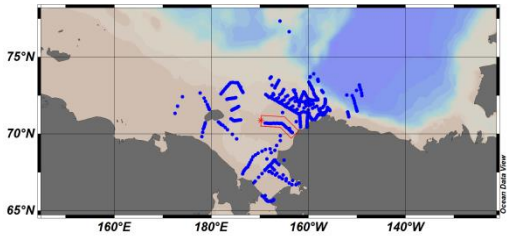


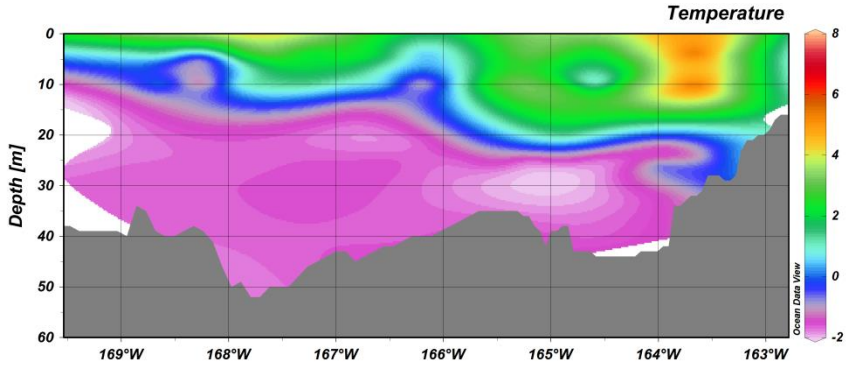


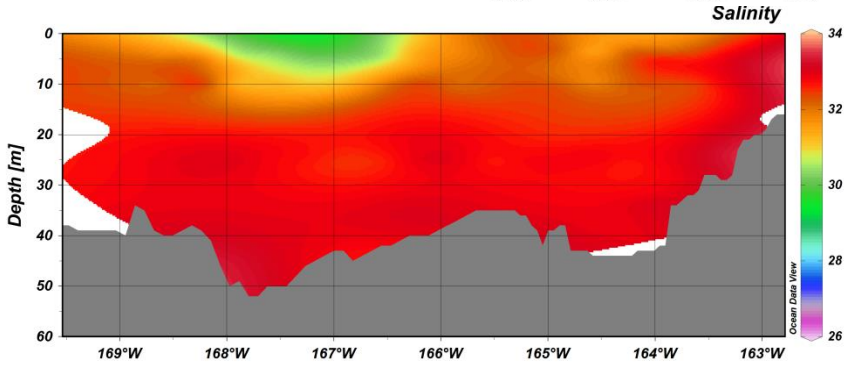
RUSALCA data combined with 2010/2011 ICESCAPE data

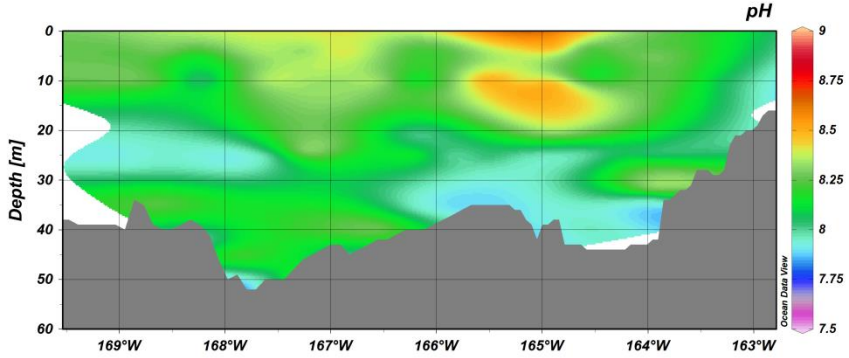
Central Channel

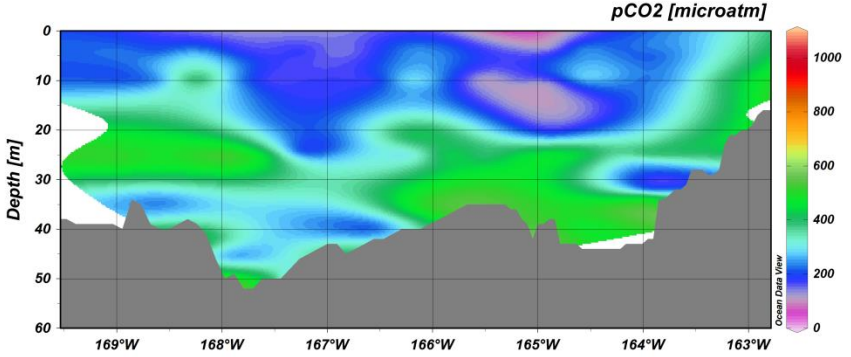
Sections of data combining 2009 RUSALCA and 2010/2011 ICESCAPE

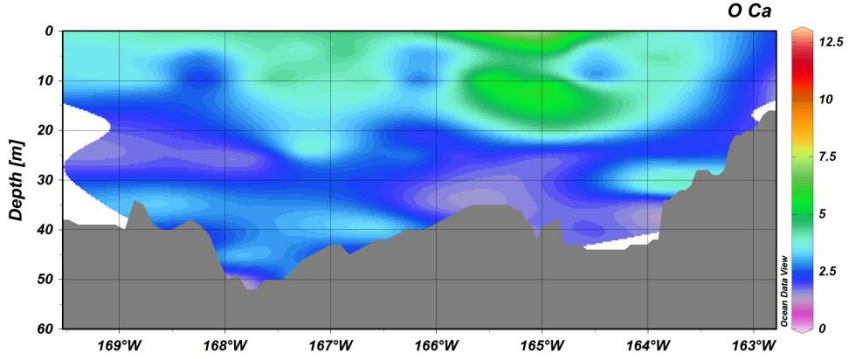


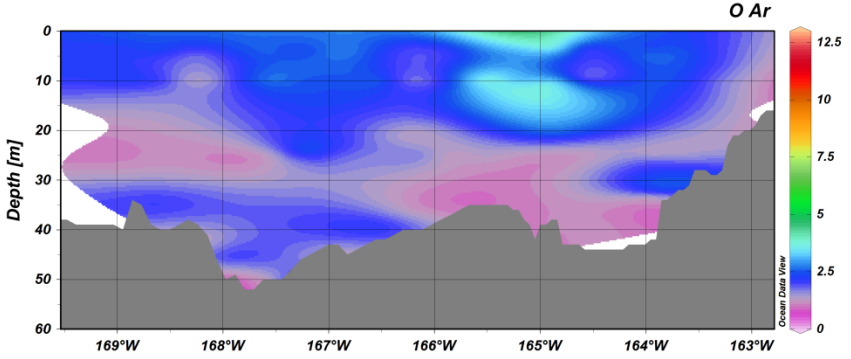








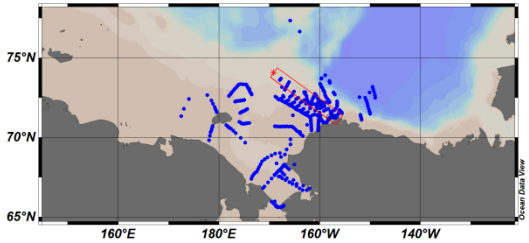


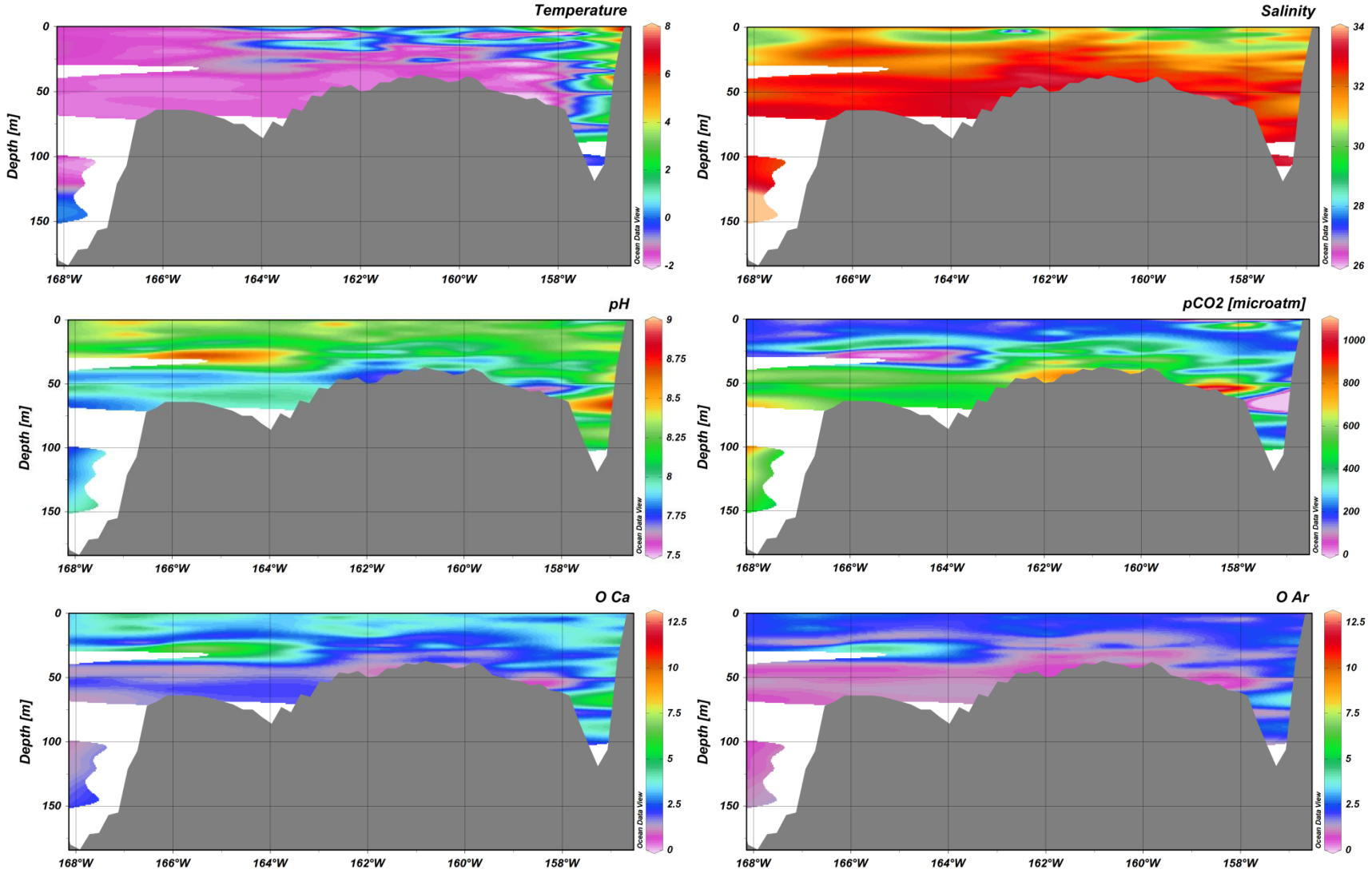


RUSALCA data combined with 2010/2011 ICESCAPE data

170° W to Point Narrow

Sections of data combining 2009 RUSALCA and 2010/2011 ICESCAPE





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