Supplementary materials for

Marine CO_2 system variability along the Inside Passage of the Pacific Northwest coast of North America determined from an Alaskan ferry

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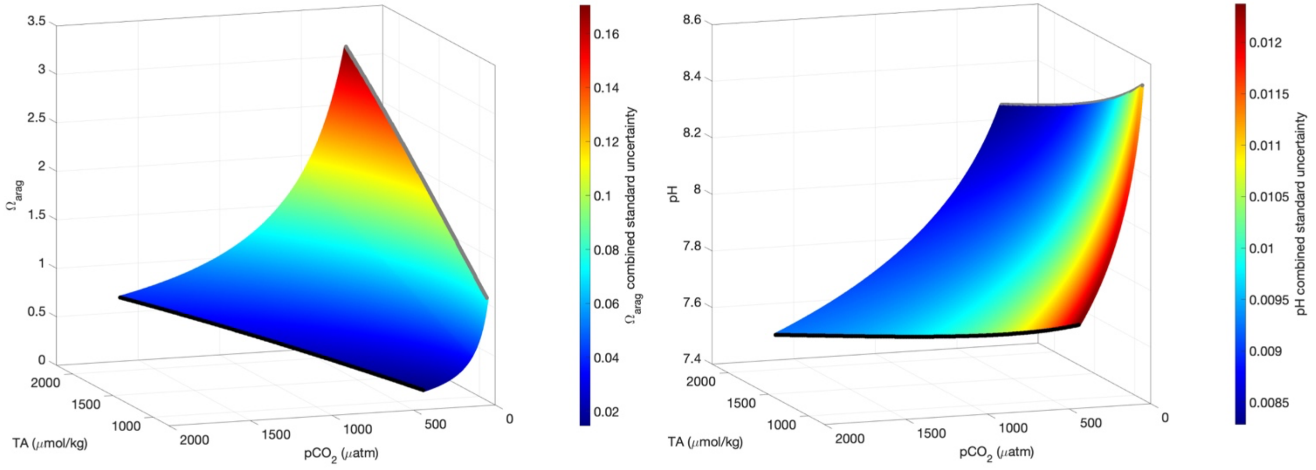
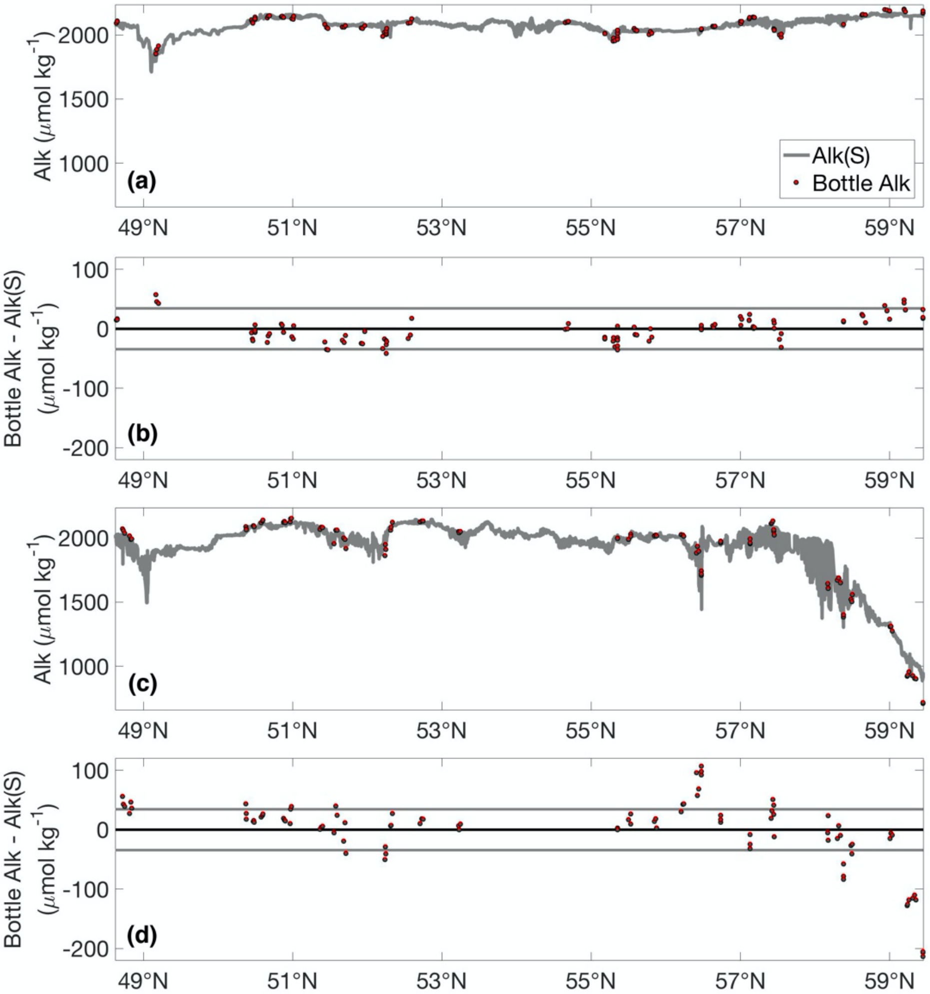
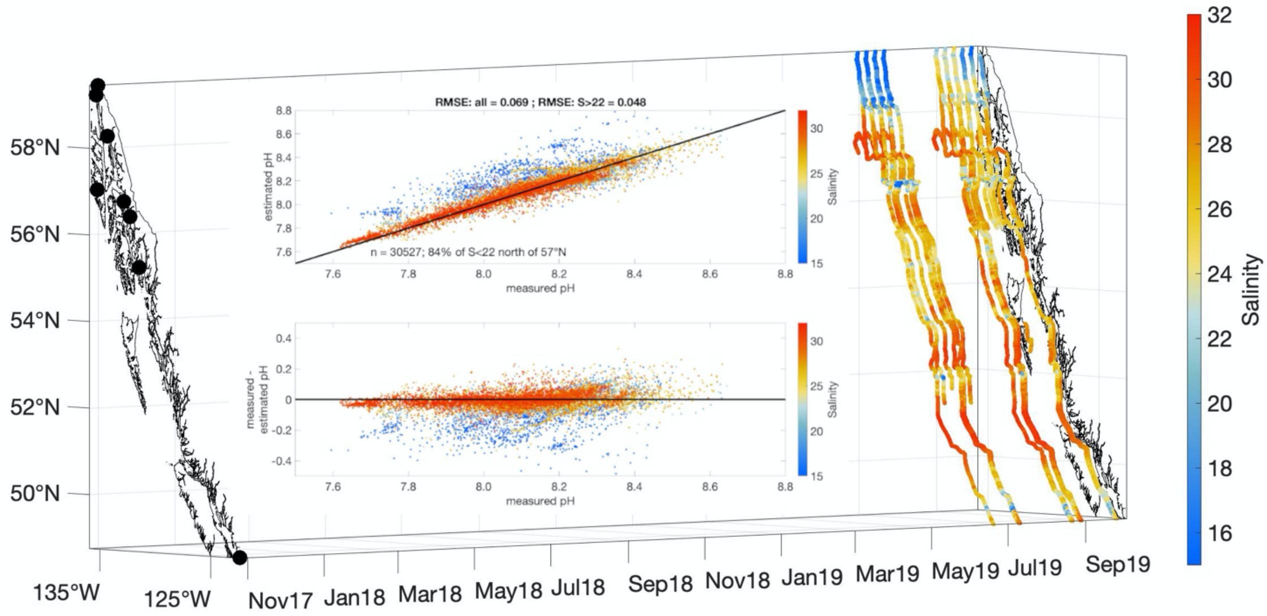


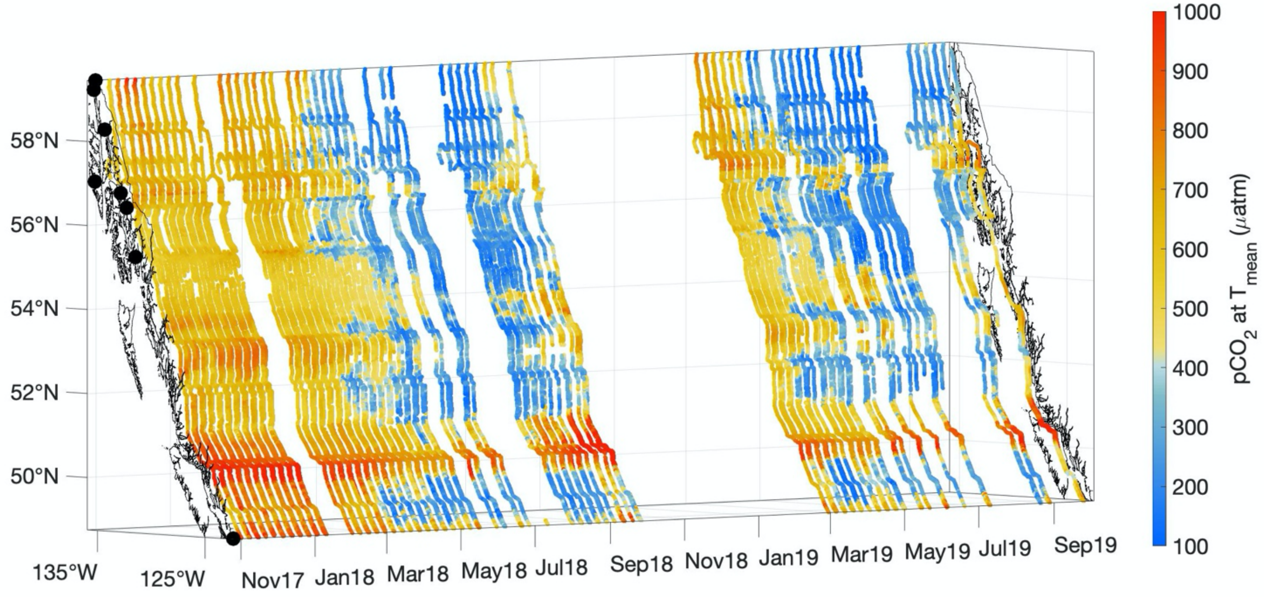
Supplemental Figure S1: Combined standard uncertainty in Ω_{arag} (left) and pH (right) as a function of pCO_2 (µatm) and TA (µmol/kg). pCO_2 is computed across a range of TCO_2:TA ratios in each panel, with the gray line equalling a ratio of 0.85 and the black line being unity.



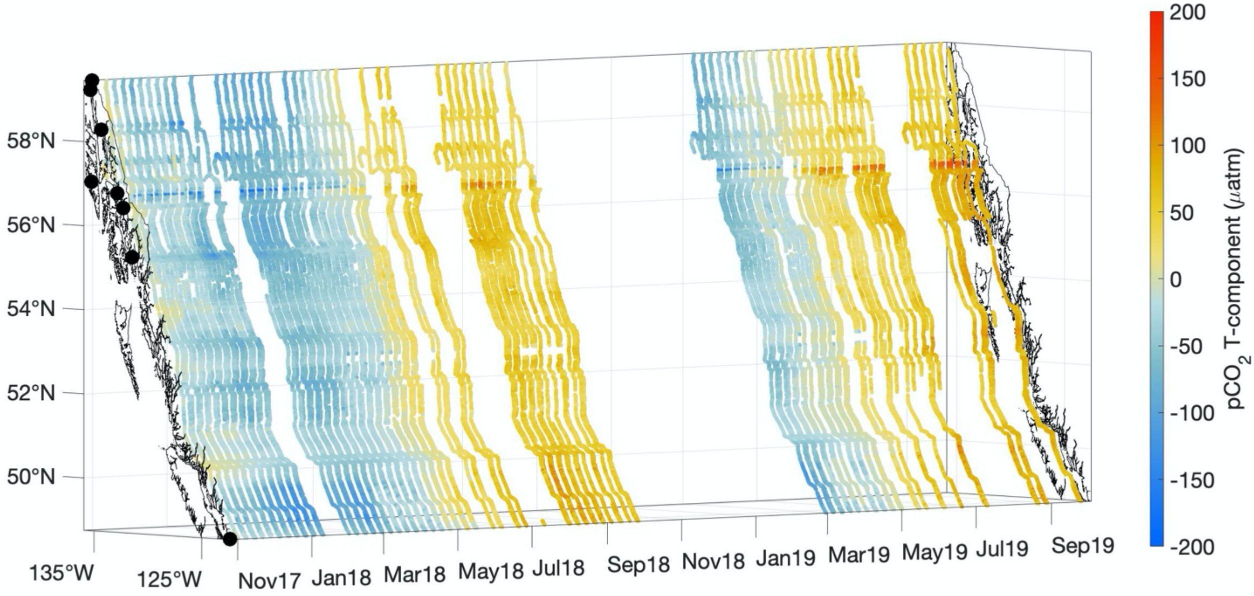
Supplementary Figure S2: Comparison between estimated and derived alkalinity from two ferry ride-along cruises between November 11 to 17, 2017 and August 25 to 31, 2018. Panel a shows alkalinity estimated using the alkalinity-salinity relationship of (Evans et al., 2015) (gray line; Alk(S)) and alkalinity calculated from discrete pCO_2 and TCO_2 measurements (red circles; Bottle Alk) from the first cruise in November 2017. Panel b is Bottle Alk minus Alk(S), with the gray horizontal lines as two times the RMSE of the Evans et al. (2015) relationship (34 µmol kg^{-1}). Panel c shows Alk(S) and Bottle Alk from the second ride-along cruise in August 2018, with Panel d is the difference in these parameters. Alkalinity is over-estimated by ~200 µmol kg^{-1} during the summer melt season in the lowest alkalinity zone of the northern portion of the transit.



Supplementary Figure S3: Map shows distribution of salinity measurements that correspond to BGC-SUMO pH data used to fill missing pCO$_2$ observations. The insert shows the comparison between BGC-SUMO pH and pH estimated from pCO$_2$ and the regional salinity-alkalinity relationship. Total number of comparison points is 30527 measurements. RMSE between measured and estimated pH was 0.069, and decreased to 0.048 for seawater measurements with $S > 22$. The largest offset between directly measured and estimated pH was in seawater with $S < 22$. 84% of $S < 22$ seawater was observed north of 57N in the region during summer months around Juneau and in Lynn Canal. In this region, the estimated alkalinity is too high, which leads to pH and Ω_{arag} being over-estimated and pCO$_2$ being under-estimated for instances where pH is used to fill missing observations in low S water. However, the region still maintains $\Omega_{arag} < 1$, so accounting for this over-estimation leads to more corrosive conditions.



Supplementary Figure S4: The biophysical component of pCO_2 variability (µatm).



Supplementary Figure S5: The temperature component of pCO_2 variability (µatm).

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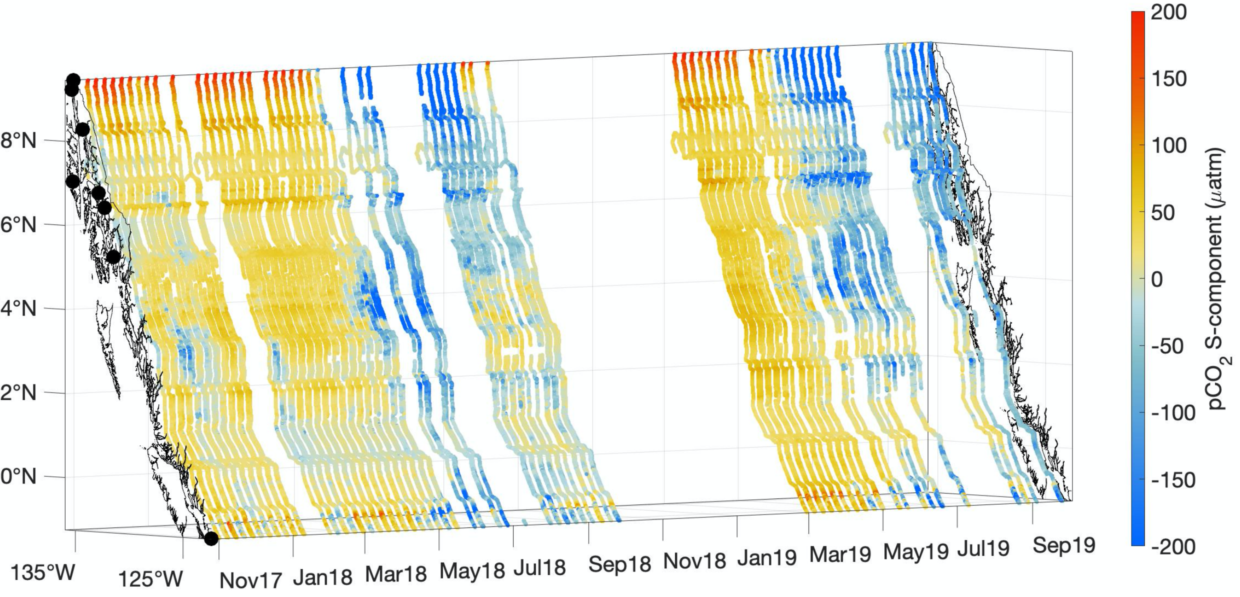

Supplementary Figure S6: The salinity component of pCO$_2$ variability (µatm).

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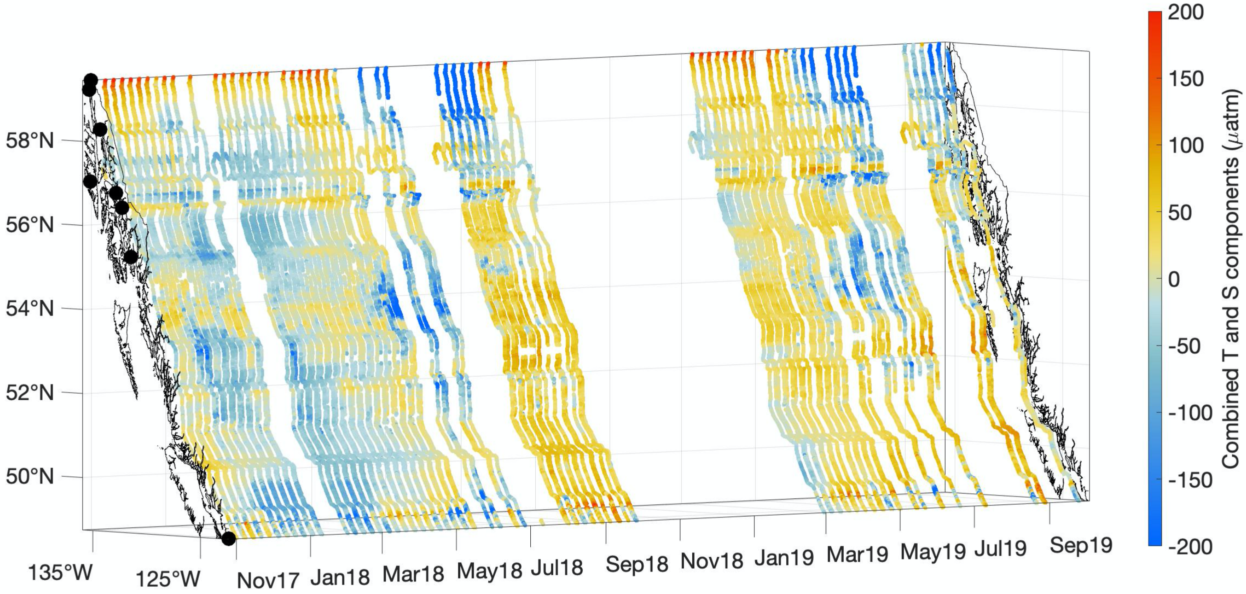

Supplementary Figure S7: The combined temperature and salinity components of pCO_2 variability (µatm).

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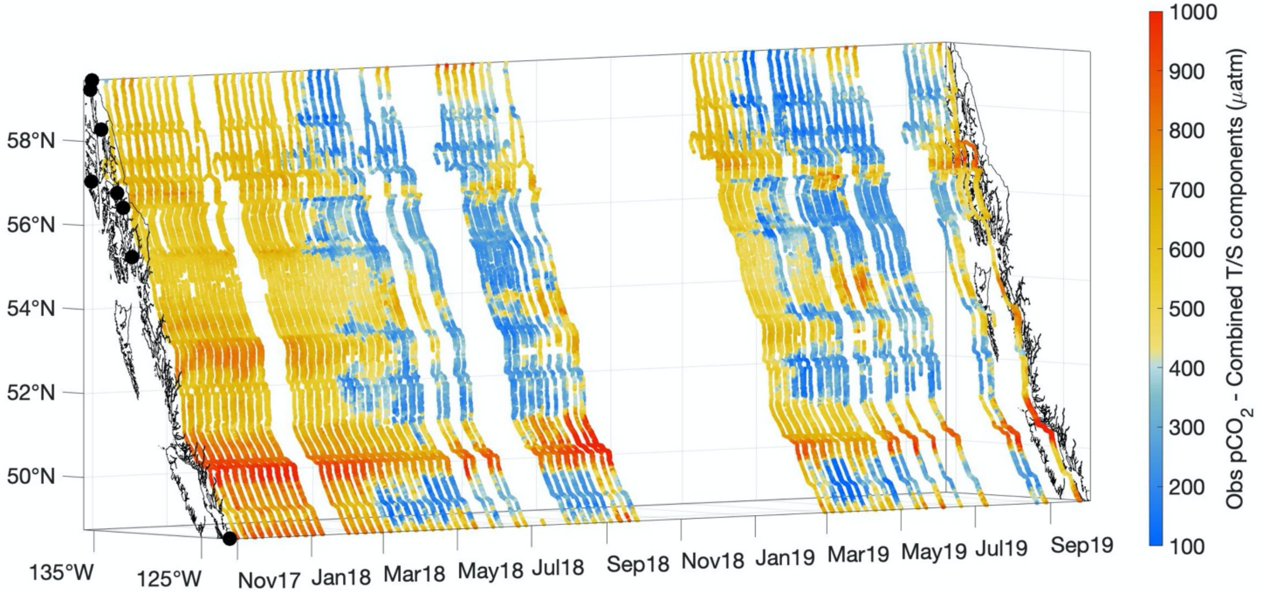
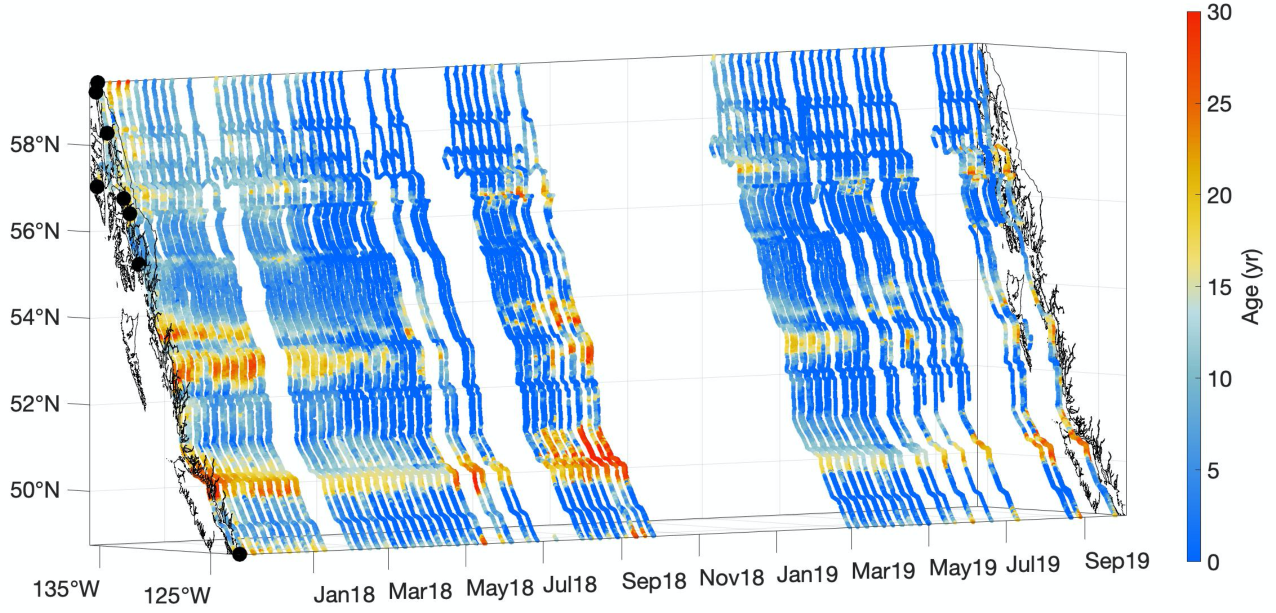


Supplementary Figure S8: Observed pCO$_2$ minus the temperature and salinity components of pCO$_2$ variability (µatm).



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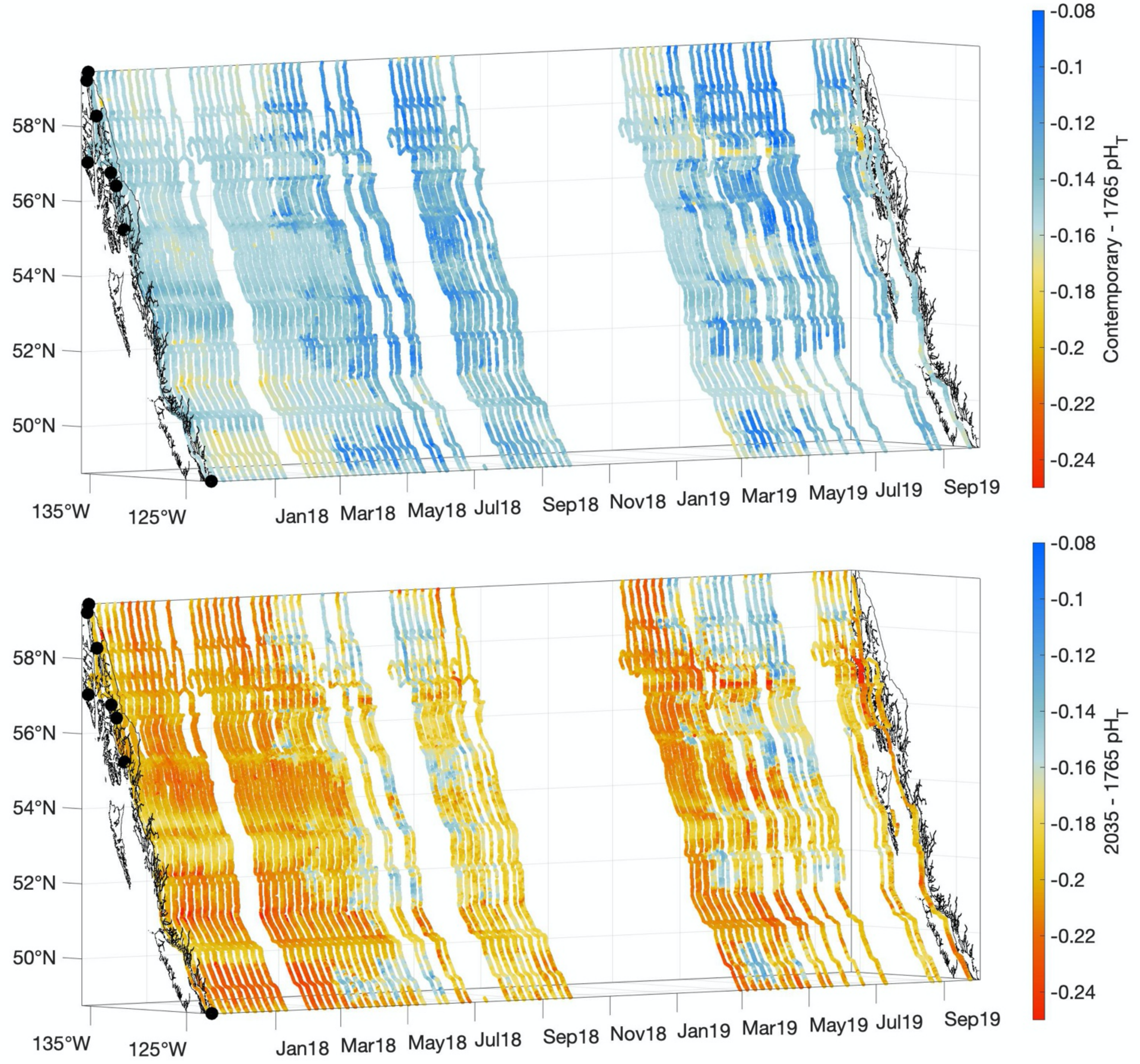
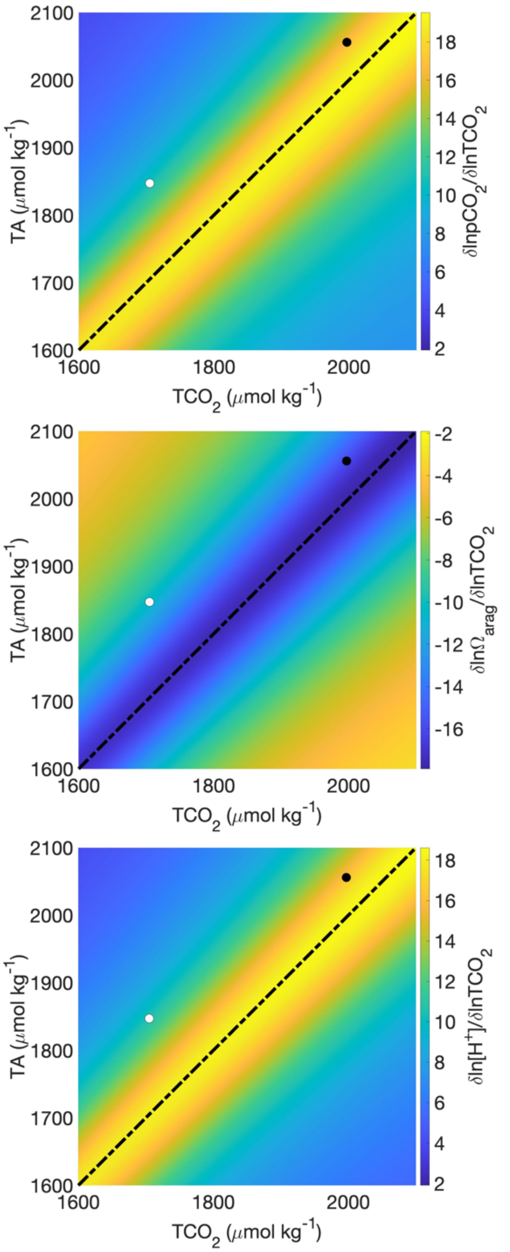
Supplemental Figure S9: The age (yr), or time since last contact with the atmosphere, of surface water along the Inside Passage.



Supplementary Figure S10: The contemporary pH values minus the estimated values for 1765 (top) and the estimated values for 2035 minus the 1765 values (bottom).



Supplemental Figure S11: Buffer factors for pCO_2 (top, the Revelle factor), Ω_{arag} (middle), and $[H^+]$ (bottom) as a function of TCO_2 and TA. The buffer factor is the percentage change in each variable following a change in TCO_2. The dashed line denotes equal TCO_2 and TA across the range of values shown, and is the minimum buffering state (and maximum Revelle factor) for all buffer factors. Average TCO_2 and TA values for summer (white circle) and winter (black circle) are shown to highlight that winter conditions on average are closer to the minimum buffering state, and therefor percentage changes in these values will be greatest during winter.