EGU21-13862
https://doi.org/10.5194/egusphere-egu21-13862
EGU General Assembly 2021

The Impact of a Modest Anthropogenic Carbon Increase on the Carbonate Chemistry Balance of a Temperate Fjord System

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Coastal regions are typically characterized by considerable physical variability that in turn leads to dramatic variability in coastal carbonate chemistry. Recent shipboard and mooring-based observations have shown large spatial and temporal variations of carbonate chemistry parameters, including air-sea CO_2 flux and aragonite saturation state, in one prominent coastal region in the Northeast Pacific Ocean - the Salish Sea. The range of the observed variability in the regional carbonate system is significantly larger than the global anthropogenic change, complicating the detection of secular carbon trends. Simultaneously, sparse observations limit understanding of the carbonate balance as a whole. Here, we use a highly resolved coastal model, SalishSeaCast, to characterize the drivers of the carbonate chemistry balance of the Salish Sea, with an emphasis on air-sea CO_2 flux and aragonite saturation state. We then investigate the impact of a relatively modest increase in anthropogenic carbon in this region in the context of the governing physical and biological dynamics of the system. We examine the striking effects of the anthropogenic change to date on the inorganic carbon balance of the system, highlighting impacts on the aragonite saturation state of the system and its buffering capacity, as well as suggesting some bounds for the regional air-sea and lateral carbon fluxes. We then use the GLODAP dataset of global coastal carbon observations to consider our results in the context of other regions of the Pacific Rim and the global coastal ocean.