An inland sea high nitrate-low chlorophyll (HNLC) region with naturally high pCO_2

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A time series of data for temperature, salinity, nitrate, chlorophyll and carbonate chemistry was collected from September 2011 to July 2013 at the University of Washington's Friday Harbor Laboratories (FHL). Seawater conditions were high nitrate-low chlorophyll (HNLC), with average nitrate and pCO_2 concentrations of ~25 ± 5 mmol l^{-1} and ~700 ± 103 matm (pH 7.80 ± 0.06). The high nitrate and pCO_2 originate from the high values for these parameters in the source waters to the Salish Sea from the California Undercurrent (CU). These properties are due to natural aerobic respiration in the region where the CU originates, which is Pacific Equatorial Water (PEW) and the oxygen minimum zone in the eastern tropical North Pacific. Alkalinity varies little so the increase in pCO_2 is due to inputs of dissolved inorganic carbon (DIC). This increase in DIC comes from both natural aerobic respiration within the ocean and input of anthropogenic CO_2 from the atmosphere when the water was last at the sea surface. The main surface source of this water is approximately 50°S; 150°W in the west-central South Pacific. As the CU flows poleward along North America, it mixes laterally with colder, fresher Pacific Subarctic Upper Water (PSUW) which outcrops in the NW North Pacific (near 50°N, 170°E). The contribution of the low O_2 PEW southern end-member decreases poleward and off the Washington coast the CU has nominal contributions of 40% PEW and 60% PSUW. The anthropogenic "ocean acidification" contribution to DIC in the source waters of the California Undercurrent is 36 mmol l^{-1}. This contribution ranges from 13% to 22% of the total increase in DIC. The remaining increase in DIC is due to natural aerobic respiration. Because these conditions have probably existed for a long time, the biological community in the San Juan Islands should be an excellent location to study adaptation to high values of pCO_2 (and thus low pH).