

INTERANNUAL VARIABILITY OF pCO₂, AND CHANGES IN SURFACE SALINITY AND TEMPERATURE IN THE UPPER SUBPOLAR GYRE IN THE NORTH PACIFIC OCEAN FOR A 9 YEAR PERIOD

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ABSTRACT

We investigated the interannual variability of the partial pressure of carbon dioxide (pCO₂) in the surface waters of the western subarctic gyre (155°E to 165°E, 48°N to 53°N) and the Alaska Gyre (AG, 195°E to 210°E, 45°N to 52°N) for a period of 9 years. We used automated measurements of pCO₂ in the surface water (pCO_{2sw}) and the air (pCO_{2air}) as well as sea surface temperature (SST) and salinity (S) obtained from the Japanese-Canadian joint Volunteer Observing Ship (VOS) program. We observed annual trends in the pCO_{2sw} and based on simple least square fit to observed data, the surface waters in the WSG showed a gradual pCO_{2sw} increase of 0.4 ppm yr⁻¹ which was three times larger than in the AG (1.8 ppm yr⁻¹) for the 9-year period. In the WSG, this was about half of the estimated atmospheric pCO₂ increase for the whole period (10 ppm or 1.2 ppm yr⁻¹), whereas gas exchange explained much of the increase in the AG (pCO_{2air} increased 1.6 ppm yr⁻¹). Interestingly, the two gyres showed opposite annual trends in the SST and salinity and in the WSG we observed a salinity and SST increase of 0.018 yr⁻¹ and 0.07°C yr⁻¹ (0.56°C for the whole study period), respectively, whereas we observed a small freshening of 0.015 yr⁻¹ and a cooling trend of about 0.11°C yr⁻¹ in the AG. We examine the possible mechanisms to explain the annual trends in pCO₂, based on the observed changes in SST and salinity as well as observations made by other investigators.