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TITLE: Autonomous seawater <i>p</i>CO₂ and pH time series from 40 surface buoys and the emergence of anthropogenic trends

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ABSTRACT:

Abstract. Ship-based time series, some now approaching over 3 decades long, are critical climate records that have dramatically improved our ability to characterize natural and anthropogenic drivers of ocean carbon dioxide (CO2) uptake and biogeochemical processes. Advancements in autonomous marine carbon sensors and technologies over the last 2 decades have led to the expansion of observations at fixed time series sites, thereby improving the capability of characterizing sub-seasonal variability in the ocean. Here, we present a data product of 40 individual autonomous moored surface ocean pCO2 (partial pressure of CO2) time series established between 2004 and 2013, 17 also include autonomous pH measurements. These time series characterize a wide range of surface ocean carbonate conditions in different oceanic (17 sites), coastal (13 sites), and coral reef (10 sites) regimes. A time of trend emergence (ToE) methodology applied to the time series that exhibit well-constrained daily to interannual variability and an estimate of decadal variability indicates that the length of sustained observations necessary to detect statistically significant anthropogenic trends varies by marine environment. The ToE estimates for seawater pCO2 and pH range from 8 to 15 years at the open ocean sites, 16 to 41 years at the coastal sites, and 9 to 22 years at the coral reef sites. Only two open ocean pCO2 time series, Woods Hole Oceanographic Institution Hawaii Ocean Time-series Station (WHOTS) in the subtropical North Pacific and Stratus in the South Pacific gyre, have been deployed longer than the estimated trend detection time and, for these, deseasoned monthly means show estimated anthropogenic trends of 1.9±0.3 and 1.6±0.3 µatm yr?1, respectively. In the future, it is possible that updates to this product will allow for the estimation of anthropogenic trends at more sites; however, the product currently provides a valuable tool in an accessible format for evaluating climatology and natural variability of surface ocean carbonate chemistry in a variety of regions. Data are available at https://doi.org/10.7289/V5DB8043 and https://www.nodc.noaa.gov/ocads/oceans/Moorings/ndp097.html (Sutton et al., 2018).

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