

Observations for climate: The NOAA component of the CLIVAR CO₂/Tracer Repeat Hydrography Program

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The CLIVAR Repeat Hydrography CO₂/Tracer Program is a systematic and global re-occupation of select hydrographic sections to quantify changes in storage and transport of heat, fresh water, carbon dioxide (CO₂), chlorofluorocarbon (CFC) tracers, oxygen and nutrients. It builds upon earlier programs (e.g., World Ocean Circulation Experiment (WOCE)/Joint Global Ocean Flux Study (JGOFS) during the 1990s) that have provided global full-depth data sets against which to measure future changes, and have shown where atmospheric constituents are sequestered by the oceans. The NOAA component of the current program sponsored by the Climate Program Office is part of the integrated US multi-agency effort with the National Science Foundation as a major co-sponsor. The lines with NOAA as lead have been meridional sections in the Atlantic and Pacific Ocean. These repeat occupations have shown significant changes in inorganic carbon, oxygen, chlorofluorocarbons and temperature over the last decade(s). The sampling effort using a wire mounted electronic conductivity temperature and depth (CTD) profiler, and flow-through sampling bottles that can be closed at desired depths is decades-old technology but currently the only means to routinely obtain high accuracy chemical and temperature measurements at depths greater than 2000 m. The observed changes in inorganic carbon compared to previous measurements are attributed to a combination of anthropogenic carbon invasion from the atmosphere and natural or climate-induced variability. The different components of the observed changes are investigated by several means, including full characterization of the inorganic carbon system in seawater, empirical methods utilizing the extensive physical and biogeochemical measurements, and transient tracers.