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Decadal changes in the aragonite and calcite saturation state of the Pacific Ocean

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NOAA's Climate Observations and Monitoring (COM) Program includes Repeat Hydrography cruises to document changes in ocean carbon chemistry and pH that directly impact the degree of aragonite and calcite saturation in the surface and subsurface waters. Based on measurements from the WOCE/JGOFS global CO2 survey, the CLIVAR/CO2 Repeat Hydrography Program and the Canadian Line P survey in the Pacific Ocean, we have observed an average 0.34% yr-1 decrease in the saturation state of surface seawater with respect to aragonite and calcite. The upward migrations of the aragonite saturation horizons, averaging about 1 to 2 m yr-1, are the direct result of the uptake of anthropogenic CO2 by the oceans and regional changes in circulation and biogeochemical processes. The shoaling of these saturation horizons is regionally variable, with more rapid shoaling in the South Pacific where there is a larger uptake of anthropogenic CO2. In some locations, particularly in the North Pacific Subtropical Gyre and in the California Current, the decadal changes in circulation can be the dominant factor in controlling the migration of the saturation horizon. If CO2 emissions continue as projected over the rest of this century, the resulting changes in the marine carbonate system would could mean that many calcifying species in the Pacific would no longer be able to sustain a sufficiently high rate of calcification to maintain their viability.