

GLOBAL CHANGE IN OCEAN CIRCULATION FROM SATELLITE SEA SURFACE TEMPERATURE RECORDS: IMPLICATIONS FOR THE FUTURE OF CORAL REEFS, FISHERIES, AND CLIMATE CHANGE

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Since the 1980s, corals have experienced unprecedented high temperature-induced coral bleaching and subsequent mortality. Location, intensity, severity, duration, and recovery from bleaching are predictable by the satellite sea surface temperature (SST) "HotSpot" method (Goreau & Hayes, 1994). HotSpot patterns have been mapped over the last 2 decades, and show strong regional trends: SST increases are many times the average rates in some regions, but lower in others. These detailed spatial patterns imply that world-wide alterations in wind velocity, ocean current intensity, and deep-water upwelling is systematically changing global ocean circulation. The HotSpot data suggests that intensities of warm currents are increasing, intensities of cold currents are decreasing, coastal upwelling is being reduced, open-ocean upwelling is increasing, and flow from the Pacific to the Indian Ocean is increasing. Because of their magnitude, these changes will have much greater effects on regional climatic extremes and ecosystem alterations than mean global warming rates. The most rapidly warming areas are likely sites of imminent regional coral reef ecosystem collapse. Corals might survive in areas warming most slowly, influenced by increased cold water upwelling, but as marginal coral communities, not coral-dominated reefs, due to increased competition from algae and filter feeders. Pelagic fisheries would be displaced from intense coastal upwelling zones to less productive and remote offshore upwelling areas. Observed changes imply concomitant shifts in global warming, ocean-atmosphere CO₂ fluxes, marine biodiversity, and primary productivity patterns.