SNAPSHOT

Warming world stirs up cold waters

Despite the worldwide ocean-warming trend of recent years, sea surface temperatures off the coast of central and southern Peru have decreased since the 1950s, a study suggests. Although the reason for the cooling isn't entirely clear, there are at least two ways it could have been triggered by climate change.

Some of the world's most productive fisheries lie along the eastern shores of oceans, where winds and currents conspire to bring nutrient-rich waters from the deep sea to the surface, and photosynthetic algae — the base of the ocean's food chain — proliferate. Of these bountiful regions, Peru's fishery is by far the most productive, yielding about ten times the fish biomass of other so-called eastern boundary coastal upwelling systems, according to Dimitri Gutiérrez, a biological oceanographer at the Marine Research Institute of Peru in Callao.

Previous studies have suggested that climate change might increase the temperature difference between land and sea. This could boost alongshore winds, which would encourage the upwelling of cold deep-sea waters, cooling the surface.

Although measurements from 'ships of opportunity' off the Peruvian coast indicate that sea surface temperatures have increased in recent decades, that data may not be very reliable for tracking coastal upwelling areas, explains Gutiérrez. For one thing, he notes, ships don't always follow the same route through the region, so data might not be consistent. And in bad weather (which is often accompanied by high winds), ships may avoid certain regions altogether, skewing sea surface temperature data even further.

Gutiérrez and his colleagues turned to seafloor sediments to better assess past sea surface temperatures (*Geophys. Res. Lett.* **38,** L07603; 2011). Specifically, they looked at certain biomolecules called alkenones in sediment samples from the seafloor 57 kilometres southwest of Pisco, Peru, going back 150 years. The proportion of saturated versus less-saturated alkenones varies with the type of marine phytoplankton that thrive at different sea surface temperatures. These microorganisms end up in seafloor sediments when they die and fall to the bottom of the ocean, explains Gutiérrez.

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Their analysis shows that from 1860, sea surface temperatures off Peru dropped about 1 °C over 90 years. After 1950, the rate of temperature decline accelerated threefold, with surface temperatures falling about 0.36 °C each decade. These results match shorter-term temperature measurements from piers along central and southern Peru, which show a similar range of cooling for the past 30 to 50 years. The rate of sea surface temperature decline off Peru closely tracks the drop in sea surface temperature seen off northern Chile by other researchers since 1979 — a hint that the changes are real and cover an extensive area.

Another possible explanation for the long-term cooling of the seas off Peru is that climate change has strengthened the South Pacific high-pressure cell — a semi-permanent weather feature that sits west of northern Chile and drives winds in the region. Intensification of this high-pressure area, just like increased temperature difference between land and sea, would boost wind speeds along the Peruvian coast. Determining which mechanism is responsible will require more observations and modelling, says Gutiérrez.

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