Climate change signal detected in the Indian Ocean

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The signature of climate change over the past 40 years has been identified in temperatures of the Indian Ocean near Australia.

"From ocean measurements and by analysing climate simulations we can see there are changes in features of the ocean that cannot be explained by natural variability," said CSIRO oceanographer Dr Gael Alory.

"These oceanic changes are almost certainly linked to changes in the heat structure of the atmosphere and have led to a rise in water temperatures in the sub-tropical Indian Ocean of around two degrees celsius.

"At the same time, we are seeing changes in ocean circulation in tropical regions as a result of a long-term weakening of the Pacific Ocean trade winds. This affects sea surface temperature in regions relevant to the source and distribution of rainfall across southern Australia," Dr Alory said.

The research – by Dr Alory, his CSIRO Wealth from Oceans National Research Flagship colleague, Dr Gary Meyers, and CSIRO Marine and Atmospheric's Dr Susan Wijffels – has recently appeared in the journal, Geophysical Research Letters. The paper examines trends in Indian Ocean temperatures over 40 years that can help scientists and resource managers understand fluctuations in rainfall patterns over southern Australia.

The research, contributing to the Australian Climate Change Science

Program and partly funded by the South East Australia Climate Initiative, combined access to ocean observations using the volunteer 'ships of opportunity' program and a set of models used by scientists in developing the Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment. Thanks to the operators and crew of commercial ships, Australian scientists have access to a regular series of ocean measurements to a depth of 800 metres across the Indian Ocean.

The team's key findings were:
-- a general warming of the ocean surface indicating the influence of rising atmospheric temperatures;
-- a strong warming (about 2°C over 40 years) between 40°S and 50°S down to a depth of 800metres;
-- and, sub-surface cooling in the tropics due to deep waters rising closer to the surface.

Dr Alory says the research confirmed a long-held view that temperature changes in the Pacific and Indian oceans can be partly explained by the effect of the 'Indonesian throughflow' – a system of currents which transports water between the oceans through the maze of straits and passages in the Indonesian Archipelago.

"The cooling is occurring between Australia and Indonesia where the Indonesian throughflow emerges into the Indian Ocean and is linked to the observed weakening of Pacific Ocean trade-winds," he says. The models also helped to explain trends in the subtropical Indian Ocean temperatures and changes in relevant ocean features. In this area, the deep-reaching warming is due to a strengthening of westerly winds drawing a southward shift in ocean current patterns. These findings are consistent with research in the South Atlantic and South Pacific ocean basins.

He said that the change in atmospheric conditions altering ocean

temperatures – weakening of Pacific Ocean trade winds and strengthening of westerly winds – have been mostly attributed to human activity: the production of aerosols (tiny atmospheric particles), ozone depletion, and greenhouse gases. Strengthening westerlies are related to changes in the Southern Annular Mode – an atmospheric feature similar to the El Nino Southern Oscillation and considered the dominant influence on Southern Hemisphere atmospheric variability.

Dr Alory said climate models used in the IPCC Fourth Assessment show that changes in westerly wind patterns are expected to intensify in a global warming scenario and to accentuate the southward shift in sub-tropical ocean circulation patterns.

Source: CSIRO Australia

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