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## Subpolar oceans, a key factor in the climate control of the tropics



An international team of researchers, led by members of the UAB Institut de Ciència i Tecnologia Ambientals (ICTA), published in *Science* the first registers of the evolution of Northern Pacific and Southern Atlantic sea-surface temperatures, dating from the Pliocene Era -some 3.65 million years ago- to the present. Data obtained in the reconstruction indicate that the regions closer to the poles of both oceans have played a fundamental role in climate evolution in the tropics.

This research solves another piece of the jigsaw puzzle that is the study of oceanic behaviour and its influence on climate. The results are based on the doctoral thesis presented by Dr Alfredo Martínez-García (currently, a researcher with both the Swiss Federal Institute of Technology, ETH Zurich, and with the DFG-Leibniz Centre at the University of Postdam, Germany). The thesis was undertaken at the UAB and directed by Dr Antoni Rosell Melé, an ICTA ICREA researcher and adjunct professor with the Department of Geography. This work was carried out in collaboration with Dr Gerald H. Haug, of ETH and DFG-Leibniz Centre; Dr Erin L. McClymont

of Newcastle University (UK); and Dr Rainer Gersonde, of the Alfred Wegener Institute (Germany).

The study of Pliocene climate has now been the object of intense research for several years, as this era represents -in the Earth's history- the most recent climatic period in which, over a sustained period of time, average temperatures on the planet were significantly higher than those of the present. As a result, the Pliocene is thought of as a climatic period that might be representative of the Earth's climate in future conditions of global warming. In this study, the researchers analysed marine sediment collected by the Integrated Ocean Drilling Program (an international initiative), and measured its composition of organic compounds termed alkenones.

Reconstruction of the surface temperature in the Northern Pacific and Southern Atlantic has enabled a simultaneous sea-surface cooling to be identified in the subpolar regions of the two hemispheres in the period between 1.8 and 1.2 million years ago. This finding coincides in time with the formation of the equatorial Pacific cold tongue -which currently almost disappears during the "El Niño" phenomenon.

Previous studies have shown that, during the warm conditions of the Pliocene, this cold tongue was not present; thus, conditions in the equatorial Pacific were similar to those of a permanent "El Niño" episode. Data obtained in this study indicate that the cooling and expansion of polar waters towards the tropics intensified atmospheric circulation. And this fact played a fundamental role in the equatorial Pacific, leading to the reduction in depth of the thermocline -the layer of ocean water in which the temperature fall rapidly- and therefore to the appearance of the equatorial cold tongue that we can currently observe.

The research undertaken provides empirical evidence, previously suggested by studies using climatic models, that the oceans in high latitudes may play a key role in the control of tropical climate and, most especially, in the thermocline depth in the equatorial Pacific.

The study contributes to the debate on which regions on the planet are those that, when their local climates change, give rise to processes of global change. It is often indicated that these regions are found in the tropics, since, when phenomena such as "El Niño" occur, they have global repercussions. This study provides evidence for the key role that may be played by the polar regions of the planet.

Currently, high latitudes are the ones that appear to be responding in the clearest way to global warming. Given the direct relationship established in this study between high-latitude climate variation and thermocline depth in the equatorial Pacific, it appears possible that the equatorial Pacific cold tongue will eventually respond to the current warming, giving rise to a climatic scenario similar to that of the Pliocene.

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## References

"Subpolar link to the emergence of the modern equatorial Pacific cold tongue". Alfredo Martínez-García, A., Rosell-Melé, A., McClymont E. L., Gersonde R., Haug G. H. Science 18 June 2010.

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