LATEST NEWS

Detailed map of sea surface temperatures at height of last ice age published

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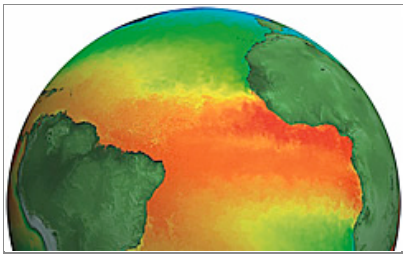
A new map showing the temperature of the sea surface at the height of the last ice age, 23,000 to 19,000 years ago, will help scientists improve their models' ability to predict future climate change.

The results of the project, called the Multiproxy Approach for the Reconstruction of the Glacial Ocean Surface (MARGO) appear in *Nature Geoscience*.



Sea-surface temperatures. This image is derived from satellite instruments, but scientists have now pieced together the most detailed picture yet of sea-surface temperatures from the last ice age, 23,000 to 19,000 years ago.

They pull together the work of around 50 specialists in the ancient climate. These experts combined 696 estimates of sea surface temperature from different methods in different areas into a single map.

The researchers drew on evidence from microfossils of ancient plankton as well as on two geochemical methods.

More data was available in some areas of the ocean than in others; the north Atlantic and the tropics were particularly well represented, while subtropical areas of the Pacific drew on fewer measurements, in part because great depths in these areas make many geological methods of gauging ancient sea surface temperatures difficult.

MARGO divides the ocean surface into a grid of 5° by 5° squares. In each one the various available estimates of sea surface temperature were averaged, with different results weighted according to their perceived reliability.

For each square the researchers ended up with a temperature figure as well as a number representing their confidence in it - if all the available results were close together, this estimate of confidence was high, while widely-spread results had the opposite effect.

'We decided not to gather any further data, but instead to put together the large body of existing research', says Professor Michal Kucera, a micropaleontologist at the University of Tuebingen in Germany and one of the project's leaders.

He says much of the project's challenge came from the need to quality-check this heterogeneous data and harmonise it into a global temperature map.

For example, in the Atlantic and around the tropics the study relied heavily on information about the ancient climate contained in fossilised plankton called foraminifera, whereas in the Southern Ocean data came from fossilised diatoms, another type of plankton.

And this microfossil data had to be synthesised with geochemical studies looking at ratios of magnesium to calcium in calcite deposits, and at organic compounds called alkenones, produced by coccolithophores - a type of marine algae that produces alkenones of slightly different composition in relation to changes in temperature.

MARGO has been running since 2001, with several published papers culminating in this one. It covers the period between 23,000 and 19,000 years ago, which scientists know as the Last Glacial Maximum, or LGM.

The map will replace the one produced by a pioneering study in the 1970s and 1980s during a project called Climate Long-Range Investigation, Mapping and Prediction (CLIMAP).

'If CLIMAP was like inventing a car, this project puts a much better engine in it,' says Kucera. 'It greatly improves an existing concept. These results should be valid for at least five to ten years, until another group comes along and produces better data to replace them - and this will not be a trivial project.'

'This is a huge step forward from CLIMAP,' says Professor Eelco Rohling of the National Oceanography Centre, Southampton (NOCS), who contributed to the project's coverage of the Mediterranean area. 'Whenever you rely on only one source of information there is the possibility for bias to creep in; the MARGO project avoids this by combining the results of many different researchers and several different techniques.'

He notes that the project's results are more statistically robust, though he adds that the CLIMAP reconstruction was a key advance in past climate research when it was produced and that many of MARGO's improvements were directed by learning from CLIMAP.

The new map broadly agrees with many features of CLIMAP. That in itself is valuable, scientists say - it confirms that previous assumptions weren't too far off the mark, but also gives scientists a more accurate sense of the reliability of these estimates.

In addition, MARGO helps fill the gaps in CLIMAP's coverage, as researchers have naturally concentrated much of their efforts on areas where there was most uncertainty in the years since CLIMAP was produced.

But there are also some surprises. The study shows that during the LGM there were temperature gradients from east to west in the tropical oceans and North Atlantic that hadn't been obvious in the CLIMAP results, although Rohling notes that now scientists know what to look for it may be possible to detect some signs of this pattern in the earlier study.

For example the results for the Atlantic Ocean show more cooling along the coast of Africa than along that of South America at similar latitudes. Models of climate during the LGM don't show these gradients. 'This shows that at present our models are quite accurate when looking at the Earth as a whole,' says Kucera. 'But when we look at how heat was distributed in more detail around the world, the models and data disagree.'

This is one of the ways in which the researchers believe the project's results will help improve climate models. 'It is not too difficult to tune a climate model so that it represents the modern climate state quite well,' Rohling says. 'But if we want to look into the future we need to know how good such a model is at dealing with change.'

He adds that MARGO's results will provide vital opportunities to test the models' ability to deal with very different climatic conditions. Ultimately this should help them get to grips with predicting how the climate will behave in future.

'Constraints on the magnitude and patterns of ocean cooling at the last glacial maximum' Nature Geoscience. February 2009.
