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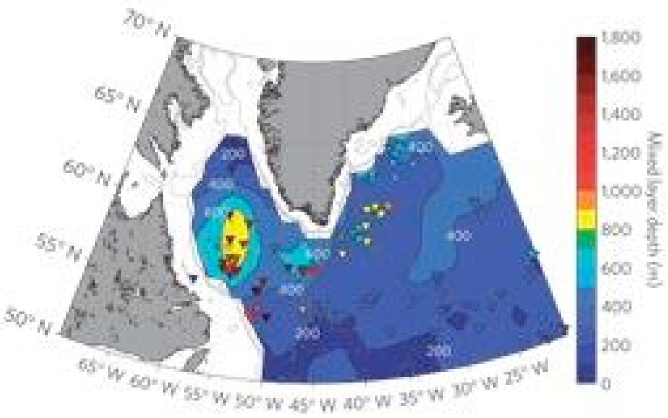
News
North Atlantic cold-water sink returns to life



Convective mixing resumes after a decade due to massive loss of Arctic ice.

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North Atlantic overturningNorth Atlantic overturning — back with a vengeance?
Nature

Scientists have found evidence that convective mixing in the North Atlantic, a mechanism that fuels ocean circulation and affects Earth's climate, has returned after a decade of near stagnation – thanks, perhaps, to a dramatic loss of sea-ice in the Arctic during the summer of 2007.

Convective mixing, or 'overturning', of ocean waters at high latitudes helps to drive the Atlantic 'heat conveyor belt' that carries warm water northwards and cooler deep-water back south. The phenomenon also helps to remove carbon dioxide from the atmosphere — as cold water sinks, it carries dissolved CO2 with it, locking it away in the depths of the ocean for centuries.

But cold winters are one of the prerequisites for convection in the deep-water formation regions around Greenland, such as the Labrador and Irminger Seas, and a warming climate would be expected to slow or stop the process.

There's been very little convection in the North Atlantic over the past decade, prompting concerns that the impact of global warming was already being felt.

Now two teams of scientists have independently found evidence that overturning has resumed in the North Atlantic.

A team led by Kjetil Våge of the Woods Hole Oceanographic Institution in Massachusetts has found that convection returned to the region last winter (2007-2008) with a vengeance1. And Igor Yashayaev and John Loder of the Bedford Institute of Oceanography in Nova Scotia, Canada, separately report that the convection last winter in the Labrador Sea was the deepest since 19942.
Temporary blip?

Våge and his colleagues suspect that weather peculiarities alone cannot explain the unexpected return of convection.

Temperatures last winter were 5-6 °C colder in the North Atlantic than in the previous seven years. But the location of high and low pressure systems over the region means that weather patterns did not favour overturning.

They suggest that a cap of cooler fresh water – massive sea-ice export from the Arctic basin along both sides of Greenland during the previous summer – has facilitated freezing of parts of the Labrador and Irminger Seas. As a result, cold continental-origin air blowing over the region had not been warmed by the relatively warm ocean when it reached the convection areas. The temperature difference between air and open water led to a massive transfer of heat from the ocean to the atmosphere, thus fuelling convection.

Whether the convection is back to stay, however, is not known. "There is a lot of natural fluctuation at play," says Detlef Quadfasel, an oceanographer and climate scientist at the University of Hamburg in Germany. "One nice day of ocean weather doesn't really tell you a lot about what you might have to expect in the future."

But there is little doubt that, in the long-term, ocean convection will decrease if northern latitudes continue to warm at the current rate. "As the water column gets ever more stable, it will get increasingly difficult in a warming environment to produce deep convection in the North Atlantic," says Jürgen Fischer, an oceanographer at the IFM-Geomar Leibniz Institute of Marine Sciences in Kiel, Germany. "You'll probably need very exceptional conditions, such as those of last winter, to mix the oceans."

Global consequences

Reduced convection should in theory weaken the entire Atlantic meridional overturning circulation (MOC) — responsible for carrying warm tropical water northwards — with far-reaching consequences for Earth's climate. But so far at least, scientists have not observed any significant changes to that large-scale circulation. Findings published in 2005 that seemed to indicate a big slowing of the MOC were later found to be in the range of natural fluctuations (see 'Ocean circulation noisy, not stalling').

One reason, says Fischer, is that the observational basis is still thin. The Argo programme, a global array of 3,000 robots that measure temperature, salinity and water pressure, has only last year become fully operational, for example.

But already it's clear that the response of the Atlantic Ocean circulation to high-latitude changes is much more complex than has been assumed. According to Våge and his colleagues, the "myriad of factors" that favoured the return of overturning last winter make it "difficult to predict when deep mixing is likely to occur".

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References

1. Våge, K. et al. Nature Geosci. doi:10.1038/NGEO382 (2008).
2. Yashayaev, I. & Loder, J. W. Geophys. Res. Lett. doi: 10.1029/2008GL036162 (in the press).