Cooler times ahead?

Kim Marshall-Brown

National Oceanography Centre, Southampton

Right: *This image of people skating on the frozen Thames represents a potential, if highly unlikely, future scenario*

Scientists have found that the overturning circulation in the Atlantic Ocean, which maintains Europe's moderate climate, was weaker in 2004 by 30% relative to earlier estimates. What does this mean and what impact could it have on our climate?

Three scientists at the National Oceanography Centre (NOC) in Southampton – Harry Bryden, Hannah Longworth and Stuart Cunningham – published the above findings last December in the science journal *Nature*.

What is overturning circulation?

Warm water heated in the tropics heads northwards as the Gulf Stream. At latitude 45°N (level with Spain) it splits in two. One branch heads south back to the equator due to the Trade Winds and the Earth's rotation. This is what happens in the Pacific Ocean and it is called a **circulating current**. The other branch continues northwards past Britain and Norway and far north into the Arctic Ocean. Westerly winds pass over this warm water, pick up the heat and blow it over northwest Europe, which keeps our climate moderate.

When this water reaches the Arctic, it gets very cold. As ice forms (which is fresh water) the salt is left behind and this salty brine water becomes very dense, which causes it to sink. It sinks to the ocean floor and makes the return journey south, very cold and salty. As the water sinks it effectively pulls water from the south to flow northwards. This is called **overturning circulation**.

In the absence of overturning circulation in the northern Pacific Ocean, Alaska, which is on a similar latitude to the UK, is much colder in the winter than here.

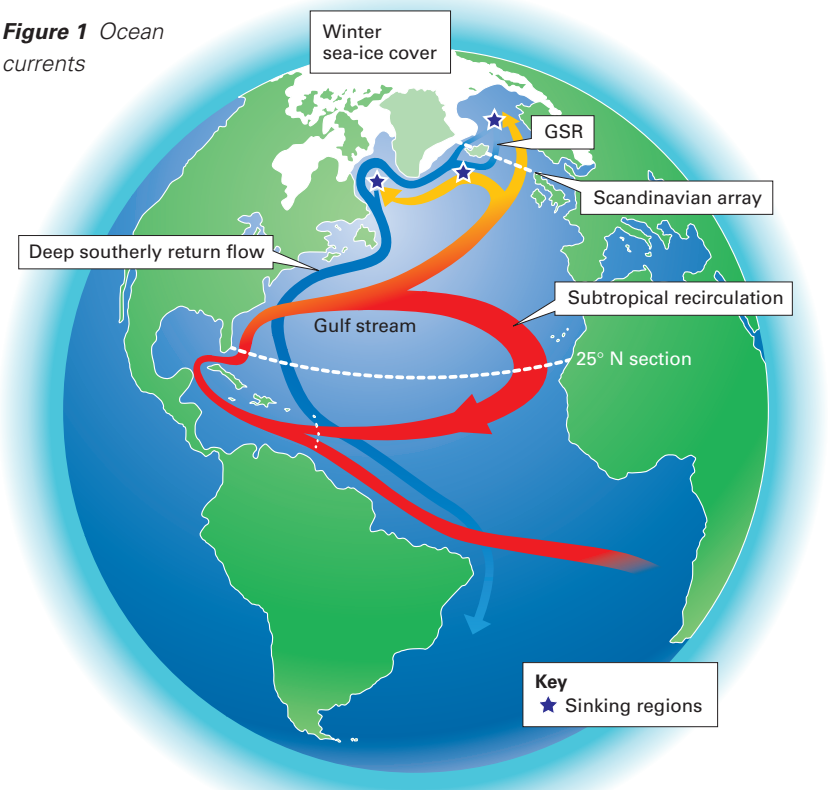


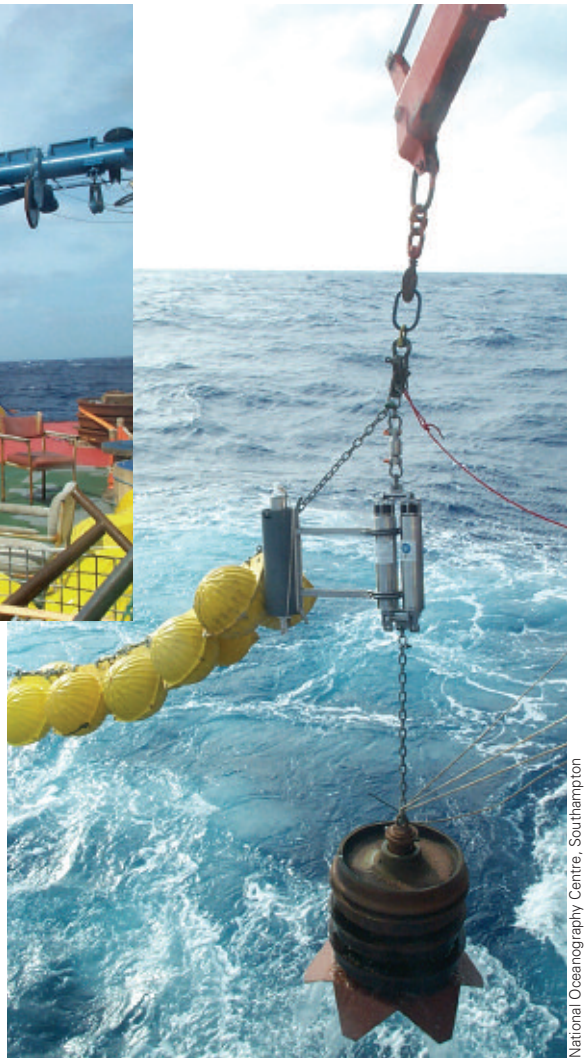
Figure 1 *Ocean currents*

The important news

It would seem that more of the Gulf Stream is going into the southward circulating branch, less is making its way north past our shores and less is returning to the tropics as deep, cold, salty water. This could be due to global warming creating fresher waters in the north through more rain and melting glaciers – a bit like the scenario in the film *The Day After Tomorrow* but nowhere near as fast!

How do scientists know this?

Scientists have been measuring the ocean as it flows across latitude 25°N which runs just below the Canary Islands, stretching from Miami to the Saharan coast of Africa. There have been five research cruises over the last 50 years, in 1957, 1981, 1992, 1998 and the last one in 2004. Until 1992 the figures recorded



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Clockwise from top left:

A mooring cable being played out

Redundant railway wheels set as anchors for the mooring on the sea bed

Glass floats in their protective covers (see the back page)

were pretty much the same. On this last cruise the figures showed that the flow had weakened by 30%.

This may be seasonal or just a blip; without constant measurements we cannot know for certain. Scientists decided to monitor the circulation and heat transport more closely by taking more frequent measurements of the temperature and salinity of the water and the speed at which it is moving.

Since 2004 scientists at the National Oceanography Centre, Southampton, led by Dr Stuart Cunningham, have deployed an array of instruments across the Atlantic Ocean at 25°N. The instruments measure current speeds, temperature and salinity continuously and record them on dataloggers. The instruments are tethered at different depths to a mooring that stretches from just under the water surface to the seafloor, involving around 5 km of cable in some areas of the ocean. Nine are sited across the Deep Western Boundary Current east of the Bahama Islands, four across the Mid-Atlantic Ridge and nine across the continental slope off the coast of Africa. The back page shows one of the moorings in more detail and explains how it works.

Scientists sailing on research vessels retrieve the data from the buoys once a year. The monitoring array involves close collaboration with American scientists at the University of Miami and National Oceanic and Atmospheric Administration's Atlantic Oceanographic and Meteorological Laboratory. The project is due to end in 2008, giving 4 years of continuous observation.

Climate predictions

Scientists can use computer models to investigate different climate conditions in the future (see CATALYST Vol. 15, No. 4). When they have run the model with the overturning circulation slowed down, the UK climate, particularly Scotland, gets much colder, by several degrees. This can be quite dramatic and the models suggest it could happen in a few decades rather than hundreds of years. The overturning circulation has turned off before, during the ice ages. We know this from looking at samples of sediment taken from the seafloor — the paleo-ocean record and ice cores.

Look out for reports from scientists at Southampton, as they collect and analyse the data coming in over the next 3 years!

Kim Marshall-Brown *is the editor of* Ocean Zone, *a quarterly newsletter published by the National Oceanography Centre, Southampton.*

Find out more about the three scientists involved in the project in A Life in Science on pages 20–21.

The work of scientists at the National Oceanography Centre is described on its website (www.noc.soton.ac.uk).