Sonnenburg's team, for instance, has found that a compound called sialic acid builds up in the intestine and helps harmful bacteria to take over the gut when antibiotics have killed off helpful bacteria. The researchers are now investigating whether treating mice with compounds similar to sialic acid can inhibit this harmful transformation (K. M. Ng *et al. Nature* **502,** 96–99; 2013).

And Microbiome Therapeutics, a biotechnology company in Broomfield, Colorado, is currently conducting clinical trials with two small molecules that select for 'good' gut bacteria to help people with diabetes to take up insulin more easily. Chief executive Steven Orndorff says that the company plans to present the first results from the trials next month at an Endocrine Society conference in Chicago, Illinois.

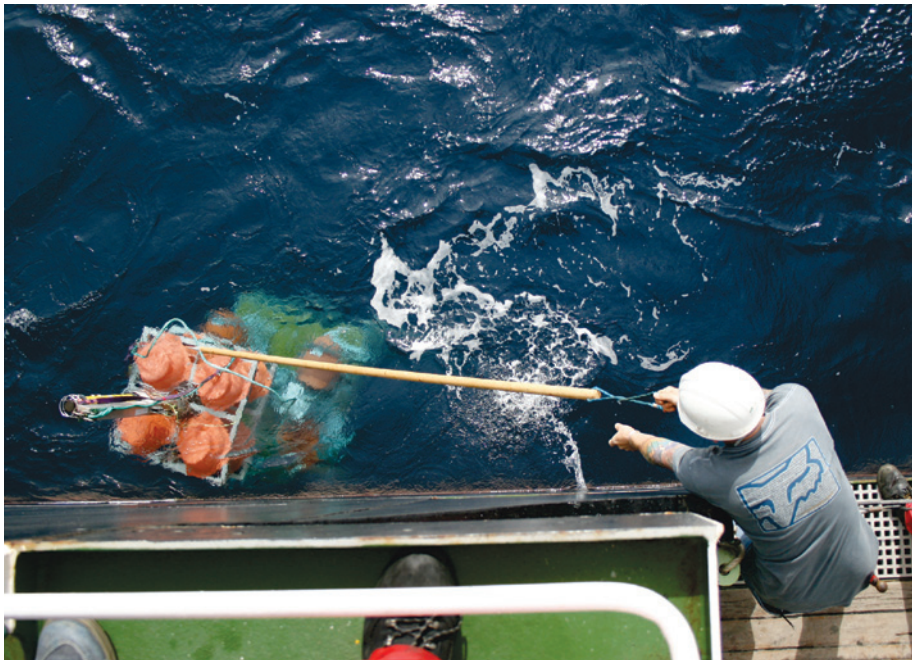
Other companies are turning the microbiome into a diagnostic tool. Enterome has created a genetic-sequencing platform that detects changes in stool microbes that warn of the onset of disorders such as inflammatory bowel disease. The firm has tracked progression of the disease in 100 such patients in a bid to avoid invasive colonoscopies.

Getting microbiome-inspired therapies to market presents a number of challenges, however. Small molecules such as those developed by Microbiome Therapeutics may be able to go through the normal drug regulatory pathway. But there may be a different or new set of regulatory hurdles for genetically modified bacteria — for example, those in development by Ghent-based ActoGeniX in Belgium and ViThera Pharmaceuticals in Cambridge, Massachusetts — that deliver anti-inflammatory agents to the gut. Other issues, including intellectual-property rights for naturally occurring bacteria, may complicate the path of products to market.

Although small start-up firms can be flexible in navigating these issues, funding and guidance from pharmaceutical giants can only help, says Bernat Olle, chief operating officer of Vedanta. In 2013, for example, Vedanta struck a deal with Johnson & Johnson, based in New Brunswick, New Jersey, to develop potential therapies for inflammatory bowel disease and other autoimmune disorders.

"The microbiome is a little drug factory in our intestine."

Pierre Belichard, Enterome's chief executive, says that such investment has been a long time coming — but companies are now flocking to microbiome research. "Doctors have been asking questions about why this new and fascinating world of science is not seen as a place to put money in," he says. "Until the beginning of this year, that was a very good question." Now, he says, investors "all want a microbiome company in their portfolio". ■



BEN MOAT

A sensor-equipped mooring that measures the strength of the Atlantic Ocean's overturning currents.

OCEANOGRAPHY

Atlantic current strength declines

But more data are needed to indicate whether the slowing is a result of human-induced climate change.

BY QUIRIN SCHIERMEIER

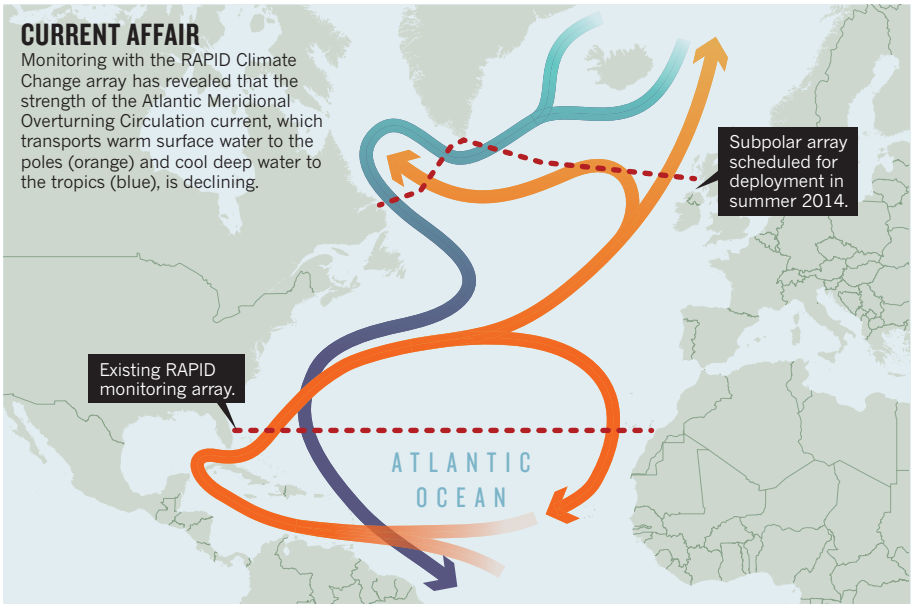
The marked slowdown in the past decade of the warm Atlantic Ocean currents that bring mild weather to northwestern Europe may be caused by natural variation and not anthropogenic climate change, as has been previously suggested.

The Atlantic Meridional Overturning Circulation (AMOC) is part of the great ocean 'conveyor belt' that ceaselessly circulates sea water, heat and nutrients around the globe. In particular, it transports large amounts of warm water from the tropics to the poles, warming the British Isles and maritime northern Europe along the way (see 'Current affair'). But since 2004, ocean sensors have detected a significant decline in the strength of the currents[1] and a cooling of the subtropical Atlantic as a result[2]. From mid-2009 to mid-2010, for example, the circulation slowed to two-thirds of its usual strength — and some oceanographers suggested that the drop caused the harsh weather in the United Kingdom and western Europe that winter (see *Nature* **497,** 167–168; 2013).

Climate scientists had speculated that the slowdown is linked to man-made climate change. But an analysis presented last month by a team of British scientists at the annual assembly of the European Geosciences Union in Vienna suggests that the AMOC's slowing could just be part of natural oceanic fluctuations. The researchers added, however, that it will take more long-term monitoring to definitively rule out climate change as a factor.

Scientists think that the AMOC might be subject to abrupt changes that have probably played a part in ancient climate events, such as the sudden temperature swings 18,000 to 80,000 years ago during the last glacial period. The AMOC's main engine — the sinking of cold, dense water to the bottom of the North Atlantic — has been identified as a potential 'tipping element' in Earth's climate system, in which small climate perturbations could push the system past a critical threshold, with potentially large consequences for humans and ecosystems[3].

Since 2004, 22 moored sensors have been deployed between the Canary Islands and



CURRENT AFFAIR
Monitoring with the RAPID Climate Change array has revealed that the strength of the Atlantic Meridional Overturning Circulation current, which transports warm surface water to the poles (orange) and cool deep water to the tropics (blue), is declining.

Florida along the latitude line at 26.5° north — where the AMOC emits its maximum heat. The sensor array, known as the RAPID Climate Change monitoring array, has continuously monitored the strength and temperature of the current at different depths.

RAPID measurements previously revealed[1] that the circulation weakened by 3% per year on average between 2004 and 2008, with a mean strength of 17.5 million cubic metres per second. Most of the past decade's observed decline occurred between April 2008 and March 2012, when the AMOC was around 15% weaker on average than in the previous four years. The measurements also showed that the strength of the currents varied by up to 70% from year to year, depending on wind and seawater temperature.

To find out whether the observed long-term decline lies within the range of natural yearly fluctuations, Chris Roberts, a climate scientist at the UK Met Office's Hadley Centre in Exeter who led the latest analysis, compared the observed trend with estimates of circulation strength derived from 14 state-of-the-art climate–ocean models. If the variability in modelled circulation strength were to differ substantially from observed trends, it could suggest that the decline is down to an external forcing factor such as climate change.

"It could have significant consequences for society."

Although the results suggested that the downward trend is extremely unusual, Roberts knew that models can substantially underestimate the actual year-to-year variability in the strength of the AMOC. When he and his team adjusted the models to incorporate more-realistic natural fluctuations, the downward trend was statistically in line with the expected variations. Even if the slowing continues at the current rate, the trend will not differ significantly from plausible estimates of natural variability for 18 more years, the team concluded. But it will take at least 10 more years of continuous observation to detect any influence of man-made climate-change effects, says Roberts.

"There's nothing at the moment that would suggest that something dramatically worrying is going on," says David Smeed, an oceanographer at the UK National Oceanography Centre in Southampton and a lead researcher in the RAPID programme. He suggests that the weakening of the AMOC could be because of the Atlantic Multidecadal Oscillation — a natural cycle of ocean variability in which Atlantic temperatures dip every 60 to 70 years.

RAPID, which was funded by the Natural Environment Research Council in Swindon, UK, was last year extended to run until 2020. Another array, funded mainly by UK and US science agencies, will be deployed this summer in the North Atlantic between Labrador, Greenland and Scotland to monitor the AMOC in subpolar regions. Together, data from the two arrays should help to explain the mechanisms behind the changes in circulation, says Susan Lozier, an oceanographer at Duke University in Durham, North Carolina, especially because the subpolar array is along a similar latitude to the main driver for the Atlantic Ocean circulation system.

Regardless of the cause of the AMOC's decline, if the trend persists "it could have significant consequences for society" in terms of the climate in northwestern Europe, says Roberts. Nevertheless, being able to predict the strength of the current could help to improve short-term regional climate forecasts, he says. ■

1. Smeed, D. *et al. Ocean Sci.* **10,** 29–38 (2014).
2. Cunningham, S. A. *et al. Geophys. Res. Lett.* **40,** 6202–6207 (2013).
3. Lenton, T. M. *et al. Proc. Natl Acad. Sci. USA* **105,** 1786–1793 (2008).