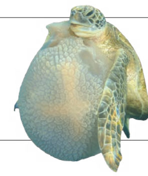
AWARDS Nature Research announces two awards for women in science **p.150**

WORLD VIEW Make drugs that improve quality of life for people with cancer **p.151**



GRIP AND FLIP Turtles use their flippers to hold and eat prey **p.153**

Watch the ocean

Long-term monitoring is essential for working out how changes in the Atlantic Ocean current system will affect the planet.

The Atlantic meridional overturning circulation (AMOC) has spurred scientific interest and human imagination for decades. A complex and fundamental system of ocean currents, including the wind-driven Gulf Stream, the AMOC influences the exchange of heat between the tropics and high latitudes. Driven mainly by cold, dense water in the salty Greenland and Labrador seas sinking to the bottom of the North Atlantic Ocean, the circulation regulates temperature and so serves as a global thermostat.

But for how much longer? Potential sharp changes in the circulation have been identified as a possible tipping point in Earth's physical systems. Since the 1950s, geologists and oceanographers have been gathering convincing evidence that alterations in ocean circulation are a key determinant of climate change.

Ice-core records from Greenland suggest that abrupt shifts in circulation strength triggered dramatic temperature fluctuations during the last glacial period. Climate fluctuations on such a scale have, fortunately, not occurred in the present Holocene interglacial era. Still, signs of a markedly weakening AMOC, reported in 2005 (H. L. Bryden *et al. Nature* **438**, 655–657; 2005), provoked concern that the circulation might be on the brink of tipping into a weak phase once again, possibly as a result of human-induced climate warming.

Subsequent ocean observations, from arrays of sensors strung across the North Atlantic, offered a more reassuring picture: the current was hugely variable, and so a single snapshot could be unrepresentative.

Researchers have now gone back and taken another look. In a paper in *Nature* this week, scientists present palaeo-oceanographic evidence that deep convection of surface waters in the North Atlantic — the engine that keeps the AMOC in constant motion — began to decline as early as around 1850, probably owing to increased freshwater influx from Arctic ice that had melted at the end of a relatively cold period called the Little Ice Age (D. J. R. Thornalley *et al. Nature* **556**, 227–230; 2018). This could have caused a weakening in the ocean circulation.

In a second paper, researchers used global climate models and data sets of sea surface temperature to date the onset of the weakening to more recent times, around the mid-twentieth century (L. Caesar *et al. Nature* **556**, 191–196; 2018). According to their models, the slowdown was about 15%; was most pronounced during winter and spring; and has led to a cooling of sea surface temperatures in parts of the northern Atlantic, together with a slight northward shift of the mean Gulf Stream path. This, the authors say, is probably a consequence of anthropogenic climate change.

Importantly, the findings agree that the AMOC is in a relatively weak state. The wide margin of disagreement between the two independent studies on when the circulation started to weaken is probably due to the different methods used — and it highlights how immensely difficult it is to capture the AMOC's past variability. This will probably frustrate those who prefer their science to send a clear signal. But then, science is rarely so obliging. Can the effects of climate change and natural variability on the AMOC be disentangled? And if the ocean circulation is sensitive to climate change, as is highly likely, will the currents respond abruptly and perhaps violently at some point, or will the transition be smooth? These are among the most pressing questions in climate science.

The slow progress on answering them should offer a stark reminder that the oceans are the most under-sampled component of the Earth system. The AMOC is just one part of a world-spanning circulation system, the physics — and influence on chemical cycling — of which is only poorly understood.

Numerical models are an indispensable tool for studying ocean circulation and climate. But despite ever-increasing computer power, models fall short when it comes to reconstructing something as nuanced and variable as ocean circulation. Long-term, serial measurements of circulation strength are what is needed.

It is crucial, therefore, that existing ocean monitoring systems — including the Overturning in the Subpolar North Atlantic Program and the South Atlantic Meridional Overturning Circulation programme — are maintained over decades to come. Data from these arrays of monitoring instruments are just beginning to shed light on the complex water flows in key ocean regions. Yet securing funding for lengthy studies is an ongoing fight.

There is more to be done. A United Nations sustainable development goal already includes a call for greater research capacity for promoting ocean health. Regional and national ocean-observation efforts should be coordinated, ideally under the Global Ocean Observing System. Meticulous observation is a prerequisite for understanding the oceans on which, ultimately, humankind depends. ■ SEE NEWS & VIEWS P.180

Cosmic sirens

Gravitational waves could help us understand differing measurements of the Universe.

Cosmology has come a long way since Edwin Hubble determined the rate of cosmic expansion around 90 years ago. Since the 1990s, multiple independent techniques have converged on values much lower than Hubble's. They differ by less than 10%, but the differences seem to be statistically significant (3.7 standard deviations). Innovative techniques, including the detection of gravitational waves from stellar collisions such as one that astronomers witnessed last August, should settle the question in the next few years. The answer could contain some new and unexpected physics.

In our expanding Universe, a galaxy's rate of recession from our own can be measured easily from its redshift — how much its light waves stretch as they travel, owing to the expansion of the intervening space. The difficult part is measuring the galaxy's distance. With his early techniques, Hubble discovered that most galaxies seem to recede at a rate proportional to their distance. His 'Hubble constant' quantifies that proportion. Today's state-of-the-art observations suggest that, on average, galaxies' speeds increase by 73.5 kilometres per second for every megaparsec (3.26 million light years) of distance. Thus, for example, galaxies 100 megaparsecs away recede at around 7,350 km s^{-1}.

This value of the Hubble constant comes from observing stars that act as standard candles. These have known intrinsic brightness, so their distance can be estimated from how bright they look in the sky. But the value of 73.5 clashes with the 66.9 estimated in 2015 by cosmologists who mapped the cosmic microwave background — the relic radiation from the Big Bang — using the Planck observatory of the European Space Agency (ESA). The discrepancy could still turn out to be caused by unknown artefacts of the measuring techniques, but both camps say that they are increasingly confident in their results.

The Planck estimate relies on what is known as the standard model of cosmology. It makes assumptions regarding the composition of the Universe, and in particular the content of dark matter and the nature of dark energy, the mysterious driver of the acceleration of the cosmic expansion. So, if the discrepancy holds up, it could point to entirely new physics, implying that dark matter is stranger than physicists had assumed, or that the effects of dark energy change with time.

By contrast, some wonder whether standard candles might not be as reliable as astronomers think. This month, another ESA mission, the Gaia telescope, will release a 3D map of the Milky Way that has unprecedented precision and depth, and will help astronomers test the reliability of these cosmic signposts. But, ideally, astronomers would like to have more direct ways of measuring distances outside our Galaxy.

Enter gravitational waves. These stand ready to address some classic astronomical challenges with strong new evidence, as described in a News Feature on page 164. They might also help to resolve the issues surrounding the cosmic expansion. Health warning: these possibilities are speculative and controversial.

When two cosmic orbs — such as the neutron stars seen merging last August — spiral into each other, they emit gravitational waves that carry information about their distance, constituting a 'standard siren'. This enabled physicists at the US-based Laser Interferometer Gravitational-Wave Observatory (LIGO) to calculate the Hubble constant. They obtained a value of 70, smack in the middle of the standard-candle and cosmic-microwave-background estimates. LIGO's data point has a large margin of error, but, as researchers collect more of these events, the results might end up leaning conclusively one way or the other.

"If the discrepancy holds up, it could point to entirely new physics."

Ultimately, gravitational waves could enable researchers to measure not just the current cosmic expansion, but also how the rate of expansion has evolved over the aeons. Two upcoming ESA projects will help enormously, especially if they get to fly at the same time, as many researchers hope. The gravitational-wave detector LISA (Laser Interferometer Space Antenna) should detect mergers of black holes across the Universe's history. And some astronomers anticipate that the X-ray observatory Athena (Advanced Telescope for High-Energy Astrophysics) might pick up photons from the same events and help researchers find the corresponding galaxies' redshifts — although others consider this a long shot.

Mapping standard sirens in this way should shed light on the nature of dark energy — cosmologists' most coveted goal. They hope that it will provide hints about the future of the Universe. Predictions for an infinitely long-lasting future are outside the realm of science. But cosmologists could still work out whether cosmic expansion will continue to accelerate for the foreseeable future, or whether that acceleration might increase, stop or perhaps reverse. ■

ANNOUNCEMENT

Awards to celebrate women in science

Female scientists are under-represented in global research. *Nature* has long argued the need for initiatives to increase their opportunities and participation — so we are delighted to announce an awards programme that aims to do both.

The two annual awards will recognize inspirational early-career female researchers and those who have worked to champion young women's and girls' participation in science. By rewarding and celebrating these achievements, we hope the programmes will contribute to a positive shift towards the equity sorely needed in the research community.

The first is called the Inspiring Science Award and will honour female scientists who have completed their PhD within the past ten years and have made an exceptional contribution to scientific discovery, as reflected in publications, poster and conference presentations, leadership, tutoring and mentoring. Candidates can be nominated by anyone in their research institute, and we encourage nominations from around the globe and across all subject areas. Our independent judging process will ensure that those working under adverse circumstances or in regions where there is limited access to scientific literature will not be unfairly disadvantaged.

The second prize, the Innovating Science Award, recognizes individuals or organizations that have led a grass-roots initiative to support increased access to, or interest in, science, technology, engineering and mathematics (STEM) for girls and young women around the globe. This backs our belief that supporting early interest in STEM worldwide is a crucial step towards sustainably increasing the representation of women in these subjects. Candidates for this award can nominate themselves.

Nominations opened on 9 April and will close on 11 June 2018. A longlist of ten nominees for each award will be announced on 24 July, and a shortlist of five will be announced on 4 September. Both awards are run by Nature Research in partnership with The Estée Lauder Companies. (Full details of the criteria and nomination processes are available at nature.com/researchawards.)

The winners of the awards will be announced in October. They will receive grants of US$10,000 to build on their efforts, and an invitation to an award ceremony. The Inspiring Science Award winner will also receive a grant of up to $5,200 to support open-access publication of their research, and the Innovating Science Award winner will receive up to $5,200 to support an event that showcases their initiative. These awards complement the existing Nature Awards for Mentoring in Science and the John Maddox Prize for promoting sound science and evidence on a matter of public interest.

Nature strives to champion and showcase the achievements of researchers, and we have a responsibility to drive positive change in the research community. Our journals are committed to supporting gender equity (see go.nature.com/2glxtdj for a collection of related content). We recognize that a huge amount must be done to overcome the many barriers that women face to entry and progression in research; these awards are just one small contribution. We look forward to identifying outstanding individuals who are deserving of these awards, celebrating their achievements and sharing their stories. ■