particular topic, are a key component of that base. With an explosion of scientific literature, "it's impossible for a single person to keep up with reading every new paper that comes out in their field", Bannach-Brown says. And that means that upholding the quality of systematic reviews is ever more important.

Pile-up of problems

Kalliokoski's systematic review examined the reliability of a test designed to assess reward-seeking in rats under stress. A reduced interest in a reward is assumed to be a proxy symptom of depression, and the test is widely used during the development of antidepressant drugs. The team identified an initial pool of 1,035 eligible papers; 588 contained images.

By the time he'd skimmed five papers, Kalliokoski had already found a second one with troubling images. He bookmarked the suspicious studies and continued collating papers for the review. As the questionable papers kept piling up, he and his team decided to use Imagetwin, an AI-based software tool that flags problems such as duplicated or rotated images. Either Imagetwin or the authors' visual scrutiny flagged 112 – almost 20% – of the 588 image-containing papers; that's nearly 11% of all the papers reviewed.

"That is actually a lot," says Elizabeth Bik, a microbiologist in San Francisco, California, who has investigated image-related misconduct and is now an independent scientific-integrity consultant. Whether image manipulation is the result of honest error or an intention to mislead, "it could undermine the findings of a study", she says.

Small but detectable effect

For their final analysis, the authors examined all the papers that met their criteria for inclusion in their review. This batch, consisting of 132 studies, included 10 of the 112 that the team had flagged as having potentially doctored images. Analysis of these 10 studies alone assessed the test as 50% more effective at identifying depression-related symptoms than did a calculation based on the 122 studies without questionable images. These suspicious studies "do actually skew the results", Kalliokoski says – although "not massively", because overall variations in the data set mask the contribution from this small subset.

Examples from this study "cover pretty much all types of image problems", Bik says, including evidence of deliberate alteration. Using a scale that Bik developed to categorize the degree of image manipulation, the researchers found that most of the problematic images showed signs of tampering.

The researchers published their review in January in *Translational Psychiatry* without telling the journal that it was based in part on papers that included suspicious images. The journal's publisher, Springer Nature, told *Nature* that it is investigating. (*Nature*'s news team is editorially independent of its publisher, Springer Nature).

When they published their preprint the next month, the researchers included details of all the papers with suspicious images. They also flagged each study on Pubpeer, a website on which scientists comment anonymously on papers. "My first allegiance is towards the [scientific] community," Kalliokoski says.

Bring reviews to life

The process of challenging a study's integrity, giving its authors a chance to respond and seeking retraction for fraudulent studies can take years. One way to clear these muddied waters, says Bannach-Brown, is to publish 'living' systematic reviews, which are designed to be updated whenever papers get retracted or new research is added. She has helped to develop one such method of creating living reviews, called Systematic Online Living Evidence Summaries.

Systematic-review writers are also keen to see publishers integrate standardized ways to screen out dubious studies – rather than waiting until a study gets retracted.

Authors, publishers and editorial boards need to work together, Bannach-Brown says, to "catch some of these questionable research practices before they even make it to publication."

1. Berrio, J. P., Hestevhave, S. & Kalliokoski, O. *Transl. Psychiatry* **14**, 39 (2024).
2. Berrio, J. P. & Kalliokoski, O. Preprint at bioRxiv https://doi.org/10.1101/2024.02.13.580196 (2024).

CLIMATE CHANGE COULD AFFECT HOW WE KEEP TIME

The effect of melting polar ice on Earth's rotation could delay the need for a 'leap second' by three years.

By Elizabeth Gibney

Climate change is starting to alter how humans keep time.

An analysis published in *Nature* on 27 March has predicted that melting ice caps are slowing Earth's rotation to such an extent that the next leap second – the mechanism used since 1972 to reconcile official time from atomic clocks with that based on Earth's unstable speed of rotation – will be delayed by three years (D. C. Agnew *Nature* https://doi.org/mqc3; 2024).

"Enough ice has melted to move sea level enough that we can actually see the rate of the Earth's rotation has been affected," says Duncan Agnew, a geophysicist at the Scripps Institution of Oceanography in La Jolla, California, and author of the study.

According to his analysis, global warming will push back the need for another leap second from 2026 to 2029. Leap seconds cause so much havoc for computing that scientists have voted to get rid of them, but not until 2035. Researchers are especially dreading the next leap second, because, for the first time, it is likely to be a negative, skipped second.

"We do not know how to cope with one second missing," says Felicitas Arias, former director of the Time Department at the International Bureau of Weights and Measures in Sèvres, France.

In metrology terms, the three-year delay "is good news", she says, because even if a negative leap second is still needed, it will happen later, and the world might see fewer of them before 2035 than would otherwise have been anticipated.

But this should not be seen as a point in favour of global warming, Agnew says. "It's completely outweighed by all the negative aspects."

Synchronizing clocks

For millennia, people measured time using Earth's rotation, and the second became defined as a fraction of the time it takes for the planet to turn once on its axis. But since 1967, atomic clocks – which tick using the frequency of light emitted by atoms – have served as more precise timekeepers. Today, a suite of around 450 atomic clocks defines official time on Earth, known as Coordinated Universal Time (UTC), and leap seconds are used every few years to keep UTC in line with the planet's natural day.

Atomic clocks are better timekeepers than Earth is, because they are stable over millions of years, whereas the planet's rotation rate varies. In his analysis, Agnew used mathematical models to tease apart the contributions of known geophysical phenomena to Earth's rotation and to predict their effects on future leap seconds.

ALESSANDRO DAHAN/GETTY

As polar ice has melted and moved mass towards the Equator, it has slowed Earth's rotation.

Many metrologists anticipated that leap seconds would only ever be added, because on the scale of millions of years, Earth's spin is slowing down, meaning that, occasionally, a minute in UTC needs to be 61 seconds long, to allow Earth to catch up. This reduction in the planet's rotation rate is caused by the Moon's pull on the oceans, which creates friction. It also explains, for example, why eclipses 2,000 years ago were recorded at different times in the day from what we would expect on the basis of today's rotation rate, and why analyses of ancient sediments suggest that 1.4 billion years ago, a day was only around 19 hours long.

But on shorter timescales, geophysical phenomena make the rotation rate fluctuate, says Agnew. Right now, the rate at which Earth spins is being affected by currents in the liquid core of the planet, which since the 1970s have caused the rotation speed of the outer crust to increase. This has meant that added leap seconds are needed less frequently, and if the trend continues, a leap second will need to be removed from UTC.

Agnew's analysis finds that this could happen later than was previously thought, because of climate change. Data from satellites mapping Earth's gravity show that since the early 1990s, the planet has become less spherical and more flattened, as ice from Greenland and Antarctica has melted and moved mass away from the poles towards the Equator. Just as a spinning ice skater slows down by extending their arms (and speeds up by pulling them in), this flow of water away from Earth's axis of rotation slows the planet's spin.

The net result of core currents and of climate change is still an accelerating Earth. But Agnew found that without the effect of melting ice, a negative leap second would be needed three years earlier than is now predicted. "Human activities have a profound impact on climate change. The postponing of a leap second is just one more example," says Jianli Chen, a geophysicist at the Hong Kong Polytechnic University.

A delayed leap second would be welcomed by metrologists. Leap seconds are a "big problem" already, because in a society that is increasingly based on precise timing, they lead to major failures in computing systems, says Elizabeth Donley, who heads the time and frequency division at the US National Institute of Standards and Technology in Boulder, Colorado.

An unprecedented negative leap second could be even worse. "There's no accounting for it in all the existing computer codes," she says.

Agnew's paper is useful in making predictions, but Donley says that there is still high uncertainty about when a negative leap second will be needed. The calculations rely on Earth's acceleration continuing at its present rate, but activity in the inner core is almost impossible to predict, cautions Christian Bizouard, an astrogeophysicist at the International Earth Rotation and Reference Systems Service in Paris, which is responsible for deciding when to introduce a leap second. "We do not know when that means acceleration will stop and reverse itself," he says.

Agnew hopes that seeing the influence of climate change on timekeeping will jolt some people into action. "I've been around climate change for a long time, and I can worry about it plenty well without this, but it's yet another way of impressing upon people just how big a deal this is," he says.

JOURNAL EDITORS RESIGN EN MASSE: WHAT DO GROUP EXITS ACHIEVE?

Editorial rebellions seem to be rising, as researchers seek more control over scholarly communication.

By Katharine Sanderson

Last month, the editors at the linguistics journal *Syntax* publicly announced their resignations in response to changes to the manuscript-handling process imposed by its publisher, Wiley.

"We have come to the conclusion that our position as editors of the journal is no longer tenable," wrote editors Klaus Abels and Suzanne Flynn in an open letter to authors and reviewers of the journal on 9 March. They added that measures designed to cut costs and tackle a backlog of papers – namely assigning copyediting tasks that were previously handled by *Syntax's* independent editorial office to a production team without specialist knowledge of linguistics – meant the journal could "no longer meet the needs of our community".

Wiley says it will continue to publish and invest in *Syntax*. "Any changes Wiley has made to *Syntax* have been designed to facilitate the timely and high-quality publishing of the journal," says Allyn Molina, vice-president of publishing development.

The move is the latest such event in what seems to be an emerging form of protest: the mass resignation of academic editors.

So far this year, the editors of five journals have resigned together, according to an unofficial tally by the website Retraction Watch. This followed 12 such moves in 2023, a big increase over the preceding years (there were 2 such events in both 2021 and 2022). The tally starts in 2015, although earlier events have been recorded.

It isn't clear whether mass resignations are set to become even more frequent, says