

A faster spinning Earth may cause timekeepers to subtract a second from world clocks

March 28, 2024

Online Desk: Earth's changing spin is threatening to toy with our sense of time, clocks and computerized society in an unprecedented way — but only for a second.

For the first time in history, world timekeepers may have to consider subtracting a second from our clocks in a few years because the planet is rotating a tad faster than it used to. Clocks may have to skip a second — called a “negative leap second” — around 2029, a study in the journal *Nature* said Wednesday.

“This is an unprecedented situation and a big deal,” said study lead author Duncan Agnew, a geophysicist at the Scripps Institution of Oceanography at the University of California, San Diego. “It’s not a huge change in the Earth’s rotation that’s going to lead to some catastrophe or anything, but it is something notable. It’s yet another indication that we’re in a very unusual time.”

Ice melting at both of Earth’s poles has been counteracting the planet’s burst of speed and is likely to have delayed this global second of reckoning by about three years, Agnew said.

“We are headed toward a negative leap second,” said Dennis McCarthy, retired director of time for the U.S. Naval Observatory who wasn’t part of the study. “It’s a matter of when.”

It’s a complicated situation that involves, physics, global power politics, climate change, technology and two types of time.

Earth takes about 24 hours to rotate, but the key word is about.

For thousands of years, the Earth has been generally slowing down, with the rate varying from time to time, said Agnew and Judah Levine, a physicist for the time and frequency division of the National Institute of Standards and Technology.

The slowing is mostly caused by the effect of tides, which are caused by the pull of the moon, McCarthy said.

This didn’t matter until atomic clocks were adopted as the official time standard more than 55 years ago. Those didn’t slow.

That established two versions of time — astronomical and atomic — and they didn’t match. Astronomical time fell behind atomic time by 2.5 milliseconds every day. That meant the atomic clock would say it’s midnight and to Earth it was midnight a fraction of a second later, Agnew said.

Those daily fractions of seconds added up to whole seconds every few years. Starting in 1972, international timekeepers decided to add a “leap second” in June or December for astronomical time to catch up to the atomic time, called Coordinated Universal Time or UTC. Instead of 11:59 and 59 seconds turning to midnight, there would be another second at 11:59 and 60 seconds. A negative leap second would go from 11:59 and 58 seconds directly to midnight, skipping 11:59:59.

Between 1972 and 2016, 27 separate leap seconds were added as Earth slowed. But the rate of slowing was tapering off.

“In 2016 or 2017 or maybe 2018, the slowdown rate had slowed down to the point that the Earth was actually speeding up,” Levine said.

Earth’s speeding up because its hot liquid core — “a large ball of molten fluid” — acts in unpredictable ways, with eddies and flows that vary, Agnew said.

Agnew said the core has been triggering a speedup for about 50 years, but rapid melting of ice at the poles since 1990 masked that effect. Melting ice shifts Earth’s mass from the poles to the bulging center, which slows the rotation much like a spinning ice skater slows when extending their arms out to their sides, he said.

Without the effect of melting ice, Earth would need that negative leap second in 2026 instead of 2029, Agnew calculated.

For decades, astronomers had been keeping universal and astronomical time together with those handy little leap seconds. But computer system operators said those additions aren’t easy for all the precise technology the world now relies on. In 2012, some computer systems mishandled the leap second, causing problems for Reddit, Linux, Qantas Airlines and others, experts said.

“What is the need for this adjustment in time when it causes so many problems?” McCarthy said.

But Russia’s satellite system relies on astronomical time, so eliminating leap seconds would cause them problems, Agnew and McCarthy said. Astronomers and others wanted to keep the system that would add a leap second whenever the difference between atomic and astronomical time neared a second.

In 2022, the world’s timekeepers decided that starting in the 2030s they’d change the standards for inserting or deleting a leap second, making it much less likely.

Tech companies such as Google and Amazon unilaterally instituted their own solutions to the leap second issue by gradually adding fractions of a second over a full day, Levine said.

“The fights are so serious because the stakes are so small,” Levine said.

Then add in the “weird” effect of subtracting, not adding a leap second, Agnew said. It’s likely to be tougher to skip a second because software programs are designed to add, not subtract time, McCarthy said.

McCarthy said the trend toward needing a negative leap second is clear, but he thinks it’s more to do with the Earth becoming more round from geologic shifts from the end of the last ice age.

Three other outside scientists said Agnew’s study makes sense, calling his evidence compelling.

But Levine doesn’t think a negative leap second will really be needed. He said the overall slowing trend from tides has been around for centuries and continues, but the shorter trends in Earth’s core come and go.

“This is not a process where the past is a good prediction of the future,” Levine said. “Anyone who makes a long-term prediction on the future is on very, very shaky ground.”