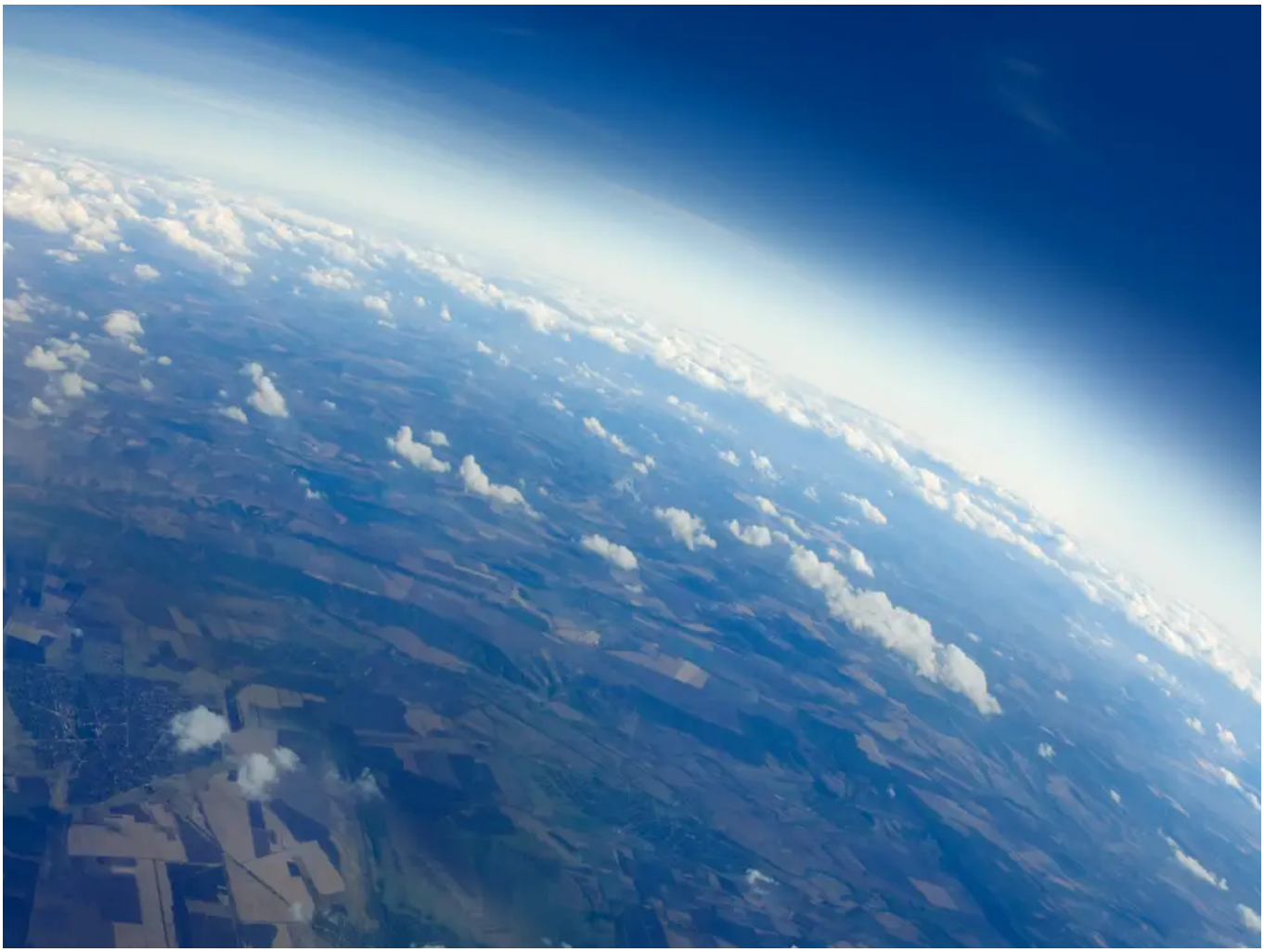
Earth's stratosphere has been shrinking for 40 years. That could one day screw with orbiting satellites.

Aylin Woodward May 14, 2021, 4:47 PM



A band of subtropical stratocumulus clouds as seen from space. Aleksandar Georgiev/Getty Images

- **The stratosphere has gotten a quarter-mile thinner since 1980 and will keep contracting.**
- **That shrinkage, caused by greenhouse gases, could throw off the trajectories of orbiting satellites.**
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About 7.5 miles above our heads, the stratosphere begins.

That slice of sky — where supersonic jets and weather balloons fly — stretches up to 31 miles above Earth's surface. But according to new research, this layer of the atmosphere has shrunk by a quarter-mile in the last 40 years.

A study published last week in the journal Environmental Research Letters shows that humanity's greenhouse-gas emissions are behind the startling contraction.

As carbon dioxide from the burning of fossil fuels enters the lowest level of the atmosphere — known as the troposphere — it traps some of the sunlight that hits Earth as that light is being reflected back into space. That's why the planet's temperature is rising. The more emissions rise, the more heat from the sun stays trapped on Earth and the less it can warm the stratosphere as it travels spaceward. So the stratosphere is cooling.

As the stratosphere cools, it shrinks (as most materials do). Between the 1960s and mid-2010s, it cooled by up to 5 degrees Fahrenheit (3 degrees Celsius). If global greenhouse-gas emissions continue at their current level or increase, that shrinkage is expected to continue.

The new study suggests that the stratosphere will get almost a mile thinner by 2080 — about a 4% decrease from its average thickness between 1980 and 2018.

communications, or the trajectories of orbiting satellites.

A contracting atmosphere

An image taken from the space station shows the limb of the Earth transitioning into the orange-colored stratosphere. NASA/Marshall Space Flight Center

Imagine Earth's atmosphere as a decadent, layered trifle cake.

The troposphere is closest layer to the planet, a 7.5-mile band where most of our weather happens, and where commercial airplanes fly. It meets the stratosphere above it at a boundary known as the tropopause.

On the stratosphere's other side is the mesosphere, which extends 50 miles up; the boundary between those two layers is called the stratopause. Then comes the upper atmosphere, reaching 440 miles high. That includes the thermosphere, where satellites and the International Space Station orbit, and the ionosphere.

According to the new study, the boundaries on either side of the stratosphere —

tropopause has been increasing, and the altitude of the stratopause has the been decreasing. Picture the filling of a whoopie pie gripped too tightly

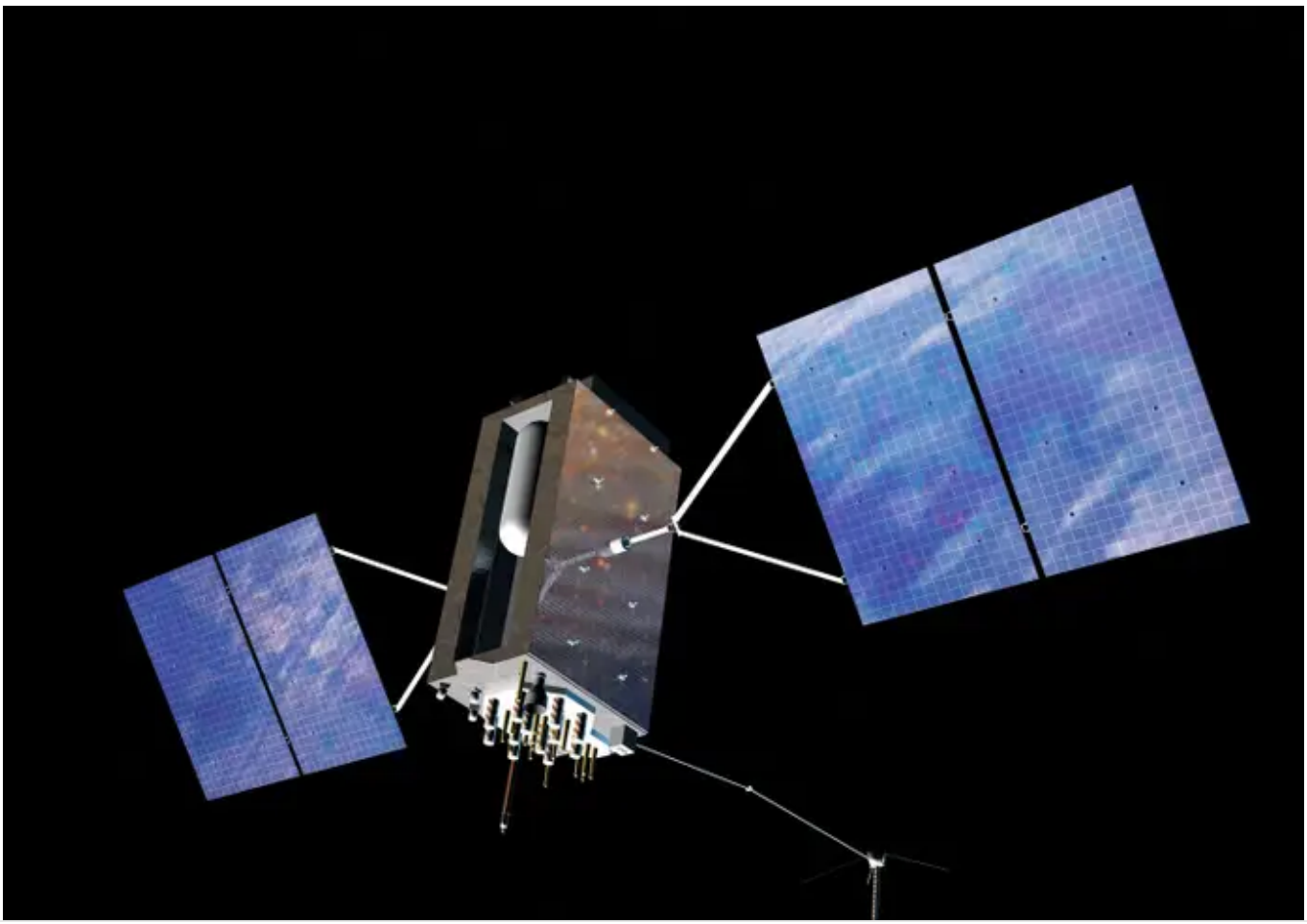
decreasing. Picture the filling of a whoopie pie gripped too tightly.

That trend, the researchers said, is expected to continue unless carbon emissions are sharply reduced. (Atmospheric carbon-dioxide concentrations hit a record high last year.)

"Carbon dioxide cools the stratosphere, and when the stratosphere cools, it actually shrinks the size of the atmosphere," Gavin Schmidt, director of NASA's Goddard Institute for Space Studies, told Canada's National Observer in 2016.

If you're in the mesosphere about 50 miles up, he added, "you actually are seeing the sky falling — it's going down by a number of kilometers."

Bad news for orbiting satellites?



An illustration of a US military GPS satellite in orbit. USAF

Satellites orbit Earth above the stratosphere, but because any change in one layer of the atmosphere can spell trouble for the others, a contracting stratosphere could impact those satellites.

"If (and it is a big if) the shrinking stratosphere were to lower all the atmospheric layers above it, low-altitude satellites would experience reduced air resistance, which could modify their trajectories," Paul Williams, a professor of atmospheric science at Reading University in the UK who was not involved in the study, told The Times.

That modification could eventually wreak havoc on GPS satellites or other space-based navigation systems, according to the new study, perhaps making them less accurate.

High-frequency radio transmissions could also get screwed up, since this means of communication involves bouncing radio waves off charged particles in the ionosphere. That's how airplane pilots talk to air traffic control towers in the northernmost regions of the planet where GPS doesn't work, like the Arctic.

"Any change to the altitude of the electrically charged layer could alter the transmission of radio waves," Williams said.

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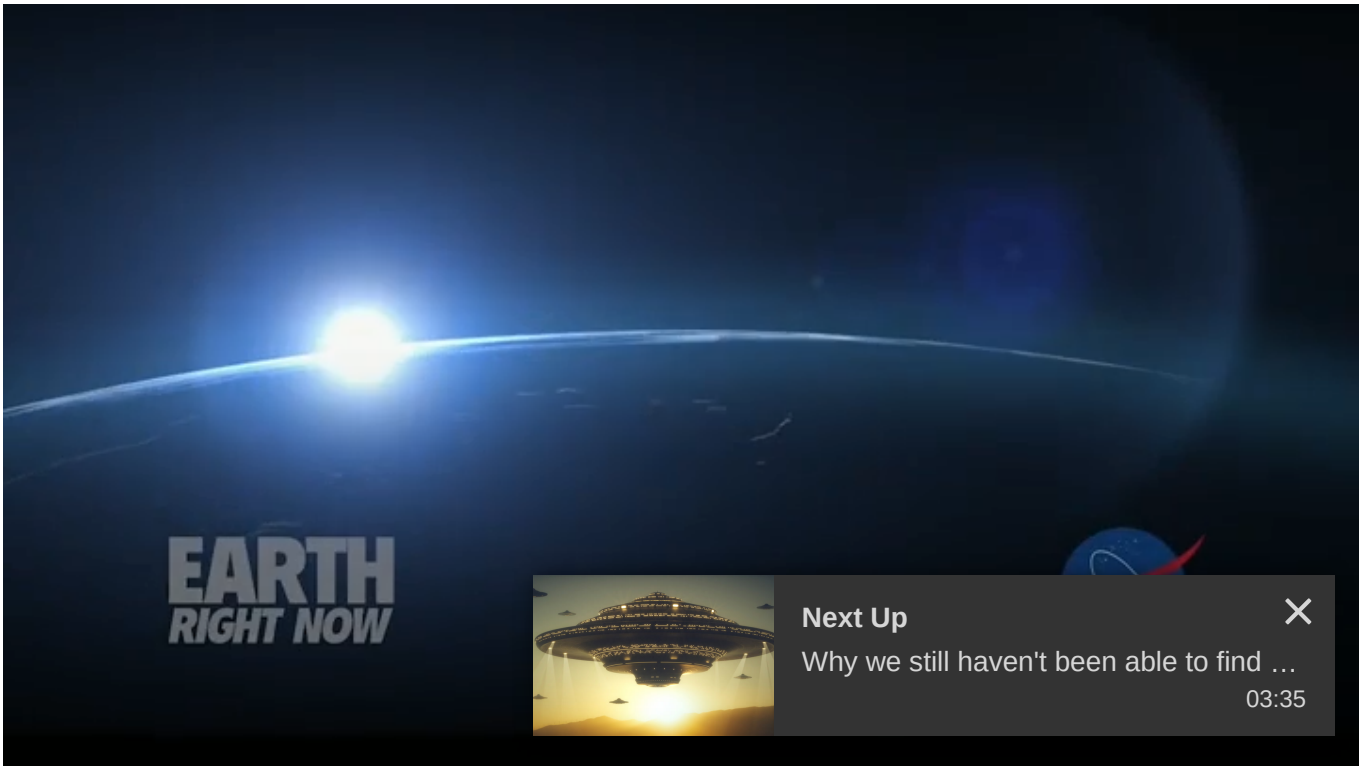

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