

‘Termination shock’: cut in ship pollution sparked global heating spurt

Sudden cut in pollution in 2020 meant less shade from sun and was ‘substantial’ factor in record surface temperatures in 2023, study finds

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Thu 30 May 2024 17.00 CEST

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Regulations at the start of 2020 slashed the sulphur content of fuels used in shipping by more than 80%. Photograph: Shaun Cunningham/Alamy

The slashing of pollution from shipping in 2020 led to a big “termination shock” that is estimated have pushed the rate of global heating to double the long-term average, according to research.

Until 2020, global shipping used dirty, high-sulphur fuels that produced air pollution. The pollution particles blocked sunlight and helped form more clouds, thereby curbing global heating. But new regulations at the start of 2020 slashed the sulphur content of fuels by more than 80%.

The new analysis calculates that the subsequent drop in pollution particles has significantly increased the amount of heat being trapped at the Earth's surface that drives the climate crisis. The researchers said the sharp ending of decades of shipping pollution was an inadvertent geoengineering experiment, revealing new information about its effectiveness and risks.

High ocean surface temperatures smashed records in 2023, alarming experts who have struggled to explain the huge rises. But scientists have mixed views on the role played by the cut in shipping pollution.

Those behind the new study say it could be a "pretty substantial" factor. Others say it is only a small factor, and that the reasons for the extraordinary rises in sea and global temperatures remain an alarming mystery.

Dr Tianle Yuan, at the University of Maryland, US, who led the study, said the estimated 0.2 watts per sq metre of additional heat trapped over the oceans after the pollution cut was "a big number, and it happened in one year, so it's a big shock to the system".

"We will experience about double the warming rate compared to the long-term average" since 1880 as a result, he said. The heating effect of the pollution cut is expected to last about seven years.

The research, published in the journal Communications Earth & Environment, combined satellite observations of sulphur pollution and computer modelling to calculate the impact of the cut. It found the short-term shock was equivalent to 80% of the total extra heating the planet has seen since 2020 from longer-term factors such as rising fossil-fuel emissions.

The scientists used relatively simple climate models to estimate how much this would drive up average global temperatures at the surface of the Earth, finding a rise of about 0.16C over seven years. This is a large rise and the same margin by which 2023 beat the temperature record compared with the previous hottest year.

However, other scientists think the temperature impact of the pollution cut will be significantly lower due to feedbacks in the climate system, which are included in the most sophisticated climate models. The results of this type of analysis are expected later in 2024.

"[Pollution particles] are one of the largest uncertainties in the climate system, and pretty hard to measure," said Dr Zeke Hausfather, at analysts Carbon Brief. He said the new analysis did a good job of using satellite data to estimate the change in trapped heat after the pollution cut, but he disagreed on how that

translated into a temperature rise. Hausfather's estimate of the temperature rise due to the pollution cut was 0.05C over 30 years.

“The [pollution cut] is certainly a contributing factor to the recent warmth, but it only goes a small way toward explaining the 0.3C, 0.4C, and 0.5C margins of monthly records set in the second half of 2023,” he said.

Dr Gavin Schmidt, at Nasa's Goddard Institute for Space Studies, said the new research was “definitely a positive contribution, but it's not using a fully coupled climate model, so there is still more work to be done. We'll see how this all gets reconciled over the coming months.”

In March, Schmidt warned: “We need answers for why 2023 turned out to be the warmest year in possibly the past 100,000 years. And we need them quickly.” He said the recent El Niño event and a rise in solar activity were not sufficient explanations.

Deliberately pumping aerosols into the air over the oceans to stimulate more cloud cover has been proposed as a way of cooling the Earth. Yuan said years of shipping pollution followed by a sharp cut was an accidental large-scale experiment: “We did inadvertent geoengineering for 50 or 100 years over the ocean.”

The new analysis indicates that this type of geoengineering would reduce temperatures, but would also bring serious risks. These include the sharp temperature rise when the pumping of aerosols stopped – the termination shock – and also potential changes to global precipitation patterns, which could disrupt the monsoon rains that billions of people depend on.

“We should definitely do research on this, because it's a tool for situations where we really want to cool down the Earth temporarily,” like an emergency brake, he said. “But this is not going to be a long-term solution, because it doesn't address the root cause of global warming,” which is emissions from fossil fuel burning.