

## Cloud loss may lead to 14°C of warming

Michael Le Page

IF WE keep burning fossil fuels with reckless abandon, we could trigger a cloud feedback effect that will add 8°C on top of all the warming up to that point. That means the world could warm by more than 14°C above the pre-industrial temperature.

This would be cataclysmic. For instance, large parts of the tropics would become too hot for warm-blooded animals, including us, to survive.

The good news is that, if countries step up their efforts to cut emissions, we should

**“The planet became so hot about 50 million years ago that crocodiles thrived in the Arctic”**

avoid finding out if this idea is correct. “I don’t think we will get anywhere close to it,” says Tapio Schneider at the California Institute of Technology.

Schneider’s team computer-modelled stratocumulus clouds over subtropical oceans. These clouds cover about 7 per cent of the planet and keep it cooler by

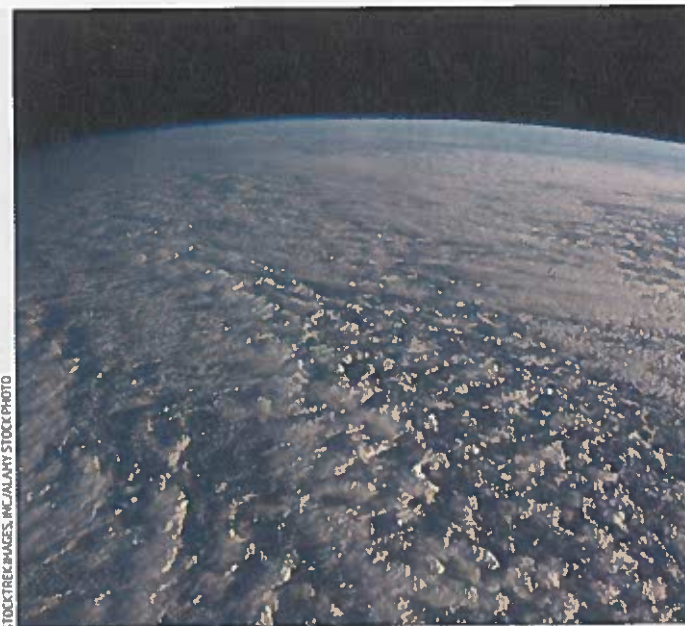
reflecting the sun’s heat back into space. The group found a sudden transition when carbon dioxide levels reached around 1200 parts per million (ppm). At that point, the stratocumulus clouds broke up and disappeared.

This finding applies only to subtropical stratocumulus because these clouds are unusual. The cloud layer is maintained by the cloud tops cooling as they emit infrared radiation – and very high CO<sub>2</sub> levels block this process.

The loss of these bright white clouds would have a dramatic warming effect, adding 8°C to the global temperature, Schneider calculates. Because the world would warm around 6°C or more if CO<sub>2</sub> levels passed 1200 ppm, this means the average global temperature rise could exceed 14°C (*Nature Geoscience*, doi.org/c223).

Carbon dioxide levels will pass 410 ppm this year, up from 280 ppm in pre-industrial times. If we burned all available fossil fuels, atmospheric CO<sub>2</sub> levels could rise as high as 4000 ppm.

However, even in the standard worst-case scenario used by climate scientists, which assumes nothing is done to curb emissions,



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Stratocumulus clouds reflect the sun’s light, keeping Earth cooler

CO<sub>2</sub> levels would only pass 1200 ppm decades after 2100.

Other climate scientists say this cloud feedback is plausible. “Conceptually, I think it’s sound,” says Helene Muri at the Norwegian University of Science and Technology. But there are some uncertainties about the numbers, so it will be important to narrow them down, she says.

The result might hold up, but we already have more than enough reasons to avoid reaching such high levels of CO<sub>2</sub>, says Kate

Marvel at the NASA Goddard Institute for Space Studies.

Emissions are currently growing in line with the worst-case scenario, however the expectation is that countries will eventually do more. “This result isn’t cause for panic,” says Marvel.

The finding could also help solve a long-standing mystery: why the planet became so hot about 50 million years ago that crocodiles thrived in the Arctic. We know that CO<sub>2</sub> levels were generally much higher at the time, but they didn’t seem high enough to explain the extreme warmth during this period. ■

## AI makes Chris Hemsworth smile again

DRAW a few lines on a photo of a face and an AI can turn your sketch into a realistic edit, no skill required.

A face-editing program, created by Youngjoo Jo and Jongyoul Park at the Electronics and Telecommunications Research Institute in South Korea, lets you change hairstyles, add smiles and even insert earrings.

The program is a generative



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adversarial network, formed of two competing AIs: a generator and discriminator. The generator edits photos based on overlaid sketches. The discriminator is given the edited pictures and untouched photos, and must distinguish real from fake.

Eventually, the generator gets so good that the discriminator can no longer tell the difference (arxiv.org/abs/1902.06838).

The pair trained the program on 29,000 celebrity photos. Masks were randomly added over parts of these

images, training the program to recognise and reconstruct particular features – eyes, for example. Similar masks taught it to recognise the colours and shadows of the face.

“This program would help designers by reducing tedious labour,” says Jo, enabling them to focus on more creative tasks. And, he says, it is easy to use without design expertise.

“The big question,” says machine-learning researcher Alex Champandard, “is how do we make these systems so that they benefit a lot of the people whose work is being disrupted?” Donna Lu ■