

Stuart Clark

Global Dimming

Next time you see the white and orange livery of an Easyjet flight overhead, resist the urge to wince at the memory of the scrum-down for seats. Instead, spare a charitable thought; Easyjet and the other short-haul, low-cost flight companies may be helping to save the planet.

“Short haul flights are damaging on fuel but seldom do they get high enough to form contrails,” says Dr Robert Noland of Imperial College, who investigates the environmental effects of air travel.

A contrail, short for condensation trail, forms when hot, humid air created in a jet engine mixes with the surrounding, low pressure, cold air of the atmosphere. Generally, the higher the altitude, the colder the air and the more likely contrail formation becomes. It’s similar to the way your breath condenses into a vaporous cloud on a cold day.

The more short-haul flight companies there are, taking up slots at airports that traditional airlines would like to use for the more lucrative high altitude long-haul flights, the fewer contrails will appear in the sky.

Because they are essentially clouds, contrails have traditionally been thought to help trap warmth and exacerbate global warming. Now they are being implicated in another, seemingly contradictory but equally important, climate change effect: global dimming.

Fading fast

“I first heard about global dimming a few years ago and, to start with, I just wasn’t sure how significant the results were,” says Peter Cox, Science Director for Climate Change at the Centre for Ecology and Hydrology, Dorset. He was not alone. Many other climate scientists had been virtually ignoring the subject for over a decade, despite the work of a graduate student at the Swiss Federal Institute of Technology, Zurich.

At first, the student himself, Atsumu Ohmura, had not believed what he was finding in the collected records of the world’s weather services. “My first thought was that the observations must be in error,” he says in a soft Japanese accent, “So I started

to behave more like a historian, searching for old records and deciding whether I could trust them or not. Eventually it was clear that during each decade from the 50s onwards, the Earth received different quantities of sunlight,” says Ohmura.

Although the records were scarce in places, he realised that the Earth’s received radiation was not changing randomly but declining in a precipitous way. Most places with records showed a loss of more than 10 percent of their sunlight over just three decades.

When he presented his data at a 1988 conference on solar radiation, his colleagues were little moved. In fact, they all but ignored him. He is philosophical about the intellectual snub. “A scientist should be motivated by curiosity not the desire for recognition,” he says.

Unknown to Ohmura, an English scientist working in Israel was in the process of rediscovering what Ohmura already knew. Gerald Stanhill of the Agricultural Research Organization, Israel, had worked since the late 1950s establishing irrigation systems across that country. For them to be effective, he needed to know how much sunlight the crops would receive so his system could supply enough water. After doing this for decades, using devices that convert sunlight into a measurable electrical signal, he noticed something.

“I was amazed to find that there was a very serious reduction in the amount of sunlight falling on Israel,” says Stanhill. Together with his collaborator Shaptai Cohen, Stanhill published his results during 2001, in a paper that coined the phrase ‘global dimming’. Again, they made little impact.

Down the pan

The tide eventually began to turn when two biologists, Michael Roderick and Graham Farquhar of the Australian National University, brought the declining rates of pan evaporation to the world’s attention. This technique is so simple it could come from a DIY children’s science kit. Simply fill a pan full of water and leave it for the day. Next morning, measure how much water is needed to top up the pan. Doing this year upon year, decade after decade, Roderick and Farquhar found that the amount of water needed was steadily decreasing. So, the Sun’s ability to evaporate the water was waning. In other words, the Sun was getting dimmer.

At the same time, climate scientists were beginning to wonder whether computer models of the Earth's climate were underestimating the effects of microscopic particles of pollution, known as aerosols. These would diffuse sunlight, in some cases absorbing it, and change the characteristics of the Earth's clouds, making them reflect more sunlight into space. It provided a plausible global dimming mechanism with the amount of dimming varying from place to place, depending upon the amount of pollution in that locality's atmosphere.

"Everything was beginning to tie together and, as a result, global dimming has been rising up the agenda," says Cox.

But it wasn't necessarily the polluters themselves that suffered the worst effects of global dimming. David Travis of Australia's Commonwealth Scientific Industrial Research Organisation linked the cataclysmic Ethiopian famine of 1984 to the global dimming caused by pollution from Europe and North America. According to Travis, dimming across the northern Atlantic altered the meteorological conditions there and inhibited the movement of tropical rain belts across Africa.

Other scientists are not convinced. "The drought has been suggested as an aerosol effect in some models but, as with any single event in the climate, it is impossible to say for certain whether that single event was caused by global dimming or whether it would have happened anyway. All we can say is that it fits the trend," says Cox.

Trying times

Ironically, it was another tragedy that gave scientists an unexpected way to test global dimming. In the aftermath of the 2001 World Trade Center attacks, commercial air traffic was banned from American skies, removing contrails from the sky, for three days. With these narrow bands of white absent from the atmosphere, more sunlight reached the Earth's surface and scientists noticed that the United States experienced warmer days but colder nights.

Alarmingly, this might suggest that global dimming may be helping to reduce global warming by preventing sunlight from reaching the ground. Combine this with some recent measurements that suggest global dimming has reversed, thanks to new pollution measures, and perhaps global warming is poised to reach nightmarish levels.

Cox believes that we may soon know. “If global dimming and global warming have been cancelling each other out then we should soon see an acceleration in the amount of global warming,” he says.

But Stanhill is unconvinced that we know enough about why global dimming happens to draw any conclusion. “China has just released solar radiation figures from 60 stations, dating back to the 1960s. They show a dimming trend through the mid-80s, followed by a brightening. The problem is that China’s production of aerosols has increased exponentially since the 80s,” says Stanhill, “Also, Antarctica is the most pristine environment on Earth, with very little aerosol pollution and yet global dimming was seen there, too.”

This clearly suggests that the aerosol theory is either faulty or simply erroneous but as Stanhill says, “At the moment, it’s the best model we’ve got.”

Michael Roderick thinks that the other thing that will clear up the confusion in the global dimming debate is more and far better measurements. “It is time for scientists to stand up and say that the measurements are just not good enough,” he says, “I can find rainfall and temperature for any city but I cannot find the amount of sunlight received. The measurements are just not being made. With \$200 million, a good network of radiometers could be set up worldwide and this would have a major impact on what we know about the amount of sunlight we receive. At the moment we’re all just guessing.”

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Effects of Global Dimming

1: The first and the most obvious effect of global dimming is that light levels reaching the Earth’s surface have dropped by alarming rates. In some places, Israel for example, light levels have dropped by over a fifth in just a few decades.

2: The characteristics of low-level, weather-bearing, clouds have changed. The pollution responsible for global dimming causes low-level clouds to contain a larger number of smaller droplets, whereas clouds naturally tend to contain a smaller number of larger droplets.

3: Less sunlight means that less water is evaporated from the ocean. Water from the oceans forms clouds that release their moisture as rain over the continents. Less evaporation means a less efficient water cycle for the Earth.

4: As the humidity and temperature of the atmosphere changes due to global dimming, regional climate cycles will change. Such an effect is thought by some to have induced the Ethiopian famine that sparked Live Aid.

5: Your ability to get a speedy tan will change as well. Pollution from India, drifting through the atmosphere on the prevailing winds, means that the northern islands of the Maldives are dimmer than their southern counterparts.

Regional effects of global dimming

The area worst hit by global dimming was Ethiopia. In the 70s and 80s the Atlantic Ocean stopped evaporating at its usual rate. The drier air failed to create the meteorological conditions necessary to pull tropical rain belts over Ethiopia. The result was a famine of reportedly biblical proportions. Some scientists believe that India's monsoon is showing signs of stalling, too.

Northern hemisphere farmers have noticed a drop in their productivity and wine growers in Europe, Australia and North America, have seen a drop in the sweetness of their grape crops.

Ironically, the light scattering that contributes to global dimming may help plant growth in tropical regions. The incoming light arrives from all angles, instead of straight sunbeams, and penetrates the nooks and crannies of the upper foliage canopy, supplying more light to the plants below.

Ask the Expert: Dr Michael Roderick, Australian National University

When did you first hear about global dimming?

I first heard that term when I read the 2001 paper on the subject by Stanhill and Cohen but, since 1998, I had been aware of Russian work that showed sunlight was declining.

What were your first thoughts?

I was working on photosynthesis models in which I was interested in the amount of diffuse, indirect light falling on the plant. When I saw the Russian result that direct light was decreasing but scattered light was showing an increase, I realised that it could explain a lot, including the declining rates of our own pan evaporation experiments.

How serious is global dimming?

I'm not sure what you mean by that question.

Some are suggesting that global dimming caused the Ethiopian famine of the 1980s.

We (Roderick and collaborator Graham Farquhar) have not said anything like that.

Is global dimming keeping global warming at bay?

I know some people say that as well but I just don't know what to think. I don't think we know enough about how this works yet to say. It is an open question that needs answering. And it's a scientific question, not a political one. Politics should not enter into this debate.

What should be done about global dimming?

Every physicist knows that global dimming/global warming, call it what you like, is about radiation balance at the surface of the Earth. But it's so difficult to get good data and the number of measuring stations is going down not up. At the same time, the number of models keeps growing. That's not a good situation for any science to be in. Without good data, models can be made to say anything.

Jargon buster:

Aerosols – Microscopic particles of pollution.

Light scattering – A process by which light bounces off a microscopic particle into a random direction.

Indirect light – Light that arrives at the Earth's surface having been scattered.

Radiometer – A device for measuring sunlight.

Find out more:

Horizon's global dimming programme:

http://www.bbc.co.uk/sn/tvradio/programmes/horizon/dimming_prog_summary.shtml

Wikipedia's global dimming entry:

http://en.wikipedia.org/wiki/Global_dimming

Global dimming: A new aspect of climate change by Gerald Stanhill, published in

Weather volume 60, pages 11-14.