Trees are much better at creating clouds and cooling the climate than we thought

October 11 2016, by Hamish Gordon And Cat Scott

Credit: AI-generated image (disclaimer)

The pre-industrial atmosphere contained more particles, and so brighter clouds, than we previously thought. This is the latest finding of the CLOUD experiment, a collaboration between around 80 scientists at the CERN particle physics lab near Geneva. It changes our understanding of what was in the atmosphere before humans began adding pollution – and

what it might be like again in the future.

Most cloud droplets need tiny airborne particles to act as "seeds" for their formation and growth. If a cloud has more of these seeds, and therefore more droplets, it will appear brighter and reflect away more sunlight from the Earth's surface. This in turn can cool the climate. Therefore understanding the number and size of particles in the atmosphere is vital to predicting not only how bright and reflective the planet's clouds are, but what global temperatures will be.

Today, around half of these particles come from natural sources. That includes dust from the ground, volcanoes, wildfires that make soot, or sea spray that evaporates midair leaving behind tiny specs of salt in the atmosphere.

Many airborne particles also result from us burning fossil fuels. This produces soot, but also sulphur dioxide gas which is made into sulphuric acid in the atmosphere. As well as causing acid rain, sulphuric acid molecules can stick together and grow into particles. Other molecules like ammonia often help glue the sulphuric acid molecules together, and overall this process forms around half of the cloud seeding particles in today's atmosphere.

The CLOUD experiment at CERN also recently discovered that gases emitted by trees can stick together to make new seeds for clouds in the atmosphere – without needing any help from other pollutants as was previously thought. Scientists had thought that the cloud seeds needed sulphuric acid (often mixed with other compounds) or iodine molecules to stick together to initiate the process.

In our new follow-up study, published in PNAS, we worked with other CLOUD scientists to simulate this process in the atmosphere. Our work suggests that even today trees produce a large fraction of cloud seeds

over the cleanest forested parts of the world.

The CLOUD experiment simulates a ‘mini climate’. Credit: Antti Onnela / CERN, Author provided

Simulations of the atmosphere before fossil fuel burning started in earnest and the industrial revolution began (in climate science defined as the year 1750) predict fewer particles than are present today. With fewer particles the cleaner clouds would have reflected less of the sun's energy and, perhaps counter-intuitively, they would have looked a bit greyer.

The CLOUD experiment

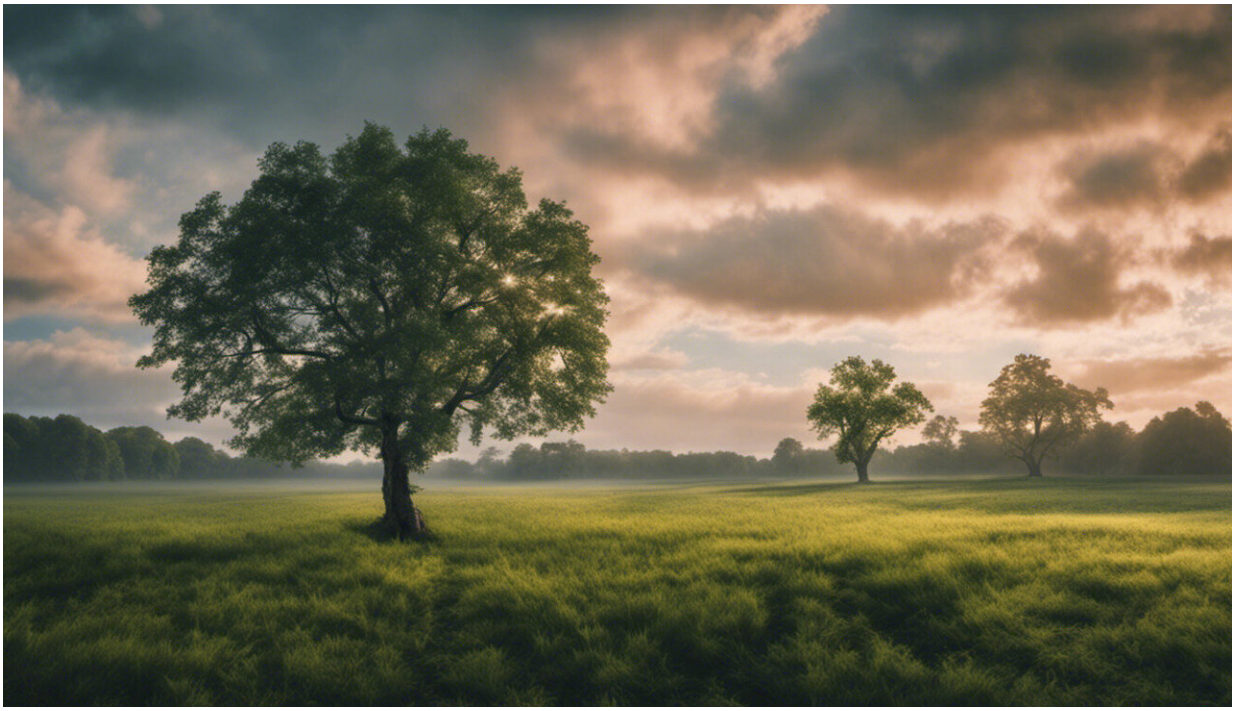
The ability of the gases from trees (terpenes) to make particles was first proposed back in 1960 to explain blue hazes seen over forests in remote areas. Many lab experiments have since confirmed terpenes can help form new particles, but until recently it was thought that other pollutants like sulphuric acid were required.

Much of the more recent progress in this area is thanks to the CLOUD experiment: a stainless steel cylinder, about three metres in diameter and three metres high. Gases are injected into the cylinder, where they react much as they would in the atmosphere and then stick together to make particles. State-of-the-art instruments count the gas molecules and particles in the chamber. We study how the number of new particles formed every second changes when we increase the amount of the sticky gases in the cylinder.

What does this mean for the atmosphere?

In today's atmosphere, there is so much sulphuric acid around that it is difficult to measure how much anything else contributes to forming new particles, and so to the clouds. However our new simulation using the CLOUD results shows that terpenes were very important in the cleaner atmosphere of a few hundred years ago. Computer modelling suggests

that estimates of particle concentrations in the cleaner pre-industrial atmosphere should be increased, while our estimates of today's concentrations are mostly unchanged.



Credit: AI-generated image (disclaimer)

It's hard to make accurate predictions at this early stage as not all of the complicated chemical processes are understood. However, the new results may be important because more particles in the atmosphere mean more reflective clouds and a cooler climate.

Pollution masking climate change

Over the past century, cooling due to increasing numbers of particles in

the atmosphere has offset, or masked, some of the warming due to increasing carbon dioxide levels. Our simulations suggest that this extra cooling might not have been as strong as previously thought.

There have recently been concerns that as we collectively improve air quality across the world, by emitting fewer particles into the atmosphere, we will also be reducing the capacity of particles to act as cloud seeds and have a cooling effect.

While our simulations remain quite uncertain, the potential importance of this new process suggests that as we reduce pollution from combustion and other sources, natural compounds could once again become more important. By helping to replace cloud seeds from air pollution, trees may be able to help us limit global temperature rises.

More information: Reduced anthropogenic aerosol radiative forcing caused by biogenic new particle formation, Hamish Gordon, *PNAS*, DOI: 10.1073/pnas.1602360113 , www.pnas.org/content/early/201 … /1602360113.abstract

This article was originally published on The Conversation. *Read the* original article.

Source: The Conversation