

Home | Print edition | **Headline news** | In depth | Physics Jobs | Events | Buyer's guide | Webinars | Contact us

Search Go

Browse by subject area

Atomic, molecular & optical physics | Nuclear & particle physics | Condensed matter | Astronomy, astrophysics & cosmology | Education |

RELATED STORIES

- ▶ [Particulate pollution cuts carbon dioxide, model shows](#)
- ▶ [A model approach to climate change \(in depth\)](#)
- ▶ [Keeping carbon out of sight but not out of mind](#)
- ▶ [Clean energy investment not on track to avoid climate change](#)
- ▶ [Can geoengineering cool the climate?](#)
- ▶ [Storing carbon - the options](#)
- ▶ [Gas field cleans up carbon dioxide](#)
- ▶ [Partial carbon capture could be stepping stone to full carbon capture and storage](#)
- ▶ [Gas field cleans up carbon dioxide](#)

RELATED LINKS

- ▶ [Gunnar Myhre](#)
- ▶ [Intergovernmental Panel on Climate Change](#)

NEWS

Jun 18, 2009

Aerosol cooling overestimated, says new study

The effect of aerosols on modulating the sun's radiation has been one of the biggest uncertainties in understanding climate change – with satellite data showing more aerosol cooling than computer models. New research reconciles the two different approaches and shows that official estimates of aerosol cooling have been too large, suggesting that any masking of overall warming will be smaller than previously thought.

Aerosols are small particles suspended in the atmosphere that either scatter or absorb solar radiation, a combined phenomenon known as the direct aerosol effect. Aerosols that scatter – such as sulphates, nitrates and organic carbon – tend to cool the Earth by sending some incoming radiation back into space, while absorbing aerosols, such as black carbon (formed from the incomplete burning of fossil fuels), heat up the Earth's atmosphere.

Scientists know that scattering outweighs absorption, and therefore the direct aerosol effect leads to an overall cooling of the climate. Indeed, it may have contributed to a drop in global temperature around the middle of the 20th century. It may also have masked some of the current warming caused by increased greenhouse gas emissions, which could amplify future warming as strict controls on aerosol emissions come into effect.

Large margin of error

In its report of 2007, the [Intergovernmental Panel on Climate Change](#) (IPCC) estimated that the direct aerosol effect has a radiative forcing, or net cooling, of -0.5 Wm^{-2} , which would offset warming due to anthropogenic carbon dioxide by almost a third. However, the margin of error was large – from -0.9 to -0.1 Wm^{-2} .

This uncertainty was mainly caused by differences in the way that the direct aerosol effect is calculated. One option is to use computer modelling, which estimates emissions of the pollutants that produce aerosols and then models aerosol production and the absorption and scattering processes. The

KEY SUPPLIERS



[More companies](#) ▶

CORPORATE PARTNERS



For maximum exposure, become a Corporate Partner. [Contact our sales team.](#)

[Buyer's Guide](#)

alternative is to use satellite measurements of the quantity of aerosols in the atmosphere combined with ground-based measurements of the relative strength of aerosol scattering to absorption. Satellite observations give larger estimates for the cooling.

Now, however, Gunnar Myhre of the Center for International Climate and Environmental Research in Oslo has used the Oslo CTM2 global aerosol model and measurements from the Moderate Resolution Imaging Spectroradiometer onboard NASA's Terra and Aqua satellites together with data from the ground-based Aerosol Robotic Network of solar photometers to show that there are two main reasons for the discrepancy.

More black carbon

The first of these is the fact that calculations based on satellite measurements assume that the relative concentrations of different aerosols in the atmosphere have remained constant throughout the industrial age. This is a problem because calculating the cooling effect of anthropogenic aerosols involves subtracting the effect of aerosols naturally present in the atmosphere, in other words working out the relative strength of scattering and absorption before the industrial era. It turns out, in fact, that emissions of black carbon have increased by more than a factor of six whereas output of the various scattering aerosols has gone up by a factor of only three or four.

The second reason is that satellites have not been able to gather data on aerosol scattering above bright surfaces — such as polar ice caps — because light scattering from the surfaces themselves is so strong. This has tended to overstate global cooling because there are far lower densities of aerosols over the icecaps.

By bringing the two approaches into line, Myhre calculates a new best estimate of -0.3 Wm^{-2} for the cooling of the direct aerosol effect. He says that this will tend to reduce future projections of global warming. This is because the expected drop in aerosol production will not lead to as large a temperature rise as previously thought. Indeed, he estimates that the direct aerosol effect offsets only 10% of global warming. However, he points out that there is still some uncertainty in the vertical distribution of aerosols within the atmosphere, which is significant in so far as absorptive aerosols have a much greater effect when located above a cloud than when below.

Myhre also points out that the direct aerosol effect is smaller than another phenomenon known as the "indirect" effect, in which aerosols enhance scattering through cloud formation.

The IPCC's estimate for the indirect effect is -0.7 Wm^{-2} , ranging from -1.8 Wm^{-2} to -0.3 Wm^{-2} . Edwin Cartlidge

About the author

Edwin Cartlidge is a science writer based in Rome

SHARE THIS

E-mail this article to a friend

Add to Connotea

Add to Cite-u-like

Add to del.icio.us

Digg this

Share on Facebook

4 COMMENTS

Add your comments on this article

erichj
Jun 19, 2009 5:12 AM
McGaheysville, United States

Diffusion by aerosols Increases Photosynthesis 1

Yes, cooling may be overestimated, however this recent research on aerosols presents a double-bind, in that , as aerosols are reduced, less diffusion of light reduces photosynthesis, drawing down 20% less CO2 into biomass. [physicsworld.com...38777](#)

Only a carbon negative system like biochar soil carbon sequestration can address this added CO2 burden caused by this double-bind of clean air.

Unlike CCS which only reduces emissions, biochar systems draw down CO2 every energy cycle, closing a circle back to support the soil food web. The "Carbon Capture" collectors are up and running; Trees & plants. The "Storage" sink is in operation under our feet; Soil. Pyrolysis conversion plants are the only infrastructure we need to build out.

1 ton biomass = 1/3 ton Biochar (= 1 ton Sequestered CO2e) and 1 MWh exported electricity.

[Reply to this comment](#) ▶ [Offensive? Unsuitable? Notify Editor](#) ▶

erinm
Jun 19, 2009 10:55 AM
United States

Climate Change 2

Scientists have much to learn about the way aerosols affect regional and global climate. We have yet to accurately quantify the relative impacts on climate of natural aerosols and those of human origin. Moreover, we do not know in what regions of the planet the amount of atmospheric aerosol is increasing, is diminishing, and is remaining roughly constant. Overall, we are even unsure whether aerosols are warming or cooling our planet. It is possible in the world that all of us may suffer world hunger when unwanted consequences may occurs only if the heat of the sun increases as years pass by. We are going to be stuck in a blackhole like committing to [Al Roker Speidi Interview Gave An Angel Its Wings](#) [personalmoneystore.c...](#)payday loans without having strong assurance what may happen next.

[Reply to this comment](#) ▶ [Offensive? Unsuitable? Notify Editor](#) ▶

hughlaue
Jun 19, 2009 6:40 PM
Port Elizabeth, South Africa

3
Climate change, aerosols and biochar
If the indirect effect is much greater and not changed much then the conclusion is moot as to whether this finding is particularly significant. Let's see what Hansen says - I do have faith in his insight. I'm all for Biochar and there is one project starting here in South Africa that will convert alien plants to biochar and help save the magnificent biodiversity of the "fynbos" in the Western Cape - really a world heritage area. I can't fathom what the second comment is trying to say, but let's try and keep big business away from biochar as an excuse for continuing fossil fuel exploitation greed.
[Reply to this comment](#) ▶ [Offensive? Unsuitable? Notify Editor](#) ▶

joebasted
Jun 20, 2009 5:14 PM
plantville, United States

4
you couldnt pay me to trust Hansen.
so since this masking is smaller, that should mean asinine predictions will be smaller as well since they dont have to play with their hypotheticals as much?
[Reply to this comment](#) ▶ [Offensive? Unsuitable? Notify Editor](#) ▶

[Add your comments on this article](#)

[All content](#) | [Print edition](#) | [Headline news](#) | [In depth](#) | [Events](#) | [Companies](#) | [Products](#)

[Home](#) | [Print edition](#) | [Headline news](#) | [In depth](#) | [Physics Jobs](#) | [Events](#) | [Buyer's guide](#) | [Webinars](#) | [Contact us](#) |

A community website from IOP Publishing

[Copyright](#) | [Privacy policy](#) | [Disclaimer](#) | [Terms & conditions](#) | [Environmental policy](#) |