

This is how aerosols fly across Earth's sky

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What is Aerosol?

Aerosols are tiny particles suspended in the atmosphere. They are often invisible or barely visible to the naked eye, but their impact on climate, weather, health and ecology is significant.

Aerosols range in size from a few tens of nanometres – smaller than the diameter of the smallest virus – to a few tens of micrometres – about the diameter of a human hair. The size and composition of aerosol particles affects how far they can travel around the world, how they interact with solar radiation and heat, and their potential health effects. Aerosols that are released directly into the atmosphere are called 'primary aerosols'. Seawater vapor, mineral dust, smoke and volcanic ash are all primary aerosols. Secondary aerosols are aerosols that are emitted in another form and then become aerosols after undergoing various chemical reactions in the atmosphere, such as sulphate aerosols from volcanoes or industrial emissions. All types of aerosols can undergo further chemical changes, known as the 'ageing effect'.

Video of Aerosol in action in the atmosphere

The sky is filled with aerosols, tiny particles that have a big impact on Earth's temperature. A new NASA visualization shows how these particles swirl through the atmosphere.

NASA's Goddard Earth Observing System tracks major aerosols — sulfate, black carbon, dust, and sea salt. It combines satellite and ground observations with advanced computer simulations to show how aerosols can affect air quality and how far away they can be from their sources.

Unlike greenhouse gases, which can persist for years and disperse globally, aerosols only stay aloft for a few days and form local clouds. These high-flying particles counteract climate warming by reflecting solar radiation back into space and acting as condensation nuclei, increasing the number of water droplets in the clouds and making the cloud masses more reflective.

' These two effects combined offset about a third of the climate warming... about half a degree Celsius ,' said atmospheric scientist Sarah Doherty of the University of Washington in Seattle.

This NASA visualization shows the distribution of aerosols, small particles that can affect global temperatures, from August 1 to September 14, 2024. Major aerosol types include sulfate (green), black carbon (red), dust (purple), and sea salt (teal).

Sulfates (green, in the visualization) are often associated with the burning of fossil fuels, especially coal. While some countries, including the United States, have curbed their use of coal, many Asian countries still rely on coal, which produces a lot of sulfates. Volcanoes also erupt sulfates; if NASA's visualization captured the 1991 eruption of Mount Pinatubo in the Philippines, Doherty says, the globe would be covered in green.

The Sahara Desert is the planet's largest source of atmospheric dust (purple). Trade winds blow Saharan dust across the Atlantic Ocean, where it is believed to nourish Earth's largest rainforest — the Amazon. Some studies suggest that Saharan dust may reduce Atlantic hurricane activity by blocking the flow of moisture in the atmosphere.

Unlike most aerosols, black carbon (red), which is emitted from biomass burning, absorbs solar radiation and warms the climate. Major causes of this include agricultural fires in sub-Saharan Africa as well as fires in the Amazon and North America.

Sea salt (teal) is whipped up by wind and waves, so its abundance is often related to wind speed. Much of the salt is carried up into the Southern Ocean, where powerful winds known as the Roaring Forties travel across the globe, unimpeded by land masses.

As countries take action to tackle air pollution, the cooling effect of aerosols is expected to diminish. In fact, that may already be happening. *' We've seen an acceleration in the rate of warming recently,' says Doherty. 'There are some analyses that suggest that's at least partly due to the decline in aerosols. '*

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