COAL-FIRED POWER STATIONS LINKED TO EXTREME RAINFALL EVENTS

Ultrafine particles from coal-fired power plants are disrupting rainfall patterns more than 1000km away, a new study has found.

The 15-year study by researchers in South Australia and Germany mapped the source, journey and effect of ultrafine particles in the lower troposphere.

It found that filtration systems on modern coal-fired power stations are the biggest individual source of ultrafine particles (UFPs) ahead of urban road traffic.

Results were gathered using ultralight research trikes and other small aircraft around the world, including Mongolia, Germany, Mexico, China and Australia. The flying laboratories are equipped with highly sensitive instruments and sensors measuring dust particles, trace gases, temperature, humidity, wind and energy balances.

The research aircraft followed the ultrafine particles for more than 1000km and could still identify from which power plant they originated.

The paper, published in the Bulletin of the American Meteorological Society, identifies ultrafine particles as particles smaller than 100 nanometres.

Although the pollution isn't visible to the naked eye, and they don't generate haze and are difficult to detect with optical equipment – these particles have been previously linked to respiratory issues.

The new research also links the ultrafine particles to weather disruptions such as a lack of rainfall near the power stations and increased rain intensity in pockets further away.

The study was led by Professor Jorg Hacker from the Adelaide-based Airborne Research Australia, which is affiliated with Flinders University in South Australia, and Professor Wolfgang Junkermann from the Karlsruhe Institute of Technology (KIT) in Germany.

Professor Hacker said when emitted, the miniscule particles could travel hundreds of kilometres and grow by coagulation and chemical processes. He said the ultrafine particles grew to sizes of about 40 nanometers after two to three hours of travel and became additional cloud condensation nuclei, which then leads to a much larger number of small cloud droplets to form than from natural processes.

"These cloud droplets are too small to fall out of the cloud immediately, whereas further away you can get very intense rainfalls," he said.

"If you change the rainfall distribution, that is a dramatic effect. It changes the hydrology of the land.

"The effect is that you do not get less rain but the distribution is different. That means that there can be less rain close to the power station and more intense rain further away."

Callide Power Station in Queensland. Picture: Jorg Hacker.

Coal-fired power plants generate UFPs through a filtration system developed to combat sulphuric acid, also known as acid rain.

South Australia leads the nation in the uptake of wind energy and roof-top solar with renewable sources accounting for more than 50 per cent of the electricity generated in the state.

This followed the closure of two coal-fired power stations in recent years, which has forced up electricity prices and increased South Australia's reliance on energy supplies from the eastern Australian states, particularly in times of peak demand.

Boxburg Power Station in Germany from the research trike. Picture: Jorg Hacker.

The researchers tracked UFPs emitted from the Port Augusta coal-fired station in South Australia before it closed in 2016. They found ultrafine particles at elevated levels at Chinchilla in Queensland, which they were able to trace back to Port Augusta more than 1400km southwest.

"Although the Port Augusta particles had decreased to relatively low concentrations by then they were still clearly identifiable," Professor Hacker said.

"When we then investigated the particle plume from the Kogan Creek powerplant about 20km upwind from Chinchilla, we looked at the instrument readout and said 'well, we should really wear masks here' because the particle concentration had shot up to 70, 80, 90 thousand particles per cubic centimetre."

Specifically, in regions with conspicuous precipitation trends such as inland southwestern Australia and Queensland, the researchers found that UFP concentrations have increased constantly and could be linked to emissions made by coal-fired power stations and refineries.

Many parts of Australia are experiencing severe drought conditions at the moment while other areas, particularly along the east coast are being hit by heavy rainstorms.

Professor Hacker said coal-fired power stations should be modified to collect ultrafine particles but conceded that it would be very expensive to do so.

He said meteorologists should also take these emissions into account when predicting rain patterns.

"We are not saying all droughts are caused by ultrafine particles – that's unrealistic," Professor Hacker said.

"But there definitely is an influence, and there is a statistical increase of intense high rainfall along the Queensland coast.

"There must be some connection between them – the physics are clear."

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Boxburg Power Station in Germany from the research trike. Picture: Jorg Hacker.