NATURAL ENVIRONMENT RESEARCH COUNCIL

Aerosols and our climate

NERC has invested £5.6 million in the APPRAISE programme. This funding will support projects over a five-year period between 2005 and 2010.

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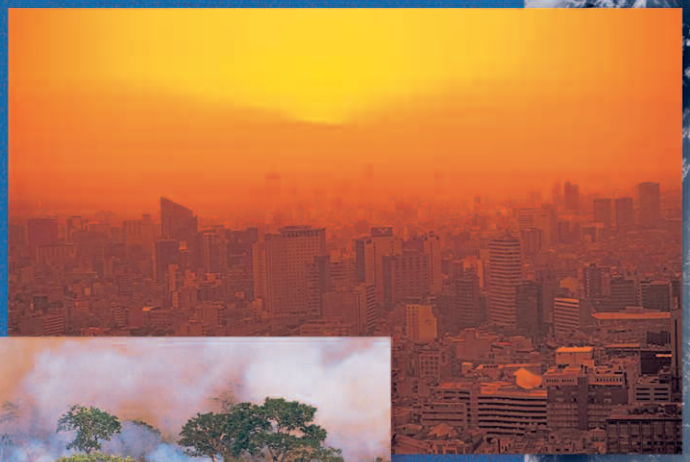
APPRAISE

Aerosol Properties, PRocesses And InfluenceS on the Earth's climate



Images beamed back from satellites have revealed great dust plumes in the atmosphere coming off the west coast of Africa. Image: NASA.

What are aerosols?

Aerosols are one of the remaining major climate change uncertainties. They are tiny particles or droplets which, when suspended in the atmosphere, can have an enormous influence on our climate. Aerosols are so small that you could line one hundred across the width of a human hair.

Over the oceans most aerosols are sulphates or sea salt but above continents they are a cocktail of substances including organic matter such as smoke particles. They are responsible for glowing sunsets and summer haze but more importantly, they can change the amount of sunlight the Earth receives (energy budget).

Some aerosols are formed naturally from ocean spray, vegetation, natural fires, dust storms and volcanoes. However, researchers believe human activity, for example burning fossil fuels or vegetation, is responsible for about ten percent of all aerosols in the atmosphere. We have also produced aerosols indirectly by increasing desertification in certain areas. It is estimated that about two billion tonnes of organic material is emitted into the atmosphere each year by both humans and natural sources.

Climate coolers?

Aerosols can reflect the heat of the sun away from the Earth, reducing the Earth's energy budget and therefore cooling it down. However, certain types of aerosols such as soot, can actually absorb solar energy and warm the atmosphere.

Atmospheric aerosols are very important in cloud formation. Some aerosol particles act as nuclei onto which evaporated water can condense forming tiny droplets. These water droplets grow and accumulate to form clouds. So the more aerosols in the atmosphere, the more changes we might see in cloud formation. The effect of clouds on the atmosphere is complex: they can act as a blanket, preventing heat from escaping to space, but they can also reflect sunlight back out to space, with a resultant cooling effect.

There are still considerable uncertainties, but current research suggests global warming caused by greenhouse gases will outweigh any cooling effects caused by these particles. On the other hand, our regional climate could be massively influenced by aerosols.

Why study aerosols?

Understanding atmospheric aerosols is one of the most important ways we can improve climate models, especially at a regional level.

Scientists still have much to learn about the way aerosols affect our climate. We need to know how those produced by human activities might shift the natural balance and where the regional hotspots might be. We also need to know if the changing climate will give rise to more aerosols in the atmosphere, or less – the feedback process.

The APPRAISE programme

This programme will help us understand and quantify how aerosols affect the Earth's energy budget and influence rainfall patterns.

There are three main projects within this programme and some of their main efforts are outlined below.

- Based in Borneo's rainforests, scientists will research how chemicals released from the tree canopy encourage aerosols to form, how this might influence local rainfall and how changes in land-use might alter future aerosol formation.
- Aerosols have different properties depending on their size, distribution and chemical composition. Scientists will discover more about how these factors influence the ice crystals in clouds and how this influences cloud properties and behaviour.
- The programme explores where aerosols originate in the UK. Scientists will follow the plumes that form downwind of cities to study the changes in the scattering or absorption of sunlight as they spread. This project will be supporting a European-wide study.