Impacting on climate

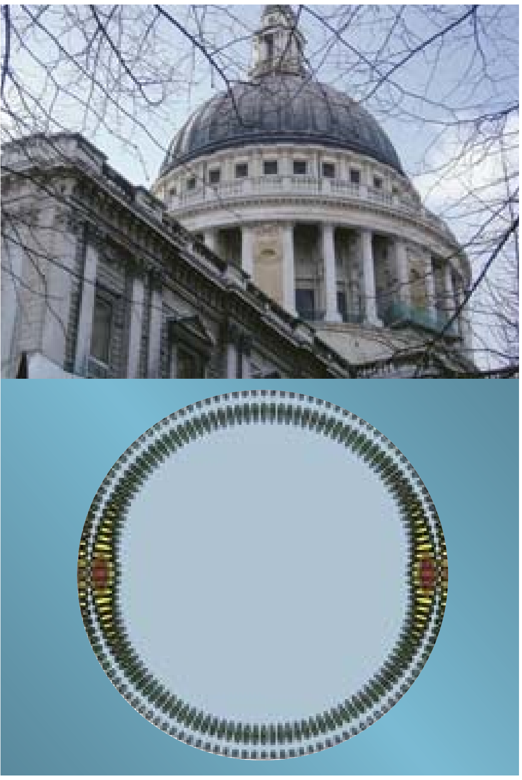
Sandy Harrison

Particles of dust, eroded by the wind from bare soils and lofted into the atmosphere, can influence regional climates by altering the balance of incoming and outgoing radiation. It can also affect chemical processes in the atmosphere. However, the magnitude of this impact on climate is very uncertain, particularly with regard to whether dust will produce warmer or colder conditions at a regional scale, and how any regional changes might affect the global climate. Researchers at Bristol are taking a multidisciplinary approach to tackling the problem.

Modern dust

Conventional wisdom suggests that about 50% of the modern dust load is natural and 50% is derived from human activities – primarily agriculture and deforestation, but also road-building and construction activities. However, this early work was based on limited studies. Recently a group led by Dr **Sandy Harrison** in the School of Geographical Sciences has shed new light on the problem. The team used dust emission indices derived from a new compilation of dust-storm observations to calibrate a dust-source model, so that it reproduced observed dust emissions in areas of natural vegetation. They then looked at the differences between the model predictions and observations in agricultural and grazed areas and used these differences to estimate how much land-use practices contributed to dust erosion. Surprisingly, they found that dust from agricultural and grazing lands contributed less than 10% of the modern dust in the atmosphere, suggesting that the scope for reducing the bad effects of atmospheric dust on urban climates and human health is limited, since most of the dust is natural.

This much lower estimate will require a reassessment of our understanding of the dust cycle, but it also indicates that more sophisticated models of the dust cycle are needed, incorporating, for example, the way in which vegetation growth controls dust emissions. The development of improved dust-cycle models has become an important goal for this team. ■



Light can circulate in a liquid droplet (below) in much the same way as sound circulates in the Whispering Gallery of St. Paul's cathedral (above)

Jonathan Reid

Whispering with light

Not only do solid and liquid particles play a crucial role in the Earth's atmosphere by determining the amount of sunshine that reaches us and is reflected back, but they also promote chemical reactions that can result in acid rain and a fluctuating ozone hole. Both the size and chemical composition of particles are critical in determining the role they play.

In order to understand fully the impact these particles have on the atmosphere, it is essential to first understand the chemistry of single particles. Using an armoury of new optical techniques, Dr **Jonathan Reid** in the School of Chemistry is developing strategies to watch the chemistry that occurs in liquid aerosol droplets. These all involve examining a single droplet with a single pulse of light fired from a laser. In much the same way that sound travels around the Whispering Gallery in St Paul's Cathedral, the pulse of light can circulate around the inside of the droplet for a few nanoseconds before escaping, trapped by the curved surface. The amount of time the light is trapped corresponds to the light travelling a distance of several metres around a droplet that may only be a few microns in diameter.

A unique spectroscopic fingerprint results from the single pulse of light, yielding, with nanometre precision, the size of the droplet. It also provides information on its composition, pH and temperature. Research is currently focused on understanding the chemistry occurring on the surfaces of such droplets, and how droplets grow or evaporate. ■

Dr Reid has recently been awarded the 2004 Marlow Medal by the Royal Society of Chemistry for this work.