changes in the patterns of SO_2 emissions. In fact, even in forecasts for which the global-mean change in SO_2 emissions is minimal, a change in the source distribution, say from a European and North American focus to one centred on eastern Asia, could alter the pattern of climate change considerably.

So far, all spatially specific projections of future climate change[9,10] have assumed CO_2 to be the only forcing agent. Because the models used still have recognized deficiencies and because their predicted changes differ widely at the regional level, the value of these projections could be questioned even if CO_2 were the only forcing agent. The fact that aerosols have been ignored means that projections may well be grossly in error over much of the world. Not only are the magnitudes of temperature change likely to be overestimated almost everywhere, but, unless the effects of aerosols are included, even the sign of the estimated changes may be wrong in some areas. Furthermore, aerosols are virtually certain to affect all climate variables, not just temperature. This adds another straw to the camel's back for climate modellers.

That challenge is multiplied for those who seek to use the results of these models. With CO_2 alone, it is relatively easy to make use of a single experimental result, such as that obtained by doubling the amount of CO_2 in the model, to estimate changes for a wide range of situations. With aerosols included, each pattern for future emissions will produce its own unique climate-change signature. To cover the range of possible emission patterns may require many, many modelling experiments. Perhaps the biggest challenge, therefore, is to devise and apply a subset of emission patterns which might be linearly combined to span a much wider range of possibilities.

But is this linear superposition approach valid? Nonlinearities may manifest themselves in two ways, at the global-mean level and in the patterns of climate change. For the first, the key parameter is the climate sensitivity, defined as the equilibrium global-mean temperature change per unit change in radiative forcing. This parameter, λ, uncertain by a factor of at least three, is thought to lie between 0.3 °C and 1.0 °C for every 1 W m^{-2} of forcing[9] with about 90 per cent confidence. But Taylor and Penner's results indicate that the climate sensitivity for CO_2-induced forcing may differ from that for aerosol-induced forcing — in other words, the sensitivity may depend on the type and pattern of forcing. If correct, this is a startling and somewhat puzzling result of considerable importance.

For CO_2, their model gives a value of 1.7 °C W^{-1} m^2, an unusually high value. For aerosol forcing, λ is substantially less, 1.0 °C W^{-1} m^2. It is not the absolute values here that are important, but the relative values. These add a new element of uncertainty to predictions of future human-induced climate change. Apart from complicating the concept of climate sensitivity that lies at the heart of many climate analyses, it means that estimating future global-mean temperature changes from simple energy-balance models that combine radiative forcings from different sources (as in ref. 8, for example) may not be valid.

Notwithstanding the climate sensitivity problem, one can ask whether the pattern of change for combined CO_2 and aerosol forcing is the same as the sum of the patterns for CO_2 alone and aerosols alone. Reassuringly, it appears that the patterns are similar — the spatial correlation between them for annual temperatures is 0.86 (K. E. Taylor, J. E. Penner and B. D. Santer, personal communication). So it may still be possible to estimate climate change for future combinations of greenhouse gas and SO_2 emissions by combining results from simpler experiments, although the assessment will undeniably be complicated by the differential sensitivity effect.

Clearly, it is vital to confirm Taylor and Penner's results with other models. If they are correct, however, their importance should not be underestimated. They imply that we are still on the upward slope of the climate-change learning curve and that it may take longer than we thought to reduce uncertainties in climate predictions. In more ways than one, therefore, aerosols add a new dimension to the problem of predicting climate change and providing results that are of use to policy makers. The outlook may indeed be warmer, but our picture of it has become much hazier. □

Tom M. L. Wigley is at the University Corporation for Atmospheric Research, PO Box 3000, Boulder, Colorado 80307, USA.

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DAEDALUS

Snap judgement

TELEVISION, says Daedalus, has a strange and terrible authority over its victims. It dictates their hopes and dreams, their sense of what life ought to be, even their sense of what life is. For narcotized millions, the characters in fictional soap operas are more real than any human family. Politics is infected too — the whole US Somalian adventure was triggered, not by considerations of policy, but by television images chosen and assembled by news editors. The moving picture, which began so promisingly, is now a major social curse. Proliferating by video, cable and satellite, its disruptive fantasies are even infecting the vulnerable Third World.

Television technology rests, of course, on an illusion: the fusion of 25 still images per second into an apparently moving picture. This image-fusion rate is not immutable. In species such as bees it is about 300–400 Hz. If bees can do it, says Daedalus, so can we. Last week DREADCO's biochemists were trying to extend the persistence of vision. They are now trying to reduce it. By speeding the diffusion of crucial ions through the membranes of the visual pathway, DREADCO's 'Quickview' tablets will raise our image-fusion rate to 1 kHz or higher.

Users of 'Quickview' will find new delight in the visual world. They will resolve previously blurred motions — the whirl of a dancer, the wing beat of a butterfly — into sharp, detailed movements. At work and on the road, their high-speed sight will detect and avert accidents. Best of all, they will be safe from television and film. Television will be a set of lines flashing down the screen; film will be reduced to a jerky sequence of stills. In neither case will there be any illusion of a moving image. Parents will rush to dose their children with 'Quickview' to cure their addiction to video nasties and computer games.

But how to cure the parents themselves? Daedalus will publish fake reports that 'Quickview' counters the effects of food-additive allergies, electromagnetic fields, passive smoking, and similar fashionable perils. Politically correct governments will react by putting 'Quickview' in bread or salt or water, as calcium, iodine and chlorine are now. At a stroke, the moving image will vanish from our lives. Its hapless junkies will be returned to the real world.

One snag is that most computer screens will become meaningless as well. But computer users don't need a moving image; they can work perfectly well with a succession of stills. Re-equipped with long-persistence or non-scanning LCD screens, they will hack valiantly on. David Jones