clean
skies ahead

Scientists such as **Dr Peter Manins** have spent decades developing new ways to measure air pollution. Have they been too clever for their own good?

Day 1 11:30

Twenty five years ago, scientists could describe the complex winds and dispersion of pollutants in a coastal region in only the most qualitative way. Indeed, I spent my early years in CSIRO trying to understand how winds at night flow downhill in a simple valley.

Only 10 years ago, my collaborators Bill Physick and Peter Hurley had just assembled a complex numerical modelling system. LADM was the first system capable of a comprehensive simulation of the variation throughout a day of local meteorology and mixing of emissions from sources such as power stations. The components of LADM drew on international experience, but relied strongly on years of collaboration by colleague John McGregor with the Bureau of Meteorology on climate and forecasting modelling, and on fundamental scientific advances in the theory of mixing developed by colleague Brian Sawford.

We had reached this point because of a shared objective I had eight years earlier: to have a numerical model to describe winds in


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complex terrain that was 'ours' to use unencumbered for commercial applications. We were well ahead of the 'new', commercially oriented, CSIRO, responsive to client needs, and this in the public-good arena!

With the backing of the Electricity Commission of NSW we showed for the first time that numerical, computer-based, regional air pollution impact assessments in complex geographies were feasible using LADM and, indeed, vital to obtain a proper understanding of the impact of major industry on the environment. Regulators and industry now accept that this approach is essential for airshed management, not the least because it correctly accounts for the finding that pollutants can return to a locality in daily changing winds, often chemically transformed into different pollutants.

To communicate results to the Commission, Peter Hurley developed an interactive graphical display system to visualise the complex results from LADM. We continue to
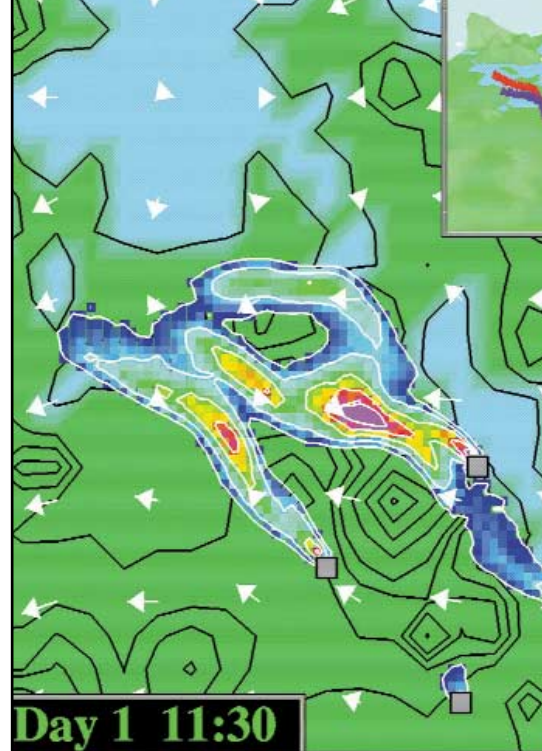
use this system for most of our analyses and for presentations to clients. Its outputs are known around the world for their graphic information impact. I believe that my group won the 1992 CSIRO Medal because, for the first time, others in CSIRO could relate to what we were doing!

Later this year LADM is to be replaced by our newly developed modelling system. The new system runs on a PC instead of a supercomputer. Rather than being restricted to modelling air pollution impact over only a few days, it can be used to predict the air pollution impacts in a complex region over a whole year anywhere in Australia, simply by specifying the date range, location and pollutant emissions properties. Impact assessments and air pollution management strategies will be revolutionised by this development. The model has other applications too: it will soon be used for wind-power prospecting throughout Australia, obviating the need for expensive exploratory measurement campaigns, and helping promote wind power as an alternative.

Early next year, in collaboration with the Bureau of Meteorology and EPA Victoria, colleague Martin Cope and I will be launching the Australian Air Quality Forecasting System. Daily hour-by-hour forecasts of air quality down to suburb scale will be issued in Sydney and Melbourne; other cities will follow later. Not only will this be valuable for concerned people to plan their day, it will


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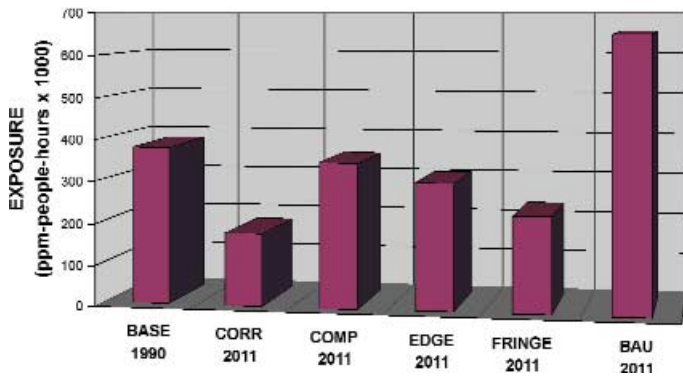
Left: A graphical display from the LADM modelling system shows possible air pollution from proposed developments in Gladstone.

Above: The coupling of a land-use planning model with an air pollution modelling system shows that BAU (business as usual, or no plan at all) gives the worst air quality future for Melbourne.

Below: Giving the public a simple choice of air quality forecast: fewer cars means cleaner air.
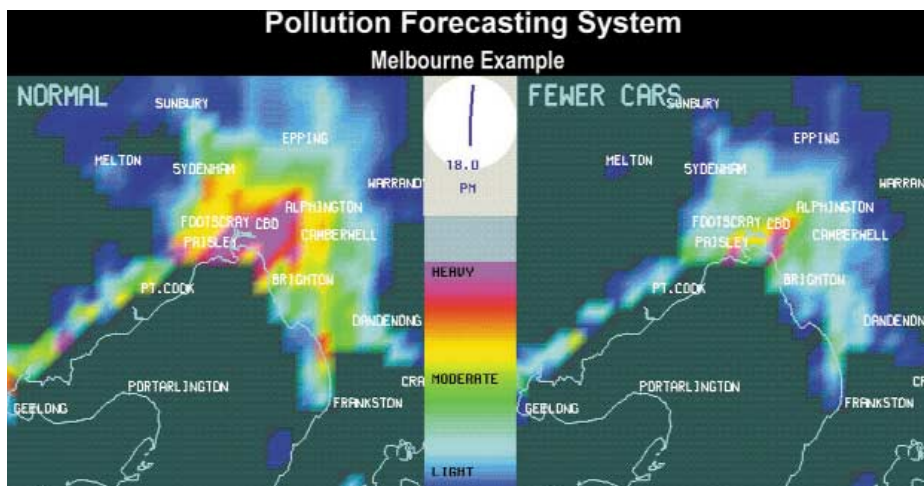
eventually provide data sets that will be of value to everyone from health professionals trying to test relations between illness and air pollution, to real estate agents touting the virtues of one suburb over another!

This information is expected to lead to societal support for changes such as road-usage pricing, increased use of public transport, environmentally cleaner products, and pressure on small to medium enterprises for cleaner production.

We are participating with CSIRO colleagues and others in the development and demonstration of two hybrid cars to be launched early next year. One of these cars will be rather futuristic, the other less so but readily adoptable by manufacturers. The environmental benefits of these cars in terms of reduced emissions of greenhouse gases and air pollutants are being assessed by our advanced air pollution models. There is potential here to develop a vehicle with virtually zero pollutant emissions.

For the recent Inquiry into Urban Air Pollution in Australia, we coupled a CSIRO land-use planning model with our air pollution modelling system. Results show that considerations of air pollution lead to clear choices between alternative urban futures. The prospects are that we can achieve a lot more, influencing the way urban designers and planners help change Australian cities to be cleaner and less reliant on private transport. Working with other engineers, we plan eventually to incorporate other weather-responsive factors such as water demand, waste disposal and energy use considerations into the overall urban design system.

No matter what the success in Australia, for the foreseeable future my colleagues and I will continue to have a lot of business abroad, particularly in Asia, in helping solve air pollution problems, whether that be by modelling, smart low-cost monitoring or by effective training and promotion of CSIRO's capabilities.

A positive outlook for air pollution

IN 25 years' time, the need for an air pollution research component in CSIRO will have disappeared. We will be out of a job. In that time I expect that:

• **Climate change** due to the enhanced greenhouse effect will be well under way, but Australia's contribution to greenhouse gases will be falling rapidly from the present 1.4%, due to major changes in afforestation, industry, energy production and transport.

• Australia's **energy consumption** will be not greatly increase, but the contribution from renewable energy sources such as hydro, solar and wind will be well above the present 5.5% and rising. Another energy source, perhaps fuel-cell banks, or even nuclear fusion, will be displacing fossil fuels as the primary source. No new coal-fired stations will have been built in Australia for 20 years and those still operating will be running at a loss.

• Small industry in Australia will have embraced **cleaner production** and environmentally friendly products such as fully biodegradable plastics. Some significant pollutant emissions will still exist, but they will be in small regions and governed by environmental factors such as wind-blown dust.

• **Urban air pollution**, presently dominated by emissions from motor vehicles in Australia, will be falling rapidly due to the displacement of petrol and diesel vehicles by hydrogen fuel-cell hybrid types with remarkable fuel efficiency and negligible pollutant emissions. (It seems that only aeroplanes will have no alternative to kerosene or avgas.) The only incorrigible urban air pollution problem will be due to fine particles, but by then their composition will be almost the same as in rural areas.

• Success with urban renewal and **urban redesign** will mean that the need for private vehicles will be considerably diminished: cars will be something to be indulged in for leisure activities. But road congestion will remain severe, despite high taxes on petrol and diesel fuels for the remaining 'older'-technology vehicles, and road-use charges that make a trip by car to the city expensive.