# Better warnings a boon for the forest

*Graeme O'Neill*

AUSTRALIA'S forest industry, firefighting agencies and natural disaster authorities have a mutual interest in improved forecasting of El Niño events. Twice this century, massive bushfires have swept through the forests of south-eastern Australia at the height of El Niño-induced droughts.

The Black Friday conflagration of February 1939 burnt through 1.4 million hectares of forest, killing 71 people. Most of Victoria's mountain forests, including the productive mountain ash (*Eucalyptus regnans*) forests of the central highlands, were destroyed. The total loss of timber was estimated at five million cubic metres, equivalent to 20 years of potential sawmilling in the region.

The Ash Wednesday bushfires of February 1983 burnt through 350 000 hectares of land. Even though 21 000 trained firefighters were deployed with modern firefighting equipment, the human and economic toll was even greater: 77 people died and insurance claims exceeded $200 million. Part of the enormous cost to the forest industry arose from the destruction of large areas of softwood plantations in South Australia and Victoria.

While fire is of major concern, Jim Gould of CSIRO's Division of Forestry says that climate variation also plays a role in outbreaks of forest diseases and insect pests. Climate variation may also influence when and where plantations are established.

'Some plantation owners deferred planting programs in the dry 1994 winter because of the high risk that seedlings planted during drought would die during the following spring,' Gould says. 'Being able to predict extreme climatic events is more important than knowing about long-term climatic means.'

Gould says forestry operates on much longer timescales than most industries, so there is a need for higher-resolution models capable of predicting the

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consequences of longer-term climatic trends and their consequences. For example, ENSO events have occurred more frequently during the past two decades. And in Australia, climatic regimes can differ markedly over short distances, so foresters would also welcome detailed models that could make useful forecasts for specific regions.

Rising carbon dioxide levels in the atmosphere raise questions about what effects global warming may have on regional climatic variability. Pronounced changes in the climate of the central-west region of New South Wales may be related to this phenomenon. Gould says such considerations could influence the choice of land to be planted and the tree species, or the provenance (geographic variation) of a species, to be planted in particular regions.

A major interest of the forestry industry is in improved prediction of climatic extremes, and their impact on regional fire risks and fire behaviour.

Gould says researchers at the Division of Forestry are attempting to tie better prediction of drought or significant rainfall events into information systems that would give fire-control agencies more time to plan for high-risk summers. If a dry summer could be reliably predicted more than six months in advance, for example, fire authorities and foresters would be able to organise fuel-reduction burns in the preceding autumn, focusing on terrains where local factors magnify fire risk.

Statewide or regional forecasts cannot address smaller-scale influences that affect where and when firefighting resources should be deployed, Gould says. The destructive bushfires that broke out in Sydney in early January 1994 illustrate the problem.

'The only reason firefighting authorities were able to deploy people and resources into NSW was because it was wet in Victoria and South Australia, so there was no real risk to communities in these areas,' Gould says. 'The NSW fires started on the north coast, and most of the resources were initially moved into this area, so that when the fires broke out in Sydney, they had to be brought back.

'Most fire-control agencies can predict from weather forecasts whether tomorrow is likely to be another bad day. But it's also important to know how bad things might be a week from today, or in subsequent months.

'The Sydney fires were different from the Ash Wednesday fires. Ash Wednesday was a two-day event, but in Sydney the fires built up over the course of a week of very high to extreme fire danger. They were able to allocate just enough resources to control them, but if they had gone another three or four days, we don't know what would have happened.

'If authorities had the ability to predict a severe fire risk in Sydney a week in advance, they might have been able to draw on resources from elsewhere. The situation in Australia is unusual in that much of the firefighting is done by volunteer local brigades, which can be rather difficult to move around.'

Gould says researchers at the Division of Forestry hope to link their findings into a computer-based geographic information system (GIS) that can evaluate local fire risks by assessing the factors that influence the rate of fire spread. This will help land managers to plan low-intensity fuel reduction burns.

'Our research is aimed at improving prediction of fire and fire behaviour, and at developing better models of fire spread,' Gould says. 'The moisture dynamics of the fuel is a critical input into any prediction system. Fine fuels are more efficient at spreading fire than coarse fuels, and depending on the weather conditions, they wet more easily and dry out more rapidly than coarse fuels.'

Gould says most authorities calculate a drought index to guide fuel-reduction burns, based on variables such as soil moisture level, the number of days since last rain and the temperature regime within this period, current daily temperatures, relative humidity and wind speed.

Experiments in 1990 and 1991 aimed at gauging the effectiveness of fuel-reduction burns in a coastal regrowth *Eucalyptus sieberi* forest in south-eastern NSW found that in one autumn, when the drought index was low, a low-intensity burn did not consume coarse fuels. The following autumn, when the drought index was even lower, the coarse fuels burned.

'We suspect that summer rainfall had brought the index down through its effect on soil moisture, but there had been little effect on coarse fuel moisture levels,' Gould says. 'We need to investigate how responsive the existing drought index is to summer rainfall, and how the moisture content of coarse fuels varies in relation to rainfall and how this affects fire behaviour.

'We also want to know how slope and aspect influence the rate at which fuel dries out. For instance, north-facing slopes tend to be much drier than south-facing slopes, but in summer there may be little difference because of the high angle of the sun.

'If you want to do a low-intensity burn for fuel reduction or ecological management, there may be only a very narrow window of opportunity. Being able to differentiate the fire risk across a particular terrain according to soil and fuel moisture could be critical to meeting your objectives.'