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Developing a probabilistic fire risk model and its application to fire danger systems

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Wildfires can result in significant economic losses where they encounter human assets. Management agencies have large budgets devoted to both prevention and suppression of fires, but little is known about the extent to which they alter the probability of asset loss. Prediction of the risk of asset loss as a result of wildfire requires an understanding of a number of complex processes from ignition, fire growth and impact on assets. These processes need to account for the additive or multiplicative effects of management, weather and the natural environment. Traditional analytical methods can only examine only a small subset of these.

Bayesian Belief Networks (BBNs) provide a methodology to examine complex environmental problems. Outcomes of a BBN are represented as likelihoods, which can then form the basis for risk analysis and management. Here we combine a range of data sources, including simulation models, empirical statistical analyses and expert opinion to form a fire management BBN. Various management actions have been incorporated into the model including landscape and interface prescribed burning, initial attack and fire suppression. Performance of the model has been tested against fire history datasets with strong correlations being found.

Adapting the BBN presented here we are capable of developing a spatial and temporal fire danger rating system. Currently Australian fire danger rating systems are based on the weather. Our model accounts for existing fires, as well as the risk of new ignitions combined with probabilistic weather forecasts to identify those areas which are most at risk of asset loss. Fire growth is modelled with consideration given to management prevention efforts, as well as suppression resources that are available in each geographic locality. At a 10km resolution the model will provide a probability of asset loss which represents a significant step forward in the level of information that can be provided to the general public.