APPLICATION OF EXTREME VALUE ANALYSIS TO FIRE WEATHER CONDITIONS FOR NSW.

Grahame Douglas[1, 2,3]

[1] School of Computing, Engineering and Mathematics, University of Western Sydney, NSW
[2] Coordinated Risk Coordination Group, NSW Rural Fire Service, NSW
[3] Bushfire CRC, Victoria.

Introduction.

Bushfires are a regular but variable phenomena in the landscape. Bushfires can occur with some regularity, however, extreme bushfire events are less likely and hard to quantify. These events are dependent on the antecedent weather conditions which give rise to severe conditions.

The determination of the severity of the a potential bushfire for land-use planning purposes is crucial in any assessment process. Property protection measures are therefore related to the concept of a 'design fire'.

In fire engineering practice, the design fire is principally based on the combustible materials within a confined area (ABCB, 2005). In bushfire engineering, the design fire is dependent on topography, fuel loads (or fuel structure) and weather conditions. In some cases applicants may seek to develop alternate design fires as weather conditions are less severe than those required by the deemed to satisfy design fire. An excessively high design fire may add significantly to costs of construction and or land clearance for property protection purposes.

The quantification of extreme weather events assists in determining suitable design bushfires based on a risk profile. These techniques are regularly used in areas of storm, flood and high wind events, however, little work has been produced for extreme fire weather.

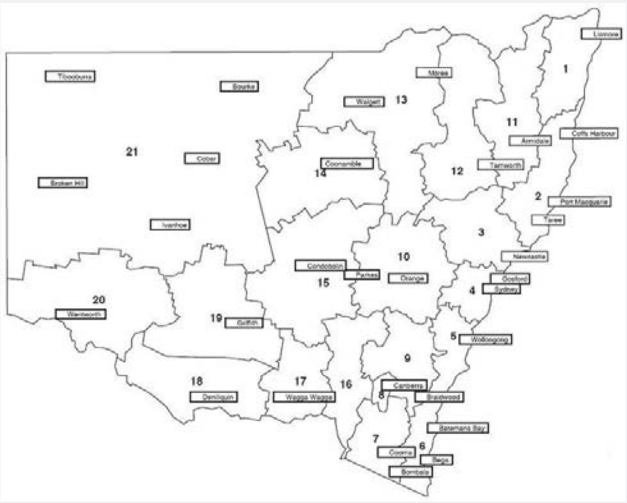

Figure1: NSW Fire Weather Districts & AWS locations used in the study.

Previous work, has focussed on historical weather records and linear regression models (eg Bradstock et al, 1998) but not pareto distributions or extreme value assessments.

Data.

Three (3) weather datasets have been acquired from the Bureau of Meteorology (BoM) and include:

1. 1976/86-2009 data on FFDI/GFDI and associated data (Lucas, 2010) (16 stations);
2. All 1950-2009 daily data available at 3:00pm wind, RH, Temp, gusts and rainfall;
3. 1994-2009 drought indices (DF, KBDI & SDI) with 3pm RH, T max and 24 hr rainfall (88 stations).

The datasets have been consolidated and 30 locational datasets have been produced covering all 21 fire weather districts (see Figure 1). These include FFDI (& in western NSW GFDI), T max, 3:00pm wind speed/directions, RH and T as well as forest fuel moisture. This covers the period from 1976 to 2009 for the 16 (Lucas) datasets and another 14 covering 1994-2009.

Methodology.

Generalised Extreme Value (GEV) Analysis provides an important tool for the determination of risk associated with the occurrence of extreme weather conditions. A drawback of the system is that on its own it only provides a static assessment in the absence of effects of climate change. Although some work has been undertaken using extreme techniques on large fires, only limited work has been done in relation to assessing fire weather parameters, either singly or in combination, using GEV approaches. This study uses a peak over threshold approach which is assessed based on the following criteria:

a) Threshold to include all values at 1 year return periods as a minimum;

b) All values exceeding FFDI 50 as a minimum based on losses of housing;

c) A minimum of n years of data points.

The approach uses the GEV following the assumed Weibull distribution and can follow the form T= (N + 1)/M where

T = return period (recurrence)
N= no of years of data
M = rank value

Results.

GEV values for 1:1, 1:20, 1:50 and 1:100 mean return periods (recurrence intervals) have been determined for all sites within the 21 fire weather districts.

An example of the results of one site is set out in Figure 2 below:

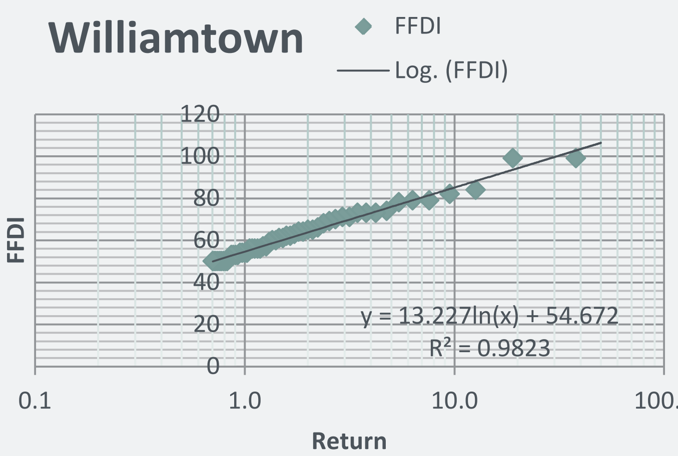

Figure 2: Return Period (recurrence) for FFDI at Williamtown (NSW) .

Discussion.

The use of extreme value analysis is normally applied in relation to specific weather parameters such as temperature, wind speeds, rainfall, hail events etc. It can be difficult to use the GEV distribution for individual parameters for fire weather as the extreme conditions may not apply when conditions are otherwise suitable for bushfire events.

The application of GEV or similar techniques allows for the filtering of data, so as to further interrogate data as it applies to bushfire conditions.

References.

Australian Building Codes Board (ABCB) (2005) *International Fire Engineering Guidelines.*

Bradstock, RA; Gill, AM; Kenny, BJ; Scott, J. (1998) Bushfire risk at the urban interface estimated from historical weather records: consequences for the use of prescribed fire in the Sydney region of south-eastern Australia. *Journal of environmental management 52 (3): 259-271.*

Lucas C. (2010) On developing a historical fire weather dataset for Australia. *Australian Journal of Meteorology and Oceanography.*