Modelling bushfire changes for South Australian regions

Climate change in South Australia:

The climate of SA has already changed because of greenhouse gas emissions and resultant global warming.

Observations show a state-wide increase in the mean, maximum and minimum temperature, increased intensity and frequency of heatwave events, and increased evaporation in many areas.

Bushfire in South Australia:

The intensity and duration of the bushfire season is measured by the Forest Fire Danger Index (FFDI), which is calculated using daily rainfall, temperature, humidity and wind data.

Only one study had assessed the future changes to fire danger in response to climate change. The study was confined to Adelaide, Ceduna, Mt. Gambier and Woomera because of data limitations.

This pilot project:

This pilot project aimed to asses if there was data available for other regions of SA that would allow us to calculate the FFDI and assess future fire danger. Such information is critical for informing decisions about: urban planning; emergency risk management, mitigation, preparedness and response; resource management; and environmental sustainability.

Results – monthly and annual changes:

Once suitable data was identified, a flowchart methodology and FFDI calculation software were developed to enable assessment of historical and future changes to fire danger in SA.

The methodology and software were then tested for two areas: Mt. Bold Reserve (MBR) in the Adelaide Hills; and Spring Gully Conservation Park (SGCP) in the Clare Valley.

Analysis of the FFDI changes between 1990 and the year 2050 indicate that at both locations the cumulative annual and monthly FFDI is most likely to increase – particularly in spring and summer. This means that the fire danger season will likely increase in both length and intensity (Figure 1).

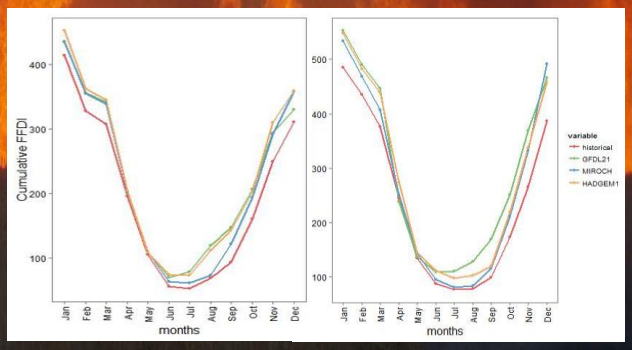

Figure 1: The cycle of mean monthly cumulative FFDI for the year 2050 compared to the 1990 climate (red). Future climates in 2050 as modelled by GFDL-21 (green), MIROC-H (blue), and HADGEM1 (orange). Results for MBR (left) and SGCP (right). The graphs show that the fire danger (cumulative FFDI) in the year 2050 is likely to be higher in spring and summer compared to the climate in 1990. So, the fire season will likely be longer and more severe in the future.

Results – threshold changes:

Threshold values of the FFDI are used to define if the fire danger is low, medium, high, very high, severe, extreme or catastrophic and what to do (Table 1). The number of days when the FFDI exceeds a threshold was also calculated for both the 1990 climate and the future 2050 scenarios.

Results show that the number of days when the FFDI is greater than 25 (very high fire danger) are projected to increase from 16 to 25 at SGCP and 17 to 20 at MBR by 2050. The number of days when the FFDI is greater than 50 (severe) are projected to double at SGCP and more than double at the MBR by 2050 compared to the historical (1990 climate) (Table 2).

Fire Danger Rating	FFDI Range	Advice (CFS 2014)
Low - Moderate	0-11	If a fire starts, it is likely to be controlled in these conditions and homes can provide safety. Be aware of how fires can start and reduce the risk.
High	12-24	As above.
Very High	25-49	As above.
Severe	50-74	These are hot, dry and possibly windy conditions for a bush or grass fire. If a fire starts and takes hold, it will be hard for fire fighters to bring under control. Well prepared homes that are actively defended can provide safety.
Extreme	75-99	These are very hot, dry and windy conditions for a bush or grass fire. If a fire starts and takes hold, it will be unpredictable, move very fast and very difficult for fire fighters to bring under control. Spot fires will start and move quickly. Embers may come from many directions. Homes that are prepared to the highest level, have been constructed to bushfire protection levels and are actively defended may provide safety. The safest place to be is away from bushfire areas.
Catastrophic (Code Red)	>100	These are the worst conditions for a bush or grass fire. If a fire starts and takes hold, it will be extremely difficult to control and will take significant fire fighting resources and cooler conditions to bring it under control. Spot fires will start well ahead of the main fire and cause rapid spread of the fire. Embers will come from many directions. Homes are not designed or constructed to withstand fires in these conditions. The safest place to be is away from bushfire prone areas.

Table 2: The average number of days each year where the FFDI is above a certain threshold at SGCP and MBR. Results for the historical climate (1990) and the year 2050 as modelled by three Global Climate Models are shown.

NOTE: Historical year is 1990 GFDL-21; MIROC-H and HADGEM1 are all year 2050	Spring Gully Conservation Park			Mount Bold Reserve		
	FFDI>25 (very high)	FFDI>40 (very high)	FFDI>50 (severe)	FFDI>25 (very high)	FFDI>40 (very high)	FFDI>50 (severe)
Historical	15.97	0.77	0.03	16.77	3.38	0.62
GFDL-21	25.34	2.26	0.09	19.15	4.69	1.08
MIROC-H	23.37	1.77	0.06	19.92	4.92	1.15
HADGEM1	24.46	2.11	0.06	21	5.62	1.77

All calculations of 2050 climate used a high emissions scenario (A1FI) as modelled by the three Global Climate Models: GFDL-21, MIROC-H and HADGEM1. Future climate data used the Change Factor technique utilized by CSIRO in the OZCLIM data sets.

Fuel load and curing data were not available and so the Grass Fire Danger Index could not be calculated. A copy of the full final project report is available on the DEWNR website at: http://www.environment.sa.gov.au/firemanagement/Fire_and_the_Environment/Fire_research

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