RURAL FIRE RESEARCH UPDATE
November 2011 | Issue 9 | ISSN 1178-7775

Future fire danger

Knowledge of potential changes in future fire risk across New Zealand is important for the country's rural fire agencies. This study aimed to provide improved estimates of the effects of climate change on future fire danger for New Zealand.

Results indicate that fire climate severity is likely to rise significantly with climate change in many parts of the country. A doubling or even trebling of fire danger is possible in some areas as a result of increases in temperature and decreases in rainfall, although higher wind speeds and lower humidity may also contribute to higher future fire dangers.

The greatest relative (%) changes are likely in areas of the country where current fire dangers are comparatively low (e.g. coastal Southland, Wanganui). However, smaller percentage changes will also result in significant increases in absolute fire danger in other areas, including several of those where fire dangers are currently highest (e.g. Gisborne, Christchurch).

Method

Fire danger ratings for the 2040s and 2090s were estimated using changes from current climate of the four key weather inputs that determine fire danger - temperature, humidity, wind speed and rainfall (based on the 1980s baseline).

These changes were obtained from statistical downscaling of 16 of the IPCC's 4th Assessment Global Climate Models for the A1B emissions scenario, which represents a 'middle-of-the-road' level of warming by the end of the 21st Century.

Changes in the weather inputs for the 16 models were applied to daily weather station observations from 20 sites across New Zealand, which were then used to recalculate daily Fire Weather Index (FWI) System values.

Fire climate severity under current and future climate was compared using two measures of severity derived from the FWI System – the Daily Severity Rating (DSR),and the frequency of days of Very High and Extreme (VH+E) Forest fire danger.

Both these measures capture the influences of higher temperatures, decreased rainfall and humidity, and stronger winds on drying out fuels, and increasing likely fire behaviour and fire occurrence potential.

Interpreting results

When describing future changes in fire climate severity, impacts on the potential number of days of Very High and Extreme (VH+E) fire danger are arguably more intuitive than those for Seasonal Severity Rating (SSR). These are summarised for fire season months for both the 2040s and 2090s in Table 1.

While both relative (%) and absolute changes in fire danger were investigated, caution needs to be applied when interpreting relative changes. The greatest percentage increases often are predicted at stations where the current fire danger is negligible (e.g. West Coast – Westport (WSA) & Hokitika (HKA)), so that any increase proves highly significant. As a result, only absolute changes (in the number of days of VH+E fire danger) are discussed here [but see the full report for description of percentage changes].

Results and discussion

Results indicate that fire climate severity is likely to rise significantly with climate change in many parts of the country. This is primarily the result of increases in temperature and decreases in rainfall, although higher wind speed and lower humidity will also contribute to higher future fire danger.

The projected changes found in this study were generally greater than those in the Pearce et al. (2005) study. However, they also varied more widely between climate models due to greater ranges in projected changes, especially seasonal differences in rainfall and temperature.

The changes indicated would see areas of elevated fire danger under current climate in Canterbury, Gisborne, Marlborough and Central Otago/South Canterbury (Figure 1, left) expand along the east coast of both islands to include coastal Otago, Wellington and Hawkes Bay by the 2040s (Figure 1, centre). These elevated risks are likely to develop further in Marlborough, Hawkes Bay and Wairarapa by the 2090s (Figure 1, right).

Despite significant increases in Southland, south Taranaki and the Coromandel, fire climate severity in these areas would increase but still remain comparatively low relative to other parts of the country.

The areas where fire dangers are most likely to increase from current levels, as indicated by the 16-model averages at the 20 stations (Table 1), are in the east and south of the South Island, especially coastal Otago, Marlborough and south-eastern Southland, and the west of the North Island (particularly around Wanganui). There is also potential for increased fire danger under the most extreme model scenarios across the lower North Island and into the Bay of Plenty.

Significant increases were projected for Wellington Aero (WNA) and Dunedin Aero (DNA), despite their somewhat benign current fire climate. Some scenarios show dramatic potential increases in the likelihood of days of VH+E fire danger on which any fires would be difficult, if not impossible to control.

Fire dangers in other areas may remain unchanged, or decrease by the 2090s, due mainly to increased rainfall. These areas include the West Coast of the South Island and areas of the North Island where fire dangers are already low, such as Taranaki, East Cape and the Coromandel. Potential also exists for decreased fire danger in Northland, Southland and parts of Canterbury under some models.

Conclusion

This study has substantially extended previous work to provide a more comprehensive and up-to-date evaluation of future fire climate and likely impacts. Results highlight the likelihood of increased fire risk in many regions of New Zealand with climate change. Changes of particular significance are projected in areas with a moderate current fire risk, namely Dunedin, Wellington and Wanganui. The next step is to develop appropriate fire management strategies to mitigate these increased risks.

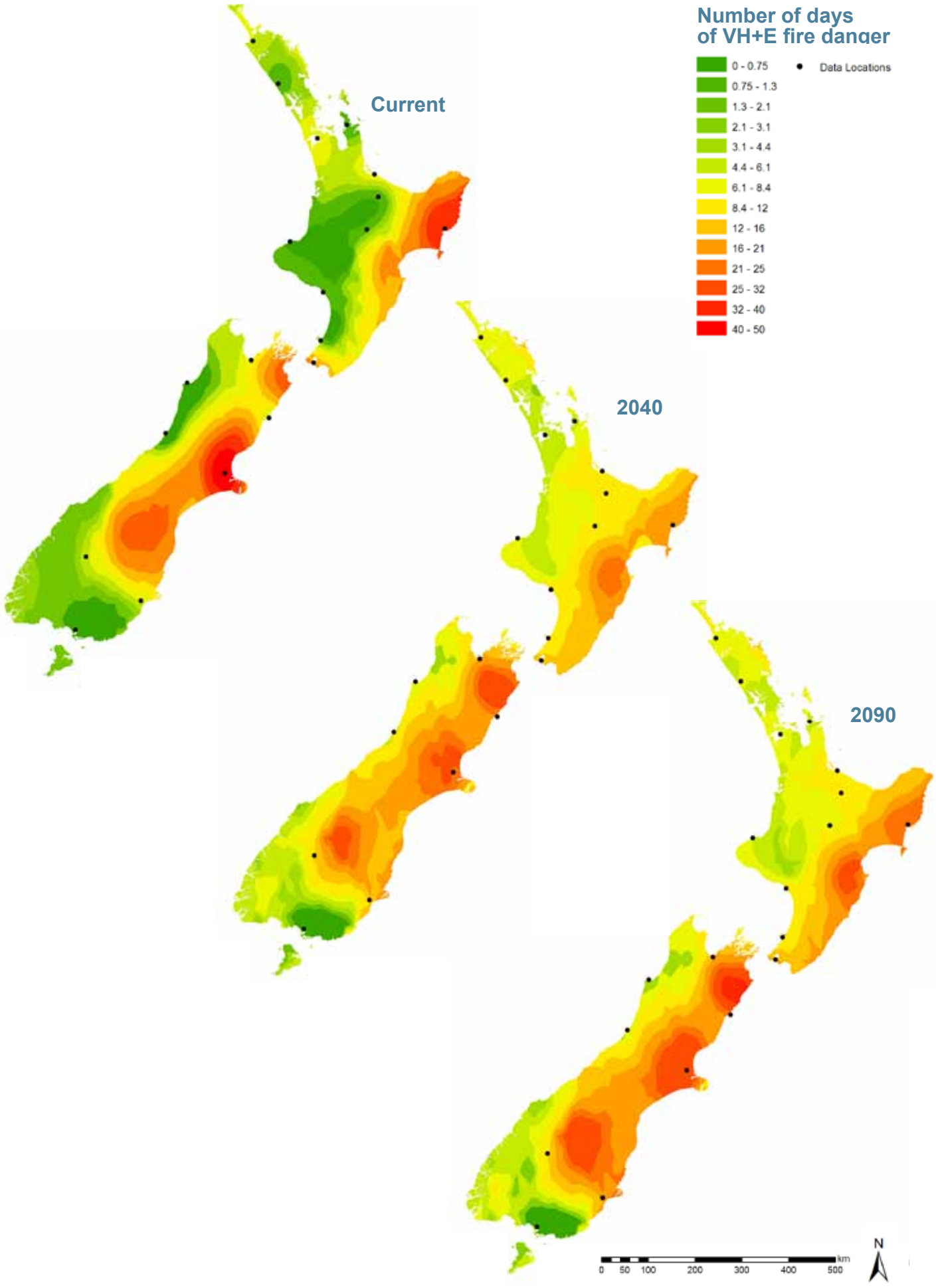

Figure 1: Pattern of projected changes in the average number of days/year of Very High and Extreme (VH+E) fire danger each fire season (Oct-Apr) from (left) current climate, to (centre) the 2040s, to (right) the 2090s, based on the overall average of the 16 GCMs investigated.

Table 1: Changes in the number of days of Very High and Extreme (VH+E) Forest fire danger for the 2040s (2030-2049) and 2090s (2080-2099) from current levels (1980-1999) projected from 16 GCMs at 20 station locations across New Zealand.

Number of days/fire season of VH+E Fire Danger						
Station Code	Station Name	Current VH+E (days/ season)	Models for 2040s (2030 - 2049) (days/season)		Models for 2090s (2080 - 2099) (days/season)	
			Model average	Model range	Model average	Model range
KX	Kaitaia	5.9	8.3	(6.6 – 10.4)	8.3	(5.2 – 13.9)
DAR	Dargaville	2.7	4.0	(2.9 – 4.9)	4.2	(2.5 – 6.6)
COR	Coromandel	1.5	2.1	(1.6 – 2.6)	2.2	(1.5 – 3.3)
AKL	Auckland	8.3	12.2	(9.6 – 14.9)	12.4	(7.7 – 22.0)
TGA	Tauranga	7.7	9.8	(8.6 – 12.1)	10.1	(8.0 – 14.1)
ROA	Rotorua	1.5	2.6	(1.8 – 3.5)	2.6	(1.7 – 4.9)
GSA	Gisborne	34.1	40.7	(35.7 – 44.0)	43.9	(34.2 – 54.6)
APA	Taupo	2.2	3.5	(2.9 – 4.3)	3.5	(1.8 – 6.1)
NPA	New Plymouth	1.1	1.4	(0.9 – 2.2)	1.5	(0.8 – 2.8)
WUA	Wanganui	2.6	5.5	(4.1 – 8.0)	5.8	(3.0 – 12.2)
PPA	Paraparaumu	2.0	3.8	(2.6 – 6.5)	4.7	(2.4 – 12.3)
WNA	Wellington	16.8	32.9	(23.9 – 51.5)	34.1	(16.2 – 64.6)
NSA	Nelson	8.9	12.4	(11.0 – 14.8)	12.8	(9.0 – 18.4)
WSA	Westport	0	0.01	(0 – 0.1)	0.03	(0 – 0.2)
HKA	Hokitika	0	0	0	0	0
KIX	Kaikoura	6.3	14.7	(9.1 – 23.4)	15.2	(6.8 – 30.7)
CHA	Christchurch	39.7	45.1	(38.4 -48.4)	48.3	(41.8 – 60.5)
QNA	Queenstown	5.7	7.0	(5.2 – 8.7)	8.0	(5.8 – 11.2)
DNA	Dunedin Aero	5.7	18.3	(13.3 – 29.7)	22.2	(13.8 – 44.3)
NVA	Invercargill	0.4	0.9	(0.5 – 1.7)	1.3	(0.6 – 3.1)
	Average	**7.6**	**11.3**	**(0 – 51.5)**	**12.1**	**(0 – 64.6)**

Acknowledgments

The research was completed for the Ministry of Agriculture & Forestry (MAF) as part of the Sustainable Land Management and Climate Change (SLMACC) Plan, under Foundation for Research, Science & Technology (FRST) contract C04X0809 (Climate Change and Fire Danger). Weather data was obtained from the NZ Fire Service's Fire Weather archive (FWSYS), and downscaled GCM changes were provided by the National Institute of Water & Atmospheric Research (NIWA).

Further information

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Funding for the Scion Rural Fire Research Group is provided by the Ministry for Science and Innovation (MSI) along with direct funding and significant in-kind support from NZ Rural Fire Sector organisations (National Rural Fire Authority, NZ Fire Service Commission, NZ Forest Owners Association, Department of Conservation, members of Local Government NZ, NZ Defence Force and Federated Farmers of NZ Inc).

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