

FIRE WEATHER ASSOCIATED WITH A FOEHN EVENT IN THE SOUTH ISLAND, NEW ZEALAND

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Background

Foehn winds, known locally as the “Canterbury Northwester”, can bring extreme fire weather conditions to the eastern South Island of New Zealand. On 6 February 2011, a Northwester resulted in a peak recorded air temperature of 41.3°C, slightly below the New Zealand record of 42.4°C set on 7 February 1973 during another Northwester. Although there was limited fire activity on 6 February 2011, the National Rural Fire Authority issued an Extreme fire danger classification for much of the eastern South Island.

Research Objectives

The principle aim of this study is to investigate the atmospheric dynamics and fire weather conditions associated with this Northwester event. The fire weather conditions are principally assessed using the New Zealand Fire Weather Index (FWI) and Continuous Haines Index (CHI). The analysis incorporates surface weather station data and output from a 2 km Weather Research and Forecasting (WRF) mesoscale model simulation.

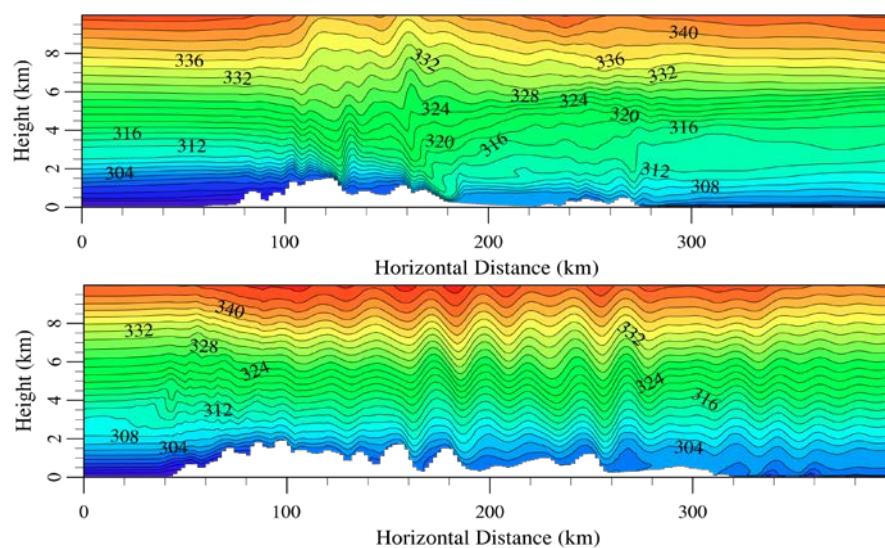


Figure 1: Horizontal cross-sections showing the potential temperature contours at 1200 NZST on 6 February 2011 for the (top) Canterbury and (bottom) Otago regions.

Orographic Blocking and Mountain Waves

Orographic blocking of the low-level northwesterly synoptic winds by the Southern Alps mountain range resulted in a northeasterly barrier flow along the west coast and flow splitting around the South Island. Breaking mountain waves developed in the foothills of the central Canterbury Plains region, directly in the lee of the Southern Alps. In contrast, trapped lee waves developed further south in the Otago region, as seen in Figure 1. The differences in the mountain wave characteristics are related to variations in the incoming wind speed profile, atmospheric stability and terrain profile.

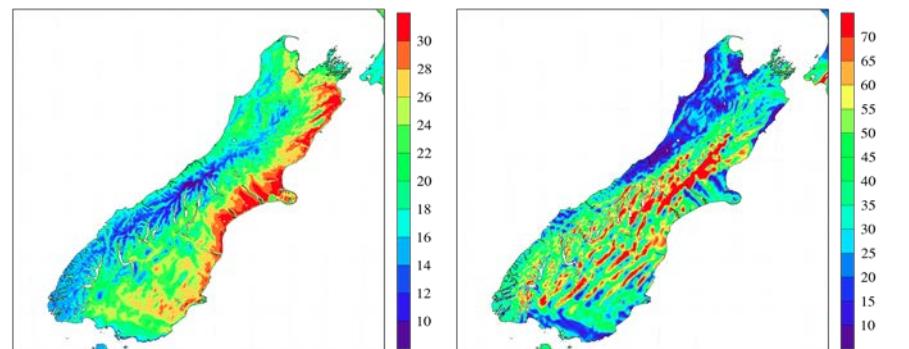
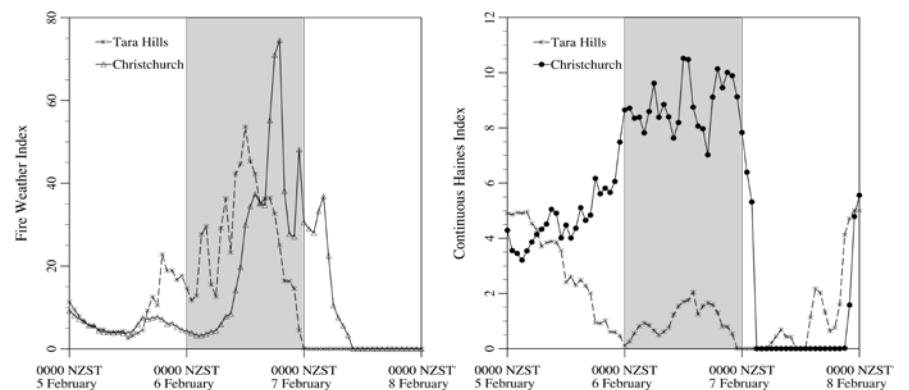


Figure 2 (top): Time series of the hourly (left) FWI and (right) CHI at the Christchurch and Tara Hills weather stations.

Figure 3 (bottom): Contour plots of (left) air temperature and (right) wind speed at 1200 NZST on 6 February 2011.

Fire Weather Conditions

The northwesterly foehn winds and mountain waves significantly affected both the FWI and CHI across the South Island on 6 February. The modelled hourly FWI peaked at over 90 in the foothills of the Canterbury Plains, directly beneath the breaking mountain waves where the wind speed at 10 m above ground level exceeded 80 km/h. The CHI peaked at an exceptionally high value of over 12 in isolated areas in the Canterbury Plains. In contrast, further south in Otago where trapped lee waves were present, both the FWI and CHI were significantly lower on average than in Canterbury.

Summary

The atmospheric dynamics and fire weather conditions associated with the Northwester event on 6 February 2011 have been investigated. The WRF model simulation results indicated that breaking mountain waves were present in the foothills of the Canterbury and resulted in localised extreme fire weather. In contrast, trapped lee waves further south were associated with more benign fire weather. Northwester events have been associated with a number of significant fires in the South Island, including the 1995 Berwick Forest fire in Otago and the 1973 Ashley Forest fire in Canterbury.