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The 6 February 2022 WA wheatbelt fires: an example of a simple wildfire case study

On the morning of 6 February 2022, three large fires broke out in the wheatbelt region of WA under extreme to catastrophic fire danger conditions. Under strong, dry, northerly winds, the fires made extensive runs to the south. The largest fire spread 35 km in about four hours before the arrival of a westerly wind change. The eastern flanks then turned into headfires and spread in isolated fronts a further 10–15 km to the east before stopping. The three fires burned a total of more than 66,000 ha in less than one day. A simple case study was prepared that exemplifies the process for capturing wildfire spread data for fire danger and behaviour model evaluation.

The need for wildfire case studies

Documentation of the behaviour and spread of wildfires allows real world fire behaviour data to be captured that can help identify previously undocumented fire dynamics, improve our understanding of possible firefighting threats, enable evaluation of existing fire behaviour, growth and danger models and forecasts, and be used for general training of operational staff.

The fires

The three Western Australia wheatbelt fires, the Bruce Rock, Narrogin and Shackleton fires (Fig. 1), were ignited during the morning of 6 February 2022, under a synoptic situation typical of large fire outbreaks in southern Australia—a strong high-pressure system located in the Tasman Sea and a cold front approaching from the south-west. All three fires spread initially under a dry northerly wind pattern with average wind speeds in the open close to 40 km/h and gusts up to 75 km/h. McArthur Grassland Fire Danger ratings at local weather stations were in the Extreme and Catastrophic classes. Fine dead fuel moisture contents varied between 4% oven-dry weight (ODW) at 0900 and 2% ODW at 1300. A westerly wind change caused by the passage of a trough from the southwest across the region impacted the fires during the afternoon, causing their eastern flanks to become headfires. The fires subsequently spread for a few more hours under decreasing burning conditions before stopping. In total, the three fires burned more than 66,000 ha in one day, with the largest of them, the Bruce Rock fire, burning about 29,000 ha.

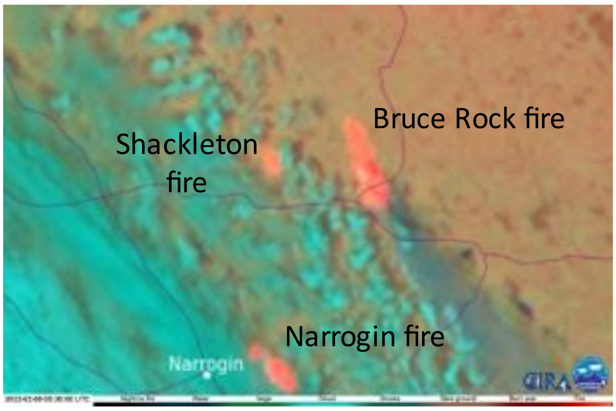

Figure 1. General view of the three WA wheatbelt fires at 1330 local time, as given by the Himawari-8 satellite thermal sensor. At the time of this image, the wind change was impacting sections of the Bruce Rock fire.

Pre-wind change rate of fire spread was estimated using 10-minute Himawari-8 satellite imagery. Given the spread distances observed, the estimated rate of fire spread data was calculated to have less than 20% error. Hourly rates of fire spread thus observed for the Bruce Rock fire varied between 7 and 10 km/h, with its main 4-hour southerly run covering approximately 35 km, for an average speed of about 9 km/h. The second largest fire, the Narrogin fire, spread for about 1 hour with a rate of spread of 12 km/h before the wind change occurred. No accurate measurements of rate of spread were possible for the Shackleton fire due to its short run before the change. No measurements of rate of spread were made after the change due to cloud cover blocking the heat signature of the fires. Nonetheless, each fire had very similar post-change propagation rates, with the headfires breaking into isolated fingers and a total overall eastward propagation of 10–15 km.

How well do existing fire models work?

The CSIRO grass fire spread model for grazed/cut grass (Cheney et al. 1998) and the 20% rule of thumb for grassfires (Cruz et al. 2022) were tested against the propagation of the Bruce Rock and Narrogin fires. Using weather data from local weather stations, the CSIRO grazed grass model performed with acceptable accuracy, over-predicting the observed rate of spread over the four hours of the main southerly run of the Bruce Rock fire by 32%. At hourly intervals the over-prediction varied between 15 and 73% (Fig. 2). The model over-predicted the speed of the southerly run of the Narrogin fire with an error of 13%.

In contrast, the 20% rule of thumb under-predicted the spread rate of both fires—by 11% for the Bruce Rock fire (Fig. 2) and 23% for the Narrogin fire.

Operational implications

The evaluation of current grassfire spread models against the observed pre-change fire behaviour highlights the satisfactory ability of current models to predict the propagation of grassfires under extreme to catastrophic fire danger conditions. The model accuracy can be considered excellent given the scale of the fires and the variability observed in wind speed at the landscape scale.

Similar (or better) fire spread prediction accuracy to that demonstrated above should be obtainable by an experienced Fire Behaviour Analyst using accurate

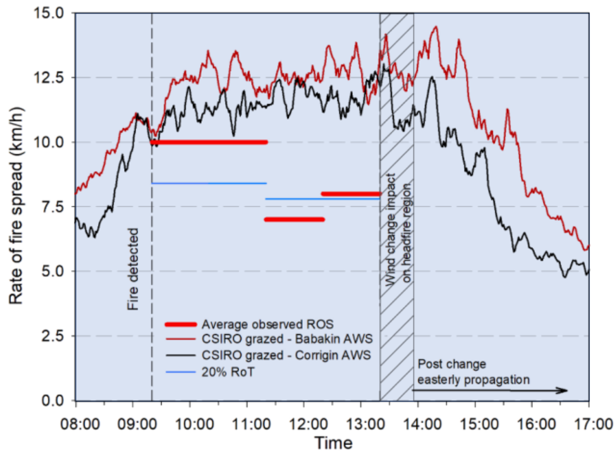

Figure 2. Diurnal variation in observed rate of fire spread for the Bruce Rock fire (thick horizontal red line) and predicted by the CSIRO grassland fire spread model for grazed/cut grass (thin red and black lines) and the 20% wind speed rule of thumb (thin blue line).

weather forecasts, appropriate fire spread models, and their own assessment of fire spread potential. The high temporal frequency (10-min) of the Himawari-8 satellite imagery does support the fire behaviour prediction process of fast spreading grassfires.

It is not expected that current models will predict well the post-change propagation of grassfires given the rapid changes in conditions and resultant fire behaviour. However, the 10–15 km easterly run and the discontinuous nature of the eastward fire spread is consistent with other historical grassfires burning under similar conditions, and such a footprint of fire area can be expected in future grassfire outbreaks affected by such a wind change.

Further reading

Cruz MG (2022) A brief analysis of the propagation and driving weather conditions of the WA wheatbelt fires of February 6, 2022. CSIRO Client Report EP2022-5622, Canberra, Australia. (Free open-source access)

References

Cheney NP, Gould JS, Catchpole WR (1998) Prediction of fire spread in grasslands. *International Journal of Wildland Fire* **8**, 1-13.

Cruz MG, Alexander ME, Kilinc M (2022) Wildfire rates of spread in grasslands under critical burning conditions. *Fire* **5**, 55.

FOR FURTHER INFORMATION
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