COUPLED FIRE-ATMOSPHERE MODELLING PROJECT
CASE STUDY OF THE WAROONA FIRE

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COUPLED FIRE-ATMOSPHERE MODELS SHOW THREE-DIMENSIONAL INTERACTIONS BETWEEN A FIRE AND THE SURROUNDING ATMOSPHERE. ACCESS-FIRE IS A NEW COUPLED MODEL USING AUSTRALIA'S PREMIER WEATHER MODEL.

FIRE-ATMOSPHERE FEEDBACK

Bushfires release energy and moisture into the surrounding atmosphere. This modifies the structure of the surrounding wind, temperature and moisture profiles in three dimensions. The dynamic feedback loops produced by fire-atmosphere coupling can have a dramatic influence on how a fire evolves and produce pyro-convection and highly variable local winds.

ACCESS-FIRE

A fire-spread model has been coupled to the ACCESS weather forecasting model by Melbourne and Monash Universities. Coupling ACCESS to a fire model builds on previous experience and provides opportunity for future development in Australia and other countries using the ACCESS framework. ACCESS-Fire will be installed and run on supercomputer facilities at the Bureau of Meteorology.

THE PROJECT

ACCESS-Fire will be tested and developed as a research tool, with future potential for operational use.

Detailed examination of high-impact events and verification against available meteorological and fire-behaviour data will improve understanding of and predictive ability for fire-atmosphere interactions.

THE WAROONA FIRE, WESTERN AUSTRALIA, JANUARY 2016

THE WAROONA FIRE

The Waroona Fire will be the first case study run with ACCESS-Fire. The fire was ignited by lightning in southwest Western Australia in January 2016. The total area burnt was 68,000 ha and the town of Yarloop was destroyed. Extensive spotting periods and two major pyro-convective episodes were features of the event.

PYROCB EVENT 6 JANUARY

On 6 January pyrocumulonimbus (fire-generated thunderstorms) were triggered by the sea-breeze front combined with strong divergence in the upper atmosphere. The fire spread rapidly through 37yo jarrah fuels at 3300 m h^{-1} with flame heights to 30 m. Environmental winds were only 10-15 km h^{-1}.

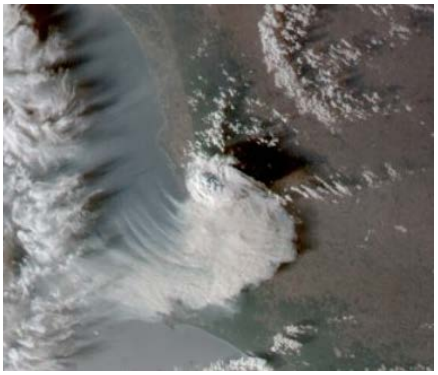

Fig 1. Pyrocumulonimbus cloud over the Waroona fire on 6 January. Note the shadow cast by overshooting cloud tops, the gravity waves and extensive smoke.

PYROCB EVENT 7 JANUARY

Fig 2. The fire plume and pyrocumulonimbus cloud with a cap of pileus cloud, indicating rapid vertical growth and high instability.

Pyro-convection developed late in the morning against normal diurnal trends.

The fire made a major run to the southeast starting 7-8am through 20yo fuels. The direction of fire run suggests it was driven by above surface winds.

Two separate convective pulses occurred around 11:30am and 1:30pm, much earlier in the day than when thunderstorms normally develop.

Fire activity and convection quietened in the afternoon, when winds were similar in speed and temperatures hotter.

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YARLOOP BURN-OVER

On the evening of 7 January, the fire rapidly and unexpectedly burnt over the town of Yarloop causing two fatalities and the loss of numerous properties. A massive ember attack was reported between 7:30-8pm. Imagery from Serpentine Doppler radar shows a sudden increase in radar returns and a growth of plume height to nearly 8 km at the same time the fire activity changed from mild to extreme.

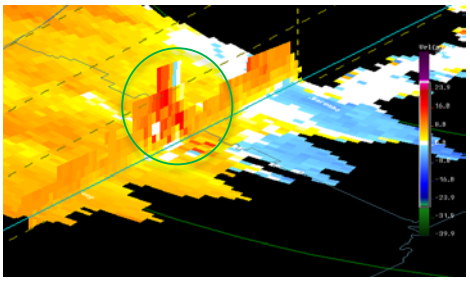

Fig 3. Doppler wind radar image at 1925hr. Red and dark orange pixels show the stronger, turbulent winds that developed rapidly over Yarloop just prior to the timing of the intense and devastating ember shower.

SIMULATIONS OF THE WAROONA FIRE WITH ACCESS FIRE

The next phase of the project will be installing and testing the coupled model. The Waroona case study will be run and the simulation results compared with observations.

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