Modelling the fire weather of the Coonabarabran fire of 13 January 2013

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Introduction: This poster describes high-resolution modelling of the weather across central New South Wales on 13 January 2013, using the Australian Community Climate and Earth-System Simulator (ACCESS). The atmospheric component of ACCESS is the UK Met Office Unified Model (version 7.5 is used in this study), initialised from 03:00 UTC (14:00 EDT) on 12 January 2013. A Bureau of Meteorology global initial condition is used.

A cascade of multiple nested models is employed, starting with a global model run, nesting down to a 3°×3° (approx. 300 km × 300 km) region. Model boundaries are shown in Figure 1.

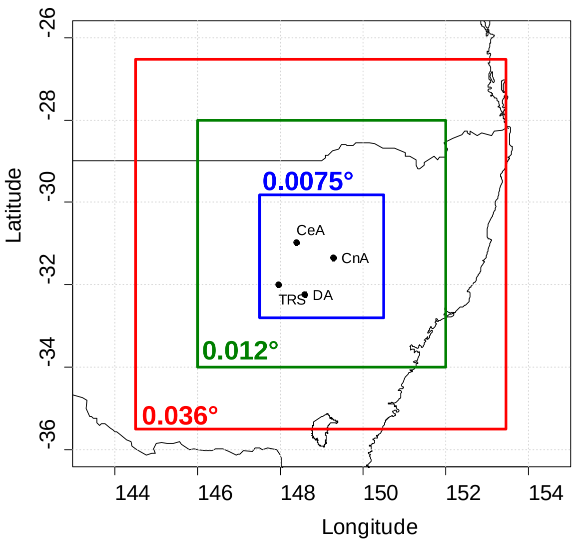

Figure 1: Model domains and resolutions (0.036°, 0.012° and 0.0075°). The locations of Coonabarabran Airport (CnA), Coonamble Airport (CeA), Trangie Research Station (TRS) and Dubbo Airport (DA) are indicated.

A fire started around 16:00 EDT on 12 January in the Warrumbungle National Park in north-east New South Wales. The weather on 13 January brought difficult conditions for fire fighting (NSW RFS 2013) and exceptionally strong north/south temperature gradients over inland NSW (M Logan *pers. comm.*). When the fire was declared out on 24 January, it had burnt an area of 55,210 ha west of Coonabarabran (NSW RFS 2013).

Model validation: The model data are compared against the available surface and upper-air observational data, to see how well the modelling performs. Air temperatures and wind directions are typically modelled well for sites west of the Great Dividing Range, particularly so for sites in relatively flat ground. Comparisons against surface observations for one such site near the fire, Coonamble Airport, are shown in Figure 2.

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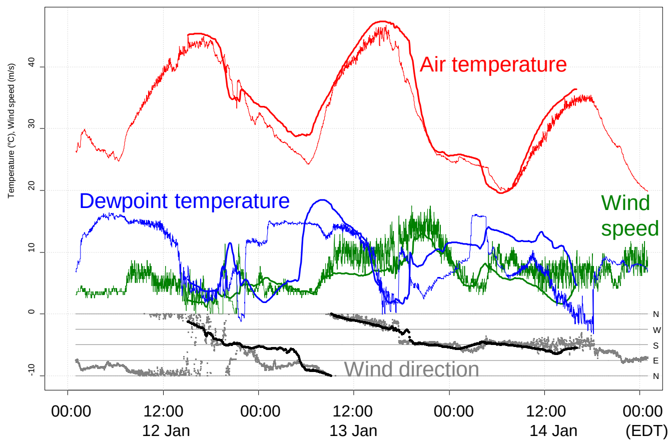

Figure 2: Near-surface (10-metre) wind and screen air/dewpoint temperature data for Coonamble Airport, northwest of the fire on 12 to 14 January 2013. Thick lines / black dots are five-minute model data from the 0.012°-resolution model run, thin lines / grey dots are one-minute-interval Automatic Weather Station (AWS) data. Model data are from the grid point nearest the AWS location.

The underestimation of the 10-metre wind speed, typical of current numerical weather modelling, is evident. Results for Coonabarabran Airport, the site closest to the fire, are less successful, possibly due to the hilly terrain around the site. Results for the other two sites bounding the fire, Trangie Research Station and Dubbo Airport, are better. Their locations are shown in Figure 1.

Discussion: The ability to suppress fires is highly dependent on a number of weather features. These include air temperature and humidity, wind strength and variability, atmospheric stability, and the strength and timing of wind changes. It is therefore important that these basic meteorological properties be well modelled: this is also an essential ingredient for the successful prediction of fire intensity and spread.

The simulations show a complicated array of interacting features. The primary meteorological feature is the trough (dashed line in Figure 3) which moves northeastward through the course of the afternoon on 13 January. This manifests as a significant wind and temperature change. Added to that are the effects of sea breezes from the NSW coast, generated on 13 January together with the residues of those generated on the previous day. Lastly the model simulates many convective cells, with their attendant wind changes. The simulations suggest a range of features seen in analogous Black Saturday simulations: pre-change boundary-layer rolls (R) and cellular convection (C), and small vortices embedded in the primary wind change (P).

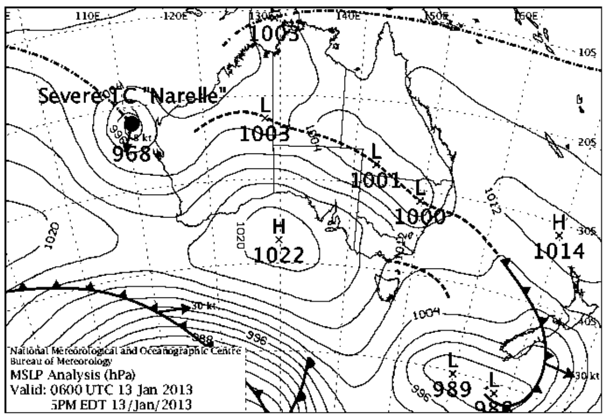

Figure 3: Mean sea-level pressure analysis (in hPa) for 06:00 UTC (17:00 EDT) on 13 January 2013.

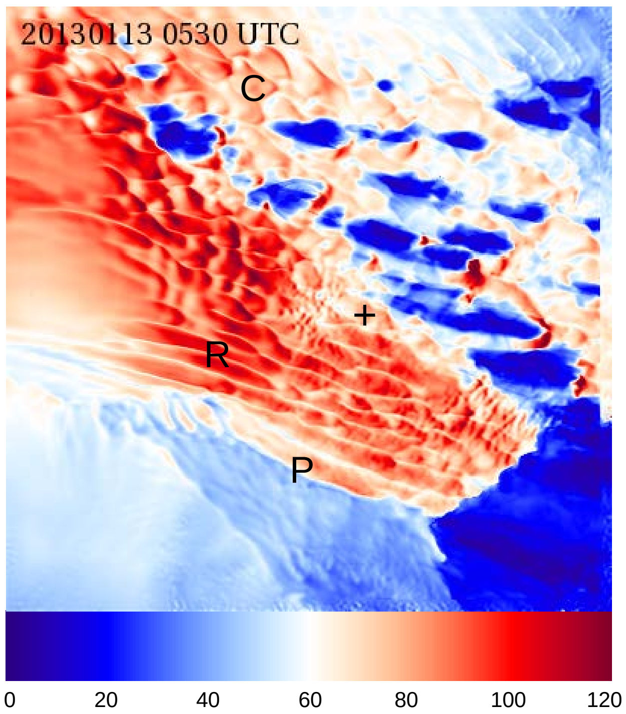

Figure 4: Notional instantaneous FFDI values for 05:30 UTC (16:30 EDT) on 13 January, in the 0.0075°-resolution simulation. A drought factor of +10 has been assumed across the entire domain: conditions as observed at Coonabarabran and Coonamble were this dry (M Logan *pers. comm.*). The black cross indicates the location of Coonabarabran Airport. The fire is located in the middle of the plot, a little to the west of the cross.

Some of these features can be seen in Figure 4, which shows notional instantaneous Forest Fire Danger Index values (Mark 5; Noble *et al*. 1980) some hours before the change reaches Coonabarabran.

References:

Noble I R *et al*. 1980: *McArthur's fire-danger meters expressed as equations*. Australian Journal of Ecology 5 201-203.

NSW RFS 2013: *Ferocious: The Wambelong fire*. Bush Fire Bulletin 35(1) 8-11.