ACCESS-Fire report

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Abstract

This is the abstract ...

1 Introduction

Introduction to project and model

Outline The remainder of this article is organized as follows...

2 Model

2.1 ACCESS

TODO: Blurb about ACCESS

Model output are 4-dimensional: latitude, longitude, vertical level (θ or ρ), and time. Most fields are defined at their grid-box midpoints. Wind speed and direction is defined at the direction-dependent gridbox edge.

2.2 Coupled Fire Model

TODO: Details about fire model

Model output has the same latitude and longitude as ACCESS output, with more frequent time steps and no vertical component. A fire front field is produced that is negative where the fire has burnt, and positive elsewhere.

2.3 Model runs

Over the course of the project the ACCESS-Fire model has been run and updated multiple times, over two regions where large scale forest fires occurred. The model runs in a nested fashion, with three to four nests so that the highest resolution possible is produced in a reasonable manner at the site of the fires (e.g. Figure 1).

The first fire under examination occurred a few kilometers East from Waroona, a suburb South of Perth. The second occurred a few hundred kilometres North of Sydney. Both locations are modelled at high resolution using ACCESS-Fire in a nested setup (Figure 1).

This report analyses output from the latest iteration of ACCESS-Fire, earlier iterations are listed here as they may help elucidate model parameterisation decisions.

Waroona_oldold

- Run in the depths of the past (Oct 2016?)
- Output at 30 minute resolution
- Meteorology not affected by fire model

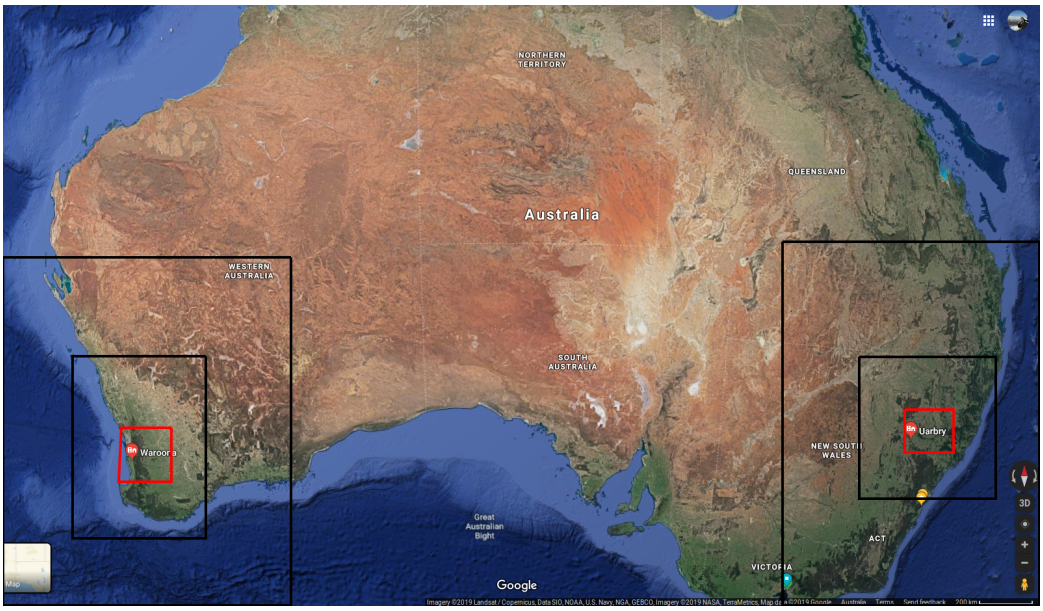

Figure 1: Three nests run by ACCESS-Fire model are shown as red rectangles. The outermost nest has resolution of approximately 3.5 km by 3.5 km, The intermediary Nest is at 1.0 km by 1.0 km, and the smallest nest (red) is at 0.3 km by 0.3 km. A fourth nest is sometimes added with .1 km by .1 km resolution. Fire coupling is enabled only within the higher resolution nest.

- slightly different grid to other model runs

Waroona_old

- Run in Aug, 2018
- Output at 30 minute resolution
- Run crashed after 21 hours due to runaway model physics (vertical wind speeds ¿ 1km/s)
- Fast fire spread parameters
- Clear PCB creation around 1100

Waroona_run1

- Run in Aug, 2019
- Output at 10 minute resolution
- Increased boundary layer stability to prevent crash
- Slower updated fire spread parameters
- No real PCB creation seen

Waroona_run2

- Run in Dec, 2019 (Raijin's last encore)
- Output at 10 minute resolution
- Increased boundary layer stability
- Fire spread parameters: Faster (older, matching Waroona_old)
- can be compared to Waroona_run2uc, which has identical settings but no fire coupling

Waroona_run3

- Run in Feb, 2020 (GADI)
- Output at 10 minute resolution
- Increased boundary layer stability
- Fire spread parameters: ?

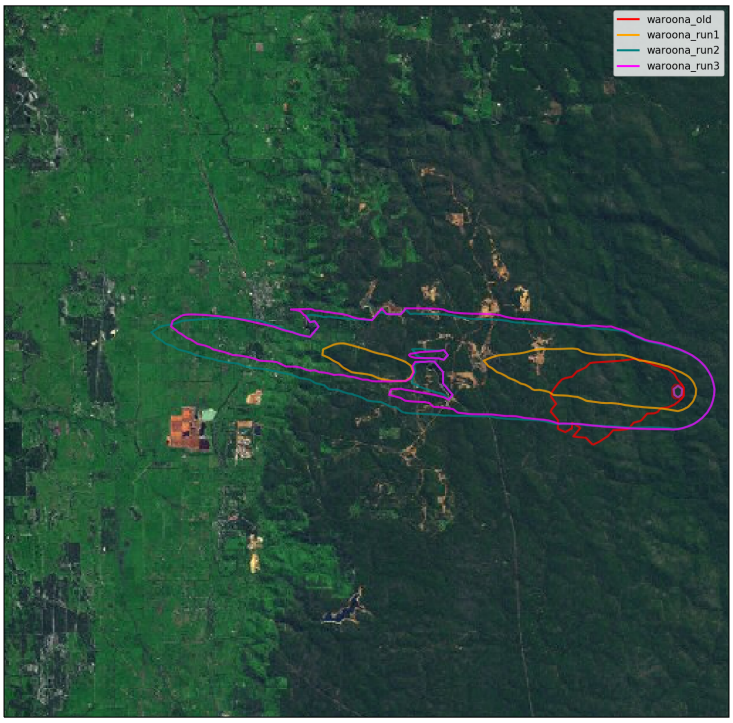

Figure 2: Model run fire fronts at start of burn and end of simulation

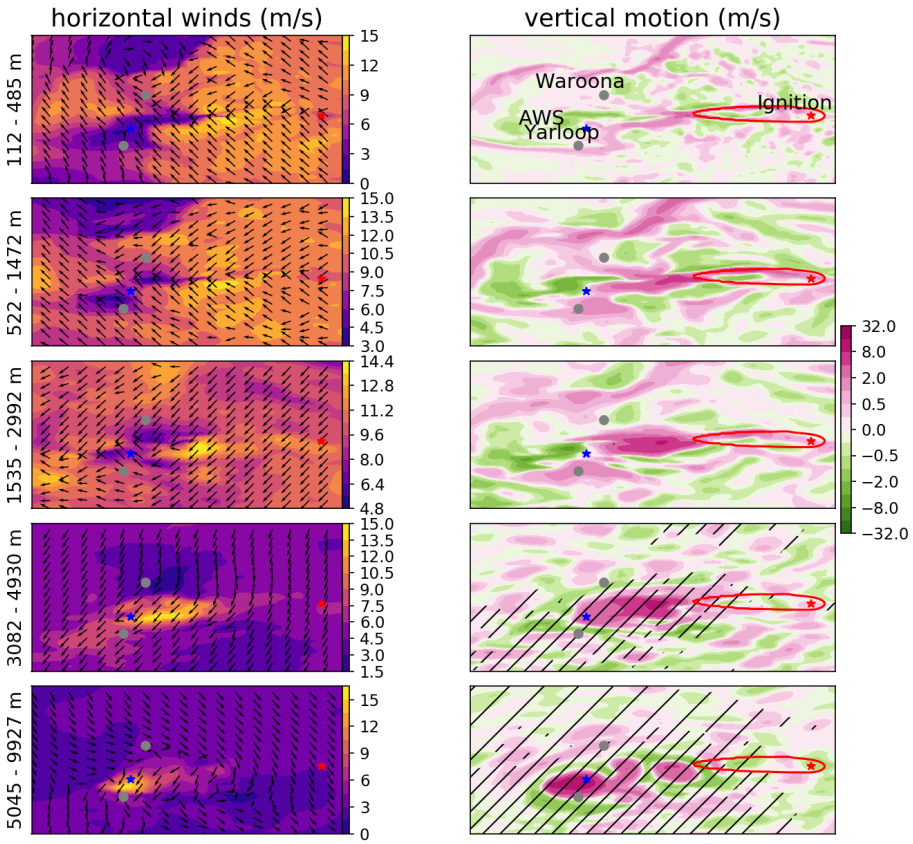

Figure 3: Left panels show horizontal wind speed (coloured contour map) and wind direction (arrows). Right panels show vertical wind speed (coloured contour map) and cloud content (diagonal stippling). The wind speeds are averaged into vertical bins based on height above the ground, showing lower to higher altitudes from the first row to the last row respectively. Cloud content is summed within each vertical bin, and the areas marked have at least 0.1 gkg^{-1} of water and ice.

2.4 Modelled Weather

2.5 Data flow

TODO: Data flow diagram for project

3 Pyrocumulonimbus

Formation General hand wavey physics etc.

Model formation Details regarding how PCB is found/examined in model output. Story about how the parameters affect model PCB formation.

Some stuff about vorticity and other metrics?

PCB Formation Threshold Kevin's PFT - point to his publication. Calculation within model output Summary showing that when fire spreads fast the output is higher. High output coinciding with low PFT is exactly when PCB occurs.

4 Ember storm

References