A case study of South Australia's severe thunderstorm and tornado outbreak (28 September 2016)

Dragana Zovko Rajak[1,2], Kevin J. Tory[1,2], Jeffrey D. Kepert[1,2], Jonathan Fischer[1], Matthew Bass[1]

[1]Bureau of Meteorology, [2]Bushfire and Natural Hazards CRC

One of the most significant thunderstorm outbreaks recorded in South Australia impacted central and eastern parts of the state on 28 September 2016. Multiple supercell thunderstorms produced at least seven tornadoes, destructive wind gusts, large hail and intense rainfall. Transmission lines were brought down in four different locations, which contributed to a state-wide power outage.

RESEARCH AIMS

High-resolution nested simulations with the Australian Community Climate and Earth-System Simulator (ACCESS) model are conducted to better understand the meteorology, and to improve prediction of similar future events. This in turn enables better risk management and preparedness for severe weather events.

MODELLING SET UP

- High-resolution nested simulations conducted using ACCESS
- Global (17 km), 4 km and 1.5 km horizontal resolutions
- Two prototype regional atmosphere (RA) science configurations tested to assess model performance over the South Australia domain
- A model diagnostic field (updraft helicity, the product of vertical vorticity and vertical velocity) is used to investigate the ability of the model to identify the potential for supercell thunderstorms, within which tornadoes may form.

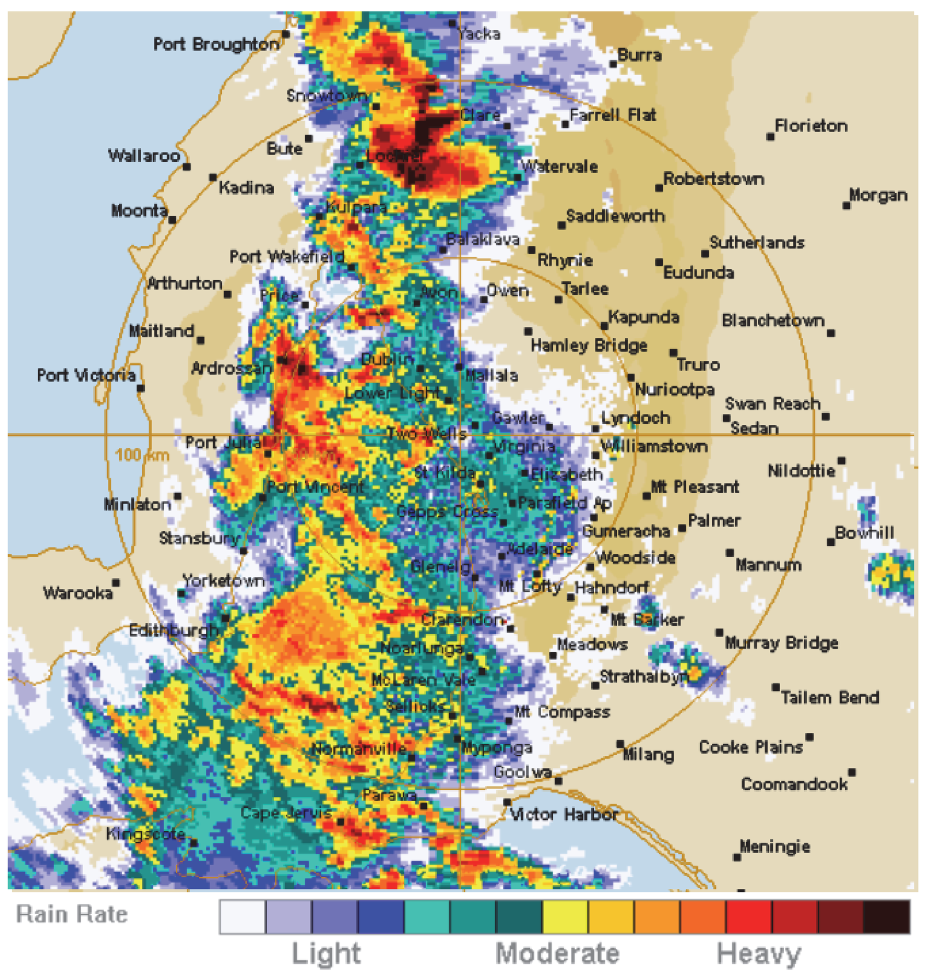

Figure 1: Radar Reflectivity (dBZ) at 0600 UTC 28 September 2016.

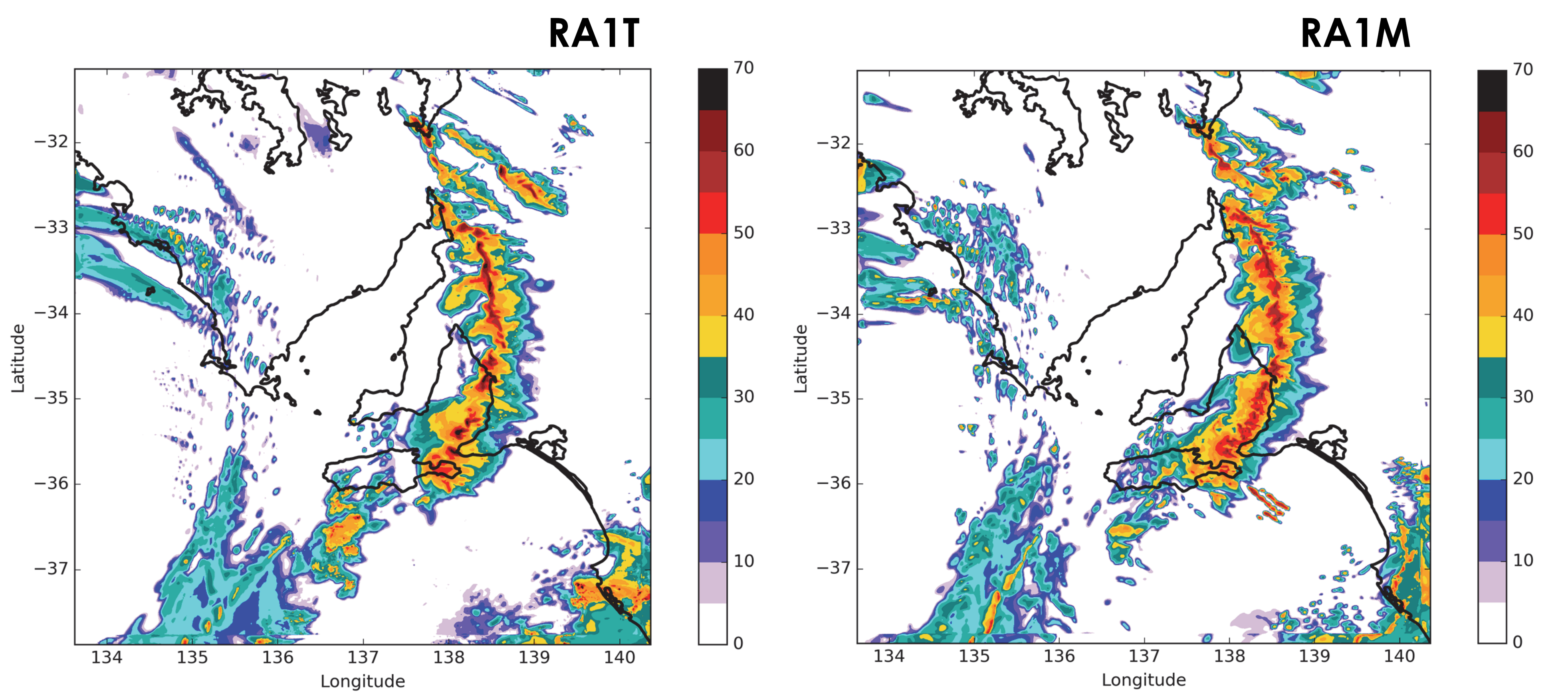

Figure 2: 0600 UTC 28 September 2016 simulated radar reflectivity (dBZ) at 2 km for (left) the tropical regional atmosphere configuration (RA1T) and (right) the mid-latitude science configuration (RA1M).

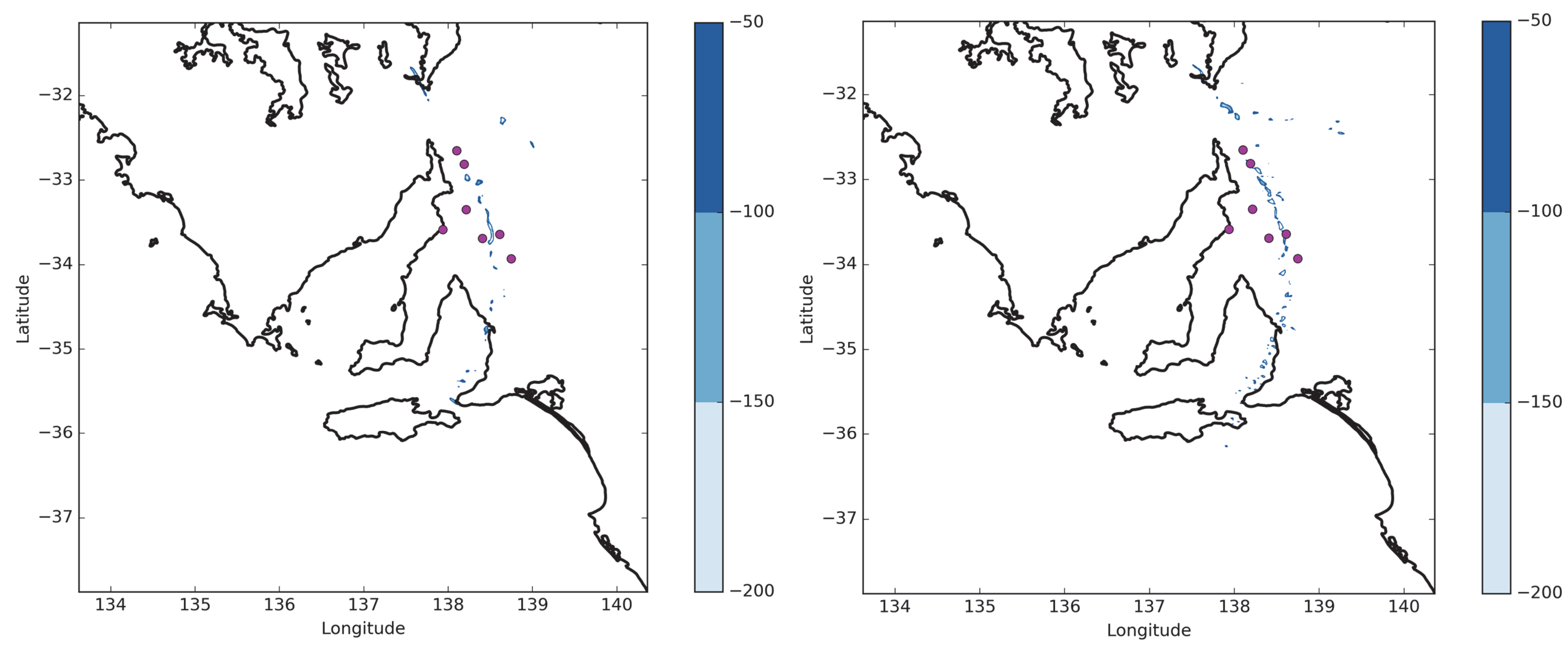

Figure 3: Updraft helicity (shaded, m^2s^{-2}) for (left) RA1T and (right) RA1M configurations. Updraft helicity (UH) measures the potential for updraft rotation in simulated storms and is negative for the Southern Hemisphere. Magenta dots show the approximate location of observed tornadoes.

CONCLUSIONS

- The overall timing and location of severe thunderstorms (Fig. 1) is depicted well by the model (Fig. 2).
- A line of updraft helicity is seen in both simulations in close proximity to the observed tornadoes (Fig. 3).
- Updraft helicity is stronger and more widespread in the RA1M simulation.

FUTURE STEPS

- Repeat the simulations at higher resolution (< 1 km), to see if the model can generate individual supercells, with structures known to favour tornado formation.
- Further investigate the updraft helicity diagnostic.

END USER STATEMENT

"This case study offers useful insight into a very severe storm complex. The results will help improve our predictive capacity for similar future events."

Dr. Paul Fox-Hughes, Tasmania and Antarctica State Office, Bureau of Meteorology.

Australian Government Department of Industry, Innovation and Science | Business Cooperative Research Centres Programme

Australian Government Bureau of Meteorology