Are convective permitting simulations meaningful for VIA work on watershed scale?

1. Experiment

A 5-year simulation is conducted with the Advanced Research Weather Research and Forecasting (WRF) model for southeast Australia using a telescopic one-way nest (a) with three domains: d01 at 50km, d02 at 10km and d03 at 2km. WRF simulations (Box 6) on the two innermost domains (d02, and WRF10) are assessed for similarity to observed gridded daily rainfall data of the Australian Water Availability Project (AWAP). Simulations are stratified according to season and maximum observed grid cell rainfall in AWAP >90th percentile. Mean climatologies are calculated for each set of binned daily data for WRF2 and WRF10. Daily catchment averages are calculated and pooled into bins according to season and to AWAP catchment value >90th percentile. Indices to assess similarity in spatial fields are the Spatial Prediction Comparison test (SPCT) Fractions Skill Score (FSS); calculated on values exceeding 95th percentile for 95km neighbourhood, and a simple variography measure in Box 2. Better skill is denoted by red colour.

2. Seasonal climatologies for high intensity events

The figures show mean climatologies for days with grid cell exceedance of 90th percentile value, 12.2 mm. In each panel from the left: WRF10, WRF2, and AWAP (all maps on AWAP 0.05° regular grid).

- Summer (December-February)
- Autumn (March-May)
- Winter (June-August)
- Spring (September-November)

3. Skill measure results

Illustrating the loss differential (Ds) for the mean winter climatologies (see Box 2) based on absolute error (AE) loss (calculated using warped simulated fields) for values exceeding the 90th percentile in each field. Differences in location distortion for WRF10 and WRF2 (B), combined loss differential (AE loss including location distortion) (C). All fields are scaled by the range of their respective climatologies to have similar intensities.

4. Catchment comparison

A time series prediction comparison test (TSPCT) was carried out for each catchment (Box 1, Fig. b) based AE loss (left panel) and correlation skill (right) (applied to 95th percentile exceedances for WRF2 relative to WRF10). For correlation skill, a negative test metric indicates smaller AE for WRF2 in summer, autumn and winter (after warping) for the 90th percentile exceedances in the maps. Other measures indicate that WRF2 has smaller positional error in autumn and winter, and more similar spatial characteristics in all seasons but winter compared to WRF10.

5. Conclusions

- There is no significant difference between WRF2 and WRF10 mean spatial climatologies for stratified across seasons and maximum grid cell intensity in observations (>90th percentile). However, the sign of test metric somewhat indicates smaller AE for WRF2 in summer, autumn and winter, and higher correlation for WRF10 in the verification data.
- Other measures indicate that WRF2 has smaller positional error in autumn and winter, and more similar spatial characteristics in all seasons but winter compared to WRF10.
- On catchment resolution, absolute errors in WRF2 are occasionally larger, in the data with numerous catchment indicating significant difference in skill (<<0.05).
- There is some concern that AE results are overly pessimistic for WRF2 on catchment resolution due to the smoothness of the verification data.

6. WRF setup

WRF simulation uses boundary conditions from reanalysis ERA Interim. The following physics schemes were used in the 5-year simulation: short and long wave radiation schemes: the rapid radiative transfer model for GCMs for long and short wave radiation (RRTMG); land surface model schemes: Noah land surface model; cumulus scheme: fifth generation Arakawa-Schubert (Kain-Fritsch (KF2010), microphysics scheme: WRF, double moment 6-class (WRF6) scheme; planetary boundary layer (PBL) scheme; the local Mellor-Yamada-Nakanishi and Noh (MYNN). References for each parameter scheme are given at: http://www2.mmm.ucar.edu/wrf/users/wrfv3.5/phys_references.html

REFERENCES