Does convection-permitting resolution improve simulated precipitation in the Maritime Continent?

Daniel Argüeso¹,², A. Di Luca¹ and J.P. Evans¹

¹ARC Centre of Excellence for Climate System Science & Climate Change Research Centre
University of New South Wales, UNSW, Sydney Australia

²SOEST, University of Hawai’i at Mānoa, HI, US
email: dab8@hawaii.edu

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Convection and precipitation in the Maritime Continent

The precipitation bias are similar to those in the N48–N144 models, while the magnitude of the bias tends to be somewhat smaller. The box over the central part of the Maritime Continent (95.625–140.625/C176 E, -8.75 to 3.75/C176 N; Fig. 1) corresponds to a region where there is a dry precipitation bias at all resolutions, and where the impact of higher resolution is such as to increase precipitation throughout the region. This domain will be used for the analyses discussed later in the paper.

Figure 3 shows the land fraction, precipitation $P$, evaporation $E$, $P - E$, and midtropospheric vertical velocity meridionally averaged in a tropical channel (covering the same latitudes as the domain highlighted by the box in Fig. 1). The land fraction shows the approximate location of the African, Maritime, and American continents. At all resolutions, the contrast between a comparatively dry Maritime Continent and wet Indian and West Pacific oceans is larger in HadGAM1 than in GPCP or ERA-Interim. The evaporation in the model is larger than in ERA-Interim over the oceans, and about the same over land. Accordingly, the bias in $P - E$ is smaller than the precipitation bias in regions where the precipitation bias is positive (such as the West Pacific), and larger where the precipitation bias is negative (such as the East Pacific). In general, $P - E$ biases follow the precipitation biases, in particular over land.

$P - E$, i.e. regions of climatological moisture convergence (divergence), are in turn closely related to regions of ascent (descent) as shown by the midtropospheric vertical velocity. It is notable that the Maritime Continent is a region of time-mean descent in the models, in contrast to ERA-Interim.

The effect of resolution is to reduce the dry bias over the Maritime continent by about one third. There are reductions of similar magnitude of the wet biases over the

Schiemann et al. (2014)
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Convection, diurnal cycle, topography, warm ocean, Local circulation

HIMAWARI SATELLITE

28 Apr 2016
Simulation of the western MC

(a) 10km
(b) 2km
(c) 2km

No convection scheme

ERA-Interim

spin-up

301 points

246/276 points
Mean precipitation bias

WRF50

WRF50

WRF10
Bias at different spatial resolutions

WRF50

WRF10

WRF2
Timing of the diurnal peak
Amplitude of the diurnal cycle

TRMM25

CMORPH8

WRF50

WRF10

WRF2
Diurnal cycle of precipitation
Local circulation and cloud mixing ratio

WRF50

WRF10

WRF2

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Precipitation quantiles
Final comments

Improvement of mean precipitation still unclear
Evidences of precipitation characteristics improved at high-resolution
Realistic representation of local circulation

NEXT:
• High-resolution SST or other sources of SST
• Increase resolution beyond 1km – away from grey zone.
Precipitation over urban areas in the western Maritime Continent using a convection-permitting model

Daniel Argüeso\textsuperscript{1,2} \& Alejandro Di Luca\textsuperscript{2} \& Jason P. Evans\textsuperscript{1,2}

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Abstract This study investigates the effects of urban areas on precipitation in the western Maritime Continent using a convection-permitting regional atmospheric model. Sea surface temperature (SST) contrasts stronger, which enhances sea breeze circulations. Together, they increase near-surface moisture flux convergence and favour convective processes leading to an over-
Bias at different spatial resolutions
Timing of the diurnal peak

TRMM25

CMORPH8

WRF50

WRF10

WRF2
Amplitude of the diurnal cycle
Diurnal cycle of precipitation

CMORPH8

WRF50

WRF10

WRF2
Local circulation and cloud mixing ratio

WRF50

07 H

WRF10

07 H

WRF2

07 H

16 H

16 H

16 H

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