Simulating realistic precipitation with convection-permitting models in the Maritime Continent

D. Argüeso[1], A. Di Luca[2], J.P. Evans[2,3] and R. Romero[1]

[1]University of Balearic Islands, Spain,
[2]Climate Change Research Centre, UNSW, Australia[3]
ARC Centre of Excellence for Climate Extremes, UNSW, Australia

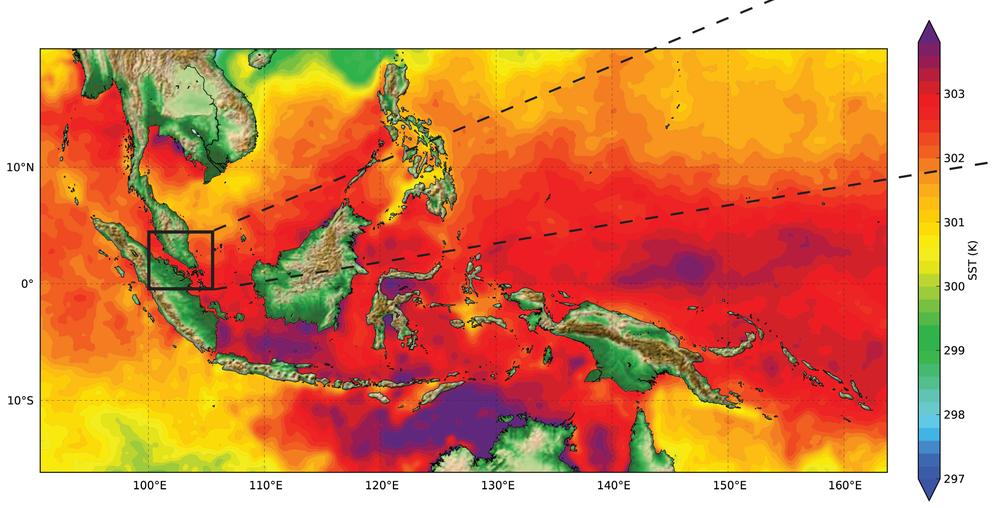
email: d.argueso@uib.es

Introducing REHIPRE project

REHIPRE is a EU funded project started in Oct 2017 aimed at identifying factors that contribute to simulating realistic high-resolution precipitation in the tropics

Challenges

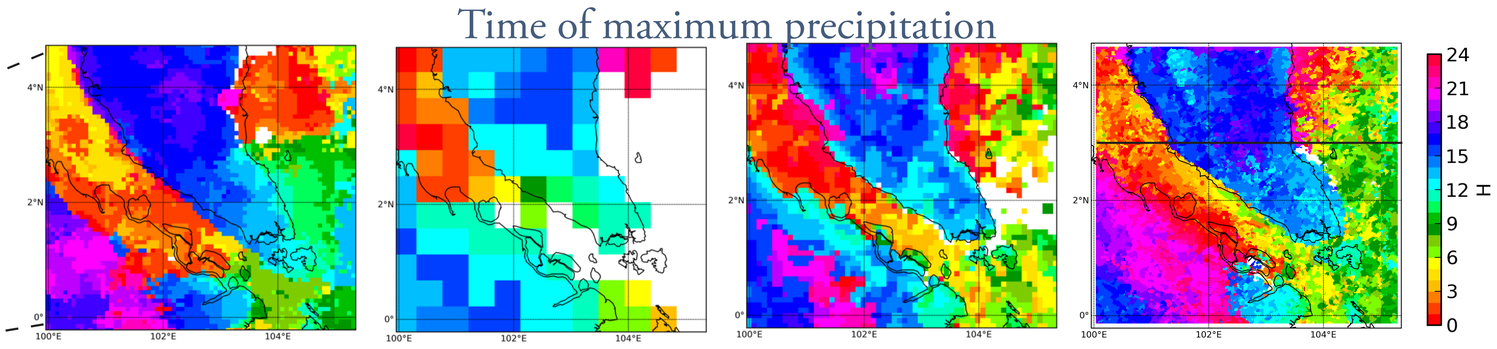
- Precipitation dominated by deep convection
- Strong diurnal cycles
- Warmest ocean on Earth
- Thousands of islands and complex topography
- Model errors propagate through the entire earth system



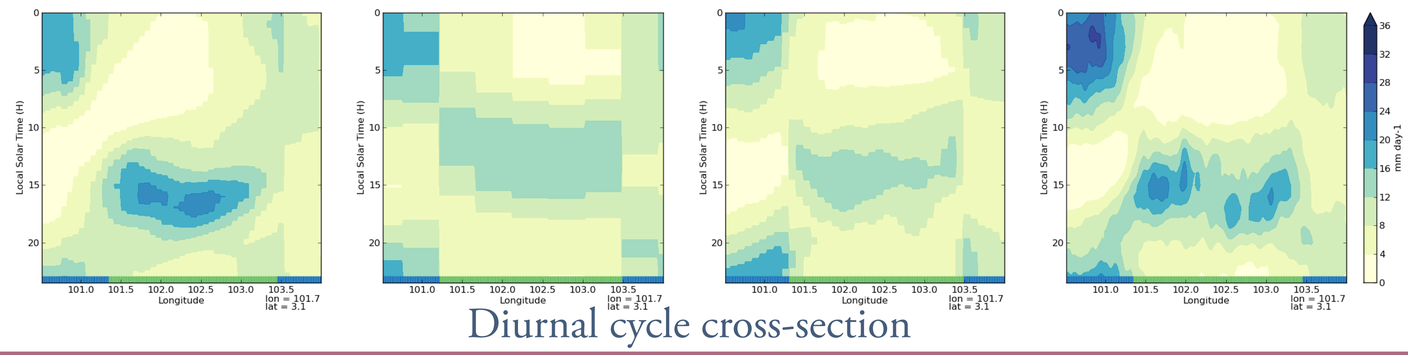
Convection-permitting background (2008-2012)

- Wet bias at 50, 10 and 2km, especially at 50 km.
- Better diurnal cycle of precipitation as resolution increases
- Better timing, shape, and amplitude with convection resolved (2 km)

Time of maximum precipitation



CMORPH 8 km | WRF 50 km | WRF 10 km | WRF 2 km



Diurnal cycle cross-section

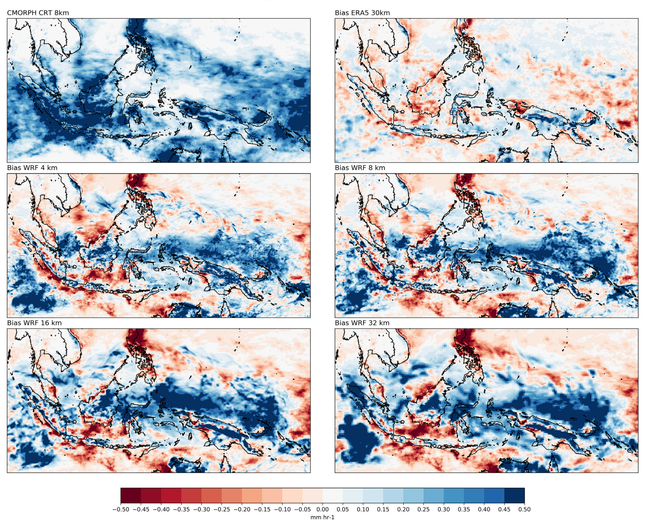
REHIPRE project - Preliminary results

1 Month simulation (Dec 2015) at 32, 16, 8 and 4 km

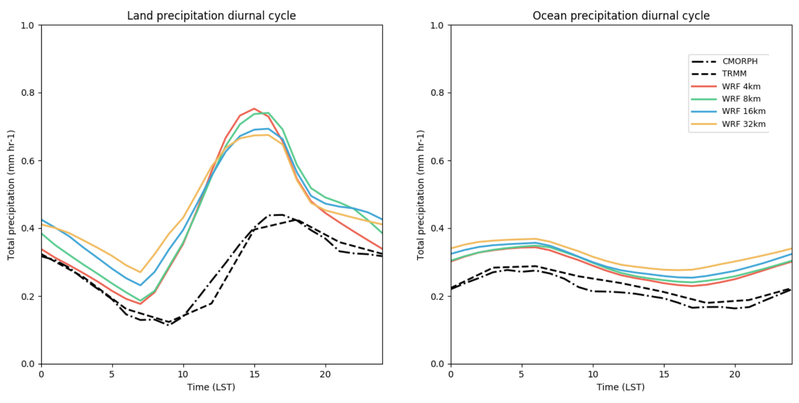
Limited improvement in mean bias with resolution (up to 4km)
Exacerbated diurnal cycle on land
Resolution alone does not provide substantial improvement

Model represents the shape and timing of the diurnal cycle well
Longer periods required to assess biases
At higher resolution, convective schemes add to already resolved updrafts

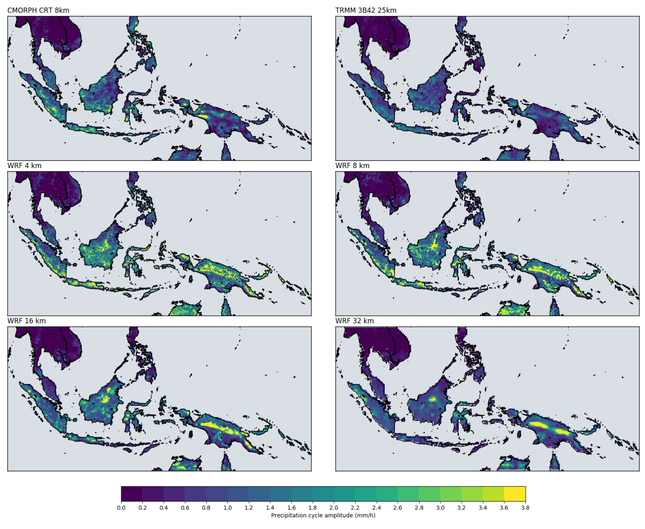
Precipitation bias



Precipitation diurnal cycle



Precipitation diurnal amplitude

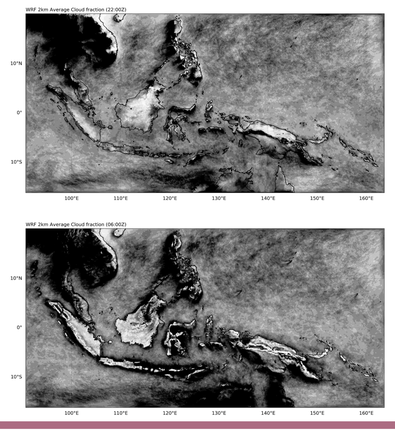


REHIPRE next steps outline

Convection-permitting at 2 and 4 km

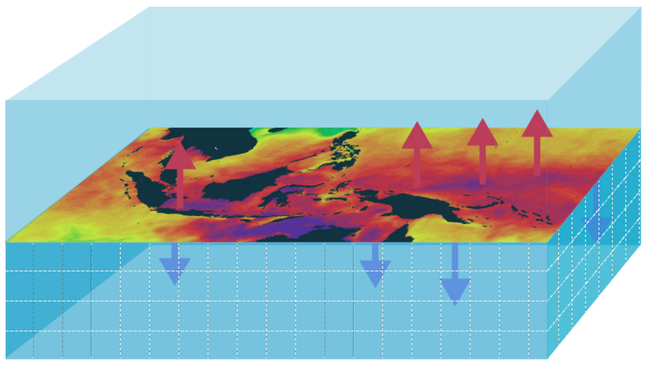
Convective schemes likely a source of errors
At high resolution, not double rainfall generation
Better response to land-sea contrast and breeze

Cloud fraction average at 22Z and 6Z



Ocean-atmosphere coupling (NEMO-WRF)

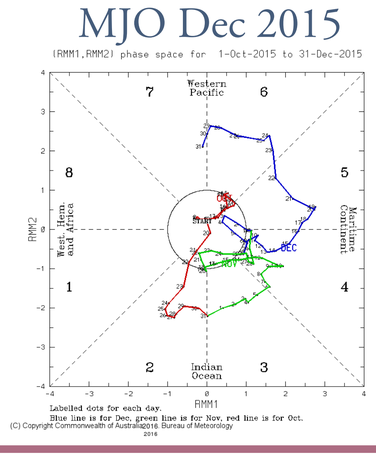
Small scale SST features resolved near the coast
Interactive ocean response to high-res atmosphere
Fine scale currents (i.e. Indonesian throghflow)



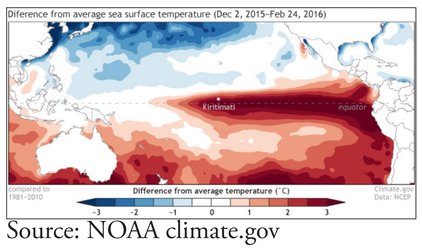
Different large scale conditions

Different phases of Madden-Julian Oscillation
Different phases of El Niño Southern Oscillation

MJO Dec 2015



ENSO Dec 2015



Source: NOAA climate.gov

Source: bom.gov.au

Universitat de les Illes Balears

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Sklodowska-Curie grant agreement No 743547