

High-resolution Regional Atmospheric Modelling Project (AUS2200): A Community-based Platform for Weather and Climate Research

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What is AUS2200?

- A high-resolution regional atmospheric modelling framework that covers the entire Australian continent and surrounding oceans at 2.2km grid spacing, using the UM atmospheric model.
- A common platform that helps facilitate research and model development that advance scientific understanding of important atmospheric processes across a wide range of scales.
- A flagship collaboration between ARC Centre of Excellence for Climate Extremes (CLEX), Australian Bureau of Meteorology (BoM), National Computational Infrastructure (NCI) and ACCESS-NRI.

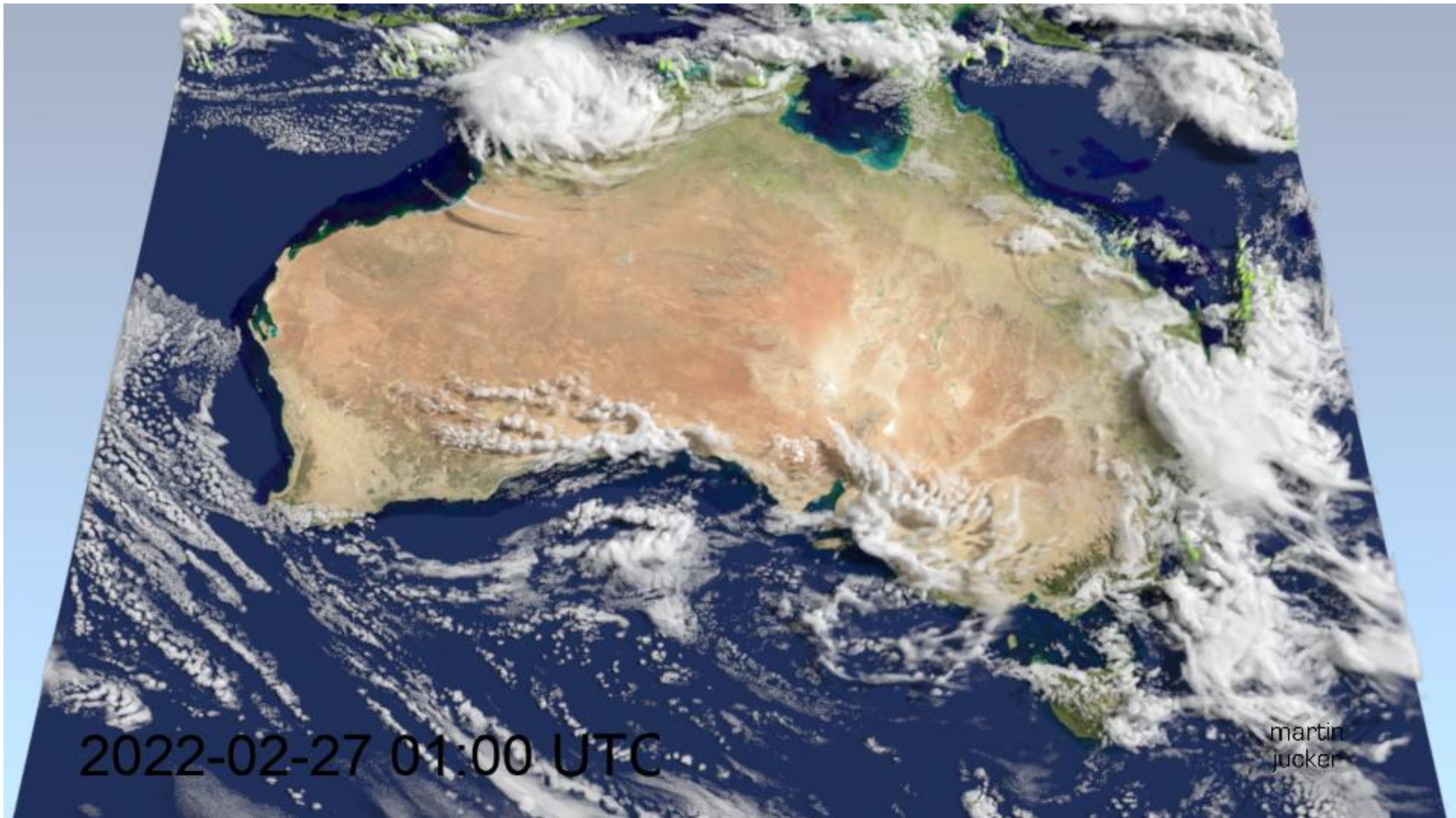


Figure 1 A snapshot of AUS2200 simulated cloud field at 2022-02-27 00:00 UTC during the 2022 Lismore flooding event. Image credit: Dr Martin Jucker, UNSW.

Aims of AUS2200?

- Unite the national atmospheric community**
 - Provide a common framework and best-practice approach to bridge across traditional boundaries between individual research groups, facilitating community building and collaborations.
- Make efficient use of resources**
 - Provide an advanced modelling framework
 - Provide a community approach to developing datasets, evaluation methods, diagnostics and toolboxes
 - Co-design experiments, document and archive model outputs
 - Facilitate collaboration and the development of a regional modelling community
- Do transformative science that has a clear path to impact**
 - Use of ACCESS/UM in a configuration similar to planned operational implementations
 - Enhance communication and knowledge transfer.

Table 1 Current specifications of AUS2200 model and new specifications as used by the Bureau's regional atmospheric modelling systems.

Model Version	UM 12.2
Science Configuration	Regional Atmosphere and Land Configuration 3 (RAL3)
Domain Size	Australia and surrounding oceans
Initial and Boundary Conditions	ERA5, ERA5-Land, BARRA2
Timeframe	Any day within the ERA5/BARRA2 records
Output frequency	Hourly to 10-min
Horizontal grid spacing	2.2 km
Vertical levels	70 levels
'Best' efficiency on Gadi	- 30.8 forecast days/day @ 9.9kSU/day (with 6,384 cores on Cascade Lake) - 54.5 forecast days/day @ 8.9kSU/day (with 10,192 cores Sapphire Rapids)

Table 2 Experiments completed to date

Weather events	Configuration details
Black Summer (2019/2020)	ERA5 - continuous with 48-hour soil moisture spin-up ERA5 + ERA5Land soil moisture - continuous/free-run with forcing from the boundaries ERA5 + BARRA2 soil moisture - continuous/free-run with forcing from the boundaries
Black Saturday (2009)	ERA5 + ERA5Land soil moisture - continuous/free-run with forcing from the boundaries
Canberra Fires (2003)	ERA5 + ERA5Land soil moisture - continuous/free-run with forcing from the boundaries
Ash Wednesday (1983)	ERA5 + ERA5Land soil moisture - continuous/free-run with forcing from the boundaries
Ash Wednesday (1980)	ERA5 + ERA5Land soil moisture - continuous/free-run with forcing from the boundaries
NSW/QLD flood (Feb-March 2022)	BARRA2 - 24-hour reinitialisation with 12-hour spin up BARRA2 - 24-hour reinitialisation with 24-hour spin up ERA5 + BARRA2 soil moisture - 24-hour reinitialisation with 12-hour spin up ERA5 + BARRA2 soil moisture - 24-hour reinitialisation with 24-hour spin up ERA5 + ERA5Land soil moisture - continuous/free-run with forcing from the boundaries ERA5 + ERA5Land soil moisture - continuous/free-run with forcing from the boundaries, with reduced SST off East Coast Australia (lat(-44,-10), lon(143,160))
Extreme rainfall in eastern/central Australia (March 2021)	ERA5 + BARRA2 soil moisture - 24-hour reinitialisation with 24-hour spin up
Extreme rainfall affecting Australian east coast (June 2016)	ERA5 + BARRA2 soil moisture - 24-hour reinitialisation with 24-hour spin up ERA5 + BARRA2 soil moisture - continuous/free-run with forcing from the boundaries ERA5 + BARRA2 soil moisture - continuous/free-run with forcing from the boundaries, with climatological SST
El Nino MJO (Jan-Feb 2016)	ERA5 + BARRA2 soil moisture - 24-hour reinitialisation with 24-hour spin up
La Nina MJO (Jan-Feb 2018)	ERA5 + BARRA2 soil moisture - 24-hour reinitialisation with 24-hour spin up
Neutral MJO (Jan-Feb 2013)	ERA5 + BARRA2 soil moisture - 24-hour reinitialisation with 24-hour spin up

AUS2200 science snapshots

- 2019/2020 Black Summer bushfires in SE Australia**

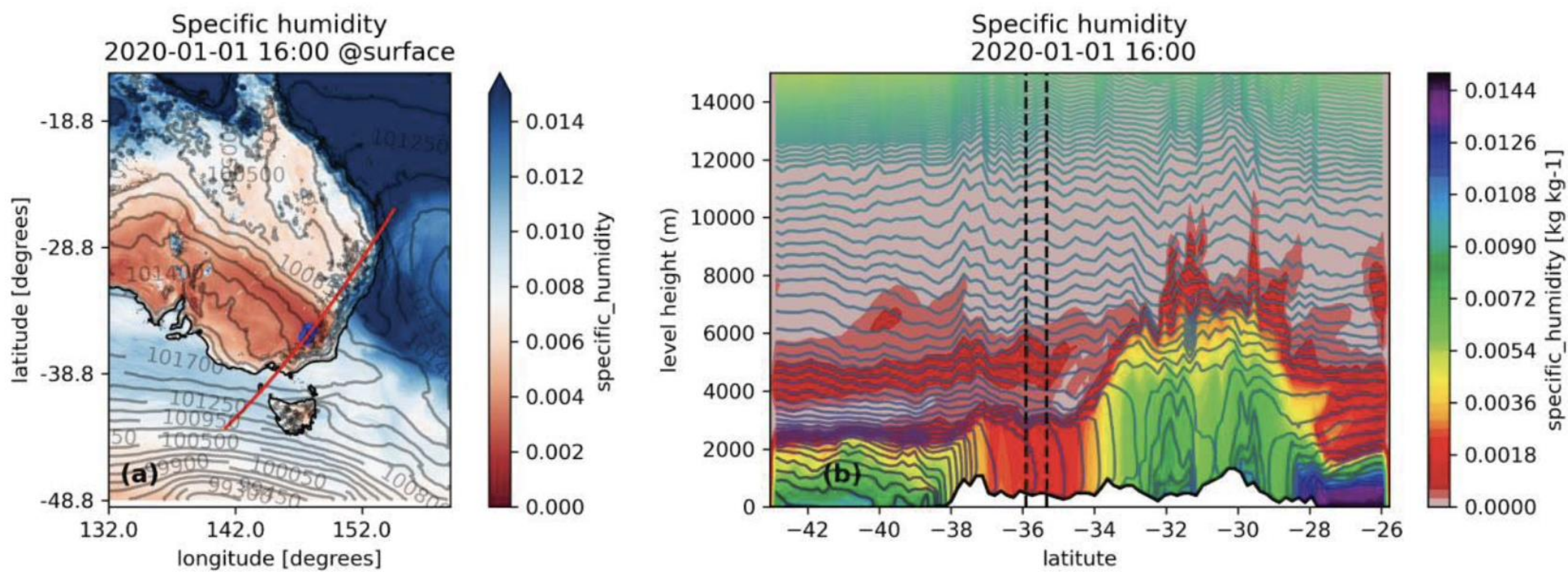


Figure 2. (a) Map of specific humidity on the surface. (b) Vertical cross-section of the atmosphere at the location shown by a solid red line on panel a. The contours in both panels are potential temperature and the times are in AEST.

- Dry air reached the surface from above the boundary layer during the day through strong downward mixing.

Ayat et al. (in review)

- AUS2200 as a tool to help understand coastal rainfall processes**

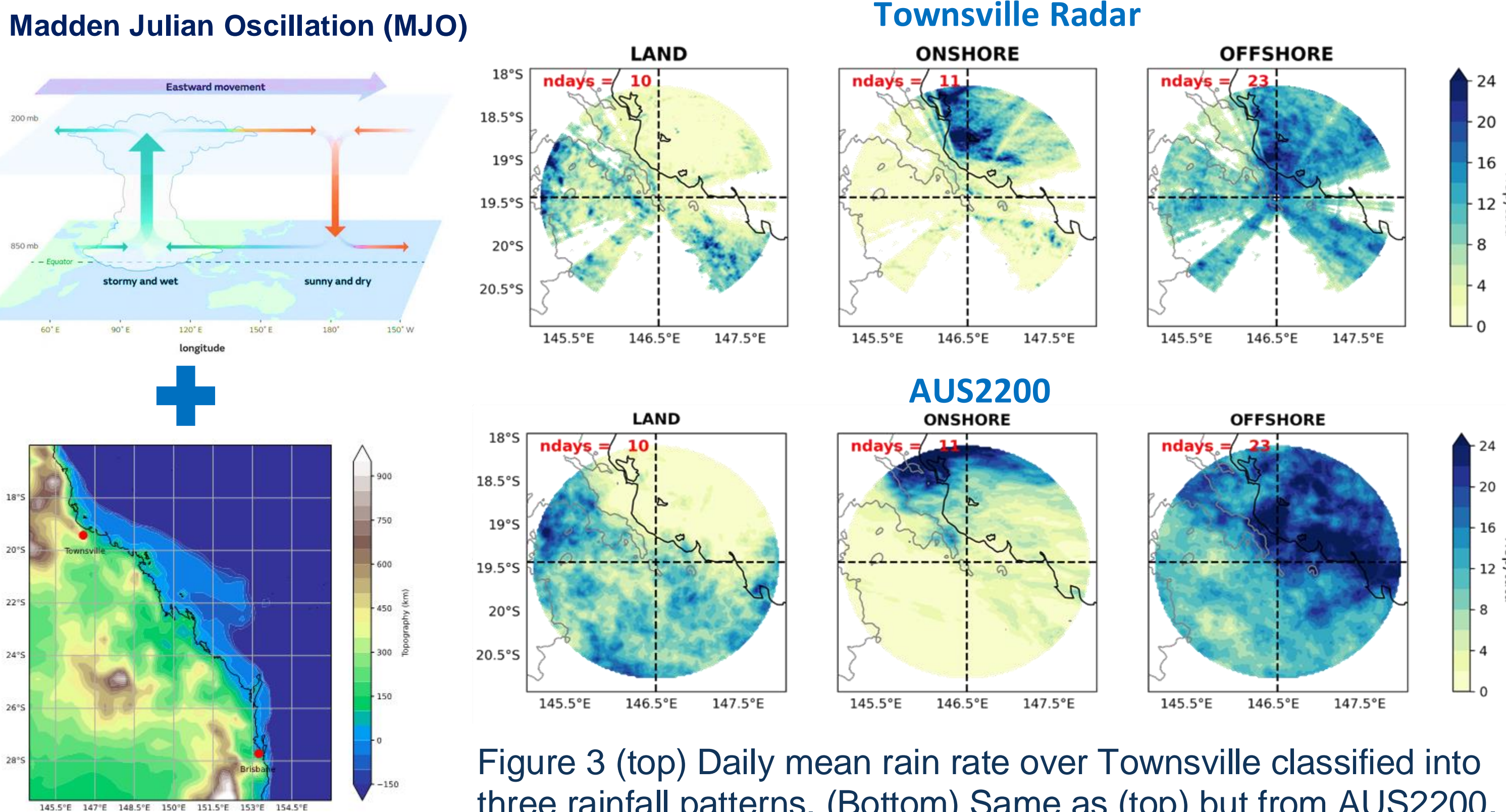


Figure 3 (top) Daily mean rain rate over Townsville classified into three rainfall patterns. (Bottom) Same as (top) but from AUS2200.

- The large-scale background wind and local-scale land-sea breeze circulation are two important factors driving rainfall propagation.
- Rainfall propagation modules the average coastal rainfall patterns.

Lan Dao et al. (in prep)

AUS2200 future plans

The future development is subject to ongoing discussions with the Atmospheric Modelling Working Group of the ACCESS-NRI. There are several additional model system features that are already under development at ACCESS-NRI, including two-level nesting capability, more flexibility in the simulation period, resolution and domain size, as well as the capability to quickly update the model to the latest developments at the Bureau and/or the Met Office. The longer-term plan also includes potential incorporations of atmospheric chemistry, ocean and land coupling capability.