METEOROLOGICAL SERVICE SINGAPORE
Centre for Climate Research Singapore

RAL3 operationalization at CCRS

Rachel Koh and Joshua Lee
Presentation by Kalli Furtado

Momentum Partnership Convective-scale Workshop

12 Sept 2024

CCRS's *SINGV* modelling systems

circa 2023

SINGV-DA | SINGV-EPS | uSINGV | cSINGV | SINGV-AV | SINGV-RCM

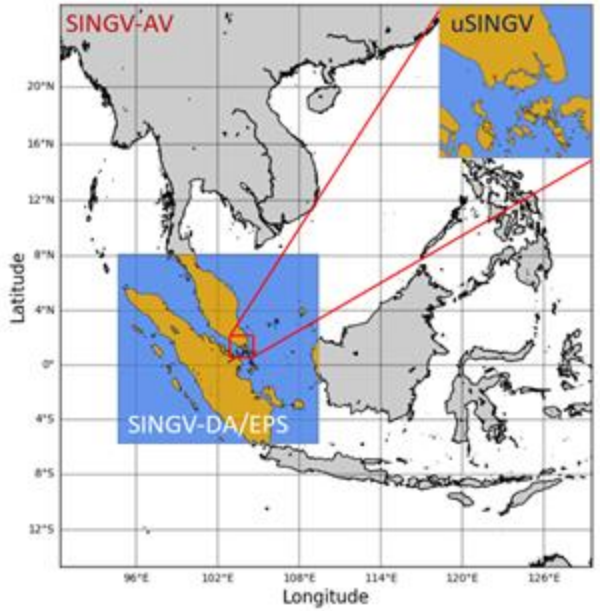
SINGV (RAL1T)

2024

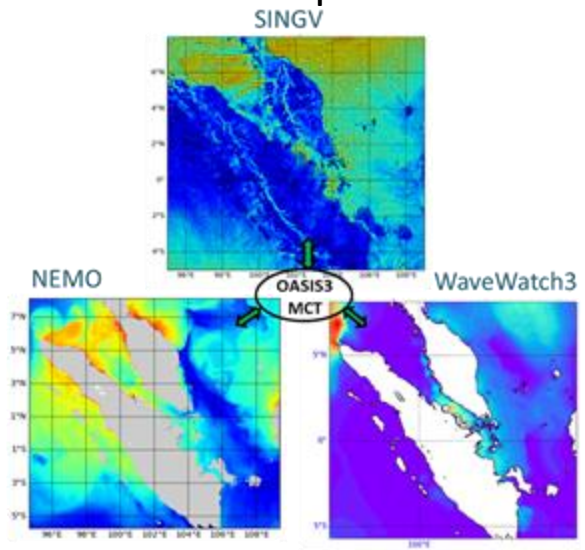
SINGV-DA | SINGV-EPS | uSINGV | cSINGV | SINGV-AV | SINGV-RCM

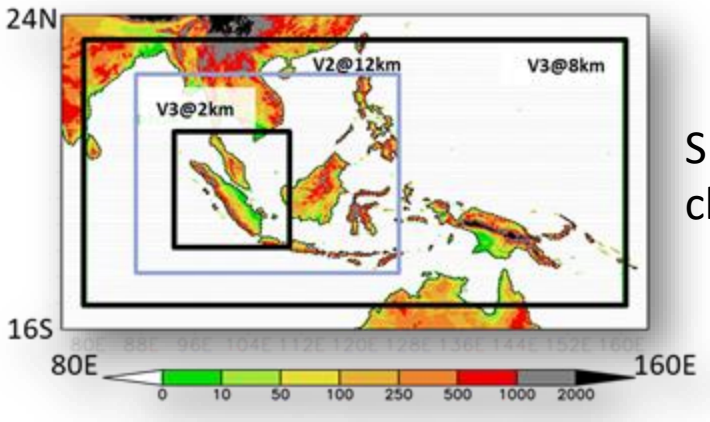
upgraded RA3.2+#504.4

SINGV (RAL1T)



cSINGV Coupled Model





SINGV-RCM climate downscaling

RAL3 configuration (CCRS version)

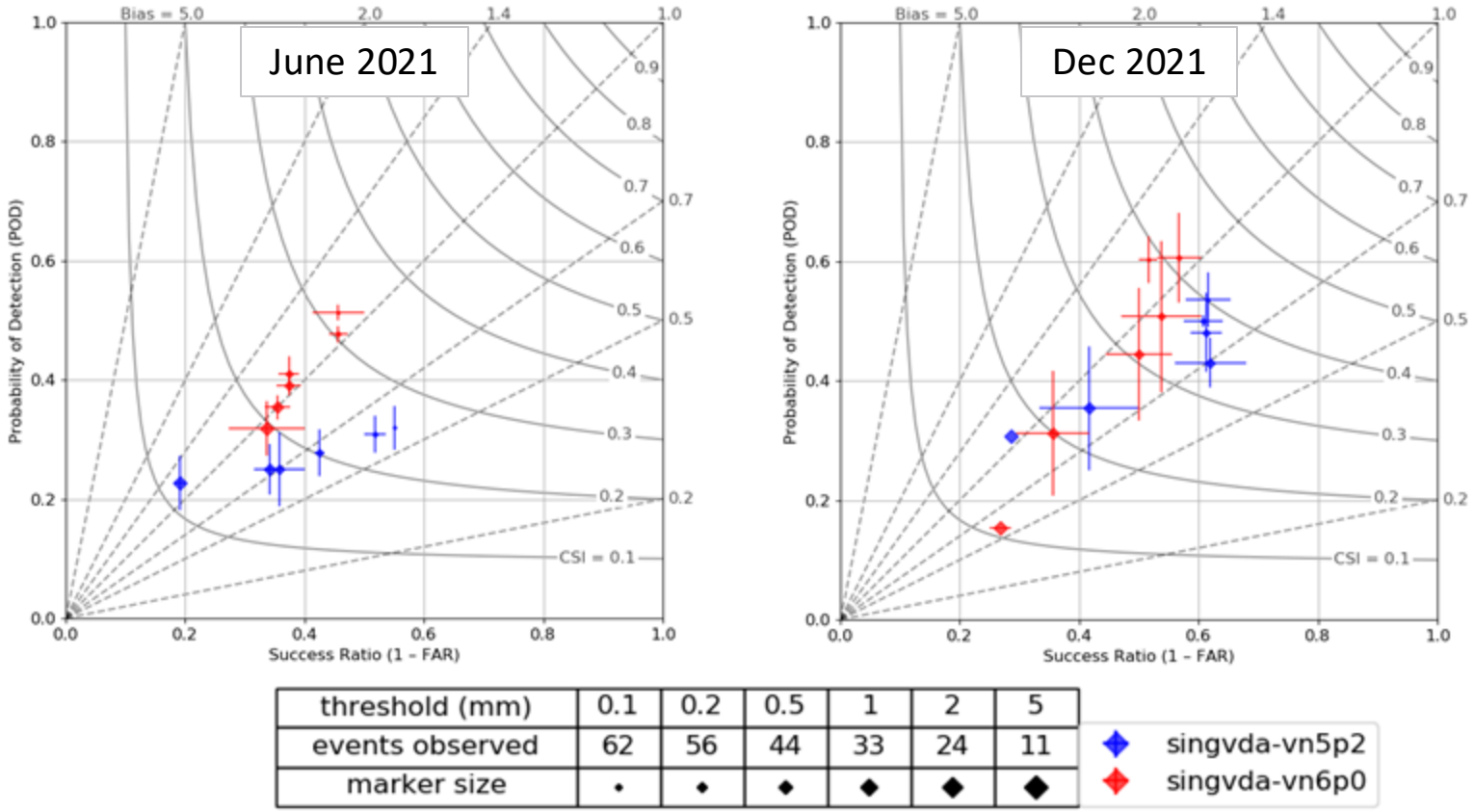
- **Headline changes**
  - Based on RAL3.2 science configuration
  - Ice-particle optical properties in Radiation consistent with CASIM (RMED #473)
  - Microphysics improvements: “Radar holes” fix (RMED #478)
  - **SINGV-DA only:** reconfiguration bug-fix (RMED #479)
  - **SINGV-DA only:** regional soil moisture cycling (improves forecast robustness)

Evaluation of precipitation in SINGV-DA

Joshua Lee

Verification against Singapore rain gauges:

3-hour mean rainfall



- Improved precipitation forecasts (higher CSI) in SINGV-DA vn6.0
- More reliable forecasts: higher POD (and FAR) in SINGV-DA vn6.0; less biased

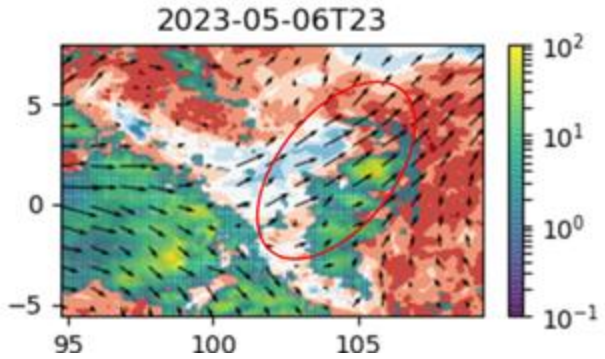
Why is rainfall improved?

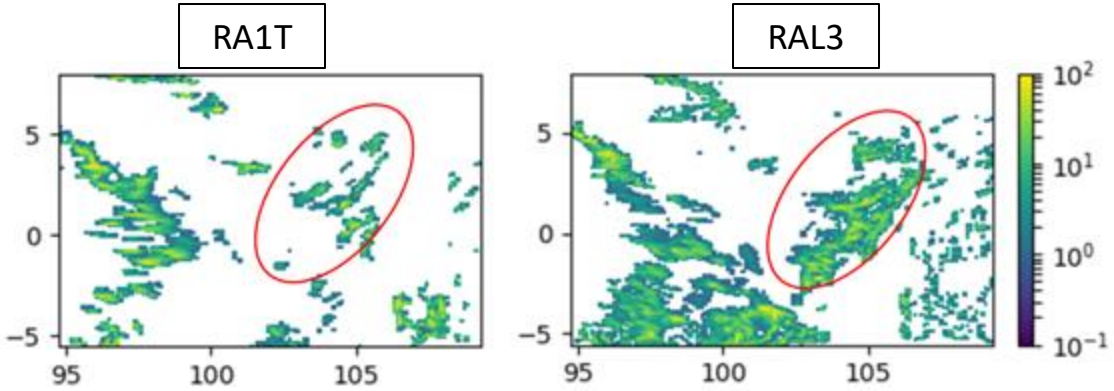
Peter Heng

Convective organization better in RAL3, due to double-moment microphysics (CASIM)

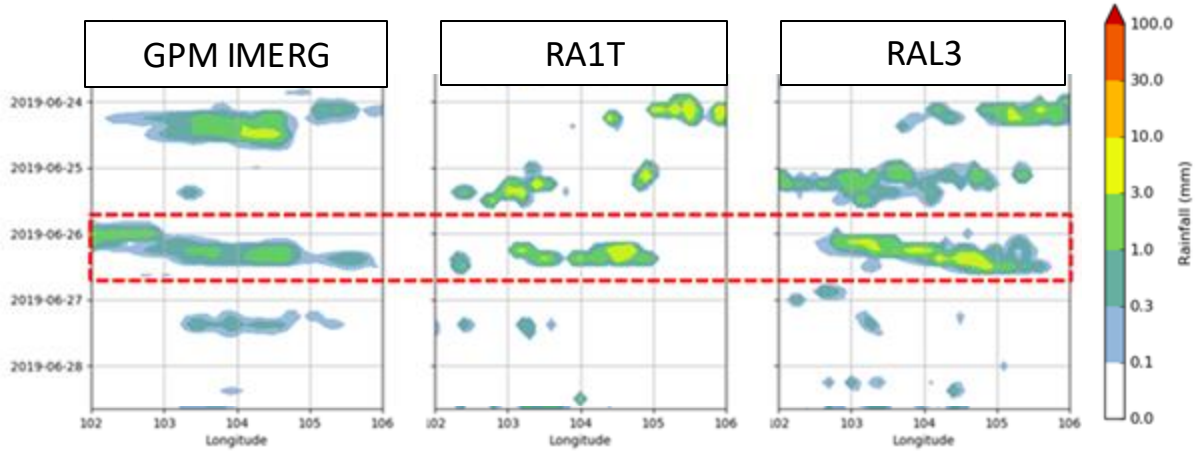
Sumatra squall case
05 May 2023

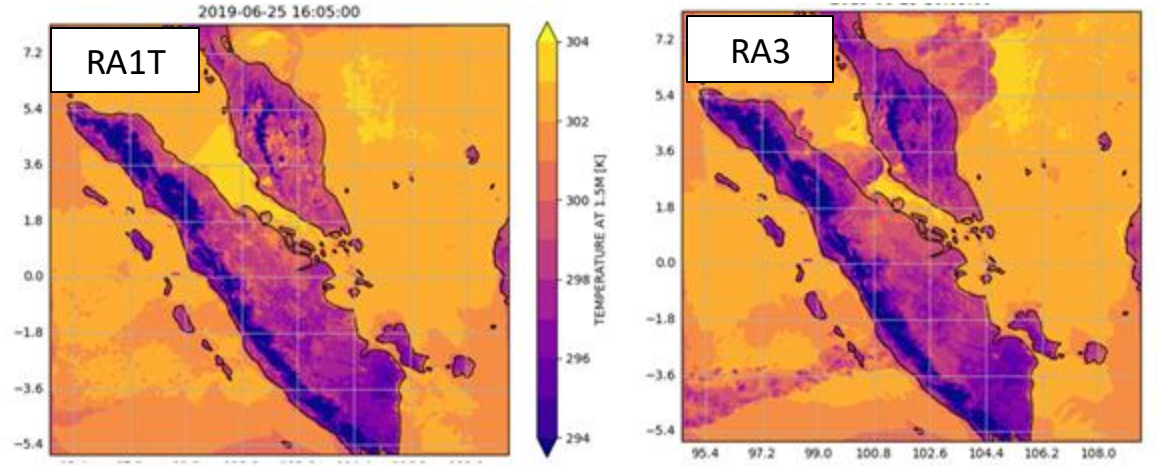
- GPM rainfall
- ERA5 winds & T850





Organized convection 06 June 2019
3h acc rainfall 0.5-2°N

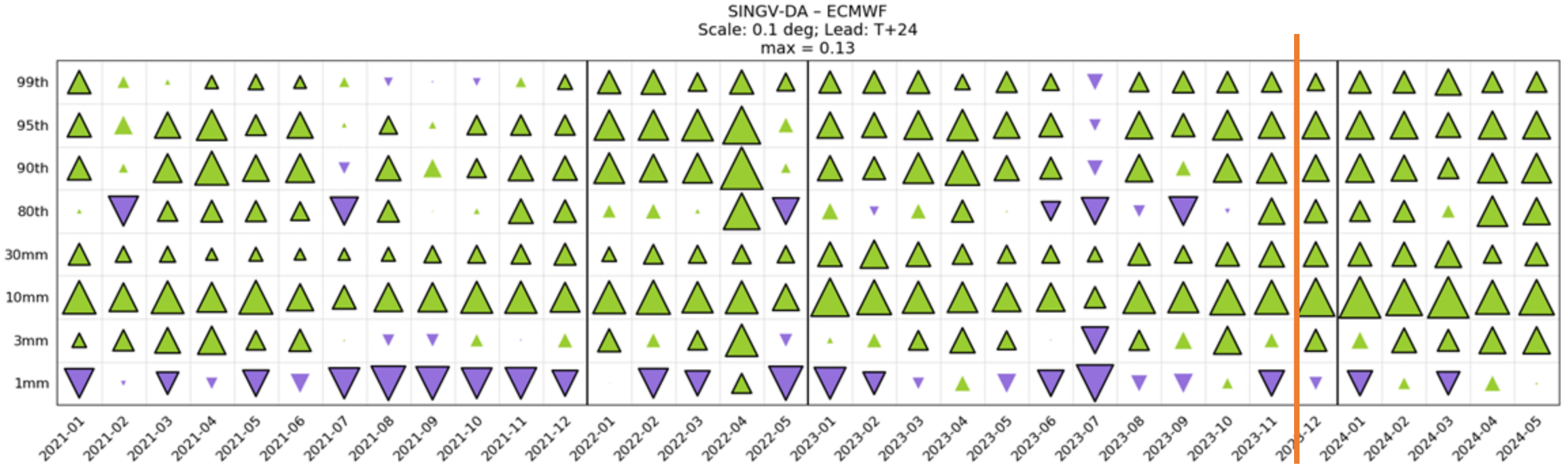




Evaluation of precipitation in SINGV-DA

Joshua Lee

- **Hinton diagrams of Fractions Skill Score for operational SINGV-DA vs ECMWF**
  - Improvements appear to be robust for 80th percentile, 3mm and 10mm thresholds

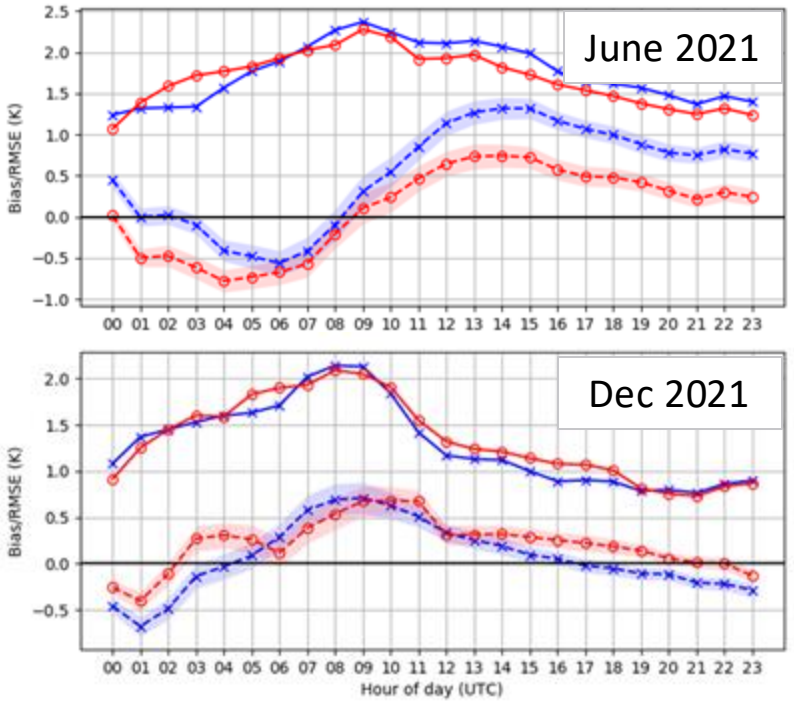


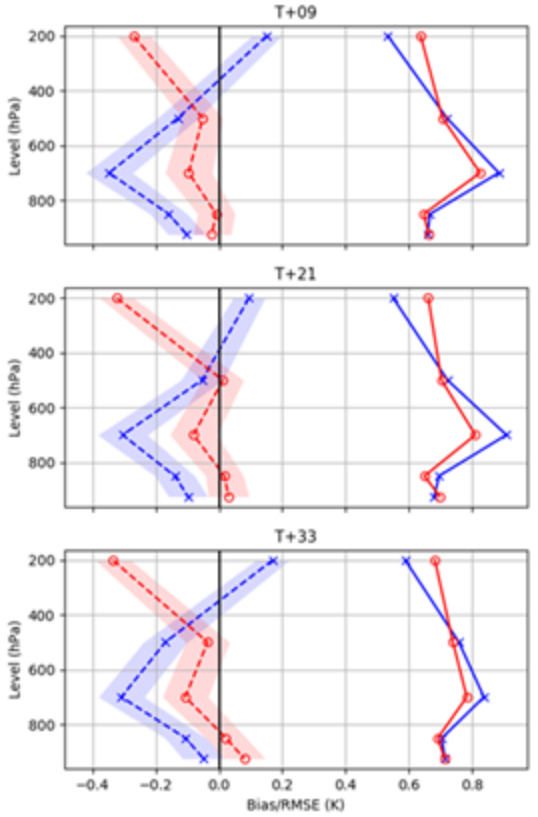
SINGV-DA vn6.0

Evaluation of temperature: SINGV-DA

Joshua Lee

Screen temperature Singapore





Verification temperature

Radiosonde

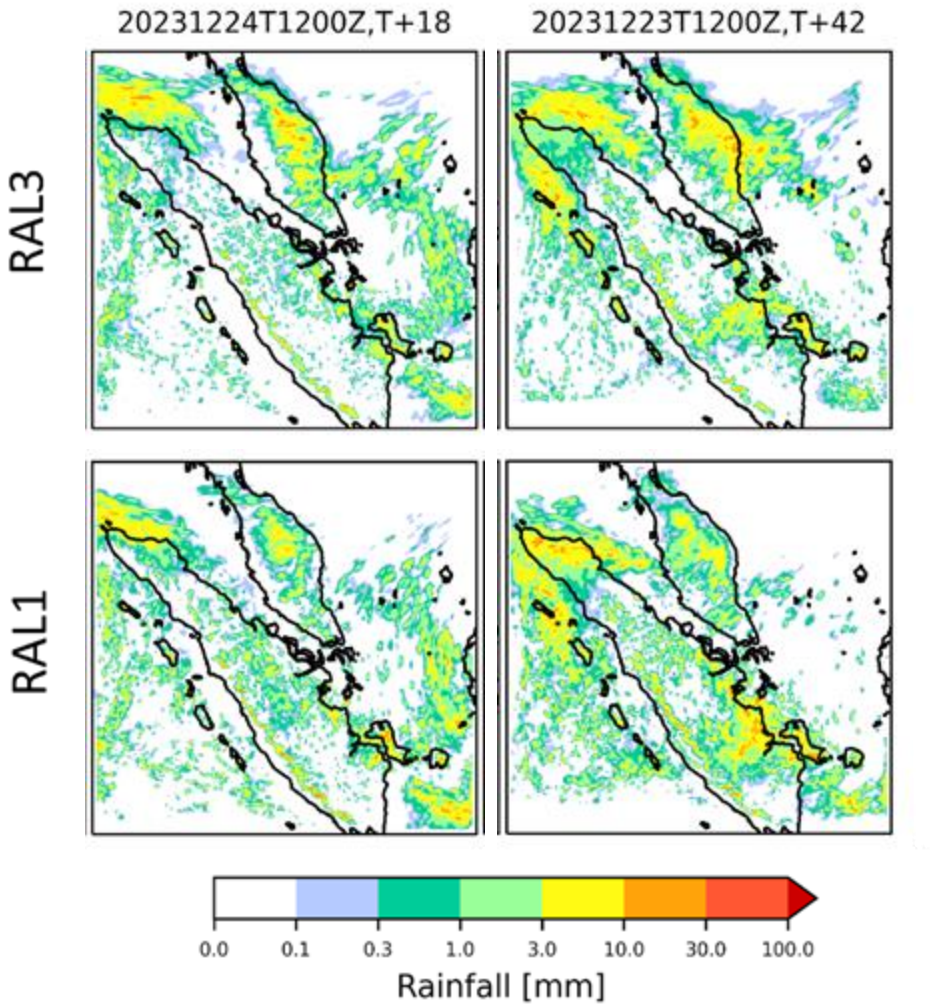
Dec 2021

- Comparable surface temperature forecasts over Singapore (slight cold bias)
- Lower tropospheric temperatures improved

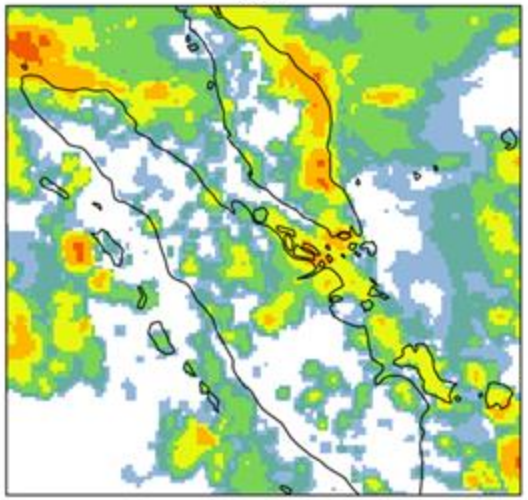
SINGV-EPS

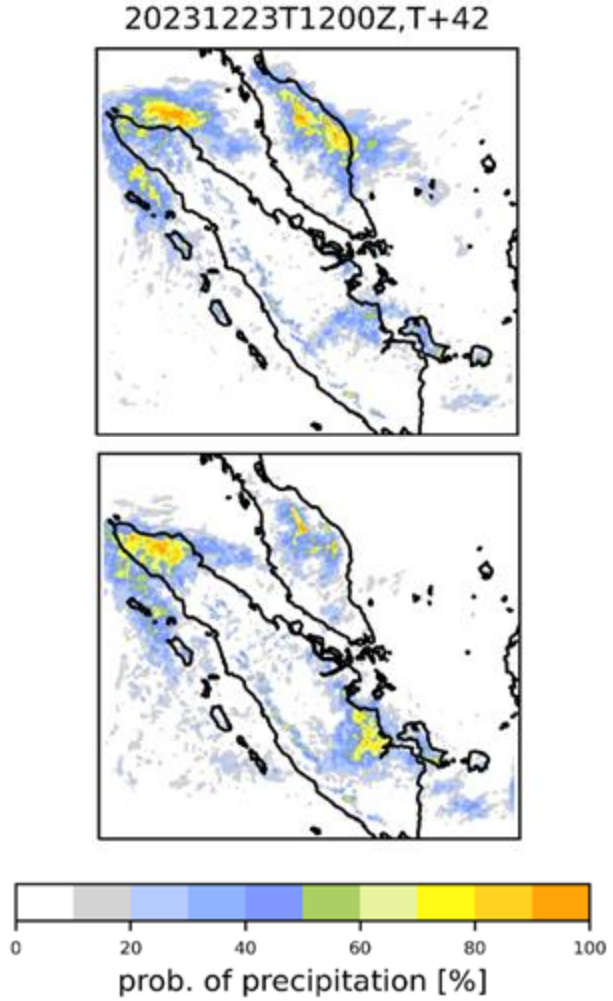
Rachel Koh

- 12-member downscaling ensemble from ECMWF HRES forecasts



GPM precipitation
2023/12/25 06 UTC

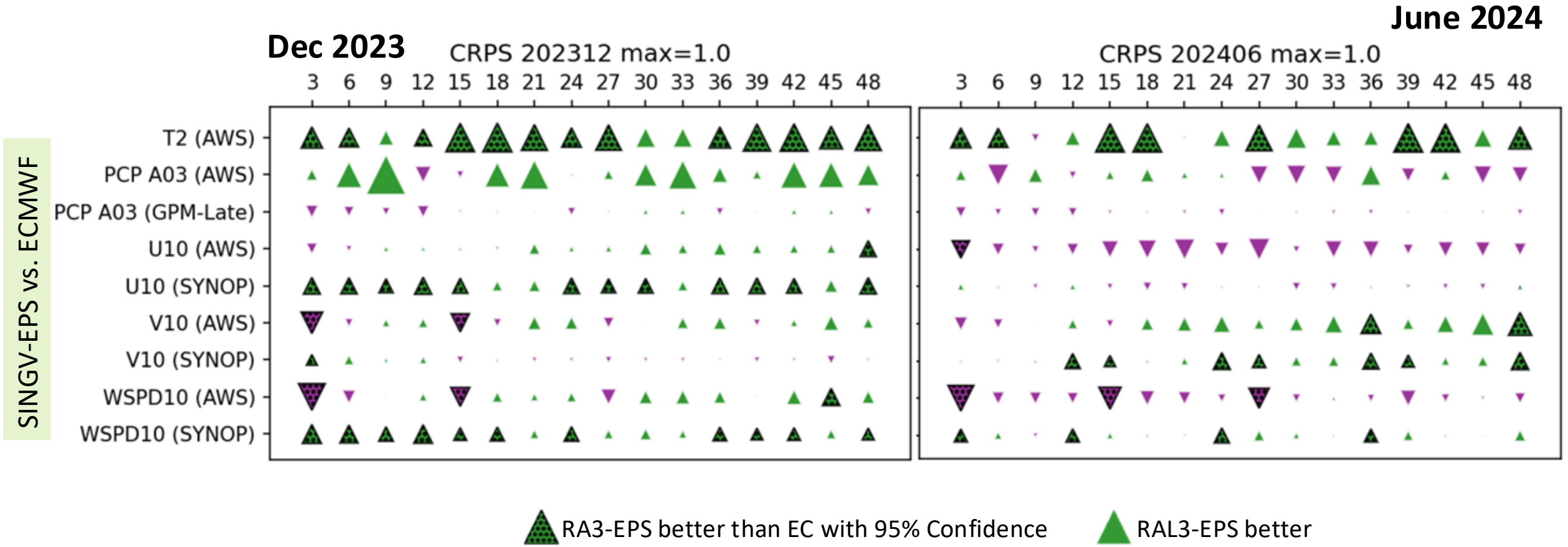




Ensemble Verification

Rachel Koh

- Continuous Ranked Probability Score: **accuracy** via distance from forecast to obs CDFs

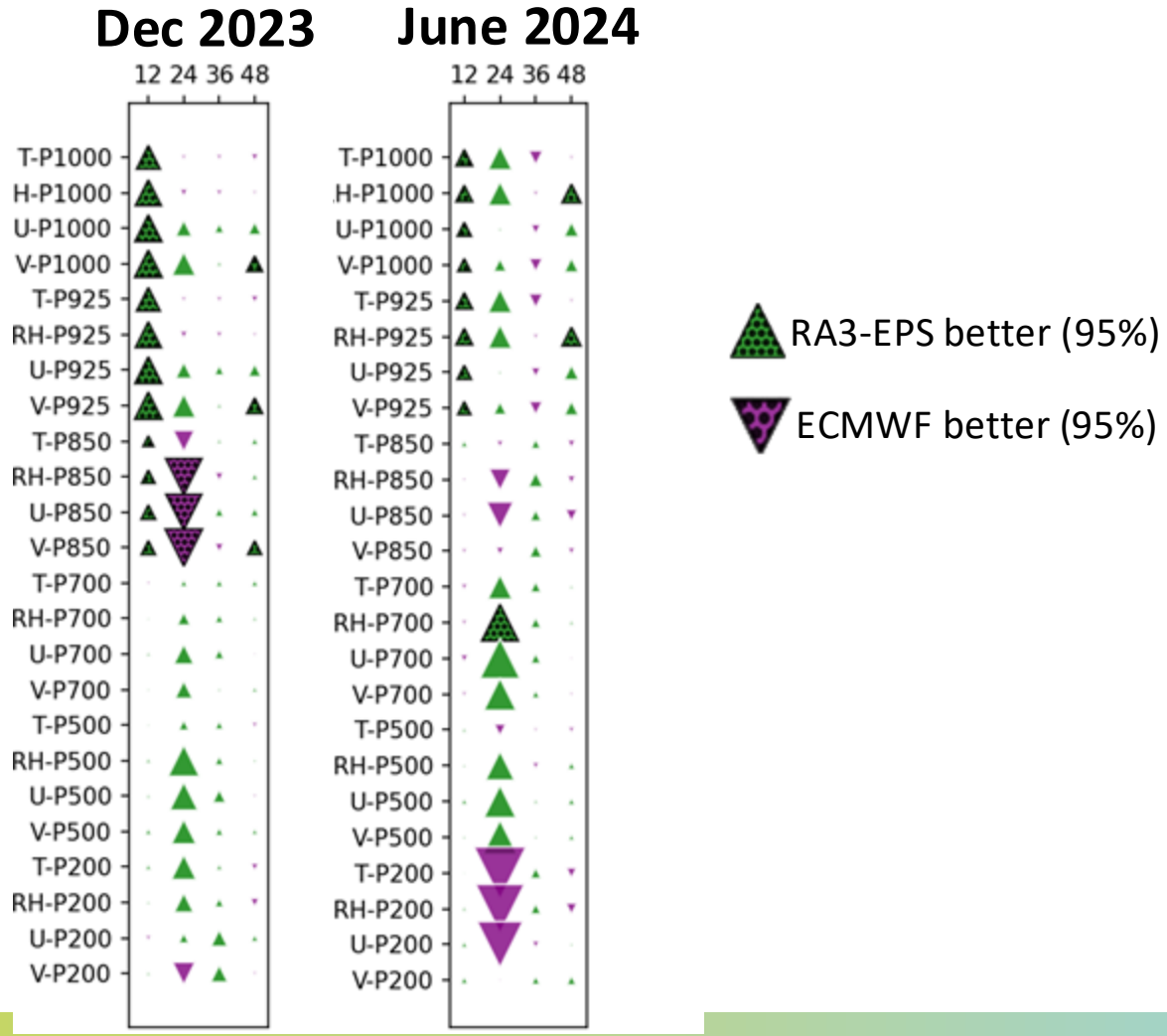


Ensemble Verification

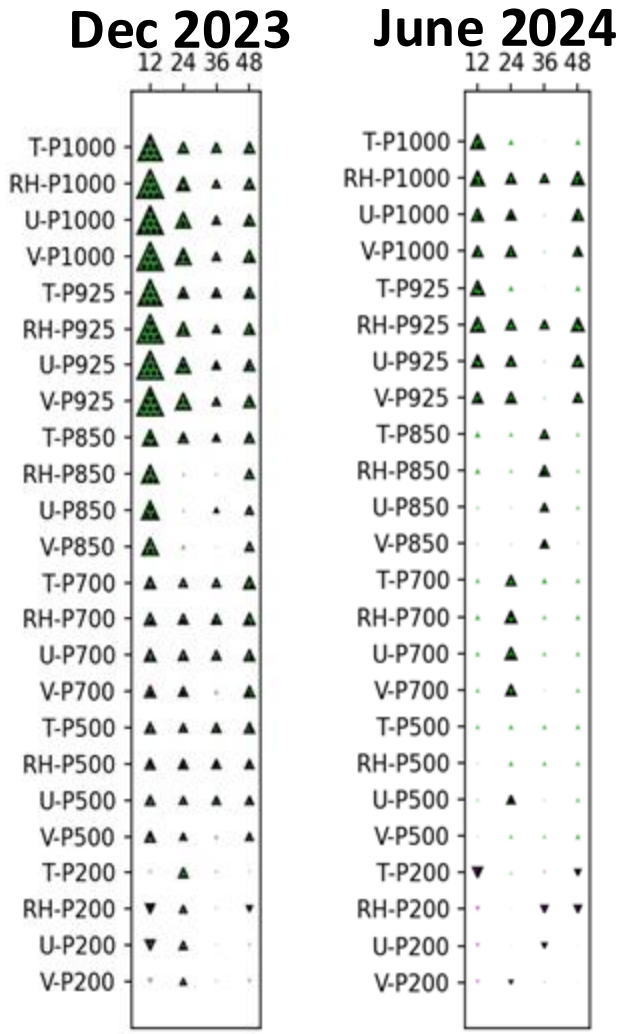
Rachel Koh

- **Accuracy:** Continuous Ranked Probability Score

SINGV-EPS vs. ECMWF



- **Reliability:** RMSE-to-spread ratio
- well-calibrated if spread represents errors



Summary

- RAL3 greatly improved precipitation performance in SINGV
- Some additional branches where incorporated to reduce a temperature bias
- Updated-RAL3 was implemented in SINGV_DA (Dec 2023)
- RAL3 is running real-time in parallel trial of SINGV-EPS downscaling ensemble
  - Aiming to operationalize later this year as a part of DA-centered ensemble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