Met Office

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UM PARTNERS

The Unified Model Partnership

All partners contribute to collaborative research and development and profit from synergies, while building the best possible earth system model together.
Core partner representatives form the UM partner board which decides on investments and strategic direction.

CORE PARTNERS
- Met Office
- Bureau of Meteorology / CSIRO (Australia)
- MoES / NCMRWF (India)
- NEA / MSS /CCRS (Singapore)
- NIWA (New Zealand)
- KMA (South Korea)

ASSOCIATE PARTNERS
- ICM (Poland)
- SAWS (South Africa)
- US Air Force (United States)

Latest DA implementations

Large Scale Blending (LSB)
https://doi.org/10.1002/qj.4495

LSB inc.

UKV an. inc.

- Use of host model (x^h) in a convective scale model (x^r) with a spectral decomposition filter (F) to incorporate large-scale motion (low pass filter).

$$x^{bld} = x^r + \delta x^F \qquad \delta x^F = F\left(R\left(x^h\right) - x^r\right)$$

- As x^h host model. R reconfiguration.
- We blend the background fields used in the UKV assimilation step.
- The LAM DA can then focus on the smaller scales that it can more reliably represent.
- Tests on the LSB feedback in MOGREPS-UK show an improvement in the spread/skill relationship (paper draft).

RADAR reflectivity assimilation
https://doi.org/10.1002/qj.3977

RadarZ Varobs

- Direct assimilation of 3D radar reflectivity volume scans for UK & Ireland radars
- Precipitating and dry observations used 3-times per hour
- Operator uses q_{rain} increment from Perturbation Forecast (PF) model.
- Use super - observations to avoid overfit.

MOGREPS – UK
Met Office Global and Regional Ensemble Prediction System – LAM version

Downscaler – normal domain

Hourly cycling – normal domain

Downscaler – big domain

dFSS

eFSS
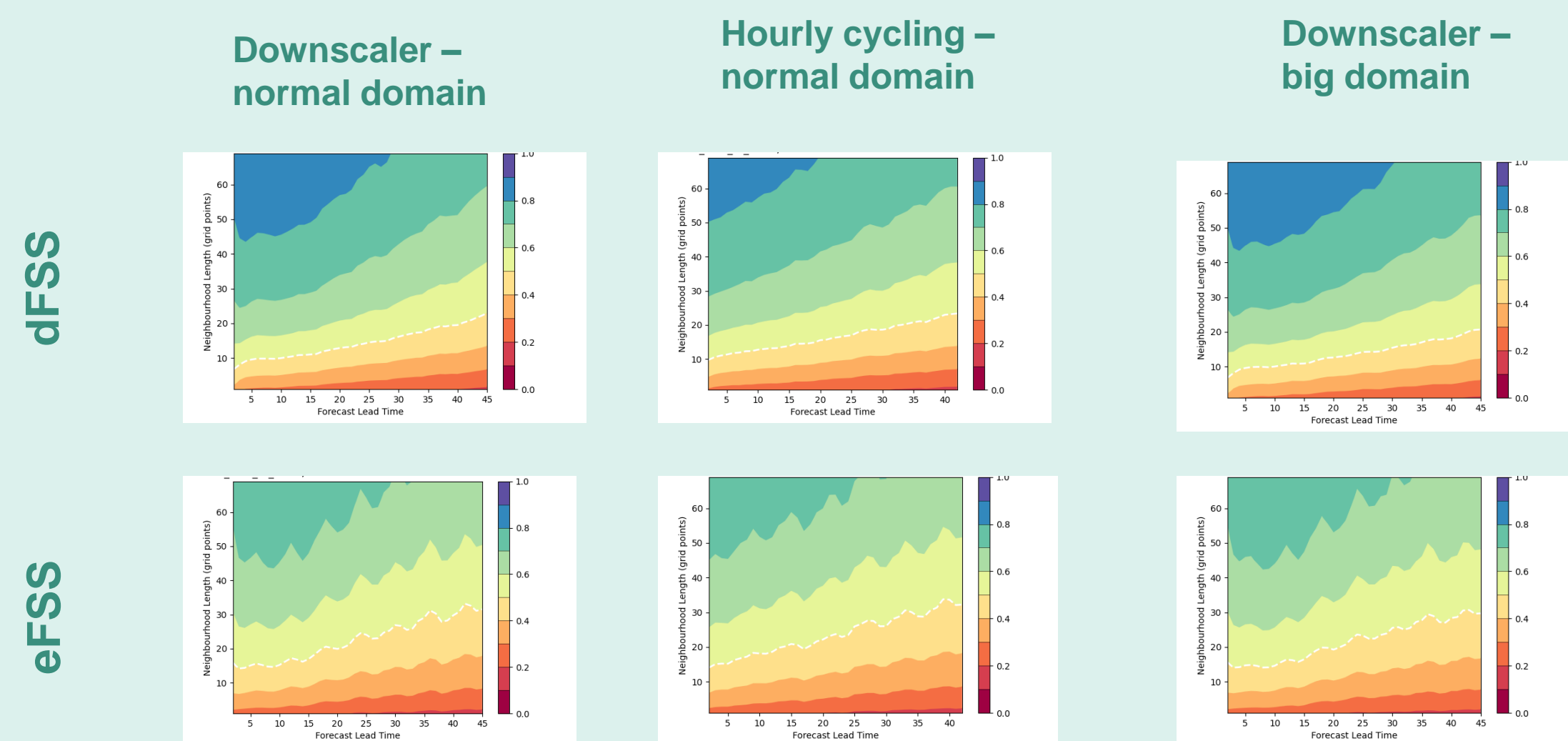
MOGREPS – UK general lack in ensemble spread. Test 14 Nov 2022 – 14 Dec 2022. sensitivity of the ensemble spread/skill to different factors:
- Domain size:
  - UKV domain: x direction 1152 km, y direction 1440km
  - Big domain: x direction 1500 km, y direction 1500km
- Initial condition:
  - Test with Downscaler, using warm start approach (https://doi.org/10.1002/qj.4268).
  - Test with whole DA system

For this period Downscaler has slightly more skill than hourly-cycling, especially at long lead times and neighbourhood sizes, but less spread.
Spread/skill relationship better using the whole DA system.
Work still in progress: longer periods and study filtered by synoptic weather regimes.

RAL3 model physics package
Large range of convection permitting models → risk of proliferation of model configurations
- RAL3 provides a single unified configuration.
- Allows a more coherent programme of model development across UM partners.
- New double-moment microphysics scheme: CASIM (see below)
- Bi-modal cloud scheme (https://doi.org/10.1175/MWR-D-20-0224.1)
- Removes stochastics boundary layer perturbation
- Land surface configuration

CASIM
Cloud **A**ero**S**ol **I**nteracting **M**icrophysics (https://doi.org/10.1002/qj.4414)

Introduces more degree of freedom → needs more constraints

5 hydrometeor species
Cloud droplets
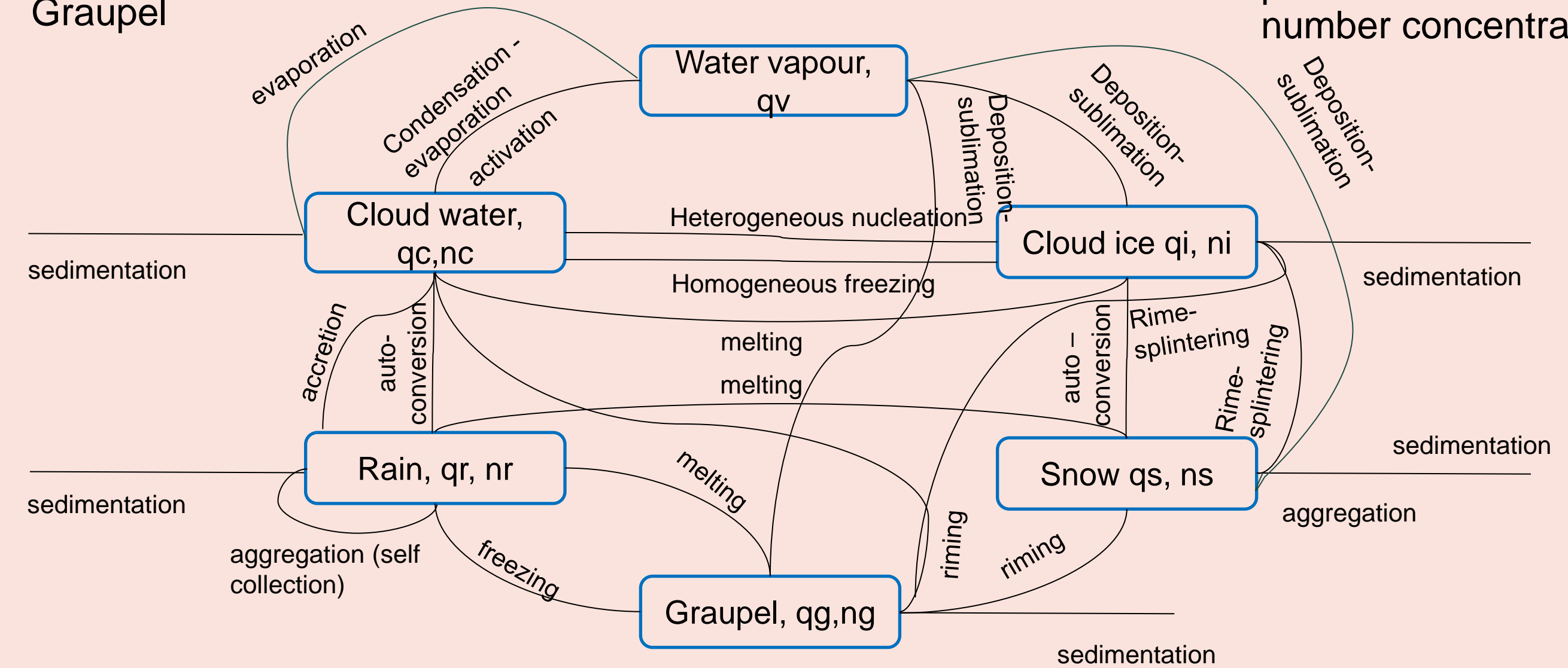Rain
Cloud ice
Snow
Graupel

2 prognostic moments
Number
Mass

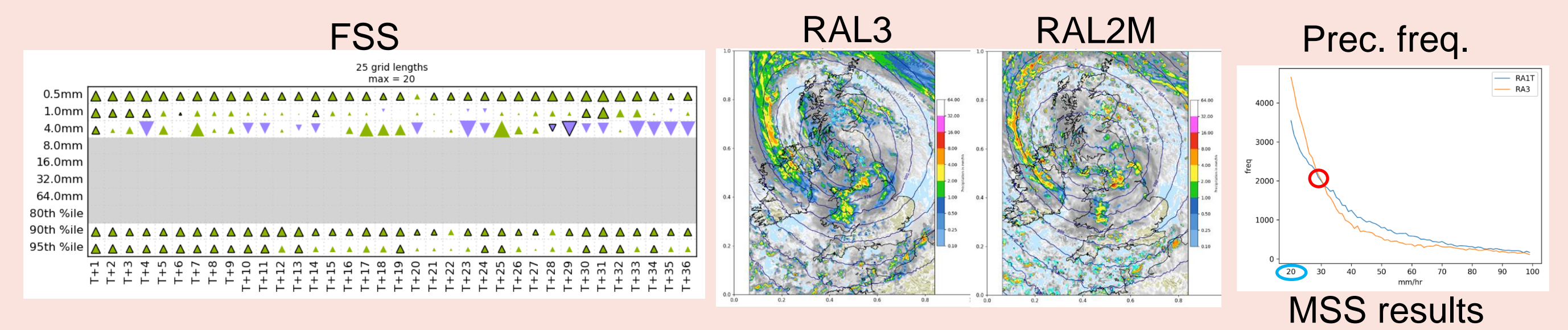Can be coupled to aerosol to represent CCN and INP.
[UKCA, MURK, ARCL]
[RAL3 config uses a prescribed in-cloud number concentration]

UKV test phase
- Produces more light rain
- Introduce more coherent precipitation.
- FSS statistically significant better for both season (winter 2021 shown below).

FSS

RAL3

RAL2M

Prec. freq.

MSS results

Partner activity (MSS)

- MSS (Singapore) operational RAL1T.
- RAL1T vs RAL3.
- RAL3 better skills in precipitation (not shown).
- RAL3 introduces a cold Bias for screen temperature.
- Traced to higher low/medium cloud amounts and reduced surface SW radiation

New version (FIX):
- **Microphysics changes** = further changes to microphysical processes (rain aggregation, snow maximum size and rain evaporation) to improve simulated radar reflectivity.
- **Radiation scheme changes** = introduce ice-particle optical properties that are consistent with CASIM microphysics.
- Reduced low cloud amount and higher SW radiation.
- Increased daytime screen temperatures
- Neutral impact on precipitation forecasts

Temperature

Low clouds

Low clouds
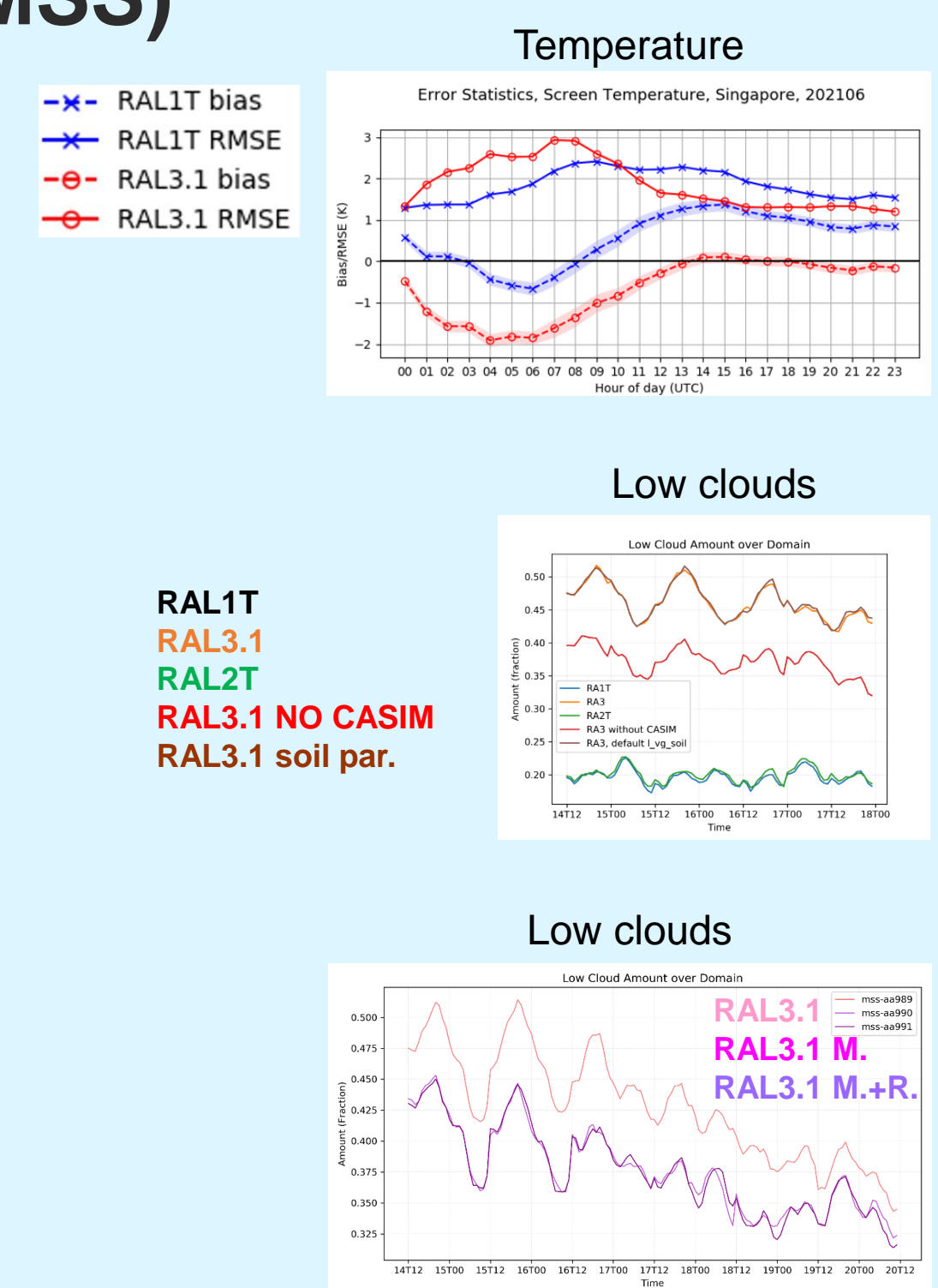
FUTURE DEVELOPMENT

UK regional NWP
- Retire UKV forecasts beyond the T+12 "NWP nowcast".
- Upgrade to 1.5km resolution UK ensemble forecasts.
- Introduce 300m resolution regional ensemble(s).

Non-UK NWP
- Warm-start large domain models to reduce initial forecast "spin-up".
- Rapid introduction new models for Defence & humanitarian response.

Transition to ensemble-based forecasting systems
- Retire UKV deterministic forecasts. Use the control member instead.
- Encourage wider use of ensemble.