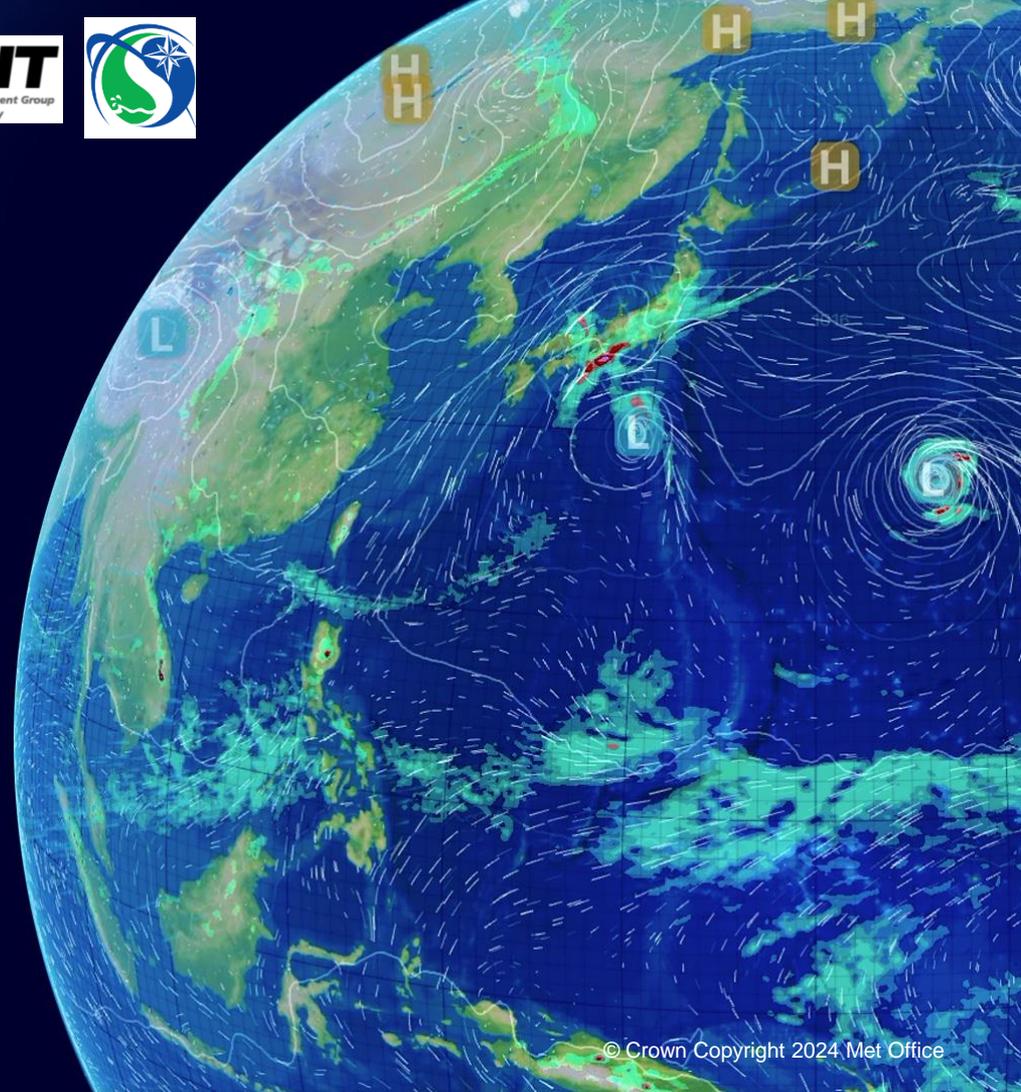# A Review of WCSSP SE Asia Model Initialization Methods: Comprehensive Comparison of Warm Start and 4DVar with Large-Scale Blending

46th EWGLAM & 31th SRNWP
1st Oct 2024

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- Introduction: Met Office Southeast Asia Convectional scale Regional Model and the two approaches of Large-Scale Blending(LSB): 4DVar with built in LSB vs Warm Start (based on LSB)

- Warm Start vs 4DVar LSB with NoObs: Close to equivalent .

- Warm Start versus Downscaler

- 4DVar LSB NoObs versus 4DVar LSB with AllObs assimilated.

- Warm Start versus 4DVar LSB with AllObs.

- Discussion of the implication for DRMs (Downsacler) initializations

Met Office Model domain, configuration and DA

- Full SE Asia NRT model domain: (90E to 154E) , (18S, 30N), horiz res of 0.04deg (4.4km) 1200x1600 lat/lon grid points.

- 4DVar DA Res: 17km

- Model: PS47 early Config. RAL3.2#504.4 90-levels.

- DA: Hourly 4Dvar with Largescale Blending.

- Obs used: AHI (radiances and GeoCloud), aircraft, AIRS, AMV, ASCAT, MHS, ATMS CrIS, IASI, MWHS (FY-3C), SAPHIR and surface. No Radar Data!
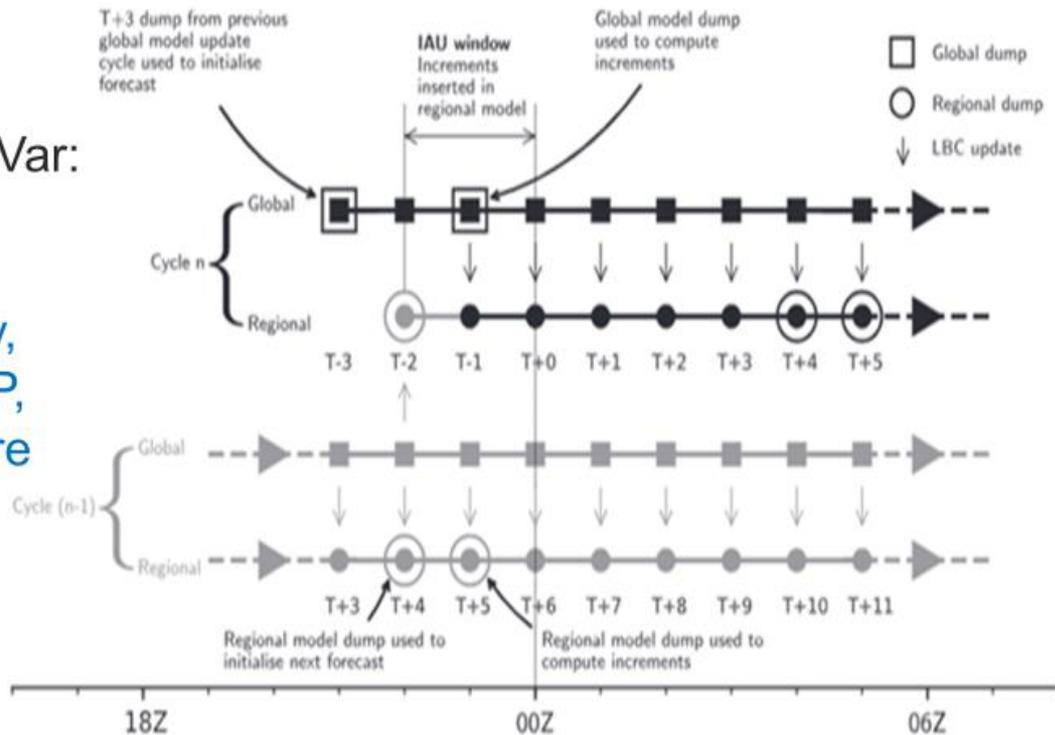

Orography in WCSSP SE Asia Domain
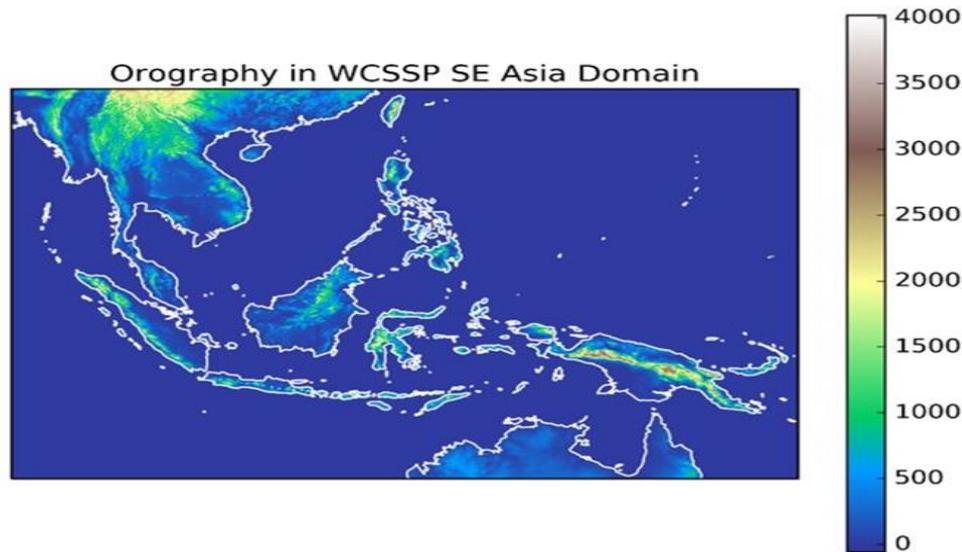
WCSSP SE Asia DA system – 4.4km UM grid with hourly 4D-Var

Met Office LargeScale Blending (LSB) Implemented in Warm Start

Adjust Var:
u, v,
Theta,
Density,
Exner P,
Moisture

- To alleviate spin-up problems in downscaler regional models without DA.

- Implemented in Africa model (James Warner..) and Darwin Bay(Short and Petch)

- All LSB based on Raymond filter

- No direct comparison done

LargeScale Blending (LSB) Implemented in 4DVar (4DVarLSB)

- Cycling Convective 4DVar (Red)
- Largescale Global (Blue)
- Blended fields(Green)
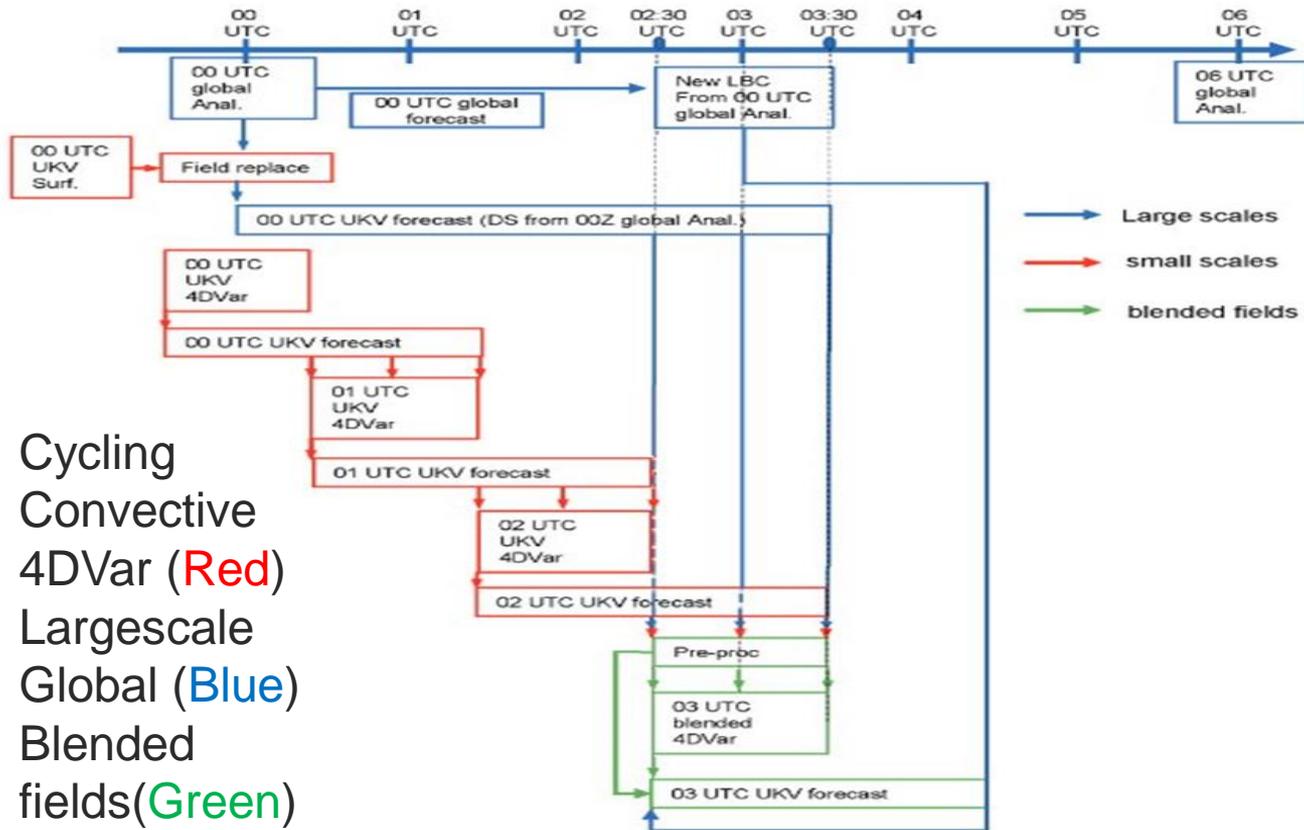
- Largescale info for UKV: LBC

- OS45 UKV: 4DVar LSB PreserveRH= true

- In SE Asia 4DVar LSB: PreserveRH= false (Research)

- All DRMs: Downscaler.

Direct Comparison of Warm Start vs 4DVarLSB Initialization Approach

Met Office

Level ground comparison:
- Same Domain
- Same Resolution
- Same Sci. Configuration
- Same Initialization Times

Table of experiments

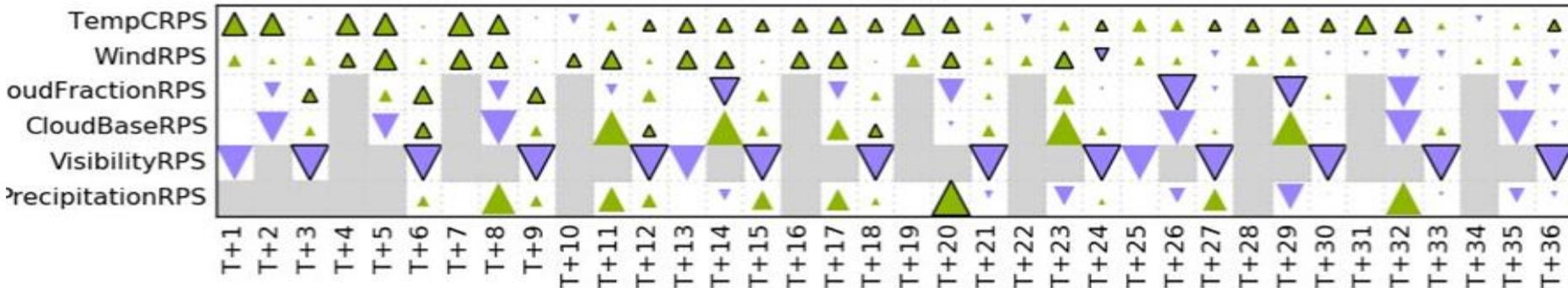| Experiment	Summer 2022	Winter 2021	Status
Downscaler	Yes.	Yes	Completed
4DVar LSB With NoObs	Yes	No	Completed
4DVar LSB Full Obs	Yes	Yes	Summer completed. Winter half way
Warm Start	Yes	Yes	Completed

Met Office — Warm Start vs 4DVar LSB with NoObs

Summer 2022 trial

% Difference (UM WarmStar700 vs. 4DVarLSB NoObs), Surface Obs
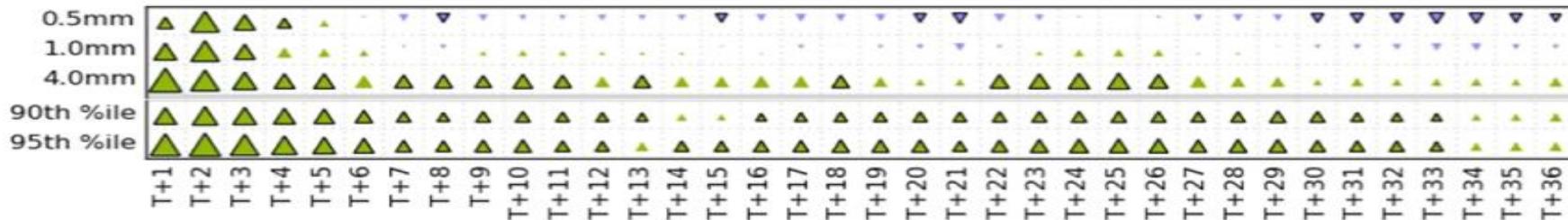7 grid lengths
max = 20

% Difference (UM_WarmStar700 vs. 4DVarLSB_NoObs), 1hr Precipitation Accumulation (mm), Analysis
25 grid lengths
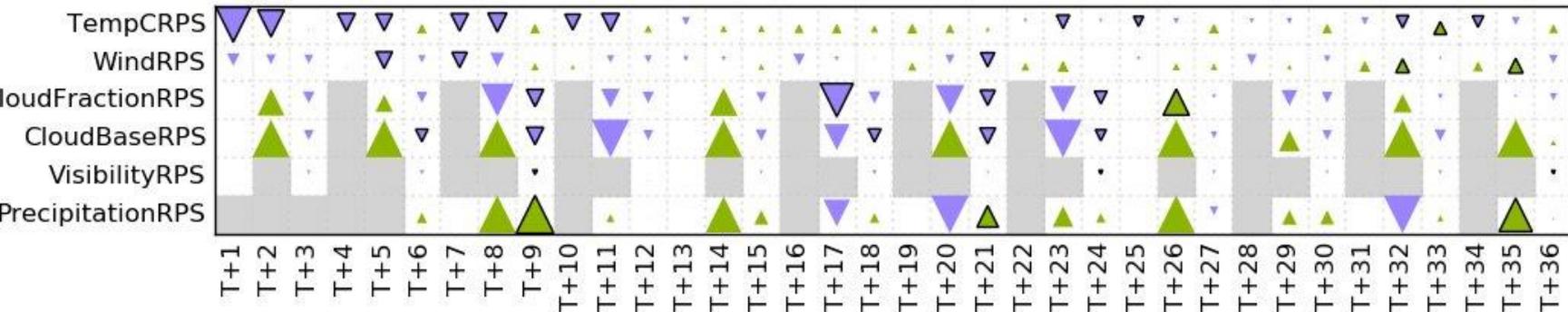max = 20

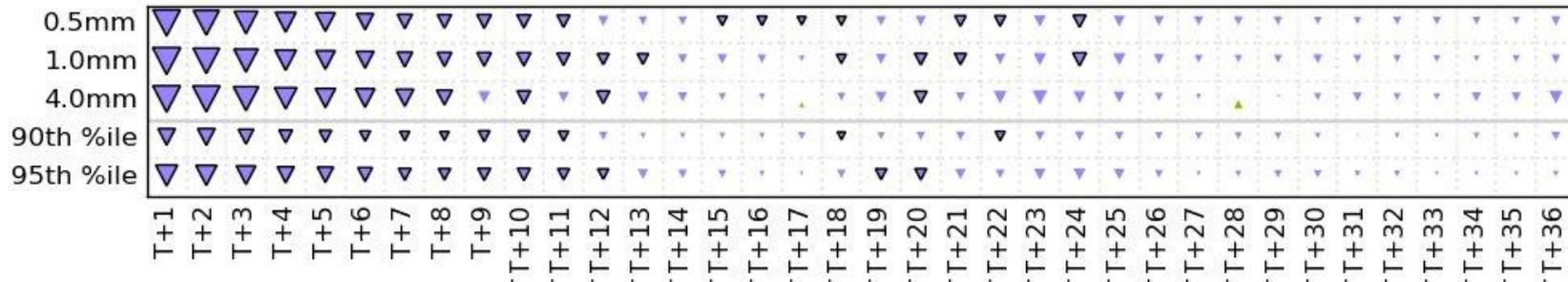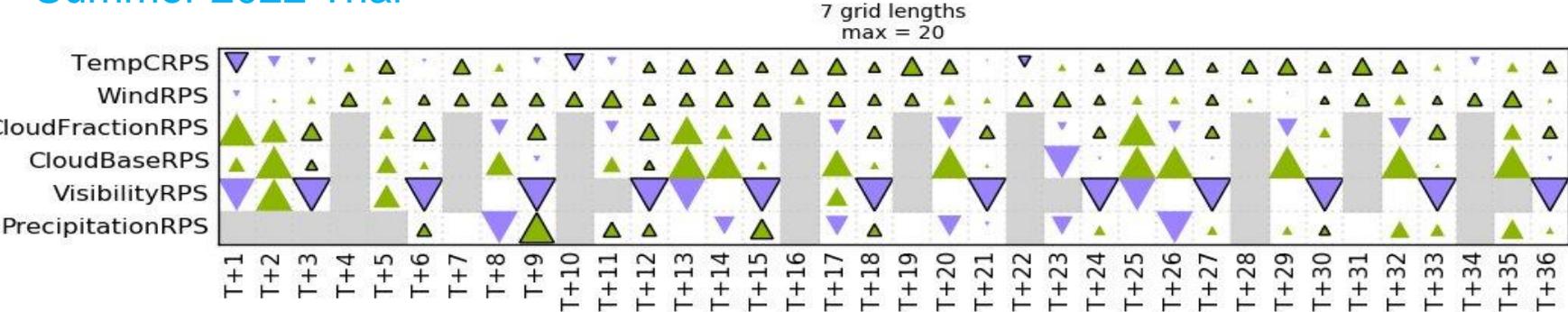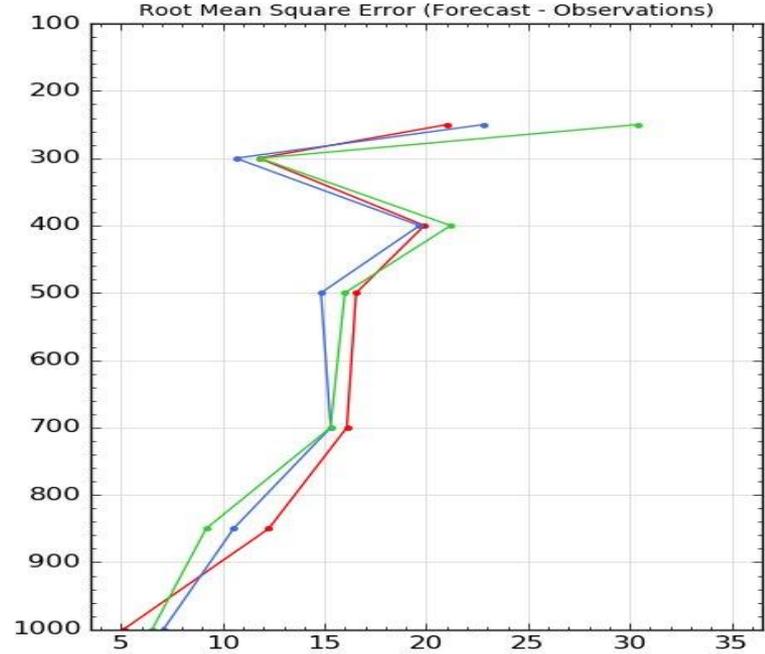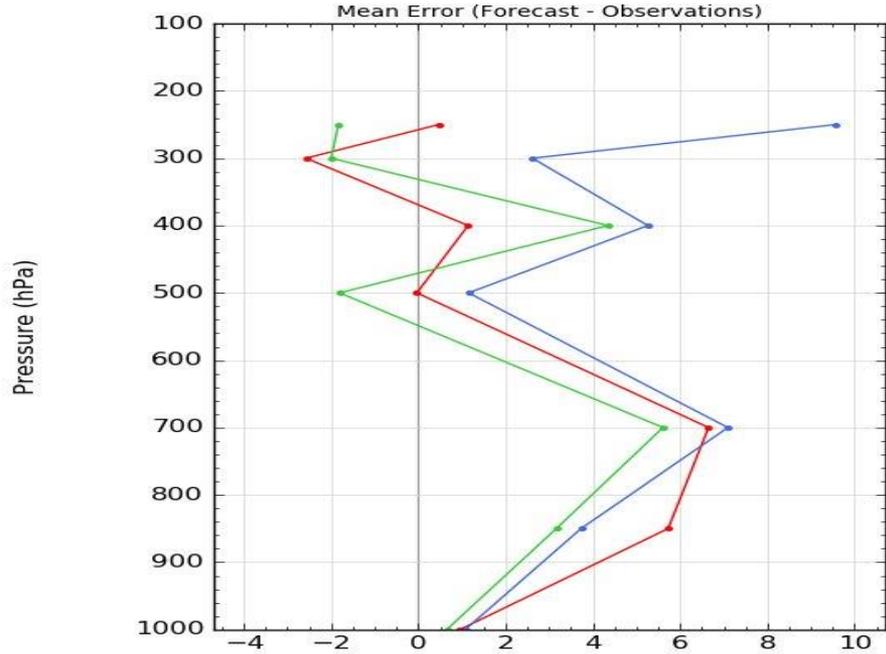Warm Start versus Downscaler --Summer

% Difference (UM_WarmStart vs. UM_DownScaler), Surface Obs

% Difference (UM_WarmStart vs. UM_DownScaler), 1hr Precipitation Accumulation (mm), Analysis

Warm Start versus Downscaler --Winter

% Difference (UM_WarmStartW vs. UM_DownScaler), Surface Obs

% Difference (UM_WarmStartW vs. UM_DownScaler), 1hr Precipitation Accumulation (mm), Analysis

4DVar LSB NoObs versus **4DVar LSB with AllObs**

Summer 2022 Trial

% Difference (4DVarLSB NoObs vs. 4DVarLSB Full), Surface Obs
7 grid lengths
max = 20

% Difference (4DVarLSB_NoObs vs. 4DVarLSB_Full), 1hr Precipitation Accumulation (mm), Analysis

25 grid lengths
max = 20

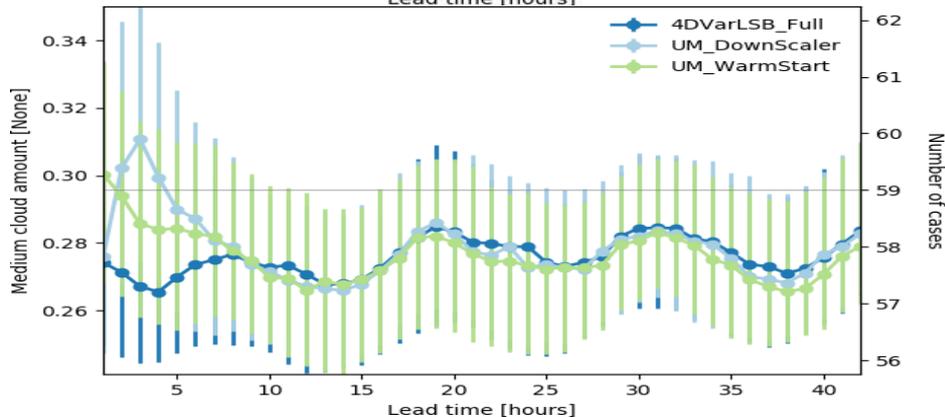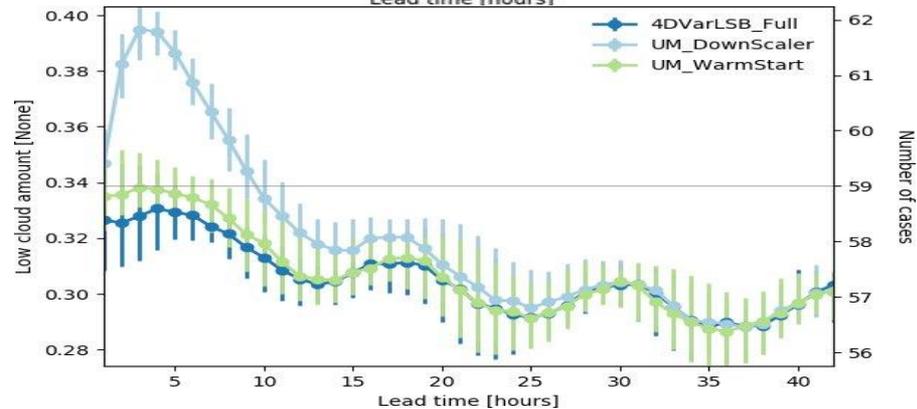**Met Office** Warm Start versus 4DVar LSB with AllObs.
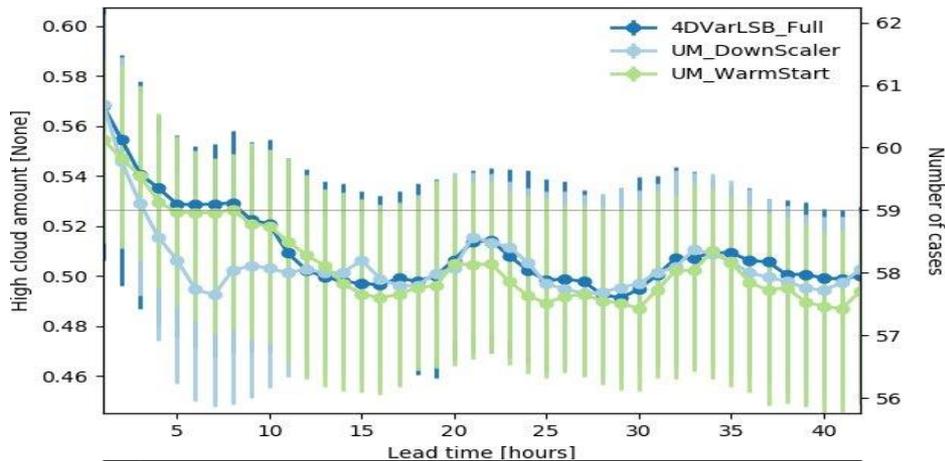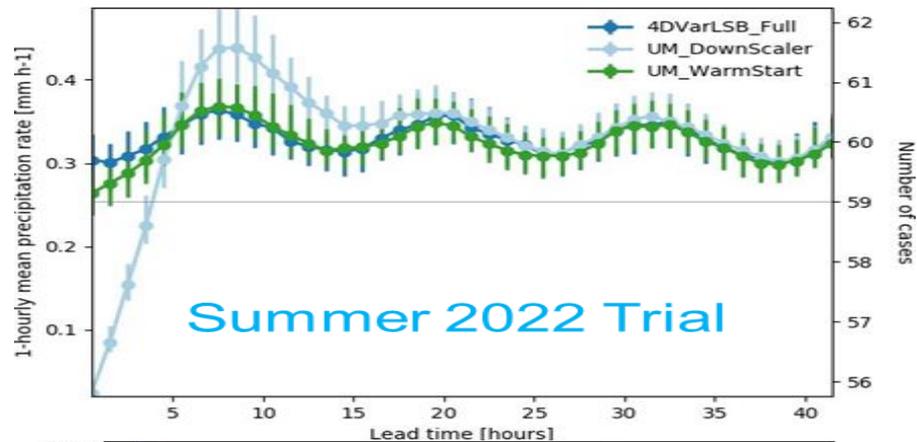
Summer 2022 Trial

Vertical Profile of Relative Humidity
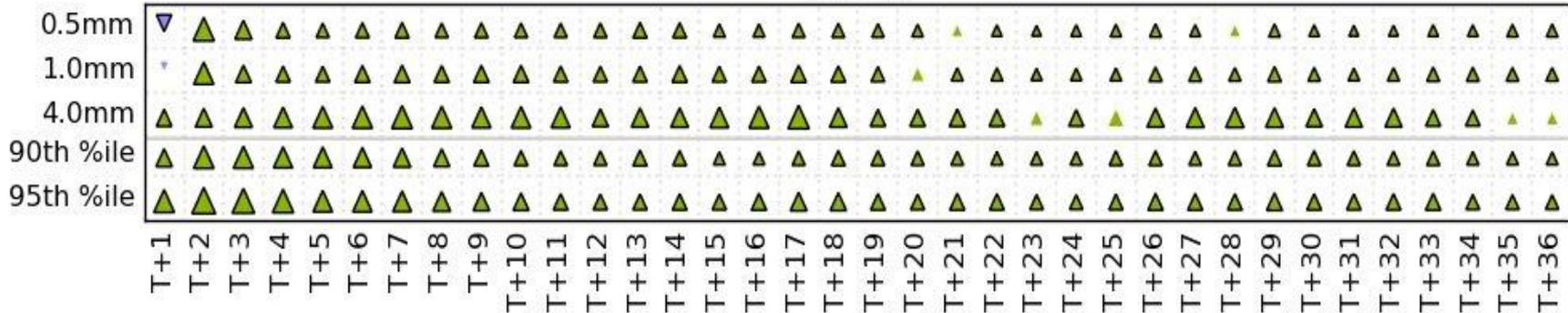
Summer 2022 Trial

Relative Humidity (%), Area 999, T+6,
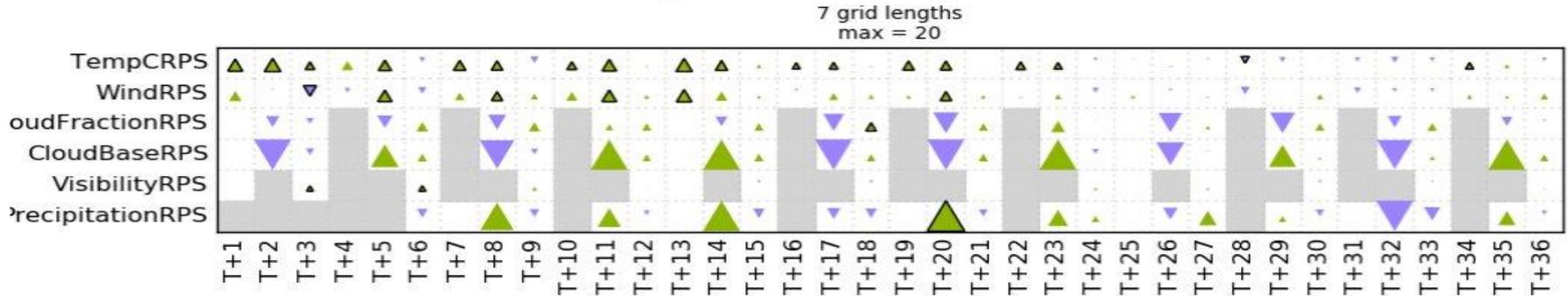Equalized and Meaned between 20220712 00:00 and 20220812 23:00, Sondes

Summer 2022 Trial

Sensitivity to Raymond Length Scale

Summer 2022 Trial

700km vs 400km
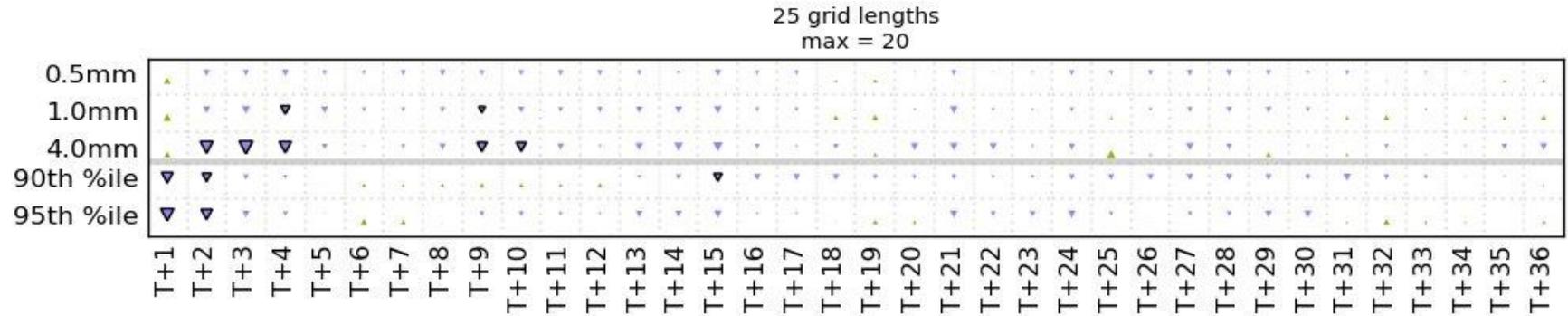
- Significant positive impacts: Warm Start vs 4DVarLSB + FullObs
- SE Asia model: Huge Domain, Sparce Local Obs, No Radar. Obs assimilated similar to global model analysis.
- Could the impacts differ for UKV?
- Diff in 4DVarLSB and WarmStart: IAU from T-2 vs One at T+0.5

    Downscaler in 4DVar and Jc?

Future Work

- Investigate why the two LSB approaches differ with NoObs
- Will the impacts hold in UKV, more Obs and Radar data assim
- Improve DRMs (Downscaler) with Warm Start? PS48 on?