Met Office
Consortia Presentation

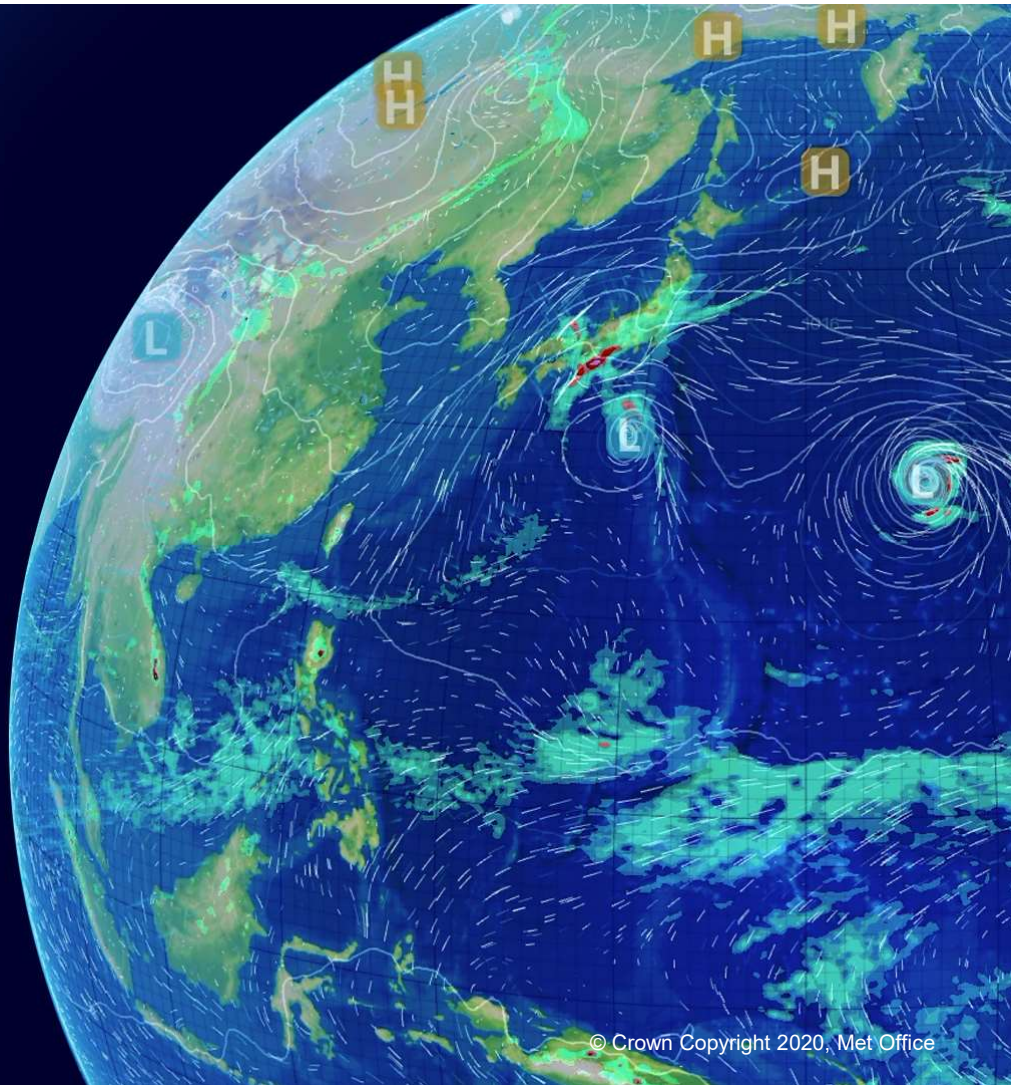
43rd EWGLAM and 28th SRNWP meeting

27th September 2021

Mike Bush

With thanks to many colleagues including:

Jenn Brooke, Gareth Dow, Anke Finnenkoetter, Charmaine Franklin, Christine Johnson, Richard Jones, Humphrey Lean, Bruce Macpherson, Anne McCabe, Saji Mohandas, Ben Shipway.



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Talk structure

- General consortia (UM Partnership) status 2021
- Field campaigns
  - SOFOG
  - LIAIASE
- Urban-scale developments
- K-Scale
- PS45
- The new supercomputer and plans for future Parallel Suites
- LFRic update

Member news

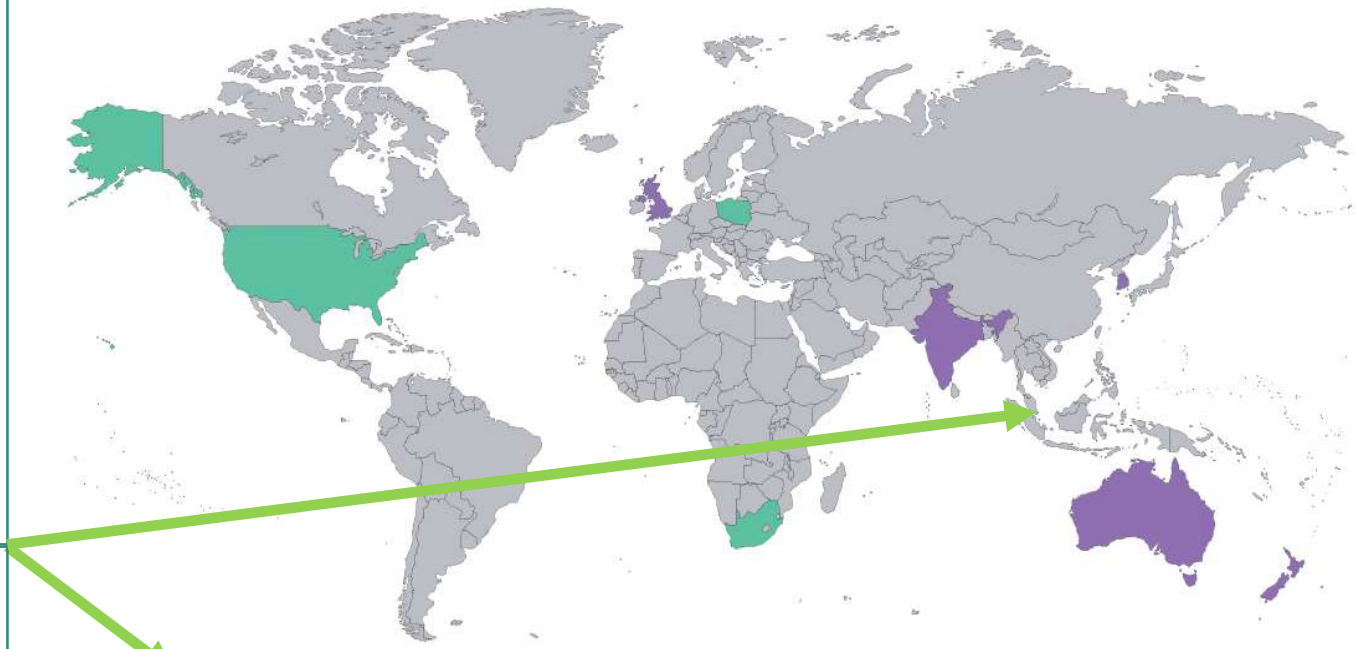
National Environment Agency Singapore (NEA), which includes Met Service Singapore (MSS) and its research division, the Centre for Climate Research Singapore (CCRS) is to become a Core UM Partner from Associate Partner.

National Environment Agency

Safeguard • Nurture • Cherish

Meteorological Service Singapore

The Unified Model Partnership 2021



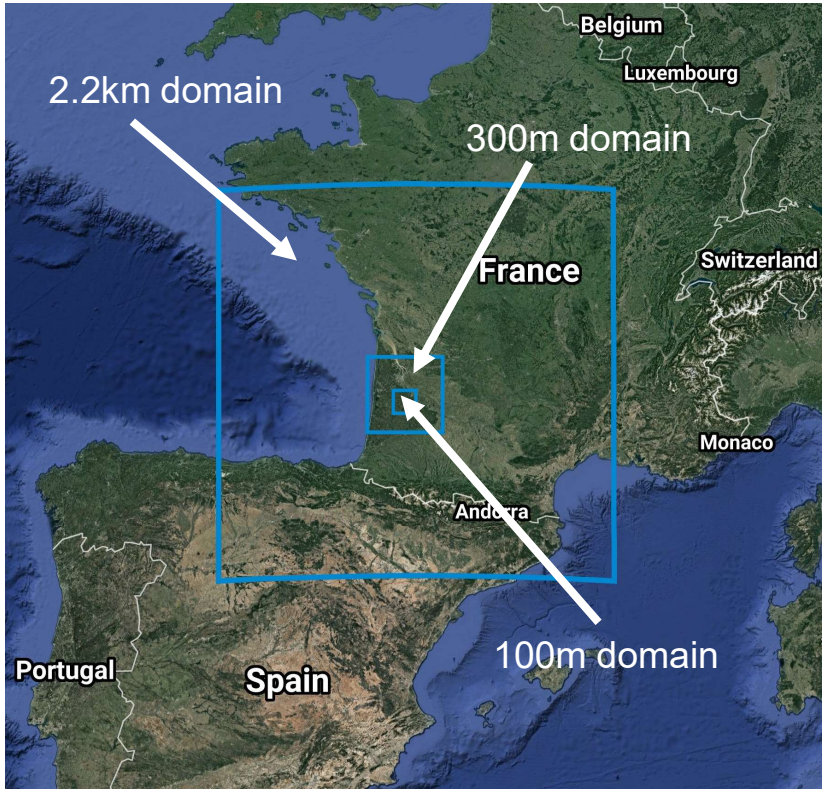
CORE PARTNERS

Met Office · Australian Government Bureau of Meteorology · CSIRO · Korea Meteorological Administration · Ministry of Earth Sciences · NIWA

ASSOCIATE PARTNERS

South African Weather Service · icm

SOFOG Ensemble experiments



18 members

IC & LBC's from the Met Office global ensemble (MOGREPS-G)

<u>3 ensembles</u>:

- 2.2km nested inside MOGREPS-G
- 300m ensemble nested inside 2.2km ensemble
- 100m ensemble nested inside 300m ensemble

These are the same domains as used for the deterministic forecasts

Anne McCabe, Met Office

SOFOG Ensemble experiments

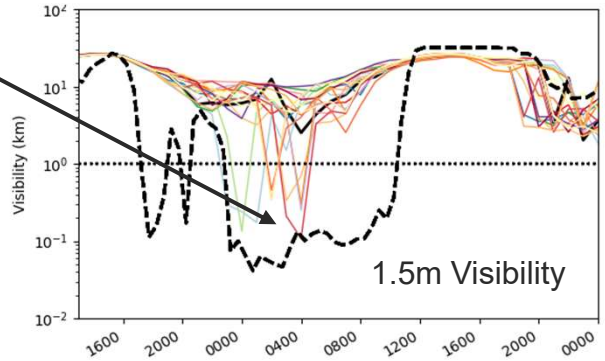
Questions we would like to answer …

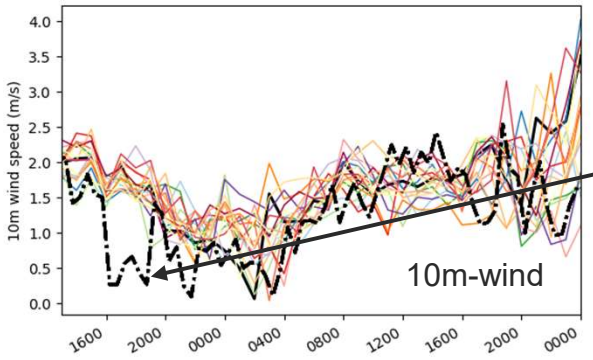
- What value do ensembles give us over deterministic systems in terms of forecasting fog?
- Can we use the ensemble to learn more about how we model fog?
- Can we use the SOFOG data to improve our ensemble set-up?
- How sensitive are the results to horizontal resolution? Does a high resolution ensemble give us any benefit over our current resolution?
- What are the challenges of using ensemble output to forecast fog. How can we best present the output for use by operational meteorologists?

Case study: 29th – 30th October 2019

Comparison of ensemble data with observations at the UKMO site

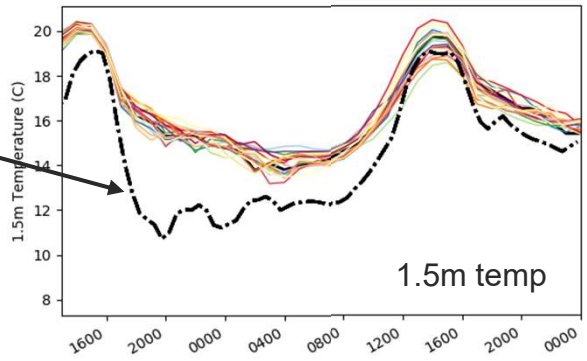
Only a few members give any indication of fog. None of the members capture the prolonged period of low visibility

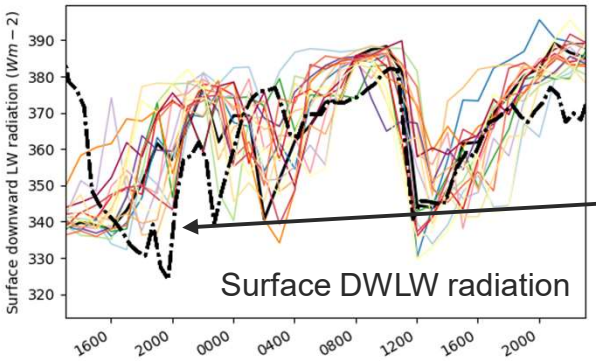




None of the ensemble members capture the drop in wind speed in the late afternoon / early evening

The ensemble is too warm and misses the surface cooling that occurs a few hours before the onset of fog





The surface downward LW radiation in the ensemble is slightly higher than the observations around the time that the observations show a rapid cooling at the surface

Time →

2.2km Ensemble

00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17

Observations are shown by the black dashed line

LIAISE: Land surface Interactions with the Atmosphere over the Iberian Semi-arid Environment

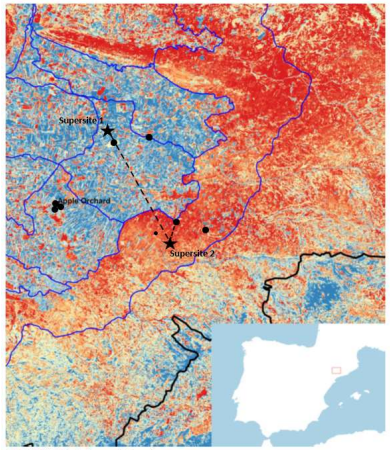
LIAISE is an international observational field campaign to better understand the impact of human activity on the water cycle in terms of land-atmosphere-hydrology interactions in a semi-arid environment.

Field deployment located in the Ebro river basin, Catalonia region (north-east Spain), which commenced in April 2021.

Co-located long term surface observations
- Two super-sites with 50m masts
- Eddy-covariance flux stations (7 locations)
- Heterogeneous land cover
- Irrigated and natural sites

2 week Special Observing Period (SOP) in July 2021
- Maximum irrigation/natural contrasts.
- Co-ordinated and co-located observations between irrigated and natural areas: surface & sub-surface measurements, remote sensing platforms, and boundary layer.

A series of community modelling experiments will be designed as part of the GEWEX (Global Energy and Water cycle Exchanges) activities, several of which will led by the Met Office.



SENTINEL2 Land Surface temperature - Courtesy : H. Nieto, IRTA

Jenn Brooke, Met Office

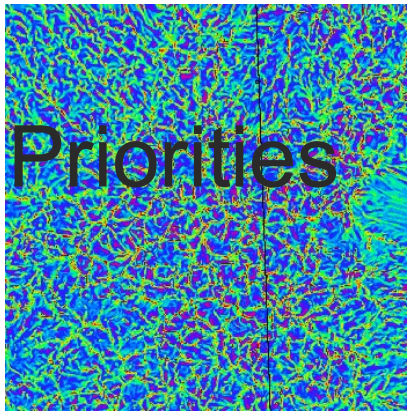
Urban-Scale Modelling Research Project Plan 2021-2026

- Deliver an enhanced Urban-scale modelling capability (an atmospheric model with grid lengths in the range 25-300m) for application across timescales
- Work with stakeholders to understand requirements
- Model development
- Assess grid resolution vs configuration complexity, domain size and ensembles
- Model evaluation

Humphrey Lean, Met Office

Met Office

Urban-Scale Model Development Priorities



- Urban Surface
  - Improving the surface energy balance in MORUSES
  - Development of a better representation of anthropogenic fluxes.
  - Development of a vertically distributed urban canopy.
- Turbulence
- Convection
- Cost

Cost of Urban-scale models.

- These models are *very* expensive!
- Work to minimise cost through configuration etc.
- Emphasis of project is on developing capability and understanding resolution trade-offs for different applications.

Configuration	Tstep	levels	Npts factor	**Npt facs*tstep fac**
1.5km (UKV)	60s	70	1.0	**1.0**
300m LM	12s	70	25.0	**125**
100m	3s	140	450	**9000**
55m	1s	140	1487	**87,480**
25m	1s	140	7200	**432,000**

Approx. relative costs of models for same area and run length based on current research configurations.

The path to high resolution

Urban-scale Modelling Key activities.

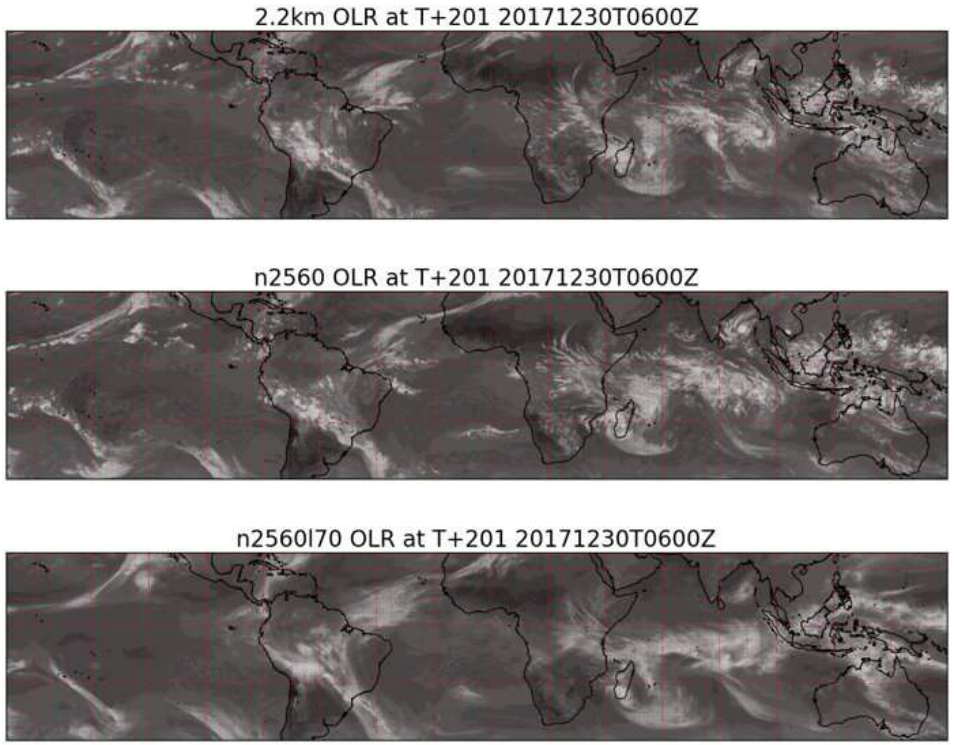
- 300m London Model upgrade (PS49).
  - Tests through UK testbed.
- Paris 2024 RDP *focus on 100m scale forecasting*
  - Model Intercomparisons (Heat, convection).
  - Obs campaign 2022 (includes OBR lidar etc).
- WesCon *Wessex Convection Experiment 2023.*
  - *FAAM, OBR surface obs, Chilbolton, others..*
- Collaboration with Reading on Urban surface and turbulence.
  - *WCSSP, FUTURE, ASSURE, Urbisphere etc..*
- Focus on Urban Heat *climate services, NSWWS*
- Focus on Convection, Urban winds *CAA.*

Humphrey Lean, Met Office

Met Office

K-Scale – Large domain kilometre grid-scale predictions

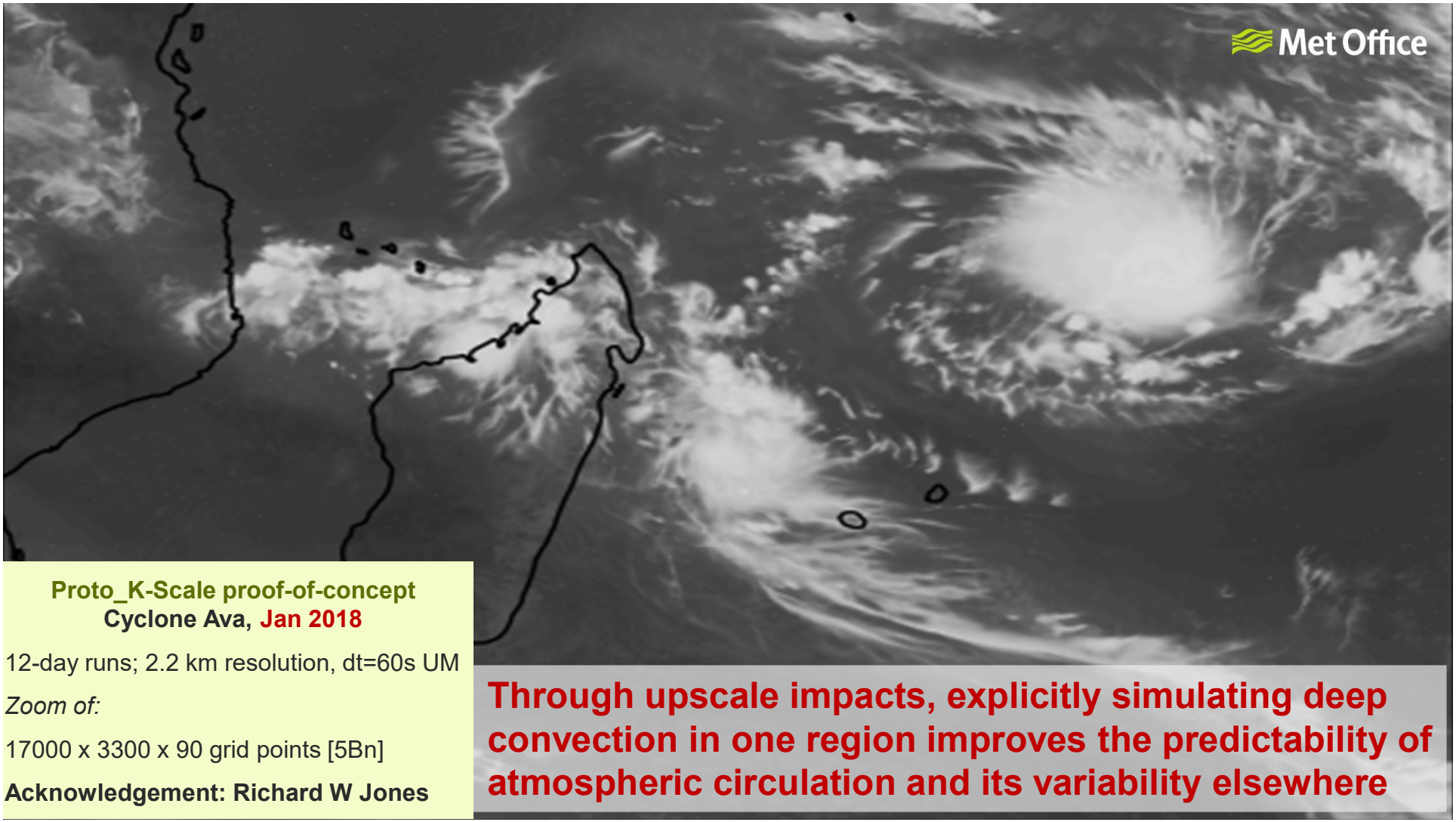
- The aim of K-Scale is to test the hypothesis that through upscale impacts, explicitly simulating deep convection in one region improves the predictability of atmospheric circulation and its variability elsewhere.
- Can global model biases associated with current-generation systems at ~10km resolution be reduced through running at ~1km and limiting dependence on some parameterisations?
- Current K-Scale simulations are a time lagged ensemble of 12-day simulations with three science configurations running on the same large domain.



2.2km explicit conv.

N2560 explicit conv.

N2560 param. conv.



Proto_K-Scale proof-of-concept
Cyclone Ava, Jan 2018

12-day runs; 2.2 km resolution, dt=60s UM

Zoom of:

17000 x 3300 x 90 grid points [5Bn]

Acknowledgement: Richard W Jones

Through upscale impacts, explicitly simulating deep convection in one region improves the predictability of atmospheric circulation and its variability elsewhere

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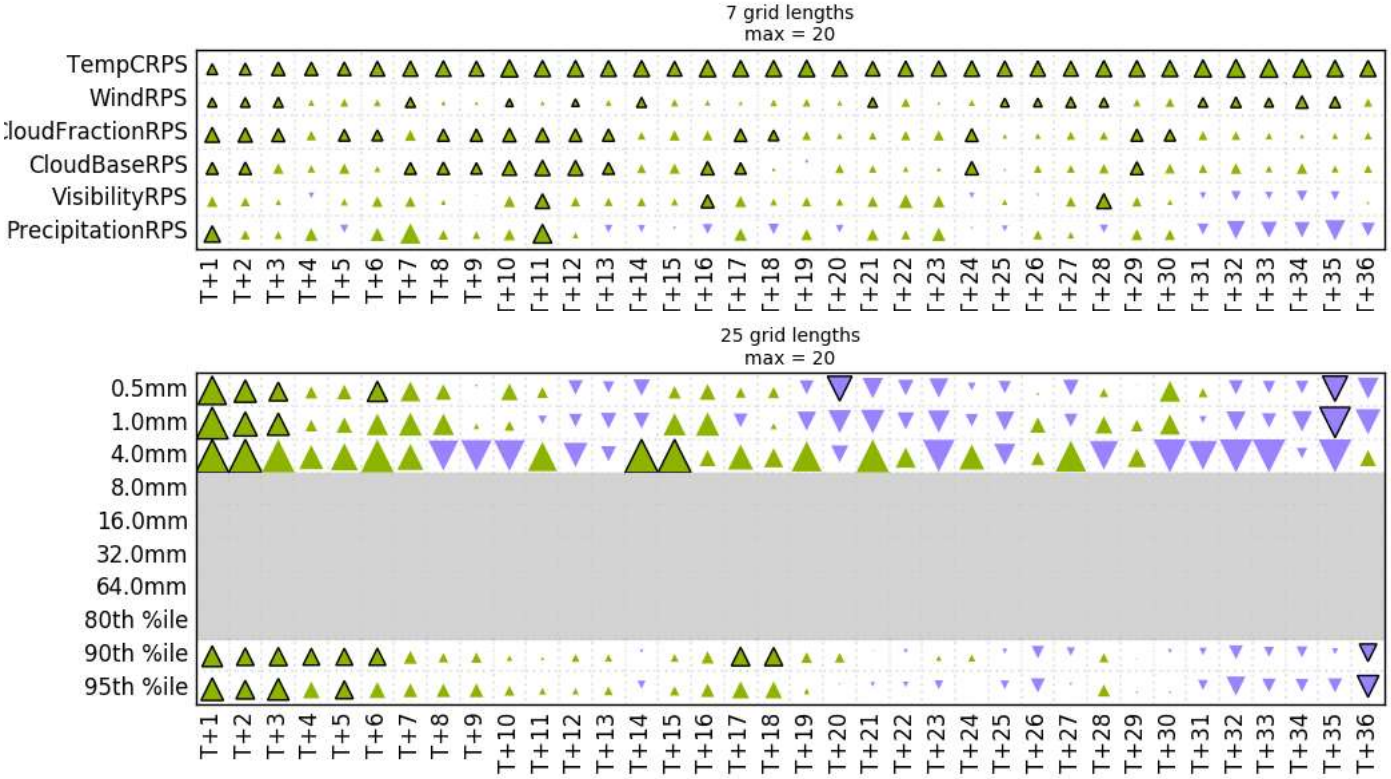
See talk by Marco Milan on Wednesday morning

PS45

PS45: to go operational in Feb 2022

- Time-varying SST from AMM15 to replace fixed OSTIA SST
- Large-scale Blending to import large-scale information from global analysis
- Direct assimilation of radar reflectivity
- Satellite changes
- Miscellaneous observation changes
- UM version upgrade to vn11.9

PS45 UKV (PS45 driven) Spring Hinton (top), FSS (bottom)



Bruce Macpherson, Gareth Dow, Met Office

Met Office

See RAL3 talk by Anke Finnenkoetter on Thursday morning

PS46, PS47 and PS48

PS46: April to July 2022

- Port of models to new HPC

PS47: November 2022 to February 2023

- Upgrade suites to Cylc8 (technical upgrade)

PS48: June to November 2023

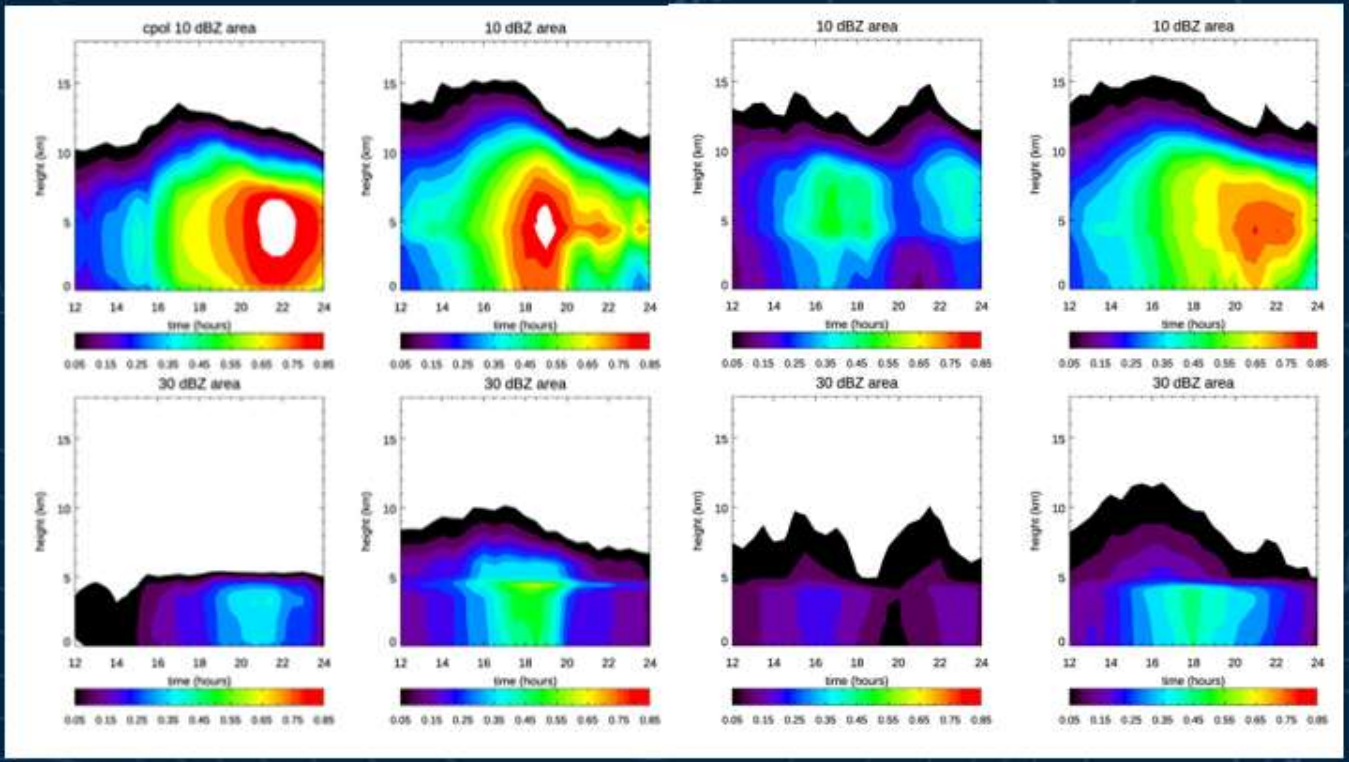
- RAL3 science upgrade
- Vertical resolution to 90 levels

Australian Government
Bureau of Meteorology

Evaluation of the size of the cloudy & raining area - tropical MCS

Figures show the fraction of the radar area covered by reflectivities > 10 (top) 30 (lower) dBZ

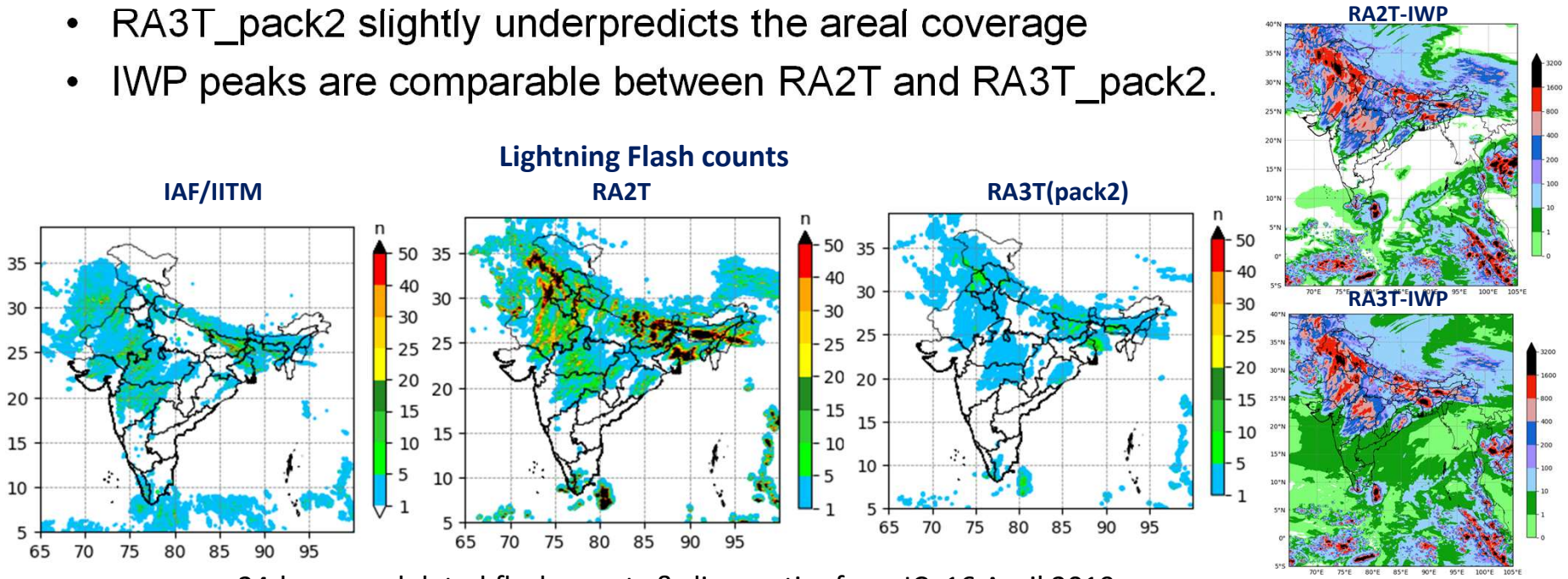
obs RAL2T RAL3T1 RAL3T2



Charmaine Franklin, BoM

NCMRWF - Lightning diagnostics summary

- RA2T peak values are overpredicted compared to observations while RA3T is slightly under predicted (better match for peak values) for relatively intense activities.
- RA3T_pack2 slightly underpredicts the areal coverage
- IWP peaks are comparable between RA2T and RA3T_pack2.



24-hr accumlulated flash counts & diagnostics from IC: 16 April 2019

Saji Mohandas, NCMRWF

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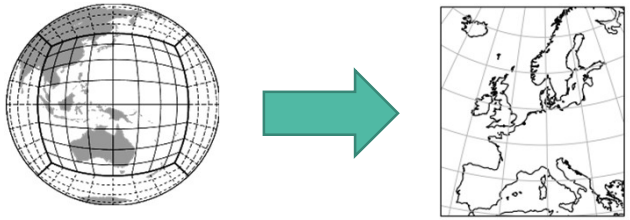
LFRic LAM developments

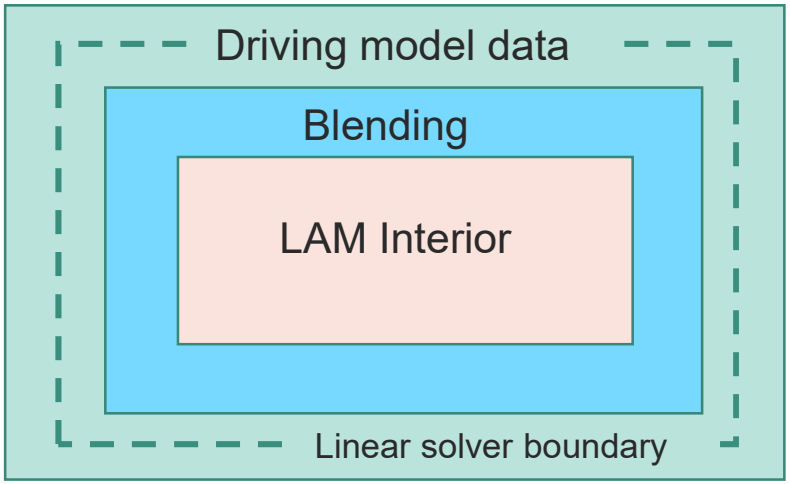
Aim: Develop a limited-area version of LFRic, using lateral boundary conditions (LBCs) such that the model can be nested in a driving model.



LFRic Global

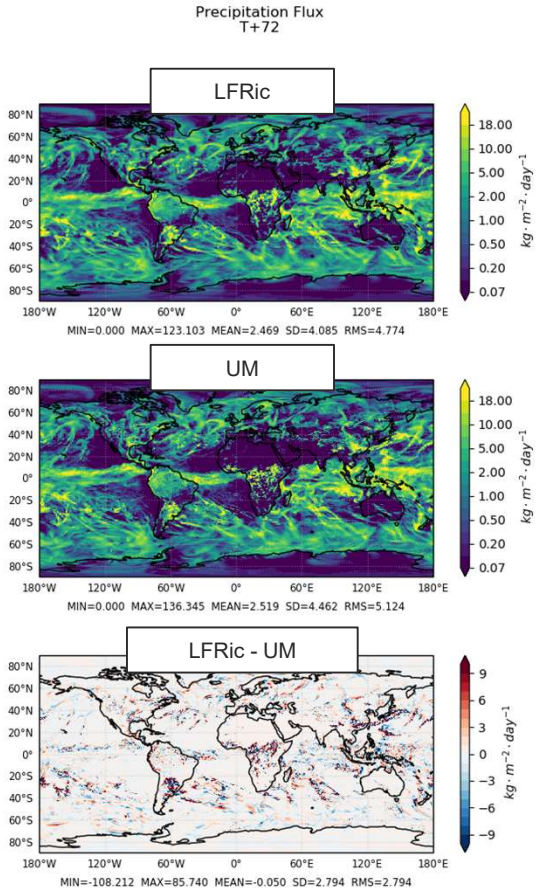
LFRic LAM

- Similar approach to the UM
- One-way nesting



LFRic LAM developments

- Up until recently, attention has focused on the global implementation of LFRic and dynamics-only idealized testing of a Limited-Area capability
- Global accuracy is good.
- Strategy for boundary conditions in FE Gungho dynamical core appears to be correct.



Christine Johnson, Ben Shipway, Met Office

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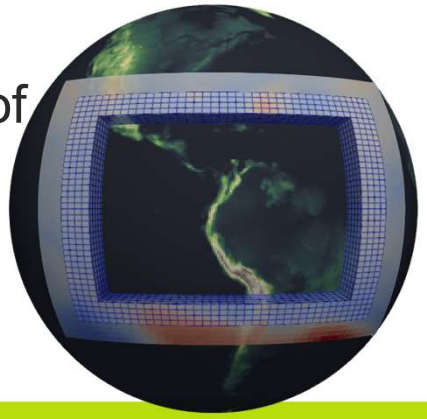
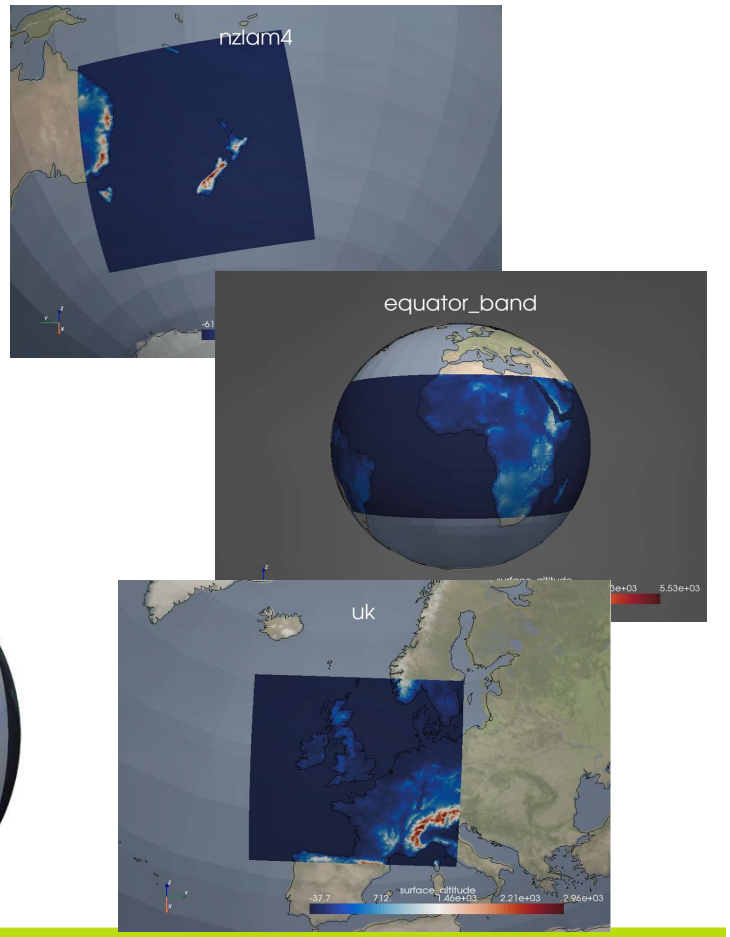
LFRic LAM developments

- Recent work has developed the tools to generate the necessary ancillary data and lateral boundary conditions from the driving model
- Initially we use the UM for the driving model data.
- We are now in the process of setting up the model to make use of these data.





Further information…

Tuesday	Wednesday	Thursday	Friday
Anne McCabe	**Marco Milan**	**Marion Mittermaier**	**Marion Mittermaier**
Towards an improved understanding of ensemble spread in MOGREPS-UK.	Data assimilation developments at the Met Office.	New perspectives on verifying convective-scale NWP lightning forecasts	When the rain falls between the gauges. How good is radar really at telling you what's happening on the ground?
Nigel Roberts		**Anke Finnenkoetter**	
IMPROVER – the next generation NWP probabilistic post-processing system at the Met Office.		Recent progress in Met Office RAL physics.	

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Thank you for listening!

Any questions?