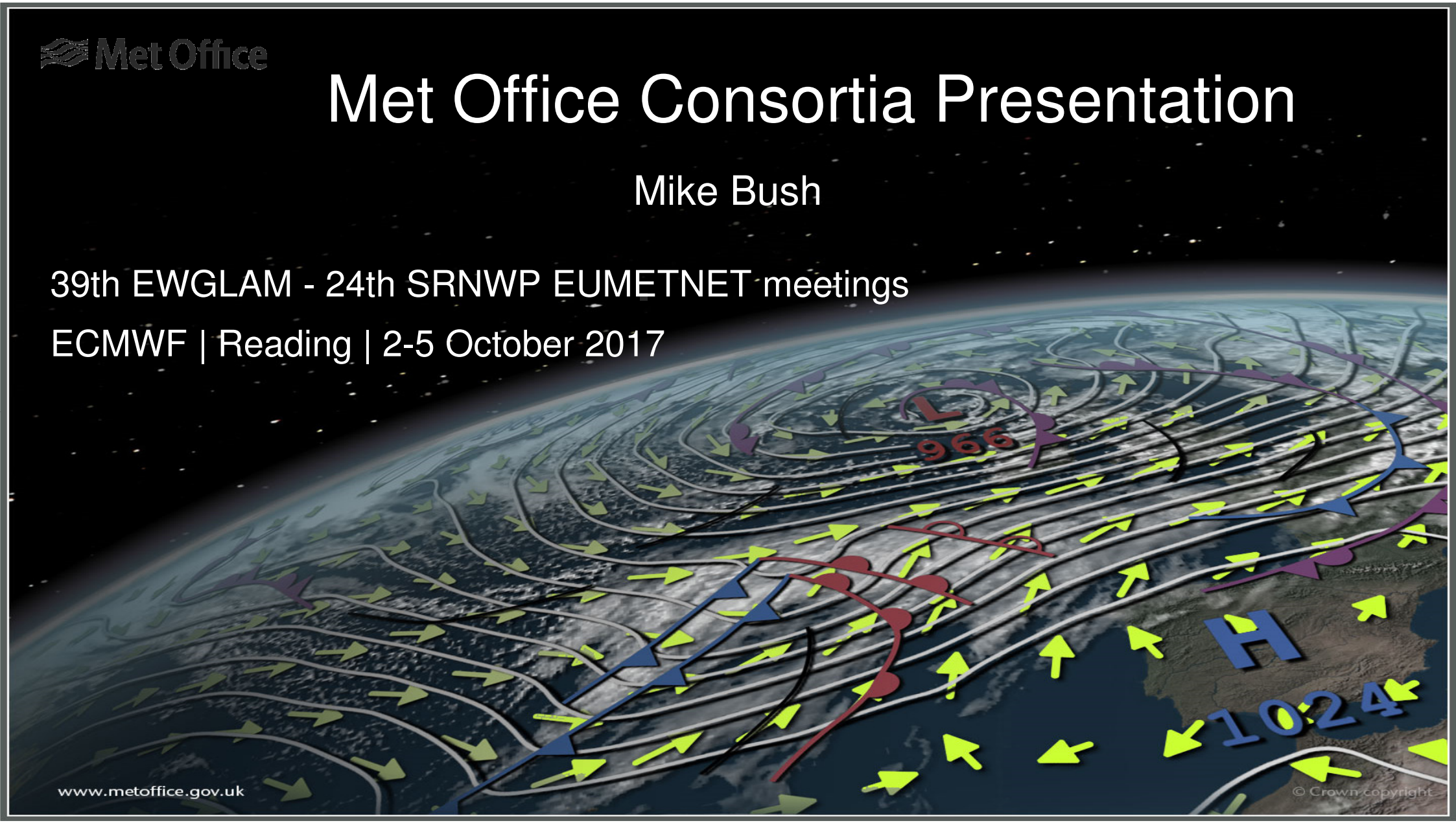
Met Office Consortia Presentation

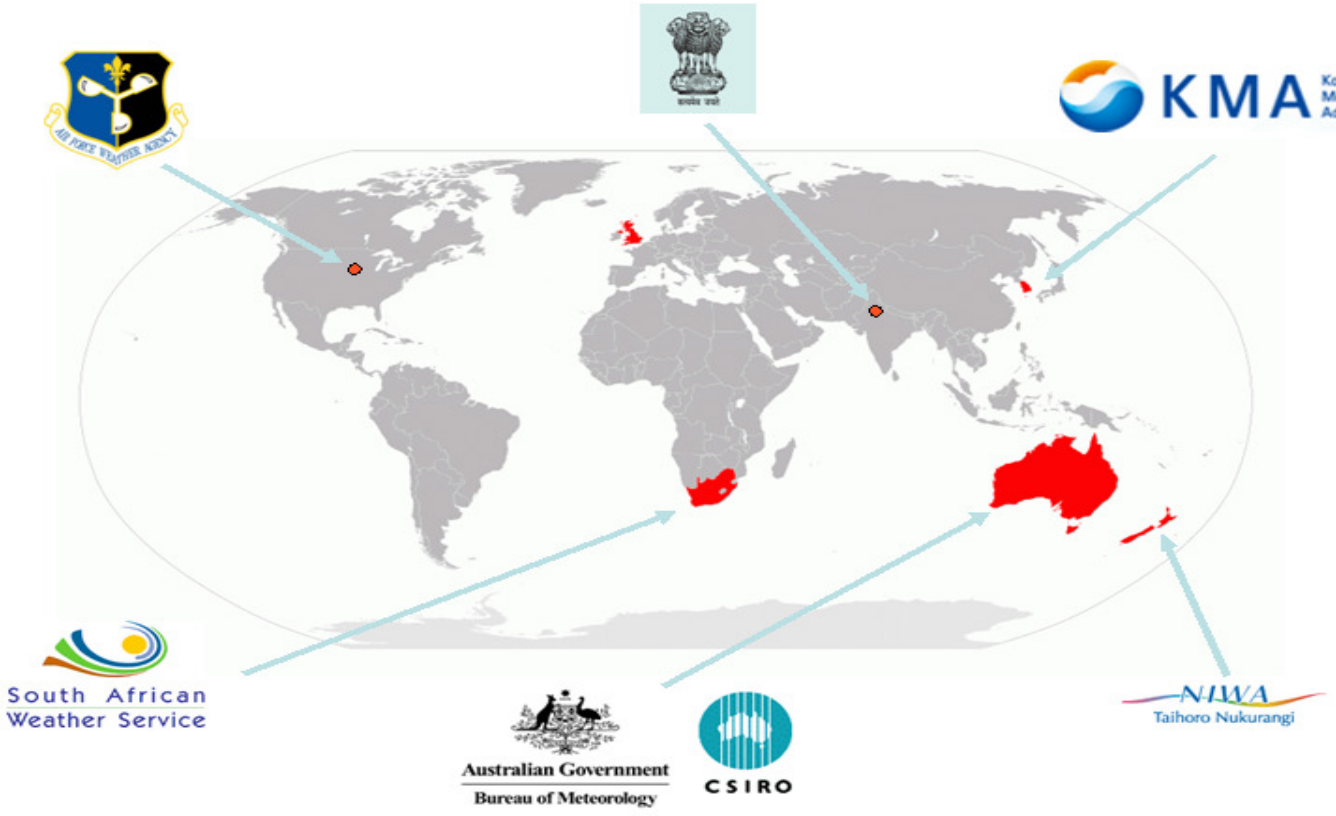
Mike Bush

39th EWGLAM - 24th SRNWP EUMETNET meetings

ECMWF | Reading | 2-5 October 2017



International UM partnership: Operational users 2017



People changes

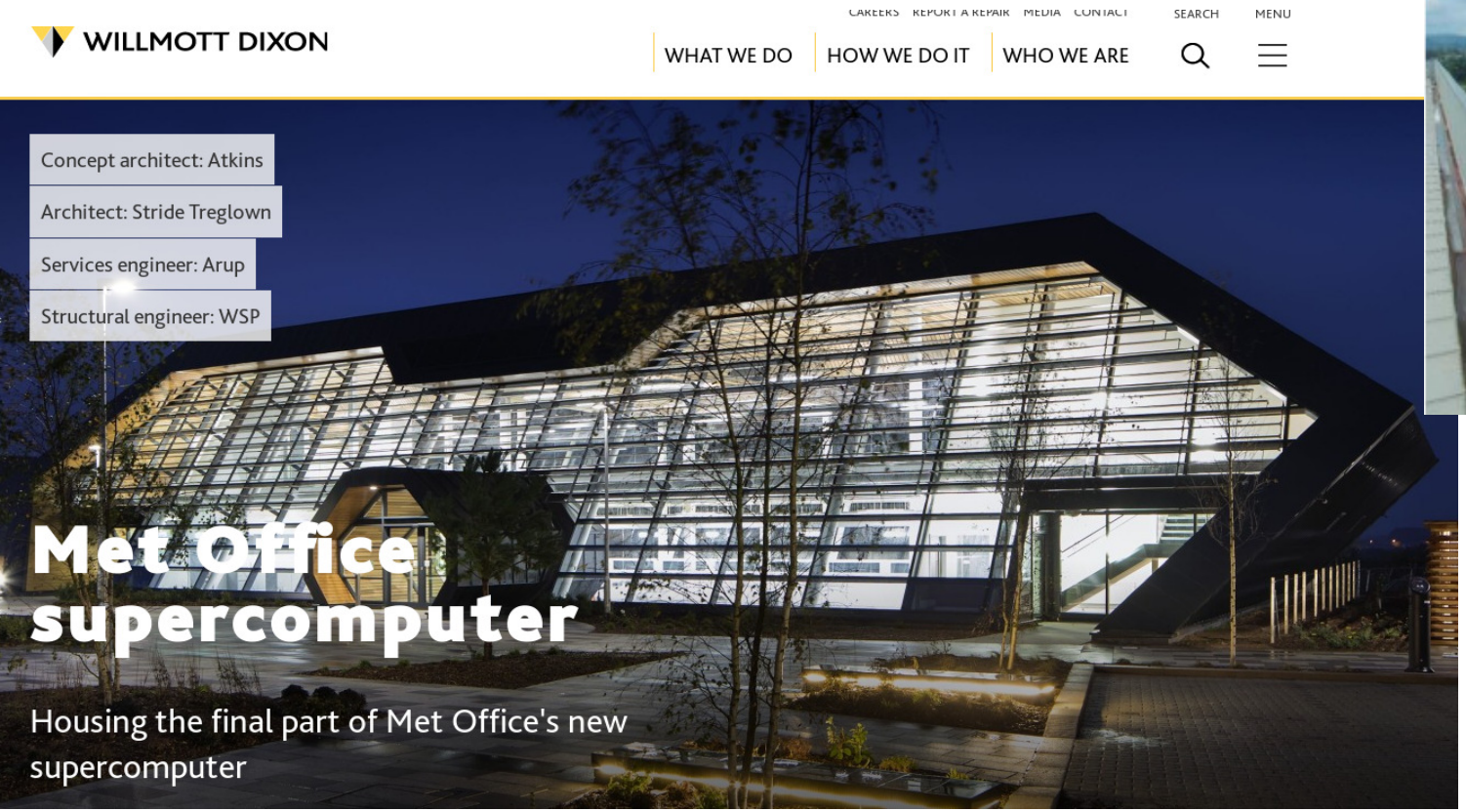
• Professor Stephen Belcher is now the Met Office Chief Scientist, taking over from Professor Julia Slingo who retired at the end of 2016 after a long and distinguished career in climate modelling and research.

• Dr Andrew Brown is now ECMWF's Director of Research

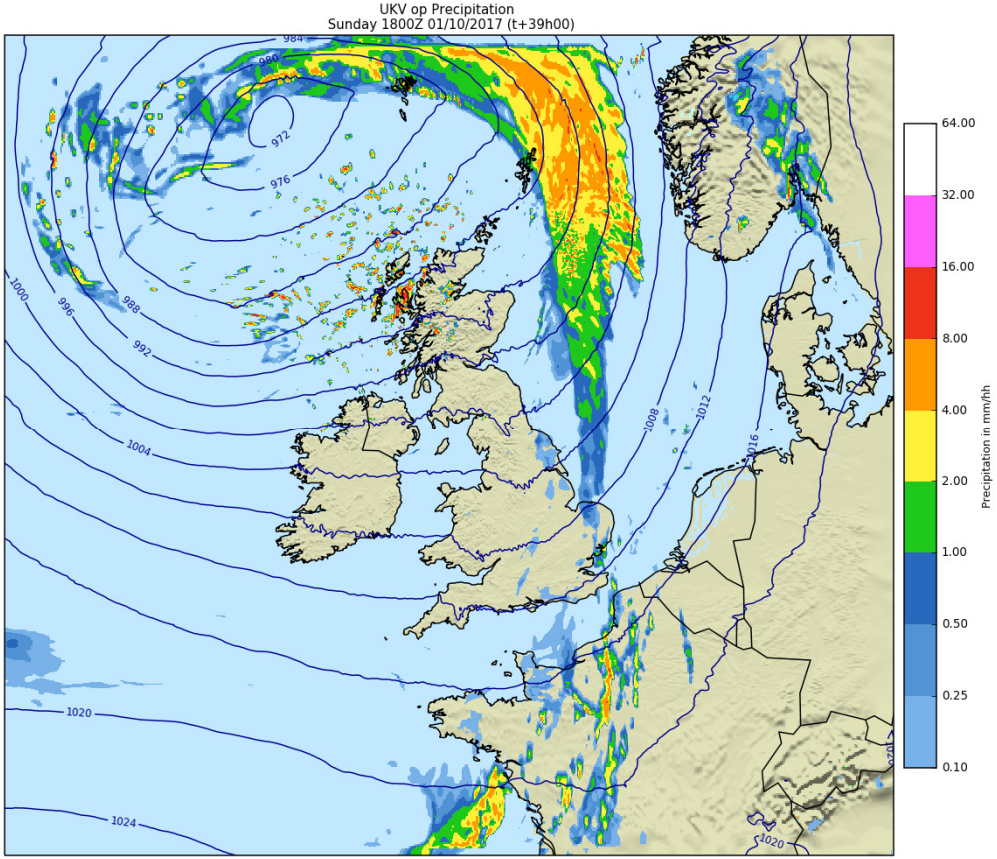
• Simon Vosper is now Director of Meteorological Science, working with on the Science strategy and its implementation.

• Keith Williams now leads APP (Atmospheric processes and parametrization)

HPC Phase 1c: new IT Hall located at Exeter Science Park.

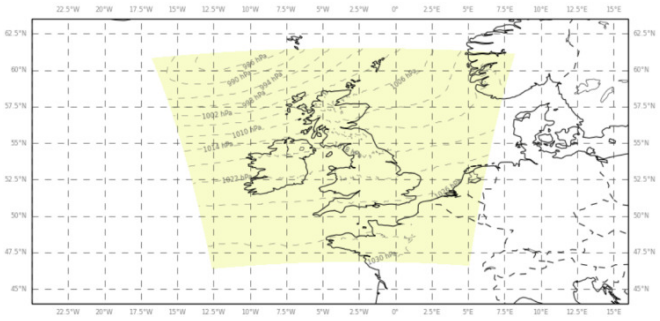


Operational Changes: PS38



- PS38 went live on 08th November 2016
- UKV/MOGREPS-UK enlarged domain
- Increase in forecast length from T+36 to T+54 for all UKV/MOGREPS-UK runs
- UKV 03Z & 15Z runs increased out to T+120

Old domain

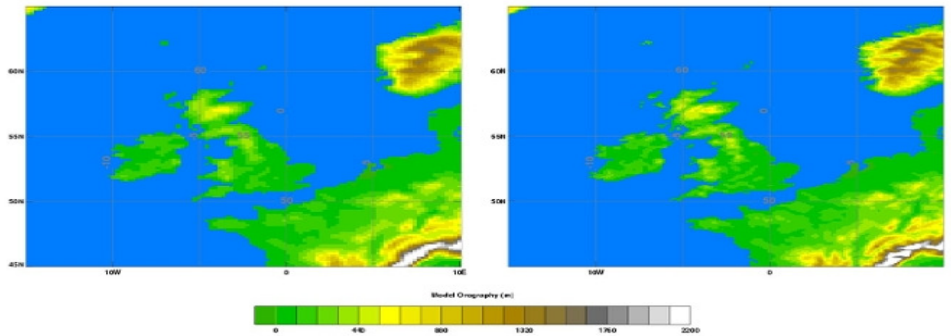


Operational Changes: PS39 (Global)

- PS39 went live on 11th July 2017.

- Horizontal resolution increase for Global model (both deterministic and ensemble)

Global model land-sea mask and orography for the 17km model (left) and 10km model (right).



- Deterministic model grid-spacing reduced from 17km to 10km.

- MOGREPS-G grid-spacing reduced from 33 km to 20 km.

- Increase in the number of ensemble members generated every 6 hours from 12 to 18. With time-lagging, this allows us to produce ensemble forecasts with 36 rather than 24 members.

Operational Changes: PS39 (U.K model)

- Hourly cycling 4D-Var replacing 3 hourly 3D-Var
- See talk by Marco Milan in the DA session on Tuesday (10:00 to 10:20)
- ZLF Moisture conservation change to the UM. Conservation of mass is not intrinsic in SL advection schemes, but somehow needs to be restored. Otherwise there can be spurious generation of increments to rain water path and hence precipitation.
- See Zerroukat et al for more details:


QUARTERLY JOURNAL OF THE ROYAL METEOROLOGICAL SOCIETY

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Research Article

ZLF (Zero Lateral Flux): A simple mass conservation method for semi-Lagrangian based limited area models†

M. Zerroukat ✉, B. J. Shipway

Accepted manuscript online: 29 June 2017 Full publication history

DOI: 10.1002/qj.3108 View/save citation

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Future Operational Changes: PS40/41

- PS40 due to go live in November 2017

- Small mainly technical upgrade. DA changes include the assimilation of roadside visibility obs.

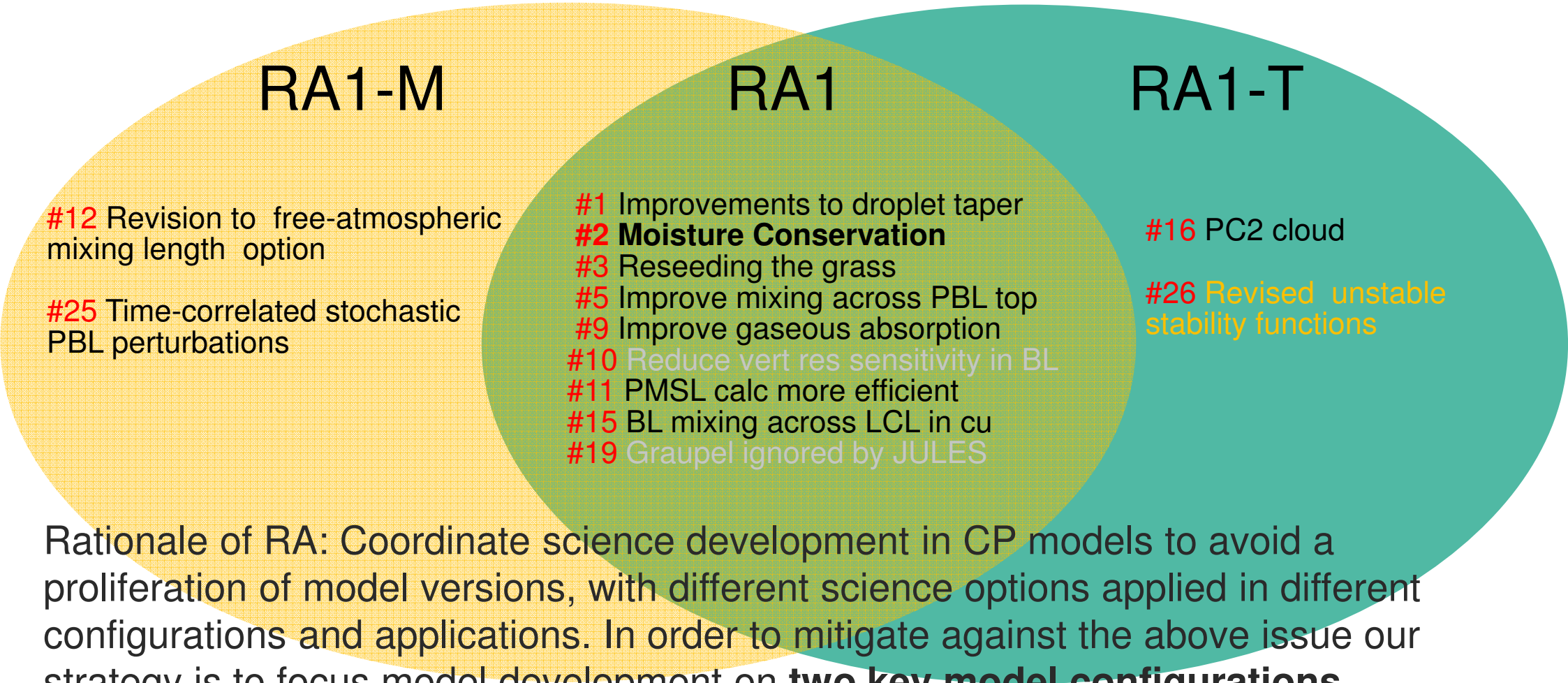
- MOGREPS-UK hourly ensemble demo suite see poster by Susanna Hagelin in the Predictability session on Tuesday (15:20 to 15:25)

- PS41 due to go live in Summer 2018 – DA changes to covariances and model changes to implement RA1.

- Beyond PS41 – PC2 cloud scheme and scale-aware convection scheme

Met Office

Prototype RA1, RA1-M (Mid-lat) & RA1-T (tropical)

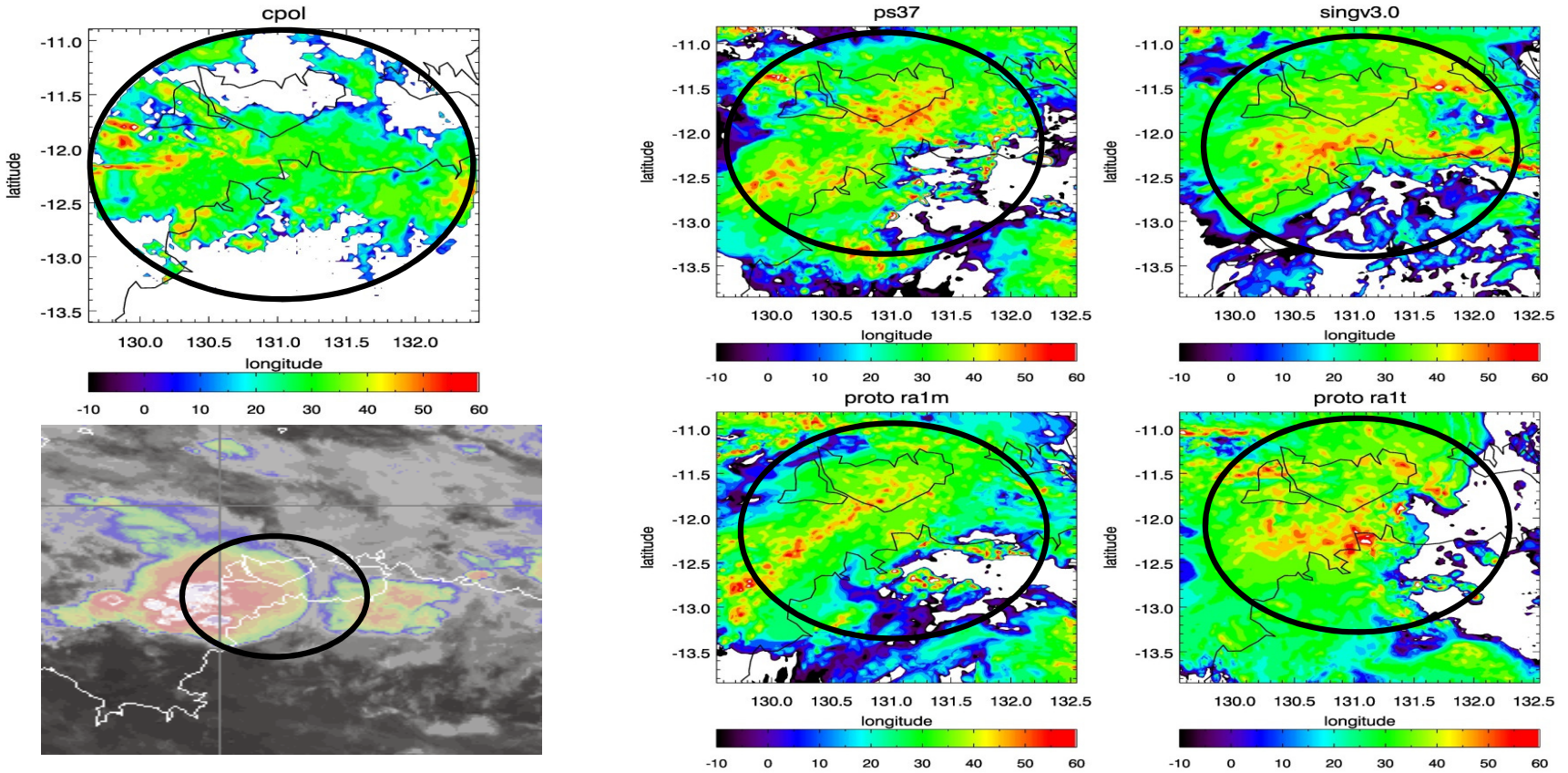


Rationale of RA: Coordinate science development in CP models to avoid a proliferation of model versions, with different science options applied in different configurations and applications. In order to mitigate against the above issue our strategy is to focus model development on **two key model configurations**

2nd Convective Scale Workshop, June 2017

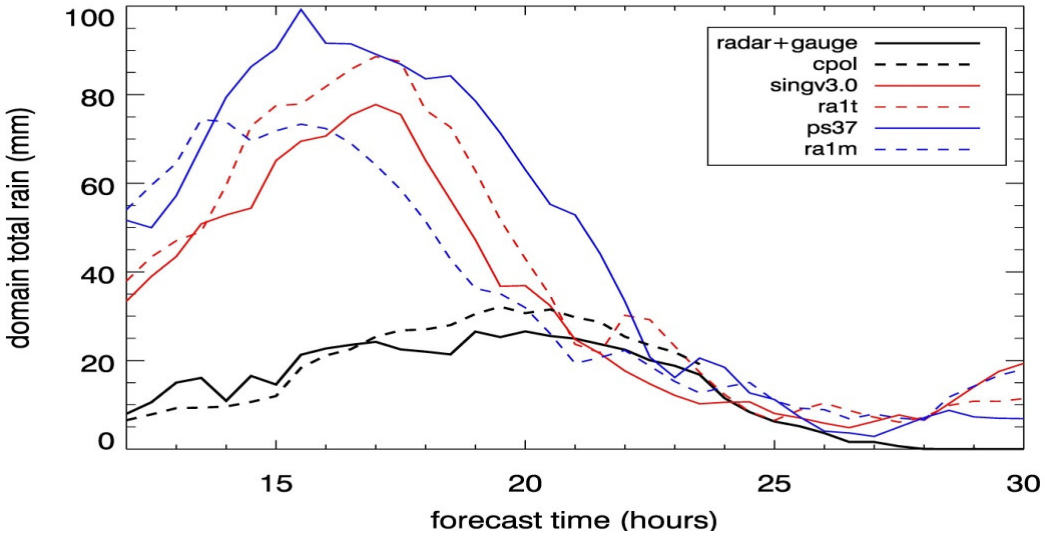
RA1 Evaluation

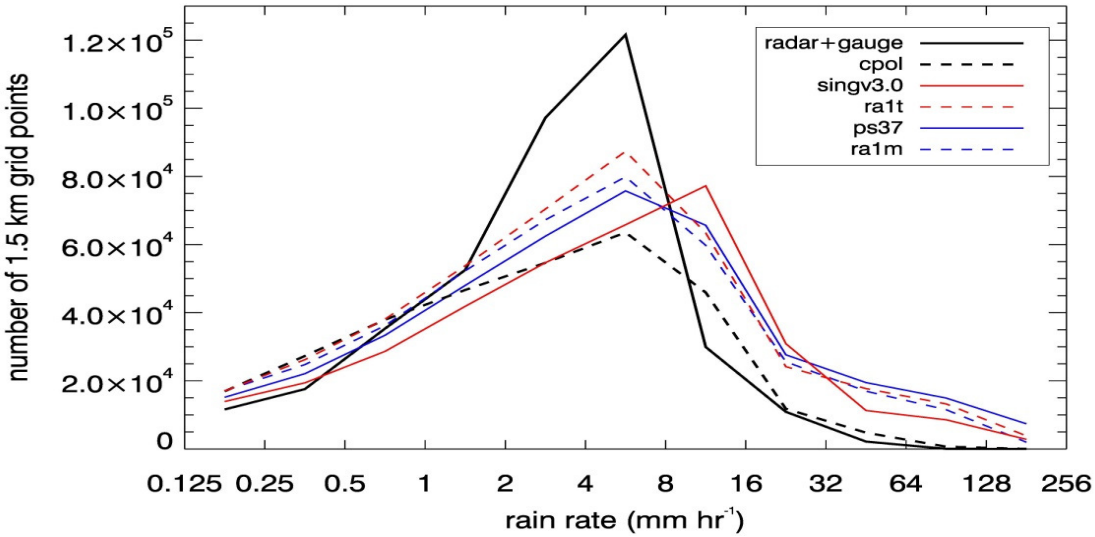
Darwin MCS: rainfall dBZ@17-18 UTC (Charmaine Franklin (BoM))

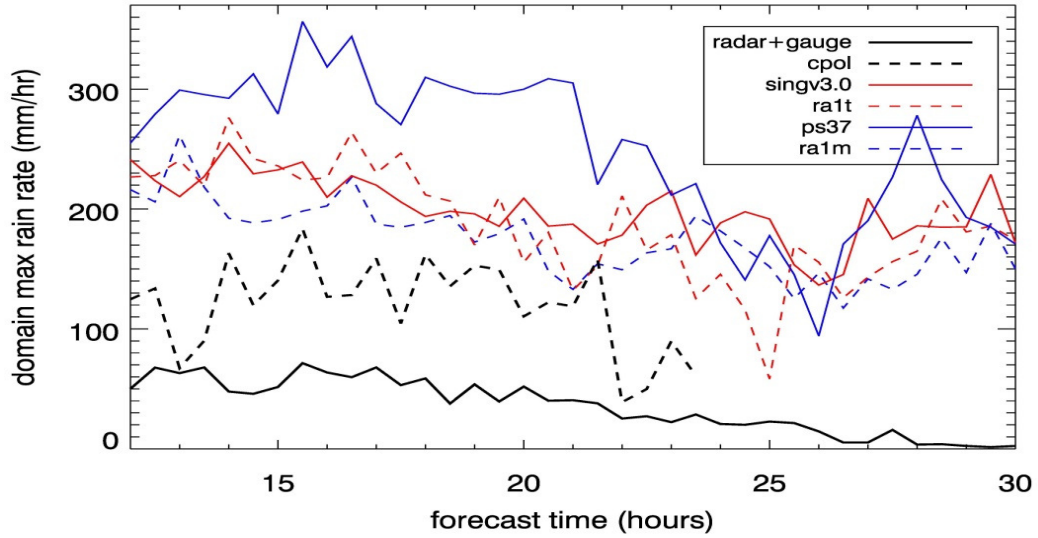


- Improved model evaluation should help us make better model development decisions see talk by Marion in the verification session on Thursday (1030)

Rainfall (slide courtesy of Charmaine Franklin (BoM))

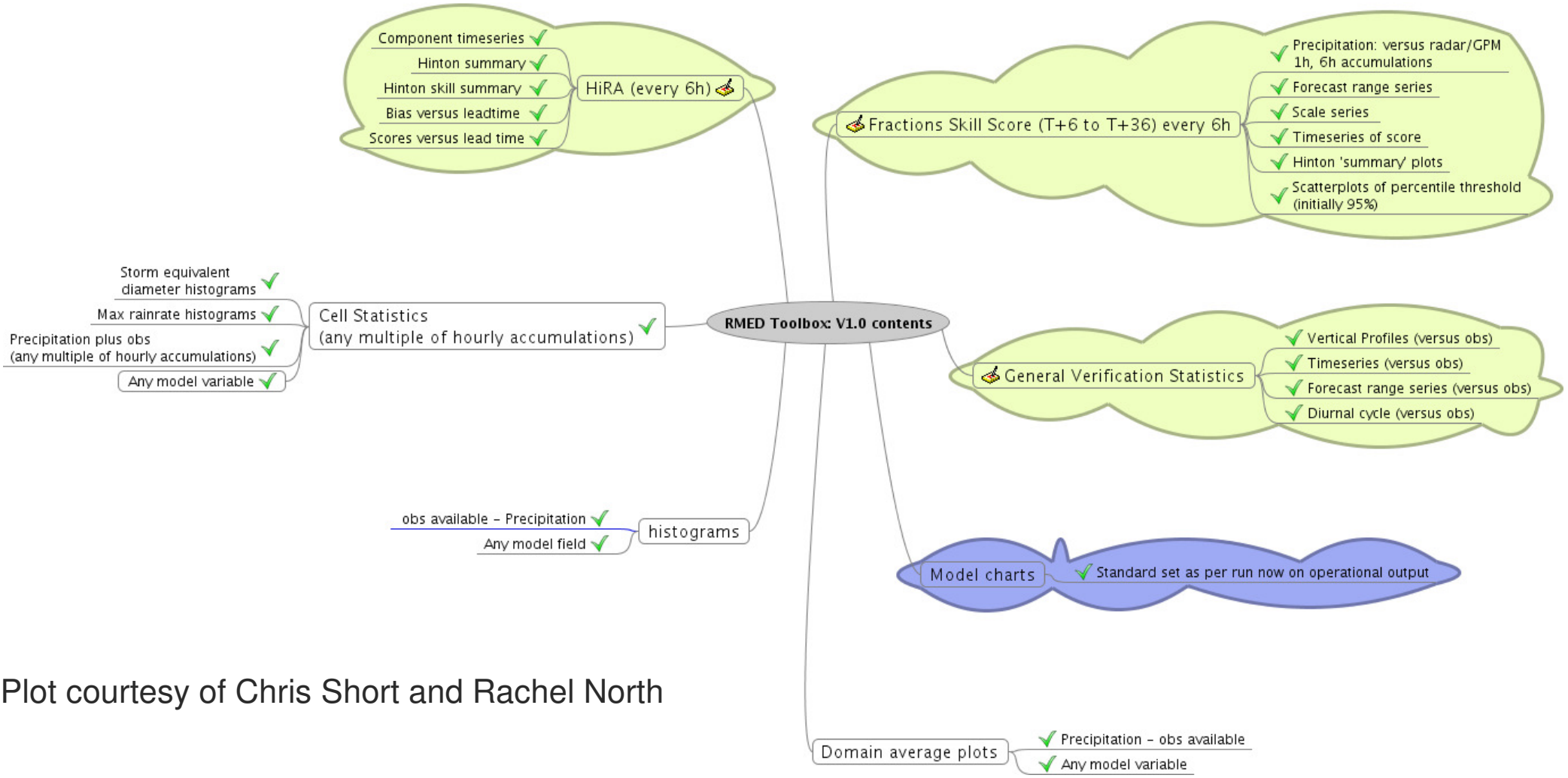






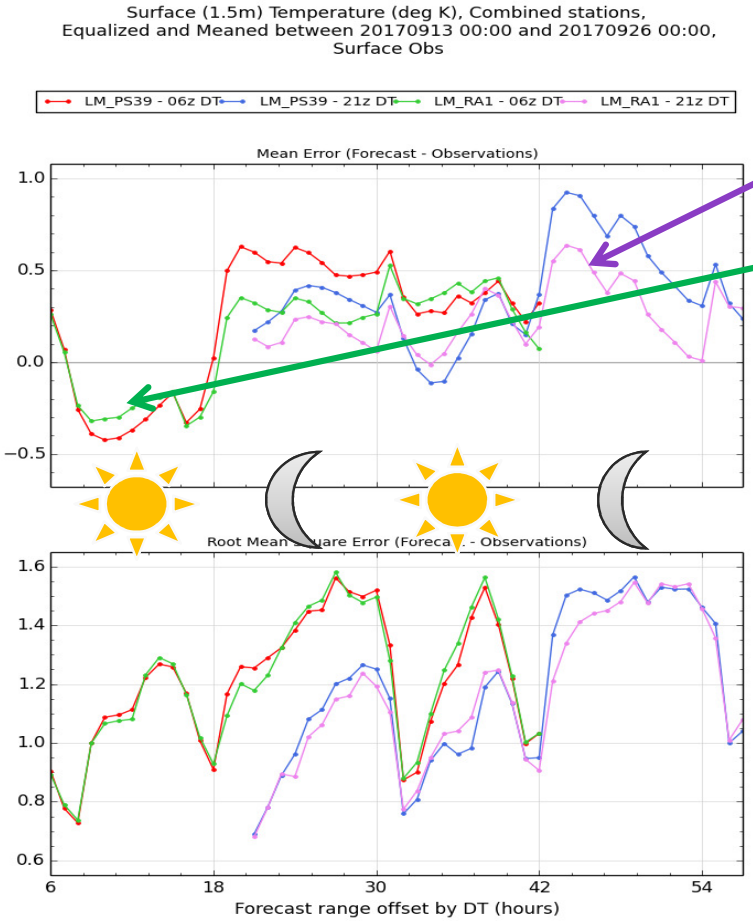
- All simulations produce too much rain
- This is due to convection initiating too early, particularly for mid-latitude configurations, and simulated system being larger
- Moisture conservation reduces maximum rain rates

RMED Toolbox



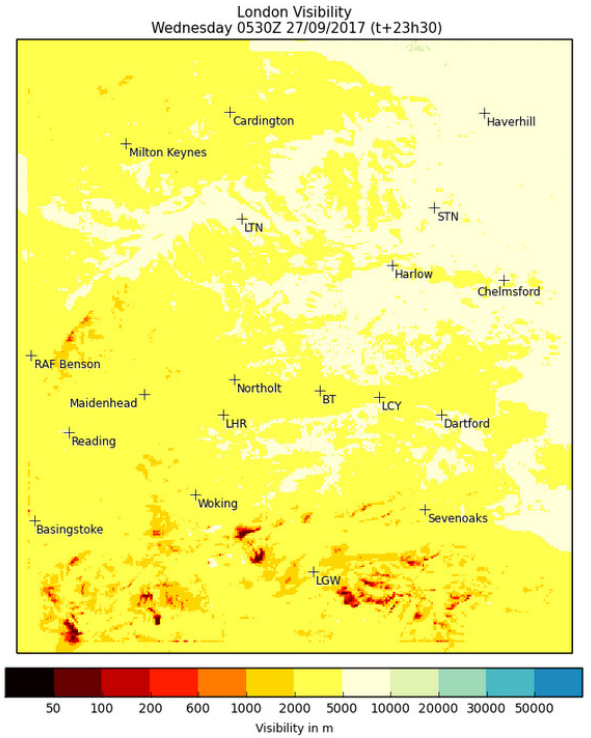
Plot courtesy of Chris Short and Rachel North

RA1 - Improvements to Screen temperature



Plot courtesy of Anke Finnenkoetter

- RA1 reduces night-time warm bias
- RA1 reduces daytime cold bias



- 333m London model – generally a less cloudy model than the UKV and with the additional detail in orography and land-use gives better fog guidance.

Convection WG Priorities

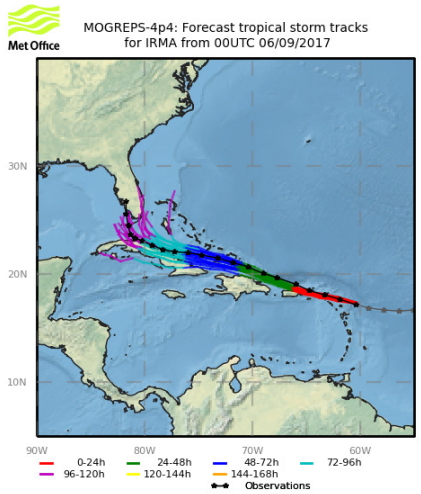
Convection WG Lead by Humphrey Lean and Stu Webster

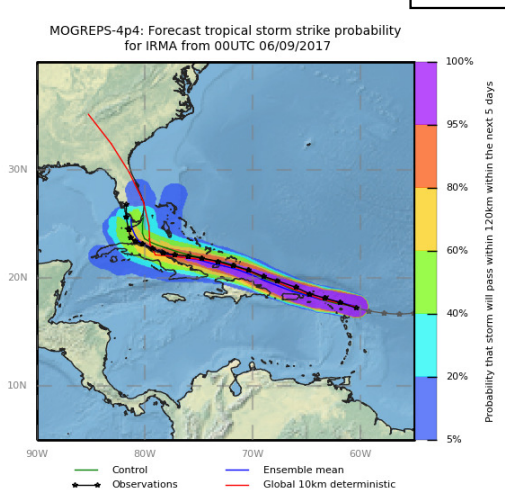
- 1. Testing of new model schemes in different parts of the world.
- 2. Use of radar data to look at rain amount, rain distribution and cell stats.
- 3. Studies to understand why model convection initiates too early in the tropics.
- 4. Comparisons of vertical velocities in models with observations from radar and aircraft.
- 5. Studies of predictability and the balance of large and small scale errors.
- 6. Studies to understand why there is too much convective rain in the models over land in the tropics.

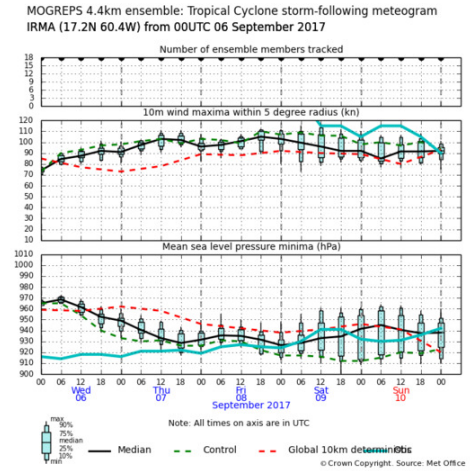
Hurricane Irma 06th Sep 00z run

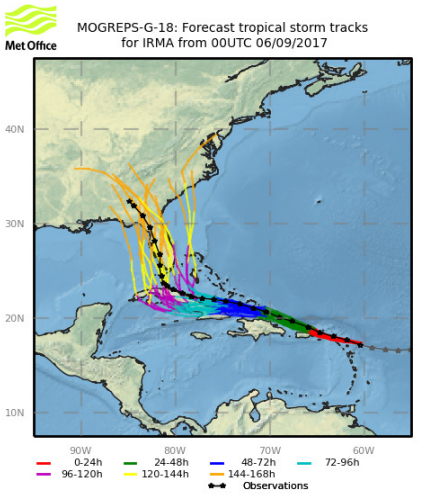
Plots c/o Helen Titley

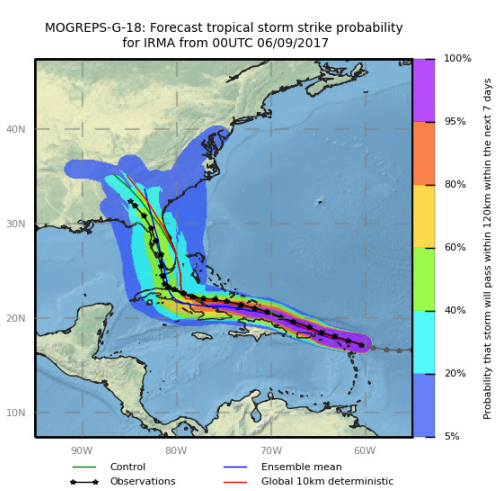
- Top = 5 day forecast for 4.4 km
- Bottom = 7 day MOGREPS-G forecast (18 not 36 members)
- 5v7 day forecast complicates direct comparison of plots.
- Actual track is overlaid in black
- Tracks broadly similar
- Propagation speed better in 4.4 km ensemble (compare location of purple lines)
- PMSL intensities in 4.4 km ensemble encompass observed value after T+48.
- “Usual” peak 10 m wind underestimation

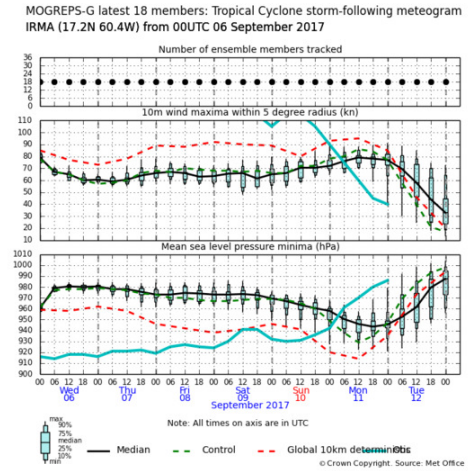










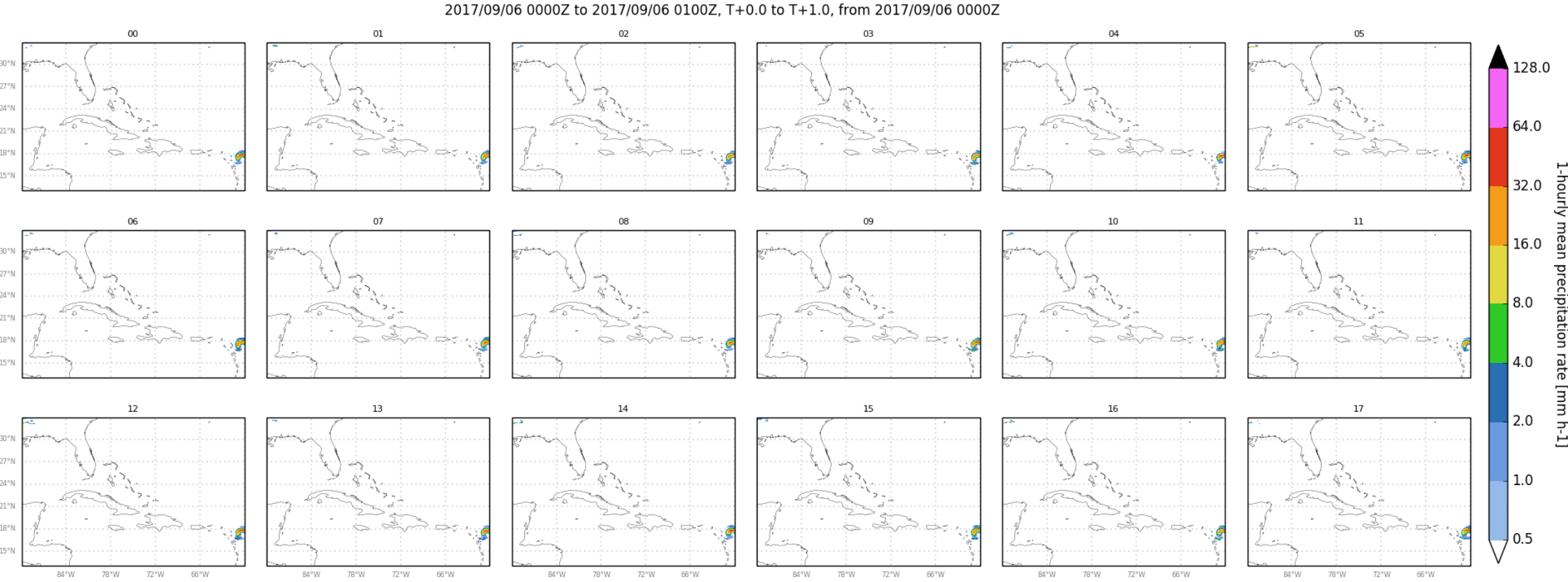


Hurricane Irma 06th Sep 00z run

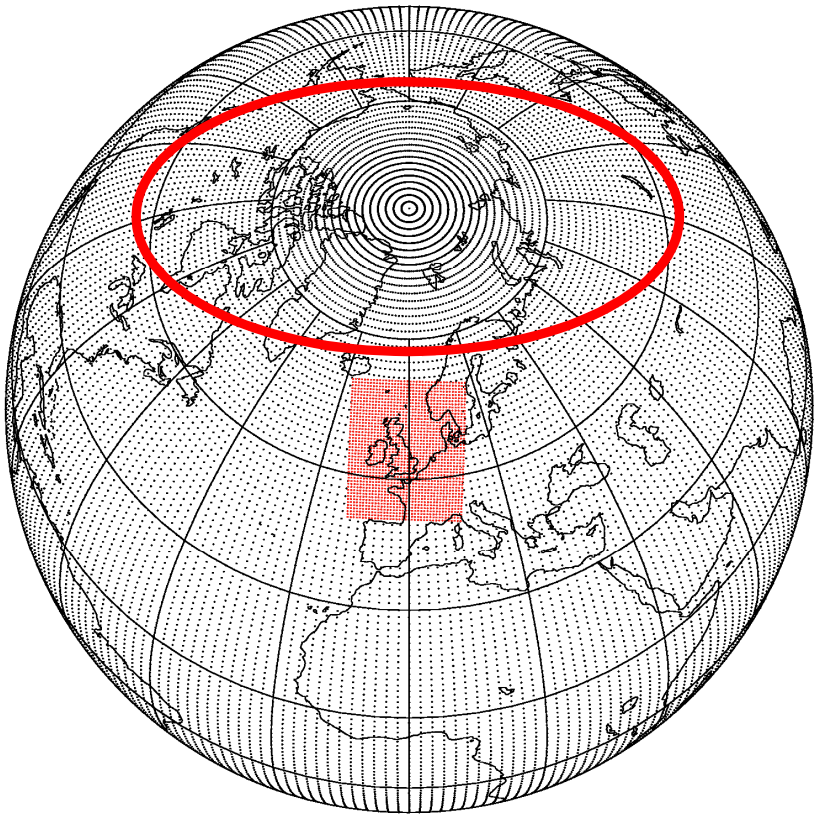
Animation courtesy of Stu Webster

Hourly precipitation rate for all 18 ensemble members.

SW Florida landfall occurred in reality at T+116



Met Office Preparing for Exascale: GungHo

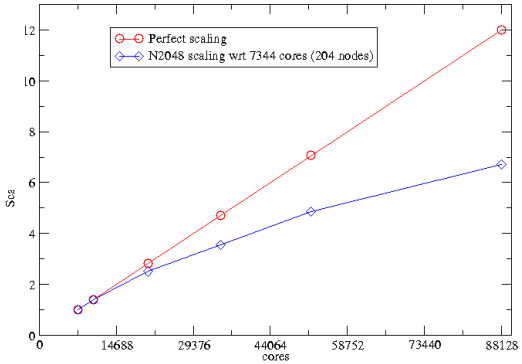


- At 10km resolution, grid spacing near poles = 12m!

Scalability = remove the poles!

⇒ which sport??

Football? Volleyball? Tennis?



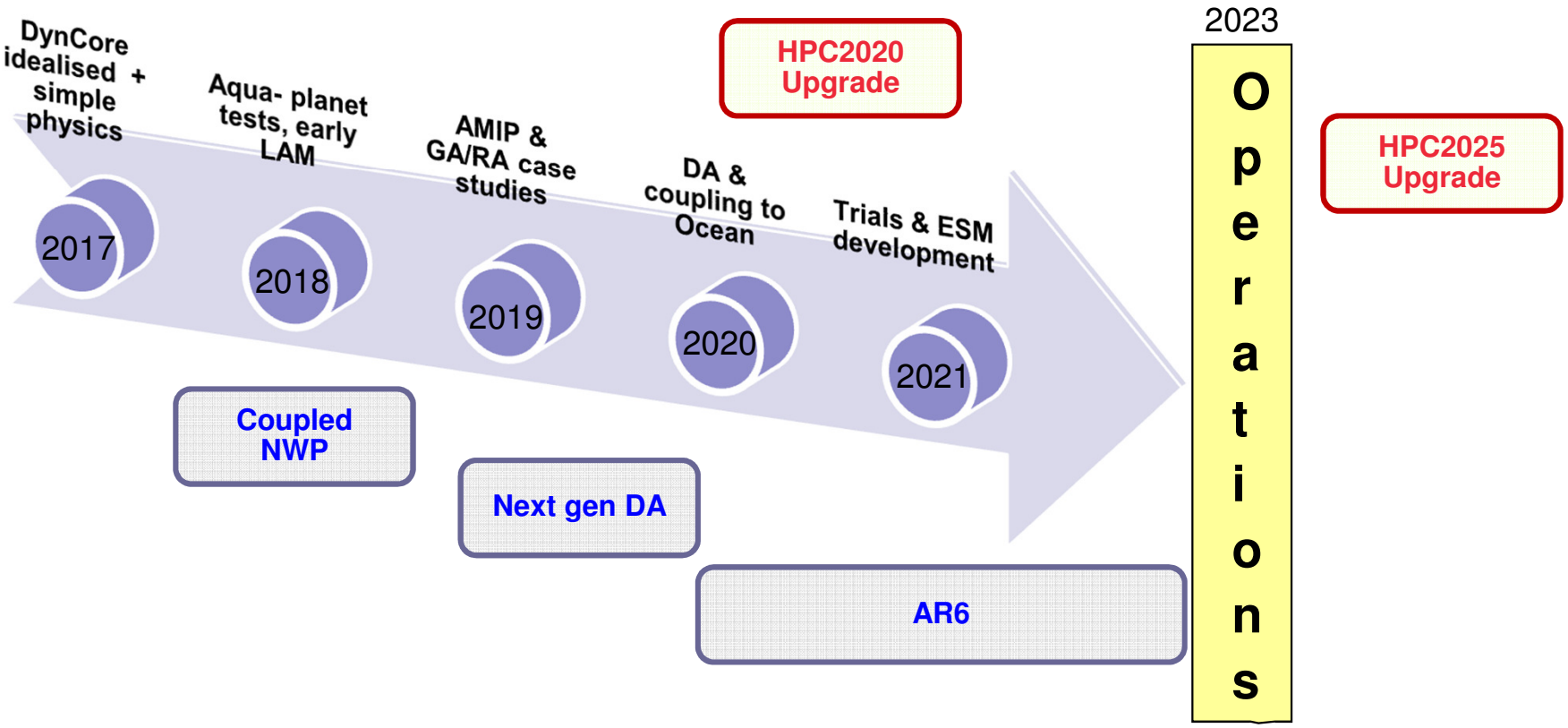
Aim of GungHo:
"To research, design and develop a new dynamical core suitable for operational, global and regional, weather and climate simulation on massively parallel computers of the size envisaged over the coming 20 years."
[Targeting mid-2020's HPC upgrade]

Challenges and Issues

- GungHo
  - Transport scheme & semi-implicit solver...
  - Does cubed-sphere mesh (or variant) deliver the goods?
  - What order of mixed finite-elements is required?
  - Coupling to the physics (science & technical aspects)...

- LFRic
  - Root & branch redesign of UM, involves DA, Ens, PP, downstream products etc etc
  - No off-the-shelf technical solutions meet all requirements
  - Resources conflict with business-as-usual work
  - Time and training to build up expertise

Preparing for Exascale. GungHo/ LFRic



Slide courtesy of Nigel Wood