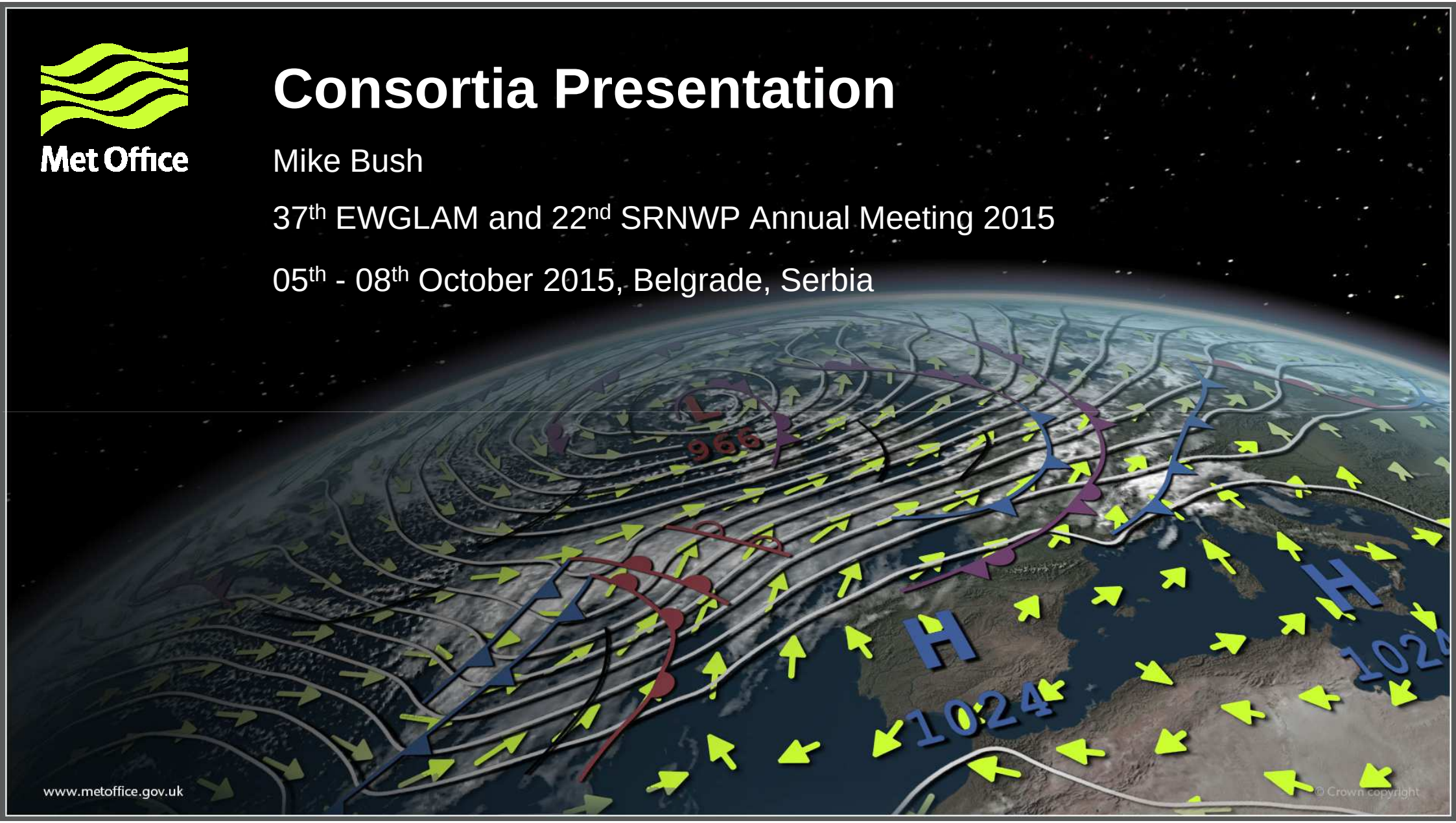
Consortia Presentation

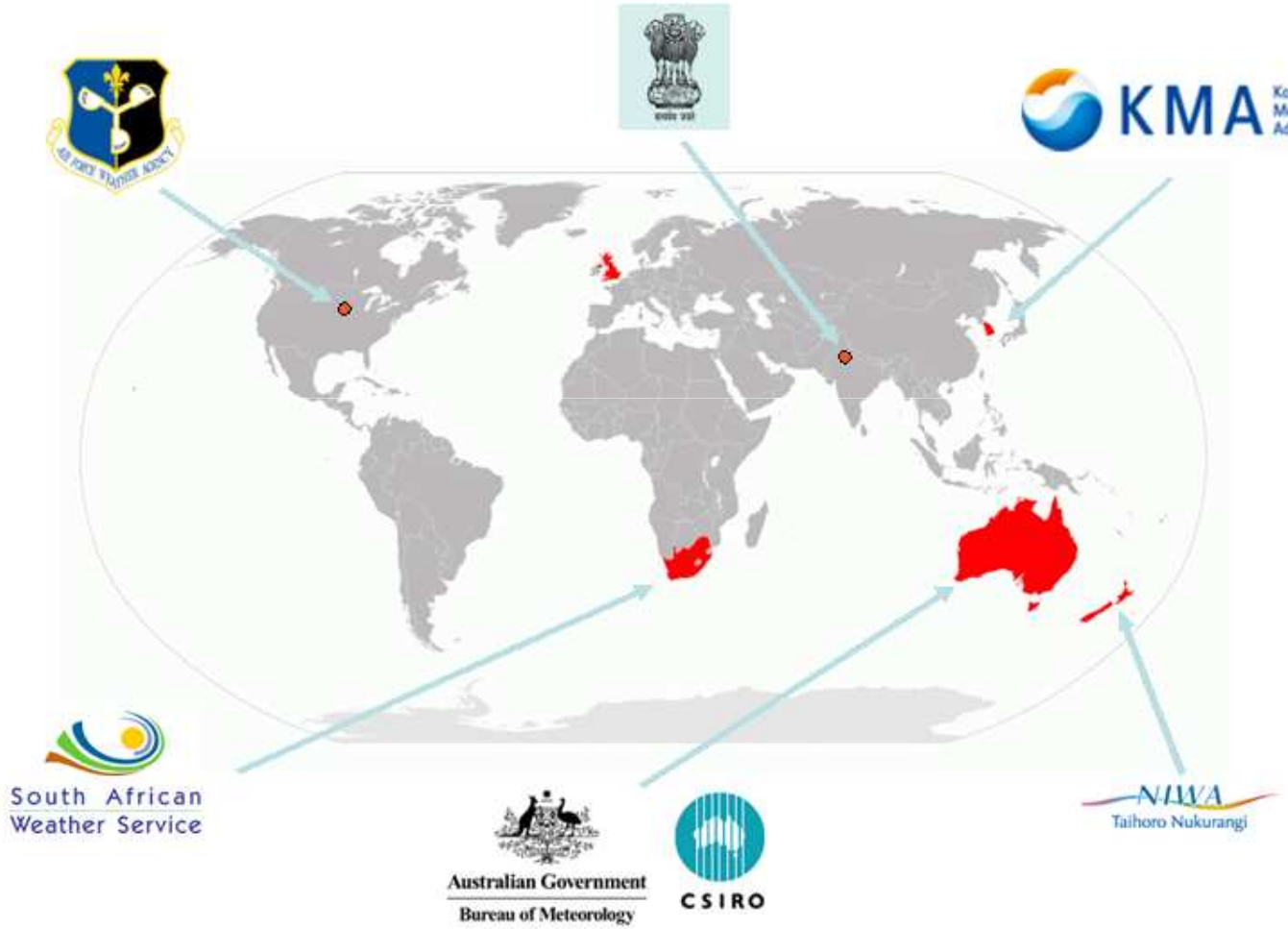
Mike Bush

37th EWGLAM and 22nd SRNWP Annual Meeting 2015

05th - 08th October 2015, Belgrade, Serbia



International UM partnership. Operational users 2015



Operational changes in the last year

1) PS35 (03 Feb 2015)

- Introduction of ENDGame dynamical core into Limited Area Model configurations

- Large package of data assimilation and physics changes introduced simultaneously

2) PS35B (10 Mar 2015)

- Introduction of stochastic perturbations to UKV/MOGREPS-UK

3) PS36 (25 Aug 2015)

- Migration of all model configurations to the new Cray supercomputer

PS37 Highlights (due to go operational in Spring 2016)

Multi-layer snow scheme

• The implementation of this scheme will help with problems over the UK with temperatures not dropping quickly enough under clear skies after snowfall and unrealistically warm temperature minima.

Urban scheme

• MORUSES, the Met Office Reading Urban Surface Exchange Scheme (Porson et al., 2010), will be implemented in the UK models.

• MORUSES calculates a separate surface energy balance for street canyons and roofs and allows the surface energy balance to vary at the grid scale according to the street canyon geometry

• Provides a better physical basis than the previous single-tile scheme

UK Ensembles

• MOGREPS-UK upgrade (see Susanna's talk on Tuesday)

Cray HPC

• This first stage of the implementation to the Cray HPC provides a like-for-like computing capacity compared to the previous IBM, whilst the next two phases (Phases 1b and 1c) will increase the computing capacity

• Phase 1a (25/08/15)

• Phase 1b (Spring 2016)

• Phase 1c and IT Hall 3 operational (Spring 2017)

Regional Atmosphere (RA) Process

- For several years now we have developed the Global model in a different way to the convective scale models

- The Global Atmosphere (GA) process has involved a much more joined-up approach between the climate and NWP communities and also land surface, wave, ocean...)

- There are formal releases of GA versions with science settings that have been thoroughly tested and evaluated and written up in the literature e.g.:

- The Met Office Unified Model Global Atmosphere 4.0 and JULES Global Land 4.0 configurations, Geosci. Model Dev., 7, 361-386, 2014

- We now plan to manage the convective scale models in a similar way with a Regional Atmosphere (RA) process

Why now?

- There has been a rapid growth in the number of projects involving convective scale configurations of the UM being run in different parts of the world and on timescales ranging from nowcasting to climate timescales

- There has been a divergence in science settings for tropical and mid-latitude model configurations, but with no overall plan to keep things unified where possible.

- The time constraints on when model changes can be made operational has meant that package testing is often rushed and model assessment and verification suffer from a lack of statistical robustness

The new RA Process

- A shared repository and TRAC system will allow our UM partners and everyone involved in model development and assessment to find standard jobs and documentation in one place.

- Regular releases of model versions on a timescale which is decoupled from operational timescales should allow for better trialling and more assessment/validation to be performed.

- The introduction of neighbourhood verification into our trialling process and decision making

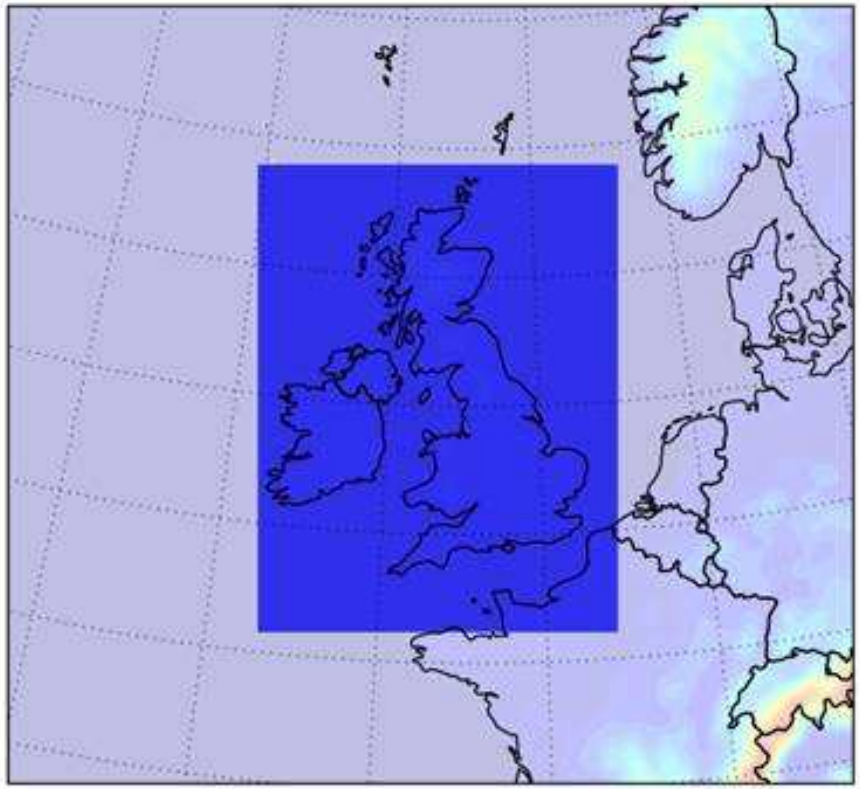
- Marion P. Mittermaier, 2014: A Strategy for Verifying Near-Convection-Resolving Model Forecasts at Observing Sites. Wea. Forecasting, 29, 185–204.

Convective scale workshop in Singapore

- There will be a workshop with our UM partners in Singapore **22nd – 26th February 2016**
- The eventual goal is to come up with a coordinated programme of work across the partnership
- Focus on model development, assessment and validation
- The value of the workshop would be increased if there were some representation from the modelling communities in Europe and the U.S.A to share ideas and experiences
- There are a couple of funded places available ☺

Planned configuration changes for PS38

- Enlarged domain for UKV/MOGREPS-UK (Summer 2016)



Advantages of enlarged domain

• Better spun-up and developed convection migrating into the UK area, including winter showers, so-called “Spanish Plume” convective systems from the south and Polar Lows headline.

• Improved coupling with ocean models, particularly over the North Sea region which will now be fully covered. This aspect also aligns the domain with the requirements for Environmental Prediction R&D;

• Better coverage of weather in the areas surrounding the British Isles for use in media presentations, which will allow us to supply media customers from the core operational UK models rather than the lower resolution Euro4 model.

Fog and low visibility

- A key component of our strategy to improve fog forecasting is a major field campaign, LANFEX: a Met Office led project, in collaboration with NCAS.

- This is amassing a wealth of data which will be used in combination with high resolution modelling studies to improve our understanding of fog processes and the representation of those processes in the UM.

- Early results from modelling a LANFEX case study at Cardington have found that the model fog becomes optically thick far more rapidly than observed

Low cloud

- Recent studies have shown that some form of adaptive fractional cloud cover parametrization is needed in the km-scale UM, which still uses the diagnostic Smith scheme with a specified fixed critical relative humidity profile, RHcrit.

- The global model uses the prognostic cloud scheme, PC2, which from GA7 will include a turbulence-based diagnosis of RHcrit.

- There are plans to test the PC2 scheme in the UKV model.

Convection (1)

• Representing convection accurately in models at km-scale remains a critically important challenge, and it is clear that improvements are needed.

• Despite the improvements which result from the stochastic perturbations introduced at PS35b the resolved convection in UKV suffers from a number of problems. These include:

• i) a delay in onset compared with observations

• ii) unrealistic structure with strong precipitation across the whole convective cell, rather than an intense core surrounded by lighter rain

Convection (2)

• iii) unrealistically-large vertical velocities (both in updrafts and downdrafts).

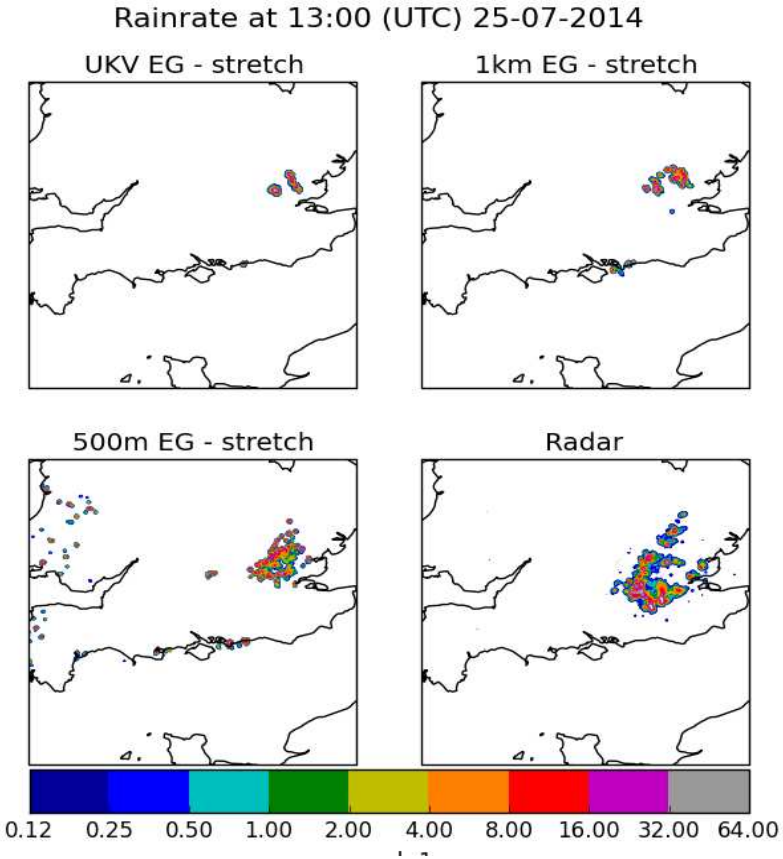
• iv) The convection also has a tendency to produce too much rain in total, with excessive heavy rain and not enough light rain

•While moderate increases in resolution and re-tuning of the turbulent mixing length may offer some small improvements, the problems generally persist.

• The fundamental issue is that convection is poorly resolved in km-scale models and since very fine (~100m) grid spacing will remain prohibitively expensive for the foreseeable future it is clear that new parametrizations are needed.

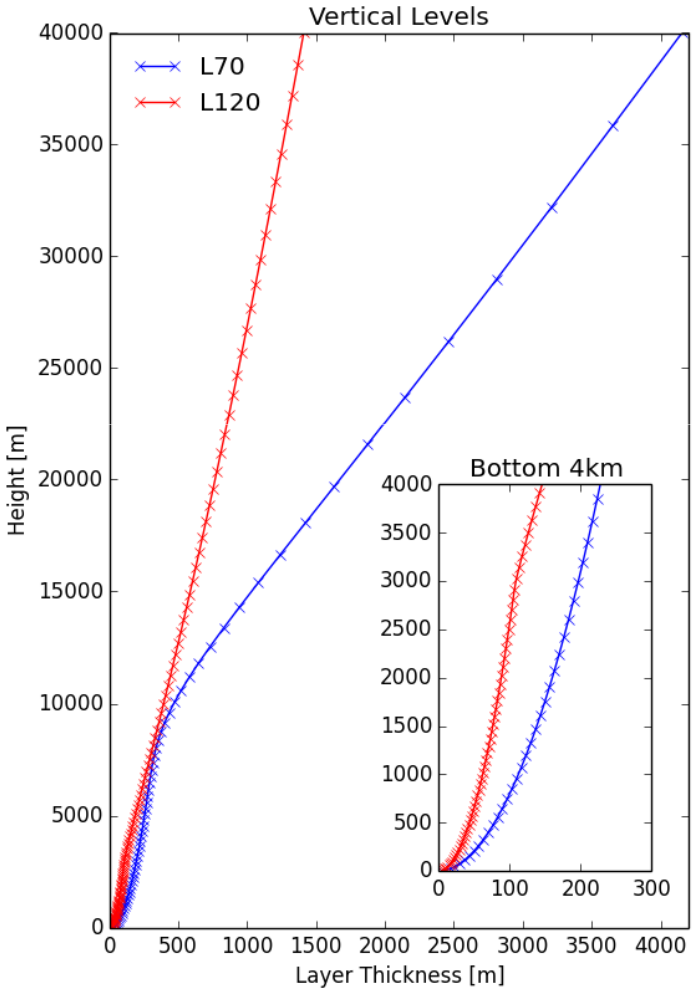
Horizontal resolution

- Possible upgrade of UKV to 1km
- The coverage of convection usually improves as the gridlength is decreased.
- The 1km model produces more smal cells but still underestimates them
- Generally, convection initiation time improves as the horizontal gridlength is decreased.
- MOGREPS-UK to 1.5km resolution? (see Susanna's talk)

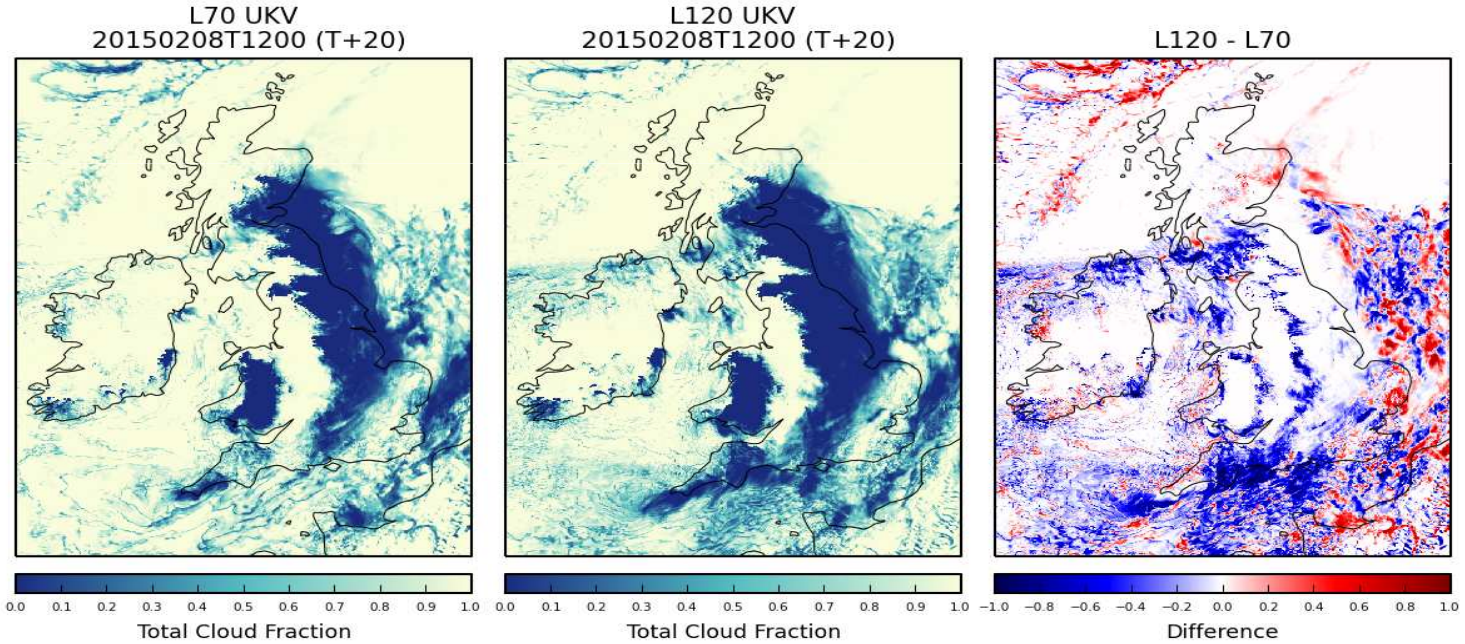


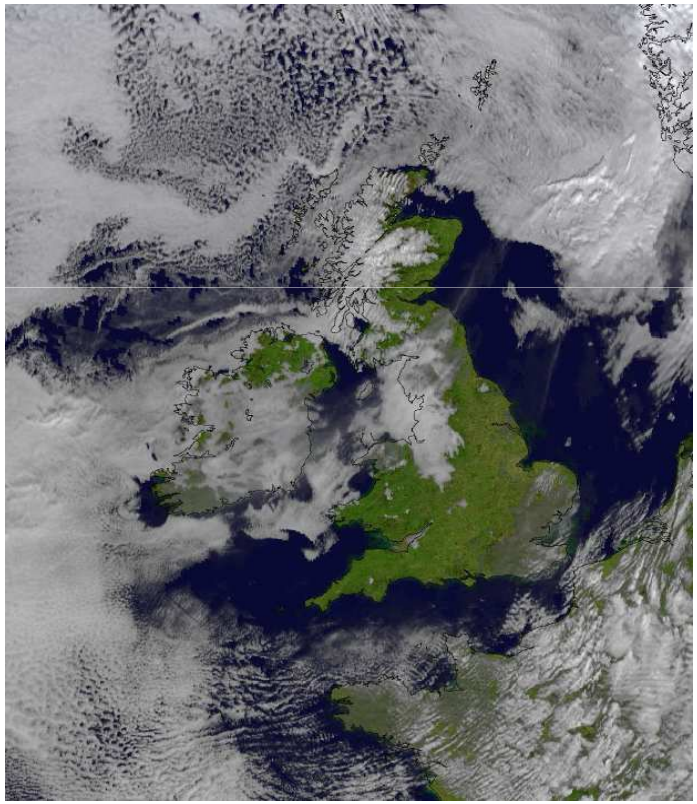
Vertical resolution

- Initial test results with L120 have shown a small impact although generally positive.
- Low and very low cloud in the UKV runs are more broken up
- Cross sections show that there are thinner low cloud layers.



Vertical resolution





LFRic and GungHo

- LFRic is the name given to the programme of work that is intended to deliver a replacement for the Unified Model over the next decade.

- LFRic will build upon the Gung Ho project, which is the Met Office collaboration with NERC and STFC Daresbury to deliver a dynamical core which scales to future architectures

- This will be by far the biggest change to affect all Met Office models in the coming decade!

Met Office

Questions?