Consortia Presentation

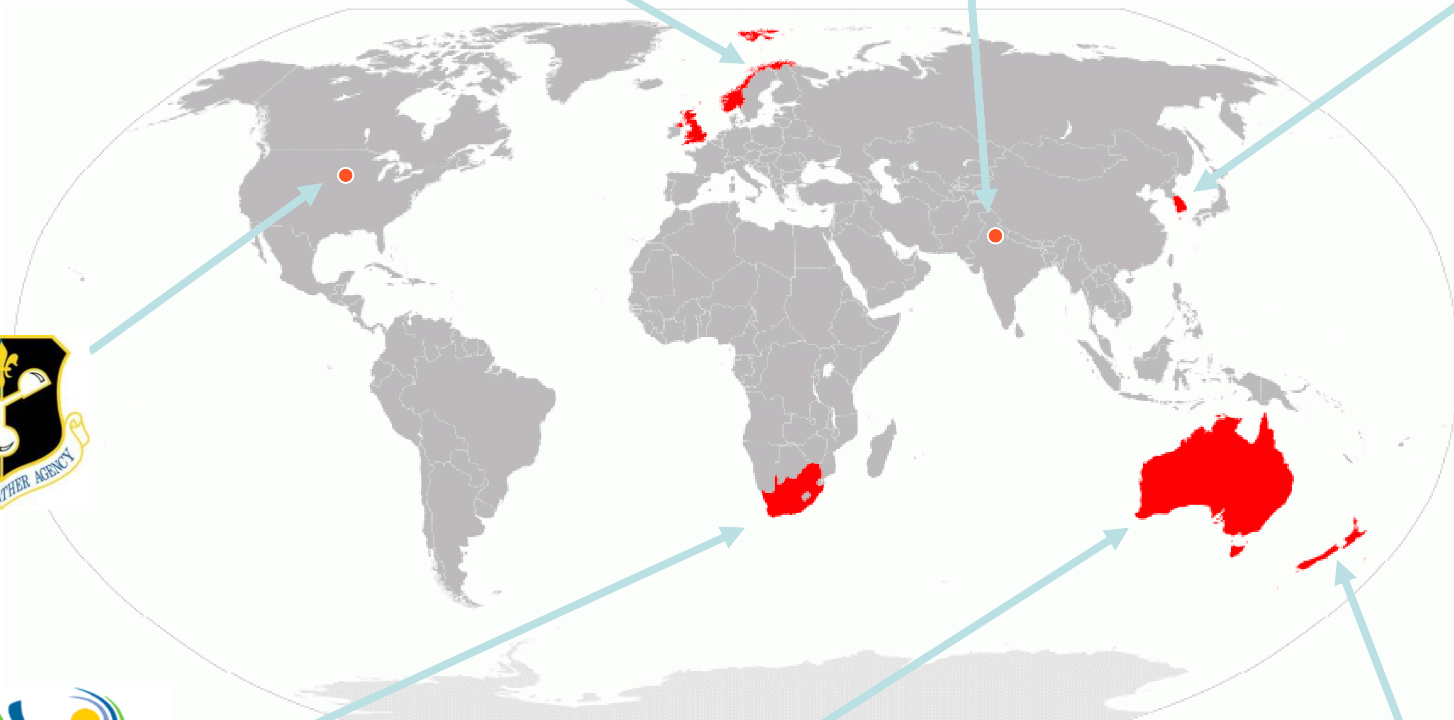
Mike Bush

Jorge Bornemann, Phil Brown, Selena Georgiou, Kirsty Hanley, Humphrey Lean, Adrian Lock, Stuart Webster, Mark Weeks, Steve Willington

35th EWGLAM and 20th SRNWP Annual Meeting 2013

30th September – 03rd October 2013 Antalya, Turkey

International UM partnership: Operational users 2013



Norwegian Meteorological Institute
met.no

KMA Korea Meteorological Administration

South African Weather Service

Australian Government
Bureau of Meteorology

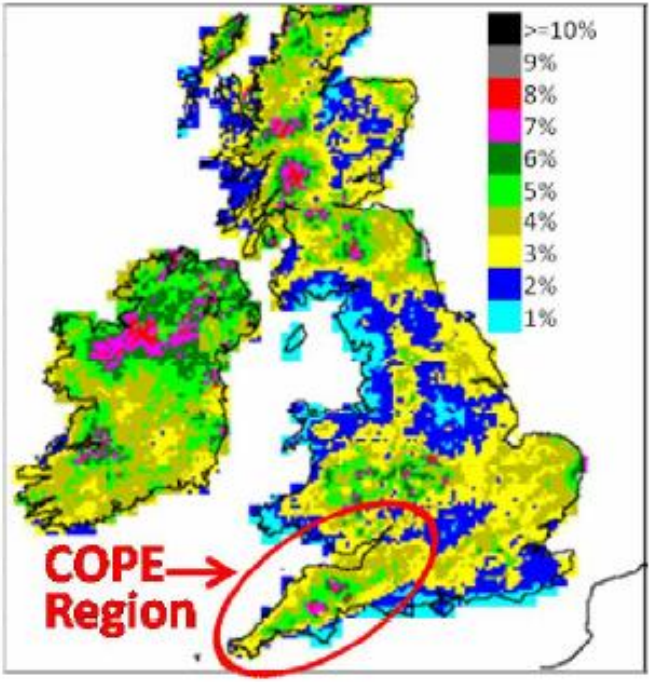
CSIRO

NIWA
Taihoro Nukurangi

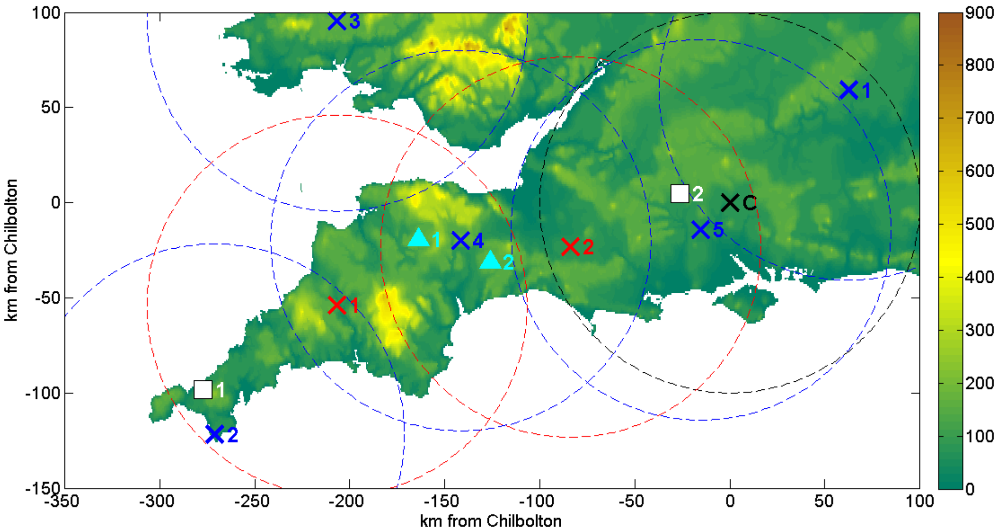
COPE

Met Office

- COnvective Precipitation Experiment
- UK-led project over SW England in June, July and August 2013.
- With typical luck, it turned out to be the driest summer in England since 1996!
- COPE aims to improve QPF forecasts by:
    - Studying the production of precipitation in organized convective systems over SW England
    - Improving the exploitation of data used for operational assimilation
    - Improving the representation of microphysical processes in operational km-scale NWP



Observations:



FGAM transportable X-band Doppler radar

U.Wyoming King Air with WCR/WCL

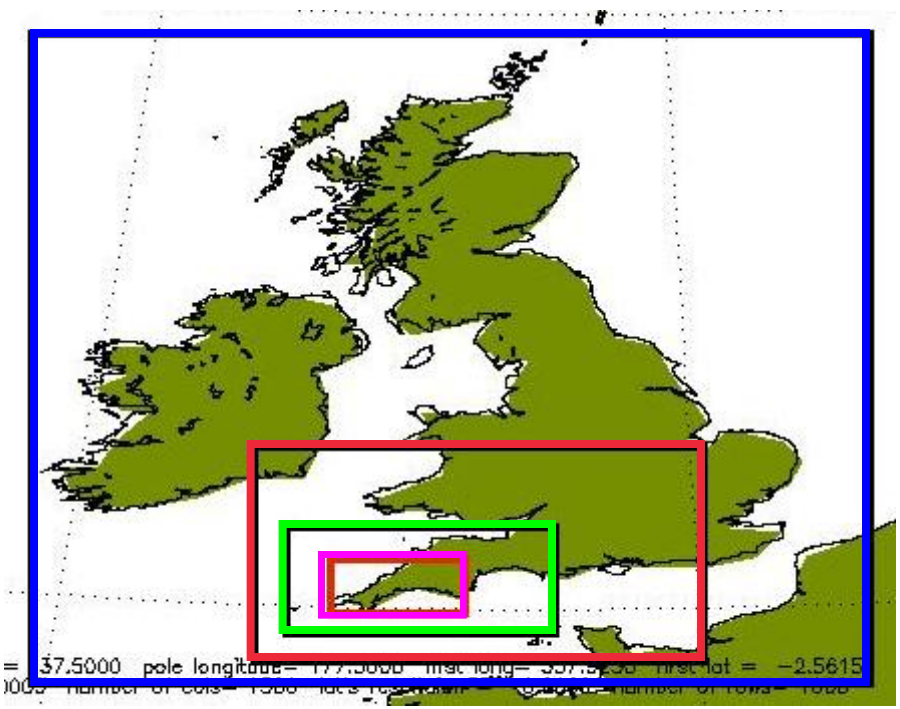
Plus:
- MO network radars (with dual-polarization and Doppler capability)

- additional radiosondes (Camborne and MRU mobile)

- Doppler lidar (MRU van)
- aerosol surface site

High Resolution COPE simulations

Set of nested models.



Model setup – UM vn8.2 PS32

UKV – 1.5km grid length, 70 levels,
2D subgrid turbulence scheme,
BL mixing in vertical.

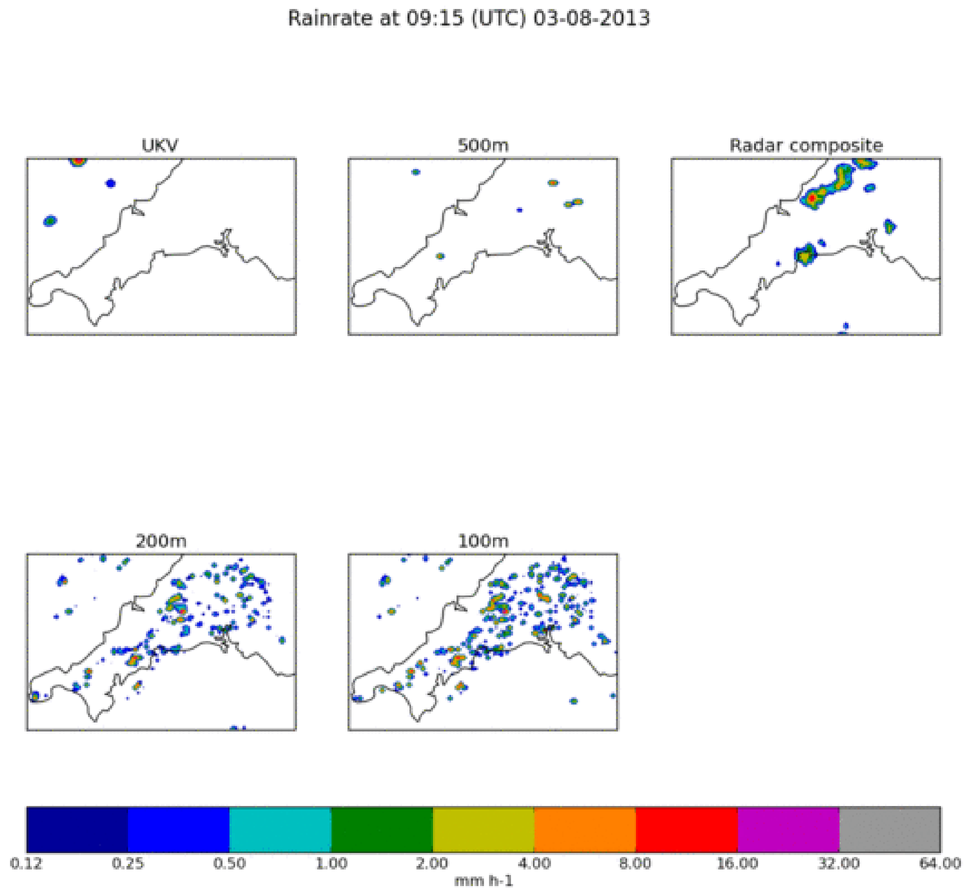
500m model – 500x400 km

200m model – 300x200 km

100m model – 150x100 km

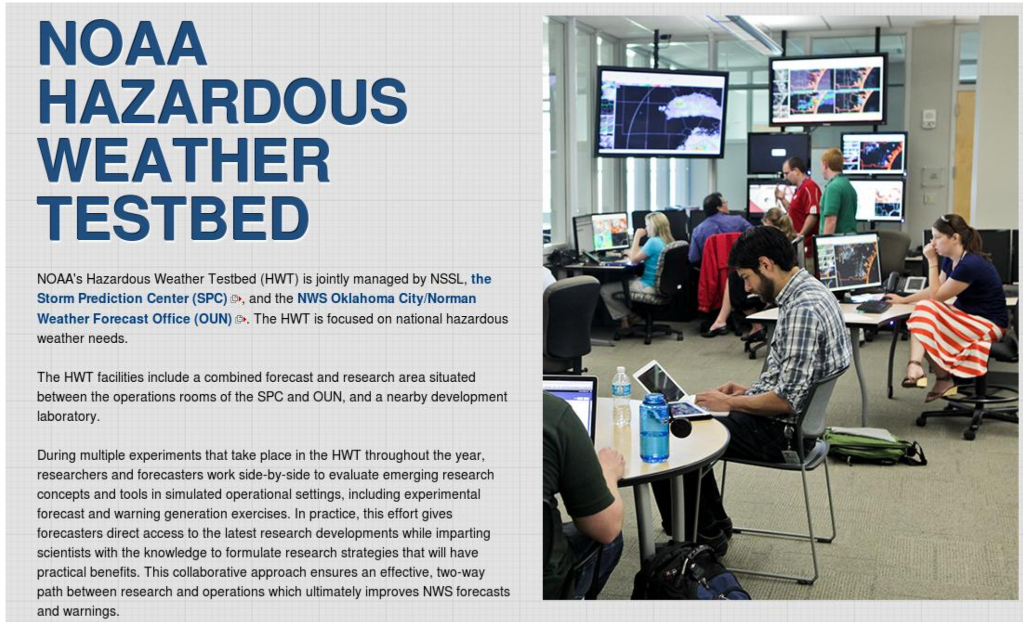
High res models: 140 vertical levels, 3D subgrid turbulence scheme, RH_{crit} is 0.97 (0.91) in 1^{st} few layers decreasing smoothly to 0.9 (0.8) at ~3.5km.

3rd August – convergence line



- 03rd August case had a nice line of showers down the centre of the peninsula which the 500m model captured quite nicely.
- The higher resolution models have lots of little showers
- Cells appear to get smaller as grid length is reduced

NOAA Hazardous Weather Testbed (HWT)



NOAA HAZARDOUS WEATHER TESTBED

NOAA's Hazardous Weather Testbed (HWT) is jointly managed by NSSL, the Storm Prediction Center (SPC), and the NWS Oklahoma City/Norman Weather Forecast Office (OUN). The HWT is focused on national hazardous weather needs.

The HWT facilities include a combined forecast and research area situated between the operations rooms of the SPC and OUN, and a nearby development laboratory.

During multiple experiments that take place in the HWT throughout the year, researchers and forecasters work side-by-side to evaluate emerging research concepts and tools in simulated operational settings, including experimental forecast and warning generation exercises. In practice, this effort gives forecasters direct access to the latest research developments while imparting scientists with the knowledge to formulate research strategies that will have practical benefits. This collaborative approach ensures an effective, two-way path between research and operations which ultimately improves NWS forecasts and warnings.

- Each year, the NOAA Hazardous Weather Testbed, based in Norman, Oklahoma, USA hosts a spring experiment to assess up-and-coming forecast developments in a simulated operational environment.
- Although Met Office scientists and forecasters have taken part in some previous years, this is the first time we have provided Unified Model forecasts.

HWT Spring 2013 Experiment

2013 Spring Experiment NWP Models and Guidance

The table below lists NWP models and guidance that will be available for testing and evaluation during the 2013 Spring Experiment. Additional details about the configuration of the guidance (e.g. specifics of parameterization schemes, setup of vertical grid, etc.) can be found in the 2013 Spring Experiment Operations Plan.

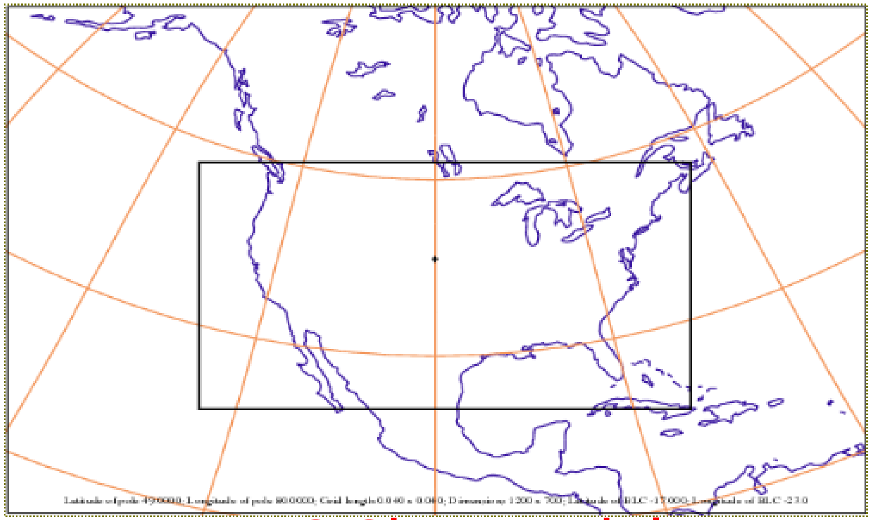
Provider	Init. Time	Model	Grid Space	Domain	Run Time	Notes
CAPS	00 UTC	WRF-ARW/ARPS 27 Member Storm Scale Ensemble Forecast (SSEF)	4km	CONUS	48 hours	Multi-model, Multi-physics, Multi-IC ensemble system with 3DVAR DA including radar
CAPS	12 UTC	WRF-ARW 8 Member Storm Scale Ensemble Forecast (SSEF)	4km	CONUS	18 hours	Multi-model, Multi-physics, Multi-IC ensemble system with 3DVAR DA including radar
AFWA	00 UTC 12 UTC	10 Member WRF-ARW Ensemble	4km	CONUS	36 hours	Single-model, Multi-physics, Multi-IC ensemble system with NO data assimilation
NSSL	Hourly/ 15,17,19 UTC	36 Member WRF-ARW Ensemble	18km	CONUS	0,1 hour/ Out to 03 UTC	Single-model, Multi-physics, EnKF system with data assimilation
UKMET	00 UTC	Unified Model	2.2km 4km	CONUS	36 hours	Unified Model
NSSL	00 UTC	WRF-ARW	4km	CONUS	36 hours	NAM ICs/LBCs
EMC	00 UTC 12 UTC	WRF-NMM	4km	CONUS	36 hours	NAM ICs/LBCs
EMC	00 UTC 12 UTC	HiResWindow WRF-NMM	4km	Central/Eastern US	48 hours	NAM ICs/LBCs
EMC	00 UTC 12 UTC	HiResWindow WRF-ARW	5.1km	Central/Eastern US	48 hours	NAM ICs/LBCs
EMC	00 UTC 12 UTC	NMMB Nest	4km	CONUS	60 hours	NMMB ICs/LBCs
SPC,NSSL,EMC	00 UTC 12 UTC	7 Member Storm Scale Ensemble of Opportunity (SSEO)	~4km	Central/Eastern US	36 hours	Consists of existing CONUS WRF-NMM, HiResW WRF-NMM and WRF-ARW, NMMB Nest, and 2 time-lagged HiResW members
SREF	03,09,15,21 UTC	21 Member Short-Range Ensemble Forecast (SREF)	16km	CONUS	87 hours	Multi-model, Multi-physics, Multi-IC ensemble system
GSD	Hourly	HRRR WRF-ARW	3km	CONUS	15 hours	RR ICs/LBCs includes DDFI Radar

UM configurations run for the Hazardous Weather Testbed (HWT)

Model domains

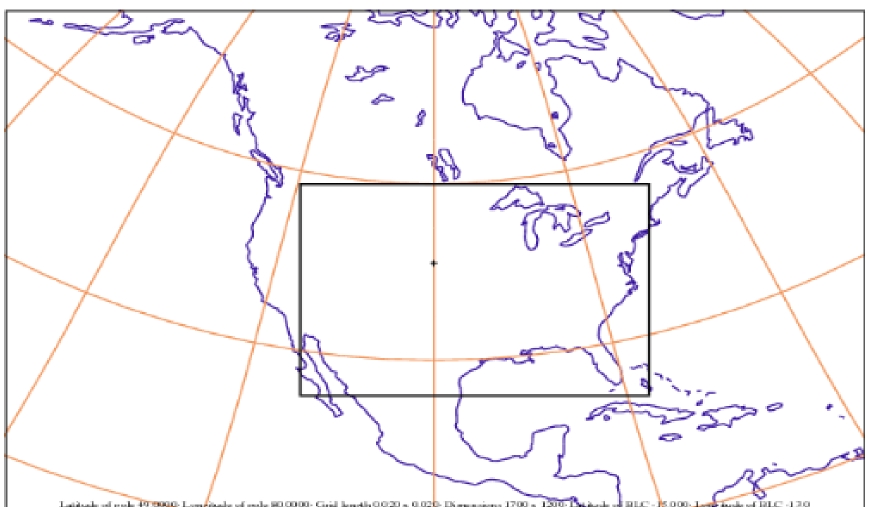
4.4km

4.4km model



2.2km

2.2km model

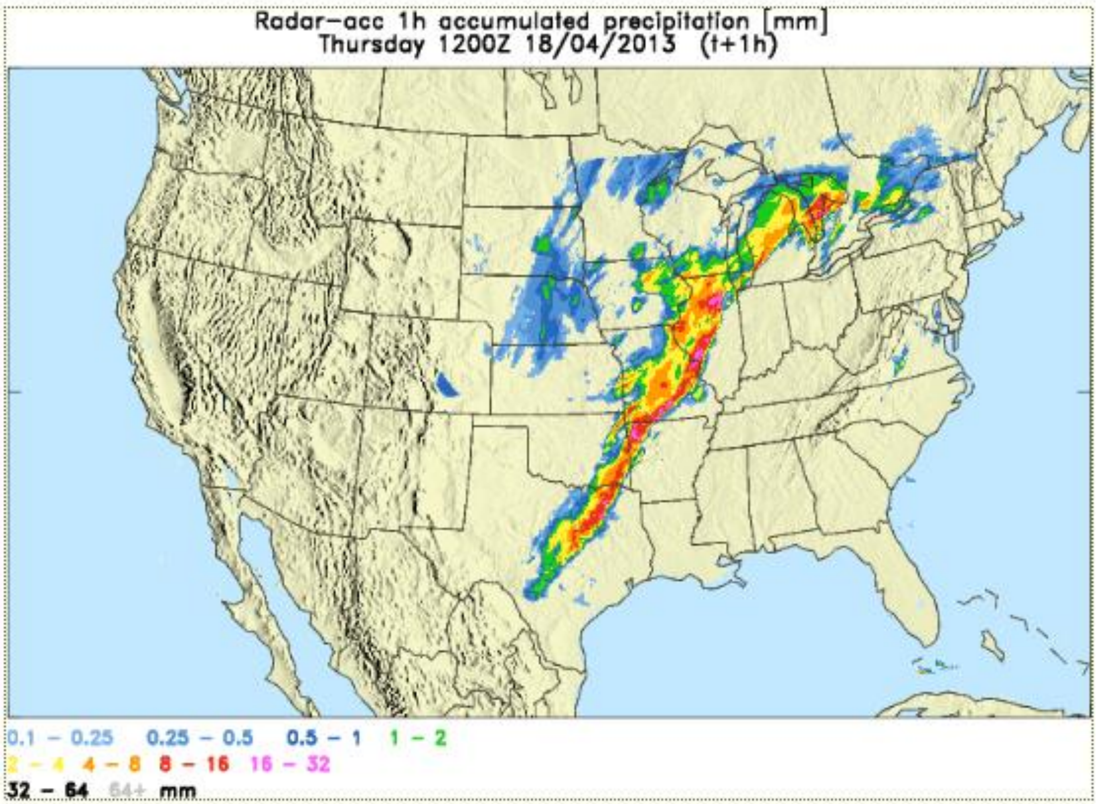


- The 2.2km model was nested inside the 4.4km model.
- The models were run with PS32 configurations, but without data assimilation and without any specific tuning.
- In order to make like-for-like comparisons with the US forecast models additional diagnostics had to be computed
- Simulated radar reflectivity and updraft helicity (used in the US to indicate potentially tornadic supercell storms)

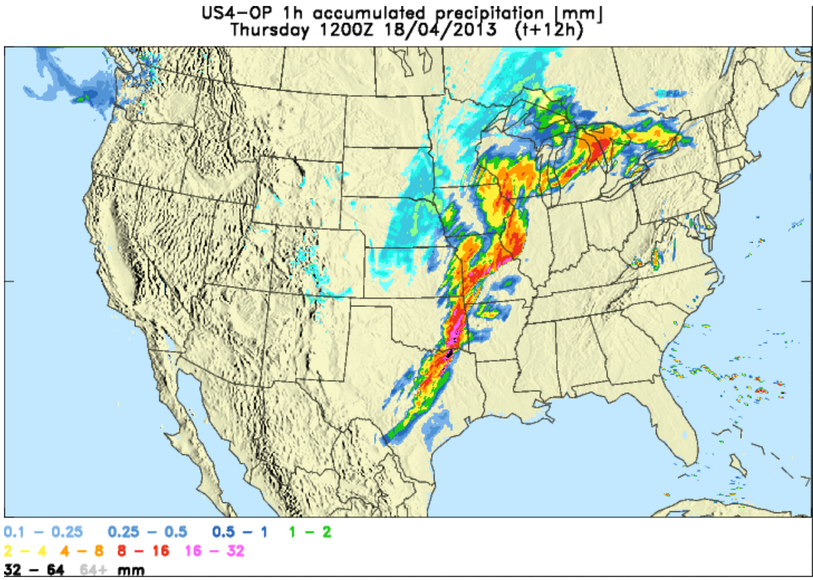
4.4km and 2.2km UM models and Radar

Radar

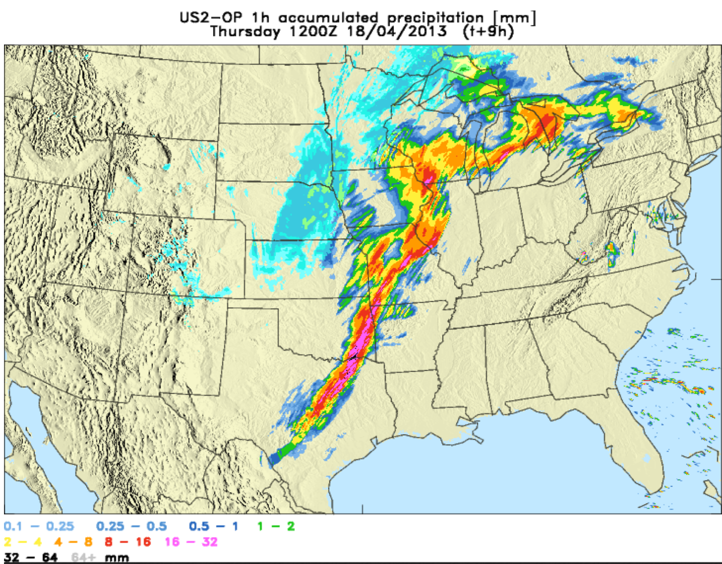
Radar Hourly accumulation



4.4km model



2.2km model



Greyzone physics developments

Turbulent mixing parametrization in the Greyzone: Basic principle

- Given a turbulent flow of length scale, L, and grid size Δx:

Unresolved, L « Δx:

a) Traditional NWP 1D parametrization good for vertical mixing

b) Horizontal turbulent diffusion negligible

OK sometimes = standard NWP

Resolved, L » Δx:

a) Traditional NWP 1D parametrization inappropriate

b) LES-style 3D turbulence scheme works well

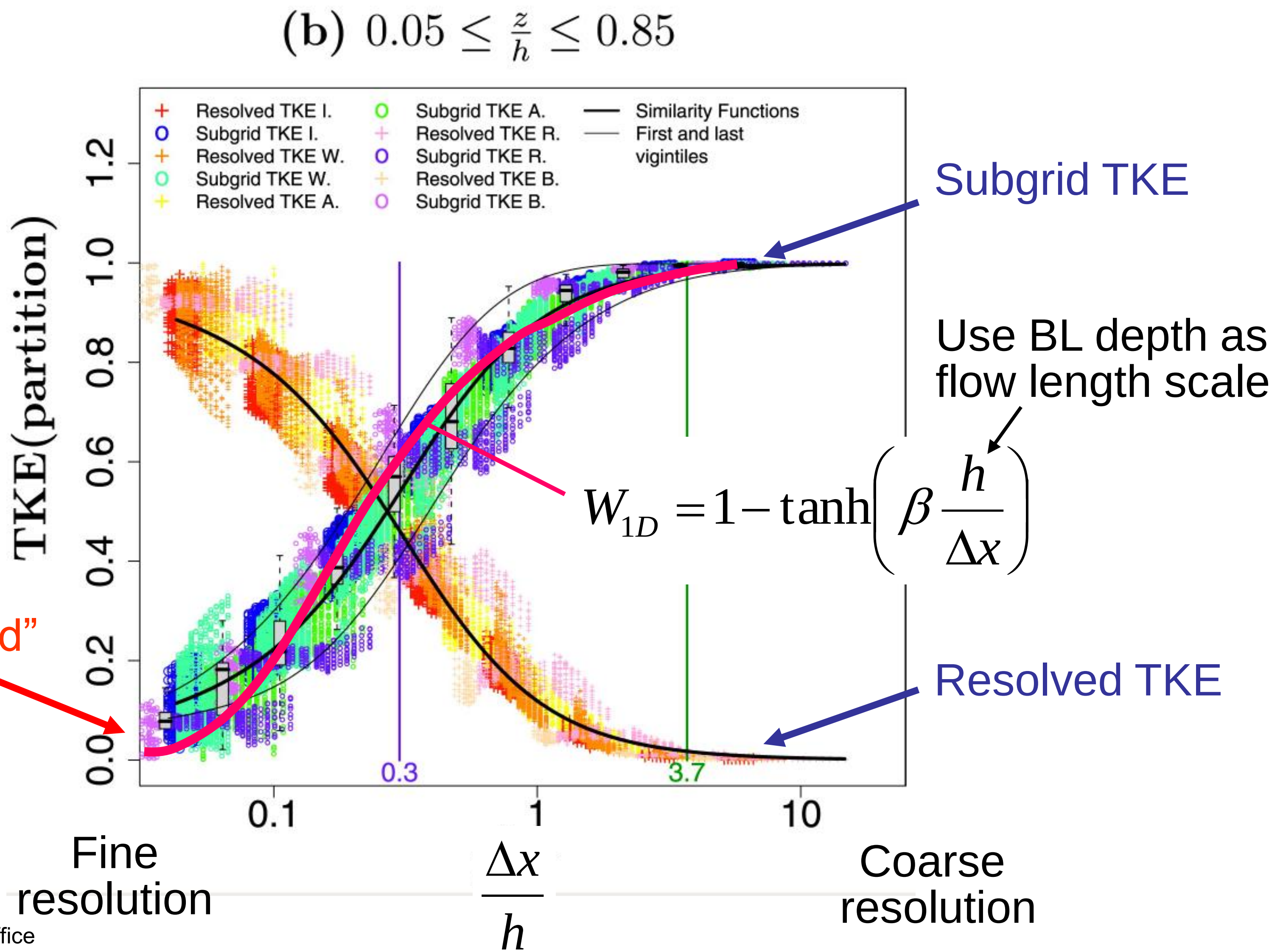
Only OK if actually well resolved

Grey zone, L ~ Δx:

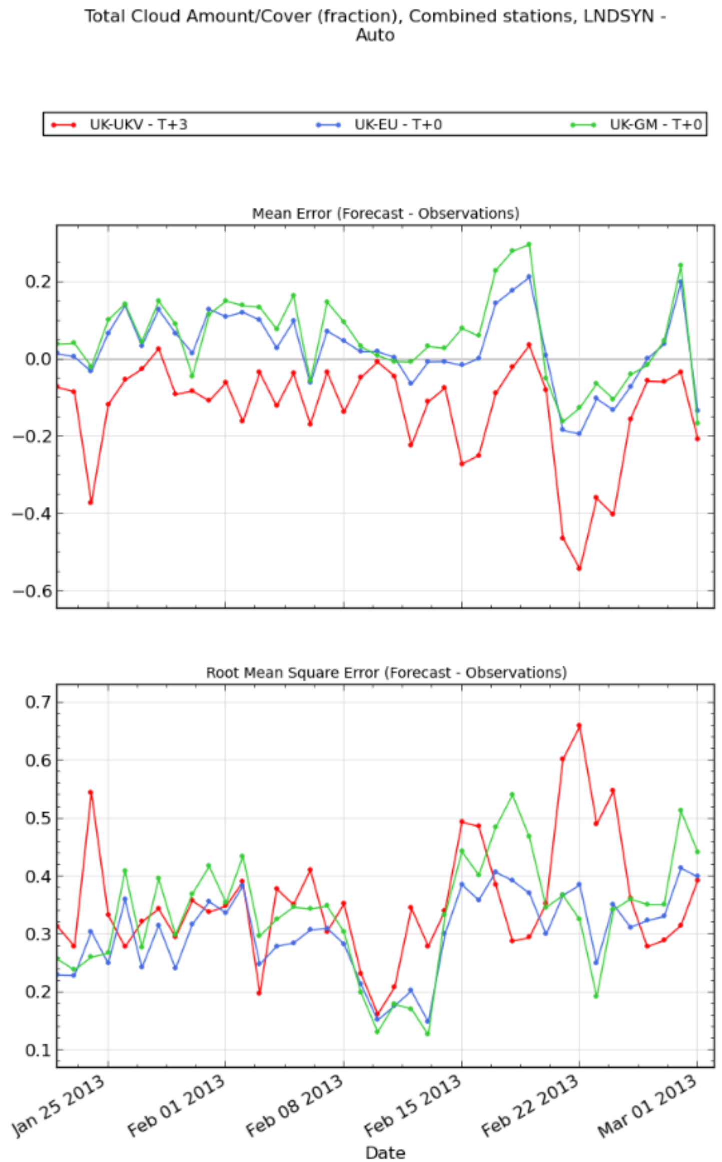
Have some plausible combination of the two (given L will vary greatly even if Δx is typically uniform)

Grey zone parametrization

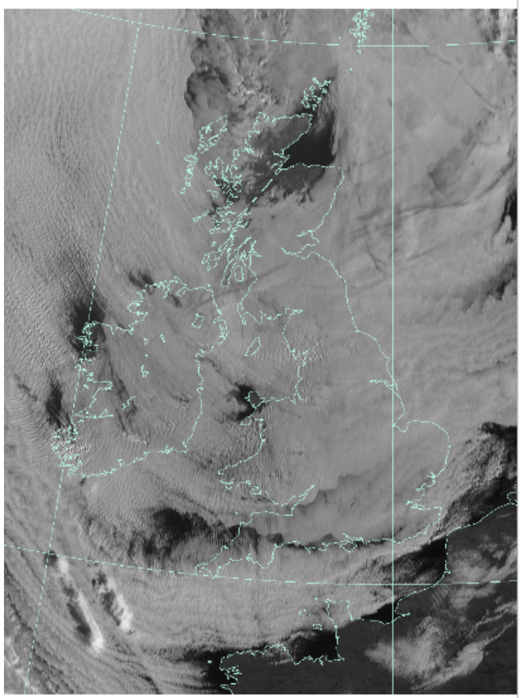
Fit to Honnert et al (2011)

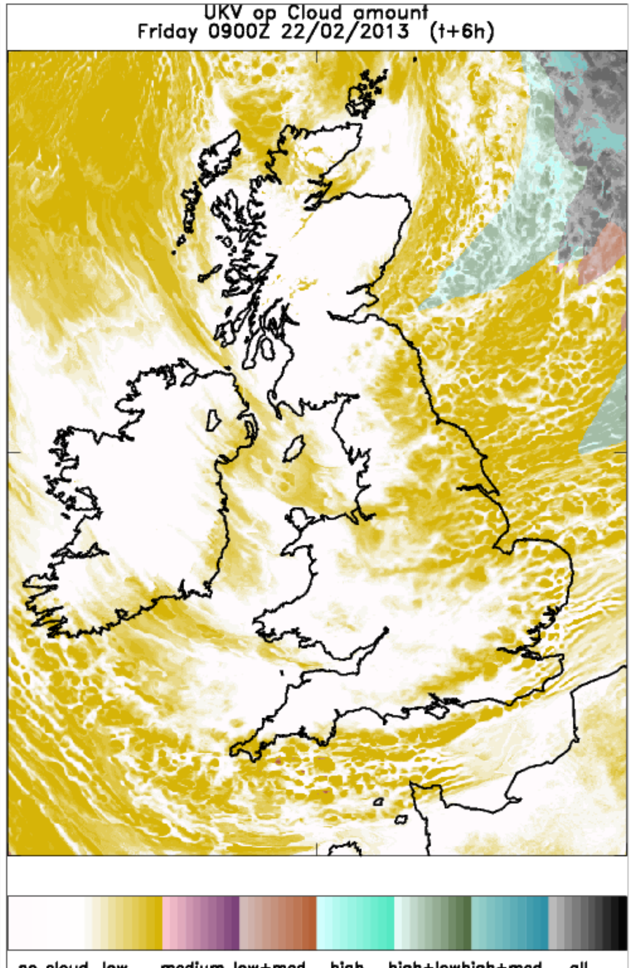


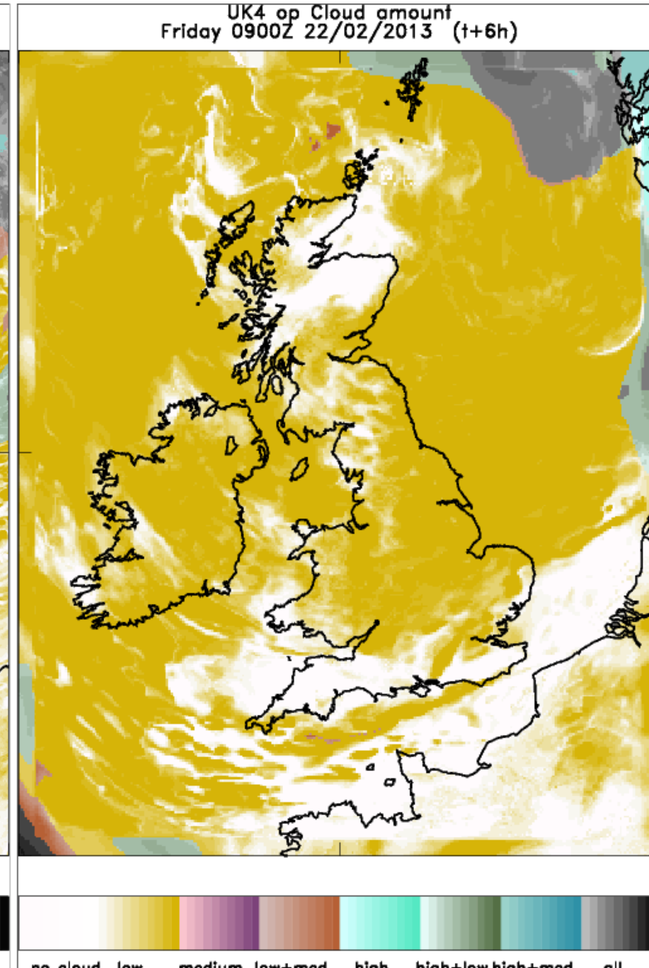
Poor Sc forecasts from UKV in February 2013



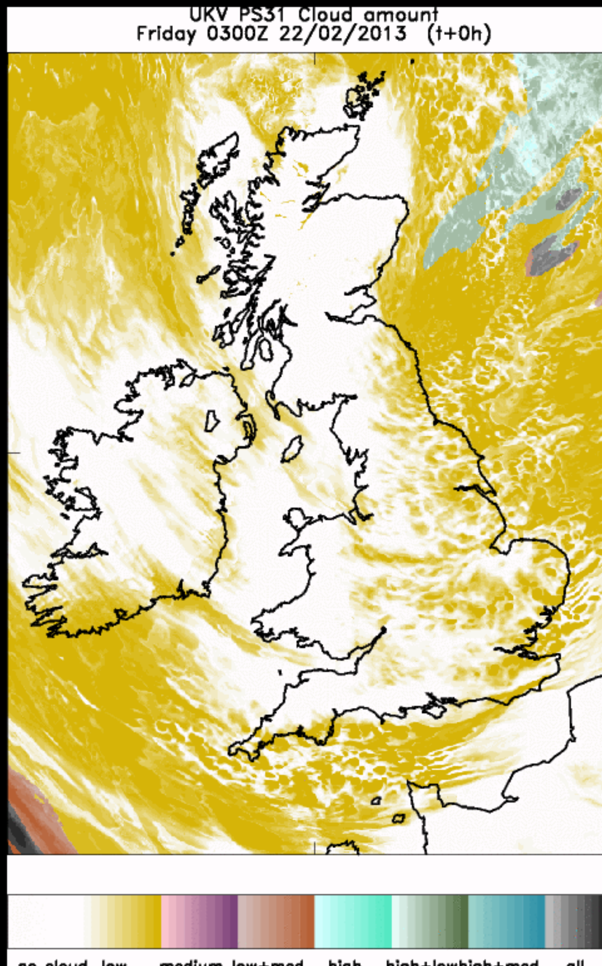
Satellite image, UKV and UK4

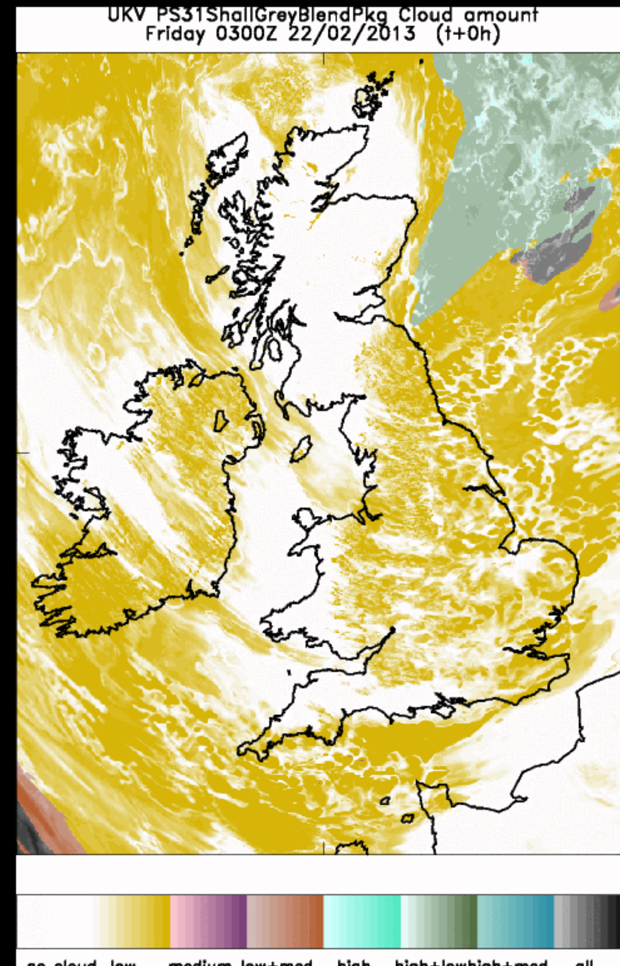






UKV OP and Greyzone turbulence test



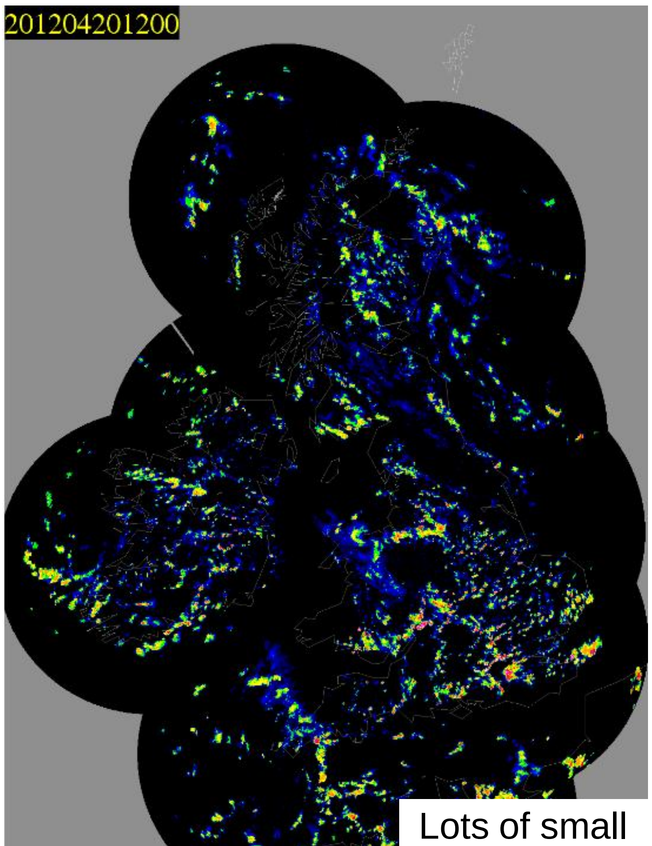


Convective showers

20th April 2012 (DYMECS)

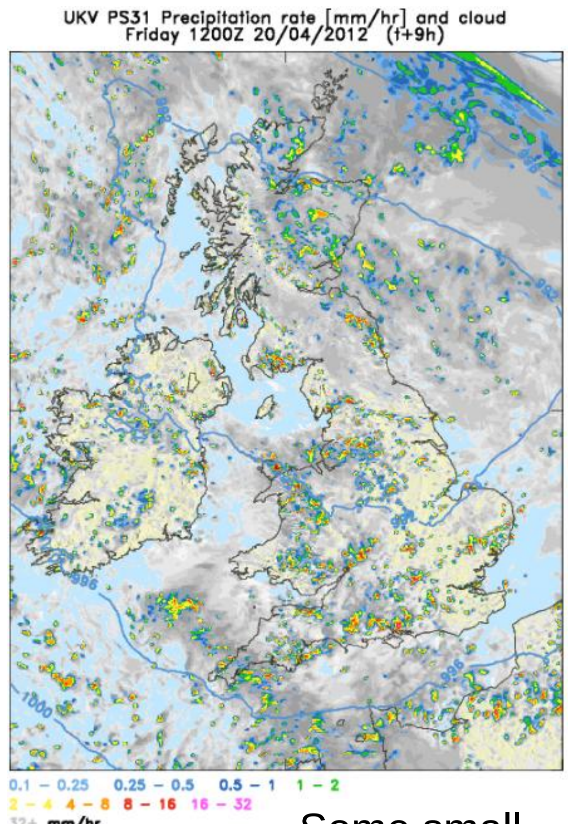
UKV (1.5km grid)

Radar



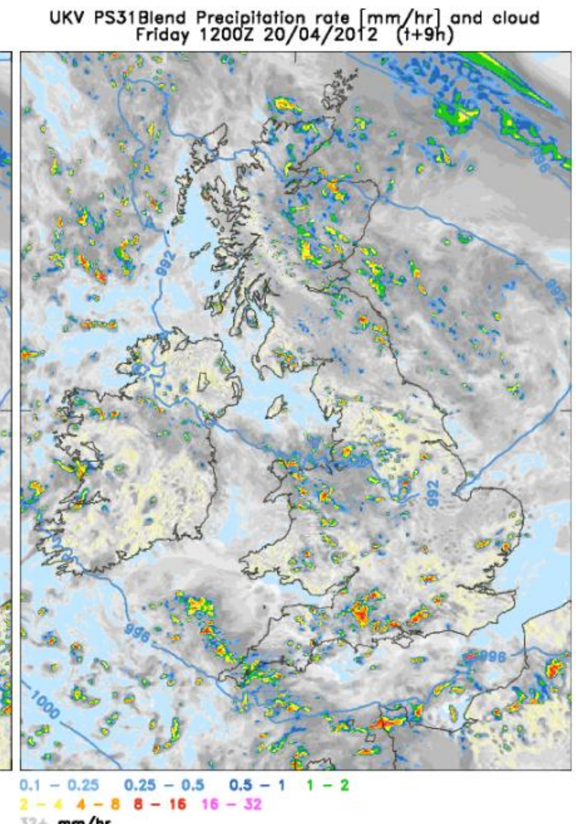
Lots of small showers

PS31 control



Some small showers

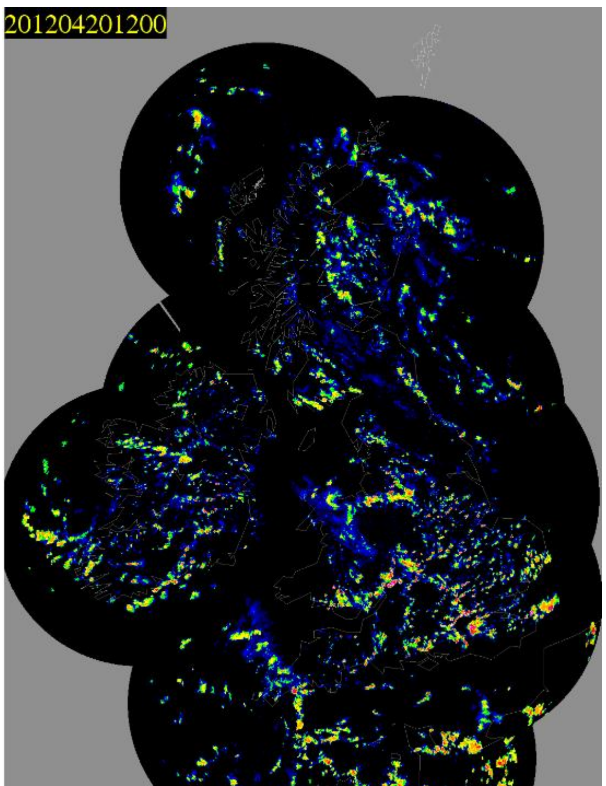
Blended BL



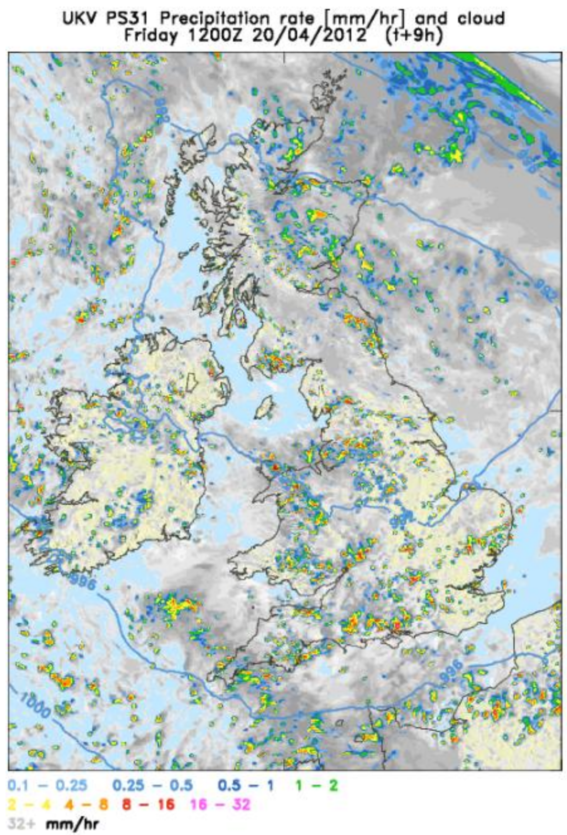
Hardly any small Showers!

Shallow cumulus parametrization

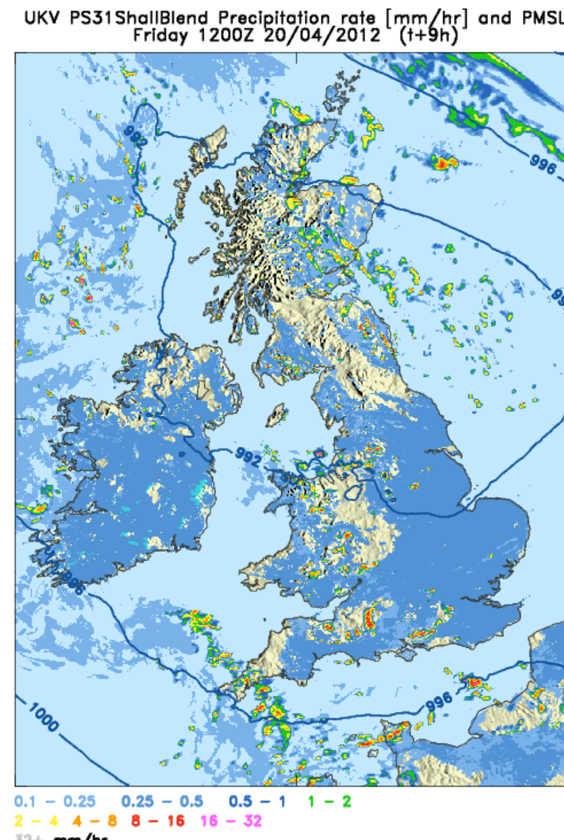
- Traditional parametrization gives more or less uniform drizzle
  - Not popular with forecasters (could post-process), but is using it actually wrong?



UKV



Blending + Shallow Cu param



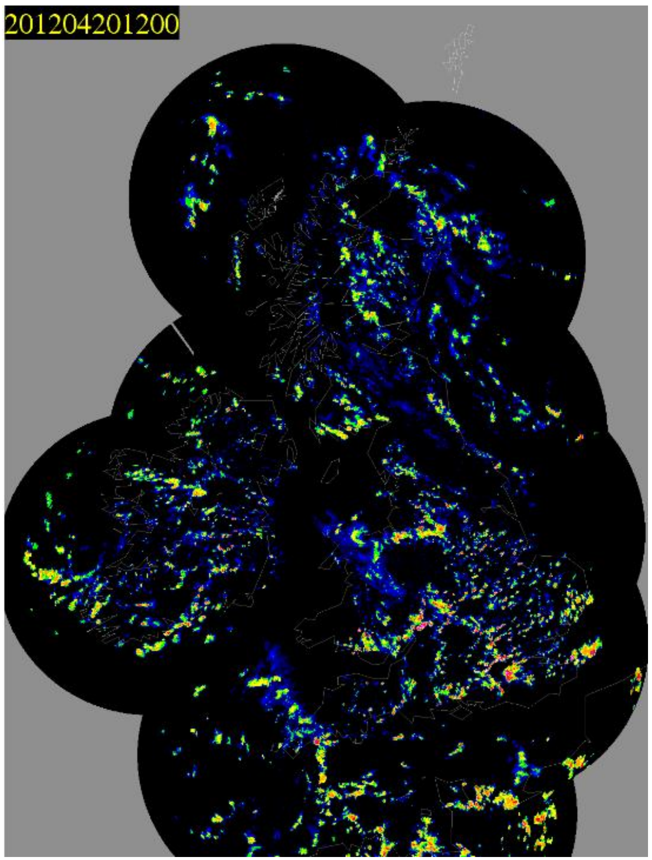
Grey zone “shallow” cumulus parametrization

20th April 2012 (DYMECS)

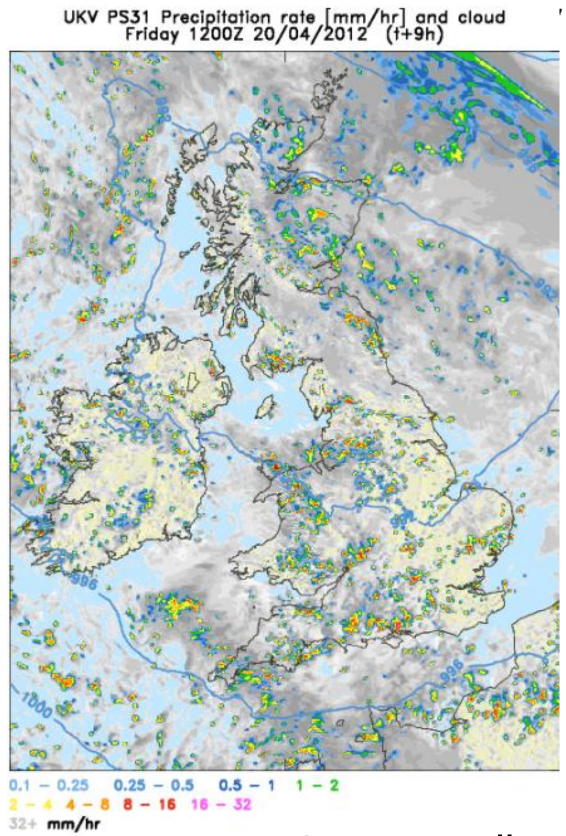
Met Office

UKV (1.5km grid)

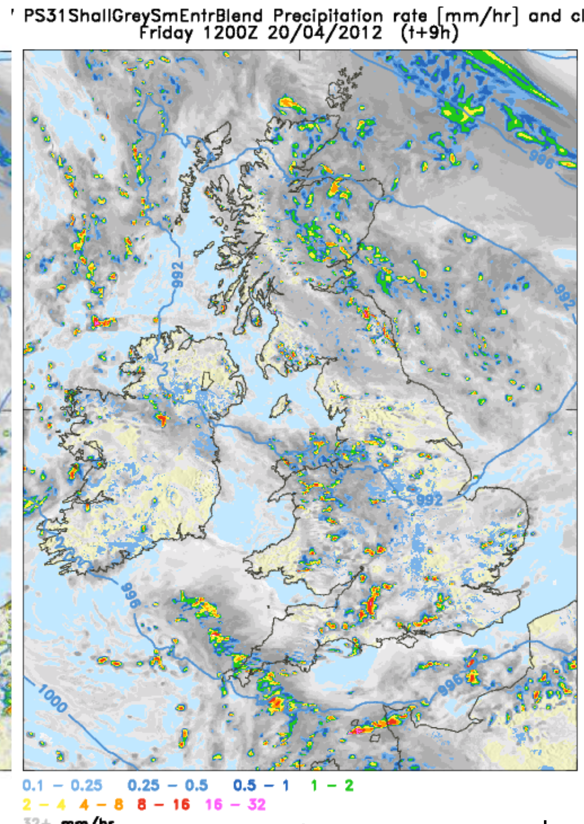
Radar



PS31 control



Grey shallow cu



Some small showers

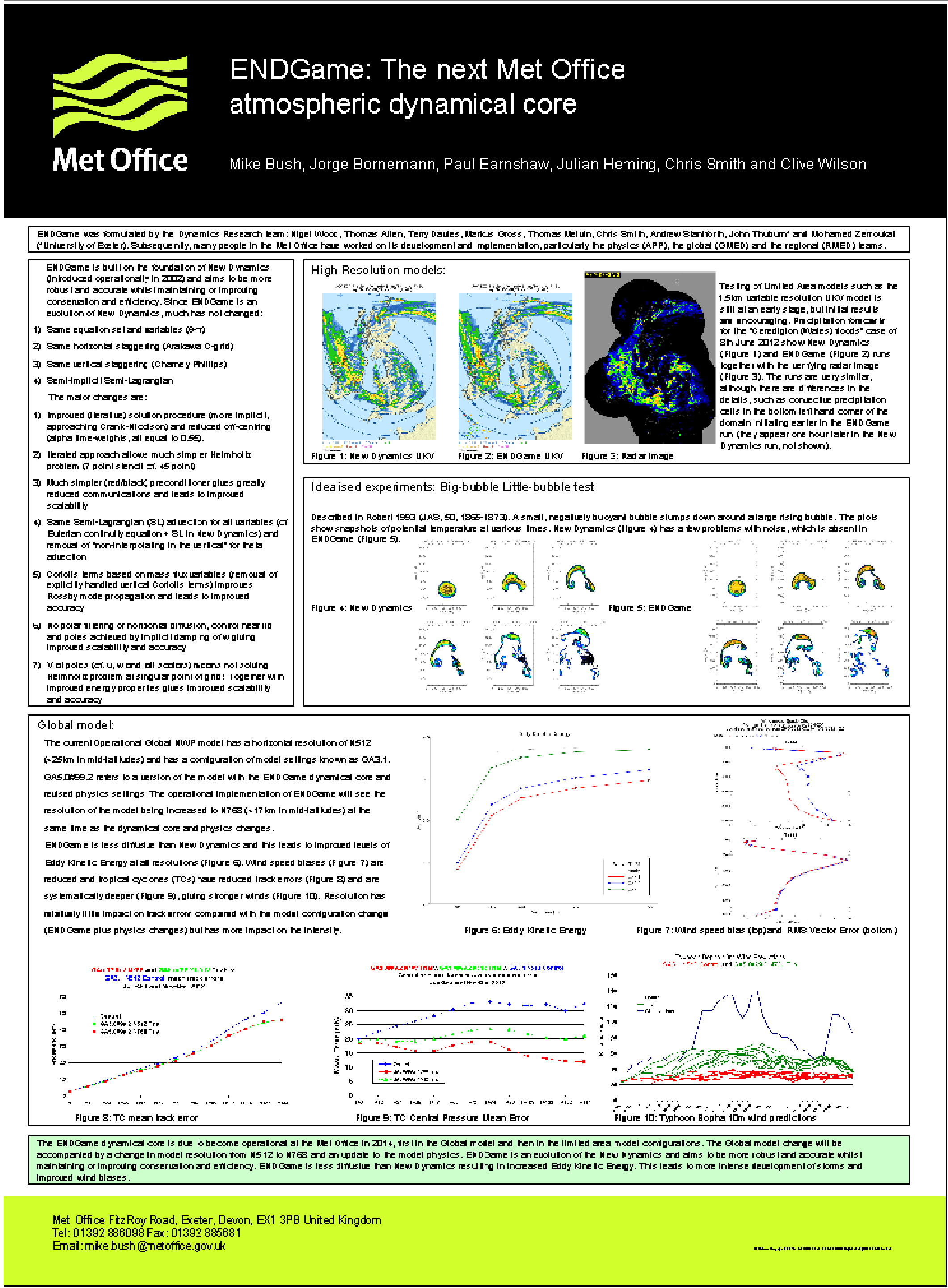
Some param^{d} showers

Summary

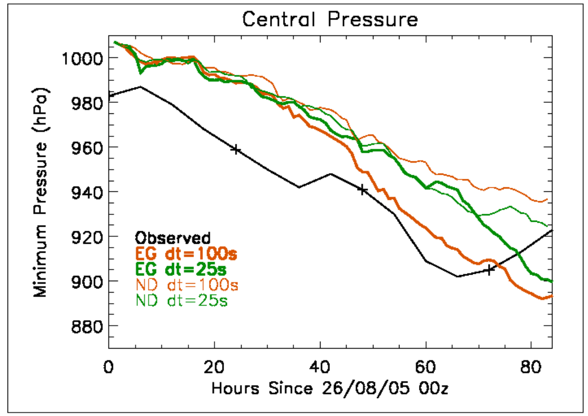
- Pragmatic blending, using BL depth as a length scale, appears to work plausibly
  - Gets around having to choose between 3D Smagorinsky or 1D boundary layer parametrization at any given resolution
  - Appears to suppress near grid-scale motions (“noise”)
  - If near grid-scale contains shallow convection (as in UKV) then a shallow cumulus parametrization is needed
- “Grey zone” shallow cu closure (using cloud top height as a length scale) seems to work OK too
- Needs to be tested far more widely and analysed more quantitatively

ENDGame

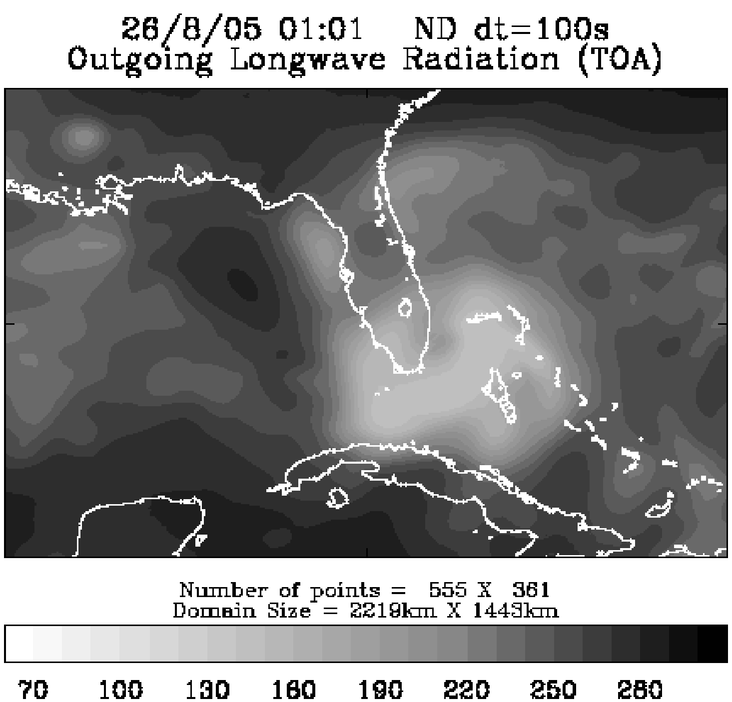
- See ENDGame Poster



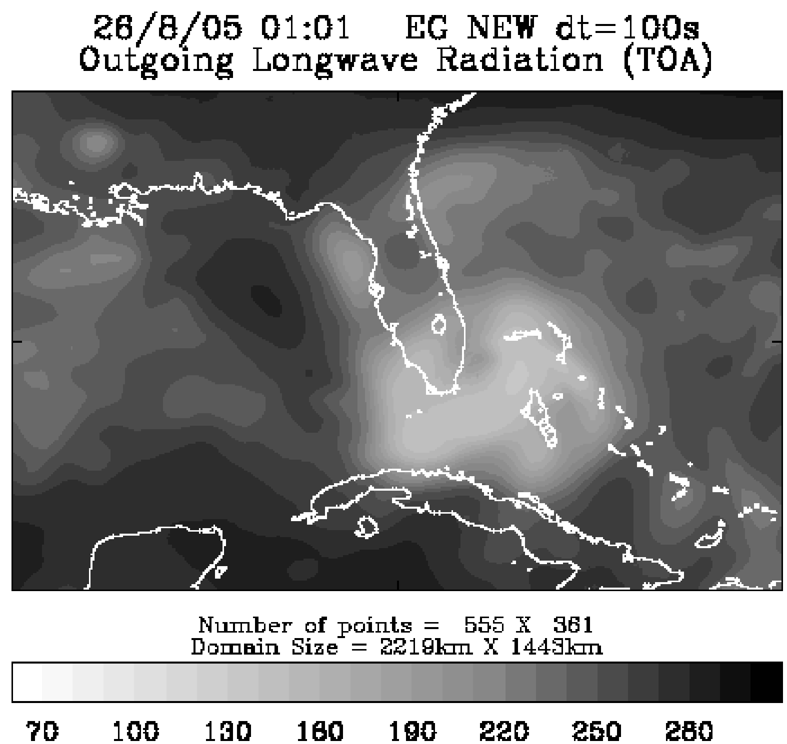
4km Hurricane Katrina simulations



New Dynamics



ENDGame



Operational changes

Parallel Suite 31 Highlights

- **Parallel Suite 31 16/01/13**
- MOGREPS-G
  - Resolution increase (N400; ~33km)
  - More members to T+9
  - Driving MOGREPS-UK
- UKV/MOGREPS-UK physics package
  See talk given last year linked from:
  http://srnwp.met.hu/Annual_Meetings/2012/index.html
- Introduction of the Euro4 downscaler model enabling the future retirement of the 12km NAE model

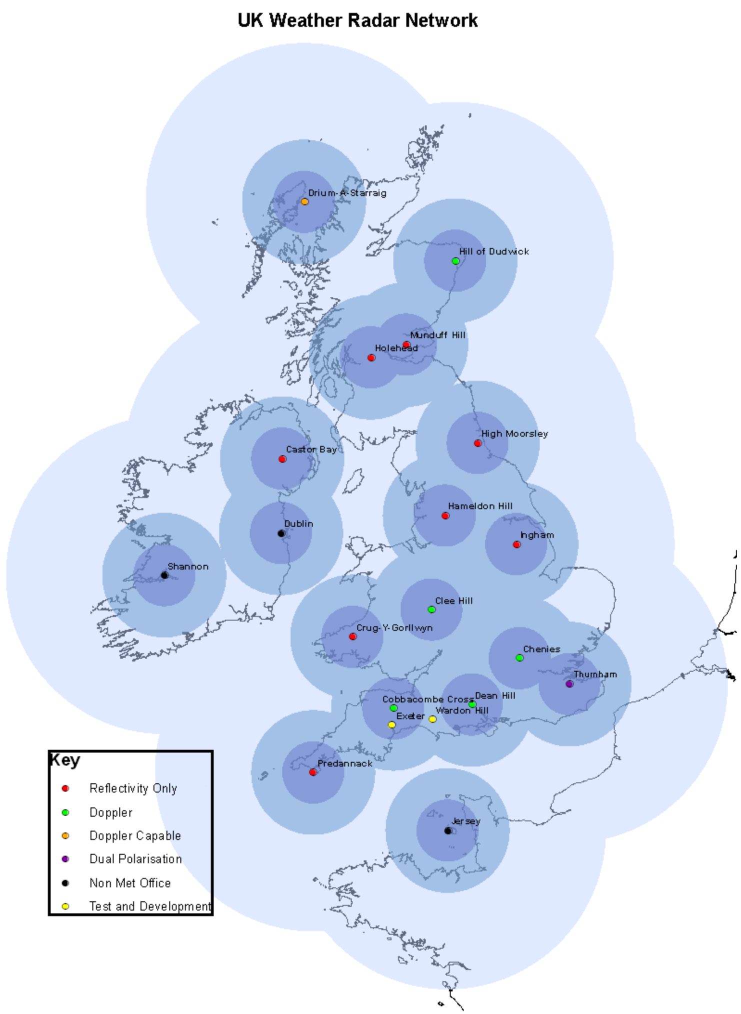
Parallel Suite 32 Highlights

- **Parallel Suite 32 30/04/13**
- Global model
  - Introduction of data from CrIS and ATMS instruments on board NASA's NPP polar orbiting satellite, giving improved verification scores
- UKV, MOGREPS-UK and Euro4 models
  - Implementation of different ice crystal and snow fall speeds with the result that forecasts of high cloud have been improved without affecting precipitation (as verified against satellite imagery)
  - Low cloud forecasts at short range have been improved due to cloud assimilation changes

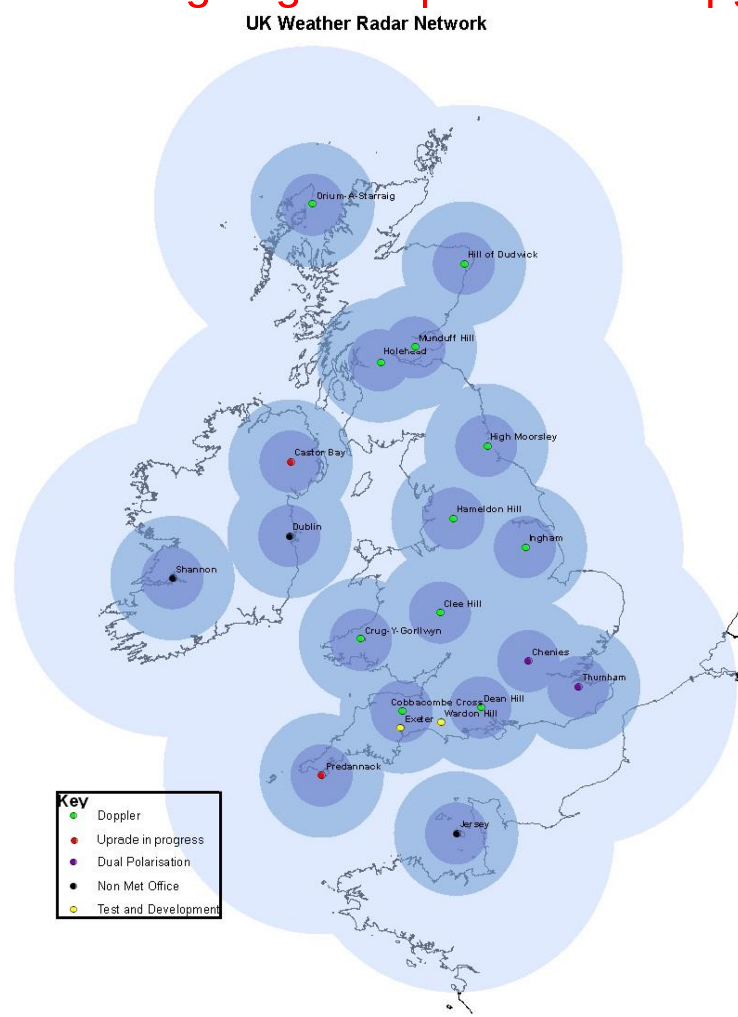
Weather radar renewal project (2011- 2015)

15 Operational Radar:
6 Doppler Radar
1 Dual Polarisation Radar

15 Operational Radar:
15 Doppler Radar
4 Dual polarisation Radar
2 undergoing dual polarisation upgrade



April 2011



September 2013

Future Plans

Met Office

PS33 Rose

- Rose provides a common solution for managing, configuring and running suites of scientific applications.
- Rose will replace
  - the Suite Control System (SCS).
  - All GHUI-based User Interfaces - . UMUI, OPSUI, etc
  - UM scripts.
- Rose provides
  - A simple application configuration
  - Suite utlilities to run Rose apps within cylc
  - Commands to install and run
  - Web based Output viewer
  - GUI for editing applications and suite configurations
  - Suite versions control and discovery GUI
- Due for operational implementation in Winter 2013/2014

PS34/PS35 Outlook for the UKV

Met Office

- **DA changes (see talk by Bruce Macpherson)**
- **PS34 (Spring 2014)**
  - New multilayer Snow scheme
    (the current snow scheme is a zero-layer scheme and suffers from excessive ground heat fluxes which can lead to warm biases).
  - New Murk sources
- **PS35 (Summer 2014)**
  - ENDGame dynamical core
  - Grey Zone Turbulence
  - Warm rain microphysics (scale aware)
  - I. A. Boutle et al. QJRMS Early View. “Spatial variability of liquid cloud and rain: observations and microphysical effects”

http://onlinelibrary.wiley.com/doi/10.1002/qj.2140/abstract

Questions?

Photo: A tornado in Kansas on the evening of the 18th May 2013 (taken by Steve Willington whilst storm chasing!)