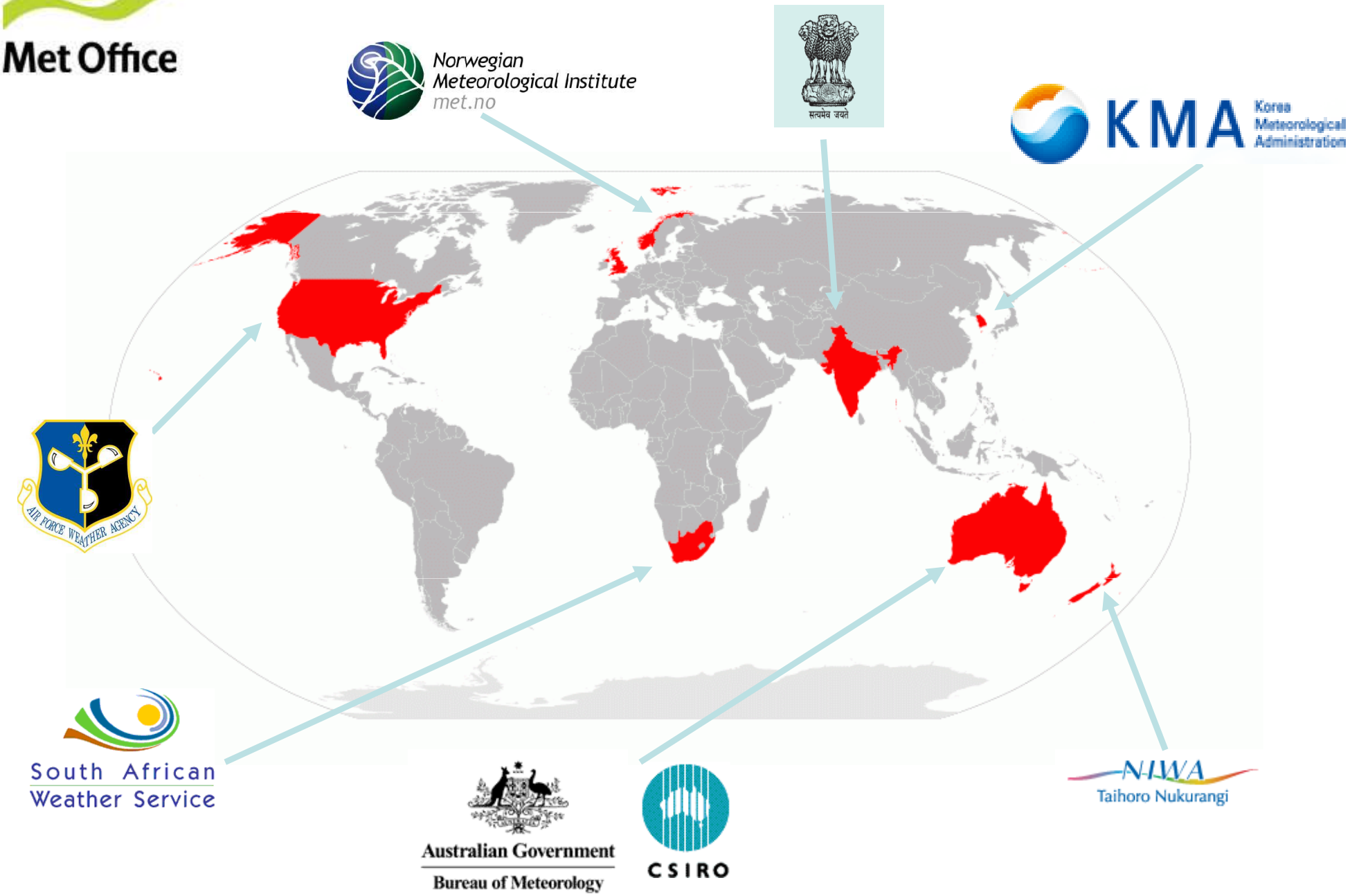
Consortia Presentation

for 33rd EWGLAM and 18th SRNWP Annual Meeting 2011
10th – 13th October 2011 Tallinn, Estonia

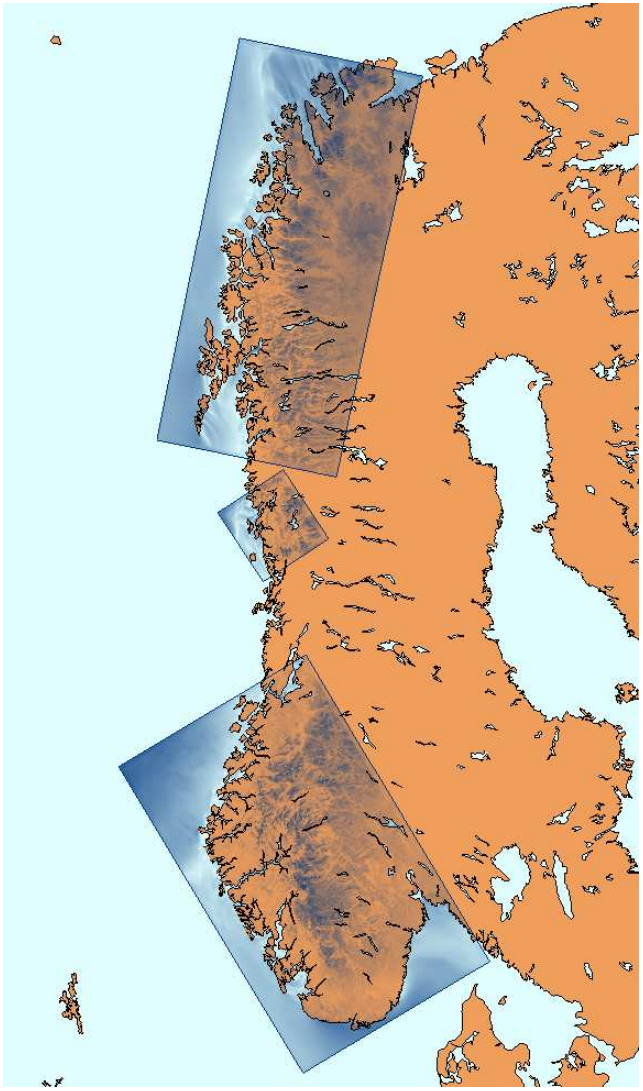
Presented by Mike Bush

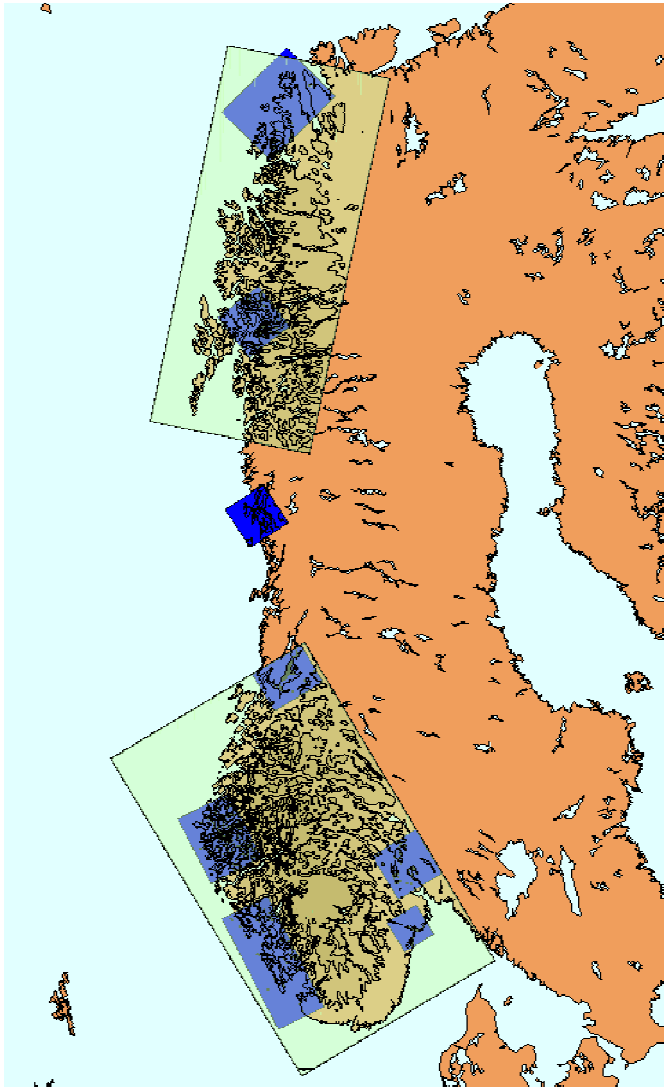
Collaboration status

Operational users 2011



Met.no: Old and new operational UM 1km domains





- Now 70 vertical levels and vn7.5

courtesy Dag Bjorge

KMA: 12km Regional Configuration

- **Major Change : Cold Start -> 4DVAR Cycle**

  Vertical Layers L38 -> L70

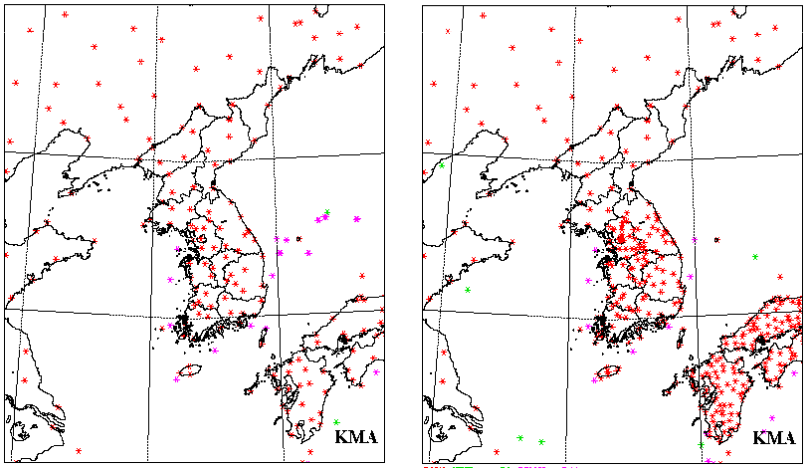
- Observation DB & cut-off : Same as Global Cycle

  Observation Source used in Global Suite

  + Radar Rainrate (MOPS)

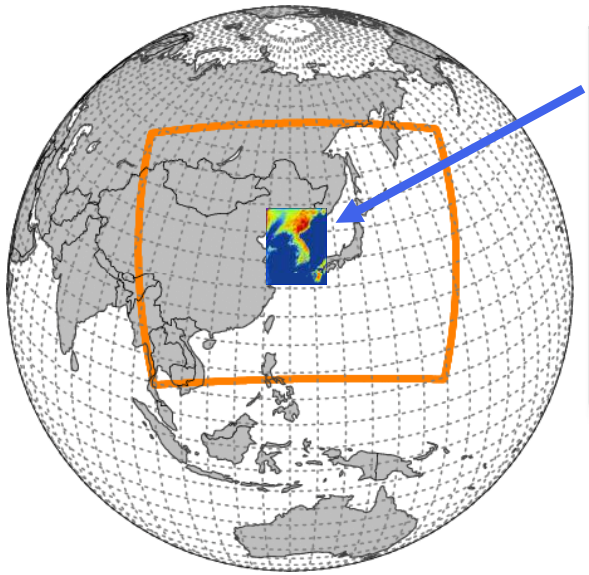
  + Additional Surface Obs. (AWS, AMEDAS)

- Inner Loop Resolution : 36km L70
- No Surface Analysis (downscaling from global data)



KMA
Korea Meteorological Administration

KMA: 1.5km L70 UM (KORV)

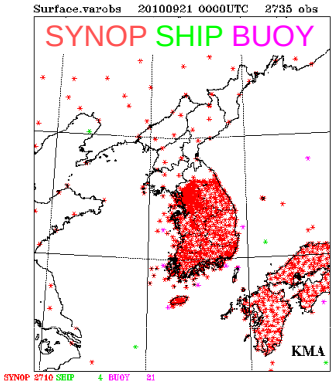


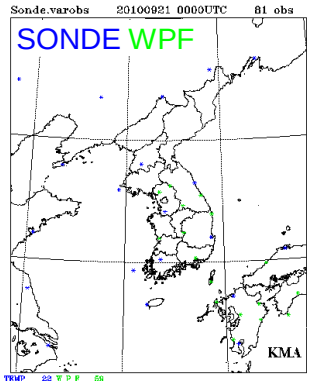
KORV
(in preparation)

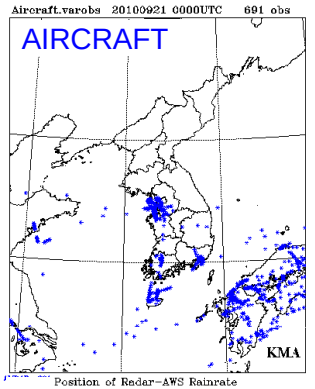
- Resolution :
  1.5kmL70 (744*928)
- Target Length :
  12 hours (3 hourly)
- Initialisation : 3DVAR

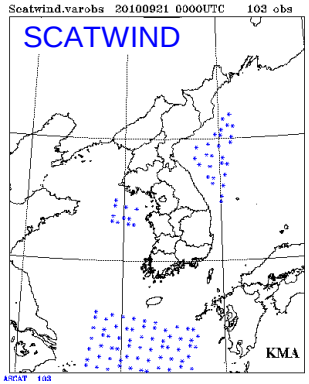
- Grid : Variable Grid (inner : 1.5km)
- Timestep size : 50 sec
- Data Assimilation : 3DVAR + FGAT
- Latent Heat Nudging
  (from hourly rain rate)

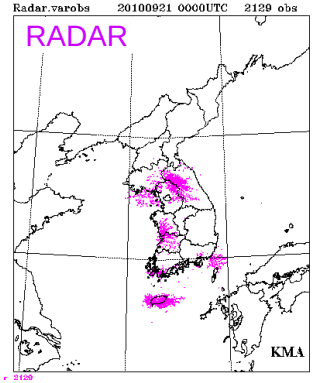
- Parallel Run : July 2011
- Operation : 2Q 2012

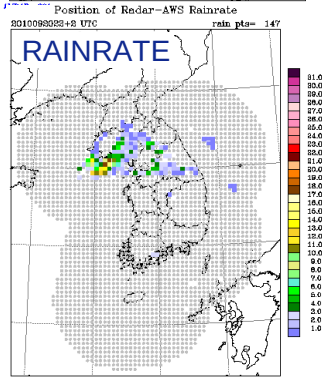












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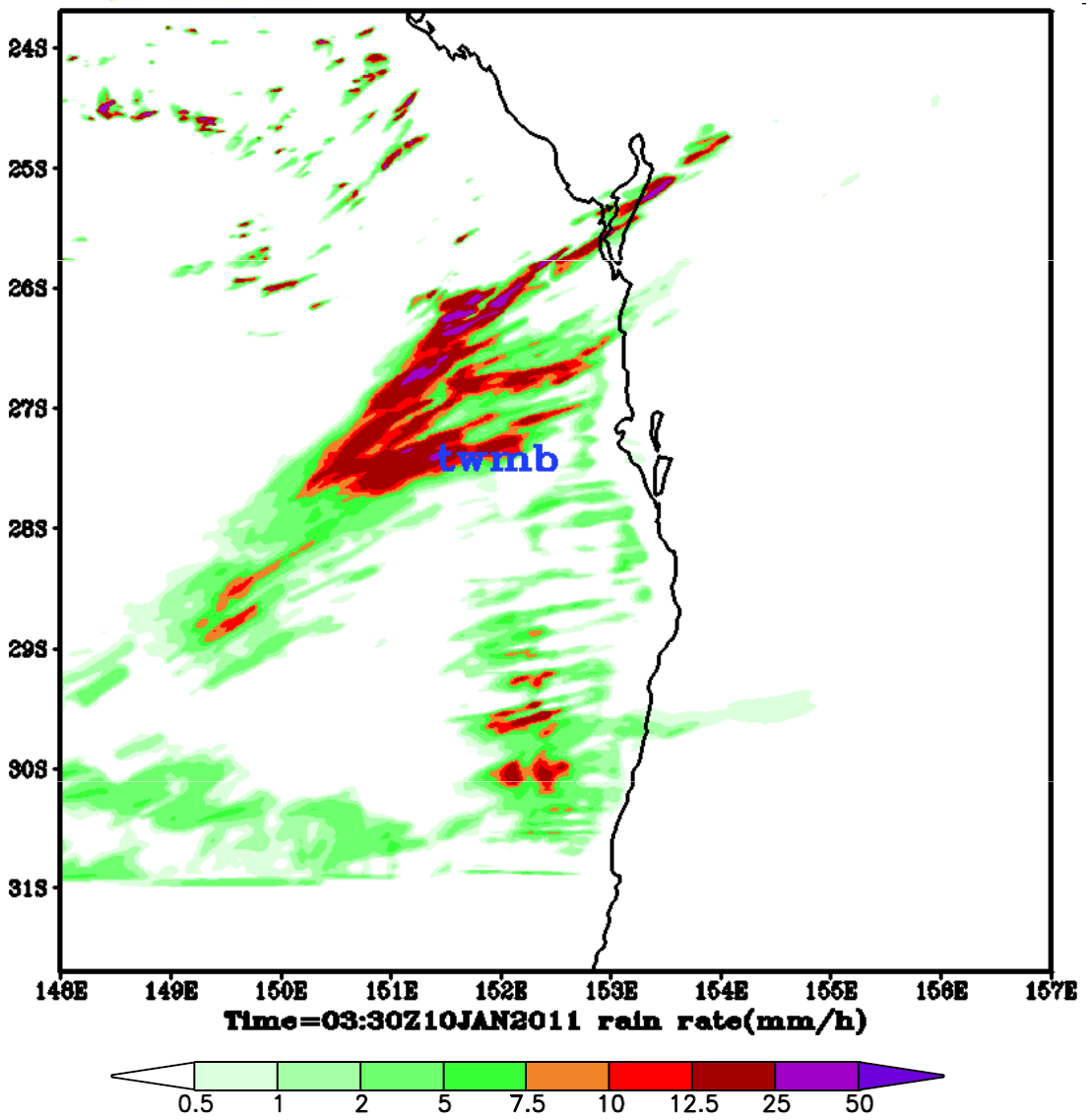
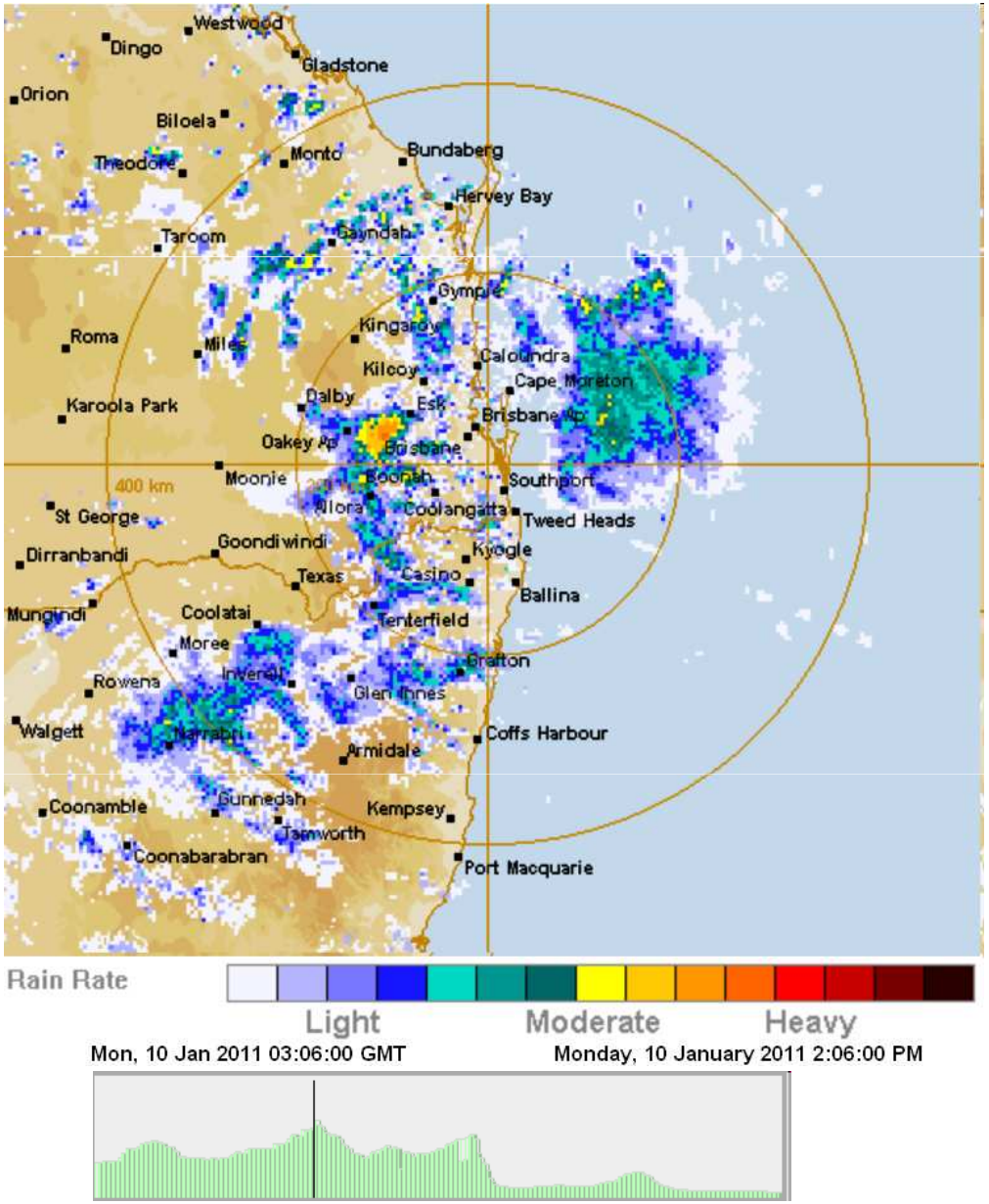
Brisbane Floods, UM1.5km, T+24





courtesy Kamil Puri, BoM

DIAbatic influence on Mesoscale structures in ExTratropical storms (DIAMET)

- DIAMET is a NERC-funded consortium project involving the Universities of Manchester, Leeds, Reading and East Anglia
- Met Office extensively involved as project partners.
- Its aim is to improve the forecasting of severe weather over the UK.
- There is a field campaign, using the NERC FAAM aircraft to probe mesoscale structures in storms approaching the UK, with high-resolution modelling of these events
- The results of the field campaign will be used to improve the Met Office Unified Model in a few key areas (convection, air-sea fluxes and microphysics)
- http://www.cas.manchester.ac.uk/resprojects/diamet/

Model development

GlobalAtmos Configuration

Single scientific configuration of MetUM global atmosphere to be used across all timescales: **GlobalAtmos (GA)**

Documentation: Walters et al. (2011), *Geosci. Model Dev.*, **4**, 1213-1271.

GlobalAtmos is:

- Specification of parametrisations and options therein
- Independent of horizontal resolution

GlobalAtmos is *not*:

- Tied to a specific system
  (e.g. Coupled climate model, NWP suite, EPS)
- Tied to a single MetUM code version
- Restricted to global model use only
  (e.g. regional climate models use GlobalAtmos)

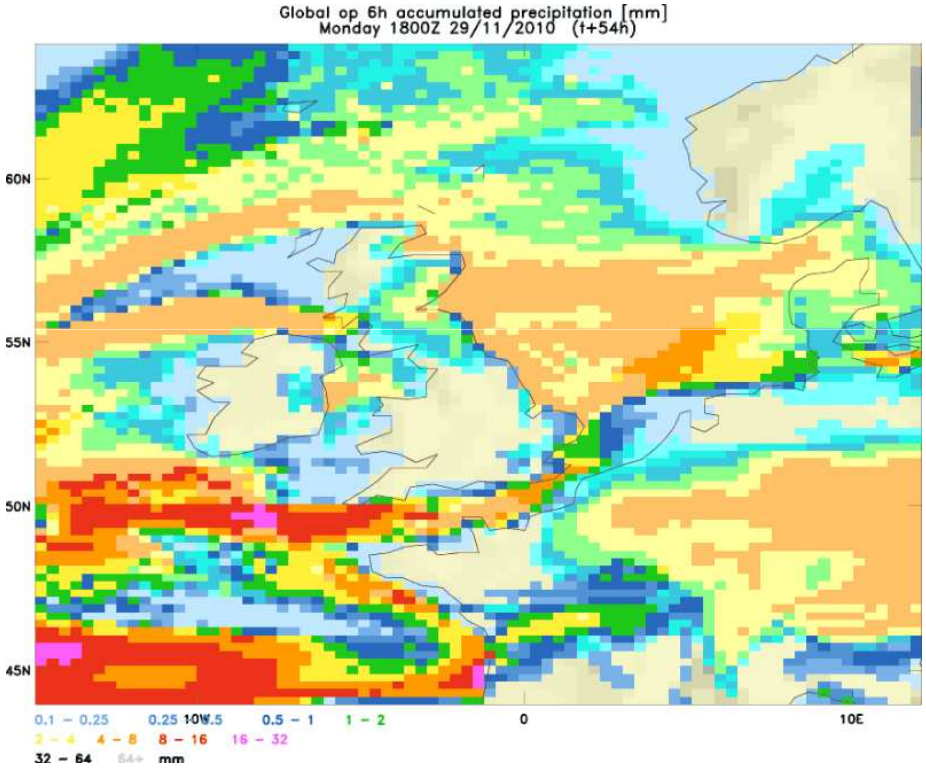
UK 4km Global downscale model

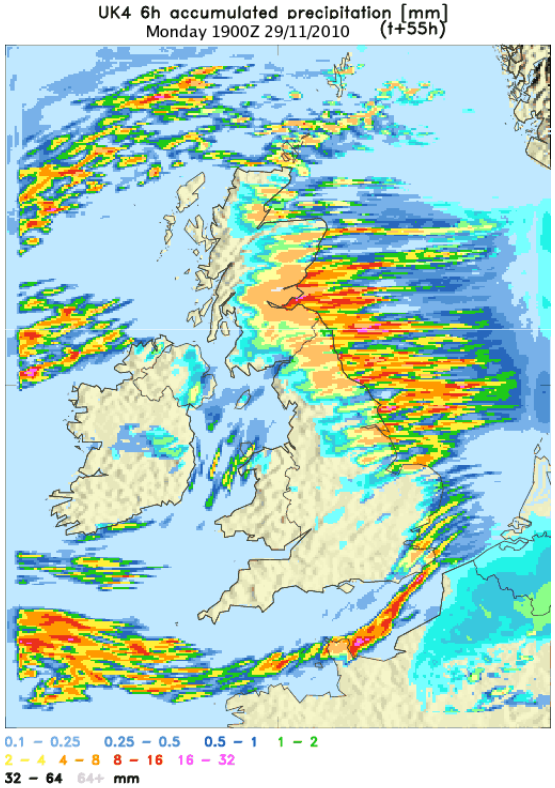
- Runs 4x daily reconfiguring from Global analysis (0,6,12,18z)
- Run length: 5 days (0,12z) , 2.5 days (6,18z)
- 3 hourly LBCs from Global model
- Uses UK4 science (with some exceptions)
- No murk aerosol in model

Initial Development

- Set-up in November 2010 as a quasi-operational model in response to requests from forecasters during the early wintry weather in late Autumn.
- Problems with the Global model not modelling the inland penetration of heavy snow showers over Eastern England/Scotland, so a longer range high resolution 4km model was set-up to give additional guidance for severe weather.

Plot1&2:
6 hrly precip accum.
Global v UK4 downscale





Comparison UK Index scores

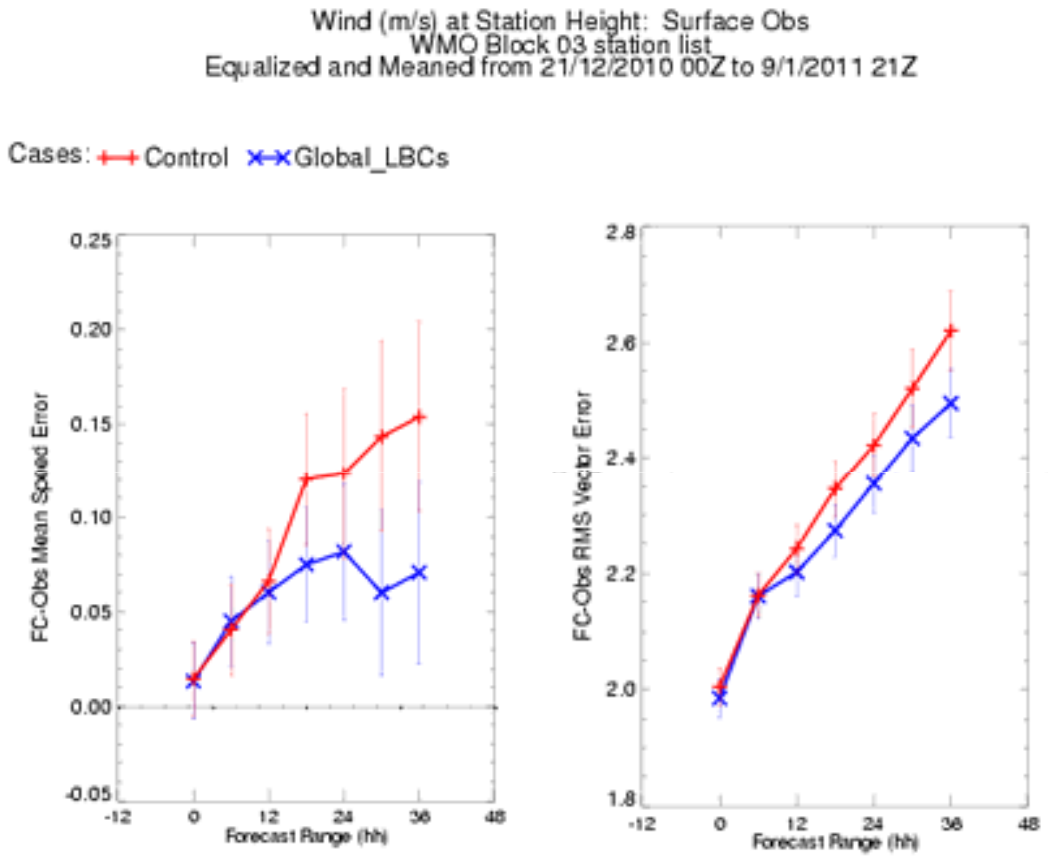
Operational UK4 **v** Global downscaled by UK4 (UK4X)

	Apr	May	Jun	Jul	Aug
Skill Score Temperature	0.4%	0.8%	0.7%	1.3%	0.2%
Skill Score Vector Wind	1.3%	0.5%	0.7%	1.1%	0.9%
ETS - Visibility	-3.3%	0.2%	-1.4%	-1.1%	-1.7%
ETS - Total Cloud	0.1%	0.4%	0.2%	0.3%	0.4%
ETS - Cloud Base Height	0.3%	0.2%	0.1%	0.3%	-0.1%
ETS - 6hr Precip	1.5%	0.0%	0.4%	-0.4%	-0.1%
Total	**0.2%**	**2.2%**	**0.7%**	**1.5%**	**-0.3%**

- Operational UK4 may benefit
  - by avoiding interpolation of coarse resolution ICs
  - from high resolution DA *(3DVAR)*
  - because driving NAE model has MURK parameterisation
- Global downscaler UK4X may benefit from
  - fresher boundaries
  - more optimal if coarser resolution DA upstream (*hybrid 4DVAR*)
  - from single nesting rather than double nesting

UKV/UK4: NAE vs Global LBCs

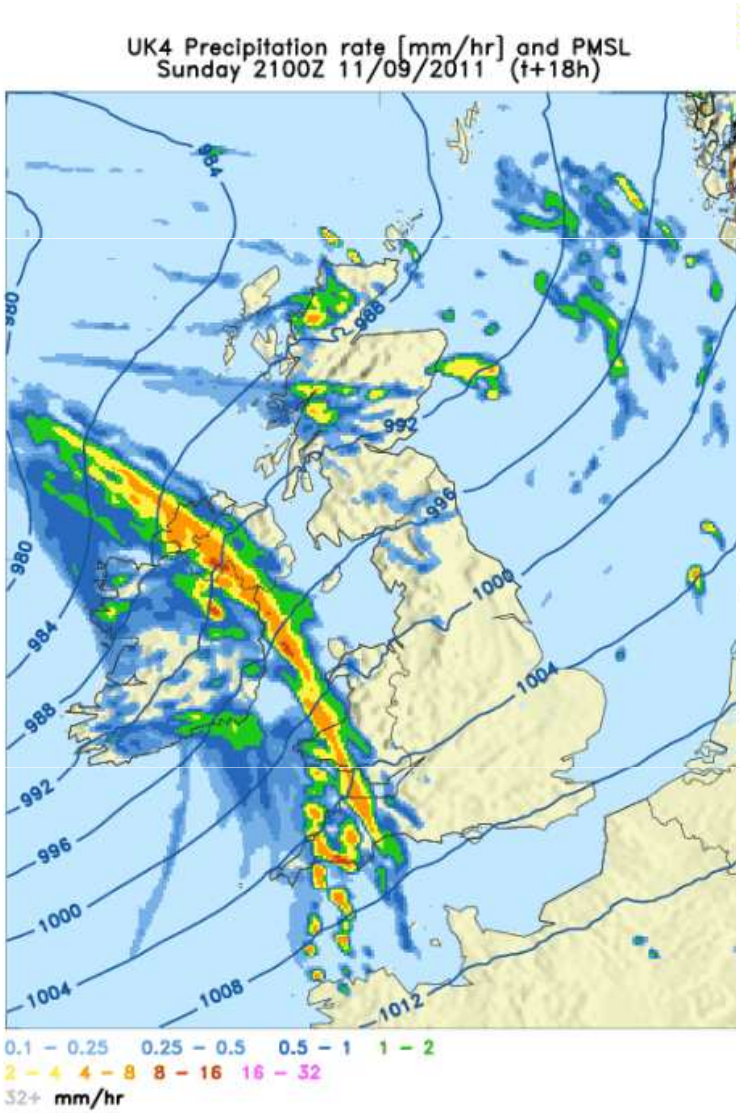
- Improvement to 10m wind and screen temperatures in Winter when using Global (3 hourly) LBCs instead of NAE LBCs

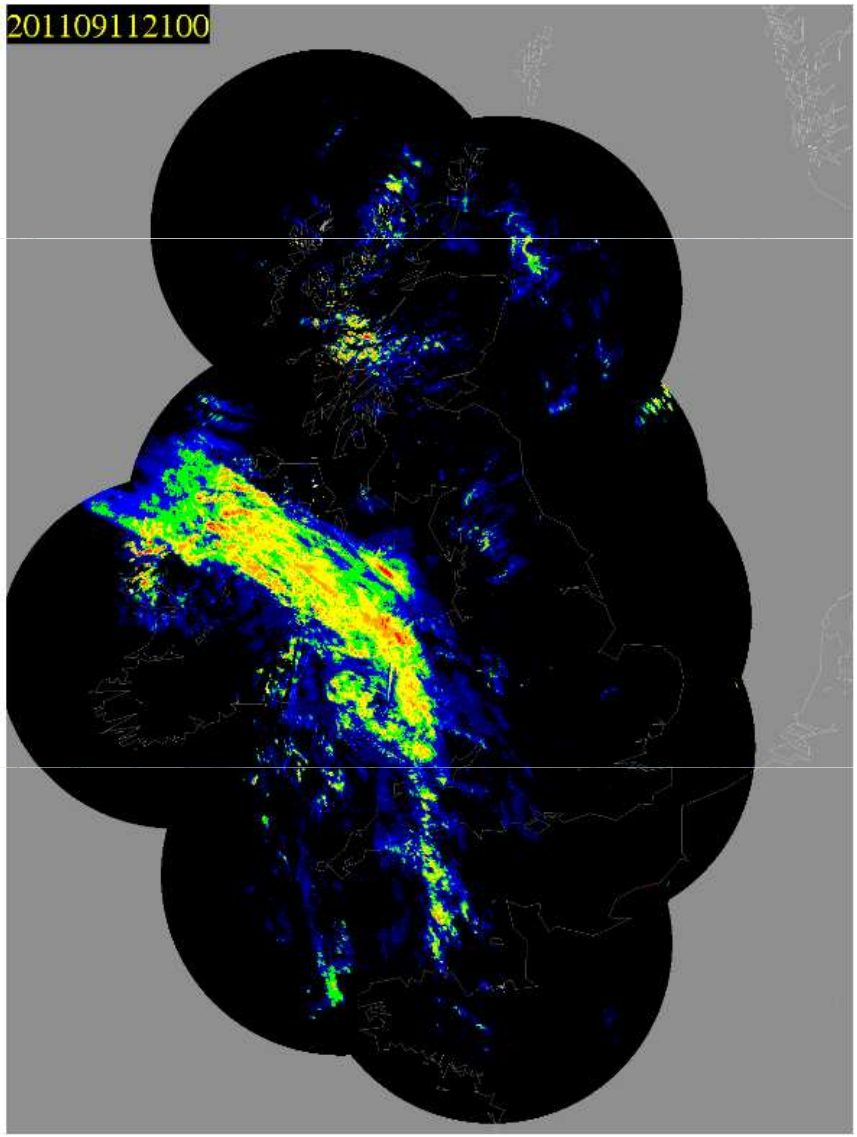


LBC sensitivity: Case Study 11/9/2011 3z

Left:
UK4 with NAE LBCs.

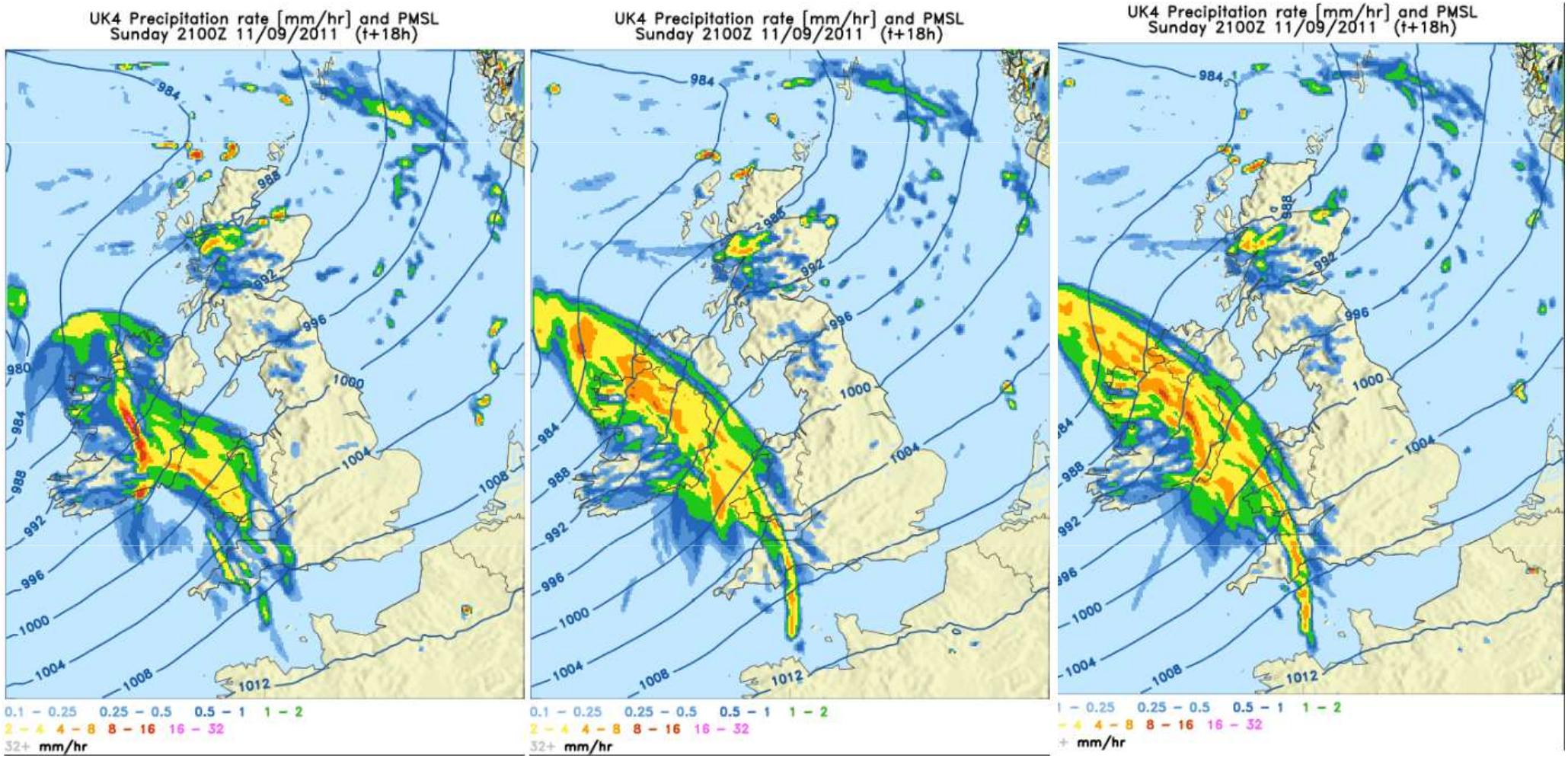
Right:
Radar at 21z 11/09/2011





UK4 with Global LBCs:

3 hourly (left), hourly (centre) and half hourly (right)



Parallel suite highlights

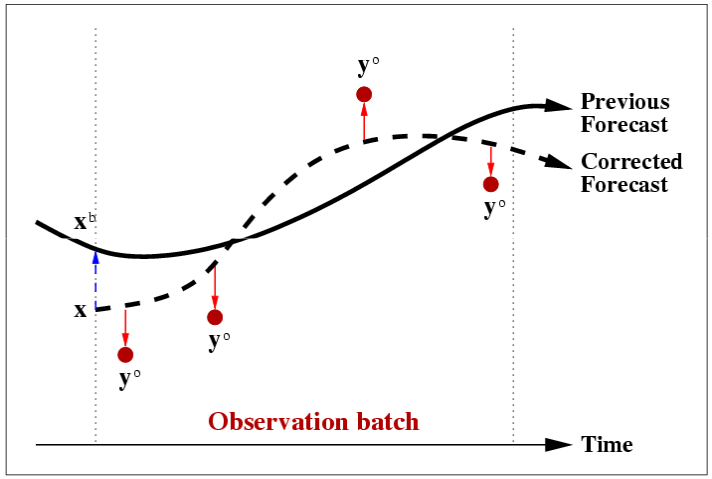
Parallel Suite Highlights

- UK4 Global downscaler implemented operationally in January 2011.
- **Parallel Suite 26 16/03/11:**
- Improvements in representation of light rain in the Global model
- Improvements in representation of drizzle and fog in the limited area models
- **Parallel Suite 27 20/07/11:**
- Global model – hybrid DA and moisture control variable
- **Parallel Suite 28 (currently running), implementation due 08/11/11:**
- Ice cloud changes in UK models
- UKV/UK4 models to use hourly Global LBCs

PS27: Global model changes

- Assimilation method
  - Hybrid – coupling with MOGREPS for estimating model error
  - Moisture control variable, replacing RH with scaled humidity variable
- Observation changes
  - Introduce METARS
  - GOES/Msat-7 clear-sky radiances, extra IASI (land)
  - Revisions to MSG clear-sky processing and GPSRO
  - Reduced spatial thinning (ATOVS/SSMIS/IASI/AIRS/aircraft)
- UM
  - Prognostic dust (non-interactive)
  - I/O server

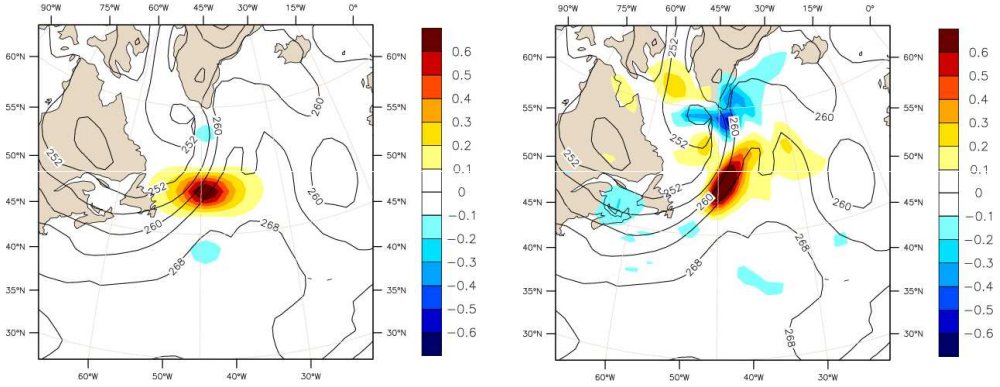
Hybrid 4D-Var



- Since late 2004, global data assimilation has been done using 4D-Var:
- **Key question**: How do we specify the "background" error characteristics at the beginning of the window?
- **Traditional approach**: Explicitly model (parameterise) the covariances.
- **Main problem**: Difficult to incorporate to "Errors of the Day"
- **Solution**: Blend in covariance data from an ensemble system, creating a "hybrid" covariance model
- Hybrid system (coupling to MOGREPS-G) now operational
- Only the first in a series of developments that will see increasing synergy between ensemble forecasting and data assimilation

Hybrid data-assimilation

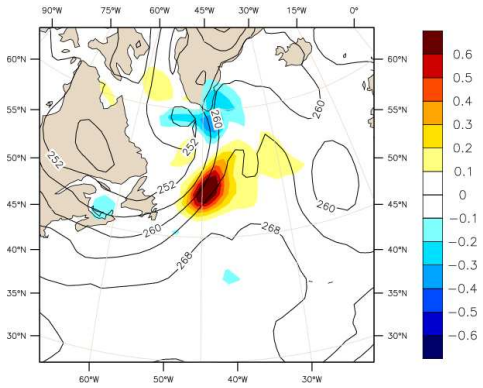
u response to single u observation:



Climatological COV MOGREPS COV

- MOGREPS is sensitive to the position of the front, and gives covariances that stretch the increment along the temperature contours.

- Ensemble currently too small to provide the full covariance, so we blend the MOGREPS covariances with the current climatological covariances; i.e., we use a **hybrid** system:

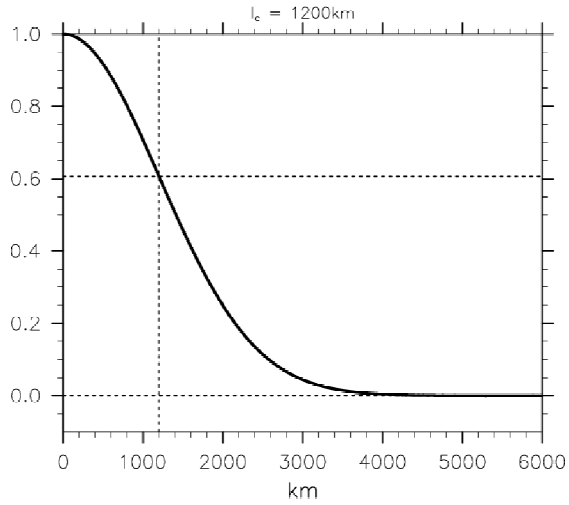


Hybrid COV

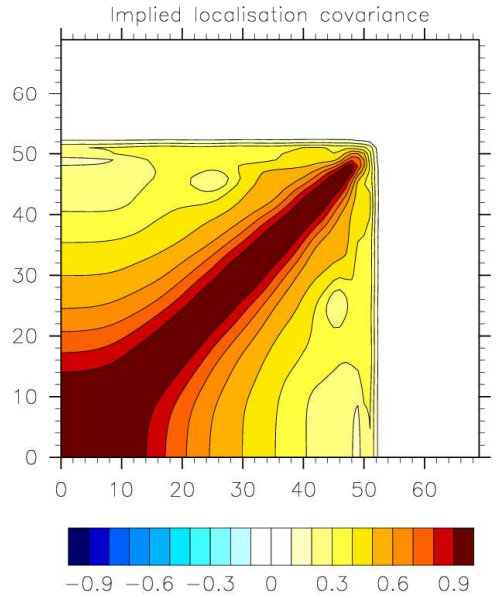
Tuning factors

- The key tuning factors are:
  - The weighting between the climatological and ensemble covariances.
  - The spatial localisation of the ensemble covariances (to reduce affect of sampling noise.)
- We have chosen:
  - 80% climatological / 50% ensemble covariance in the troposphere (designed to maintain the analysis fit to observations). Relax to the full climatological covariance above 21km.
  - The following localisation functions:

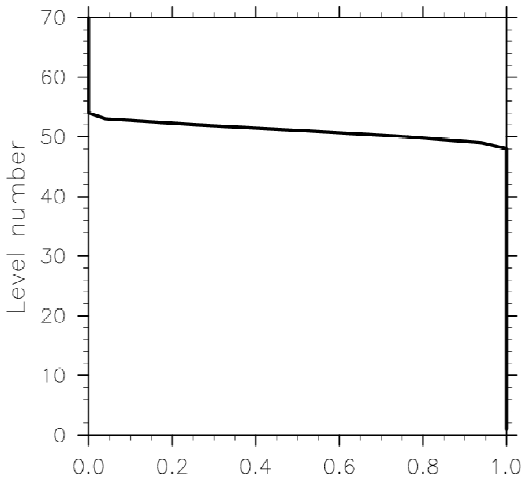
Horizontal



Vertical

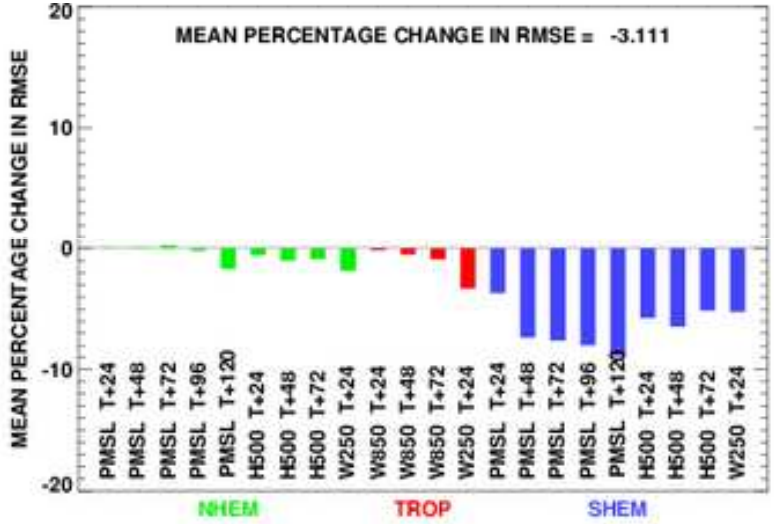


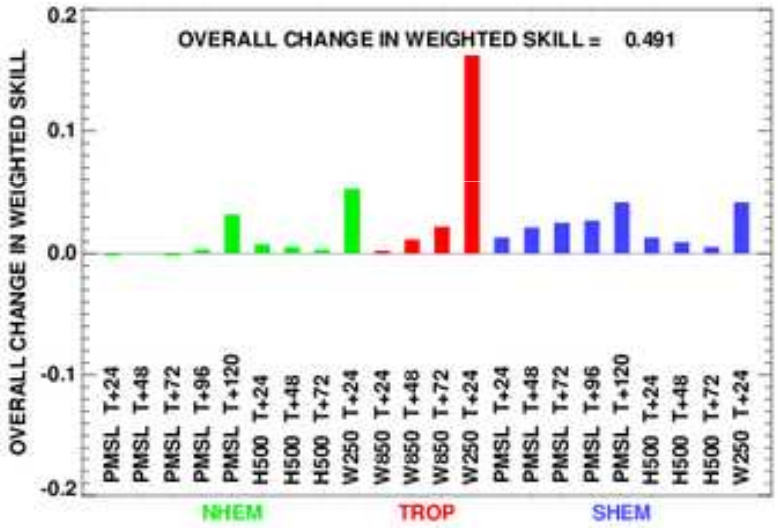
(Vertical variance)



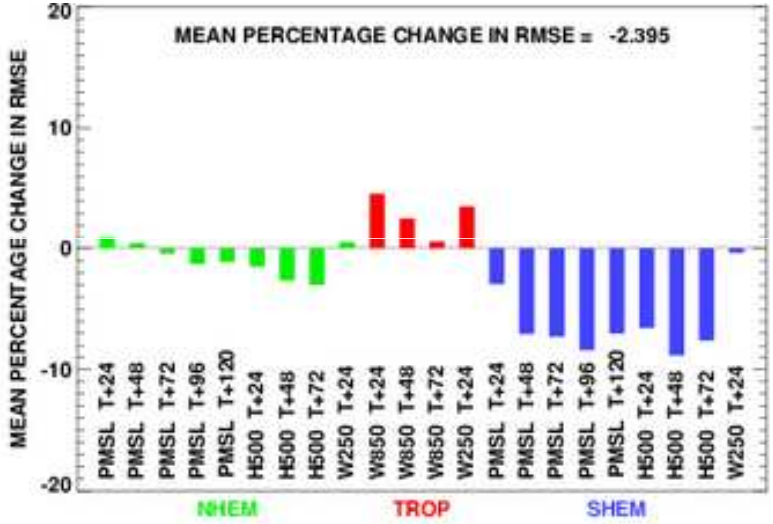
PS27 Global NWP Index Impact

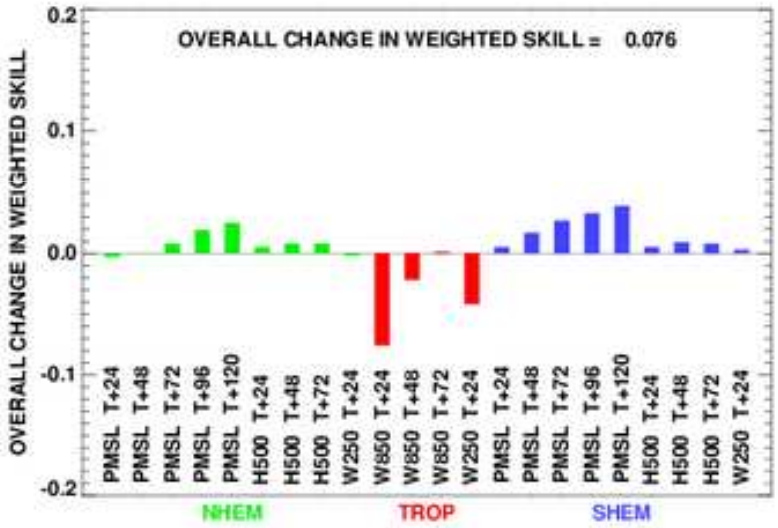
Impact Vs. Observations=+2.11





Impact Vs. Analyses=+0.67





- Biggest single reduction in overall global forecast error for many years.
- First time in memory that all parameters have reduced error vs obs. (usually a mix).

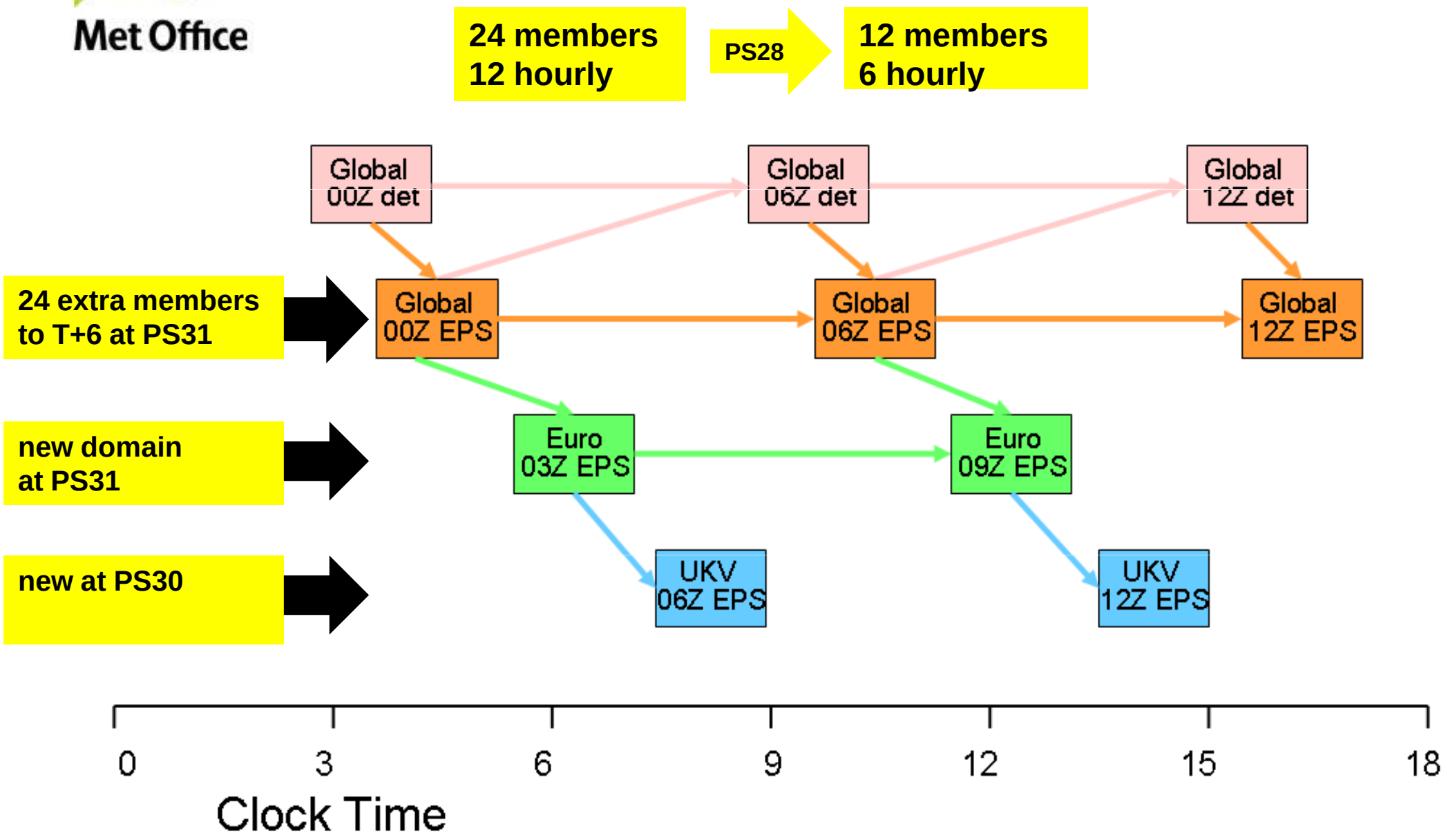
Future Plans

Upgrade plans for 2012/2013

- March 2012
  - PS29 is intended to be a science-neutral migration to the IBM Power 7
- June 2012
  - Introduce UK 2.2km ensemble (MOGREPS-UK)
- September 2012
  - Retire NAE model, with customer migration to other models
  - Retire UK4 model (as long as UKV performance is good enough)
  - Introduce MOGREPS-EU and retire MOGREPS-R
- FY 2012/2013
  - Possible vertical resolution upgrade (L85 Global/L110 UKV)
  - Possible horizontal resolution upgrade/ENDGAME in Global

6 hour EPS Cycle

with hybrid DA link



Operational NWP Configurations Spring 2013?

Global

- 16-20km 85L (85km top)
- Hybrid 4DVAR (50km inner-loop)
- 144 hr 2*/day & 60 hr 2*/day
- Downscaled via 2.2km UK

- MOGREPS-G 40km? 85L 36/12member 6/60 hr 4*/day *& 24 member 360 hr 2*/day at ECMWF*

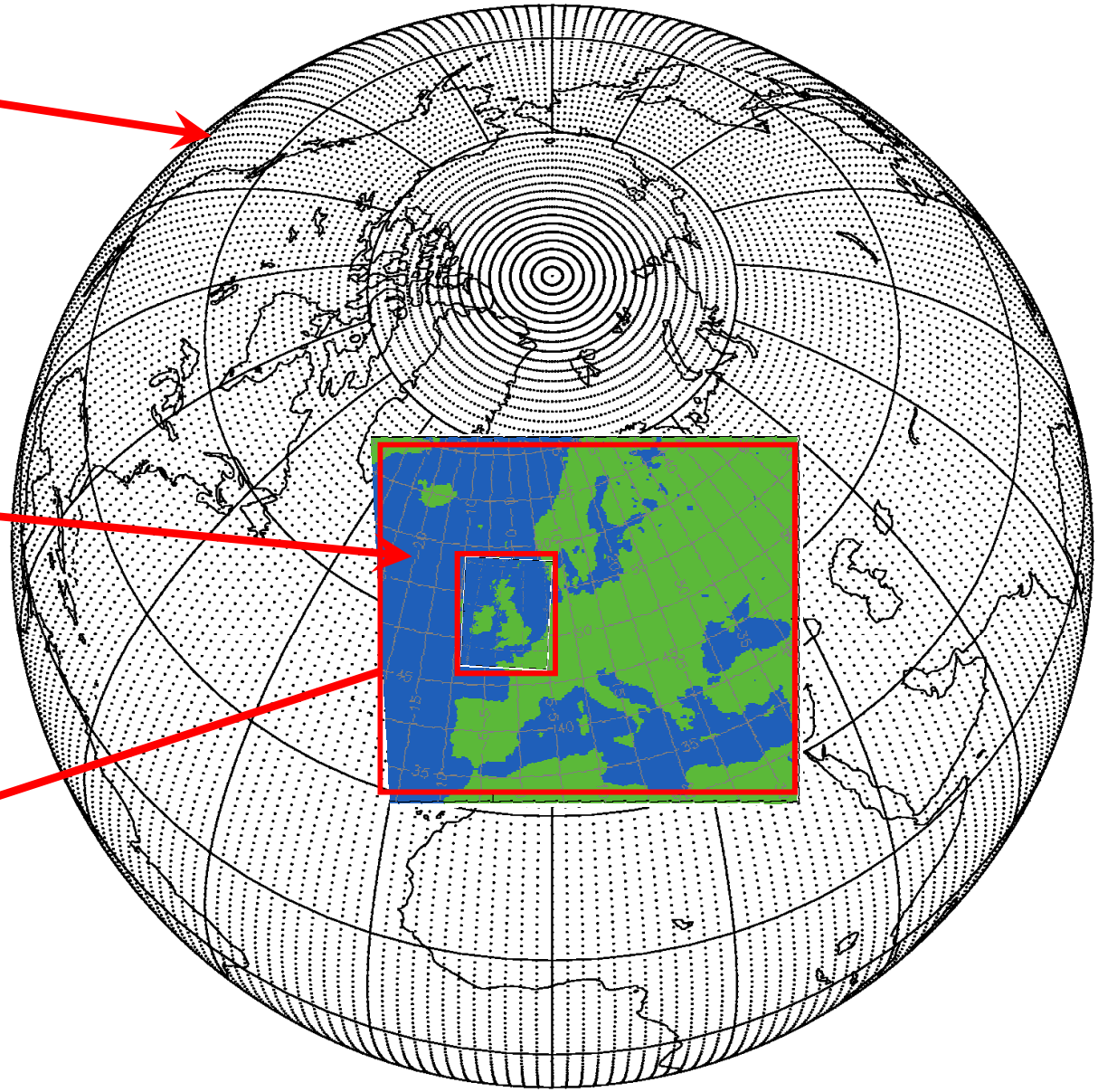
MOGREPS-EU

- Common NWP/reanalysis domain.
- 3D-Var (or NoDA)
- 12Km ~100L (40km top)
- 12 members : 48 hr ; 4*/day

UK

- 1.5km ~100L (40km top)
- 3DVAR (hourly)
- 36 hour : 4*/day

- MOGREPS-UK : 2.5km ~100L : 12 member : 36 hr : 4*/day



Questions?