The Met Office's New Global and Mesoscale NWP Models

Glenn Greed, Sean Milton, Ian Culverwell
David Cameron and Dingmin Li,
+ plus many more.

New Unified Model -2002

NEW DYNAMICS

- Semi -Lagrangian advection
- Semi-implicit time integration
- Horizontal staggering - C grid
- Vertical Staggering : Charney- Philips
- Height co-ordinate
- Non-hydrostatic formulation

HADAM4 Physics

- Edwards-Slingo Radiation √
- Mixed phase precipitation √
- New Boundary Layer √
- MOSES I and II √
- Vertical gradient cloud area
- Anvils + CMODS

√ already operational in MES

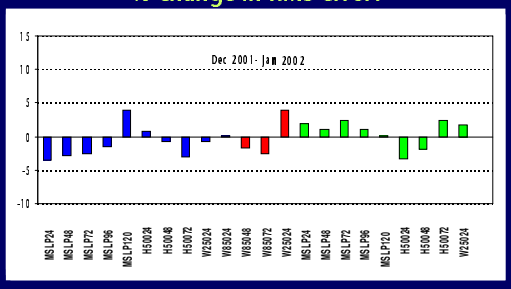
Expected benefits

- Non-hydrostatic : ability to increase resolution in UK area.
- Improved stability and accuracy - less noise in forecasts
- Improved coupling to dynamics
- Improved Physics for global model
- Unify global and UK area physics : Better boundary conditions.
- Better coupling with 3D-Var which was designed around new grid.

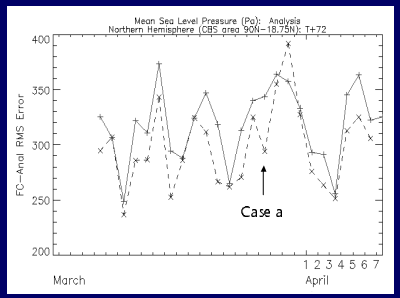
Global Testing

- N216 "shadow suite" - full assimilation cycle and forecast running since August 2001. (Continuous development)
- N216 30 day trials with full data assimilation for
  - Mar-Apr 2001
  - Jun-Jul 2001
  - Sep-Oct 2001
  - Dec-Jan 2001-02
- N216 (432x325x38)

NWP index components (vs OBS)
% change in RMS error.

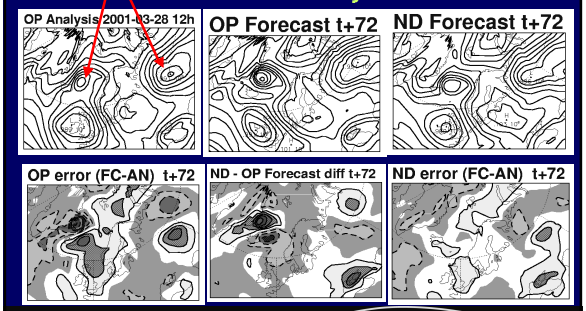


Time Series

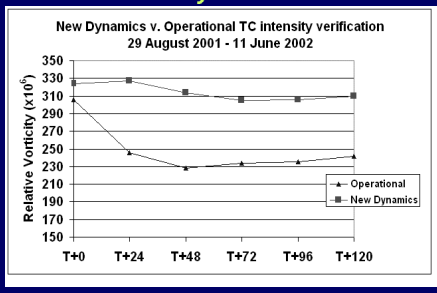


Improved depth and position of cyclones in New Dynamics forecasts.

Case Study

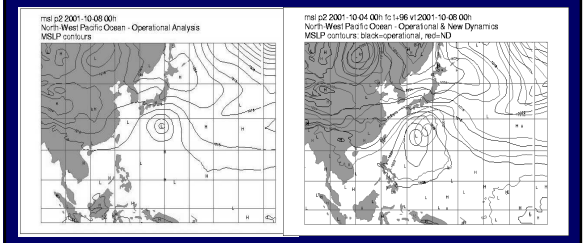


Tropical Cyclone Intensity Verification



Courtesy J. Heming

Typhoon Krosa
8th and 9th October 2001



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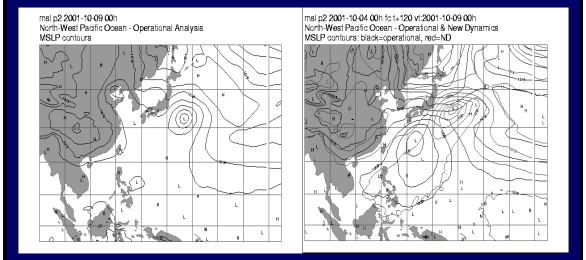
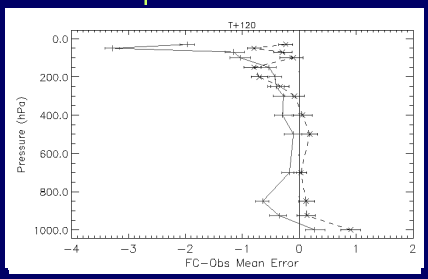
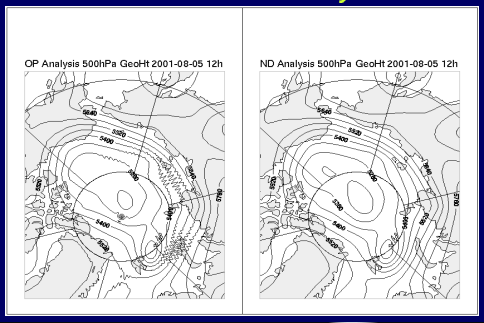


Mar - Apr 2001
T+120 Temperature Biases vs. Sondes



Reduced Noise in New Dynamics



Summary

Benefits	Problems
Reduced RMSE in Winter and Spring, neutral overall.	Tropical 250hPa wind RMS VWE too large (~5%)
Reduced NH RMSE in most seasons	Tropical 850hPa wind RMS VWE larger in summer
Improved extra-tropical and tropical cyclones	Increased warm bias in mid troposphere.
Reduced noise in ND forecasts	(SH errors larger - analysis differences) 'Fixed'

'Tiger teams'

Latest News/Future Work

- New Global and Mesoscale models went live August 6th.
- Some delays to launch to ensure downstream compliance.

- VAR vertical interpolation change to fix SH analysis problem
- Global Science upgrade (Sept 02) Land Surface exchange scheme √
- Non-hydrostatic model lead to higher resolution MES.
- New version Coupled Climate model HADGEM1

√ already operational in MES

Thank you for listening.

Are there any questions?

High Resolution and High Winds at the Met Office

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15th AMS NWP,San Antonio, Texas, 2002

Current Resolutions

- The global model is run at N216L38 (432x325x38). (approx 60km resolution)
- The current United Kingdom Mesoscale model is run at 12km resolution.
- Various other Limited Area Model (LAM) forecasts are run depending on the operational requirement.

LAM code

- The LAM's use the same code library as the global forecasts and where possible the same physics options are employed.
- The new UM (unified model) is formulated in a non-hydrostatic fashion which should allow the model to be run at higher resolution than it is currently.

Research work

- The effect of going to higher resolution is being investigated.
- Mainly we are looking at higher horizontal resolution but higher vertical resolution may actually be a better use of resources.
- The frequency of updating from Lateral Boundary Conditions (LBC's) is also being investigated

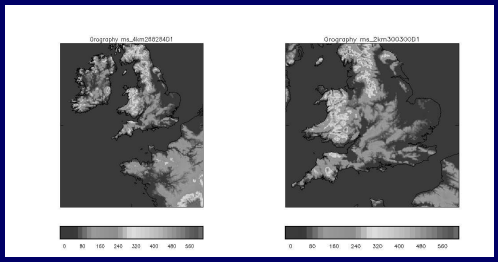
Forecast tests

- A global forecast was run at N216L38 (432x325x38)
- This generates the lateral boundary conditions (LBC's) which are used in the LAM forecasts.
- We can also generate high resolution LBC's from lower resolution LAM's, e.g 2km LBC's from 4km runs.

Test cases

- Two test cases are shown:-
- October 1987 "Great storm" to show the effect of vertical resolution on winds.
- 12th October 2000 rainfall event to show effect of horizontal resolution.

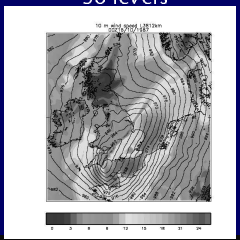
Higher resolution orography



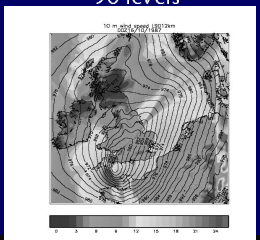
"Great Storm" (High winds)

- 10 metre wind fields

38 levels



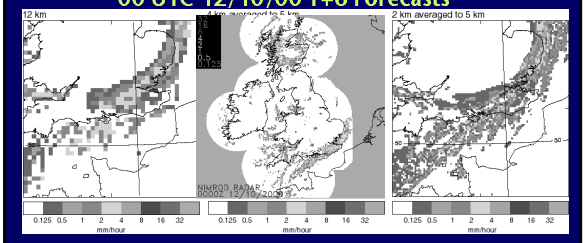
90 levels



Floods and Gales of Autumn 2000

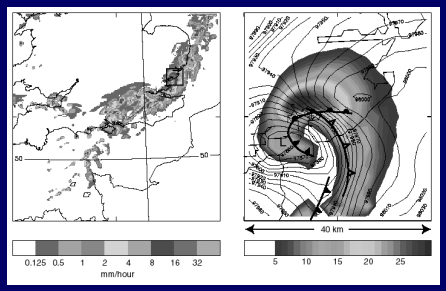
High Resolution Regional Modelling

Rainfall Rates
00 UTC 12/10/00 T+6 Forecasts



Courtesy Nigel Roberts, JCMM

Meso-cyclone (2km run)



Conclusions

- The use of higher resolution gives more detailed results and at 2km we can actually see mesoscale phenomena.
- The use of more vertical levels seems to produce better representations of large scale phenomena