

ECMWF's forecast system development

Erik Andersson, ECMWF

1. The operational forecast system

The operational forecast system at ECMWF consists of the following main components

- High resolution deterministic forecast: twice per day, 25 km 91-level, to 10 days ahead
- Ensemble forecast (EPS): twice daily, 51 members, 50/80 km 62-level, to 15 days ahead
- Ocean waves: twice daily
 - Global: 10 days ahead at 40 km
 - European Waters: 5 days ahead at 25 km
 - Ensemble: 15 days ahead at 100 km
- Monthly forecast: once a week, 51-members, 50/80 km 62 levels
- Seasonal forecast: once a month, 41-members, 125 km 62 levels, to 7 months ahead

The monthly extension of the EPS is coupled to an ocean model with a near-real time ocean analysis. The Seasonal forecast system is coupled to an ocean model based on a 12-days delayed ocean analysis

The main upgrades to the operational systems in the last two years are listed in the table below.

Date	Label	Description
06 Nov 2007	Cy32r3	IFS cycle implementation
20 Jan 2008		Revised production schedule: Products available 10 to 15 minutes earlier
11 Mar 2008		Integration of monthly forecast system with the medium-range EPS
20 May 2008		Assimilation of Metop/GRAS bending angles (radio occultation data)
03 Jun 2008	Cy33r1	Improved moist physics for 4D-Var, Assimilation of additional satellite data, Extended coverage and increased resolution for the limited-area wave model
30 Sep 2008	Cy35r1	Better handling of the melting of falling snow , New SST (high-resolution product from the UK Met Office), Sea ice analysis from the EUMETSAT Ocean and Sea Ice SAF
10 March 2009	Cy35r2	Revised snow scheme Direct all-sky 4D-Var assimilation of microwave imagers RTTOV-9 (developed by NWP-SAF) Use of ERA-interim analyses for the re-forecasts for EFI and monthly forecasts
12 May 2009		Operational assimilation of temperatures from five Indian radiosondes
8 Sep 2009	Cy35r3	Weak constraint 4D-Var (stratosphere) Non-orographic gravity wave scheme Assimilation of cloud-affected radiances for infra-red instruments

2. Performance of ECMWF forecasts

Figure 1 shows the evolution of the skill of the deterministic forecast of 500 hPa height over Europe and the extra-tropical northern hemisphere since 1980. Each curve is a 12-month moving average of root mean square error, normalised with reference to a forecast that persists initial conditions into the future. The last month included in the statistics is July 2009. For both regions skill has been consistently high relative to persistence, with skill increasing in particular over Europe at days 4-6.

WMO exchanged scores include verification against radiosondes over Europe. Figure 2, showing both 500 hPa height and 850 hPa wind errors averaged over the past 12 months, confirms the good performance of the ECMWF forecasts relative to the other global NWP centres.

3. Increased horizontal resolution (16 km)

On the 26 January 2010 the higher-resolution forecasting system was implemented. The upgrade includes:

- Deterministic from T799 to T1279 (16 km), Figure 3
- EPS from T399 to T639 (32 km)
- Wave model increases from 0.36 to 0.25 degrees

The change required substantial improvements to the technical infrastructure, affecting e.g. visualization (Magics and Metview), interpolation software in EMOSLIB and the software of MARS (the ECMWF Meteorological Archive and Retrieval System). For more detailed information see

http://www.ecmwf.int/products/changes/horizontal_resolution_2009/

4. Observation handling

The observation handling project is planned to run for a period of 2 years, with the aim to improve all aspects of data processing and diagnostics involving observations.

- Observation data base (ODB)
 - Increasing number of observation types
 - Increasing data volumes
 - Increasing complexity of data contents
- Monitoring / Graphics
 - Requirements are more and more demanding
 - Automation
 - Interactive plotting tools
- Archiving / retrieval
 - Post-mortem investigations
 - Performance assessments (AN/FC/Obs systems/Sensors)
 - Climate reanalyses
- Support for advanced data assimilation diagnostics, such as Forecast Sensitivity to Observations (FSO)
- Support for Ensembles of Data Assimilations (EDA)

5. Workshop “focus on observations”

The current workshop focuses on observations in order to introduce the ongoing ECMWF developments to the a wider audience, to benefit from experience gained elsewhere and to discuss technical issues associated with handling, archiving and visualisation of increasing volumes of observational data.

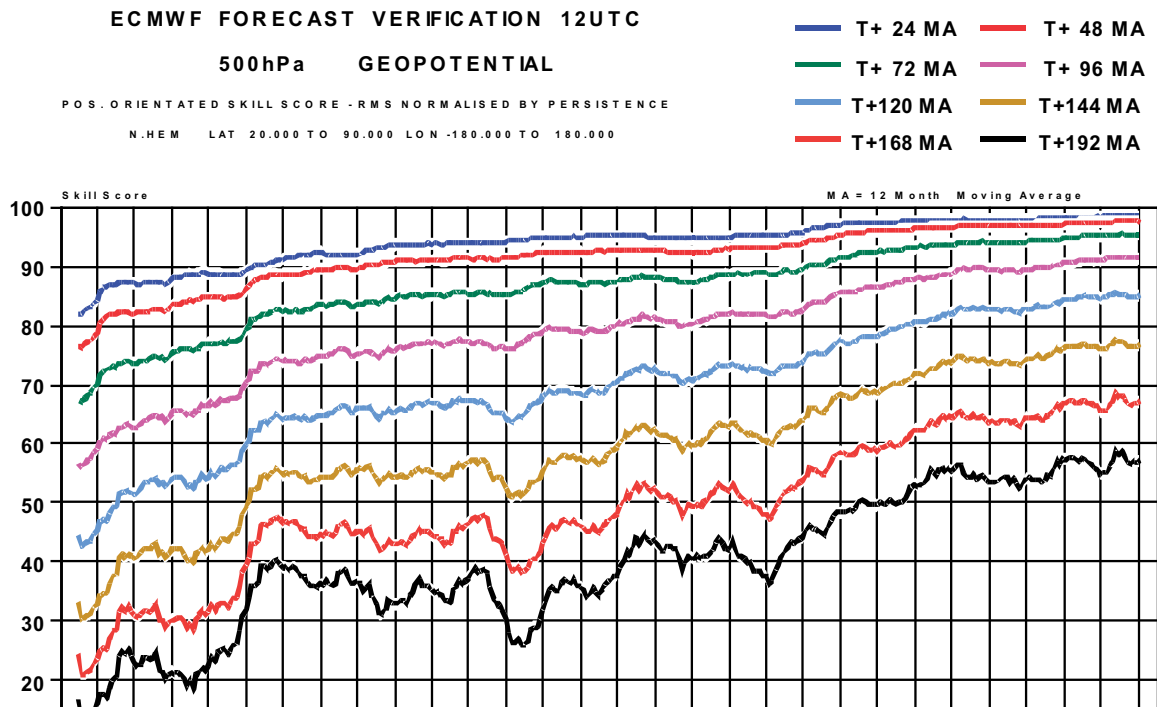
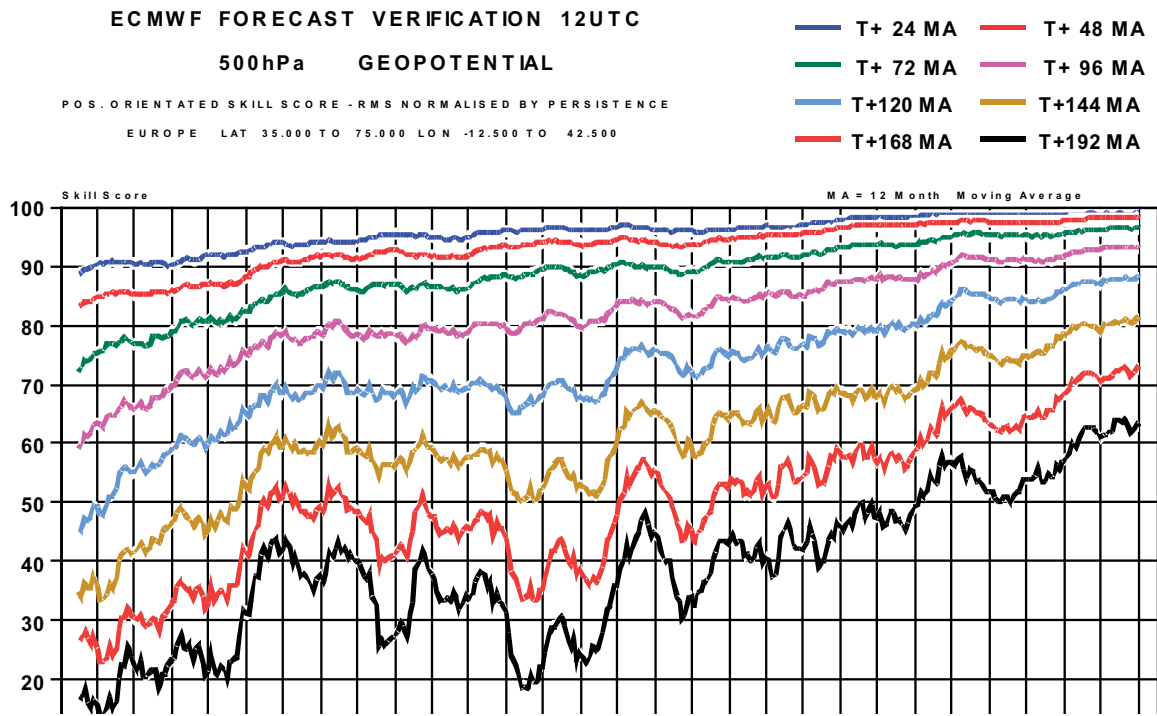


Fig. 1 500 hPa height skill score for Europe (top) and the northern hemisphere extra-tropics (bottom), 12-month moving averages, forecast ranges from 24 to 192 hours. The last point on each curve is for the 12-month period August 2008 - July 2009.

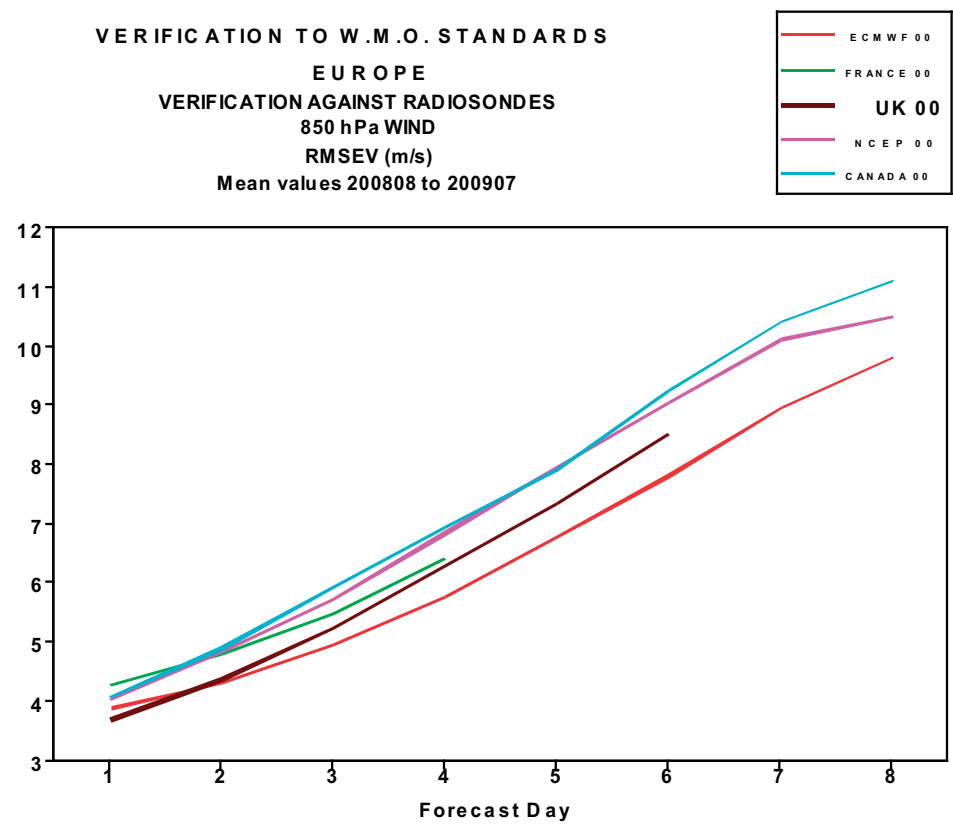
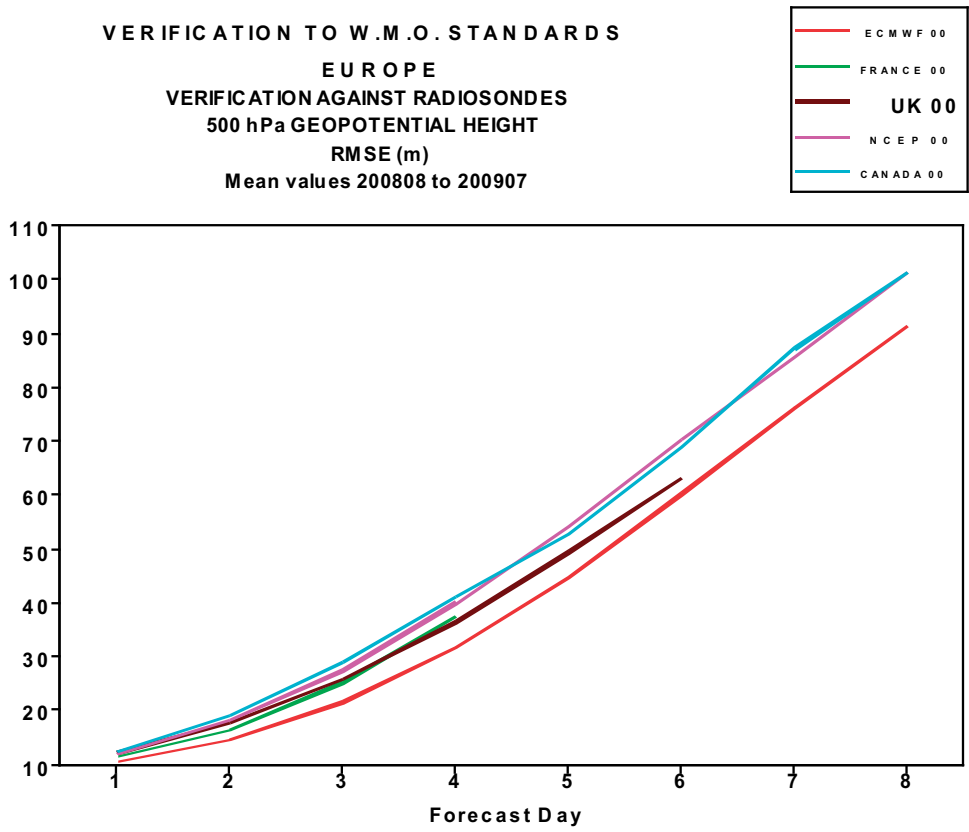


Fig. 2 WMO/CBS exchanged scores using radiosondes: 500 hPa height and 850 hPa wind RMS error over Europe (annual mean).

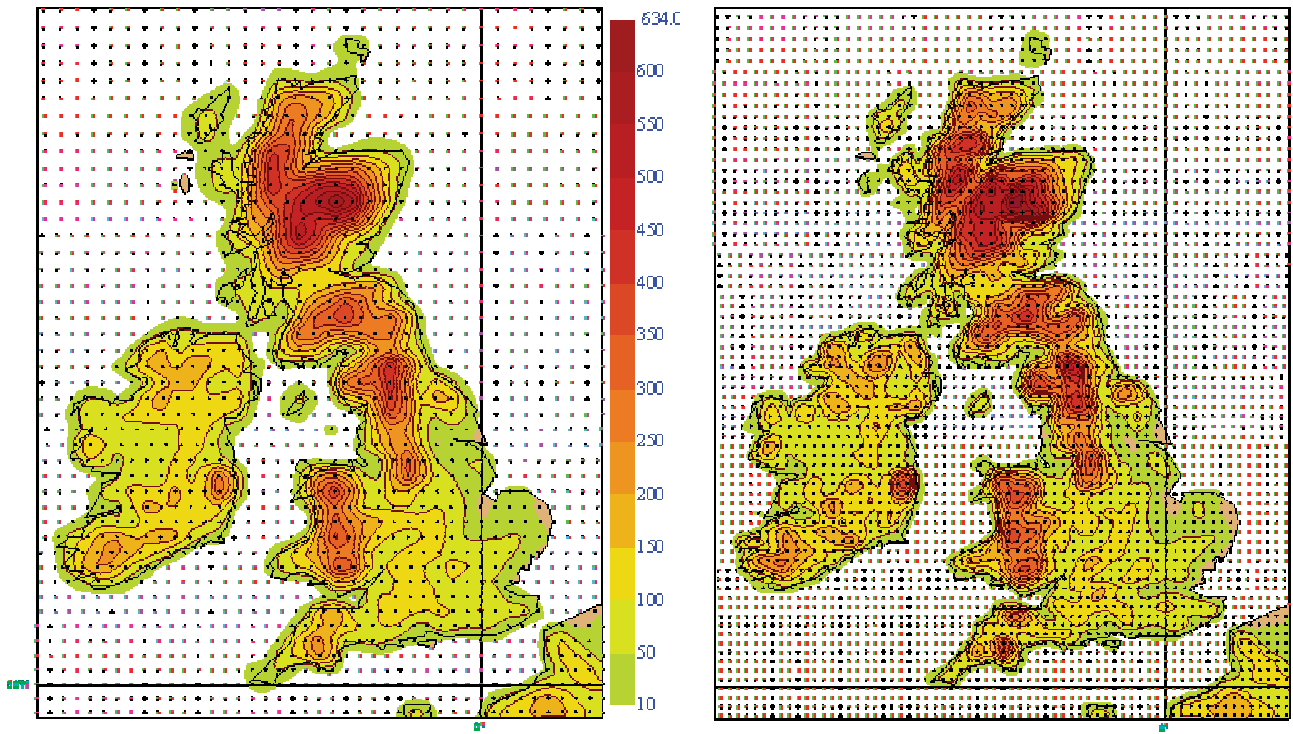


Fig. 3 The change in resolution of the deterministic model from T799 (25 km) to T1279 (16 km) and the corresponding model orography (shading, see label) in meters. The higher-resolution model was implemented 26 January 2010.