

Horizontal resolution increase

On Tuesday 26 January 2010, ECMWF upgraded the horizontal resolution of its deterministic forecasting system and the Ensemble Prediction System (EPS), including the monthly extension to 32 days.

A new cycle of the IFS model has been introduced to implement the higher resolution upgrade. This cycle is labelled 36r1.

The main contents of Cycle 36r1 are:

- Deterministic forecast and analysis horizontal resolution increased from T799 to T1279;
- EPS resolutions increased from T399 / T255 to T639 / T319 for Leg A / B, respectively;
- Wave model resolution increased from 0.36 to 0.25 degrees in the deterministic, and from 1.0 to 0.5 degrees for the EPS;
- Analysis inner loop horizontal resolution increased from T95 / T159 / T255 to T159 / T255 / T255, respectively;
- Correction of short-wave radiation interaction with clouds.

These upgrades

- **do not** include any increase in the vertical resolution;
- **do not** introduce GRIB edition 2 encoding for any fields;
- **do not** apply to the ECMWF seasonal forecasting system;
- **do not** apply the European Shelf (Mediterranean) wave model;
- **do not** include any other significant meteorological changes;

- **do** apply to products from the Boundary Condition Optional Project.

The model number identifier (generating process identification number – GRIB Section 1, Product Definition Section, Octet 6) has been changed:

- for atmospheric model fields from 135 to 136;
- for wave model fields from 120 to 104.

The model number identifier for the European Shelf (Mediterranean) wave model and the ocean model has **not** been changed and remains set to 204 and 2, respectively.

The new cycle was implemented in operations on Tuesday 26 January 2010.

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This document will be updated as required and was last changed on 29.01.2010.

For a record of changes made to this page please refer to Document versions.

A printable version of this page is available.

Further information and advice regarding the upgrade can be obtained from User Support (advisory@ecmwf.int).

News

29 January 2010

IFS cycle 36r1, the higher resolution forecasting system, was implemented on 26 January 2010. The new IFS cycle was used for the first time in the monthly extension of the Ensemble Prediction System on Thursday, 28 January 2010. See ECMWF News.

22 January 2010

The following corrections to the handling of land surface parameters have been implemented this week in the IFS cycle 36r1 e-suite.

- The NESDIS satellite snow cover product was found not to be assimilated in the snow analysis and it has been re-activated.
- The snow density update in the presence of fresh snow has been corrected. In general this reduces the snow density resulting also in the reduction of the increments of snow water equivalent.

Horizontal resolution increase

- The MODIS-based monthly albedo was corrected to be updated daily as intended. An error in the handling of invariant fields was preventing the correct updating, with the albedo being kept constant in subsequent analysis cycles.

The above fixes are expected to improve the snow evolution especially around the snow-line and to provide a consistent seasonally-varying albedo climatology in snow-free conditions.

13 January 2010

The planned implementation date of the increased horizontal resolution forecasting system, IFS cycle 36r1, in operations is confirmed as **Tuesday 26 January 2010**.

The first run with the new cycle on 26 January will be the 06 UTC analysis and forecast in the Boundary Condition project, followed by the 12 UTC main forecast. The monthly forecast extension to the EPS will be run with the new IFS cycle for the first time on Thursday 28 January 2010, including the corresponding set of hindcasts.

1 December 2009

A new version of the ECMWF model that includes a major resolution upgrade has been tested extensively for all seasons in 2009. The higher-resolution system has been run in experimental suite (e-suite) mode since 15 July 2009. The final configuration, IFS cycle 36r1, has been run since 1 October 2009. The e-suite is now running in step with operations in near-real time. The planned implementation date is **Tuesday 26 January 2010**.

The impact of the new cycle on the performance of the deterministic forecast system has been tested on more than 360 cases in total. Objective verification shows statistically significant improvements in terms of 1000 and 500 hPa height for Europe and for both extra-tropical hemispheres out to day 7. There is a systematic improvement of temperature at 850 hPa. The location and intensity of synoptic features are improved in many cases. The overall impact on weather parameters is small. However, the frequency of occurrence of intense rainfall events has increased resulting in better agreement with observations.

The wind fields from the e-suite are better at representing features such as tropical storms, fronts, land/sea transitions which translates into better wave forecasts. Tropical cyclone track and intensity forecasts are generally improved in the higher-resolution system, based on the relatively small sample available.

The EPS has been tested for 58 cases in January and May 2009 and again in the e-suite over the period 4 October to 3 November 2009. The overall benefit of the T639 EPS is reflected in the results for the probability scores which are consistently improved for 500 hPa height anomalies and 850 hPa temperature anomalies. EPS spread is in general unchanged. The EPS ensemble-mean errors are consistently lower, resulting in some overestimation of spread in terms of 500 hPa height and a better tuned spread in terms of 850 hPa temperature.

All results from the e-suite are available from the MARS archive under version 0046 – see [Test data sets from the pre-operational e-suite](#).

On **Tuesday 8 December 2009**, dissemination test data set will be made available on ECPDS as version number 0046 based on current operational dissemination requirements – see [Dissemination](#).

Horizontal resolution increase

The planned implementation date, 26 January 2009, is contingent on the ongoing testing continuing to progress well. Confirmation of the implementation will be sent closer to the time.

5 November 2009

The pre-operational testing is progressing well. However, last week the test suite was restarted with a modification to the IFS code. This modification consists of a correction to the radiation scheme, affecting the reflection of short-wave radiation by clouds.

The operational implementation is now planned for late January. A formal announcement of the implementation date and the availability of test data will follow in a few weeks' time.

The timetable for the implementation of this upgrade has been revised accordingly.

16 October 2009

The e-suite for the IFS cycle 36r1 deterministic T129L91 forecasts has been run since 25 September 2009.

The starting date of the deterministic e-suite was 15 July 2009, 12 UTC. All results are stored in MARS and are available to all users in Member States and Co-operating States for testing and adapting their applications to the high resolution forecasting system. The MARS EXPVER version number of the e-suite is 45. The e-suite is running in 'catch up' mode and is expected to reach real time by the end of October 2009.

The starting date of the EPS T639/T319 e-suite was 17 July 2009, 12 UTC. All results are stored in MARS with MARS EXPVER=45. It is planned to run the full EPS forecast with all members until 31 August 2009. Thereafter, only the EPS control and calibration/validation forecasts will be run for the remaining dates.

The model number identifier (generating process identification number – GRIB Section 1, Product Definition Section, Octet 6) for atmospheric fields will be increased from 135 to 136. The model number identifier for wave and ocean fields is to be decided.

Implementation of the increased horizontal resolution forecasting system is planned for the end of November 2009.

4 September 2009

- Test data sets from the pre-operational technical e-suite are now available in MARS – see Test data sets from the pre-operational e-suite.
- A fix is now available for MAGICS 6 to allow direct visualisation of T1279 spectral fields – see MAGICS and Magics++.

Timetable

The implementation of the horizontal resolution increase is planned as follows:

Horizontal resolution increase

- July 2009: Pre–operational technical testing
- Mid–August 2009: First high resolution test data sets for selected operational suites available in MARS
- September 2009: Start of operational e–suite
 - ◆ Meteorological test data sets for all operational suites available in MARS
- December 2009: Parallel test dissemination for selected dates.
- 26 January 2010: Implementation.

The timetable given here represents our current expectations and may have to be reviewed in light of the actual progress made.

This cycle of the IFS model is primarily to implement the higher resolution upgrade. No other significant meteorological changes are planned for this model change. This cycle will be labelled 36r1.

Further information regarding previous changes to the IFS model can be found at:

http://www.ecmwf.int/products/data/technical/model_id/.

Resolution changes

Atmospheric model

	Deterministic		Ensemble Prediction System (EPS)			
			Leg A		Leg B / C	
	Current	Upgrade	Current	Upgrade	Current	Upgrade
Spectral	T799	T1279	T399	T639	T255	T319
Reduced Gaussian grid	N400	N640	N200	N320	N128	N160
Horizontal grid resolution	~25 km	~16 km	~50 km	~30 km	~80 km	~60 km
Dissemination (LL)	0.25	0.125	0.5	0.25	0.5	0.5
Model Level Vertical resolution	91	91	62	62	62	62

- There was no change in the number and definition of the pressure levels.
- The horizontal resolution of the EPS hindcast forecasts was increased to match that of the EPS system.
- The horizontal resolution of the two EPS constant–resolution forecasts provided for calibration and validation purposes was increased:

Horizontal resolution increase

	EPS calibration / validation			
	High resolution		Low resolution	
	Current	Upgrade	Current	Upgrade
Spectral	T399	T639	T255	T319
Reduced Gaussian grid	N200	N320	N128	N160
Horizontal grid resolution	~50 km	~30 km	~80 km	~60 km
Model Level Vertical resolution	62	62	62	62

Wave model

	Deterministic		Ensemble Prediction System (EPS)			
	Current	Upgrade	Leg A		Leg B / C	
Current			Upgrade	Current	Upgrade	Current
Lat/Long	0.36	0.25	1.0	0.5	1.0	0.5
Horizontal grid resolution	~40km	~28km	~110km	~55km	~110km	~55km
Dissemination (LL)	0.25	0.25	1.0	0.5	1.0	0.5
Frequencies	30	36	30	30	25	25
Directions	24	36	24	24	12	12

The resolution of the European Shelf (Mediterranean) model was upgraded independently on 13 October 2009.

Ocean model

There were no changes made to the resolution of the ocean model used in the monthly extension of the EPS to 32 days.

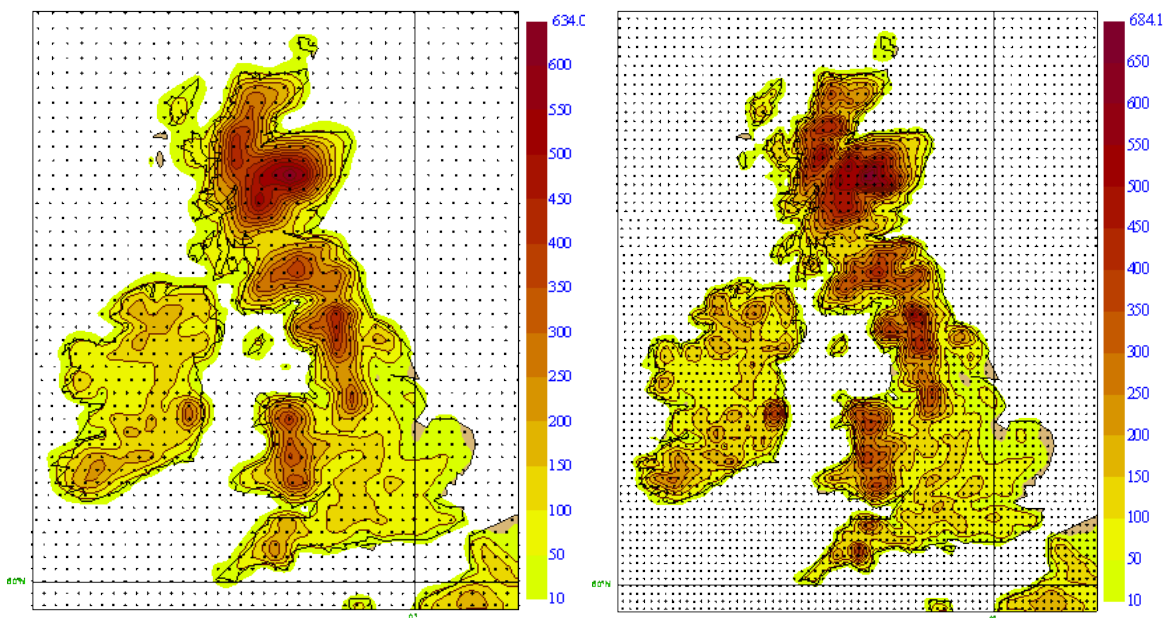
Gaussian definitions

Descriptions of the Gaussian Grids for N640, N320 and N160 used with the higher resolution model are available.

For a catalogue containing the descriptions of all other Gaussian Grids as well as the correspondence between the three types of grid resolutions (Spherical Harmonic, Gaussian Grid and Latitude–Longitude) please refer to:

<http://www.ecmwf.int/products/data/technical/gaussian/>.

The figure shows the grid spacing and orography fields over the United Kingdom and Ireland for the N400 (left) and N640 (right) Gaussian grids (click on the images for larger versions).



*N400 (T799) 25km grid spacing
(843490 grid points)*

*N640 (T1279) 16km grid spacing
(2140704 grid points)*

Land–sea mask and orography fields at reduced Gaussian resolutions N640, N320 and N160 are available for download:

- Deterministic – Land–sea mask and orography fields for the N640 grid (T1279)
- EPS Leg A – Land–sea mask and orography fields for the N320 grid (T639)
- EPS Leg B / C – Land–sea mask and orography fields for the N160 grid (T319)

Impact on users

Field sizes

The size of the fields produced by the model have increased by a factor of 2.56. When retrieving data via MARS or dissemination, if users do not specify any spectral truncation or grid resolutions, fields are provided at model resolution.

In particular, users should be aware of the increase in memory needed to process the increased resolution fields.

For example, the coefficient file used to interpolate T1279 spectral fields to a 0.125 x 0.125 regular latitude–longitude grid is about **4 GBytes** in size. This is **4 times more larger** than the coefficient file used to interpolate T799 spectral fields to a 0.225 x 0.225 regular latitude–longitude grid. A standard MARS retrieval of a T1279 spectral fields to a 0.125 x 0.125 regular latitude–longitude grid will, therefore, need about **4 times more memory**. It **may not** be possible for users to run such retrievals interactively on ecgate. In this case, retrievals will need to be submitted to the LoadLeveler batch system.

The memory and CPU limits of the various LoadLeveler classes on ecgate have been reviewed to cater for the increased resources needed.

Users running their retrievals on the HPCF may need to alter the memory requirement using the "#@resources = ConsumableMemory" LoadLeveler directive.

Dissemination

There are a number of issues that need to be addressed before the implementation of the resolution upgrade:

- Any dissemination requests that use the GG/AUTOMATIC directive need to be checked. This was undertaken by ECMWF.
- Nearest GRID point coordinates for Weather parameter requests have changed. Member and Co–operating States need to choose new GRID points coordinates or rely on interpolation.
- Line capacity should be checked to ensure that there is sufficient bandwidth available to support the possible increase in field sizes.

All results from the e–suite are available from the MARS archive under version number 0046 (EXPVER=0046).

ECMWF have migrated all Member States' dissemination requirements to the higher resolution system to provide products that are compatible with the current operational products, i.e. at the same horizontal resolution as currently disseminated. Spectral data from the deterministic Global wave model is disseminated at the new spectral resolution of 36 directions and 36 frequencies only.

On **Tuesday 8 December 2009**, a dissemination test data set was made available on ECPDS as version number 0046 based on current operational dissemination requirements. The data set comprises one full day (00, 06, 12 and 18UTC) of e–suite dissemination data (deterministic, EPS, Boundary Condition, global wave and wave EPS, and limited–area wave suites). Please contact Dragan Jokic (Dragan.Jokic@ecmwf.int) to make arrangements for dissemination tests.

Users will be able to request data at higher resolution after implementation of the new cycle.

Member State jobs

Member State users will be responsible for testing and checking the output of their jobs that use the new higher resolution data sets. In particular:

- Check new disk space requirements.
- Check new memory and CPU requirements and update Loadleveler directives of their jobs if necessary see [Impact on users – Field sizes](#) above for information about memory requirements.
- Check line bandwidth requirements for transferring the data.

These tests can be carried out using the [e-suite test data](#). On ecgate, the default user versions of EMOSLIB, MAGICS and Metview can all handle the increased horizontal resolution fields.

Member State jobs submitted through the ECaccess time-critical (option-1) mechanism need to be tested and adapted by Member State users themselves. Please contact User Support (advisory@ecmwf.int) if help is needed with adapting these jobs.

Member State projects

Those responsible for Member State projects (e.g., COSMO-LEPS, NORLAMEPS) as well as the common applications (HIRLAM, FLEXTRA, meso-nh, COSMO/LM, etc) running at ECMWF will need to:

- use [test data sets](#) to run e-suites and decide on new configuration;
- review resource requirements (disk space, memory, CPU and line bandwidth);
- see [Impact on users – Field sizes](#) above for information about memory requirements.

Boundary Condition project

The same resolution changes as for the main deterministic forecast applies also to the BC project forecast runs. The impact on [field sizes](#) and [dissemination](#) is as described above.

Test data sets for the Boundary Condition project at the higher resolution (T1279 L91) are stored in MARS and can be used for technical testing purposes (see [Test data sets from pre-operational e-suite](#)).

EPSgrams

The EPSgram facility has been upgraded or the implementation of the higher resolution model upgrade. The interfaces are fully compatible and the upgrade transparent to the user. The coordinates of the nearest grid point in the EPSgrams have changed.

Other issues

Users with other issues that are not covered here are urged to contact User Support (advisory@ecmwf.int) as soon as possible.

Software

EMOS Library

GRIB decoding

A new version of the EMOS library (release 000370) is available on the Linux PC/Cluster, IBM servers, and IBM HPCF/C1A/C1B and includes support for the horizontal resolution model upgrade. This has been the default version since 7 September 2009.

Both double and single precision versions of the library are available on each platform.

Please check that your codes work correctly with the 000370 version of the library and report any problems to User Support (advisory@ecmwf.int) or Call Desk.

The 000370 version of the library includes several changes needed for the resolution upgrade, notably

- New Gaussian definitions
- New automatic truncation

and is sufficient for users needing only to decode the increased resolution fields.

Users are encouraged to use the GRIB API Library to decode higher resolution model data – see [GRIB API](#).

Field interpolation

Users needing to interpolate the increased horizontal need to use version 000371 of the EMOS Library. This version is also available on all computing platforms at ECMWF and can be accessed as follows.

- on ecgate and the Linux PC/Cluster with the 'use' command:

```
use newemos
```

- on C1A/C1B, the 'module' command should be used:

```
module switch emos emos/371
```

The truncation can be controlled using the truncation option in [INTIN](#). For further information about the interpolation routines available in EMOSLIB see:

<http://www.ecmwf.int/publications/manuals/libraries/interpolation/>.

Note that high resolutions need more resources to carry out the required processing.

For more information about changes to the EMOS library, please refer to:

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<http://www.ecmwf.int/publications/manuals/libraries/emoslib/>.

For Member State users an export (web downloadable) version of the new EMOS library versions 000370 and 000371 are available at:

<http://www.ecmwf.int/products/data/software/download/interpolation.html>.

Member States are encouraged to install and test these versions locally.

GRIB API

Although GRIBEX will continue to work, users are encouraged to use the GRIB API Library to decode higher resolution model data.

The latest version 1.8.0 of the GRIB API Library is available for download at:

http://www.ecmwf.int/products/data/software/grib_api.html

MARS

Users should also be aware of the effect of the RESOL directive when retrieving spectral fields in spherical harmonics form. If the RESOL directive is not specified then fields will be retrieved at the new higher resolution. If RESOL is specified then triangular truncation of retrieved data will, as usual, take place accordingly before any selected post-processing .

Spectral fields are automatically truncated before interpolation to grid fields to reduce data volumes and spurious aliased values. For a table detailing the default truncations please refer to the [MARS User Guide](#).

Note that high resolutions need more resources (memory, CPU and disk space) to carry out the required processing. See [Impact on users – Field sizes](#) above for information about memory requirements.

MAGICS and Magics++

MAGICS 6 applications need to be re-linked with EMOS library version 000370 to cope with the new Gaussian definition.

A new MAGICS 6 export version (MAGICS 6.12–export) with a fix to allow direct visualisation of T1279 *spectral fields* was made available to Member State users on 14 October 2009 and can be ordered from:

<http://www.ecmwf.int/products/data/software/magics.html>.

However, only a small code change is required; for most installers it will be easier to update their MAGICS 6 installation by following the advice given at:

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http://www.ecmwf.int/publications/manuals/magics/current/Known_Bugs_and_Problems.html.

This fix is *not* required if your application is visualising data on the Gaussian or regular latitude–longitude grids.

Users are encouraged to migrate their MAGICS applications to Magics++.

Metview

Metview version 3.11.5–export using EMOS Library cycle 000370, and including the fix to allow direct visualisation of T1279 spectral fields, was made available on 7 September 2009 and can be ordered from:

<http://www.ecmwf.int/products/data/software/metview.html>.

Test data sets from pre–operational e–suite

The IFS cycle 36r1 e–suite for the deterministic T1279L91 forecasts was run from 1 October 2009 to 26 January 2010. All results are stored in MARS and can be used for technical test purposes by Member States users. The version number of the e–suite is 0046 (MARS parameter EXPVER=46).

The IFS cycle 36r1 e–suite for the EPS T639L62 / T319L62 Leg A / Leg B / C forecasts was run from 3 October 2009 to 3 November 2009 and 24 November 2009 to 26 January 2010. All results are also stored in MARS. The version number of the e–suite is 0046 (MARS parameter EXPVER=46).

These data sets are available only to registered ECMWF users with access to MARS or WebMARS.

- Deterministic atmospheric model (Class=od, Stream=da, Expver=46):
 - ◆ From 12 UTC on 1 October 2009 to 00 UTC on 26 January 2010.
- Deterministic wave model (Class=od, Stream=wa, Expver=46):
 - ◆ From 12 UTC on 1 October 2009 to 00 UTC on 26 January 2010.
- Ensemble Prediction System (Class=od, Stream=enfo, Expver=46):
 - ◆ From 12 UTC on 3 October 2009 to 00 UTC on 3 November 2009.
 - ◆ From 12 UTC on 24 November 2009 to 00 UTC on 26 January 2010..
- Wave Ensemble Forecast (Class=od, Stream=waef, Expver=46):
 - ◆ From 12 UTC on 3 October 2009 to 00 UTC on 3 November 2009.
 - ◆ From 12 UTC on 24 November 2009 to 00 UTC on 26 January 2010.

The quality of these data sets is not guaranteed. Please report any problems you find with this data to User Support (advisory@ecmwf.int).

Changes to the dissemination schedule

There were no changes to the dissemination schedule.

Document versions

Date	Reason for update
10.08.2009	Initial Version.
04.09.2009	Announced availability of test data sets from the pre-operational technical e-suite – see Test data sets from the pre-operational e-suite . Provided fix for MAGICS 6 to allow direct visualisation of T1279 spectral fields – see MAGICS and Magics++ .
16.10.2009	Announced start of IFS cycle 36r1 pre-operational e-suite – see News . Announced availability of test data sets from the IFS cycle 36r1 pre-operational e-suite – see Test data sets from the pre-operational e-suite . Announced availability of new export versions of MAGICS 6 and Metview – see MAGICS and Magics++ and Metview . Users are made aware of the additional memory requirements needed to process the increased horizontal resolution fields – see Impact on users – field sizes .
05.11.2009	Announced restart of IFS cycle 36r1 pre-operational e-suite with a correction to the radiation scheme, affecting the reflection of short-wave radiation by clouds.– see News . Timetable for implementation updated accordingly. Updated information about availability of Test data sets from the pre-operational e-suite .
01.12.2009	Announced planned implementation date – see News and Timetable . Announced availability of test data sets from the final configuration IFS cycle 36r1 pre-operational e-suite – see Test data sets from the pre-operational e-suite . Announced plans for dissemination tests – see Dissemination . Announced availability of EMOS Library 000371 – see EMOS Library .
13.01.2010	Confirmed planned implementation date – see News and Timetable .
22.01.2010	Corrected information provided about the spectral resolution of the Wave EPS. The number of frequencies and directions for both Leg A and Leg B / C of the Wave EPS will not be increased as part of this upgrade – see Wave model . Announced some minor corrections to the IFS cycle 36r1 e-suite – see News .
29.01.2010	Announced successful implementation of IFS cycle 36r1 – see News .