

Implementation of VAREPS

Implementation of VarEPS

ECMWF will upgrade its Ensemble Prediction System (EPS) and introduce the **V**ariable **R**esolution **E**nsemble **P**rediction System (VarEPS). In particular, the forecast range will be extended to 15 days using the VarEPS system with a resolution of T399 L62 for day 1 to day 10 and T255 L62 for day 11 to day 15.

This page gives a brief description of VarEPS and provides technical details about access to the data during the pre-operational test phase both in MARS and through dissemination.

The page will be updated as required. It was last changed on 01.12.2006.

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

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News

30 November 2006

Product dissemination from the extended range ensemble forecasting system VarEPS was implemented on Tuesday 28 November.

New probability products for the range 11 to 15 days have been added to the ECMWF range of graphic products on the web. Please visit:

<http://www.ecmwf.int/products/forecasts/d/charts/medium/eps/>.

EPSgrams to 15 days can be accessed by selecting the new "15 day" option on individual EPSgrams – see [EPSgrams](#) below for further details.

Any feedback on the new VarEPS products would be welcome.

21 November 2006

The planned date for the implementation dissemination from the second leg (days 11 to 15) of the new VarEPS forecasting system is confirmed as **Tuesday 28 November 2006**. The first cycle to run in the new configuration will be for 12 UTC.

Data for the extended range out to day 15 can only be requested in dissemination *after* 28 November 2006. Details on how to request the new products in dissemination will be added to the dissemination manual on the web on the day of implementation. The manual can be found at:

<http://www.ecmwf.int/services/dissemination/3.1/>.

For early testing please retrieve the data from MARS

27 October 2006

One day of test data for the VarEPS e–suite is now available in dissemination and MARS. The data is for both 00 and 12 UTC on 23 October 2006. The experiment version is 9035 (MARS parameter expver=9035).

For this test run, both atmospheric and wave ensemble products corresponding to the current dissemination requirements are queued in delayed mode (Stand By) on the dissemination system and will remain available for the next 3 weeks. Users are welcome to trigger transmission of test products.

In addition, test data for 24 – 28 October will be available from MARS.

For further information see [Test data sets from pre–operational e–suite](#) below.

13 October 2006

Initial announcement of VarEPS implementation to Member State representatives.

Timetable

The planned timetable for the VarEPS implementation is as follows:

12 September 2006

- Implementation of IFS cycle 31r1.
- Routine running of VarEPS out to day 15 started (for testing without dissemination).

13 October 2006

- Detailed information about the VarEPS implementation sent to Member States.

26 October 2006

- Test data to be made available in MARS and through dissemination.

28 November 2006

- Implementation of VarEPS product dissemination. The first cycle to run in the new configuration will be for 12UTC.

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

Introduction to VarEPS

The *V*ARIABLE *R*ESOLUTION *E*NSEMBLE *P*REDICTION *S*YSTEM (VarEPS) has been designed to benefit from an increased resolution in the early forecast range initially to 15 days and eventually to one month with the merger of the medium-range ensemble and the monthly forecasting systems. The process of implementing VarEPS will take place in three phases:

- **Phase 1 (Implemented February 2006):** increase of the horizontal and vertical resolutions of the 10-day EPS from T255 L40 to T399 L62. For further information see: http://www.ecmwf.int/products/changes/high_resolution_2005/
- **Phase 2 (Implementation planned for 28 November 2006):** extension of the forecast range to 15 days using the VarEPS system with a resolution of T399 L62 for day 1 to day 10 and T255 L62 for day 11 to day 15.
- **Phase 3 (Implementation planned for 2007):** weekly extension of VarEPS to one month with a T255 L62 atmospheric resolution and ocean coupling introduced at day 10 (the precise configuration of this final stage of VarEPS is still to be finalized).

This web page describes *Phase 2* of the upgrade process.

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Continuity in the EPS product range to day 10 will be maintained. Extended products to day 15 will be made available.

This operational upgrade is for the implementation of VarEPS only and will be mainly a technical change.

- *No* meteorological changes are planned.
- There will be *no* change to either the IFS cycle number nor the model number identifier (generating process identification number – GRIB Section 1, Product Definition Section, Octet 6).
- There will be *no* extension of the T799 deterministic forecast range.

The first cycle to run in the new configuration will be for 12UTC on 28 November 2006.

Operational VarEPS technical configuration

Technically, each VarEPS member is generated by a two–leg forecast.

Atmospheric model

For the atmosphere model the horizontal resolution is different for the two legs of the forecast. The vertical resolution of 62 levels is the same for both forecast legs. Details are summarized in the following table.

<i>VarEPS (Atmospheric)</i>	<i>Spectral resolution / Vertical levels</i>	<i>Reduced Gaussian grid</i>	<i>Horizontal grid resolution</i>	<i>Forecast range</i>	
				<i>days</i>	<i>hours</i>
<i>Leg 1</i>	T399 / L62	N200	50km	1–10	000–240
<i>Leg 2</i>	T255 / L62	N128	80km	11–15	246–360

VarEPS will also include two other constant–resolution forecasts for calibration and validation purposes:

<i>VarEPS Calibration / Validation</i>	<i>Spectral resolution / Vert. levels</i>	<i>Reduced Gaussian grid</i>	<i>Horizontal grid resolution</i>	<i>Forecast range</i>	
				<i>days</i>	<i>hours</i>
<i>1. High resolution</i>	T399 / L62	N200	50km	1–15	000–360
<i>2. Low resolution</i>	T255 / L62	N128	80km	1–15	000–360

Data from these two forecasts will be accessible through dissemination and in MARS.

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All atmospheric model VarEPS products for both forecast legs, including the two calibration/validation forecasts, will be available on a 0.5 degree latitude–longitude grid through dissemination.

Wave model

The configuration of the wave model in the two VarEPS forecast legs is as follows:

<i>VarEPS (Wave)</i>	<i>Spectral resolution</i>		<i>Horizontal grid resolution</i>	<i>Forecast range</i>	
	<i>Frequencies</i>	<i>Directions</i>		<i>days</i>	<i>hours</i>
<i>Leg 1</i>	30	25	100km	1–10	000–240
<i>Leg 2</i>	25	12	100km	11–15	246–360

VarEPS will also include two other constant–resolution forecasts for calibration and validation purposes:

<i>VarEPS Calibration / Validation</i>	<i>Spectral resolution</i>		<i>Horizontal grid resolution</i>	<i>Forecast range</i>	
	<i>Frequencies</i>	<i>Directions</i>		<i>days</i>	<i>hours</i>
<i>1. High resolution</i>	30	25	100km	1–15	000–360
<i>2. Low resolution</i>	25	12	100km	1–15	000–360

Data from these two forecasts will be accessible through dissemination and in MARS.

All wave VarEPS products for both forecast legs, including the two calibration/validation forecasts, will be available on a 1.0 degree latitude–longitude grid through dissemination.

VarEPS technical characteristics

Users should be aware of the following key VarEPS technical characteristics.

1. Leg 2 initial conditions

Each *Leg 2* forecast starts from a *Leg 1* day 9 forecast interpolated at the T255 L62 resolution (in other words, for all the state–vector variables, the *Leg 2* initial state is defined by a truncated *Leg 1* forecast instead of analysis fields).

The 24–hour overlap period has been introduced to reduce the impact on the fields that are more sensitive to

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the truncation from the high to the low resolution (e.g. convective and large scale precipitation).

High resolution wave spectra are smoothed out to the lower spectral resolution of the second leg.

2. Change in GRIB headers

VarEPS products from individual members, control runs and derived products representing only single steps of all perturbed EPS members (for example, Ensemble Mean and Ensemble Standard Deviation), contain the leg information (*Leg 1* for day 1 to day 10, *Leg 2* for day 11 to day 15) as follows:

- Leg base date (in format YYYYMMDD)
- Leg base time (in format hhmm)
- Leg number

To allow the representation of the VarEPS forecast leg information the new ECMWF local extension definition 30 has been created.

This local definition is used for VarEPS fields both from MARS and in the dissemination. VarEPS fields encoded using local definition 30 have Octet 41 of GRIB section 1 set to 30.

To be able to handle this new local definition with ECMWFs GRIB software users will need to:

- use version of 000281 or greater of the EMOS Library;
- copy local definition 30 to the appropriate configuration directory.

If using the EMOS Library GRIBEX routine to decode VarEPS fields:

- KSECI element 24 is set to 1 to indicate that an ECMWF local use definition is required.
- KSECI element 37 is set to 30 to indicate local definition 30 is required.

The changes to the GRIB headers are designed so that the truncation point can be moved.

Member State users are advised to build their products in a flexible way.

See EMOS Library below for information about the changes needed to the ECMWF GRIB software.

Post-processed products

Extension of EPS products to day 15

Extended products to become available to day 15 through dissemination and MARS are:

- Direct model output of all current parameters from EPS members, control forecast, ensemble mean, standard deviation (6 hourly).
- Two calibration / validation runs (6 hourly).
- Probabilities for all current parameters (12 hourly).

Other derived products, e.g. clusters, tubes etc, will not be extended beyond day 10.

Extra time steps for ensemble mean and standard deviation

Three-hourly time steps up to T+144 will be made available for the ensemble means and the standard deviation parameters through dissemination and in MARS.

New probability GRIB coding

In preparation for the future link of VarEPS with the monthly forecasting system (Phase 3 of the VarEPS implementation), the probability forecast parameters will be changed.

- New parameter names and numbers are used to describe different weather parameter thresholds.
- Some time range indicator values will be corrected to take into account the higher frequency in post-processing (old style definitions were based on 12-hourly steps).
- Additional periods will be provided for some probability parameters.

For further details of the new probability parameter names, numbers, the time range indicator values and additional periods as well as example MARS requests, see [VarEPS Derived Probability Parameters](#).

To allow for smooth transition from old to new style probability coding we will provide both types of products through dissemination for a limited overlap period until the end of March 2007.

MARS archiving of the old style products will be discontinued with the implementation of product dissemination from VarEPS.

ECMWF can assist in setting up the dissemination requests for the new style products: the contact point at ECMWF is Dragan Jokic

Flux parameters in VarEPS

Flux fields are quantities accumulated since the beginning of the forecast, e.g. all precipitation and snowfall parameters. Reducing the resolution of the model at step T+240 will require interpolation between Gaussian grids used in *Leg 1* (N200) and *Leg 2* (N128). As a consequence, noise will appear in flux fields when taking differences in time for timestep intervals starting from T+240 or spanning T+240, e.g. precipitation for the interval T+(252-240) or T+(246-234).

To limit unnecessary impact from interpolation on the consistency of the fields, users wishing to extend their applications to day 15 are advised as follows:

1. For applications requiring products starting from or spanning step T+240 users should specify the keyword

GAUSSIAN = REDUCED, GRID = 128

in the dissemination request. This will provide the user with all fields on the original N128 model grid of VarEPS *Leg 2*.

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2. For applications requiring products starting from or spanning step T+240 users wishing to obtain products interpolated to regular lat/lon grids are advised to have the products from *Leg 1* truncated to the N128 grid prior to interpolation to their choice of lat/lon grid. This can be achieved by specifying an additional key word:

RESOL = REDUCED GAUSSIAN 128

in the dissemination requests. This new feature of requesting the truncation of Gaussian grids prior to further interpolation to regular grids will also become available in MARS.

Note:

- ***New applications using only data starting from step T+246 will not be affected by interpolation problems.***
- ***All product requests for applications using flux parameters, based on current product dissemination to day 10, will not require any changes.***

Note also that, when computing differences for flux parameters between one timestep and an earlier timestep, a more satisfactory result will be obtained by performing the subtraction on the reduced Gaussian grid and then interpolating the result to a lat/lon grid as a final step.

- ***For time intervals spanning the truncation time step, the difference should be computed on the N128 reduced Gaussian grid of forecast Leg 2.***

Additional information on VarEPS and how to combine VarEPS *Leg 1* and *Leg 2* data across timestep T+240 in a consistent way can be found in the article "The ECMWF Variable Resolution Ensemble Prediction System (VarEPS)" published in ECMWF Newsletter No. 108 (pp14–20) – Summer 2006 and also at:

http://www.ecmwf.int/products/data/operational_system/evolution/evolution_2006.html.

An example MARS retrieval showing how to compute differences for flux parameters is also available.

Weather parameter files

Weather parameter files to T+240 based on the underlying N200 reduced Gaussian model grid will continue to be made available through dissemination.

A second weather parameters product will be generated at the end of VarEPS *Leg 2*. The time range for this product will be again from the beginning of VarEPS *Leg 1* to the end of VarEPS *Leg 2* (T+360). All data will be provided at 6 hourly intervals from the underlying N128 reduced Gaussian model grid of VarEPS *Leg 2*.

The planned addition of extra 3-hourly time steps out to step T+144 will require new BUFR product definitions and will be introduced after the necessary testing independent of the VarEPS changes.

Software

EMOS Library

To handle the new ECMWF local extension definition 30 used in the GRIB headers of VarEPS fields, users need to use at least version 000281 of the EMOS library, which can be downloaded from

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

In addition all users of EMOS library export version 000281 or greater will need to install the new local extension definition 30, which is available to download from:

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

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

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

Metview and Magics

Due to changes in the way the VarEPS fields are coded, the Metview and Magics versions available to the Member States are no longer able to produce automatic plot titles for, e.g. EPS members, control, mean and standard deviation. It is recommended to install new releases of Metview and Magics. Alternatively, it is possible to update the relevant routines in the current versions.

New export versions of Magics and Metview

The new export versions of Metview 3.9 and Magics 6.11 have now been released. These versions include the updated routines below and other updates.

Member States can order the new Magics export version 6.11:

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

The new Metview export version 3.9 can be ordered from:

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

Update of routines in current installed versions

Updated versions of routines that are required for supporting the new GRIB header local extension definition 30 can be downloaded from the web.

For Magics the updated routines are available from:

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

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For Metview the routines can be found at:

<http://www.ecmwf.int/publications/manuals/metview/install/3.8/KnownBugs.html#fix060912>.

Metview and Magics on ecgate

New versions of Magics 6.11 and Metview, which can handle and plot correctly the new VarEPS data, are available on ecgate. These versions became the default USER versions on Monday 13 November (Magics 6.11) and Tuesday 14 November (Metview 3.9).

Note that the Graphics Section now have an RSS feed available for informing Member States of new releases of Metview and Magics. It is available from the [Magics home page](#).

WebMARS

Due to changes in the way the VarEPS fields are coded WebMARS is unable to plot VarEPS fields. It is planned to upgrade the WebMARS service to provide support for plotting VarEPS fields on 22 November.

Test data sets from pre-operational e-suite

One day of test data for the VarEPS e-suite is available in dissemination and MARS. The data is for both 00 and 12 UTC on 23 October 2006. The experiment version is 9035 (MARS parameter expver=9035).

For this test run, both atmospheric and wave ensemble products corresponding to the current dissemination requirements are queued in delayed mode (Stand By) on the dissemination system and will remain available for the next 3 weeks. Users are welcome to trigger the transmission of these test products.

In addition, test data for 00 and 12 UTC from 24 to 28 October is available in MARS (MARS parameter expver=9035). Test data can be accessed in MARS from:

- [Ensemble Prediction System](#) (Class=od, Stream=enfo, Expver=9035)
- [Wave Ensemble Forecast](#) (Class=od, Stream=waef, Expver=9035)

Only registered users of ECMWF computing systems will be able to access the test data sets in MARS.

The quality of these data sets is not guaranteed. Please report any problems you find with this data to User Support . The data is intended for testing technical aspects of the VarEPS implementation.

Technical changes requiring user action

Change of resolution at the forecast truncation step

Users of VarEPS data and products to day 15 both from MARS and through the dissemination should be aware of the change in horizontal resolution (from T399 to T255 for atmospheric fields) which occurs at day 10 (the forecast truncation step).

Note that the changes are designed so that the truncation step can be moved. Users are advised to build their products in a flexible way.

Changes to GRIB headers

Users of VarEPS products and data sets should be aware of the changes made to the GRIB headers and, specifically, the use of a new ECMWF local extension definition 30, that allow the VarEPS leg information to be represented. For details see [Changes to GRIB headers](#) above.

This new local extension will be used both in fields from MARS and in the dissemination throughout the forecast range.

In particular, users should check that programs using ECMWF software to decode VarEPS data have been linked with version 000281 or greater of the EMOS Library. For further details see the section on the [EMOS Library](#) above.

Similarly, users with programs that use the Magics library to visualize VarEPS fields will need to link their programs with Magics version 6.11 in order to produce automatic plot titles for, e.g. EPS members, control, mean and standard deviation. For further details see the [Metview and Magics](#) section above.

Increase in data volume

The increase in forecast length for VarEPS will result in a corresponding increase in the data obtained via dissemination or retrieved from the MARS archive for any additional data requested beyond day 10.

Users should:

- Check new disk space requirements.
- Check line bandwidth requirements for transferring the data.
- Check new memory, CPU and Wallclock requirements and update Loadleveler directives of their jobs if necessary.

MARS and Dissemination

With the implementation of VarEPS, the time range of all EPS direct model output, ensemble means, standard deviation and probability products will be extended to step 360.

The two additional calibration/validation deterministic runs at T399 and T255 resolution will become available through MARS and dissemination as:

- **T399:** *stream=ENFO, type=CV, number=1*
- **T255:** *stream=ENFO, type=CV, number=2*

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and similarly for the corresponding wave model calibration/validation runs that are archived in *stream=WAEF*.

All individual EPS members, control runs and products representing only single steps of all perturbed eps members (for example, Ensemble Mean and Ensemble Standard Deviation), will include the new ECMWF local extension definition 30 for all forecast steps. See Change in GRIB headers above for more details.

The time range of the forecast probability parameters will be extended to step 360. Additional post-processed probability products will also be available. See Post-processed products above.

Note that for MARS only (not dissemination):

- To retrieve probability parameters (Event Probabilities), *type=EP* must be specified in the MARS request instead of *type=FP*.
- To retrieve the Total Precipitation probabilities, users must now request the time window (e.g. 24–48) as opposed to just the end accumulation step.

For further information, including details of the new parameter names and numbers used to describe different weather parameter thresholds, see VarEPS Derived Probability Parameters.

Results from the e-suite runs will be made available in the MARS archive. For further information see Test data sets from pre-operational e-suite above.

EPSgrams

EPSgrams to T+240 will continue to be made available based on the underlying N200 model grid. The current Metview Metgram Coach will remain backwards compatible.

Users producing EPSgrams for days 1 to 10 will not need to make any changes to their Metview macros.

The EPSgram system has been enhanced to include *Leg 2* information. These are now available from the ECMWF web site at:

<http://www.ecmwf.int/products/forecasts/d/charts/medium/epsgrams/>.

Each grid point location now offers two EPSgrams. Navigation is as before but there is now a Product menu on the left-hand side offering either 10 days or 15 days.

For example, to view the 15 day EPSgram for Reading, first view the 10-day EPSgram and then select "15 days" from the Product menu on the left-hand side.

A metview macro will be made available in early 2007 for users wishing to produce their own EPSgrams to day 15.

Other issues

Users with other issues that are not covered here are urged to contact User Support as soon as possible.

Further reading

- The new ECMWF Variable Resolution Ensemble Prediction System (VarEPS): methodology and validation.
ECMWF Technical Memorandum No. 499 (July 2006)
- The ECMWF Variable Resolution Ensemble Prediction System (VarEPS)
ECMWF Newsletter No. 108 (pp14–20) – Summer 2006
- Computation of accumulated fields in VarEPS

Document versions

<i>Date</i>	<i>Reason for update</i>
16.10.2006	Initial Version.
27.10.2006	Announced availability of <u>Test data sets from pre-operational e-suite</u> in dissemination and MARS. Updated version of <u>Table of new VarEPS probability parameters</u> .
09.11.2006	Updated information on <u>VarEPS Derived Probability Parameters</u> including example MARS requests. Announced release of new <u>Metview and Magics</u> export versions. Provided information about <u>WebMARS</u> support for VarEPS.
24.11.2006	Confirmed implementation date – see <u>News</u> .
01.12.2006	Announced implementation of VarEPS product dissemination – see <u>News</u> .