Implementation of IFS Cycle 41r1

Description of the upgrade

Integrated Forecasting System (IFS) Cycle 41r1 includes a large number of changes affecting all components of the forecasting system. Significant changes to the model physics, assimilation, observation usage and the ensemble configuration have been shown to deliver significant analysis and forecast benefit.

The domain of the high-resolution limited-area wave model is extended to the entire globe, and is no longer a 'limited-area'.

IFS Cycle 41r1 was implemented successfully in operations on Tuesday 12 May 2015. The first run of the new cycle was for the 12 UTC main analysis and forecast runs. The monthly forecast extension to the ensemble was run with the new IFS cycle for the first time on Thursday 14 May 2015.

Implemented: **12 UTC run on 12 May 2015.**

News

19 May 2015

IFS Cycle 41r1 implemented a revised set of forecast output fields for the ocean waves. These were based on a new method to split the 2d ocean wave spectrum into its principal components. The new scheme splits the wave spectrum into one wind waves and up to three swell partitions. The parameters characterising the three swell partitions (significant height, mean wave direction and mean wave period of first, second and third swell partitions) are new, supplementing the total swell parameters already produced.

The previous wave products split the spectra into just two components (wind waves and total swell). However, the new wind waves partition is different from that determined by the previous scheme, usually containing slightly more energy. The total swell is defined by all spectral components that are not wind waves, and, therefore, also affected by the introduction of the new partitioning scheme.

One effect of the new scheme is that the new total swell is significantly less smooth than before (this is a feature of how the new partitioning works). However, it had the unintended consequence that users have been unable to use the new significant height of total swell field in the same way as they have been used to.

Therefore, ECMWF has decided to revert to the previous scheme to compute both total swell and wind waves parameters. The three new swell partition parameters will still be produced, based on the new scheme. However, the sum of their energy will not equal the energy contained in the total swell (the difference being extra wind waves energy). The new parameters remain experimental products and are not included in the Catalogue of ECMWF real-time products.

Starting with the forecast from 06 UTC on 19 May 2015, the wind waves and total swell parameters (significant height, mean direction and period of wind waves and total swell: shww - paramId=140234, mdww - 140235, mpww 140236, shts -140237, mdts - 140238, mpts - 140239) will be produced using the previous scheme

This change only applies to the model output fields; the model itself uses the full wave spectrum and is unaffected by the change.

13 May 2015

IFS Cycle 41r1 was implemented successfully in operations on Tuesday 12 May 2015.

Because of unexpected delays in the previous night's e-suite run the change did not take effect with the 06 UTC Boundary Condition cycle, but had to be delayed until the 12 UTC main analysis and forecast runs.

The monthly forecast extension to the ensemble will be run with the new IFS cycle for the first time on Thursday 14 May 2015.

5 May 2015

The date of implementation of this cycle has been confirmed as 12th of May 2015.

Contents of this page

Related links

- News article
- Forecast scorecards
- Forecast User Guide
- Detailed IFS documentation

All IFS cycles

- Terminology for IFS testing
- Implementation of IFS Cycle 49r1
- Implementation of IFS Cycle 48r1
- Implementation of IFS Cycle 47r3
- Implementation of IFS Cycle 47r2
- Implementation of IFS Cycle 47r1
- Implementation of IFS cycle 46r1
- Implementation of IFS cycle 45r1
- Implementation of Seasonal Forecast SEAS5
- Implementation of IFS cycle 43r3
- Implementation of IFS Cycle 43r1
- Implementation of IFS cycle 41r2
- Introducing the octahedral reduced Gaussian grid
- Horizontal resolution increase
- Boundary-Condition Programme ENS at 06 and 18 UTC
- Implementation of IFS Cycle 41r1
- IFS cycle upgrades pre 2015

The first operational run using the new cycle will be the 06 UTC analysis and forecast in the Boundary Conditions Optional Programme on 12 May followed by the 12 UTC main assimilation and forecast. The monthly forecast extension to the ensemble will be run with the new IFS cycle for the first time the following Thursday 14 May 2015.

24 April 2015

Both the monthly forecasts and re-forecasts are extended to 46 days. At this range forecast skill is relatively low and the forecasts should be used with care. No post-processed products taking into account the extension are produced at this time but may be provided in the future once experience has been gained with the additional steps. Inclusion of model output from days 32 to 46 in the catalogue will be discussed in the next few months.

1 April 2015

Corrected versions of the climate files are now being used in the IFS cycle 41r1 e-suite. Starting from 2015-04-01 00 UTC all test products in MARS and test dissemination will have used the corrected input data. The tentative implementation date is now Tuesday, 12 May 2015. This date will be confirmed about one week before implementation.

30 March 2015

Pre-operational testing of IFS cycle 41r1 has revealed some issues with the new climate files which were erroneously shifted north by a few kilometres. These files include fields such as the land-sea mask, orography etc.

A fix is expected to be implemented in the e-suite within the next few days. Regrettably, this incident will result in a delay of the implementation of the IFS cycle by about four weeks. This will give users the chance to repeat their testing if they wish to do so.

Timeline of the implementation

Date	Event
13 Mar 2015	Initial announcement to Member States
16 Mar 2015	Availability of test data in dissemination
12 May 2015	Implementation date

Datasets affected

- HRES
- ENS

Resolution

Horizontal	Vertical
Atmospheric • HRES: T1279 (~ 16 km) • ENS: Leg A T639 (~31 km), Leg B T319 (~ 65 km), Leg C T255 (~ 80 km) Wave • HRES: 0.25 degrees • ENS: 0.5 degrees	Atmospheric • HRES: L137 • ENS: L91

Meteorological content

Forecast

- New surface climate fields (land-sea mask, sub-grid orography), also affecting number of land and sea points.
- New CO_2/O_3/CH_4 climatologies from latest MACC-II reanalysis produced at ECMWF.
- Revised semi-Lagrangian extrapolation reducing stratospheric noise.
- Revised interpolation of moist variables in the upper-troposphere/lower stratosphere (UTLS).
- Cloud scheme change of rain evaporation, auto-conversion/accretion, riming, precipitation fraction.
- Improved representation of supercooled "freezing" rain.
- Modified convective detrainment.
- Activation of the lake model (FLAKE).
- Active use of wave modified stress in coupled mode.
- Revised sea-ice minimum threshold, sea-ice roughness length and consistency between SST and sea ice concentration.

Data assimilation

- Upgrade of inner loop resolutions of 4D-Var to T_L255 for each of the three iterations of the outer loops.
- Reduction of number of iterations in 1st inner loop and use of full linear physics package.
- Changed calculation of background error covariances from using EDA samples of perturbations from last cycle (1/3) and climatology (2/3).
- Active use of:
    - SSMIS moisture sounding channels over land and sea-ice;
    - surface-sensitive ATMS channels over land;
    - ASCAT in soil moisture analysis;
    - Altika and Cryosat altimeter wave height data.
- Upgrade of radiance observation operator with RTTOV-11.
- Assimilation of GPS-RO with two-dimensional observation operator.
- Assimilation of high-resolution radiosondes.

Medium-range/monthly ensemble (ENS)

- LegB extended to 46 days (instead of 32) on Mondays and Thursday (at 00UTC).
- Twice weekly 11-member re-forecasts.

Meteorological impact

Upper air

The new model cycle provides improved high-resolution (HRES) and ensemble forecasts (ENS) throughout the troposphere and in the lower stratosphere. In the HRES there is a significant reduction of forecast errors in the upper-air fields in the extra-tropics and tropics. Improvements are seen both in verification against the model analysis and verification against observations. They are largest and most significant in the tropics and southern hemisphere and smaller but still significant in the northern hemisphere. In the ENS improvements are largest and most consistent in Europe. In the southern hemisphere there is a deterioration of ENS temperature at 850 hPa which is, however, present only in the verification against the e-suite's own analysis. It is due to a change in the analysis in the area resulting from a change in the usage of water vapour sounding data over sea ice.

Weather parameters

Gains in forecast performance are most consistent for total cloud cover and precipitation. Improvements are also seen for 2m temperature, and for 2m humidity in parts of the northern hemisphere and the tropics. 10m wind speed shows a deterioration in the tropics, as well as in the southern hemisphere and in Europe at short lead times, when verified against observations. This is coming mainly from coastal stations and appears to be related to use of the lake model (which introduces a change of roughness length) at coastal grid points that have sub-grid scale water surfaces.

Wave forecast

Ocean wave forecasts (significant wave height and mean wave period) show a deterioration when verified against the model analysis; however this is due to improvements in the wave analysis which uses additional satellite radar altimeter data (CryoSat-2, SARAL/ALTIKA) in the new cycle. When verified against observations, significant improvements in wave forecasts are seen both in the tropics and extra-tropics.

Synoptic evaluation

The synoptic performance of the new cycle was assessed over a wide range of case studies. The improvements to the cloud and precipitation physics in the model reduce the occurrence of light precipitation (drizzle) in situations where stratiform rain dominates, and also increases the amount of precipitation in heavy events. The new lake model will improve 2m temperature forecasts in the vicinity of the (sub-grid) lakes that are now represented in the model. Users may notice some differences when comparing with station observations in these locations: the model values represent an average temperature of lake and land together (weighted by areal coverage), while stations are generally representing land points only. Such discrepancies are likely to depend on the time of year and the prevailing weather type.

For tropical cyclones in HRES the average position error has reduced slightly, to give a lead time gain of about 6h at day 5. In HRES the sea level pressure minimum at the centre of tropical cyclones is on average slightly lower at all lead times. Up to and including day 3 this makes the forecast better, by reducing the slight positive bias. From day 5 onwards however the pre-existing bias towards over-deepening has increased slightly.

There were no other major systematic differences from the operational cycle.

Monthly forecast

Results suggest a generally positive, although not statistically significant, effect on skill scores in the northern extra-tropics and tropics (except for SSTs in the extra-tropics). There is a clear improvement in the skill scores for the Madden-Julian Oscillation (MJO), likely due to the revised organized convective detrainment and the revised convective momentum transport. The improvement amounts to a gain of about 1 day in MJO predictive skill (measured as the lead time at which the correlation reaches 0.6). The MJO is also slightly stronger, and the ensemble spread is closer to the error.

Evaluation

Comparison of scores of model cycle 41r1 and cycle 40r1

New and changed parameters

New model output parameters

Several new parameters are introduced at IFS cycle 41r1. All new parameters are archived in MARS and will be provided in dissemination with the 41r1 cycle implementation.

Surface precipitation type

Surface precipitation type (including freezing rain) and precipitation rates for large-scale and convective rain and snowfall are among the new model output parameters introduced. A precipitation type is assigned wherever there is a non-zero value of the total precipitation rate in the model output field, however small. This means that if only the precipitation type is plotted the areal coverage of 'dry' (precipitation type = 0) may look unrealistically small. So the precipitation type should be used carefully together with the combined precipitation rates to provide, for example, indication of potential freezing rain events. Users should also note that if they need to interpolate the precipitation type field they should only ever do this using a 'nearest neighbour' approach.

An initial assessment of freezing rain is reported in the Autumn 2014 ECMWF Newsletter. Although the first evaluation for a number of case studies shows promise, further work is required to assess the ability of the IFS to predict the probability of freezing rain at different forecast ranges – feedback about these experimental products is welcome.

Visibility

The new "visibility" diagnostic in IFS Cycle 41r1 is an experimental product with limited evaluation to date and therefore should be used with great care. Users' expectations of the quality of this experimental product should remain low. It is in the operational system so that we can gain experience with this diagnostic, evaluating over time with the aim of improving the diagnostic and its usefulness as a forecast product.

The "visibility" diagnostic is defined as near surface horizontal visibility (i.e. representative of the lowest 20m layer above the surface). The visibility is calculated using an exponential scattering law and a visual range defined by a fixed liminal contrast of 0.02 (e.g. Clark et al. 2008, Q.J.Roy.Met.Soc.). The extinction coefficients are calculated for the contributions from cloud and precipitation and climatological seasonally varying aerosol species. The extinction coefficient of clean air is taken to be equivalent to a visibility of 100 km so values can be no larger than this. So in principle, the IFS is able to represent reduced visibility effects of fog, precipitation and seasonally averaged aerosol loading, but not local deviations of the aerosol fields or the interactions of fog and aerosol particles. Where there is fog forecast by the model (cloud water drops in the lowest model layer), visibility can reach values below 500 m, although initial evaluation suggests visibility is too far when fog is predicted by the model (i.e. the fog is not optically thick enough). This will be addressed in the future.

As a weather hazard, fog is an extremely important, but difficult, variable to be able to predict. The visibility diagnostic includes information on the reduced visibility in fog. However, correctly predicting very low visibility (fog) is dependent on predicting the correct dynamic and thermodynamic conditions in the boundary layer and can be highly variable in space and time, often tied to orographic features that are not resolved by the model, and a probabilistic approach using the ensemble members will likely be of most benefit.

It should be stressed that this is a preliminary implementation of a "visibility" diagnostic, but there are plans for further evaluation and improvement in the future. Further evaluation and feedback is always welcome.

Ocean waves (wind waves and swell)

In IFS cycle 41r1 a new partitioning of ocean waves into wind waves and swell has been introduced. The new scheme splits the wave spectra into wind waves and up to three swell partitions (swell 1, 2 and 3, ranked by their respective energy). There is a new set of model output parameters (significant height, mean direction and mean period) to characterise each of the three swell partitions.

As originally implemented in IFS cycle 41r1, the new wind waves partition was different to that determined by the previous scheme, usually containing slightly more energy. The total swell, defined by all spectral components that are not wind waves, was also affected by the introduction of the new partitioning scheme, being significantly less smooth than before (this is a feature of how the new partitioning works). This had the unintended consequence that users were unable to use the new significant height of total swell field in the same way as before.

Therefore, starting with the forecast from 06 UTC on 19 May 2015, ECMWF reverted to the previous scheme to compute both total swell and wind waves parameters. The three new swell partition parameters based on the new scheme are still produced. However, the sum of their energy is not equal to the energy contained in the total swell (the difference being the extra wind waves energy). The new parameters remain experimental products and are not included in the Catalogue of ECMWF real-time products.

Full list of new parameters

A full list of the new parameters introduced at IFS cycle 41r1 is provided in the table below. More detailed information about these parameters can be found in the parameter database.

Table of new parameters introduced at IFS cycle 41r1

paramId	shortName	name	GRIB edition	Component	Notes	Proposed for Catalogue
paramId	**shortName**	**name**	**GRIB edition**	**Component**	**Notes**	**Proposed for Catalogue**
26	cl	Lake Cover	1	HRES	Invariant	✓
228007	dl	Lake depth	1	HRES	Invariant	✓
228008	lmlt	Lake mix-layer temperature	1	HRES, ENS		✓
228009	lmld	Lake mix-layer depth	1	HRES, ENS		✓
228010	lblt	Lake bottom temperature	1	HRES, ENS		✓
228011	ltlt	Lake total layer temperature	1	HRES, ENS		✓
228012	lshf	Lake shape factor	1	HRES, ENS		✓
228013	lict	Lake ice temperature	1	HRES, ENS		✓

228014	licd	Lake ice depth	1	HRES, ENS		✓
228217	ilspf	Instantaneous large-scale surface precipitation fraction	1	HRES, ENS		✓
228218	crr	Convective rain rate	1	HRES, ENS		✓
228219	lsrr	Large scale rain rate	1	HRES, ENS		✓
228220	csfr	Convective snowfall rate water equivalent	1	HRES, ENS		✓
228221	lssfr	Large scale snowfall rate water equivalent	1	HRES, ENS		✓
228222	mxtpr3	Maximum total precipitation rate in the last 3 hours	1	HRES, ENS		✓
228223	mntpr3	Minimum total precipitation rate in the last 3 hours	1	HRES, ENS		✓
228224	mxtpr6	Maximum total precipitation rate in the last 6 hours	1	HRES, ENS		✓
228225	mntpr6	Minimum total precipitation rate in the last 6 hours	1	HRES, ENS		✓
228226	mxtpr	Maximum total precipitation rate since previous post-processing	1	HRES, ENS		✗
228227	mntpr	Minimum total precipitation rate since previous post-processing	1	HRES, ENS		✗
228029	i10fg	Instantaneous 10m wind gust	1	HRES, ENS		✓
228088	tcslw	Total column supercooled liquid water	1	HRES		✓
228251	pev	Potential evaporation	1	HRES, ENS		✓
260015	ptype	Precipitation type	**2**	HRES, ENS	GRIB 2, Index: 1=rain 3=freezing rain 5=snow 6=wet snow 7=sleet 8=Ice pellets	✓
003020	vis	Visibility	1	HRES, ENS	Experimental	✓
57	uvb	Downward UV radiation at the surface	1	ENS		✓
206	tco3	Total column ozone	1	ENS		✓
203	o3	Ozone mass mixing ratio	1	ENS	On pressure levels	✓
140121	swh1	Significant wave height of first swell partition	1	WAM-HRES, WAM-ENS, WAM-LAM		✗
140122	mwd1	Mean wave direction of first swell partition	1	WAM-HRES, WAM-ENS, WAM-LAM		✗
140123	mwp1	Mean wave period of first swell partition	1	WAM-HRES, WAM-ENS, WAM-LAM		✗
140124	swh2	Significant wave height of second swell partition	1	WAM-HRES, WAM-ENS, WAM-LAM		✗

140125	mwd2	Mean wave direction of second swell partition	1	WAM-HRES, WAM-ENS, WAM-LAM		✗
140126	mwp2	Mean wave period of second swell partition	1	WAM-HRES, WAM-ENS, WAM-LAM		✗
140127	swh3	Significant wave height of third swell partition	1	WAM-HRES, WAM-ENS, WAM-LAM		✗
140128	mwd3	Mean wave direction of third swell partition	1	WAM-HRES, WAM-ENS, WAM-LAM		✗
140129	mwp3	Mean wave period of third swell partition	1	WAM-HRES, WAM-ENS, WAM-LAM		✗
140207	wss	Wave Spectral Skewness	1	WAM-HRES, WAM-ENS, WAM-LAM		✗

The inclusion of a significant number of the new parameters in the Catalogue of ECMWF real-time products was approved by the Advisory Committee on Data Policy in April 2015 as indicated in the table. The inclusion of wave parameters and the extension to 46 days of the monthly forecast will be discussed in the coming months.

Availability of ENS model level parameters in dissemination

ENS model level parameters will be available in dissemination for all members at all post-processing time steps to day 15. These fields will not be archived in MARS.

Changes to existing parameters

Discontinuation of the following

- The following parameters are obsolete.

ParamId	ShortName	LongName	Note
173128	SR	Surface roughness	Use forecast surface roughness - FSR (244128)
234128	LSRH	Logarithm of surface roughness length for heat	

The surface roughness fields SR and LSRH should no longer be used (they have not been upgraded to the new climate resolution). Users of surface roughness should instead use the forecast field (FSR).

FSR is a prognostic variable that changes during the forecasts (for example due to snow cover changes).

The archiving of the 2 fields SR, LSRH will be discontinued in a later cycle.

- After consultation with our users, we have stopped archiving the Budget Values (shortName BV, paramId 128128).

Technical content

New land-sea mask, orography and climate fields

The underlying data sources for the land-sea mask, lake mask, mean and sub-grid orography fields, glacier information, and surface albedos have been changed.

The land-sea mask and orography are based on the following raw data information:

- ESA's Globcover V2.2 based on Envisat MERIS (300 m resolution) mapping 2005/2006 (ESA, 2010);
- the Shuttle Radar Topography Mission (SRTM30) dataset provided by the US geological survey (SRTM, 2004) at about 90m resolution;
- the Global Land One-kilometer Base Elevation (GLOBE, 1999) (only north of 60°N and south of 60°S), and;
- specialised DEMs of Greenland (BPRC, 2002), Iceland (IMO, 2013), and Antarctica (RAMP2, Liu et al., 2001) replacing the corresponding data points on the 1km latitude/longitude grid.

The lake mask has been created from the land sea mask and complemented by consistency algorithms.

The surface albedos representative of different spectral bands are based on a 0.05° (approximately 5km) MODIS 5-year gap-filled and snow free product provided by the University of Massachusetts, Boston. The albedos are specified in parametric form but, for consistency with the approach in current operations, they are pre-calculated at local solar noon.

In addition, new data has been introduced for lake depth and other lake parameters.

Changes will be seen in the level of filtering the mean orography (especially for ENS, but also a better representation of orography in South America, and a better match to station data for HRES), individual points which change from land to sea and vice versa, and small changes in the sub-grid orography fields. The climate file changes are expected to produce small local differences in all ECMWF near-surface forecasts of weather parameters.

The GRIB packing accuracy of the new climate fields used as input to the model has been increased from 16 to 24 bits per value. As a consequence, the following analysis fields required for initial conditions have an increased GRIB packing accuracy of 24 bits per value.

paramId	shortName	name
26	cl	Lake cover (new at cycle 41r1)
27	cvl	Low vegetation cover
28	cvh	High vegetation cover
43	slt	Soil type
74	sdfor	Standard deviation of filtered subgrid orography
129	z	Geopotential
141	sd	Snow depth (already 24 bits at cycle 40r1)
160	sdor	Standard deviation of orography
161	isor	Anisotropy of sub-gridscale orography
162	anor	Angle of sub-gridscale orography
163	slor	Slope of sub-gridscale orography
172	lsm	Land-sea mask
174	al	Albedo
228007	dl	Lake depth (new at cycle 41r1)

The accuracy of the corresponding forecast parameters in the FDB, archived in MARS and in dissemination is not changed.

The new land-sea mask and orography fields at reduced Gaussian resolutions N640, N320 and N160 are available for download:

- HRES: Land-sea mask and orography fields for the N640 grid (T_L1279)
- ENS Leg A (days 1 to 10): Land-sea mask and orography fields for the N320 grid (T_L639)
- ENS Leg B (days 11 to 15): Land-sea mask and orography fields for the N160 grid (T_L319)

Note on albedo

The albedo field (AL 174128) is a fixed snow- and ice-free albedo derived from the climate fields. As the underlying climate fields have changed, there are differences between the current and 41r1 AL fields. These are particularly large over Antarctica and Greenland since the current AL field has a different (larger) value in these areas. The area of high albedo over south-east Greenland in the 41r1 fields is a feature present in the original climate data sets.

As in current operations, the AL field is not used in the forecast; it provides an indication of the total (broadband) albedo climatology (excluding snow and ice effects) for diagnostic use only. Users are advised to use the forecast field (FAL 243128) which also contains the snow and ice effects. FAL is a prognostic variable that changes during the forecasts.

You can read a detailed description of the albedo in the model.

ENS Leg B extended from 32 to 46 days on Mondays and Thursday (at 00UTC)

Both the monthly forecasts and re-forecasts are extended to 46 days. At this range forecast skill is relatively low and the forecasts should be used with care. However, results have shown that there is positive skill in some aspects of the forecasts in the 30-45 day range. Users are encouraged to read the review of extended-range performance in ECMWF Technical Memorandum 738 on 'Sub-seasonal predictions' for further information, before developing products using these forecasts. ECMWF will continue to investigate forecast performance and potential products for the 30-45 day range.

At this stage, no post-processed products are produced beyond day 32. Additional products taking into account the extension may be provided in the future once experience has been gained with the additional steps.

Increase frequency of steps for STRD in the Monthly Forecast and re-forecasts.

Surface thermal radiation downwards (STRD, paramId=175) is now available at 6-hourly steps for Legs A, B and C.

New ENS re-forecast configuration

The ENS re-forecasts will be run twice a week, for Mondays and Thursdays (instead of just Thursday as now). The size of each re-forecast ensemble will be increased from 5 to 11 members and the forecast range extended to 46 days. This will provide a substantial increase in the sample size for the model climates for the medium-range EFI/SOT and the extended-range (monthly) products.

The ENS re-forecasts are produced in advance. Usually, the Monday re-forecasts will be available for extraction from MARS on the Monday 2 weeks before while the Thursday re-forecasts will be available on the Thursday 2 weeks before. In other words:

- on Monday 18 May re-forecasts for Monday 1 June can be extracted.
- on Thursday 21 May re-forecasts for Thursday 4 June can be extracted.

Note that the availability of these data sets in advance is not guaranteed. Users should make arrangements to use only the three the re-forecasts received in dissemination in case of issues with the advance production of the re-forecast data sets.

Changes in the model climate (M-climate) used for EFI and SOT

The M-climate will continue to use a 5-week period of re-forecasts but will now include all intermediate runs, e.g. M-climate prepared on Thursdays will include all Thursday and Monday re-forecasts within the 5-week window, so altogether 9 sets of re-forecasts. Hence the sample size substantially increases from 500 realisations to 1980 realisations (11 members, 20 years, 9 sets). M-climate will be updated twice a week (every Monday and Thursday) to benefit from the more frequent re-forecast runs.

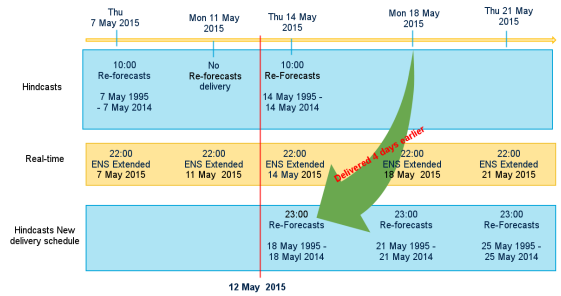
The same M-climate dataset will be used for both the 00 UTC and 12 UTC ENS runs, for all EFI parameters. This will fix the undesirable flip-flopping of the EFI forecasts for certain parameters such as 2-metre minimum and maximum temperatures caused by an inconsistency between real-time forecast and re-forecast datasets using different time windows for the 24-hour period for which the products are valid.

Changes in the model climate used for the monthly forecast

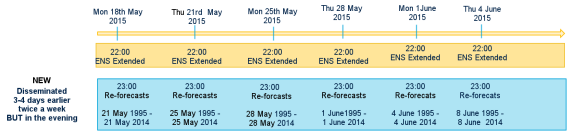
The model climate for the Thursday forecast will use the re-forecasts from that Thursday and from the Monday either side. The total number of re-forecasts in the model climate will therefore be 660 (11 members, 20 years, 3 sets of start dates). The model climate for the Monday forecast will also use 3 re-forecast sets (from Thursday, Monday, Thursday). So both Monday and Thursday forecasts will use the same number of re-forecasts for the model climate.

Both re-forecast runs (Monday and Thursday based) will be made available in dissemination where each re-forecast will be disseminated separately. The additional Monday run will be disseminated at 23:00 UTC on the preceding Thursday; the Thursday run will be disseminated at 23:00 UTC on the preceding Monday.

The diagram below shows the schedule for the transition:



Thereafter, the schedule will be:



Changes in the Extreme Forecast Index (EFI) and Shift of Tails (SOT)

The EFI/SOT products were extended late in May 2015 to include two new time ranges, T+000-360h and T+240-360h for 2-metre mean temperature, total precipitation and 10-metre mean wind.

The new re-forecast configuration reduces sampling errors in the M-climate, especially near the extremes. This makes the EFI and SOT more robust, and reduces the spurious fluctuations (due to under-sampling of the climate distribution) that are sometimes seen in the EFI and SOT between successive forecast times. A revision to the EFI computation code has also improved the numerical accuracy.

Limited-area ocean wave model

The domain of limited-area ocean wave model is extended to the full globe. Fields are encoded from 90° N to 78°S on a 0.1^{o} reduced latitude-longitude grid.

Product availability if also extended and are available at the following post-processing steps:

- hourly from T+000h to T+120h;
- 3-hourly from T+123h to T+144h;
- 6 hourly from T+150h to T+240h.

The MARS labelling remains unchanged (stream=wave, class=od, type=fc, domain=m).

Products in dissemination are available at multiples of a 0.125^{o} regular latitude-longitude grid.

Users retrieving data on the native grid (MARS grid=av) should be aware that the extension to the full globe will result in fields that are 7 times larger.

Changes to GRIB encoding

The GRIB model identifiers (generating process identification number) for the new cycle will be:

- Atmospheric model ID=145 (previous cycle 144)
- Ocean wave model ID=111(previous cycle 110)
- Limited-area ocean wave model ID=211(previous cycle 210)

These are found in:

- GRIB 1: Product Definition Section 1, Octet 6
- GRIB 2: Product Definition Section 4, Octet 14

or with the grib_api key generatingProcessIdentifier.

Changes to the fields CIN and CBH

Convective Inhibition (shortName CIN, paramID 228001) and Cloud Base Height (shortName CBH, paramID 228023) are Forecast fields available both from the HRES and the ENS systems. With this cycle, we have changed these fields to include a bitmap with missing values. Before this cycle, CIN had a

value set to 1000 and CBH a value of 20000 coded as missing value. Users of MARS and the dissemination will mainly benefit from this change in the interpolation software. If you face problems with this change, please contact User Support, who can offer a temporary solution to replace the bitmap with the old missing values given above.

Software

EMOSLIB

EMOSLIB has been updated to handle the new wave parameters. Users using these and/or the extended Limited Area wave model fields should use the new version 402, which can be selected with 'module' at ECMWF or which is available for download.

MARS

Users accessing the new wave fields and/or the extended Limited Area wave model fields should use the latest version of MARS ('mars -n'). The default version of MARS will be updated before the implementation of the new cycle.

GRIB API

To process the newly added parameters using the GRIB API shortName and paramId keys, you need at least GRIB API version 1.12.3

Dissemination

As soon as 41r1 cycle is implemented users can request new parameters and step ranges.

The additional extended ENS re-forecast run will be available in dissemination using MARS key word USE=MONTHLY RUN MONDAY.

On the Thursday following implementation of cycle 41r1:

- the re-forecast data for that day's 00UTC monthly extension will be disseminated at 10:00 UTC
- the real-time forecast data for that day's 00UTC monthly extension will be disseminated at 22:00 UTC
- the re-forecast data for the following Monday's 00UTC monthly extension will be disseminated at 23:00 UTC

Thereafter:

- the re-forecast data for the Thursday 00UTC monthly extension will be disseminated at 23:00 UTC on the preceding Monday
- the re-forecast data for the Monday 00UTC monthly extension will be disseminated at 23:00 UTC on the preceding Thursday

Dissemination requirements for the re-forecast data will be based upon those in operation 24 hours before the schedule. In exceptional circumstances, it may be necessary to base the dissemination requirements on those in operation from approximately 2 weeks before the schedule.

For the new Limited-area wave model, the key word DOMAIN=M remains. Products can be requested on any sub-area within AREA=90/0/-78/359.875 and multiplies of GRID=0.125/0.125.

Resources

ECMWF Newsletter Number 144: https://www.ecmwf.int/en/elibrary/14588-newsletter-no-144-summer-2015