ECMWF forecast system upgrade - 47r1

Florian Pappenberger

Director of Forecasts

@FPappenberger



#IFS47r1 #newfcsystem @ECMWF



Keep up to date with the implementation steps - on this side

Webinar on 'Cycle 47r1 overview'

Extended-range impact on scores and MJO





Prof. Andy Brown Director of Research 30mins

The webinar slides are available to download.



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Questions????

USE THE CHAT 8

Your questions will be answered immediately





Ivan Tsonevsky

Anna Ghelli



Tim Hewson



Irina Sandu



lain Russell





Andy Brown



Thomas Haiden



Fernando Prates



Staff @ECMWF



Martin Leutbecher



Carsten Maass



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Implementation timeline



On the 2nd June

- A full set of product services (e.g. dissemination of test data, ecCharts) will be offered until the operational implementation of the new cycle.
- The test products will be generated daily, shortly behind real-time from the high resolution and ensemble runs and based on the operational dissemination requirements.
- Graphical display of IFS cycle 47r1 test data using ecCharts will become available
- Implementation of new cycle will be on 30 June 06UTC



Keep up to date with the implementation steps

https://confluence.ecmwf.int/display/FCST/Implementation+of+IFS+Cycle+47r1

Contains all details on upgrade.

Please watch the page

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 ● Watch
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	Calendars Create ···	Search 🔍 🛛 🗘 🕫 🥌 ^
Forecast User	Pages / Forecast User Portal / Changes to the forecasting system 🖉 🔮	🖋 Edit 🖙 Save for later 💿 Watching < Share 🚥
	Implementation of IFS Cycle 47r1	
Pages	Created by Carsten Maass, last modified yesterday at 5:06 PM	
99 Blog	Page updated on: 💼 20 May 2020	
SPACE SHORTCUTS	Description of the upgrade	Meteorological content
Forecast charts	This cycle includes changes in the treatment of observations and	Meteorological impact
Porecast evaluation	improvements in the data assimilation and to the model. Quintic vertical interpolation in the semi-Lagrangian advection scheme has been introduced	New metrics for Tropical cyclones New and changed parameters
€ Catalogue real-time products	as well as the inclusion of a better surface albedo climatology making use of	Technical content
99 ECMWF Forecast User Guide	more data from the MODIS instrument.	Availability of IFS cycle 47r1 test data Resources
PAGE TREE	New Metrics of Tropical Cyclone (TC) "size" will supplement the existing forecasts of TC track and intensity. We encourage users of these BUFR data to	
> Known IFS forecasting issues	test their decoding software, see New Tropical Cyclone Wind Radii product.	NEWS!
✓ Changes to the forecasting system		💼 20 May 2020 Near real-time release candidate test data will be
Terminology for IFS testing	#IFS4/r1 #newtcsystem @ECMWF	available from the 00Z run on 2 June 2020
Implementation of IFS Cycle 4		19 May 2020 CIN and EFI for CAPE and CAPE-shear have been reviewed, List of new and changed parameters now available
• New Tropical Cyclone Wind Ra		27 Apr 2020 Interactive ENS and HRES scorecards are now available
Introducing the octahedral redu		26 Apr 2020 The next two webinars will be
Implementation of IFS cycle 46R		• 27th May 2020 at 8:30 UTC - join the webinar
Implementation of IFS cycle 45r		• 28th May 2020 at 14:30 UTC - join the webinar
Implementation of Seasonal For		
Implementation of IFS cycle 43r	luu lau autotian timalian	
Implementation of IFS Cycle 43r	Implementation timeline	
Implementation of IFS cycle 41r		
Scorecard for IFS cycle 38r1 ENS		Delease
Horizontal resolution increase		candidate Implementation
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47r1 performance – ENS scorecard

based on ~350 model runs

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Verification against analysis

Verification against observations

EUROPEAN CENTRE FOR MED

47r1 performance – ENS scorecard

based on ~350 model runs

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Symbol legend: for a given forecast step...

EXERCIN

experiment better than control statistically significant with 99.7% confidence
 experiment better than control statistically significant with 95% confidence
 experiment better than control statistically significant with 68% confidence
 not really any difference between control and experiment

experiment worse than control statistically significant with 68% confidence
 experiment worse than control statistically significant with 95% confidence
 experiment worse than control statistically significant with 99.7% confidence

EUROPEAN CENTRE FOR MEDIUM-RA

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47r1 performance – ENS scorecard

based on ~350 model runs



December 2018 to mid April 2020

47r1 performance – ENS scorecard

based on ~350 model runs

			Northern	nemisphere	Southern	nemisphere	Tro	pics
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	10m wind speed							9
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based on ~350 model runs

Large reduction of temperature errors in the stratosphere



Due to (among other changes):

- revised weak-constraint 4D-Var
- quintic vertical interpolation in the semi-Lagrangian advection scheme



			Northern h	emisphere	Southern h	remisphere	Tro	pics
			RMS error	CRPS	RMS error	CRPS	RMS error	CRPS
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EUROPEAN CENTRE FOR MEDIUM-RANGE

based on ~350 model runs

Improvements in tropospheric temperature



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based on ~350 model runs

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### based on ~350 model runs

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10m wind speed

Total precipitation Significant wave height .

**C**ECMWF

# 47r1 performance – HRES scorecard

### based on ~630 model runs

Qualitatively similar to ENS scorecard:

- Apparent degradations against own analysis
- Mostly neutral to positive against observations

			Northern h	emisphere	Southern h	nemisphere	Tro	pics
			Anomaly correlation/	RMS error/	Anomaly correlation/	RMS error/	Anomaly correlation/	RMS error/
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	Relative humidity	700						
	2m dew point							
	Total cloud cover							
	Total precipitation					Δ		14
	Significant wave height	_						

# Questions????

# **USE THE CHAT** 8

# Your questions will be answered immediately





Ivan Tsonevsky

Anna Ghelli



Tim Hewson



Irina Sandu



lain Russell





Andy Brown



**Thomas Haiden** 



**Fernando Prates** 



Staff @ECMWF



Martin Leutbecher



**Carsten Maass** 



#IFS47r1 #newfcsystem @ECMWF

# Tropical cyclone max wind - min pressure relationship



Colour shading and dashed line: TCo1279 forecasts (h9s0), all forecasts intialised from 0 UTC. Pink symbols and dotted line: Best Track data. Colour shading and dashed line: TCo1279 forecasts (h9s3), all forecasts intialised from 0 UTC. Pink symbols and dotted line: Best Track data.

Tco1279 forecasts from 0 UTC for period 25-08-2019 to 01-01-2020 (coloured shading and dotted line). Reported values (pink symbols and dotted line) for tropical cyclones:

Ambali, Belna, Bualoi, Calvinia, Dorian, Faxai, Fengshen, Hagibis, Halong, Humberto, Kammuri, Kyarr, Lingling, Lorenzo, Maha, Matmo, Nakri, Phanfone, Sarai, Sebastien



# Tropical Cyclone Size: Wind Radii (34-, 50- & 64-kts)

Radii: maximum extent of 10-m wind thresholds (34-, 50 & 64-kt) in each quadrant (NE, SE, SW & NW) from the TC centre (products are freely available)



- Product available for the HRES and ENS (all TCs in analysis and those that develop during the forecast –'genesis')
- Can be helpful to 1) identifying coastal areas potentially affected by winds of TS strength or higher; 2) ship routing forecast
- More information in <u>https://confluence.ecmwf.int/display/FCST/New+Tropical+Cyclone+Wind+Radii+product</u>

**ECMWF** EUROPEAN CENTRE FOR MEDIUM-RANGE WEATHER FORECASTS



# Convective inhibition diagnostic (CIN)



#### 46r1



- CIN has been revised to use virtual potential temperature instead of equivalent potential temperature
- Considerable reduction in average CIN values



47r1



Severe thunderstorms developed over NW Bulgaria in the evening hours on 20 May 2020 producing very large hail.

The new improved computation of CIN and the fact that now CAPE and CIN represent the same air parcel considerably improve CIN for diagnosing deep, moist convection.



CECMV

# Changes in EFI for CAPE and CAPE-shear

Improve the representation of 24-hour maxima by better sampling (maximum of hourly over previous 6 hrs)











## 47r1 – new parameters

Surface parameters added to the HRES analysis

Param ID	Short name	Name	Units
<u>229</u> / <u>230</u>	lews / inss	Instantaneous eastward/northward turbulent surface stress	N m ⁻²
<u>210186</u>	Aluvpi	UV visible albedo for direct radiation, isotropic component	(0 - 1)
<u>210187</u>	aluvpv	UV visible albedo for direct radiation, volumetric component	(0 - 1)
<u>210188</u>	Aluvpg	UV visible albedo for direct radiation, geometric component	(0 - 1)
<u>210189</u>	alnipi	Near IR albedo for direct radiation, isotropic component	(0 - 1)





# Changes in parameters formats

Technical change to GRIB headers of Event Probabilities (type EP) for tropical storms

Param ID	Short name	Name	Units
131089	pts	Probability of a tropical storm	%
131090	ph	Probability of a hurricane	%
131091	ptd	Probability of a tropical cyclone	%

Technical change to BUFR messages of Tropical Cyclone Tracks in HRES and

Obstype	Name	BUFR edition
32	Tropical Cyclone track	3/4

### For details see

https://confluence.ecmwf.int/display/FCST/New+Tropical+Cyclone+Wind+Radii +product







# 47r1 – recommended software versions

ECMWF will update the default versions of its software packages and libraries **across all user platforms** on Wednesday 3 June 2020

The new default versions, including

ecCodes 2.17.1 Magics 4.3.3 Metview 5.8.3

are ready to handle the data produced, including all new parameters introduced with 47r1

MWF is updating the default versions of its software packages and libraries used across all user platforms at the centre as p         When?         The changes will take place on Wednesday 3 June 2020 10:00 UTC         What platforms are affected?         All user platforms at the centre will see their default additional software stack updated:         • All dusters in our High Performance Computing Facility, mainly CCA and CCB         • ECGATE         • Linux Clusters         • Linux Clusters         • Linux Clusters         • D I need to do anything?         We strongly recommend you test that your programs, scripts and suites work with the new versions of any software or library affected before the change happens.         ble of contents         • Table of contents         • Table of contents         • Table of contents         • Software stack ready for next operational IFS cycle	ECMW	
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Users are strongly encouraged to test their software applications and data processing chain with the new versions of the various software packages.





# Recent software updates

Our software packages are now available on conda with Python 3 interfaces on PyPi

- ecCodes:
  - Many performance improvements
  - Improved support for Windows
- CodesUI improvements:
  - Easier location of keys with new filter on the standard namespace dump
- Metview improvements:
  - -New set of pre-defined areas available
  - New/improved set of thermodynamic functions available

Namespaces Standard dump			Sections		Values			
ecCodes names	Ŧ							
param								
Key			Туре		Value			
ifsParam			long		167			
indicatorOfParam			long		2t			
marsParam			string	g	167.128			
paramid						long		167
paramIdECMF						string	g	167
parameterName						string	g	2 metre temperature
parameterUnits						string	g	К





### Next steps

- Start of release candidate test phase with 00 Z run on 2 June 2020
- Implementation planned for June 30th
- Please do 'watch' the cycle 47r1 implementation wiki page to keep in touch with the latest news

https://confluence.ecmwf.int/display/FCST/Implementation+of+IFS+Cycle+47r1

# THANK YOU







### Changes to surface albedo: 1. spectrum



- The MODIS albedo climatology is available for the UV/Vis and Near-IR spectral regions, the split being at 0.7  $\mu m$
- This lies in the middle of an RRTMG band, and previously the entire band was assigned to the Near-IR region, effectively putting the split at 0.625  $\mu m$
- In 47r1 we carefully average the albedos in this band, which tends to make snow and ice surfaces brighter overall, and vegetated and desert surfaces darker (hence slightly warmer)



### Changes to surface albedo: 2. solar zenith angle dependence



• The MODIS climatology provides maps of three coefficients in the two spectral ranges (six components in total) and the albedos are computed as follows (Schaaf et al. 2002):

- $\alpha_{direct}(\theta) = A_{iso} + A_{vol}(-0.008 0.071\theta^2 + 0.308\theta^3) + A_{geo}(-1.285 0.166\theta^2 + 0.042\theta^3)$
- $\succ \alpha_{diffuse} = A_{iso} + 0.189A_{vol} 1.378A_{geo}$

where  $\theta$  is solar zenith angle in radians

- Before 47r1, the albedo to diffuse radiation,  $\alpha_{direct}$ , was computed offline for <u>fixed overhead sun</u> ( $\theta = 0$ ) so was systematically underestimated
- In 47r1 the solar zenith angle dependence is correctly represented via the explicit use of the six components