

# ECMWF computing services, products and outreach activities

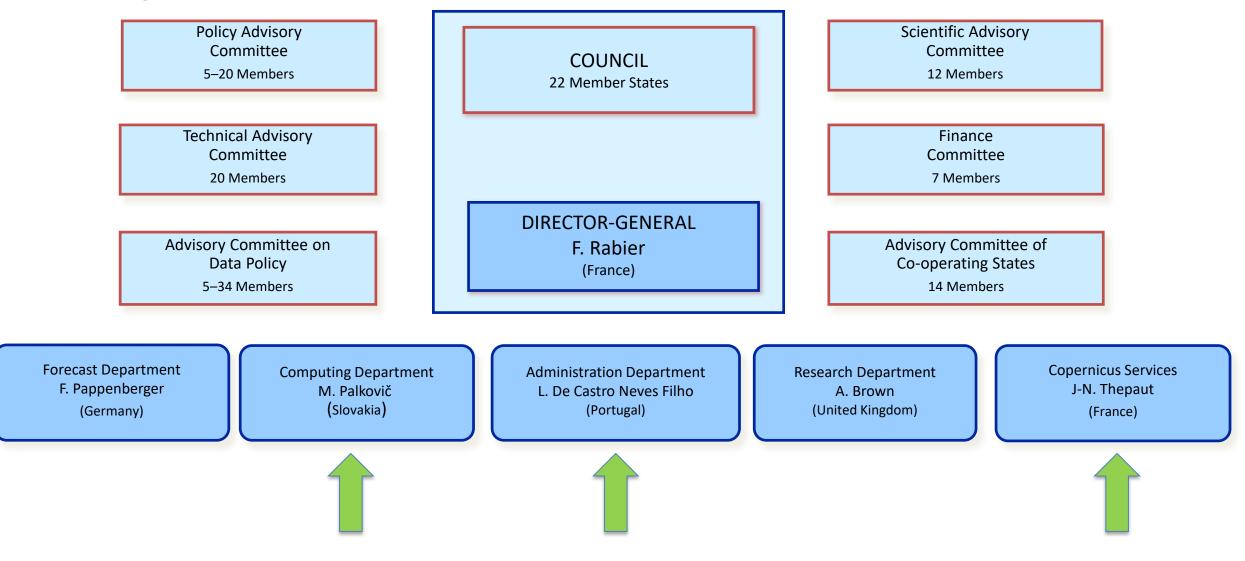
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# Organisational structure of ECMWF



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

# The operational forecasting system

#### High resolution forecast (HRES) :

- twice per day 9 km 137 levels, to 10 days ahead

#### **Ensemble forecast (ENS):**

- twice per day 51 members, **18 km** 91 levels, to 15 days ahead
- Monday/Thursday 00 UTC extended to 1 month ahead (Monthly Forecast, 18/36 km)

#### Ocean waves: twice per day

- HRES-WAM: 10 days ahead at 14 km (coupled)
- HRES Stand Alone Wave (SAW) model : 10 days ahead at 11 km (\*)
- ENS-WAM: 15 days ahead at 28 km (coupled)

#### Seasonal forecast: once a month

- 51-members, ~35 km 91 levels, to 7 months ahead
- sub-set of 15 members is run for 13 months every quarter (**30 years of hindcasts**)
- EUROSIP Multi model seasonal is replaced by Copernicus Seasonal

# Model in focus

2016

Integrated Forecasting System (IFS) cycles	22 Nov.	43r1
Cycle 43r1:		
Upgrade to the dynamical ocean model used for the medium-range ensemble and its monthly extension, new model output (ceiling, height of convective cloud top, height of 0/1	2017	
degree wet-bulb temperature, direct solar radiation, wave energy flux magnitude/mean direction, significant wave height of all waves within a range of periods	11Jul.	43r3
Cycle 43r3:		
new radiation scheme, improvement in convection, new aerosol climatology, changes in observation assimilation	2018	
Cycle 45r1	6 Jun.	45r1
consistent gains in the extended range. A key plank of the upgrade is enhanced dynamic coupling between the ocean, sea ice and the atmosphere. The upgrade extends this coupling to ECMWF's medium-range high-resolution forecasts (9 km horizontal resolution)	2019	
Cycle 46r1	Q2	46r1
Continuous data assimilation and introduction of a 50-member Ensemble of Data Assimilations: weakly coupled data assimilation for sea-surface temperature in the tropics;	2020	
improvements in the wave model, the convection scheme, the radiation scheme and the use of observations.	Q2	4711

# Model in focus

#### BOLOGNA PLANS

48r1

- Single precision operational implementation (HRES fc, ENS, extended-range)
- Unified vertical resolution (ENS, extended-range to match existing HRES L137)
- ENS horizontal resolution increase to 9-11 km
- Daily extended-range ensembles (ideally 51 members) \*see separate presentation
- Moist physics framework upgrade, multi-layer snow scheme
- pySuite-based analysis suites

49r1

- OOPS and COPE operational implementation
- NEMO 4, SI3
- Multi-layer surface variables / multi-layer soil scheme

# Services in focus

## Time Critical applications (some examples)

Country	Description	Start TC application
IRELAND	HARMONIE (LAM, resolution 2.5 Km, 65 vertical levels). It uses ECMWF boundary conditions.	2017
IRELAND	Data acquisition (to run DA on ECMWF HPCF)	2017
PORTUGAL	ALADIN (LAM).	2013
ITALY	COSMO-LEPS (LAM ensemble)	2004
GERMANY	Disaster Backup NWP of DWD	2014
HIRLAM consortium	GLAMEPS (LAM ensemble)	2010
SPAIN	HARMONIE (LAM)	2015
AUSTRIA	ALADIN-LAEF (LAM ensemble)	2011
SERBIA	NMMB (LAM – nonhydrostatic multiscale model – NCEP). It uses ECMWF as boundary conditions	2017
UNITED KINGDOM	UKMO SSPS (Site-Specific Post-Processing System)	2013
GREECE	COSMO	2018
SERBIA	Nonhydrostatic Multiscale Model (NMM-B), 4Km resolution (IFS boundary conditions	2018



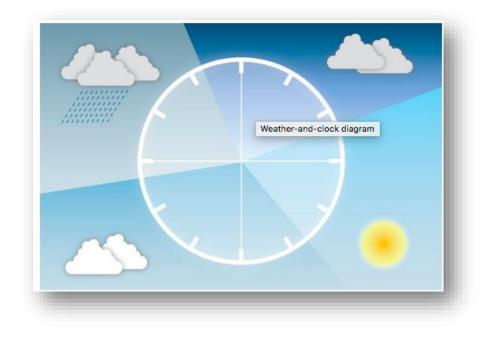
# Services in focus

# Availability of Boundary Conditions optional programme data

ENS model levels (and more) from the BC optional programme:

- Stored on FDB and available for 30 days
- More information here: https://confluence.ecmwf.int/display/UDOC/ENS+BC +model+level+data+in+MARS

The hourly data and 06/18 UTC forecast runs from its Boundary Conditions optional programme are now available to all users holding a real-time licence, upon request.



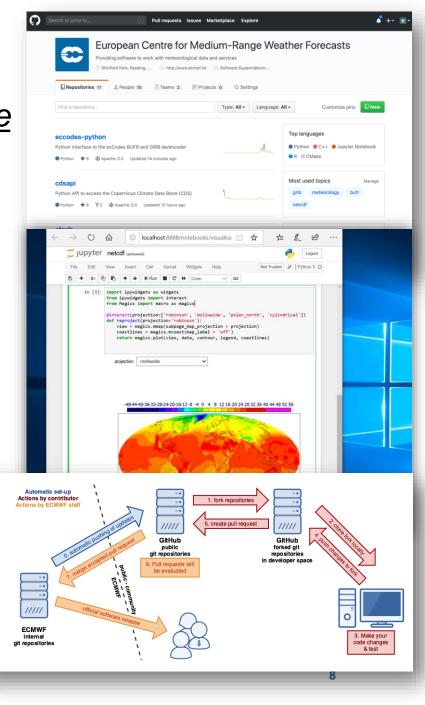
BC optional programme members can request the products via the standard channel:

https://msaccess.ecmwf.int:9443/do/ product/requirements

# Software in focus

Embracing open development for ECMWF software

- ECMWF now available on GitHub
  - Allows for easier code contributions
- Package software on conda & pip
   Easy reach for Python community
- Ported key libraries to Windows
  - Need help from community
  - Test suites are running from GitHub



# Software in focus

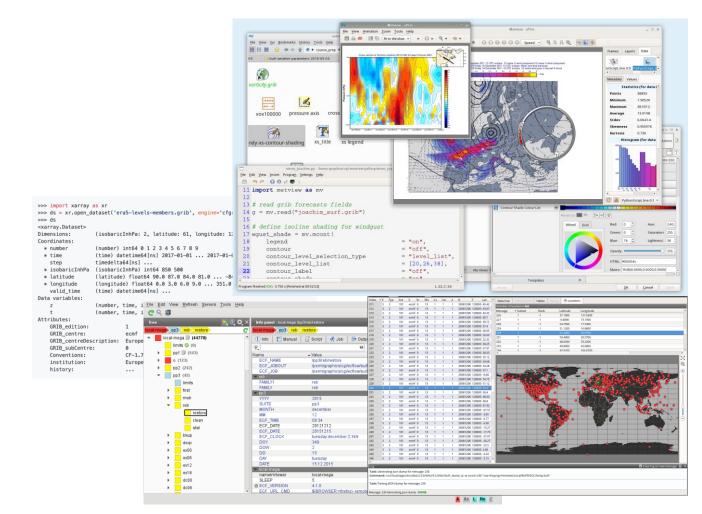
#### Libraries

- ecCodes
- odb\_api
- Magics
- Python modules: cfgrib, pdbufr, web\_api

#### Tools

- ecFlow + ecFlowUI
- Metview
- FDB

Many more miscellaneous codes to support core software packages – not intended for direct usage!

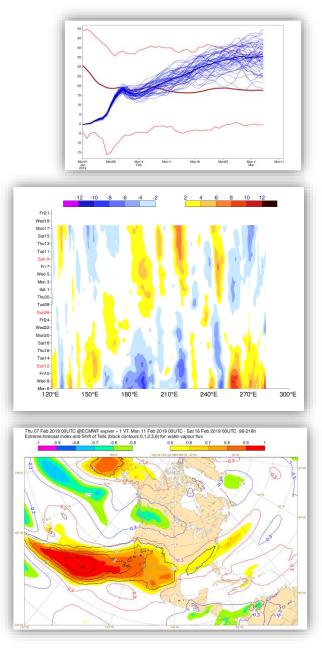


#### **Deprecated software**

- Emoslib
- BUFRDC
- grib\_api
- SMS

# Products in focus

- Test products for winter cold spells (medium and extended range)
- Point rainfall in ecCharts
- New forecast output fields (46r1):
  - 200m wind, parameters on PV=1.5, 2
  - Ocean waves
  - Ocean fields
  - Integrated water vapour transport EFI
  - Extended-range EFI
- Reforecasts initialised from ERA5: more consistent model climatology



# Products in focus

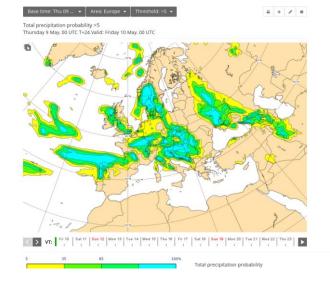
#### ECMWF is a World Meteorological Centre

shortName	Description	threshold
tpg <threshold></threshold>	Total precipitation of at least <threshold> mm</threshold>	25, 50, 100 mm
10fgg10	10 metre wind gust of at least 10 m/s	10 m/s
ptsa_gt_ <threshold>st dev</threshold>	Probability of 850hPa temperature standardized anomaly greater than <threshold> standard deviation</threshold>	1, 1.5, 2 stdev
ptsa_lt_ <threshold>std ev</threshold>	Probability of 850hPa temperature standardized anomaly less than - <threshold> standard deviation</threshold>	1, 1.5, 2 stdev





Probabilities: 24hr total precipitation

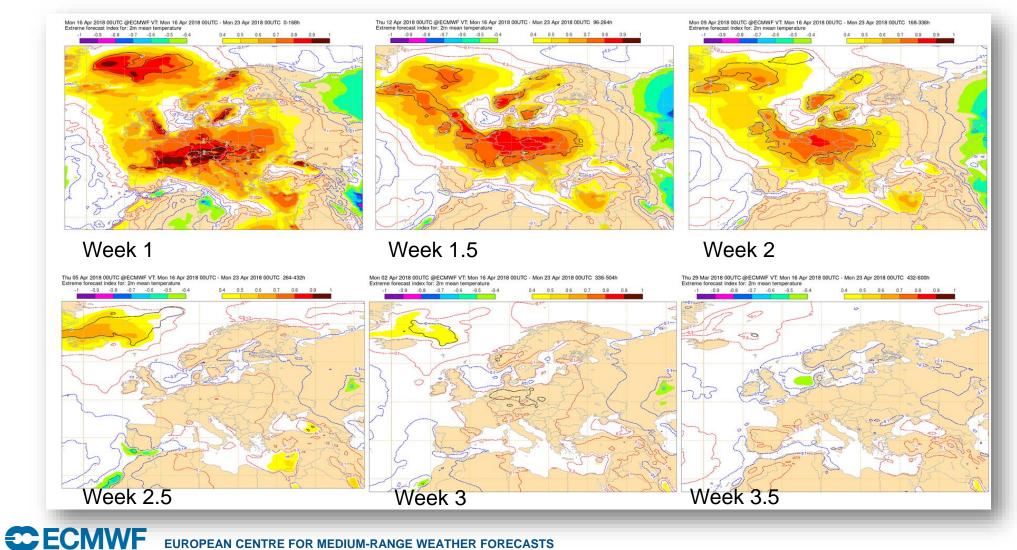


- All parameters are in GRIB edition 2
- Parameters available for ENS

# **Products in focus**

## **Extended range EFI/SOT**

#### 2018 spring heatwave



EUROPEAN CENTRE FOR MEDIUM-RANGE WEATHER FORECASTS

# Forecast performance: headline scores

#### 2 primary scores

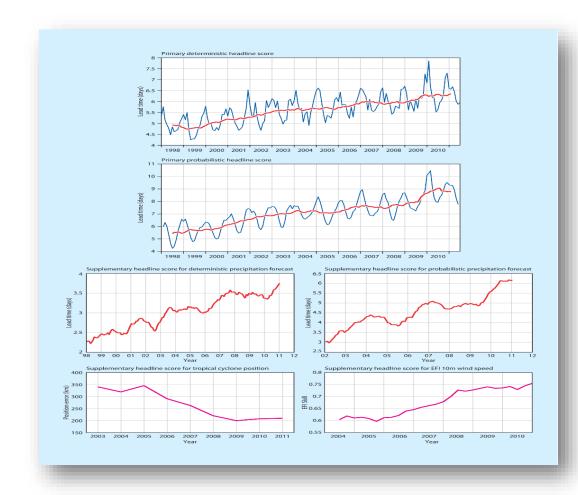
- HRES upper-air skill
- ENS upper-air skill

#### **6** supplementary scores

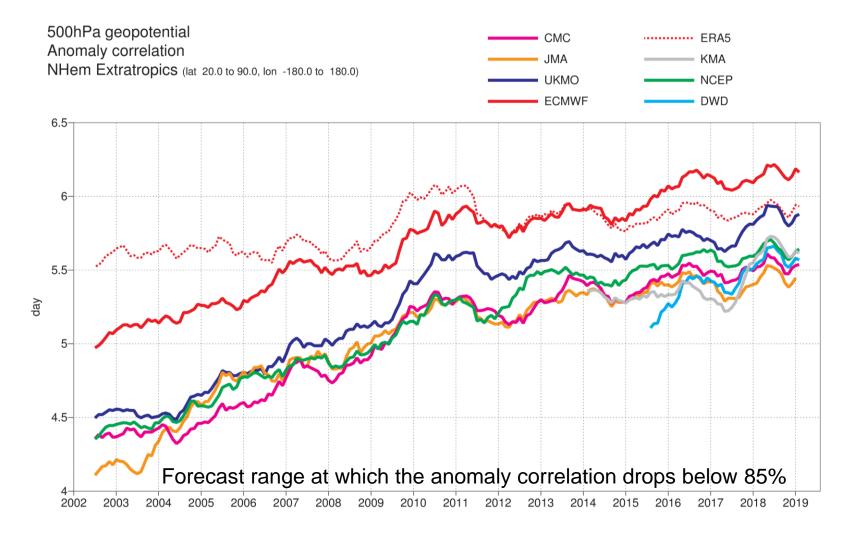
- Precipitation
- HRES skill
- ENS skill
- Percentage of large temperature errors
- Weekly mean 2m temperature (terciles)

#### Severe weather

- Tropical cyclone track position error
- EFI skill

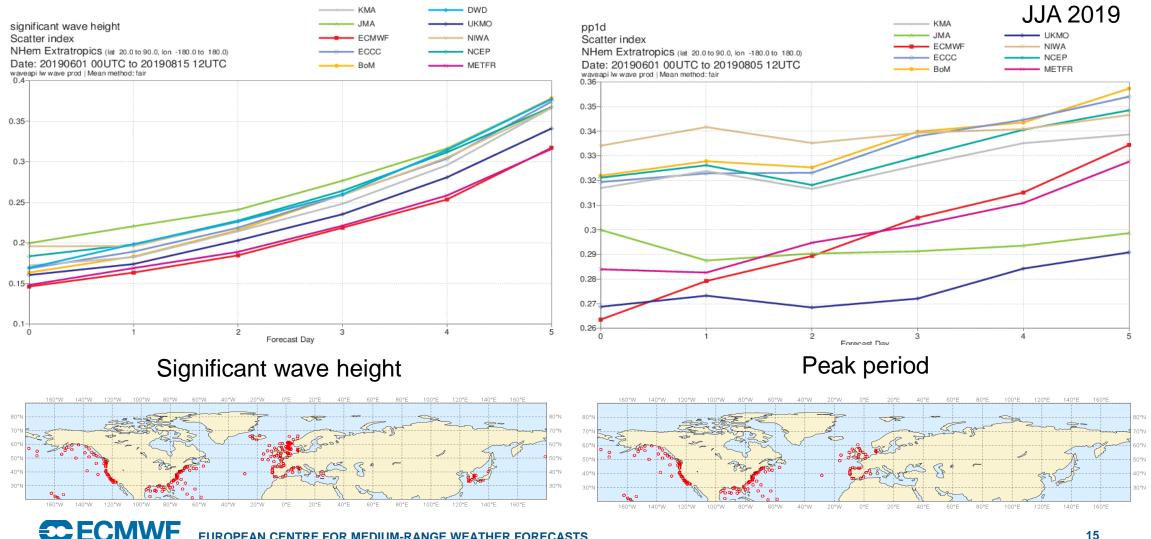


#### **Comparisons with other centres – Z500 Northern Extratropics**

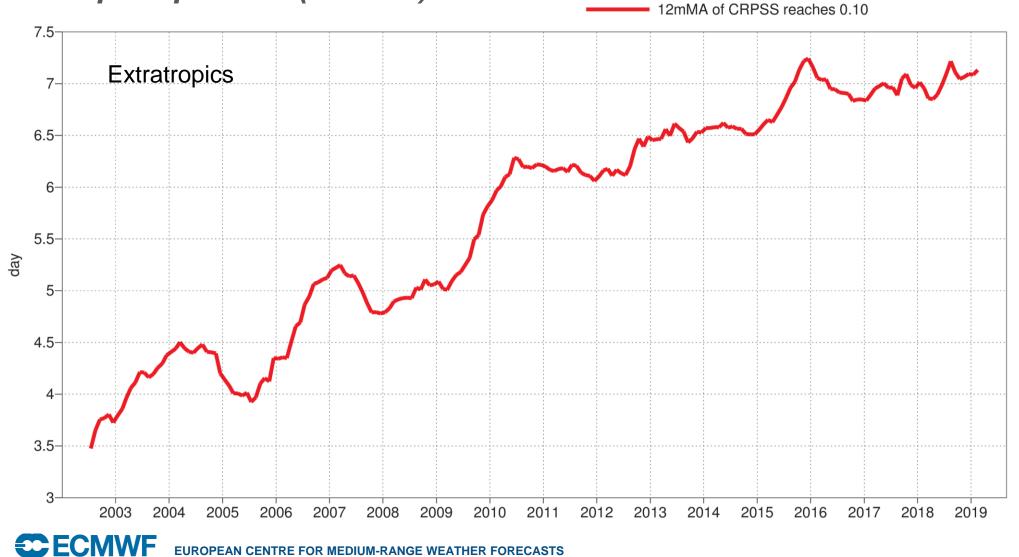




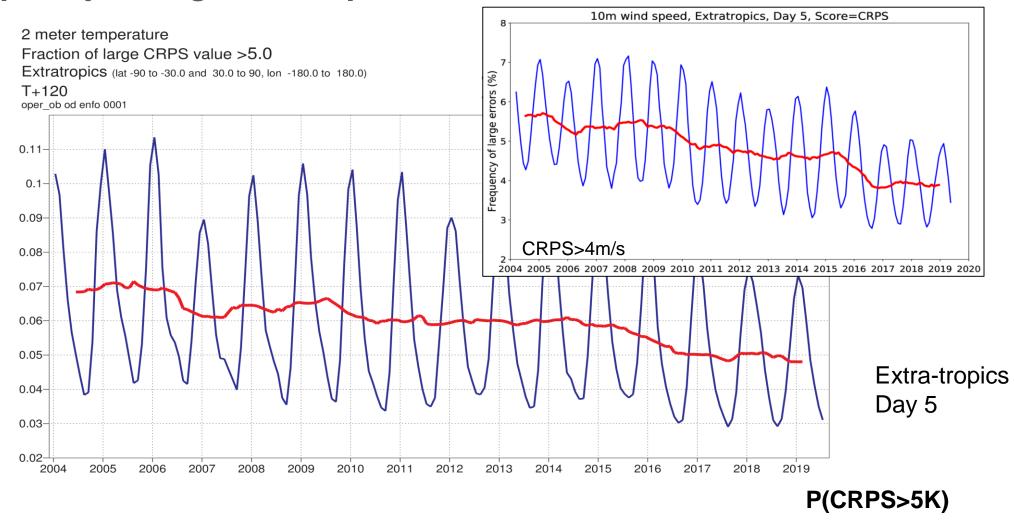
#### WMO Lead Centre for Wave Forecast Verification (N. Hemisphere extratropics)



### ENS precipitation (CRPSS)



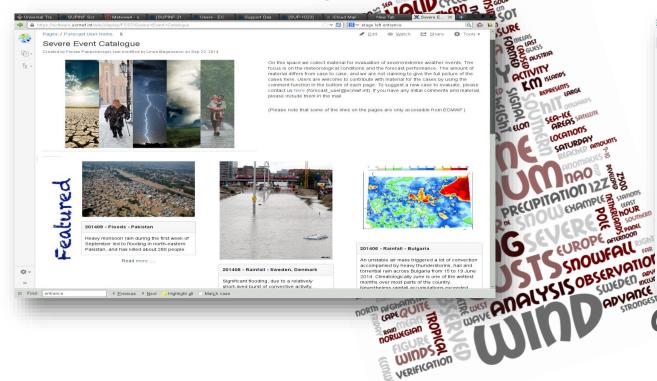
#### Frequency of large 2m temperature and wind errors - ENS



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

# Outreach in focus

#### Severe event catalogue



#### Forecast User Home:

https://software.ecmwf.int/wiki/display/FCST/Foreca st+User+Home

#### Forecasting issues

Created by Timothy He	forecasting issues	
Please note that nu forecasts. Topic / title	beeinglordering does not indicate/imply any sort of priority. Recent entries/changes/updates are shown in green. Greyed out means no longer current, but these issues can b	e relevant when examining archived
2m Temperature	Description	Related activities
T1. 2m temperature in the presence of inversions	In common with all models, 2m temperature forecasts from the IFS tend to have much larger errors, on average, during low level inversion situations, which are particularly common at high latitudes in winter. The basic physical explanation is that a set change in atmospheric energy content has a much larger impact on acreen temperature in merrorison situations than in nostable situations, because the nearly change is commod through a much smaller depind the tamosphere (a	New reporting practices for radiosonde data ("BUR#" messages), being introduced around the world, could alleviate this problem somewhat, by providing model analyses with a much more detailed representation of the near surface layers.
T2. City temperatures too low	Due to the urban heat island effect not being represented, screen temperatures in large urban areas, particularly cities, are commonly too low compared to observations. The problem can be accentuated in winter by snow cover.	'Urban tiles' to be introduced in land surface scheme in due course.
T3. Screen temperatures fall too much near coasts	As a consequence of the radiation prid being larger than the model prid (due to computational constraints) night-time radiative cooling over land near to the coast is often too rapid. This is because cooling progresses according to "f", and at near-coast points "f is approximately the average temperature of the hand and (warmer) coase. As a result screen temperatures drots to much - halted errors can sometimes exceed 10C. The problem is enhanced (i) when there is snow cover, (ii) at high latitudes, and (iii) where coasts have a convex shape (land-relative).	Improvements due to radiation code "fixes" were introduced with cycle 4182 in March 2016. In example cases the impact of these changes has been very positive. More substantial radiation code changes are likely in the longer term.
T4. Meteogram temperature issues in complex topography	In addition to the normal problems of representing screen temperatures in complex topography in current-generation global models, the user should be aware that the method by which screen temperatures on Meteograms are generated from model acreen temperatures assumes a standard space trate (BS-C drop per km increase in attuate), and so if the difference in height between the site choice, and the nearest model gridpoint (as shown in the KB)gram the) is large, the scope for large entropy between the site choice, and the nearest model gridpoint (as shown in the KB)gram the) is large, the scope for large entropy decrease, this is especially true in winter-fine when inversions are more common; by definition an inversion implies a temperature issue T above.	Resolution upgrade in March 2016 (41R2) has helped. Re-calibration project should help even more.
T5. China "cold spot"	In products that intrinsically display 2m temperature output in some 'anomaly' form - such as monthly forecast anomalies, seasonal forecast anomalies, and in the shorter ranges EFI and SOT - there has been a semi-permanent winter-time 'cold' spot' over eastern China. It is not real in the sense that temperatures are not always 'below	

#### Changes to forecasting system

#### Pages / Forecast User Home 🏻 🍙

Changes to the forecasting system

Lucas on Mar 27, 2018

ation about planned changes to the IFS forecasting system and documentation describing previous changes. Pli planned changes this information is subject to revisions as we proceed with experimentation

cements of the implementation schedules for new model cycles will still be made by email, and relevant information will then be posted on dedicate pages on the ECMWF web site, where you can also find information about previous changes to the ECMWF forecasting system. The terminology used is described

#### Planned changes

-

Implementation of IFS Cycle 45r1 - IFS Cycle 45r1 planned implementation date 5 June 201

#### Past changes

- Implementation of Seasonal Forecast SEAS5 SEAS5 implemented 5 November 201
- Implementation of IS based and Potecasi SANAS SANAS implemented to November 201
   Implementation of IFS bycle 437 IFS bycle 437 implemented 11 July 2017
   Implementation of IFS bycle 4371 IFS bycle 4371 implemented 21 November 2016
   Horizontal resolution increase IFS bycle 4172 implemented 8 March 2016
   Boundary-Condition Programme ENS at 06 and 18 UTC Implemented 8 July 2015

#### Twitter handle: #newfcsystem @ECMWF

Mailing li:

out IFS change

click subscribe

Alternatively acces

mailing list has been created to inform

subscribe to or unsubscribe, please send an email forecast\_changes-request@lists.ecmwf.int

changes, enter your email address and click Subscribe

with the word subscribe or unsubscribe as Subjec

# Outreach in focus

## User guide to ECMWF products

#### https://software.ecmwf.int/wiki/display/FUG/Forecast+User+Guide

ECMWF Spaces      Calendars     Create	Search Q Q 42 🚱
Forecast User Guide	Pages to Save for later ™ <u>Watch</u> ≪ <u>Share</u> … Forecast User Guide
<ul> <li>SPACE SHORTCUTS</li> <li>Forecast User Home</li> <li>PAGE TREE <ul> <li>1 Introduction</li> <li>2 The ECMWF Integrated Forecasting System - IFS</li> <li>3 Availability and Interpolation of NWP output</li> <li>4 NWP Evolution versus Reality</li> <li>5 Forecast Ensemble (ENS) - Rationale and Construction</li> <li>6 Using Deterministic and Probabilistic Forecasts</li> <li>7 ENS Products - Dealing with Uncertainty</li> <li>8 ENS Products - What they are and how to use them</li> <li>9 Physical Considerations when Interpreting Model Output</li> <li>10 Interfaces for displaying Model Output</li> <li>11 Conclusion</li> <li>12 Appendices</li> </ul> </li> </ul>	<text></text>
C Space tools 《	The aim of this User Guide is to help meteorologists make the best use of the forecast products from ECMWF - to increase understanding of the ensemble forecast process, to develop new products, to reach new sectors of society, to satisfy new demands. The User Guide presents the Integrated Forecasting System (IFS) and advises on how best to use the output, not least on how to build up trust in the forecast information. A good forecast that is not trusted is a worthless forecast. The emphasis is on the medium-range forecast products, as this is ECMWF's primary goal, and because medium-range NWP output generally differs significantly from dealing with short-range or seasonal NWP. This guide is intended to give an outline of structure and use of the ECMWF IFS and how the high-resolution forecast (HRES), ensemble forecast (ENS), extended range forecast and seasonal forecast models inter-depend and interact. Links to more detailed descriptions of processes are given, mainly at the end of each section, whilst separate online ECMWF training resources are also available to explain aspects of the ECMWF IFS more visually. Education is a key component of the work at ECMWF and further educational material is available through the web site (e.g. Webinars (recordings), Slidecasts (slides and audio recordings), Tutorials, Training lectures (presentations in PDF))

# Learning in focus

#### Our offers:

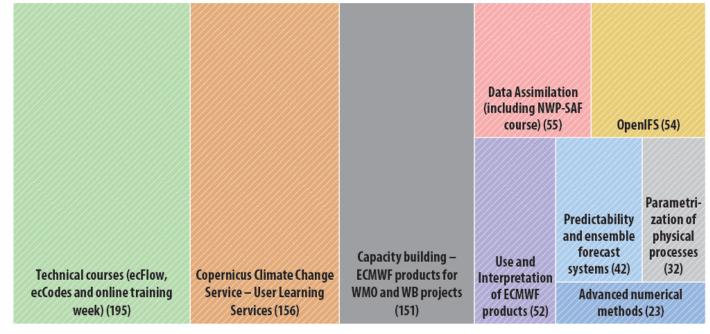
Courses are designed to enable participants to develop an understanding of advanced numerical forecasting and to use ECMWF's services and products effectively. We provide user learning activities within C3S and CAMS

#### Areas

- Meteorology (NWP and use of products)
- Software/computing

#### Other learning opportunities

- WMO Fellowship scheme
- Annual seminar



760 learners in 2019! (September 2019)

#### Follow us #ECLearn

The European Weather Cloud



# The European Weather Cloud

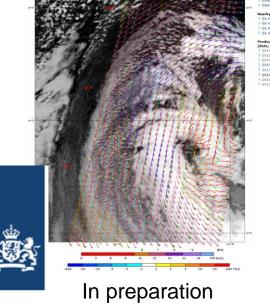
OGC Web services on full ECMWF forecasts without need of data transfer to DWD



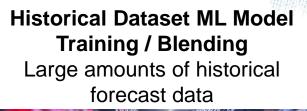
Staff just arrived

#### SEES: Synergy of ECMWF and EUMETSAT Services

Display simultaneously EUMETSAT OSI SAF and ECMWF forecasts



In preparation to start January 2020





**Participants:** Switzerland, United Kingdom, France, Germany, Netherlands, Finland, Sweden, Norway, Austria, Denmark, EUMETNET (discussions), ECMWF and EUMETSAT





Highlights for next year

- 1. New ECMWF strategy is currently developed
- 2. Discussion on moving towards open data
- 3. We are moving to Bologna

