ECMWF computing services, products and outreach activities

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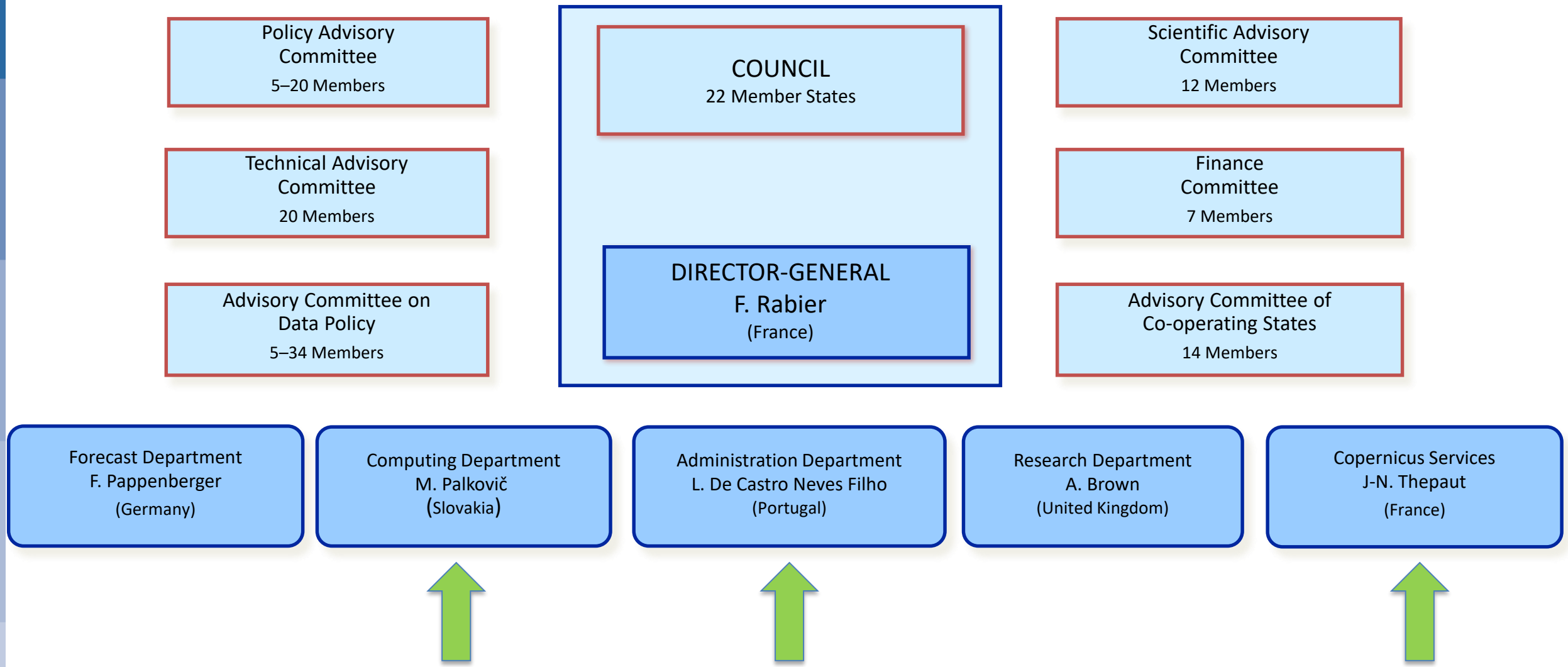
ECMWF

Organisational structure of ECMWF



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

Integrated Forecasting System (IFS) cycles

- 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 degree wet-bulb temperature, direct solar radiation, wave energy flux magnitude/mean direction, significant wave height of all waves within a range of periods

- Cycle 43r3:

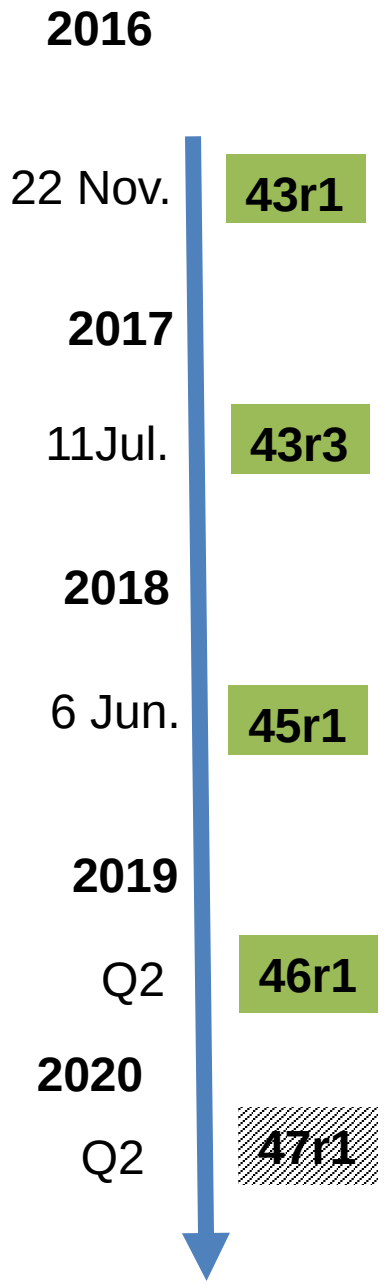
  new radiation scheme, improvement in convection, new aerosol climatology, changes in observation assimilation

- Cycle 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)

- Cycle 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; improvements in the wave model, the convection scheme, the radiation scheme and the use of observations.



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

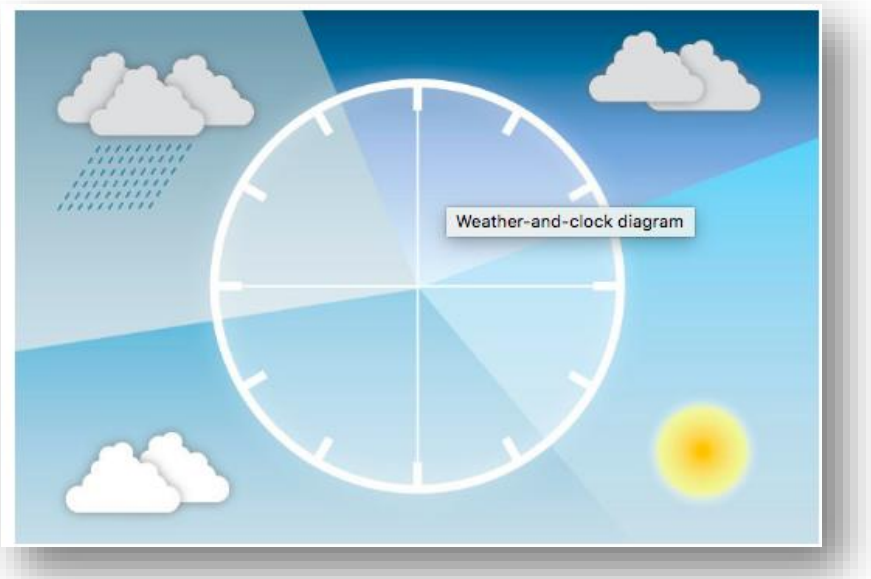
Services in focus

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.

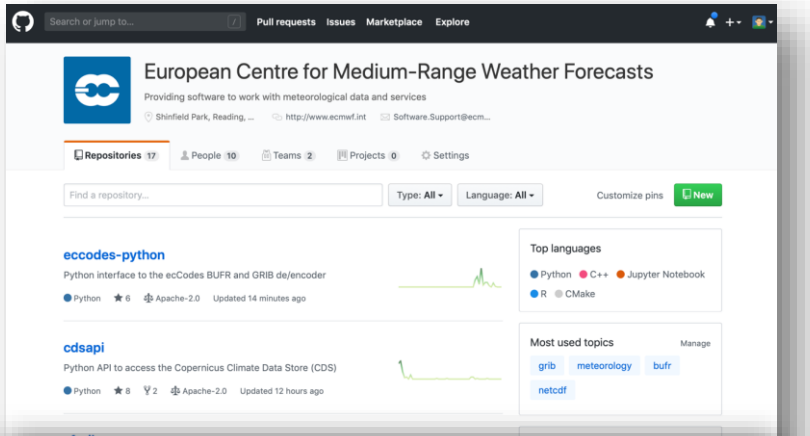
BC optional programme members can request the products via the standard channel:

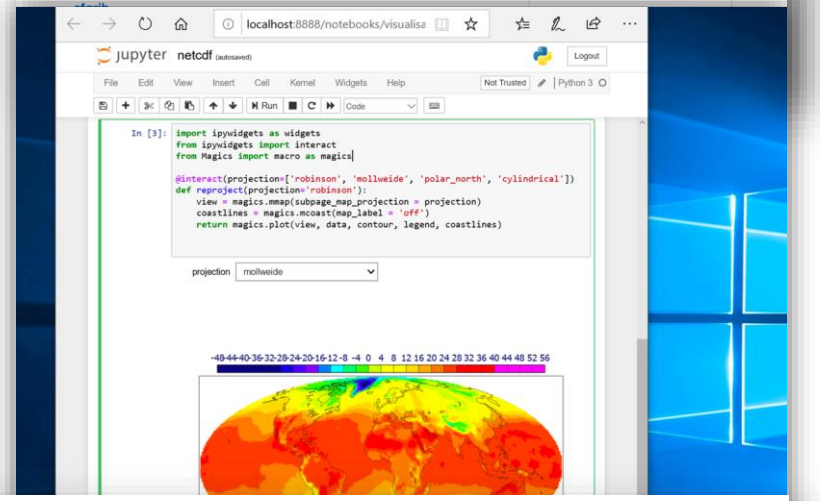
https://msaccess.ecmwf.int:9443/do/product/requirements

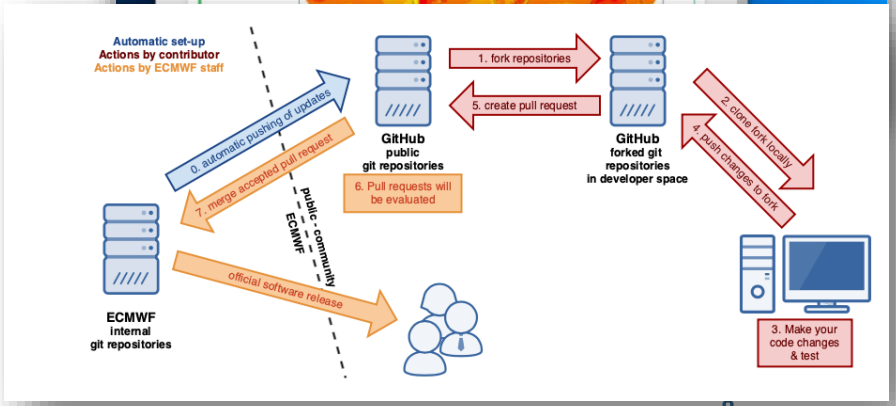
Software in focus

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

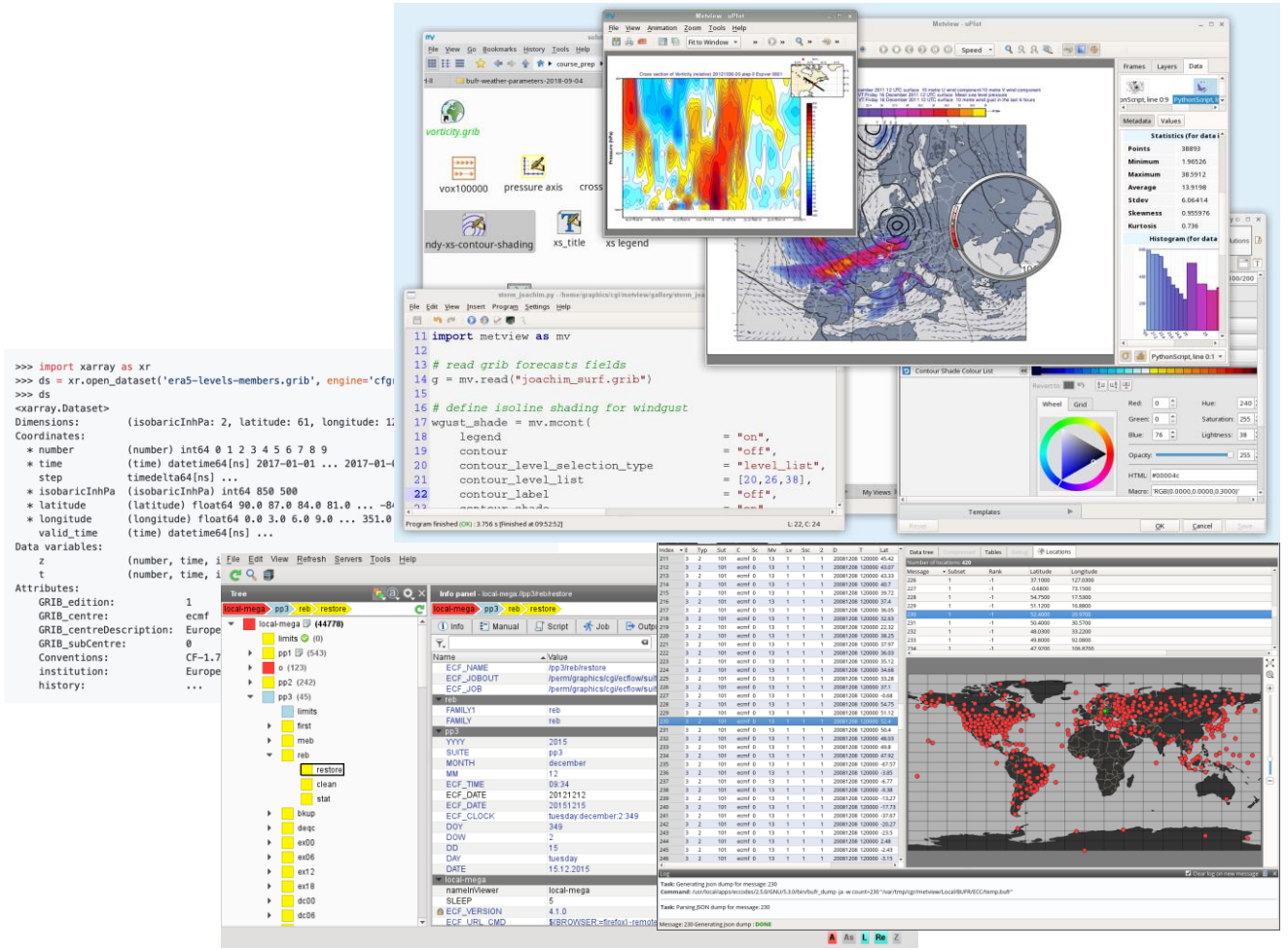
Libraries

- 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!

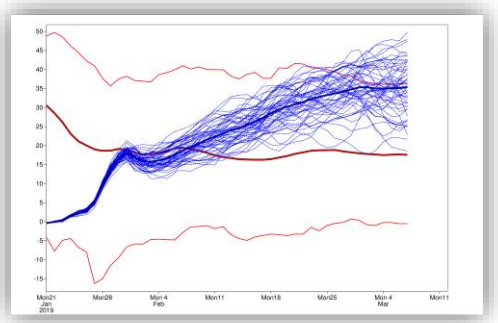


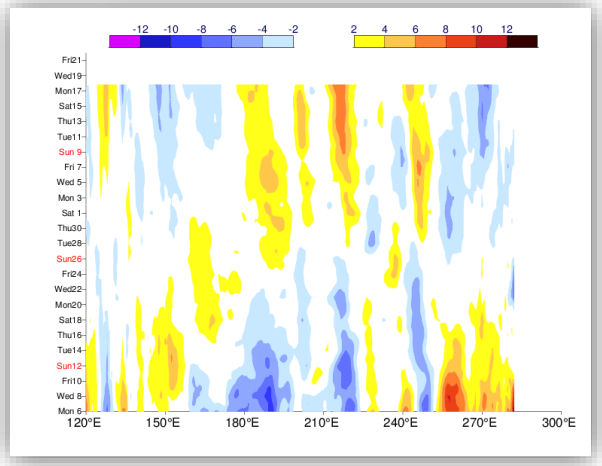
Deprecated software

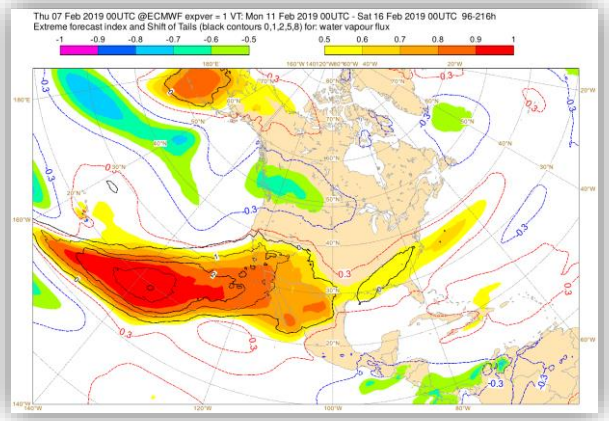
- Emoslib
- BUFRDC
- grib_api
- SMS

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

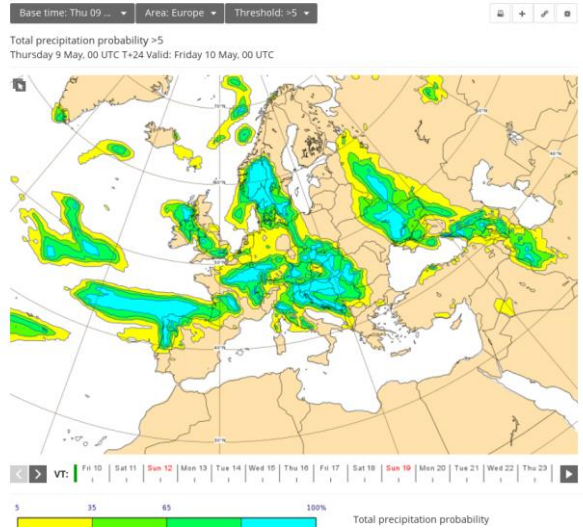
ECMWF is a World Meteorological Centre

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

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

WORLD METEOROLOGICAL ORGANIZATION

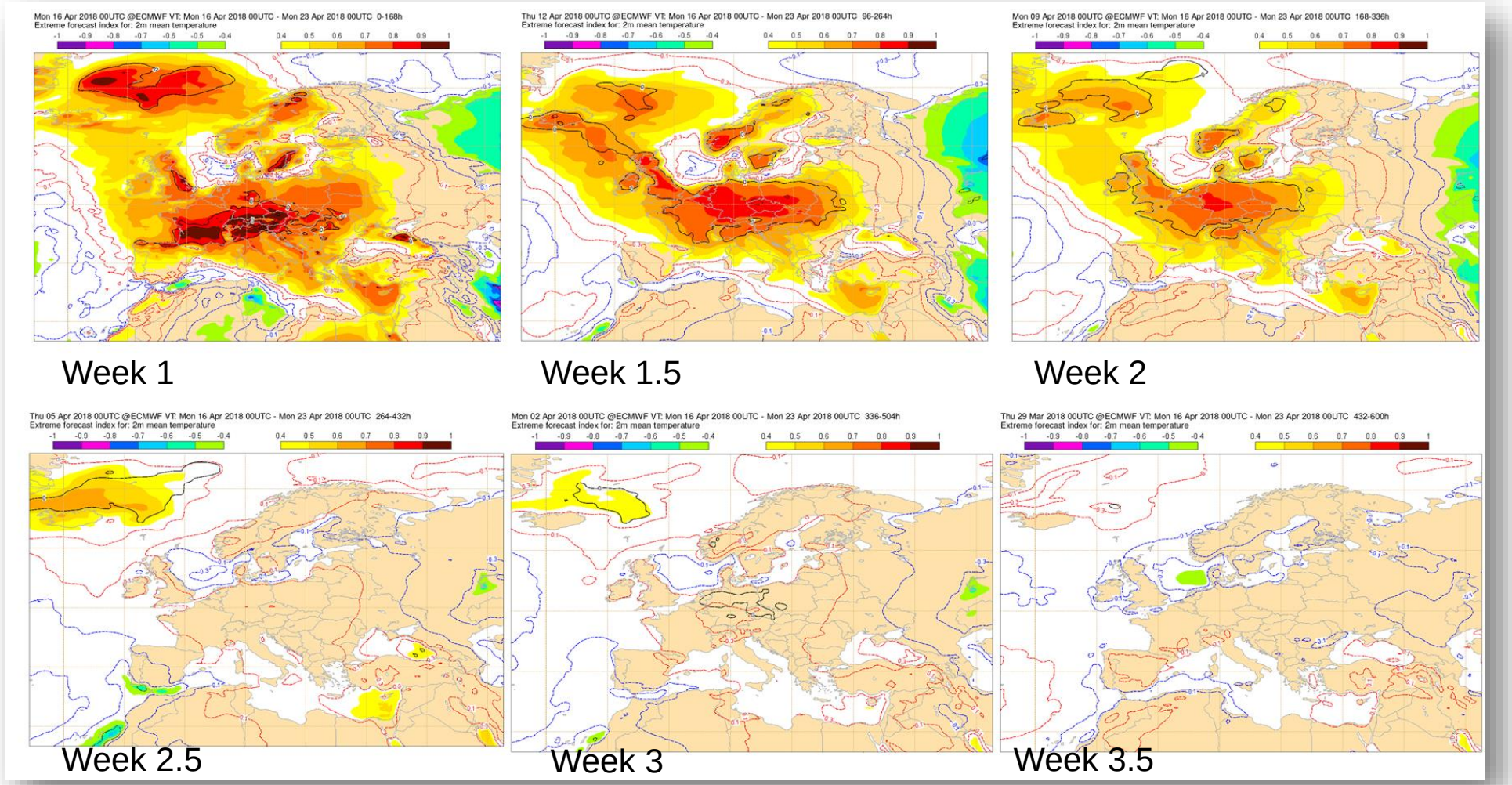
Probabilities: 24hr total precipitation



Products in focus

Extended range EFI/SOT

2018 spring heatwave



Forecast performance in focus

Forecast performance: headline scores

2 primary scores

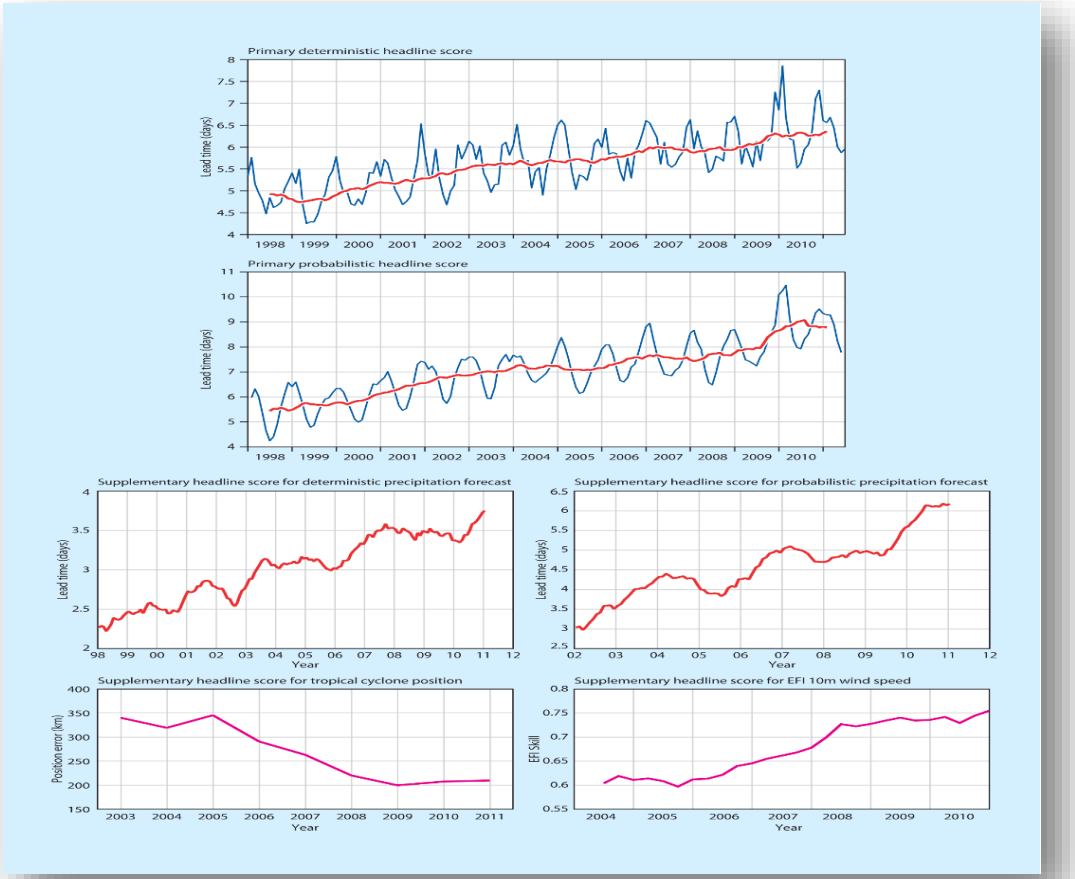
- HRES upper-air skill
- ENS upper-air skill

6 supplementary scores

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

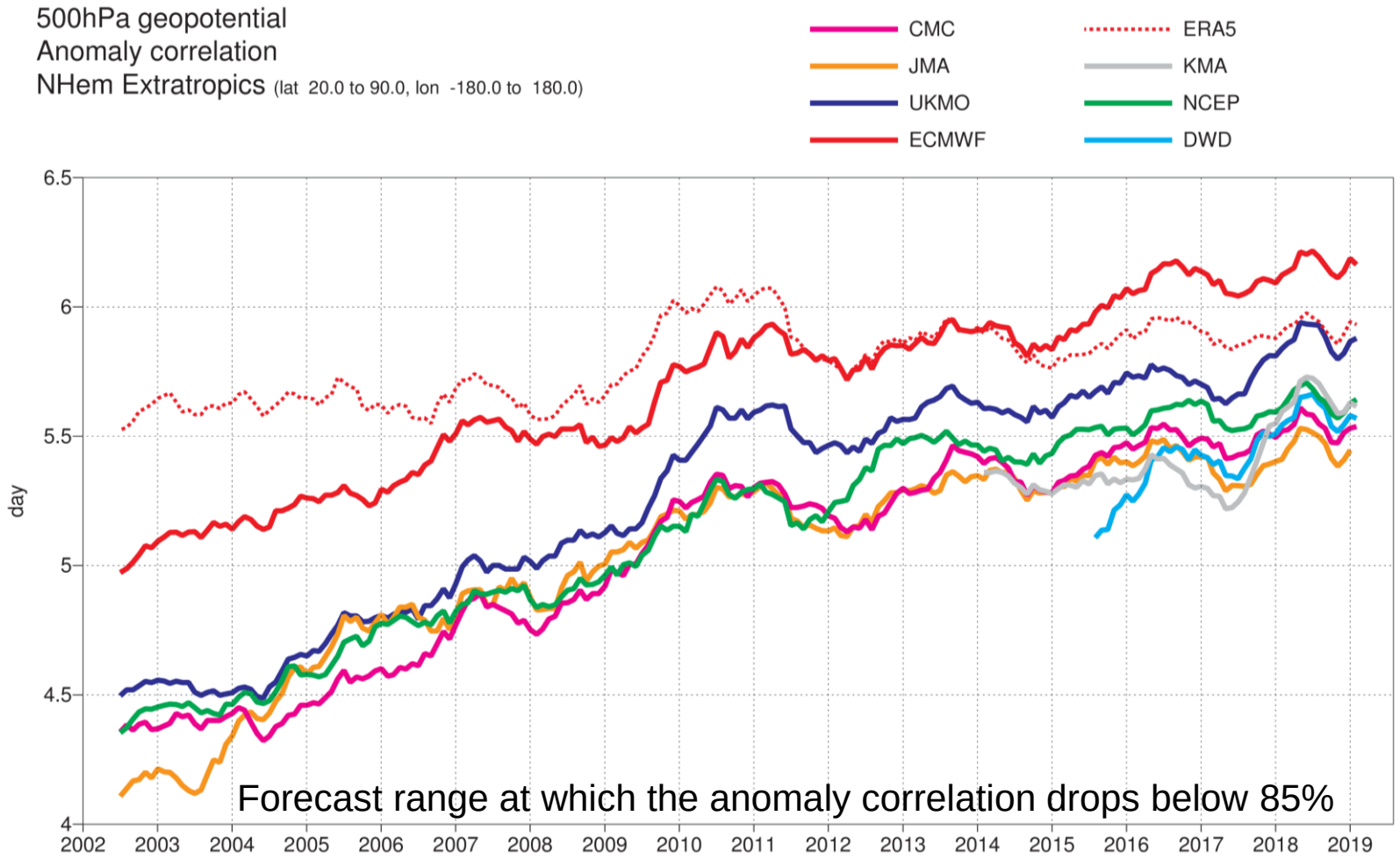
Severe weather

- Tropical cyclone track position error
- EFI skill



Forecast performance in focus

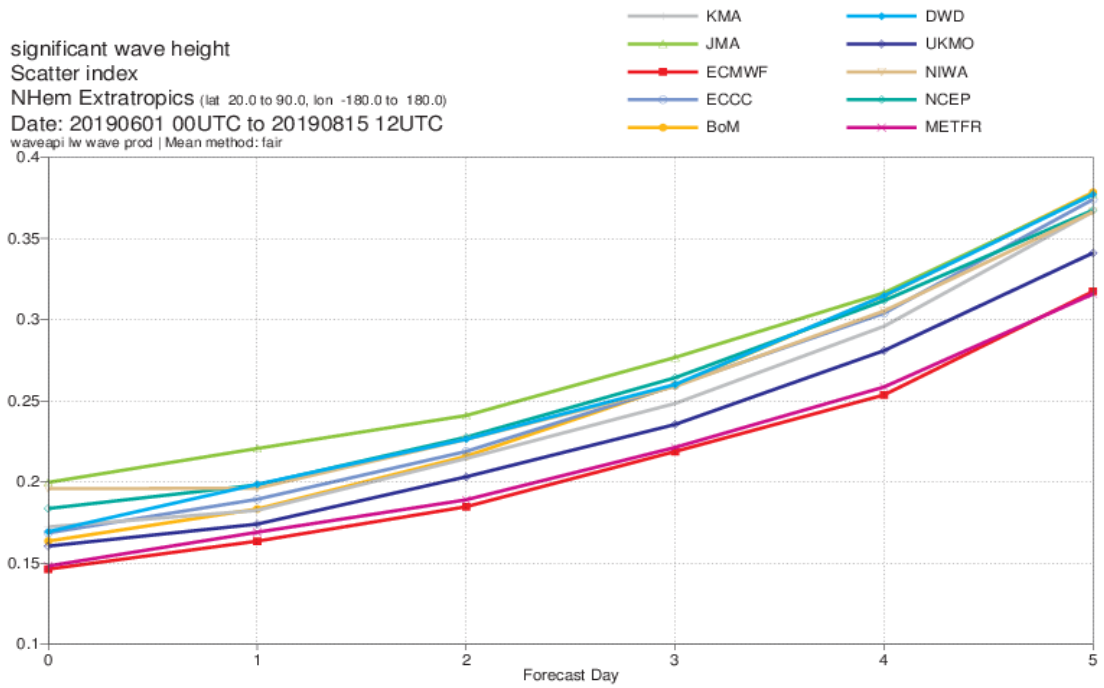
Comparisons with other centres – Z500 Northern Extratropics



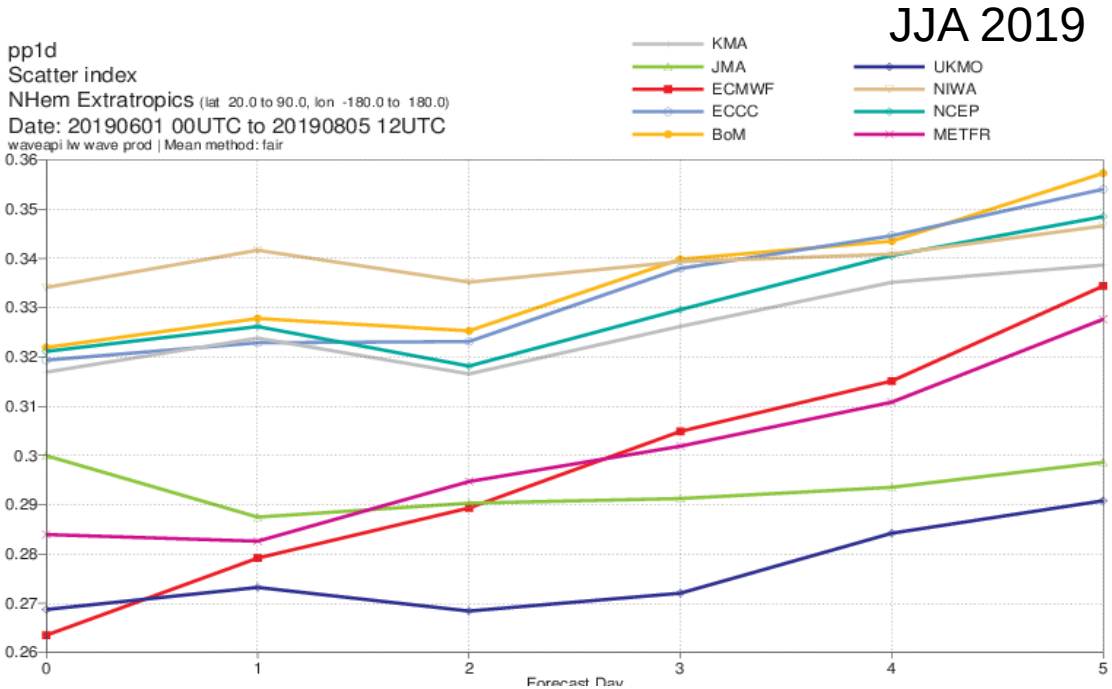
Forecast performance in focus

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

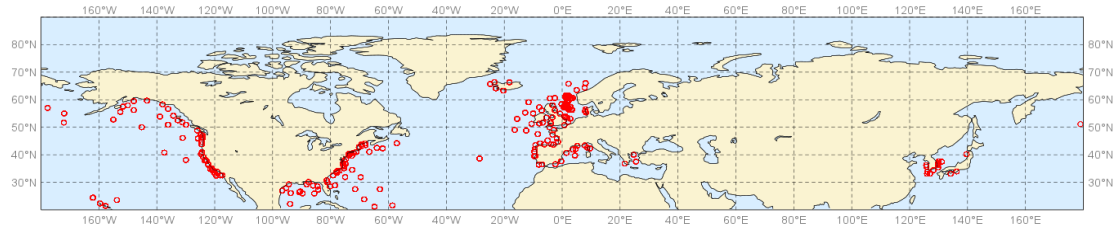
JJA 2019

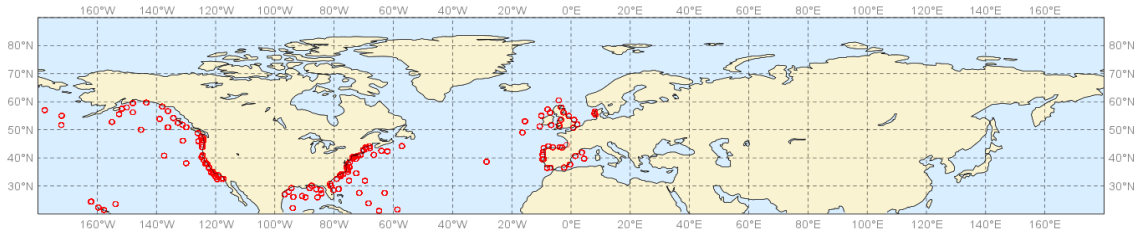


Significant wave height



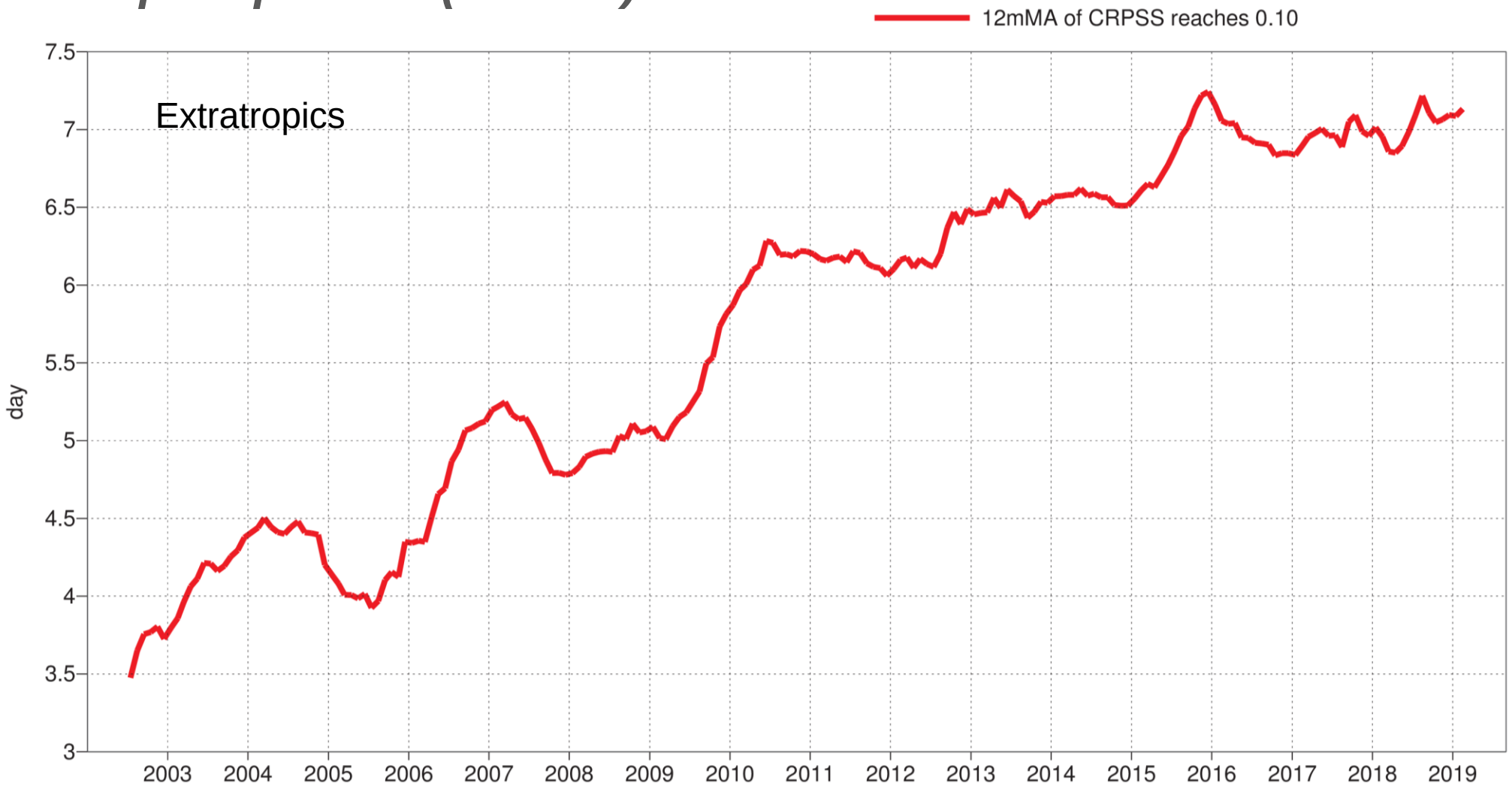
Peak period





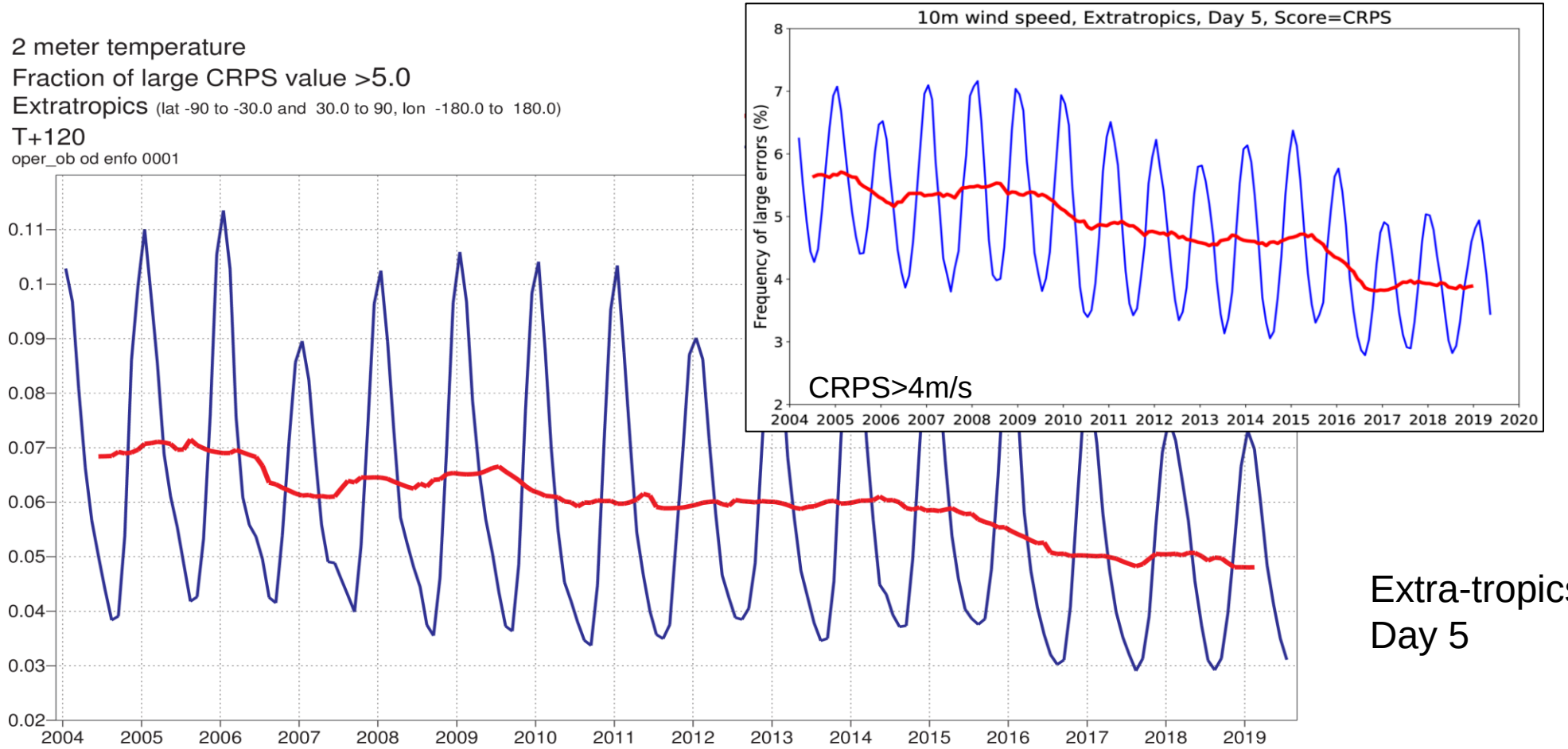
Forecast performance in focus

ENS precipitation (CRPSS)



Forecast performance in focus

Frequency of large 2m temperature and wind errors - ENS

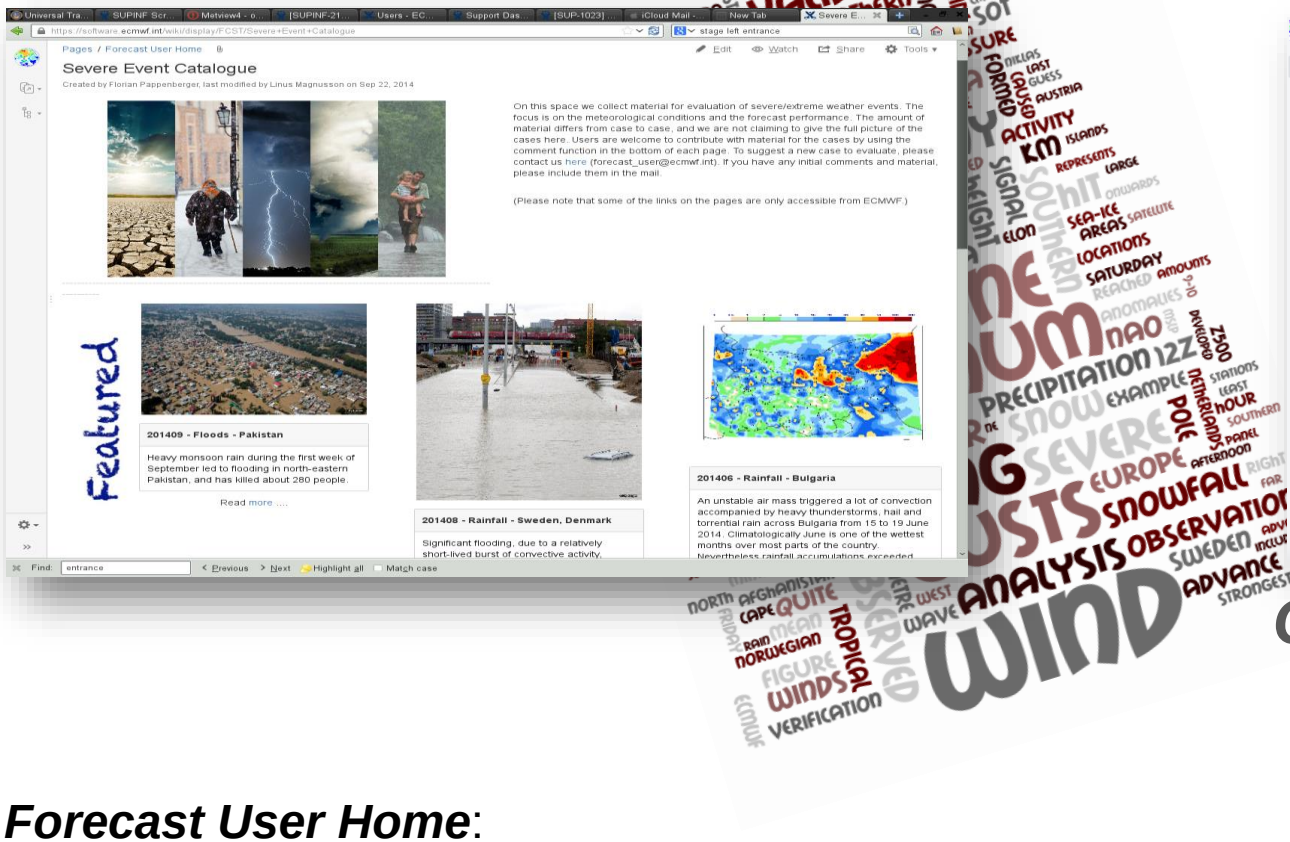


Extra-tropics
Day 5

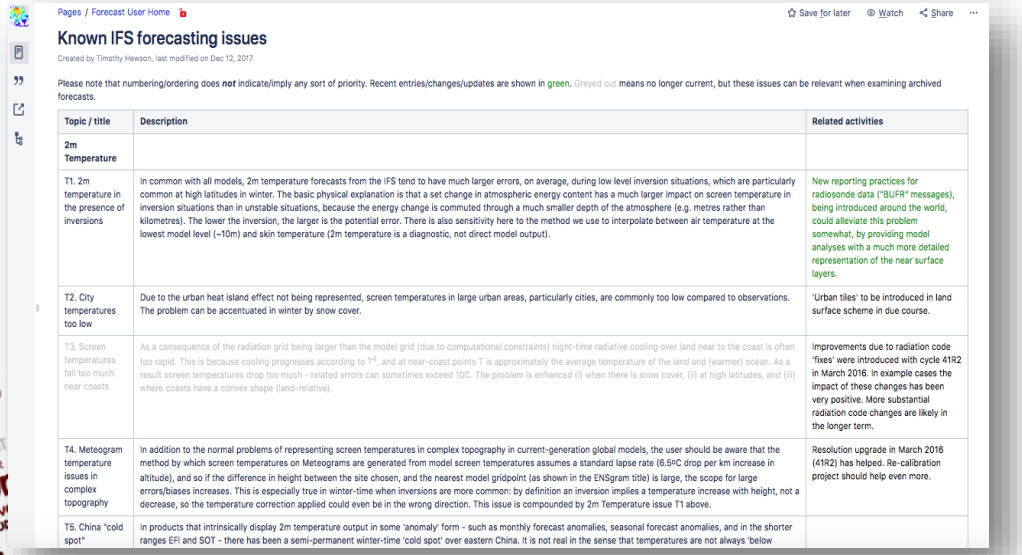
P(CRPS>5K)

Outreach in focus

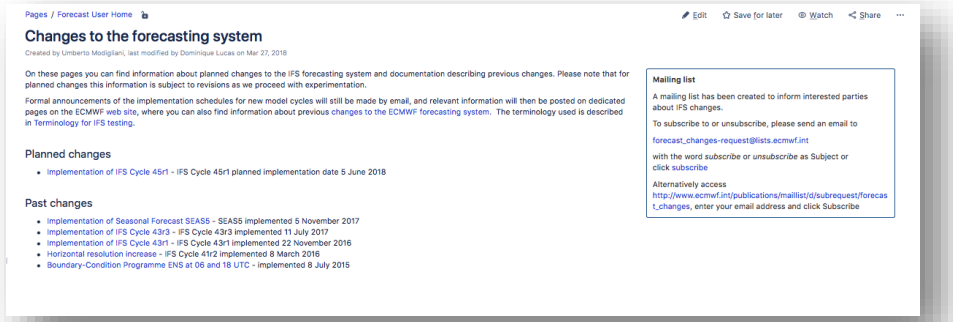
Severe event catalogue



Forecasting issues



Changes to forecasting system



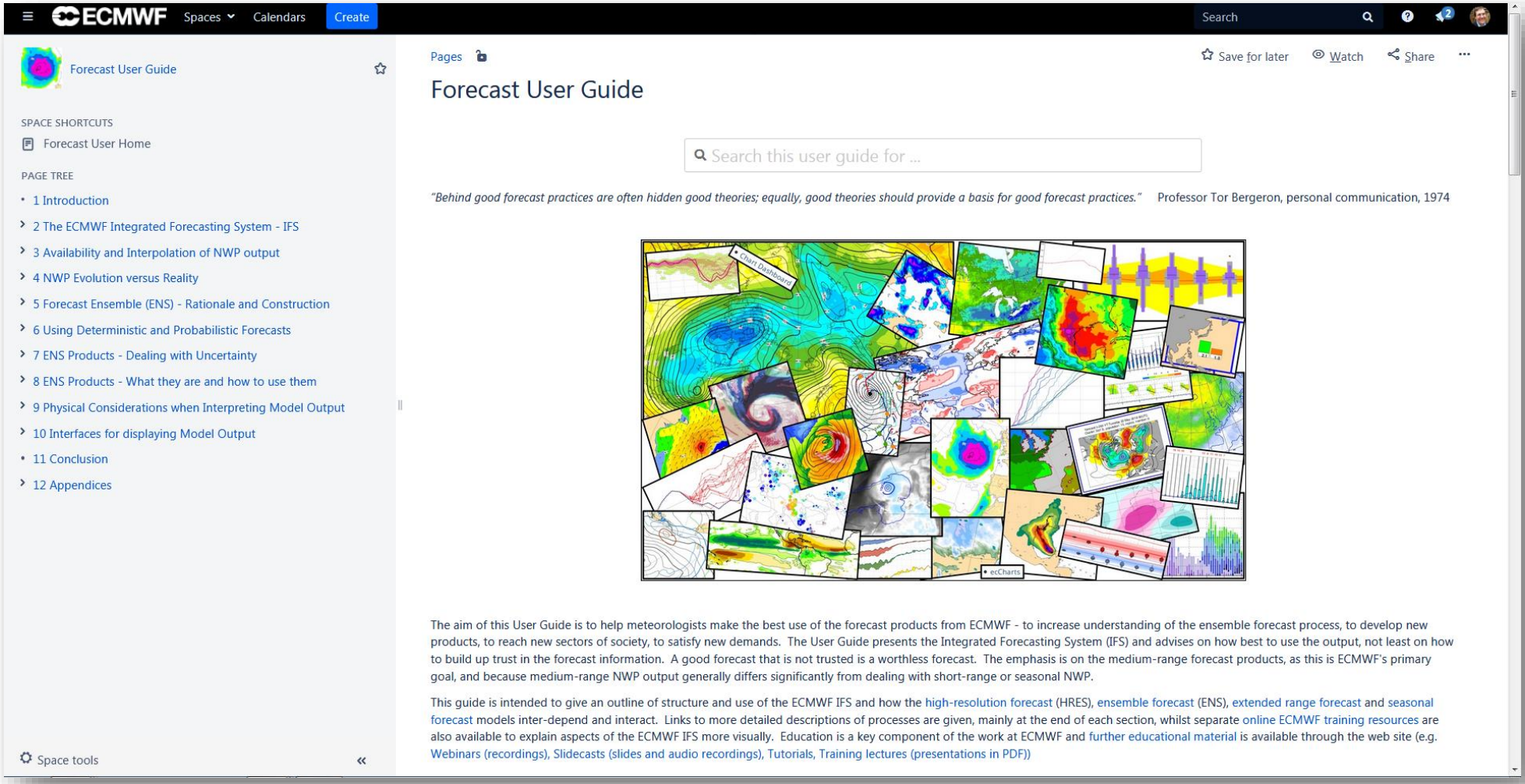
Forecast User Home:
https://software.ecmwf.int/wiki/display/FCST/Forecast+User+Home

Twitter handle: #newfcsystem @ECMWF

Outreach in focus

User guide to ECMWF products

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



Learning in focus

Our offers:

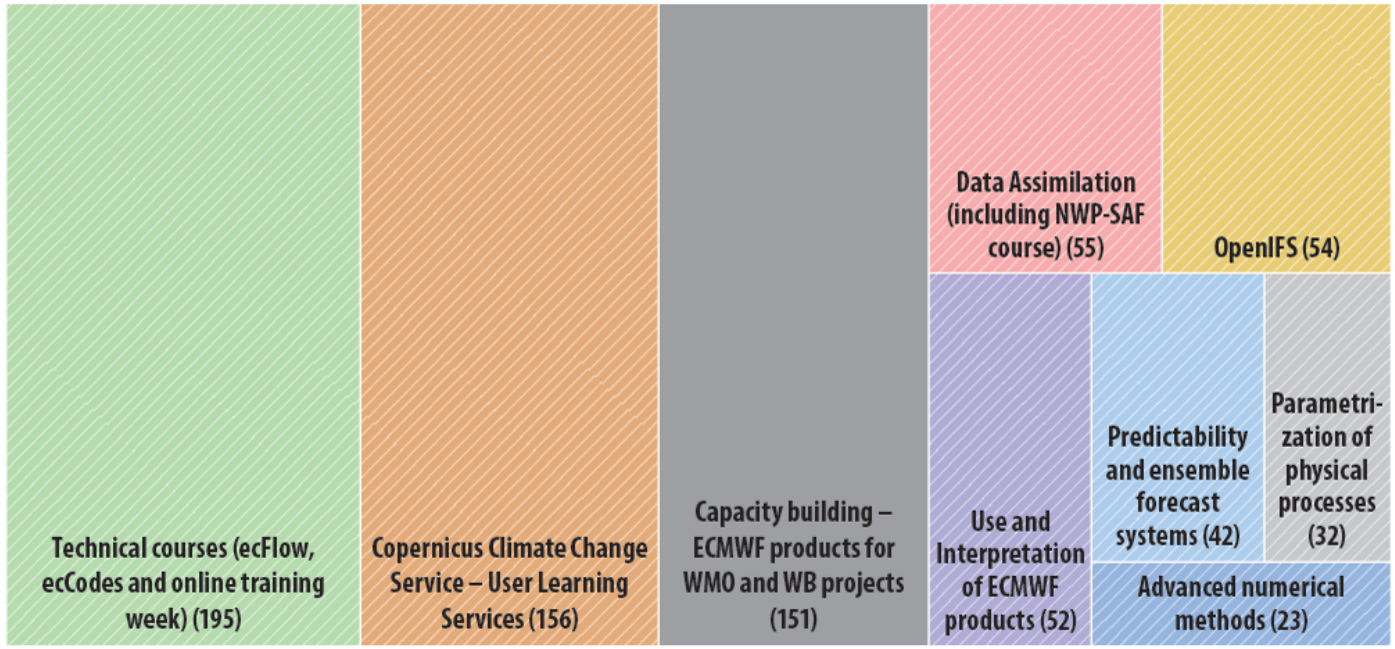
Courses are designed to enable participants to develop an understanding of advanced numerical forecasting and to use ECMWF's services and products effectively. We provide user learning activities within C3S and CAMS

Areas

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

Other learning opportunities

- WMO Fellowship scheme
- Annual seminar



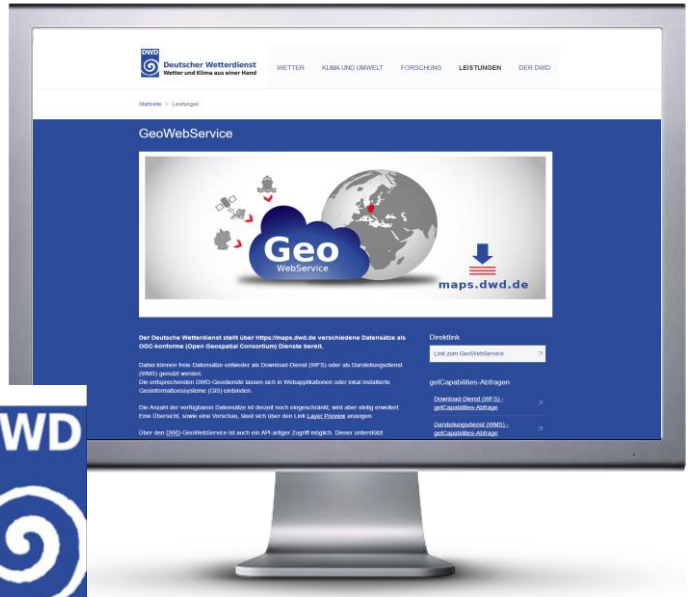
760 learners in 2019!
(September 2019)

Follow us #ECLearn

The European Weather Cloud

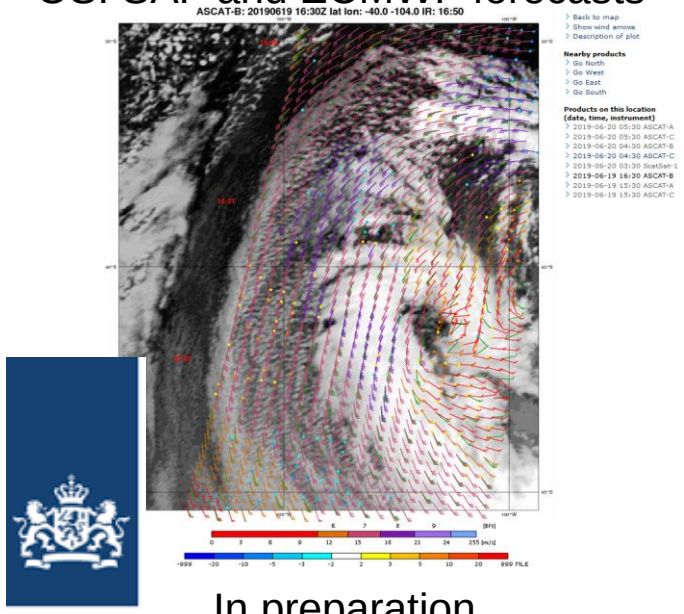
The European Weather Cloud

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



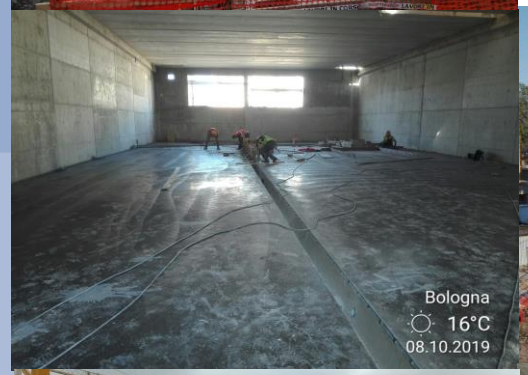
In preparation
to start January 2020

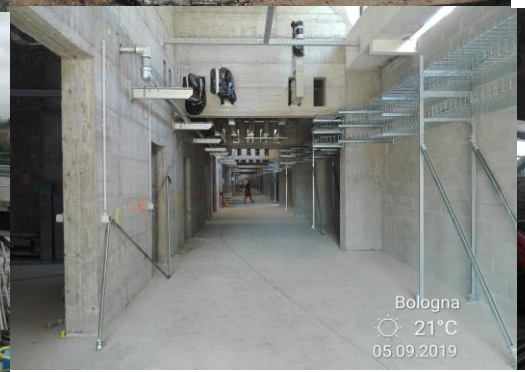
Historical Dataset ML Model Training / Blending
Large amounts of historical forecast data

Coming in 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**