THE STRENGTH OF A COMMON GOAL

Using ECMWF Forecasts 2018

THE STRENGTH OF A COMMON GOAL

ECMWF's purpose is to develop a capability for medium-range weather forecasting and to provide such weather forecasts to the Member and Co-operating States

ECMWF is complementary to the National Meteorological Services and works with them in research, numerical weather predictions, supercomputing and training.

ECMWF 2016-2025 strategy: overview

Targets by 2025:

- **Primacy of Ensemble** → **5 km horizontal resolution**
- H**igh impact weather** up to **two weeks ahead**
- **Large scale patterns and regime transitions** → four weeks ahead
- **Global-scale anomalies** → **a year ahead**
- More collaboration with Member States and the wider community

  → improved NWP and its **scalability**

Organize around 5 themes:

Advancing Weather Forecasts; Delivering Global Predictions Sustaining High Performance computing; Supporting ECMWF; Serving member and co-operating states

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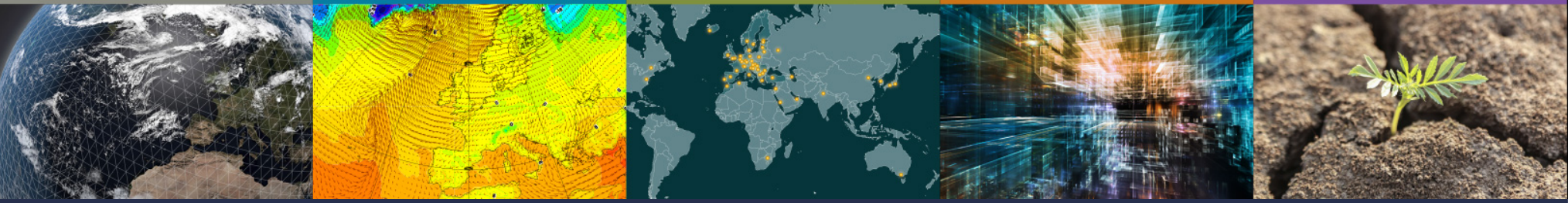


Advancing weather forecasts

Model in focus

- Cycle 43r3:

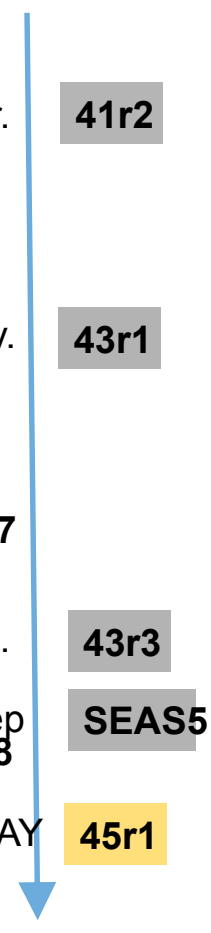
  new radiation scheme, improvement in convection, new aerosol climatology, changes in observation assimilation

- SEAS5:

  SEAS5 includes updated versions of the atmospheric (IFS) and interactive ocean (NEMO) models and adds the interactive sea ice model LIM2. The IFS uses a new grid and horizontal resolution has been increased

- Cycle 45r1:

  upgrade is extending this coupling to ECMWF's medium-range high-resolution forecasts (9 km horizontal resolution); a better use of observations, notably through a scheme to account for the drift of radiosondes during their ascent; the use of more satellite observations; more realistic ocean depth (bathymetry), which mostly affects the wave fields in coastal areas, generally resulting in higher wave heights where the water has become deeper and vice-versa; the introduction of new products useful in the prediction of severe weather, including forecasts of lightning flash density and of maximum convective available potential energy (CAPE) over the last six hours of the forecast



https://www.ecmwf.int/en/forecasts/documentation-and-support/changes-ecmwf-model

IMPLEMENTATION CHOCOLATE

2016	
8 Mar.	41r2
22 Nov.	43r1
2017	
11Jul.	43r3
5 Sep	SEAS5
2018	
TODAY	45r1

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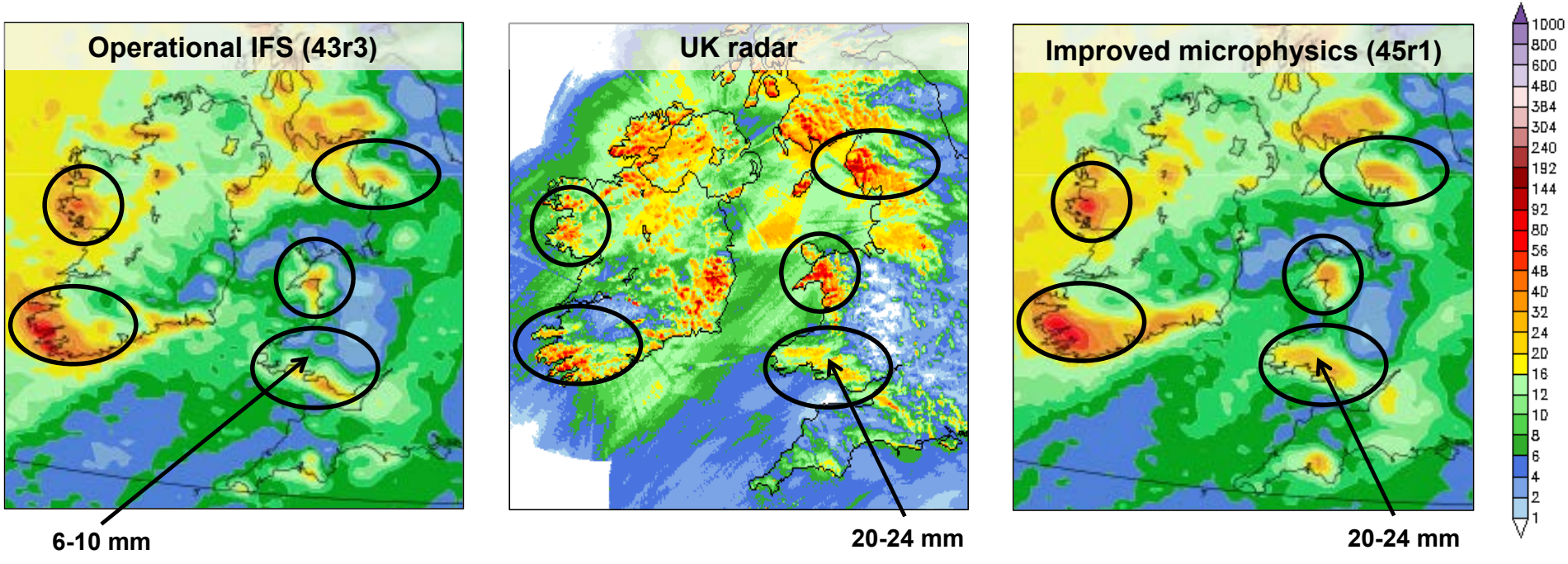
The first operational run will be the 06 UTC followed by the 12 UTC main assimilation and forecast.

https *wf-model*

Preparing 45r1: Warm-rain microphysics

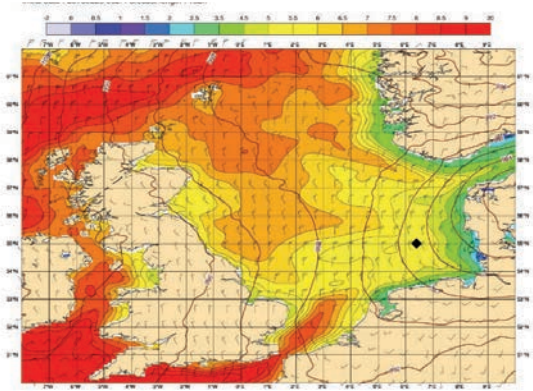
Improvements in precipitation along coast lines/lakes and over orography

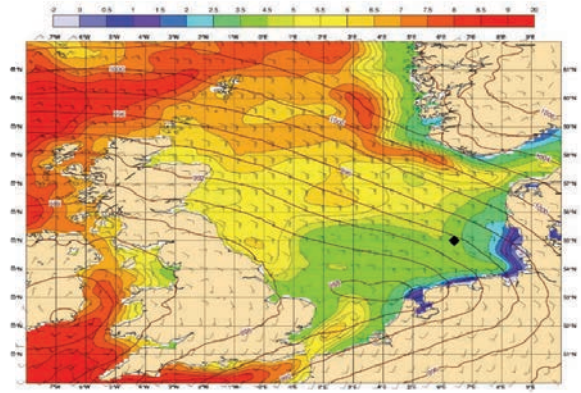
Example case study 14 May 2017 00Z 48hr forecast accumulated precipitation (mm)



North Sea: SST Cooling After Days of Easterlies

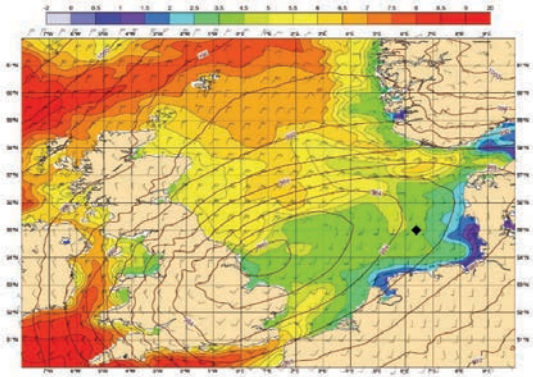
Uncoupled +192h

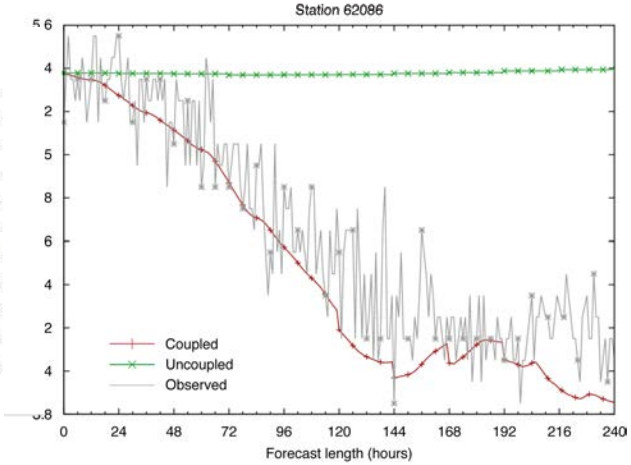




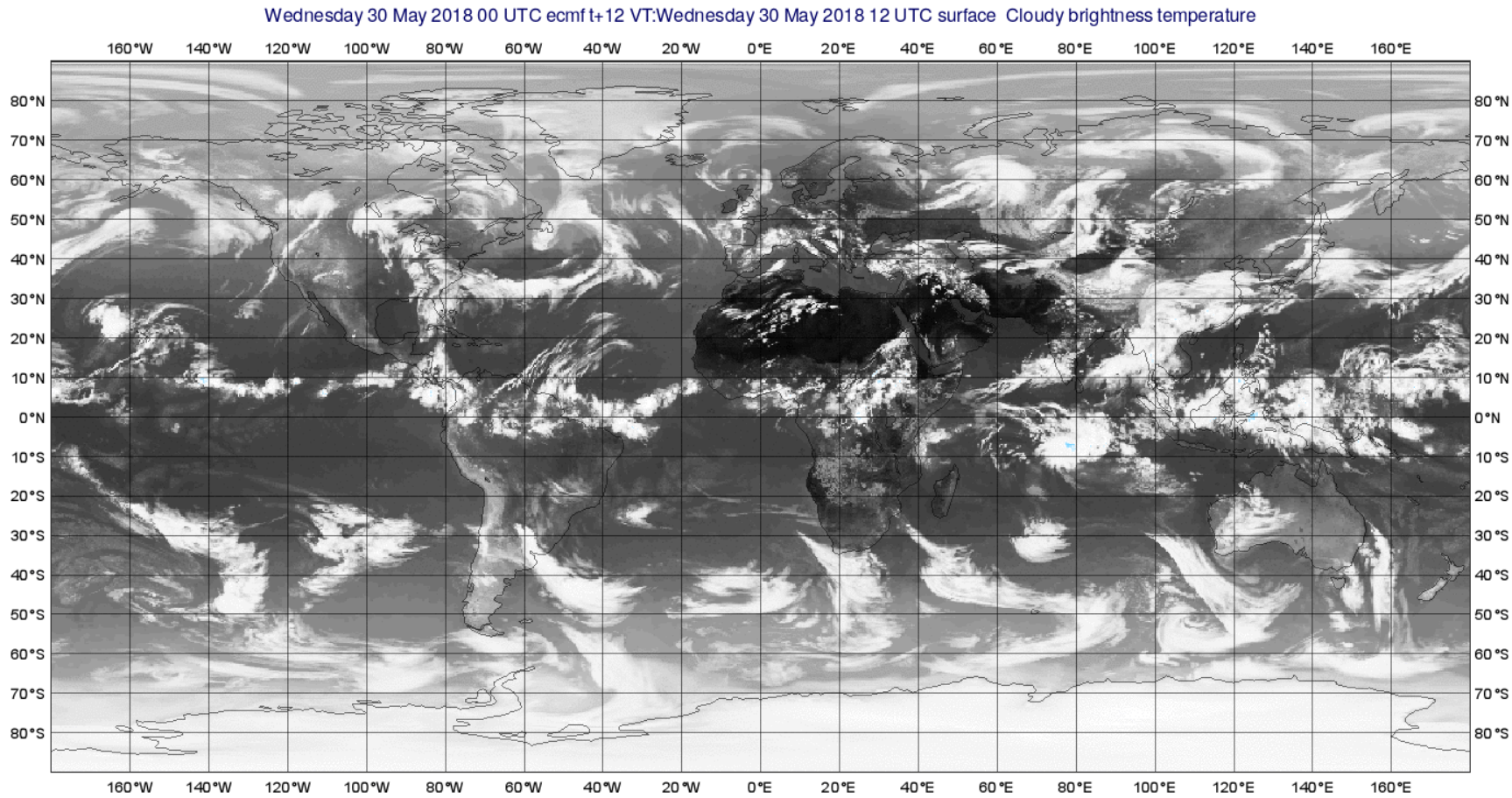
Analysis

Coupled +192h

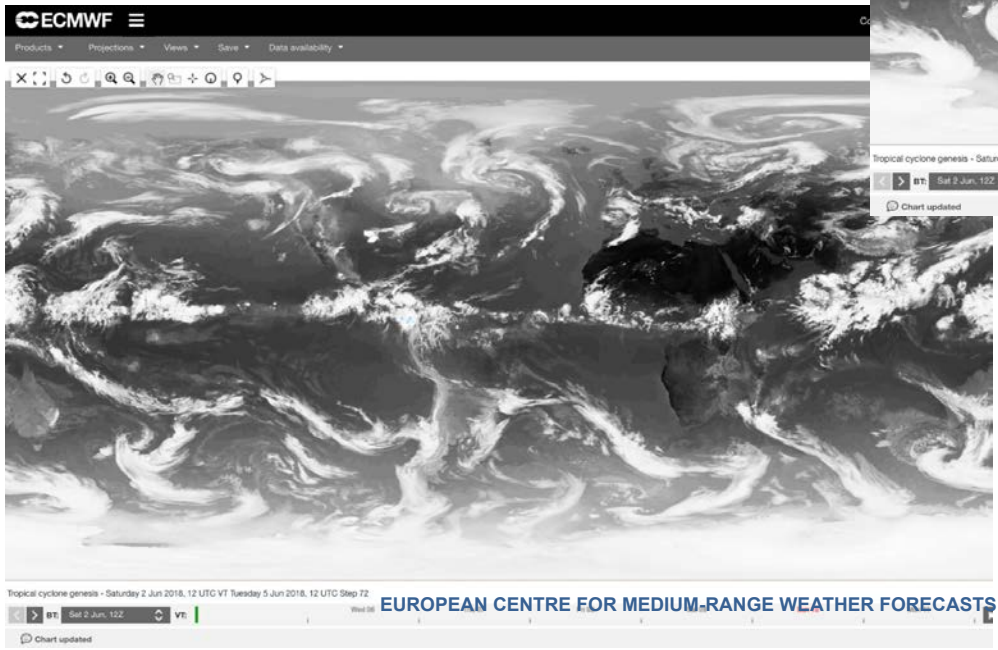


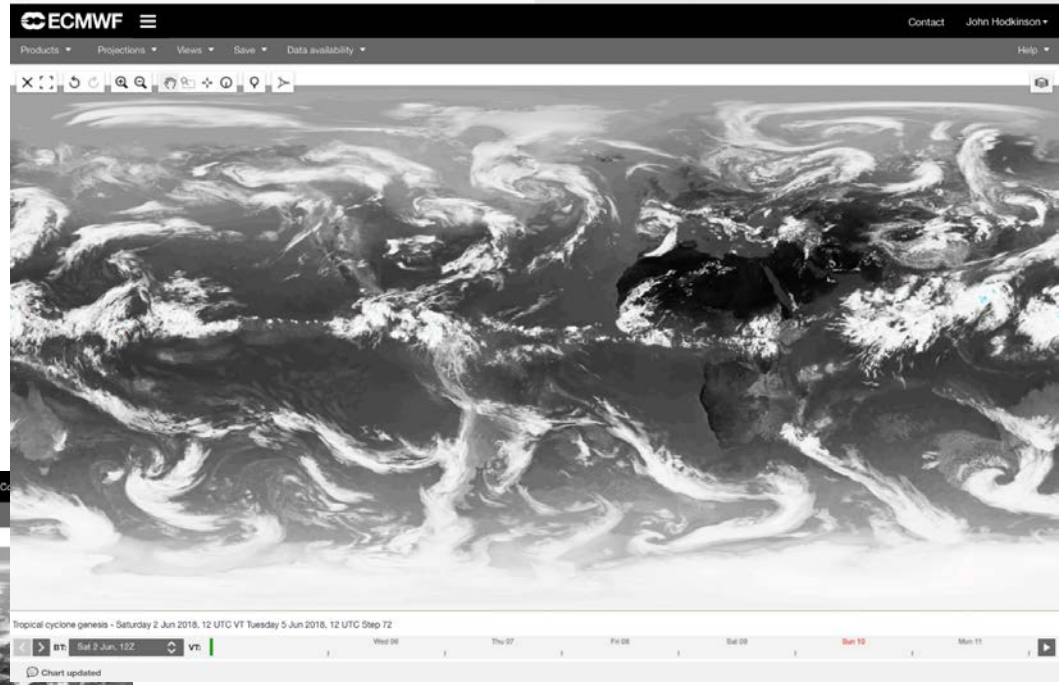


45R1 -issue with the Cycle 45r1 Simulated Satellite imagery data



FIXED!


ECMWF
Products
Projections
Views
Save
Data availability
Tropical cyclone genesis - Saturday 2 Jun 2018, 12 UTC VT Tuesday 5 Jun 2018, 12 UTC Step 72
BT:
Sat 2 Jun, 12Z
VT:
Chart updated


ECMWF
Contact
John Hodkinson
Products
Projections
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Data availability
Help
Tropical cyclone genesis - Saturday 2 Jun 2018, 12 UTC VT Tuesday 5 Jun 2018, 12 UTC Step 72
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Chart updated

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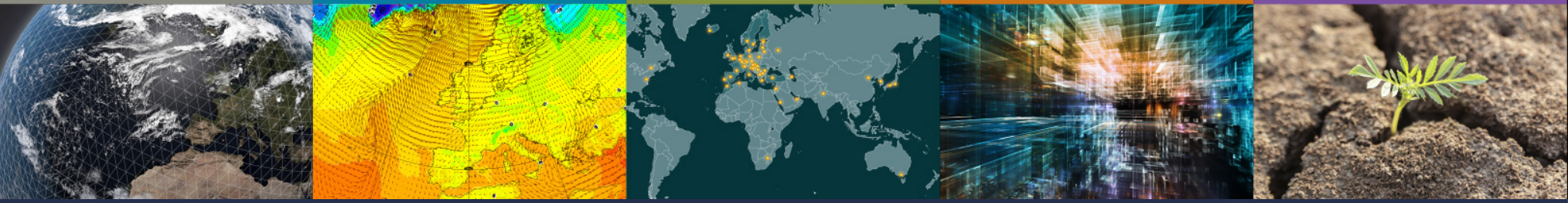


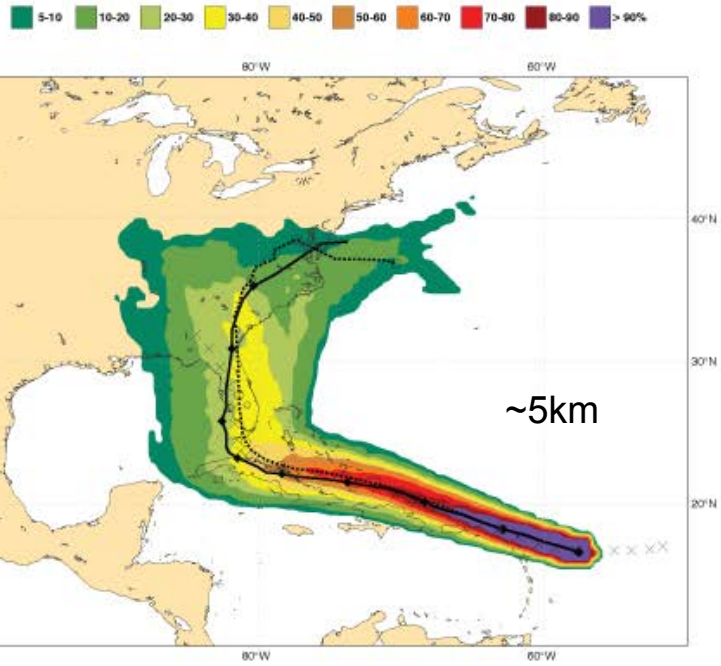
Advancing weather forecasts

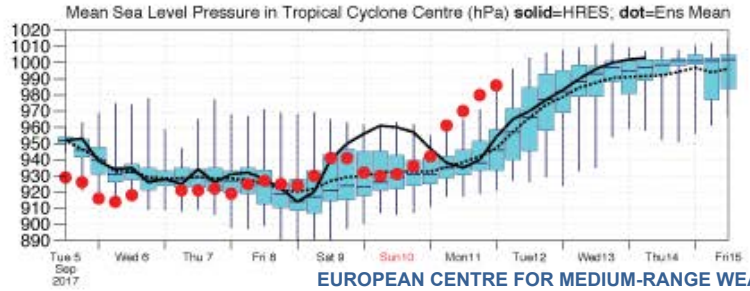
What is next??

Date 20170905 12 UTC @ **ECMF**

Probability that **IRMA** will pass within 120 km radius during the next **240** h

tracks: **solid**=HRES; **dot**=Ens Mean [reported minimum central pressure (

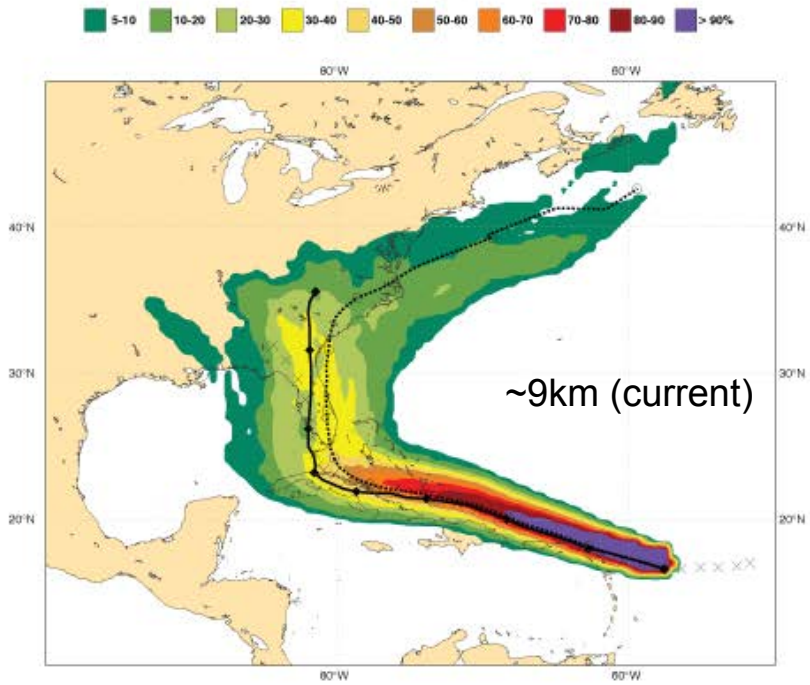


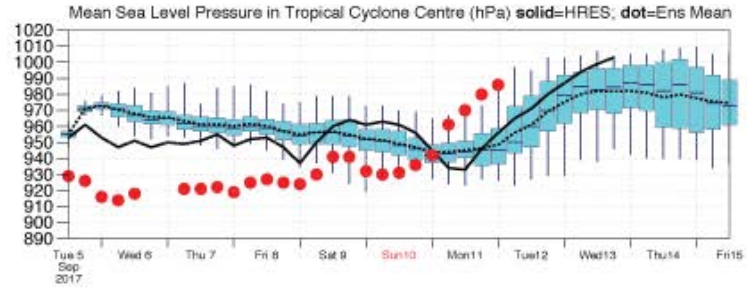


Date 20170905 12 UTC @ **ECMF**

Probability that **IRMA** will pass within 120 km radius during the next **240** hours

tracks: **solid**=HRES; **dot**=Ens Mean [reported minimum central pressure (hPa) **929**]

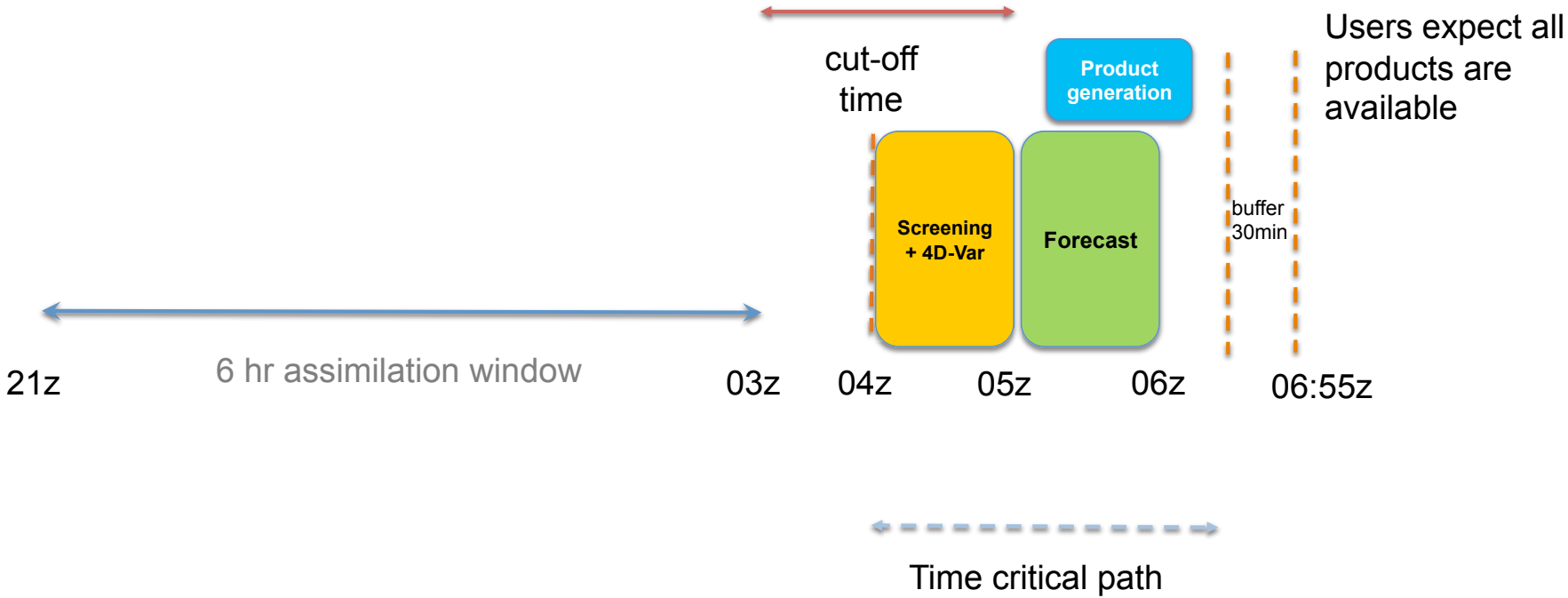




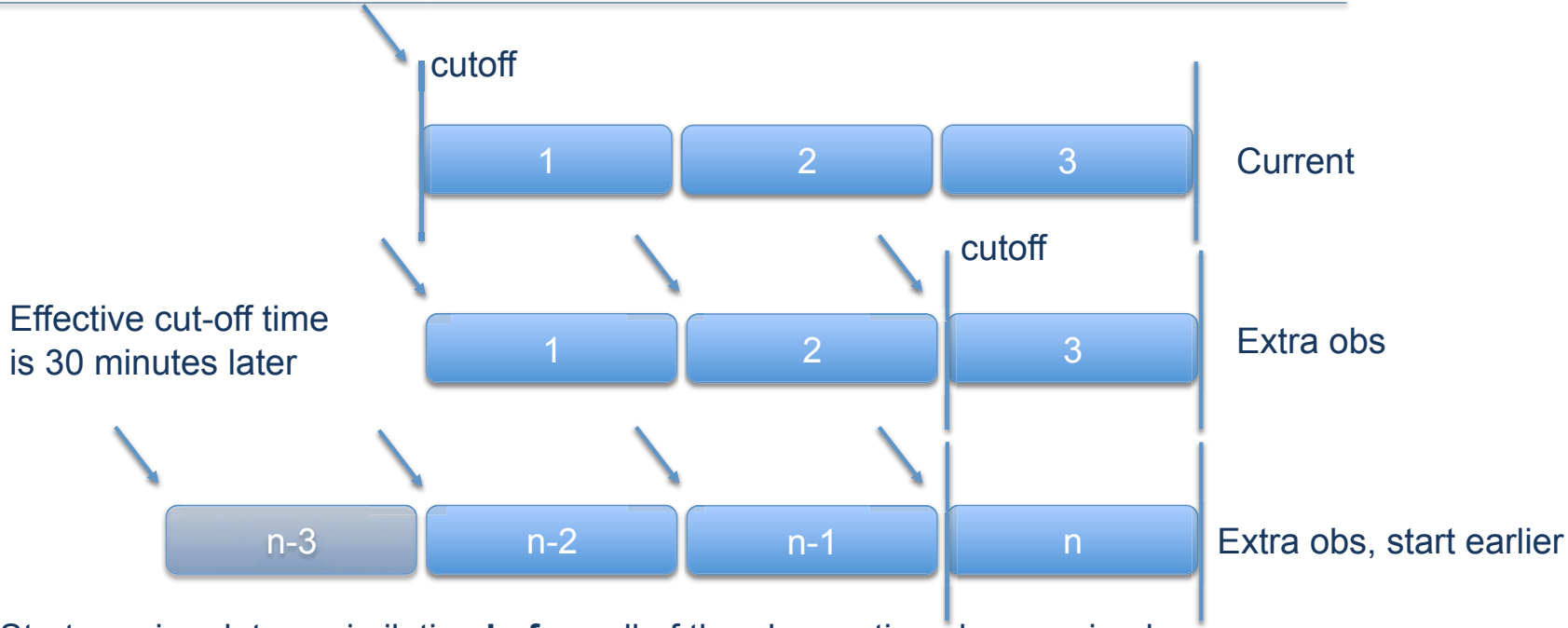
Data assimilation and the time critical path

Early Delivery example:

By the time the analysis is complete,
the most recent observations are almost 2 hours old



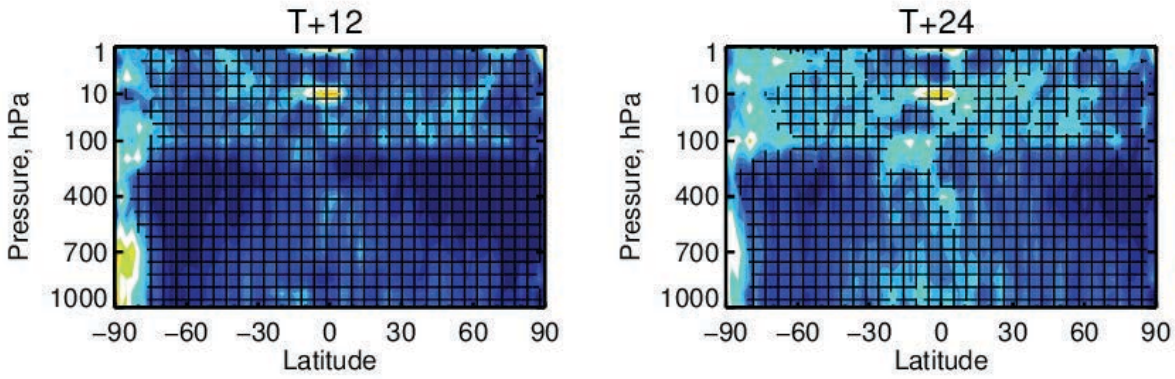
Implications



- Key point: Start running data assimilation **before** all of the observations have arrived
  - Most of the assimilation is removed from the time critical path
  - Configurations which were previously unaffordable can now be considered.

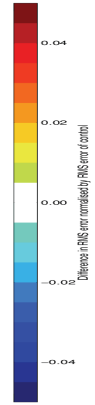
Continuous DA configuration allows **both**:
- Later cut-off to collect **more observations**
- Including allowing a longer assimilation window
- and **More time to perform DA computations**

Improvements at all forecast ranges



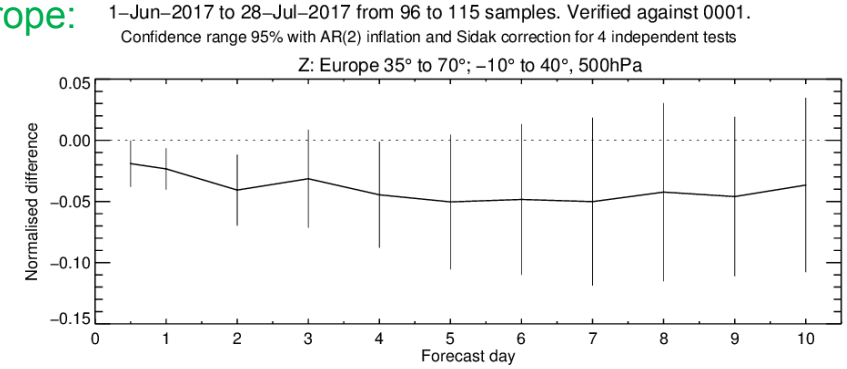
Vector wind RMS error

(bad)



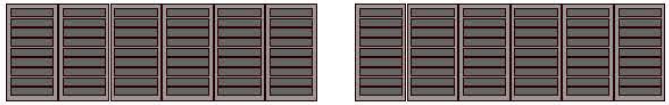
(good)

Europe:

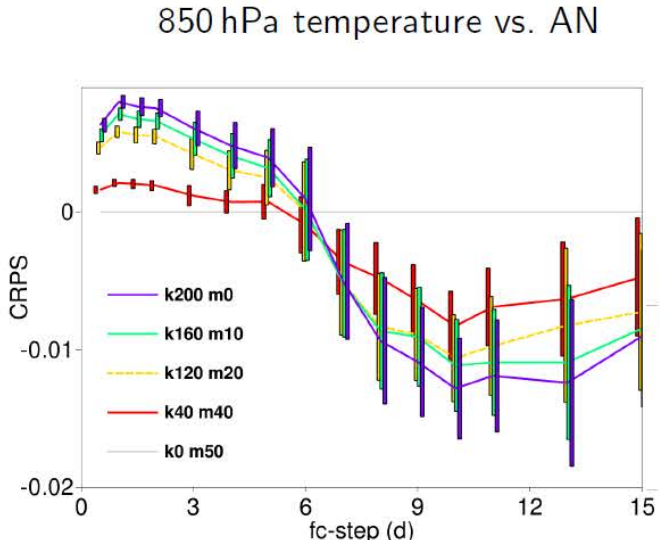


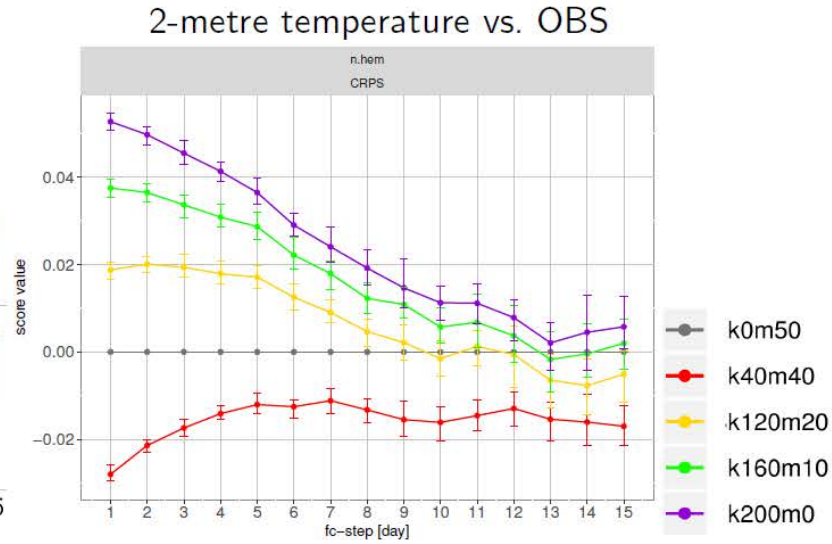
Future ensemble configuration?

Is 50 members with the same resolution still a good choice?



current HPC resources





New strategy for hindcasts … under investigation

1. 51m twice a week (cost 0) *102 RT 440 HC*
2. 15m every day (cost 0) *105RT 440 HC*
3. 21m every day (cost x1.4) *147RT 440HC (+ 8%)*
4. 25m every day (cost x1.7) *175RT 440HC (+13%)*
5. 51m every day (cost x3.4) *357RT 440HC (+ 47%)*
6. 200m twice a week (cost x4) *400RT 440HC (+55%)*

Cost could be reduced if additional daily forecasts stop at day 32 instead of 46

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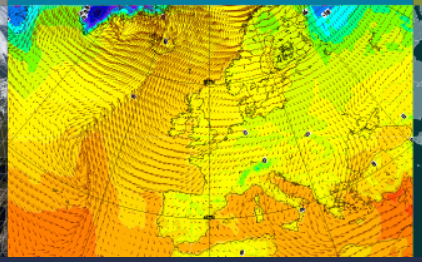
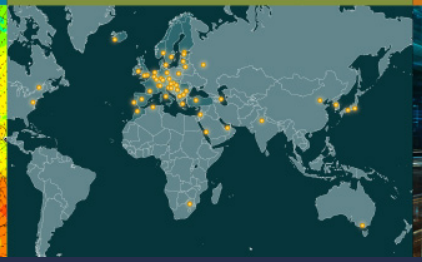
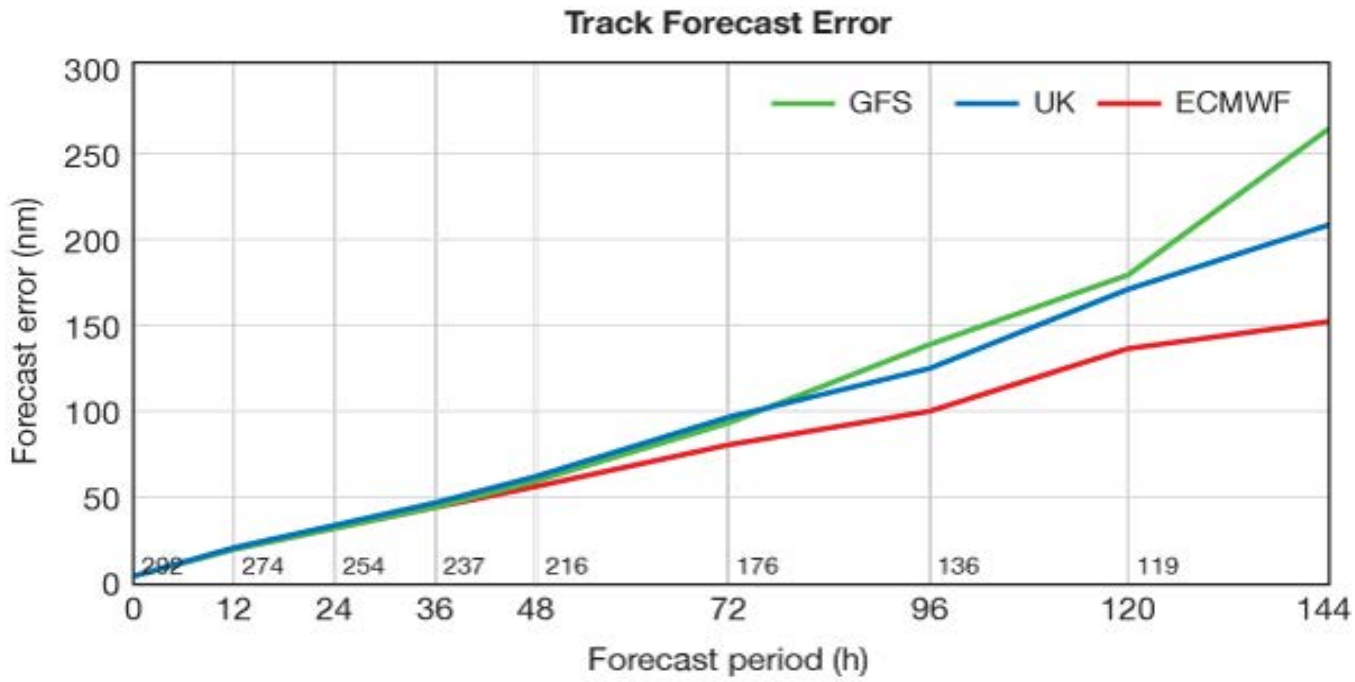



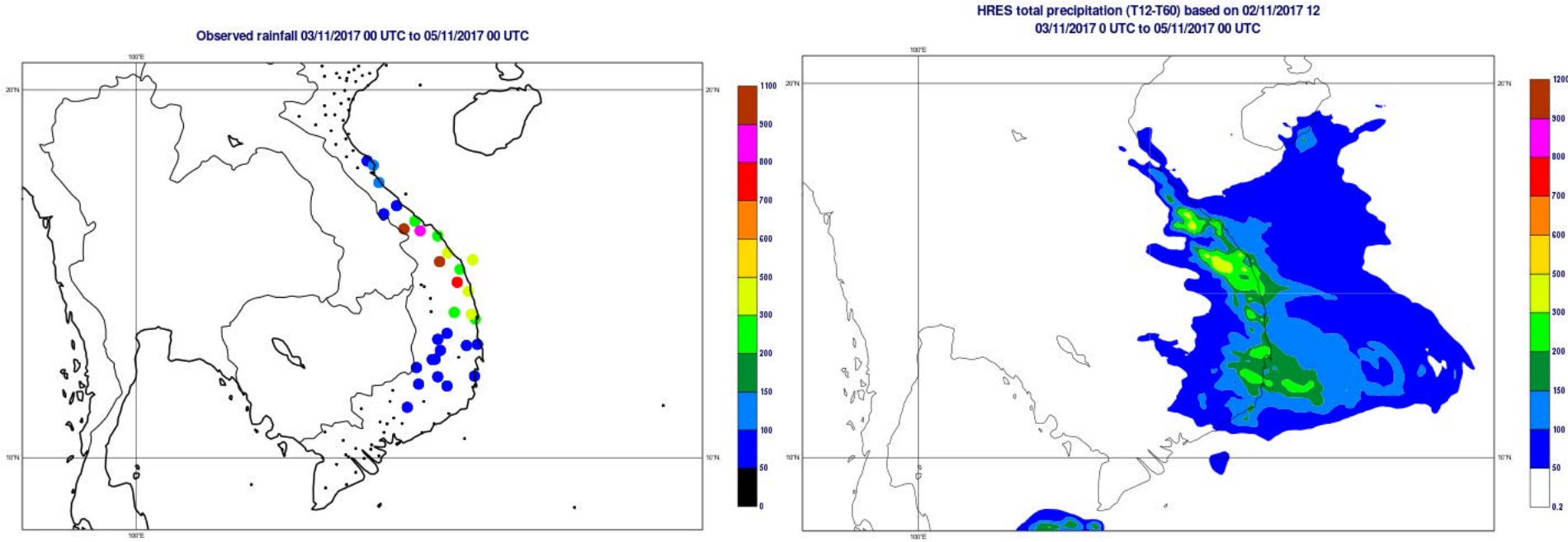
Delivering global prediction

Tropical cyclones track forecasts: an accolade from the NHC

Verification Presentation



WMO Fellow helping ECMWF evaluation



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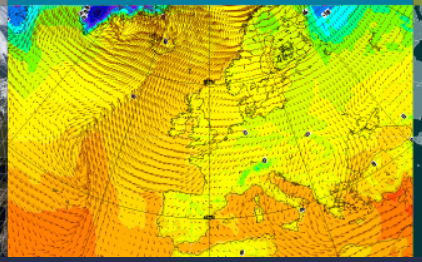
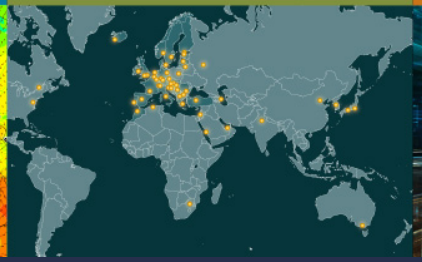



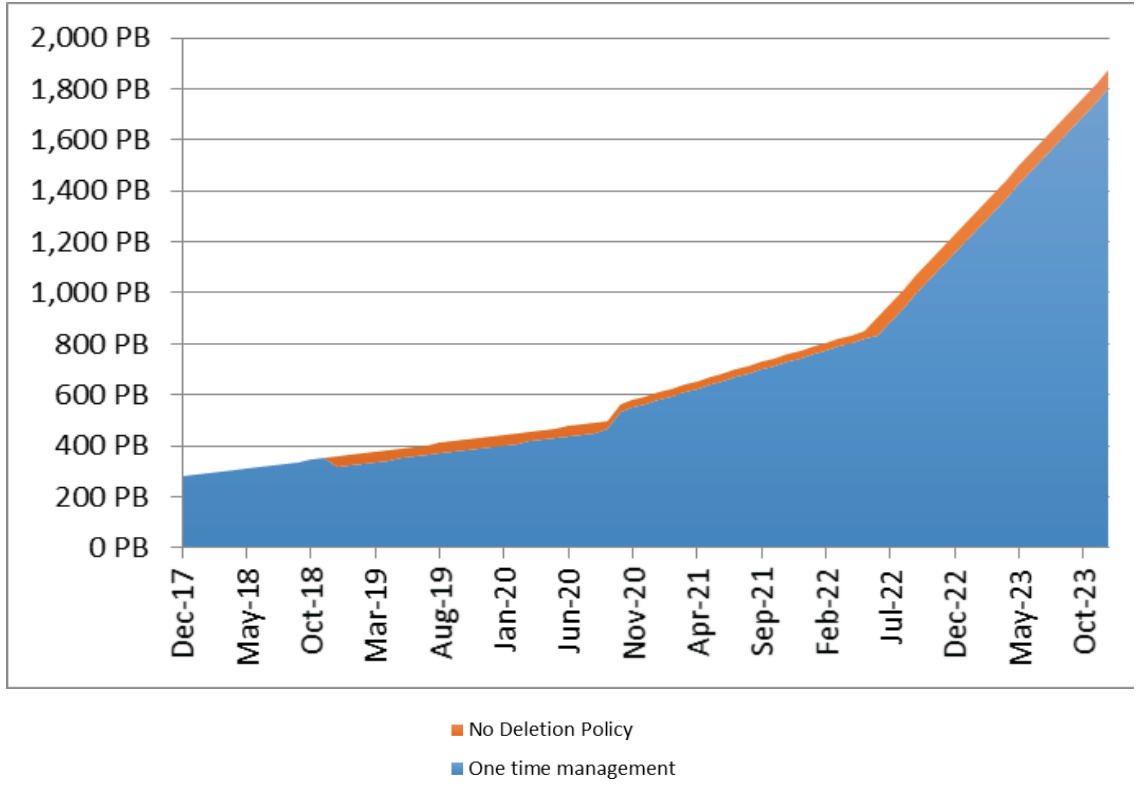
Sustaining high performance computing

Scalability efficiency gains

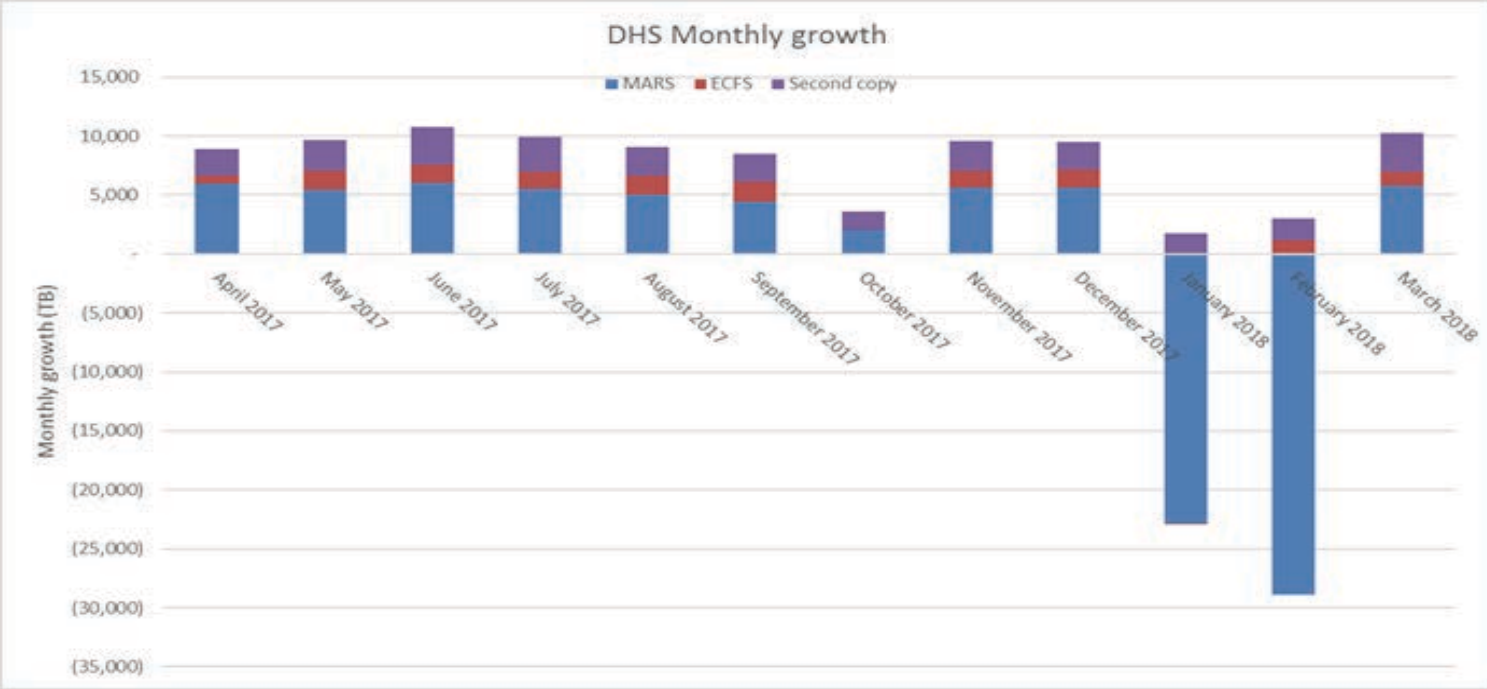
Scalability Programme efficiency gains:		
EDA	Extraction of 1st screening trajectory from critical path	x0.95
	Parallel execution of long-window 4DV sub-windows	x1
	Multi-grid capability for atmospheric composition	x1
	Asymmetric and pre-conditioned EDA	x0.5
	Replacement of finite differences with EDA derived perturbations in SEKF	x0.85
	Code improvement through better use of OpenMP, MPI, vectorization and data handling	x0.95
	Total	***x0.4***
ENS	Single precision for forecasts	x0.6
	Multi-grid capability for atmospheric composition	x1
	Elimination of SKEB model perturbations	x0.95
	Code improvements through better use of OpenMP, MPI, vectorization and data handling	x0.95
	Total	***x0.55***

Projected growth of the archive

Towards a more sustainable data management



Data archive grows



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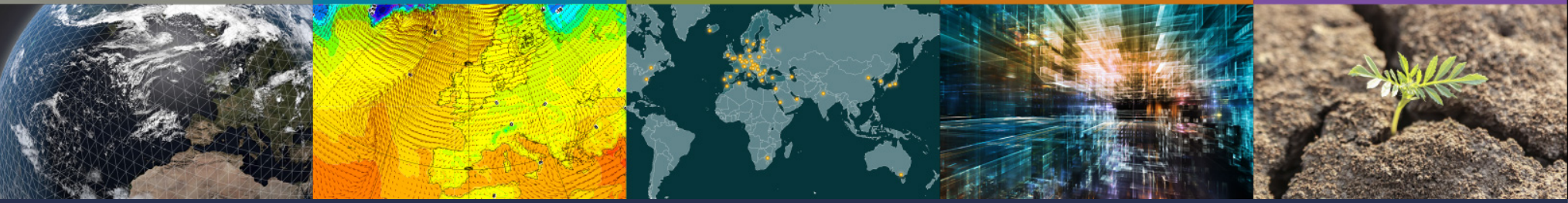
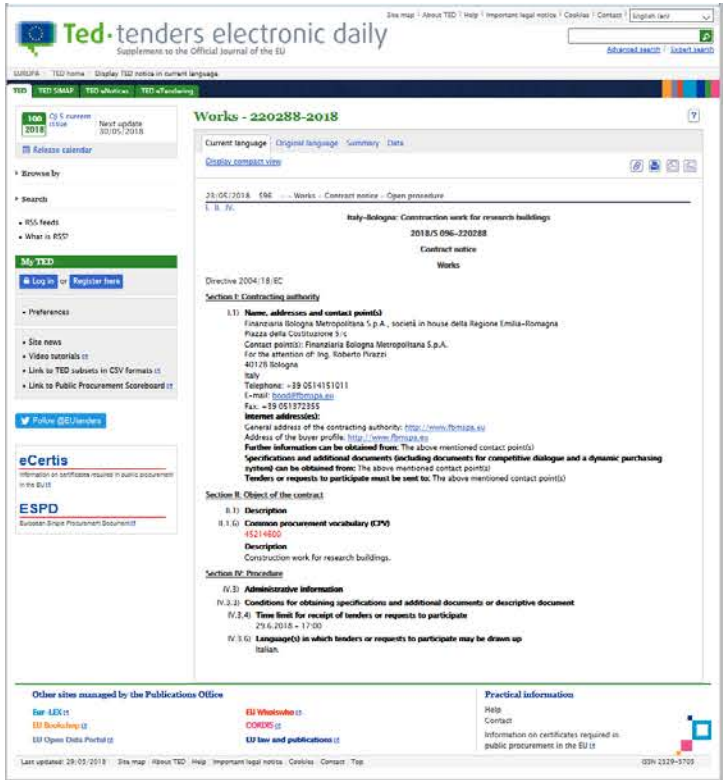


Supporting ECMWF

Bologna: It is all happening



- ECMWF Agreement signed by both Chambers and by President of Italian Republic
- 23 May – Publication of building tender in the European and Italian Official Journal
- August – Review of bids
- 10 October – Contract signature
- Mid-October – Official ground breaking in Bologna

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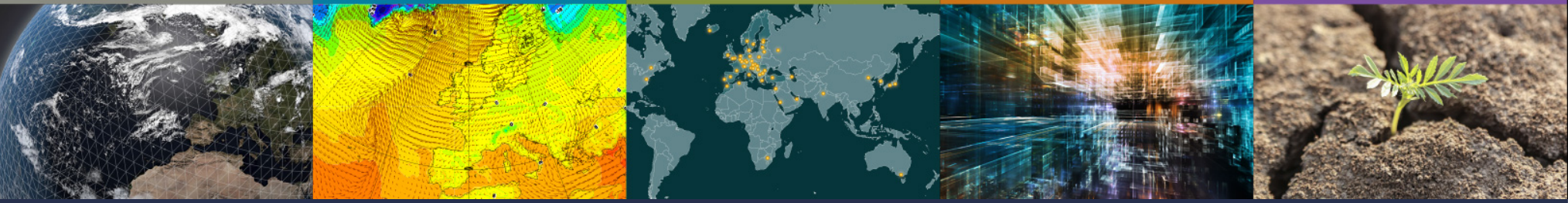


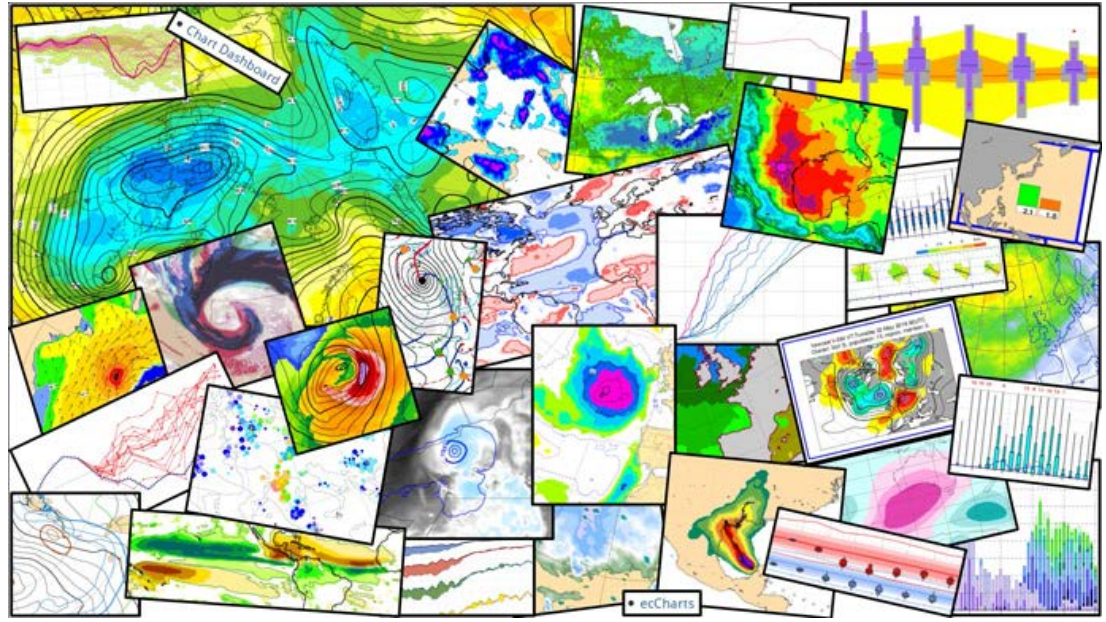
Serving Member and Co-operating States

NEW: User guide to ECMWF forecast products

- A new edition of ECMWF's user guide is now available online.

The **ECMWF Forecast User Guide** helps forecasters and other meteorologists to make the best use of the forecast products from ECMWF.

- The user guide provides all the tools needed for correct interpretation of ECMWF products, enabling users to deliver a high-quality service to their own customers. It also encourages users to employ new or previously overlooked forecast technique

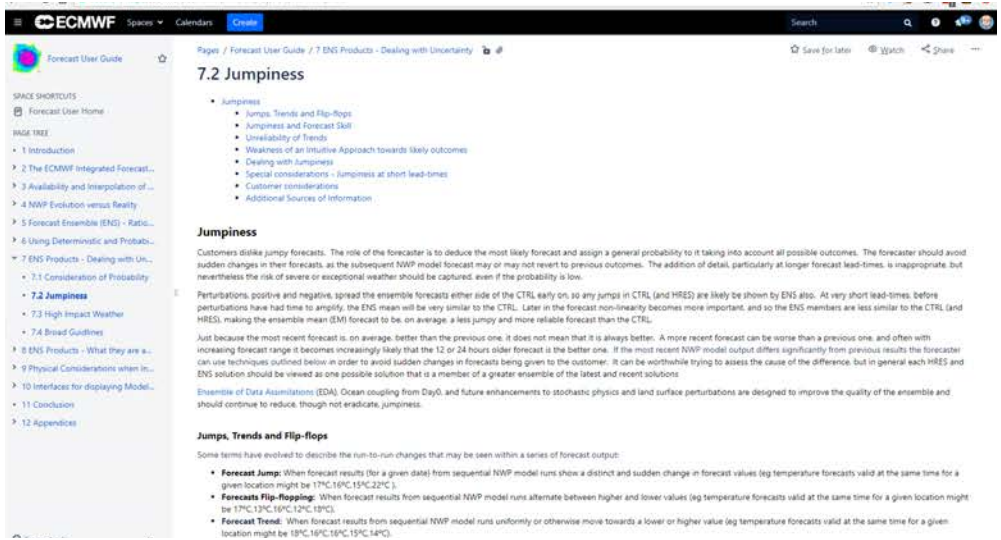


https://software.ecmwf.int/wiki/display/FUG/1+Introduction

ECMWF

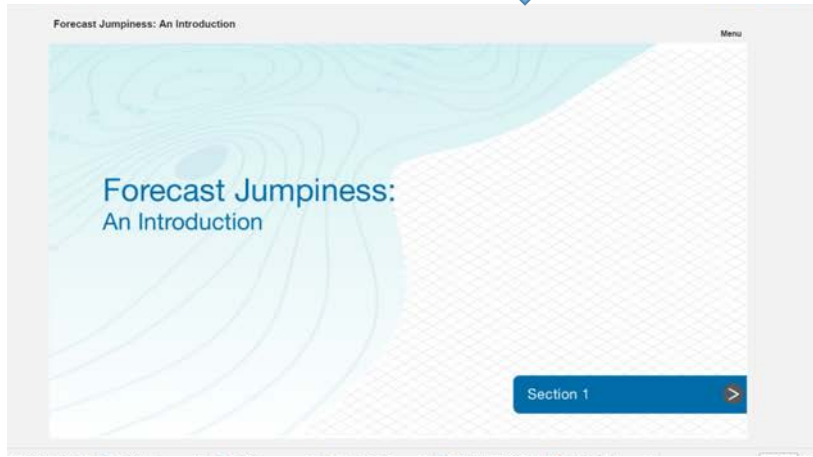
Owens, R G, Hewson, T D (2018). ECMWF Forecast User Guide. Reading: ECMWF. doi: 10.21957/m1cs7h

Connected resources …



User Guide

E-Learning Module

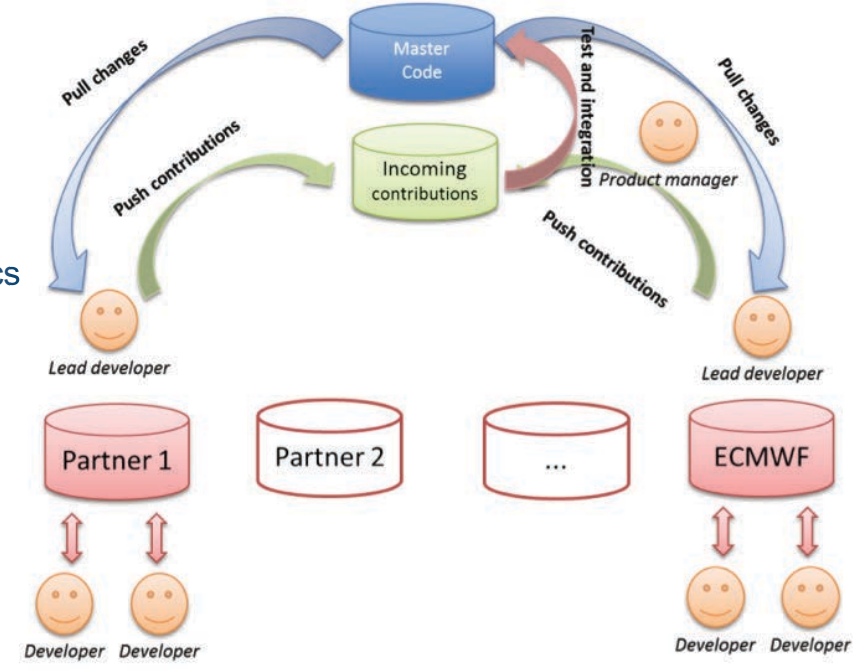


ECMWF

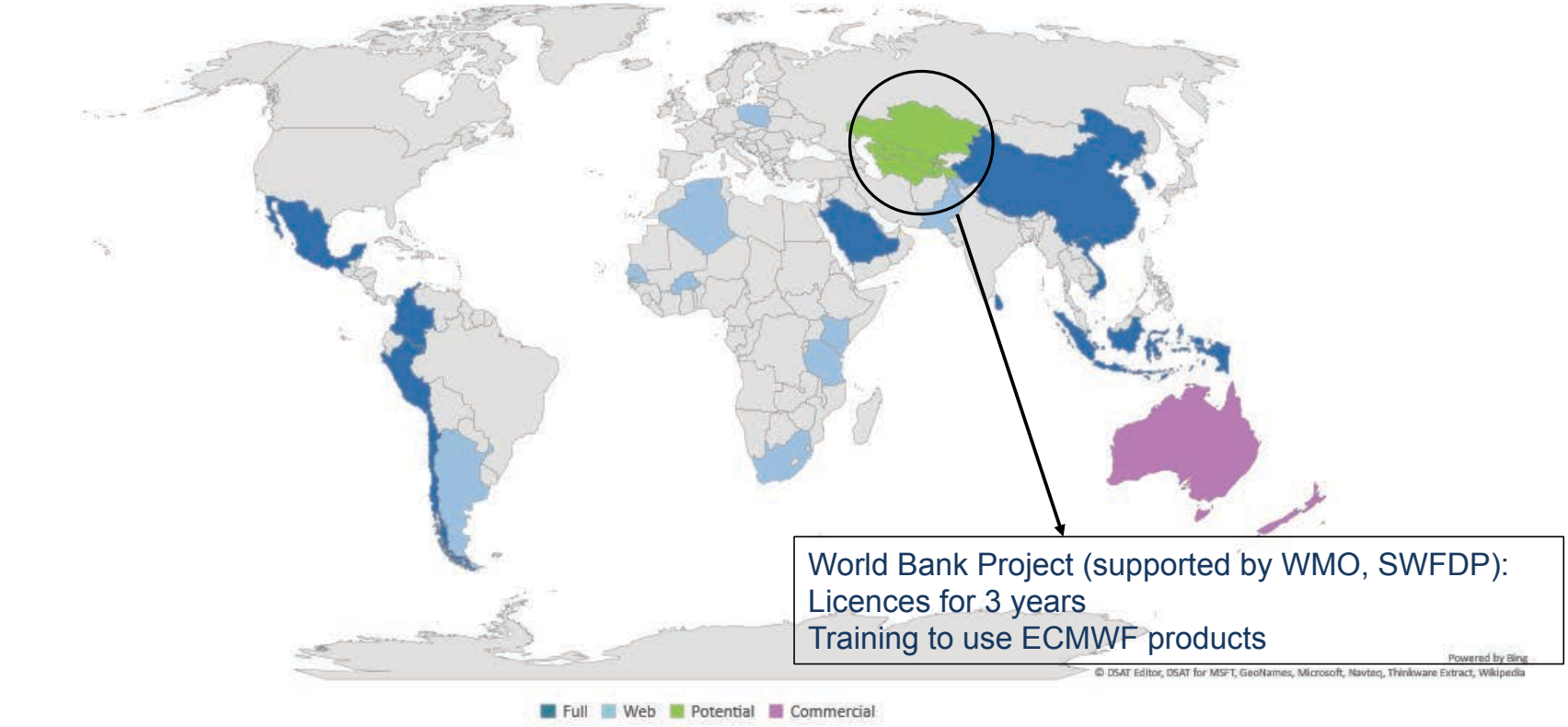
https://www.ecmwf.int/en/en/learning/education-material/elearning-online-resources

Providing software to MS/CS: Code contributions to ECMWF software

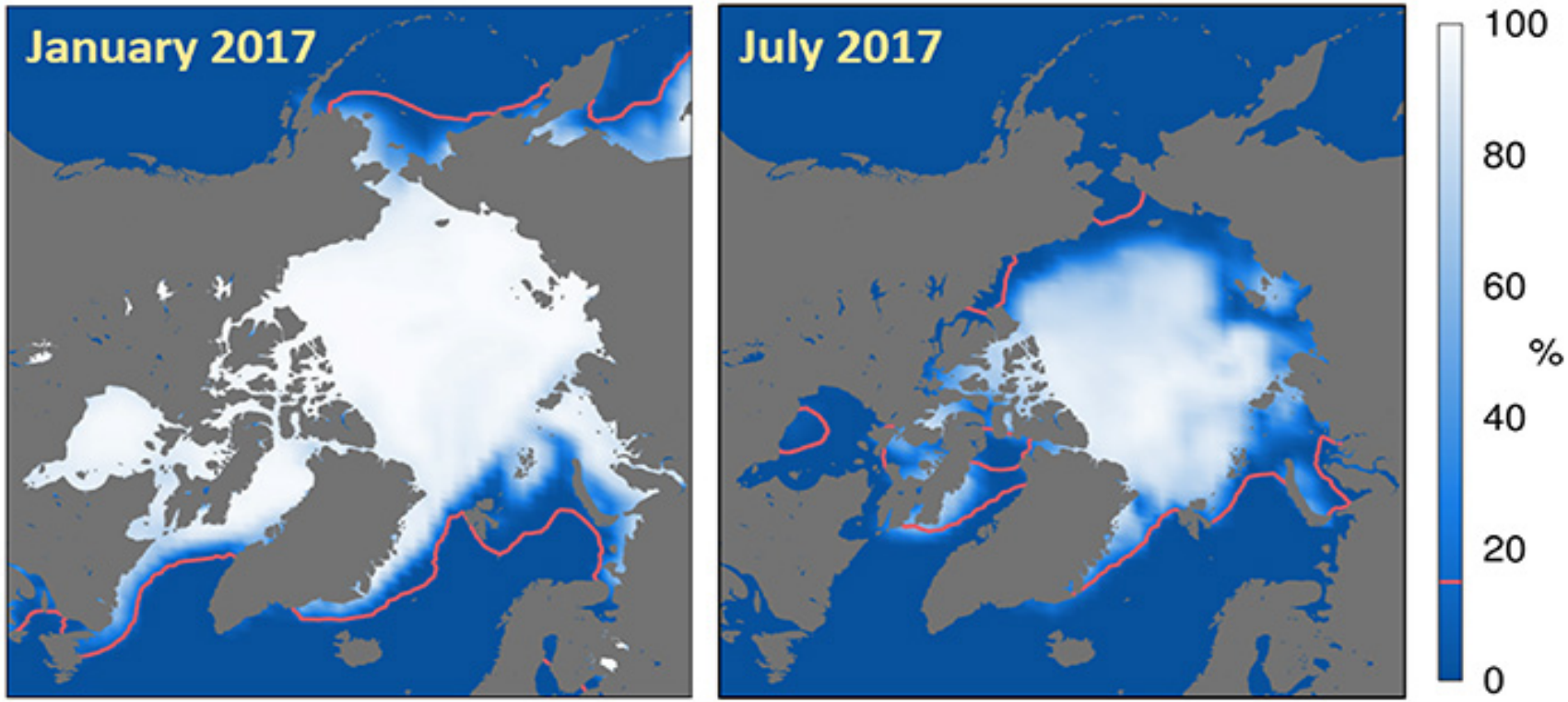
- **We appreciate contribution to our software**
  - Provide bug fixes
  - Improve performance
  - Add features not used/required at ECMWF
  - Example: Météo France
    Contributed many (bug) fixes to GRIB-API/ecCodes and Magics which will benefit the wider community.
- **We want to make it easier to do so!**
  - Soon our source code git repository will allow developers to commit code contribution through simple clicks in the web interface
  - Build automatic regression tests to give fast feedback to developers



NMHS licenses & World Bank Project



A State of the climate focussed on Europe



European Commission

Copernicus
Europe's eyes on Earth

Climate Change Service
climate.copernicus.eu

IMPLEMENTED BY ECMWF

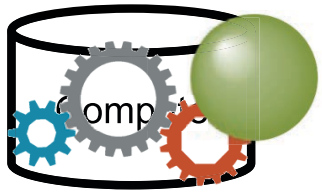
Climate Data Store - from vision to reality

Climate Change

OPENING 14th of June

events.ecmwf.int

Hackathon: Innovate with Open Climate Data (9-10 June 2018) · ECMWF Events (Indico)



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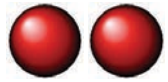

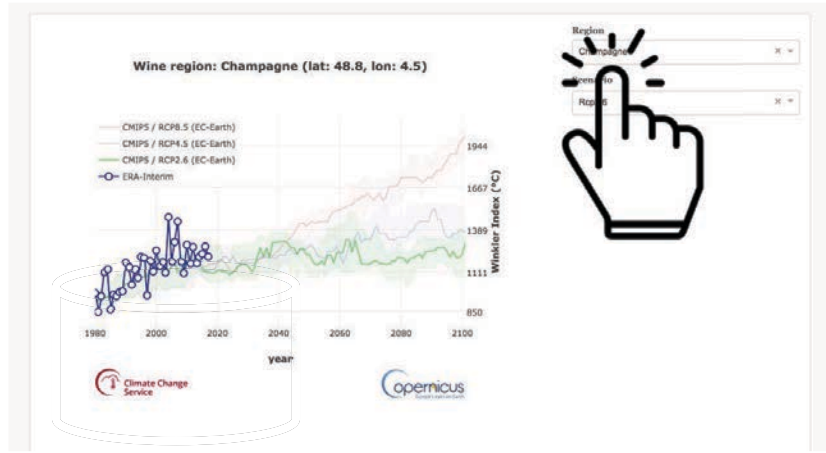

Toolbox

Broker

Adaptor

ESGF

Adaptor

Website
ftp server

Adaptor

ECMWF
MARS archive

ECMWF opernicus Europe's eyes on Earth European Commission

Climate Data Store - from vision to reality

Climate Change

OPENING 14th of June

events.ecmwf.int

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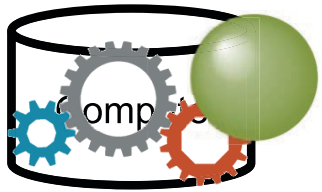

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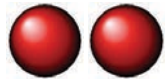

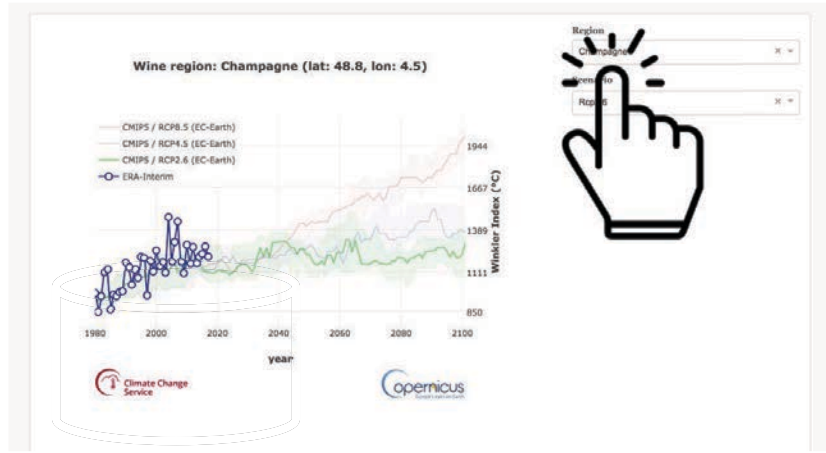

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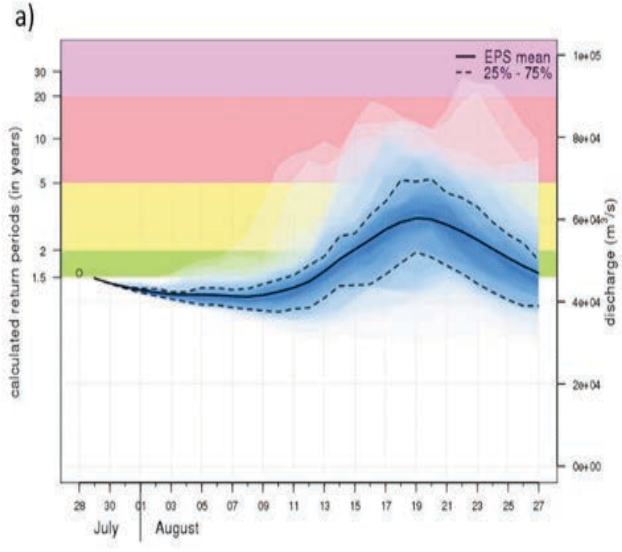
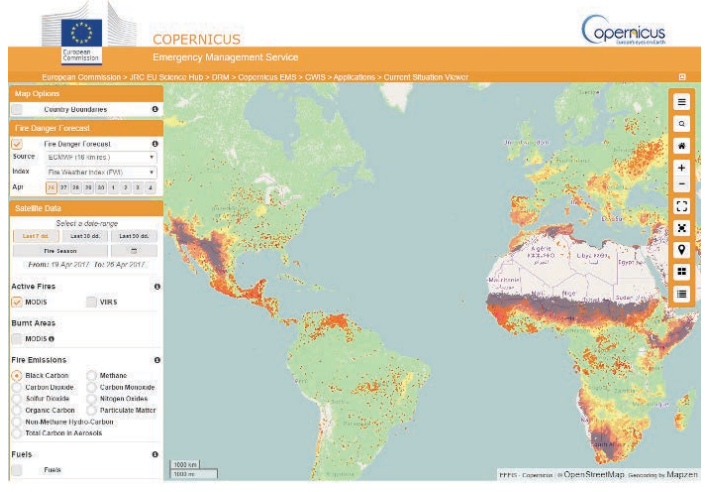
Contributing to the Copernicus Emergency Management Service

Global Flood Forecasting



Global Fire Forecasting



The strength of a common goal