

# **ECMWF Products including:**

- Precipitation Type,**
- Extreme Forecast Index (EFI) and Shift of Tails (SOT)**

High latitude Winter Weather course 2023

30 January 2023

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User Outreach and Engagement

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## ECMWF

European Centre for Medium-Range Weather Forecasts

An independent  
intergovernmental organisation

Established in 1975

With

- 23 Member States
- 12 Co-operating States



# 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** 137 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)
- **ENS-WAM**: 15 days ahead at **28 km** (coupled)

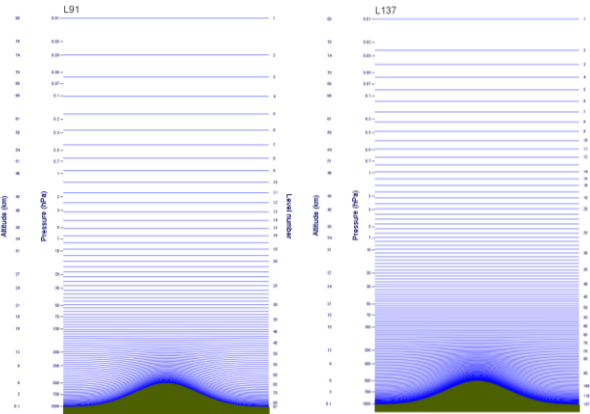
## Seasonal forecast: once a month

- 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**)

**Major updates in  
48r1 – June 2023**

# Implementation of ECMWF new model cycles 47r2 and 47r3

Successfully implemented  
47r2 – 11<sup>th</sup> May 2021  
47r3 – 12<sup>th</sup> October 2021



## 47r2

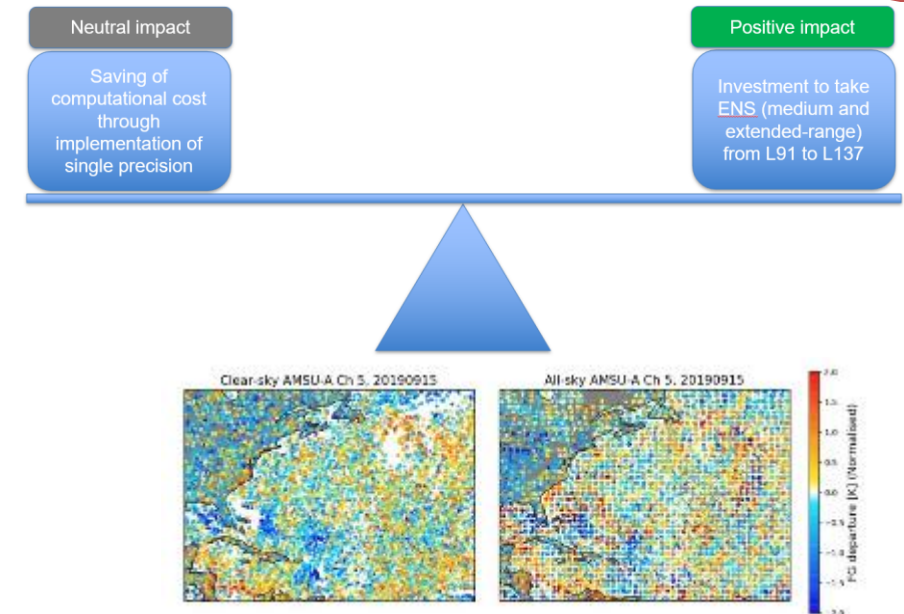
- Single Precision – models less computationally expensive to run
- Increased model levels from 91 -> 137
- New parameters for humidity, UV, Infrared and orography
- More Tropical Cyclone tracks

## 47r3

- Changes to observation usage in the assimilation
- Weak constraint 4DVar for stratosphere in EnsembleDA
- Major revision to improve the physical and numerical basis for moist processes in the IFS – clouds, convection, turbulent mixing, microphysics

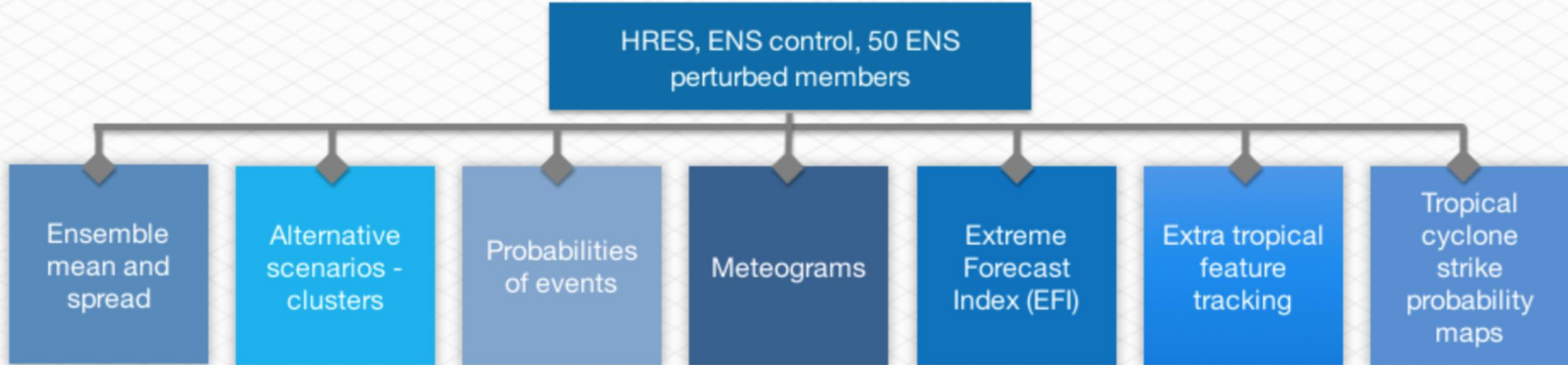
<https://confluence.ecmwf.int/display/FCST/Implementation+of+IFS+Cycle+47r2>

<https://confluence.ecmwf.int/display/FCST/Implementation+of+IFS+Cycle+47r3>





## ECMWF forecast products



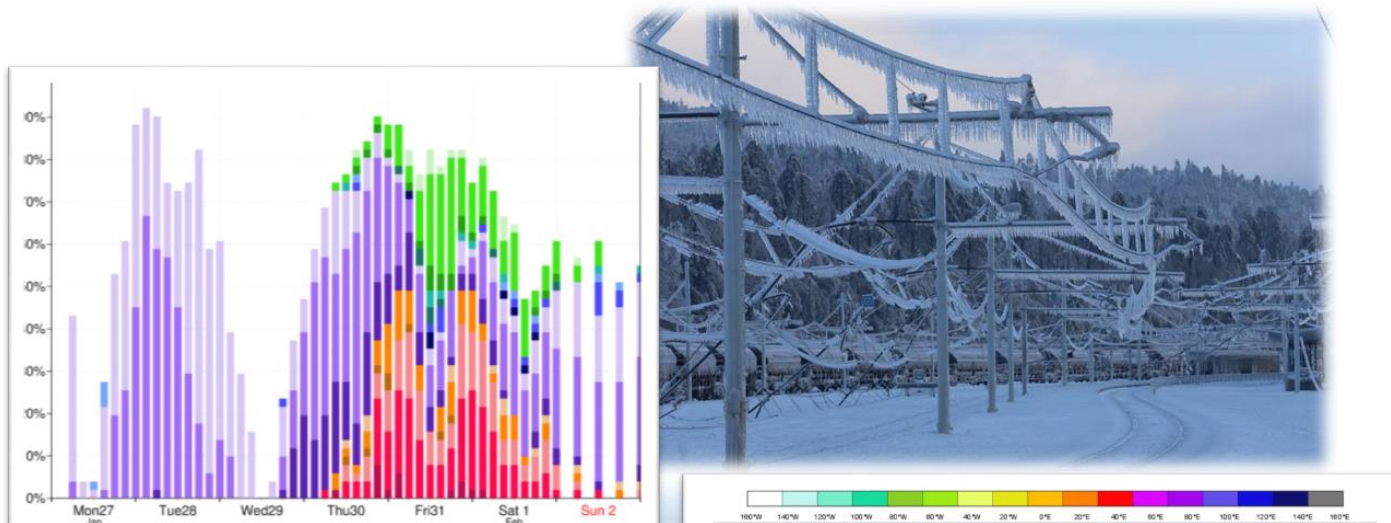
# Precipitation Type

## Estimation with ECMWF probabilistic products



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[estibaliz.gascon@ecmwf.int](mailto:estibaliz.gascon@ecmwf.int)



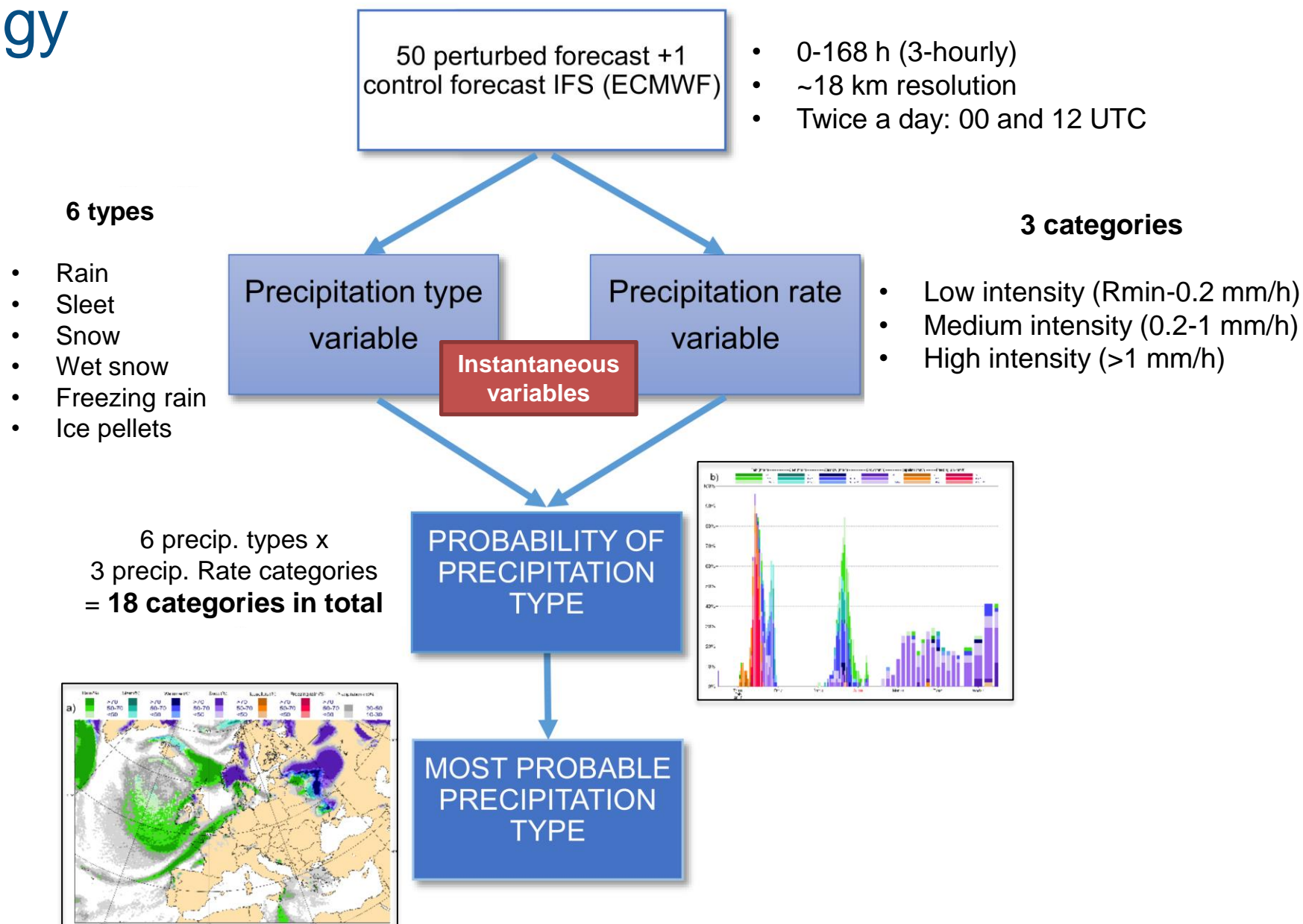
# Why these probabilistic products?

- **Difficulties** of accurate **forecasting of precipitation type** in winter at ground level, specially mixed (freezing rain).
- **Freezing rain** is particularly **hazardous** due to its ice-loading effects on power wires and because it can make travel extremely dangerous. But also **heavy snowfalls**.
- The **uncertainty** of mixed phases forecasting can be partially **reduce** using **ensemble** forecast.
- We also used a technique with **precipitation rate** variable to classify dry from precipitating in order to try to enforce a **zero frequency bias** for each precipitation types: **reduce misses and false alarms**.

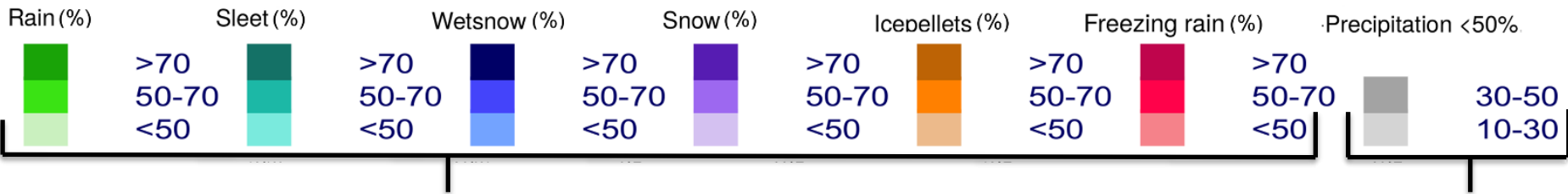




# Methodology

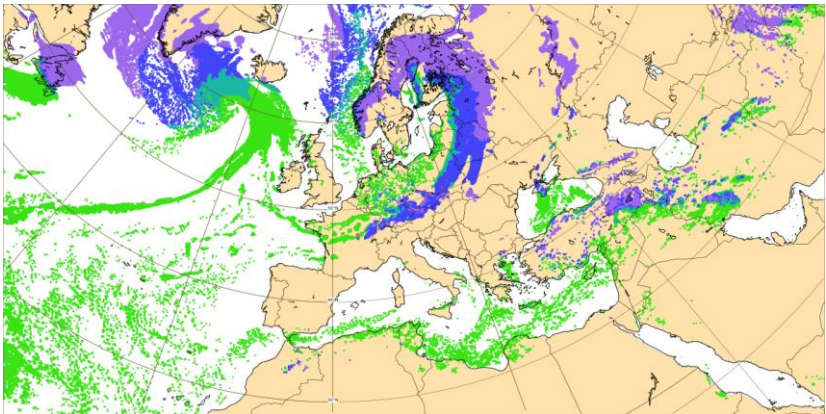


# Most probable precipitation type product

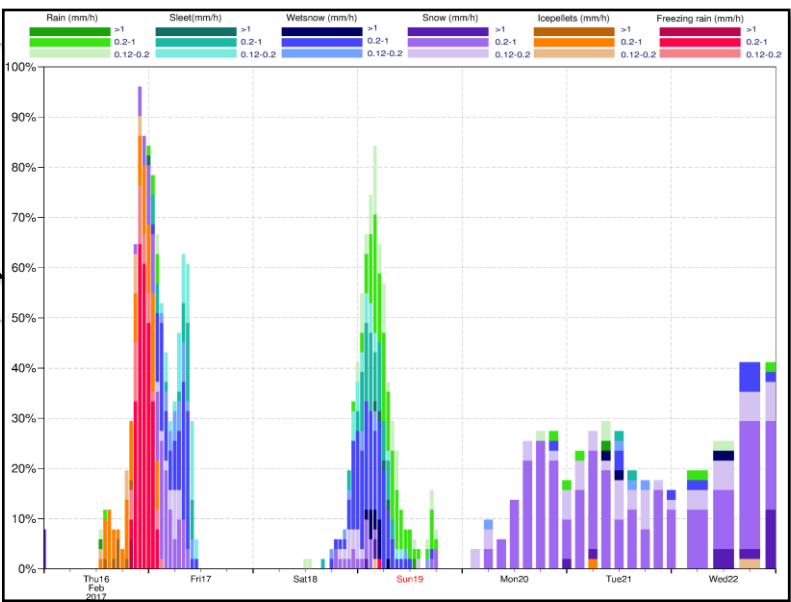
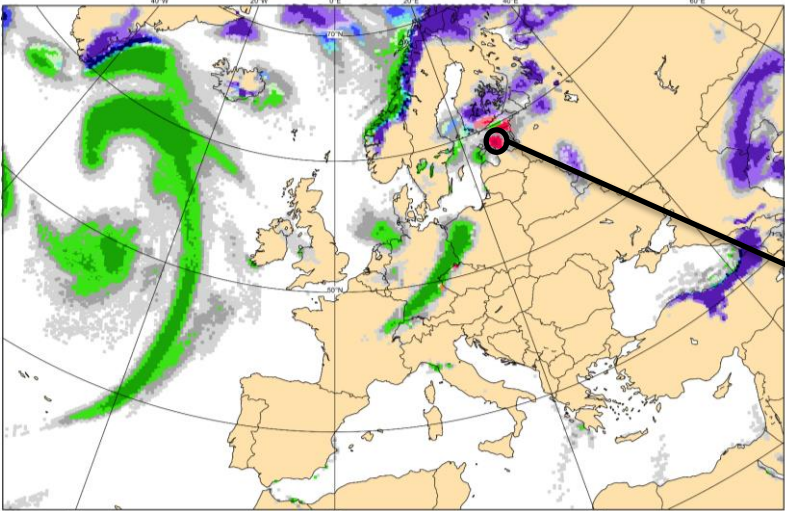


**Colours:** most probable precipitation type if **total precip > 50 %**

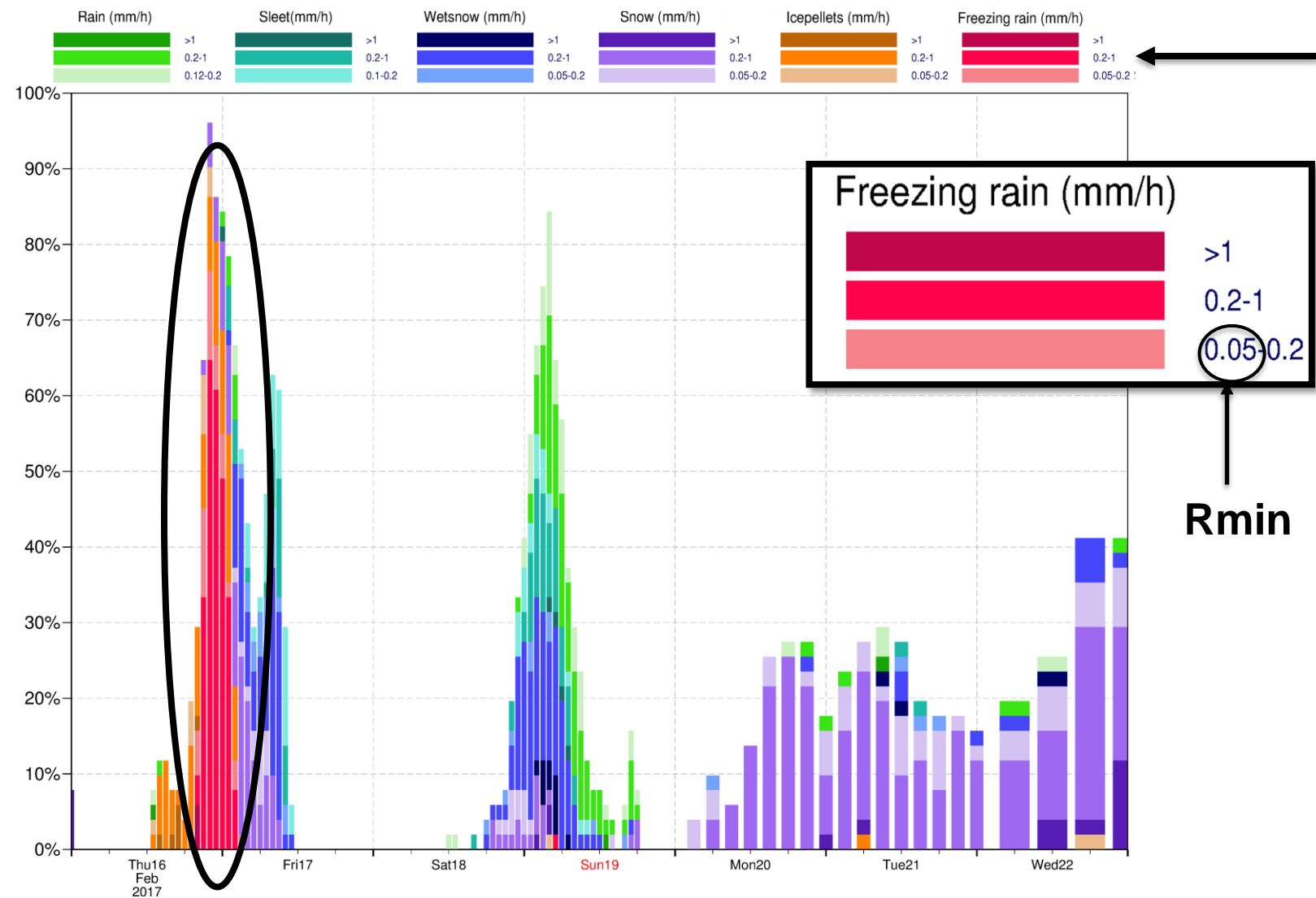
**Grey shading:** when the probability of any type of precipitation is **10-30%** or **30-50%**. **THE TYPE OF PRECIPITATION IS NOT SPECIFIED**



Current visualisation on OpenCharts



# Probability of precipitation type meteograms



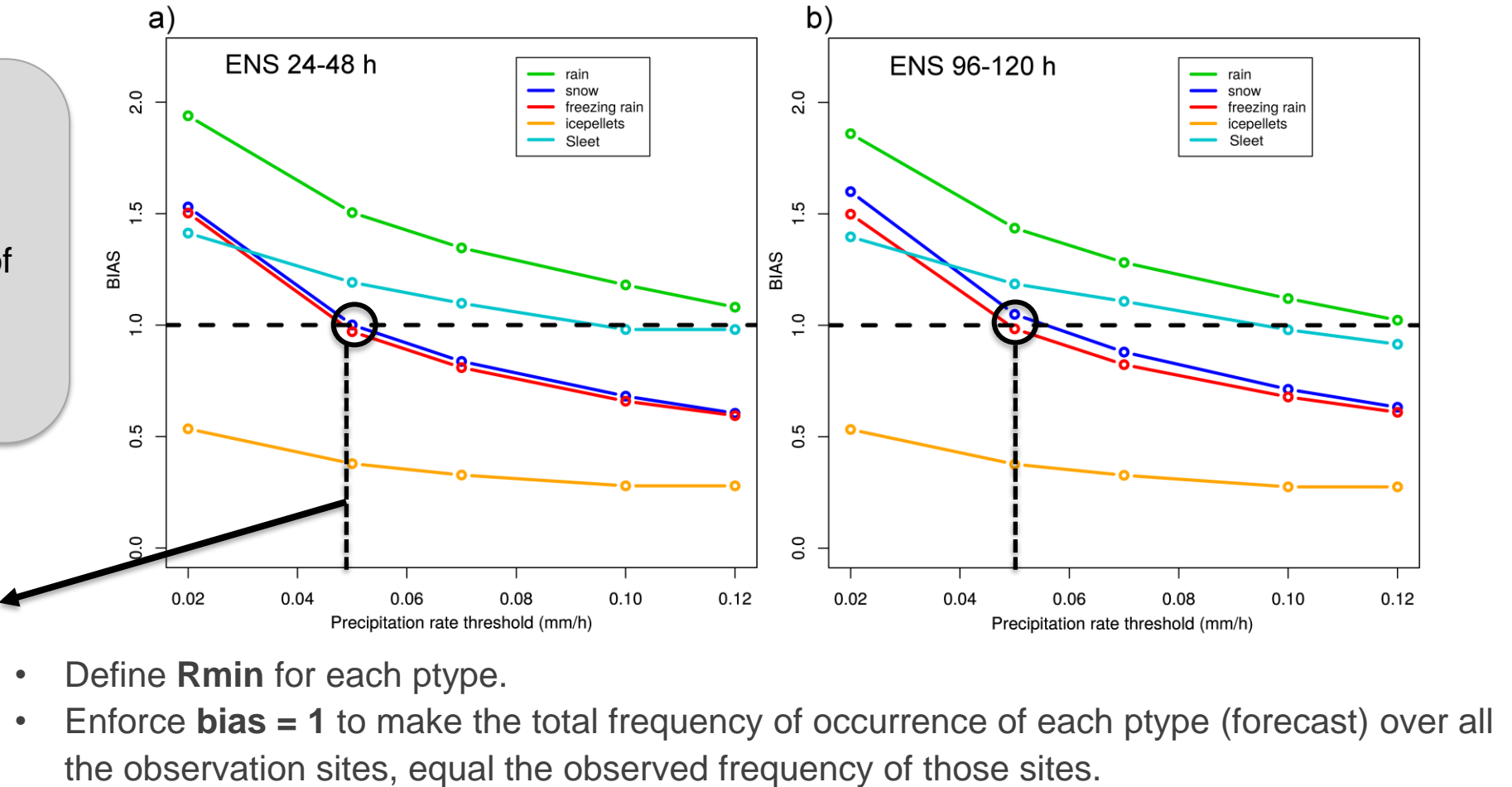


# Reducing systematic bias with precipitation rate (frequency bias)

## Categorical forecast:

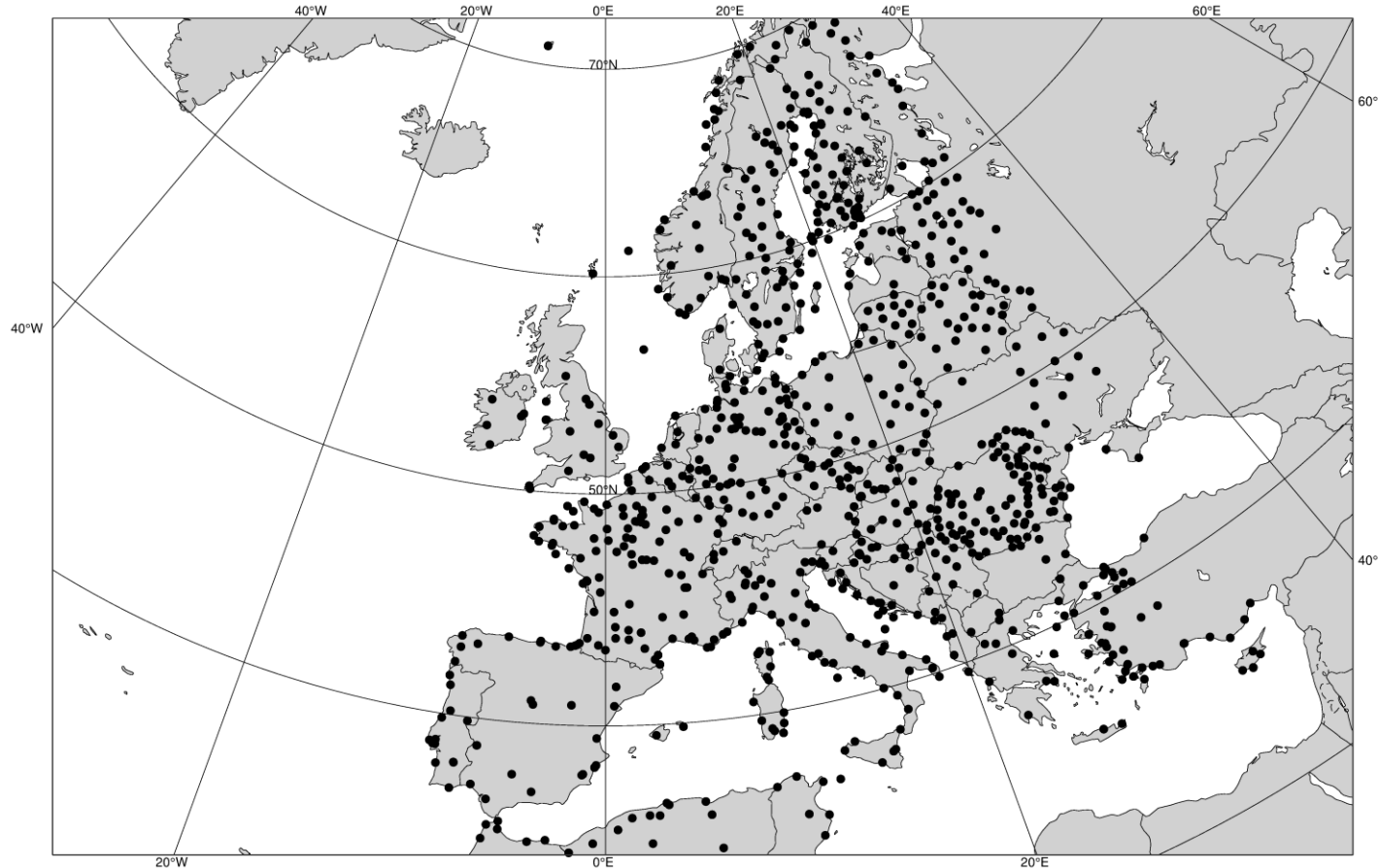
**Bias** = (total number of events forecast)/(total number of events observed)

Precipitation rate threshold =  
**0.05 mm**



# Verification

## Manual SYNOP stations available



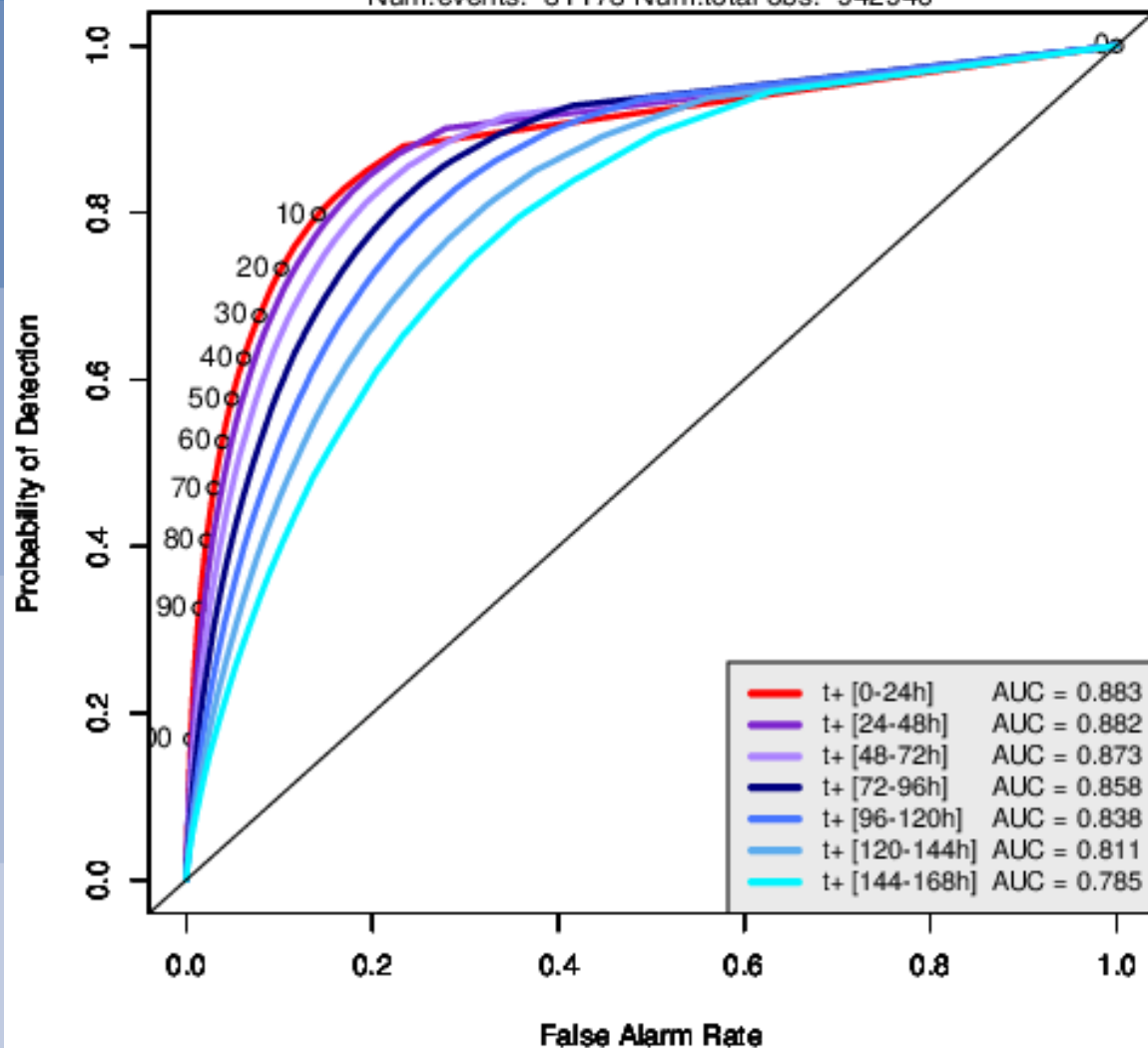
- The verification is developed using **3-hourly** observations of present weather from *manual* **SYNOP** in **Europe** in 5 months **winter periods** every year.
- SYNOP stations with a 150 m altitude difference with the closest ENS point are removed from the verification.

# Verification: ROC curves (winter 2020-2021)



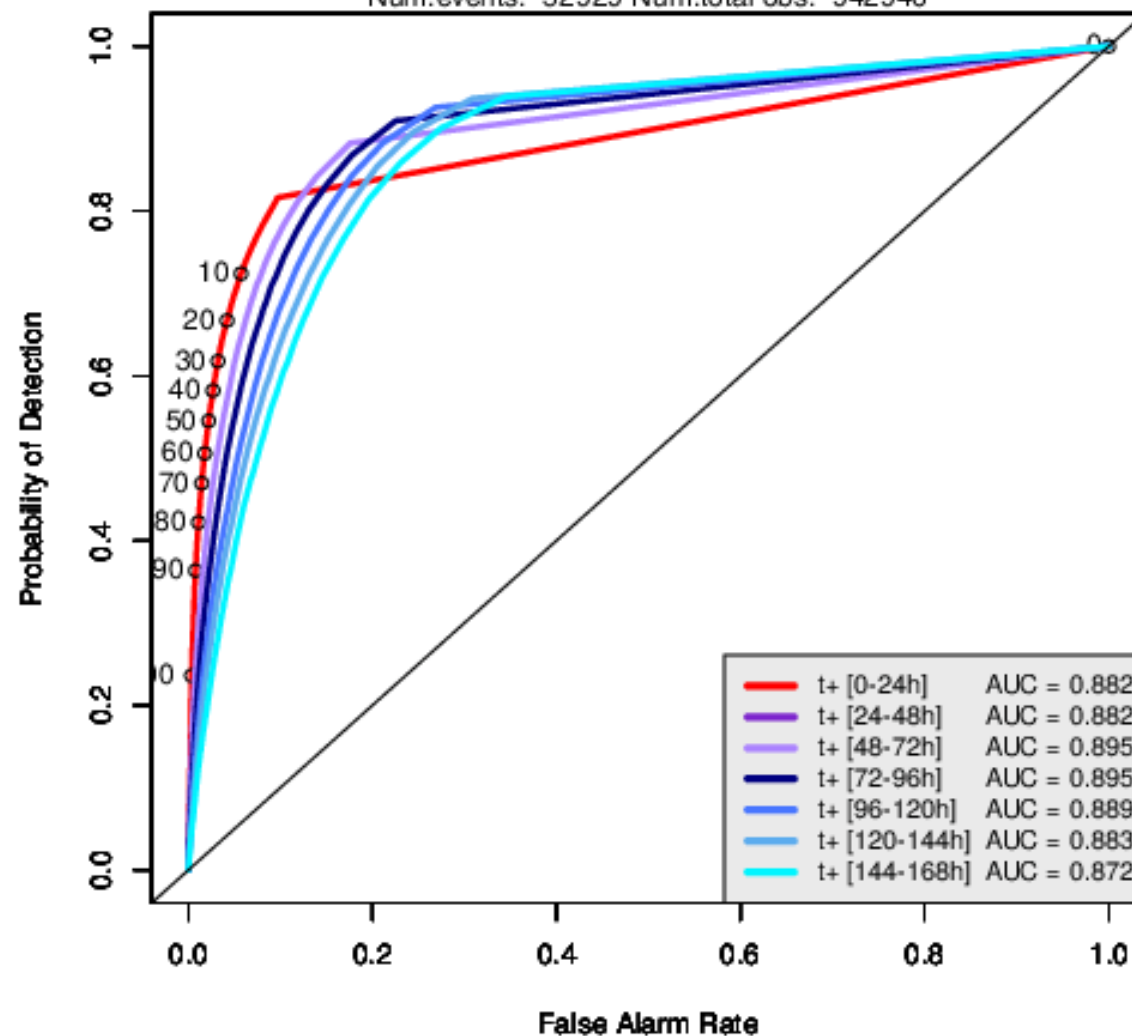
ROC diagram for rain probability

Num.events: 81178 Num.total obs: 942946



ROC diagram for snow probability

Num.events: 52929 Num.total obs: 942946

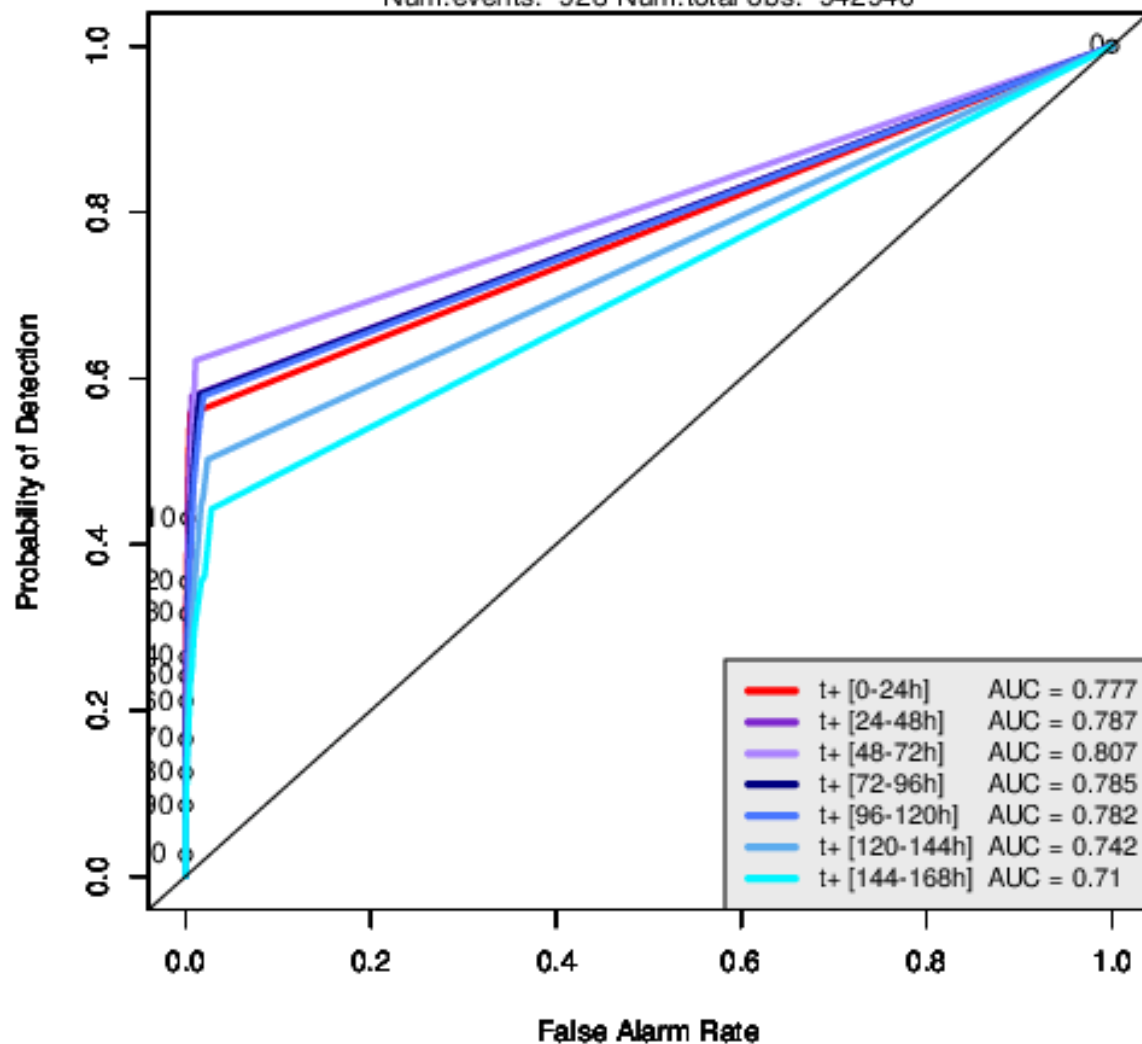


# Verification: ROC curves of probabilities



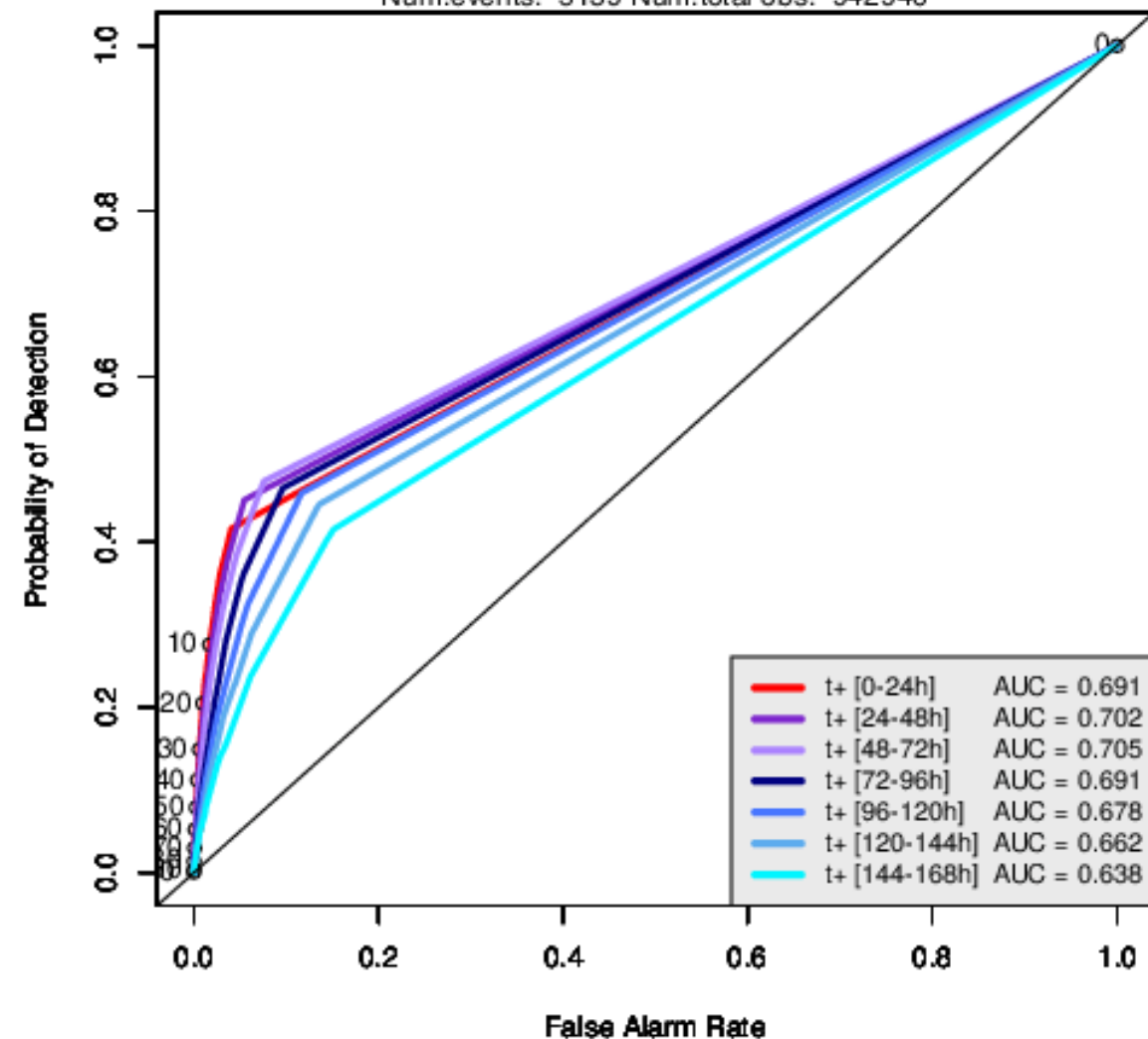
ROC diagram for freezing rain probability

Num.events: 928 Num.total obs: 942946

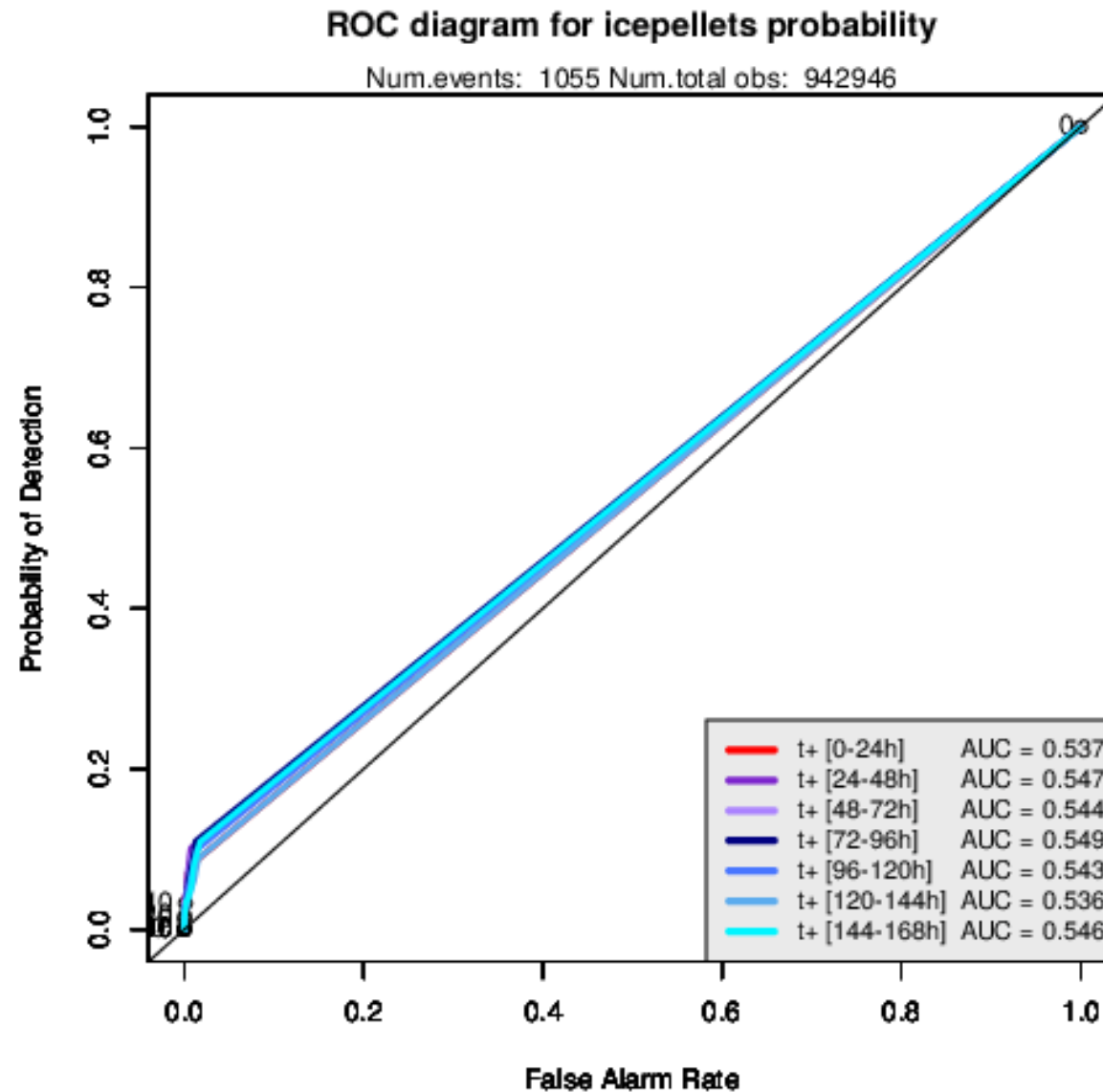


ROC diagram for sleet probability

Num.events: 5139 Num.total obs: 942946



# Verification: ROC curves for icepellets



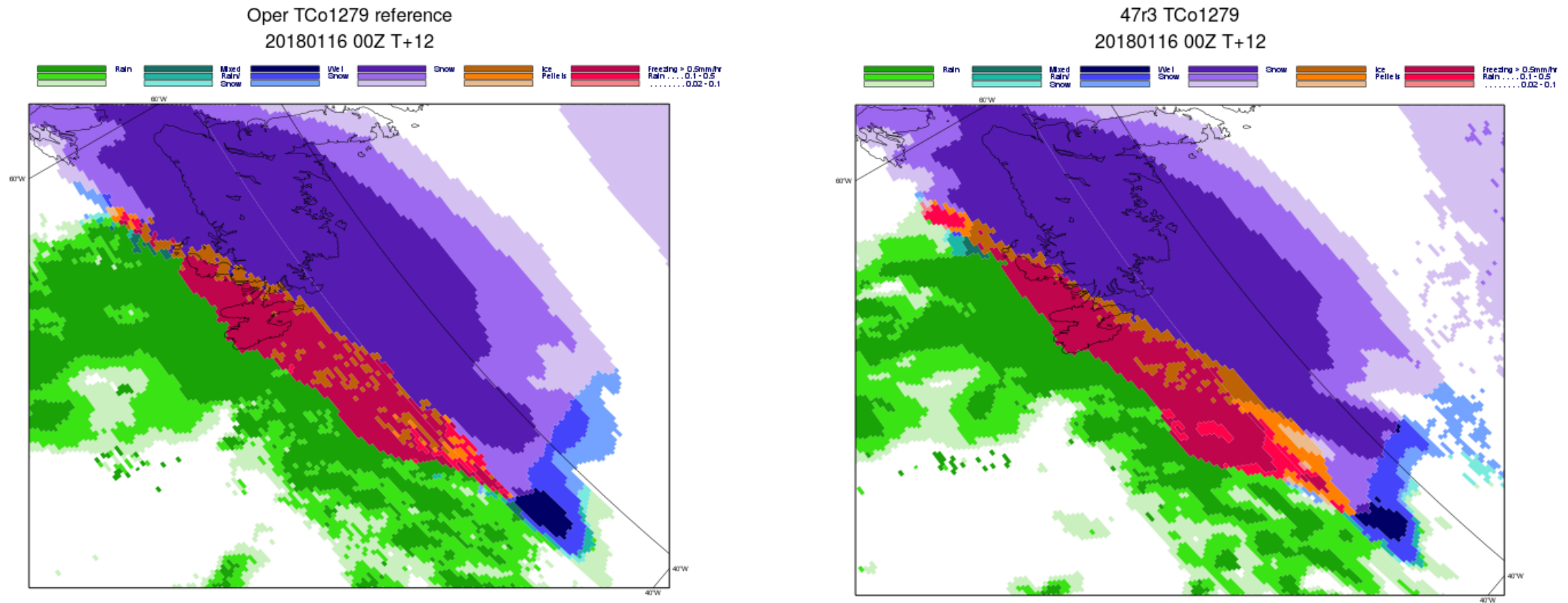
# Improvements

- 47r3 (12th October 2021)
  - Precipitation type diagnosis changed for ice pellets and freezing rain
  - Reduction of the general precipitation bias
- 48r1 (Q2 2023) possibly
  - Including freezing drizzle in the precipitation type diagnostics



# More consistent diagnosis of ice pellets/freezing rain in 47r3

Example: Freezing rain case over Newfoundland 2018-01-16  
Less noisy ice pellet diagnosis in regions of freezing rain



rain / mix rain-snow / wet snow / snow / ice pellets / freezing rain

# Case Study: Snowstorm - December 2021



## Ikea customers and staff sleep in store after snowstorm

2 December 2021



The group slept in the showroom on beds, sofa beds and mattresses

**Customers and staff at an Ikea store in Denmark had the ultimate sleepover after getting stranded by a snowstorm.**

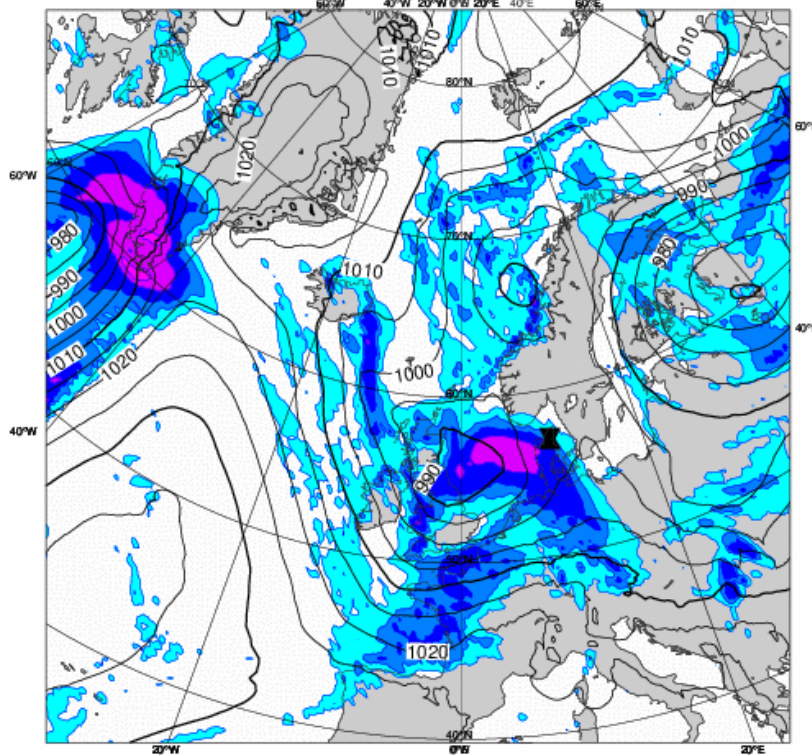
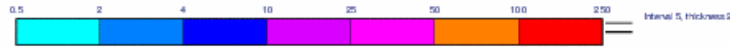
Up to 30cm (12in) of snow fell in the city of Aalborg, leaving at least 25 staff and customers unable to go home.

So the group bedded down in the showroom, dined on the store's food and watched television.

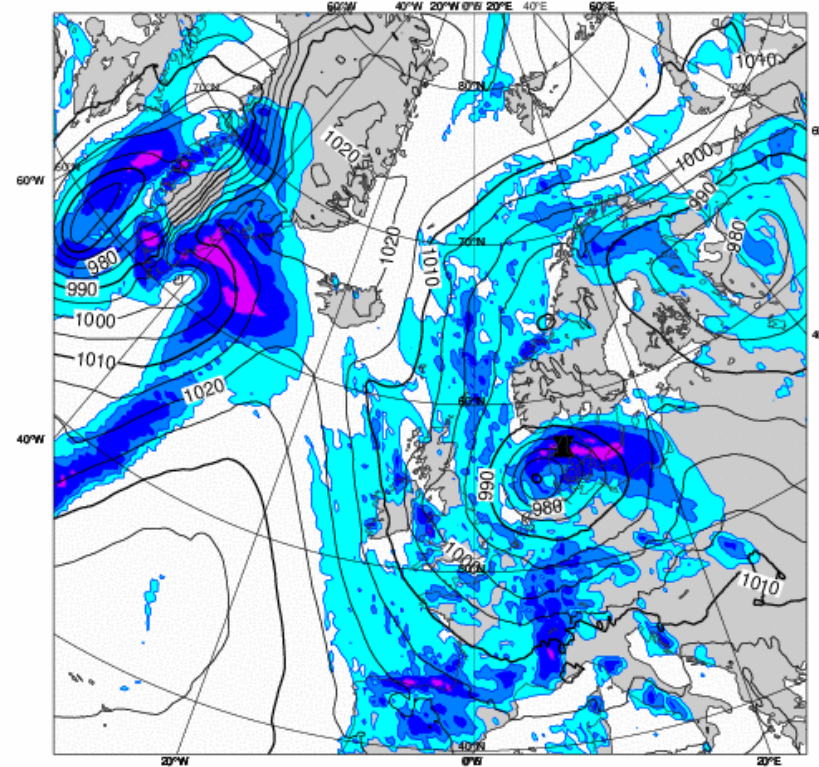
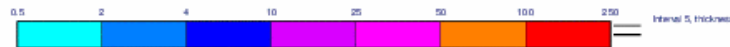


# Case Study: Snowstorm - December 2021

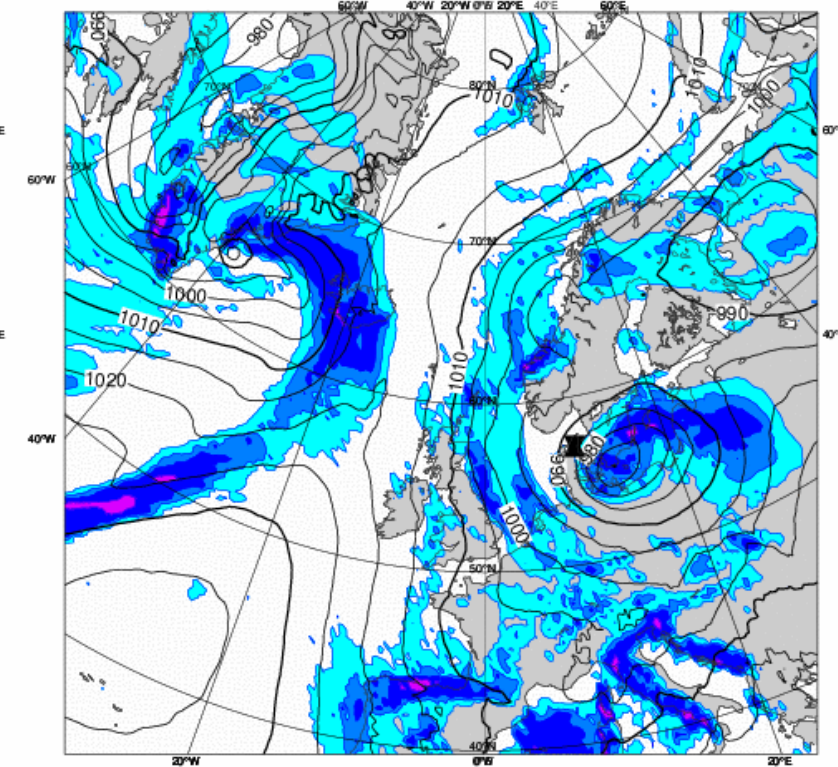
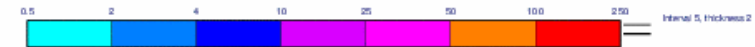
tp 0, msl 0, 2021120100 0



tp 0, msl 0, 2021120112 0

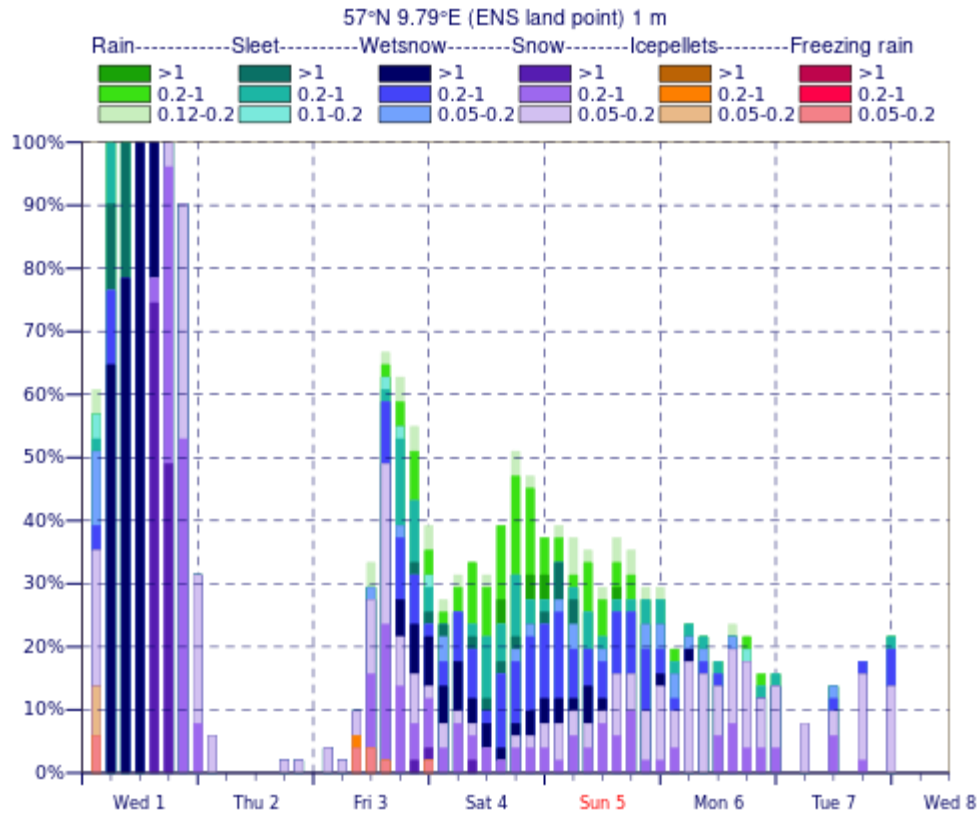


tp 0, msl 0, 2021120200 0

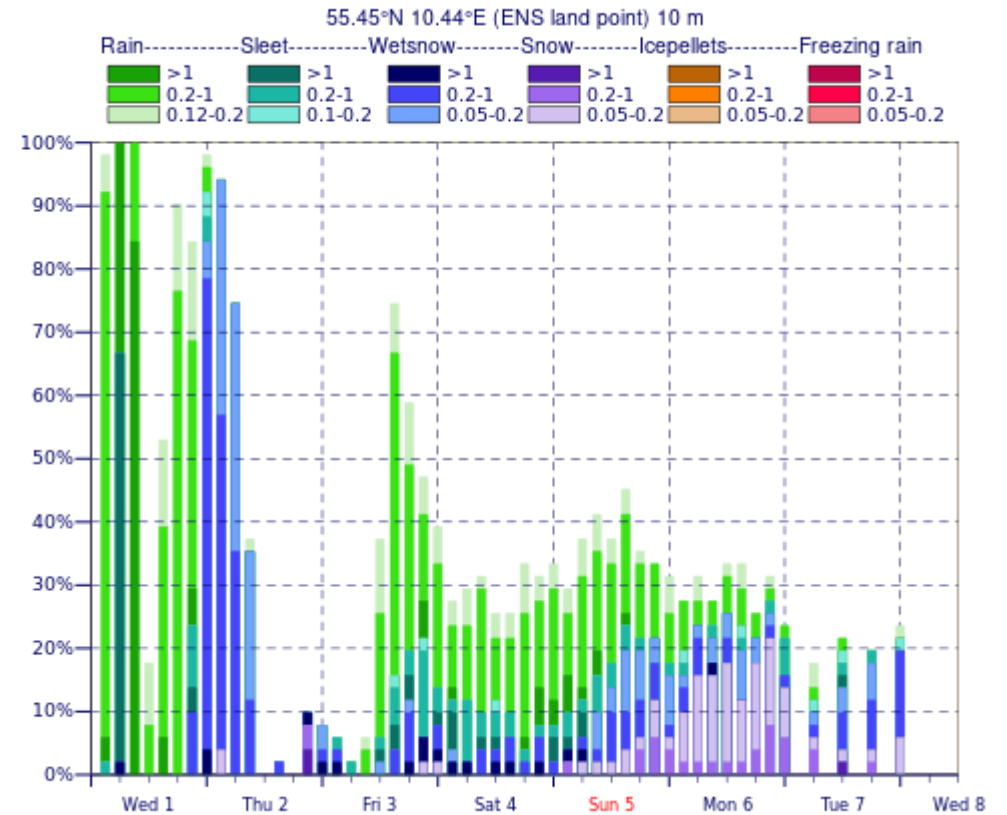


# Case Study: Snowstorm - December 2021

1 December 00UTC



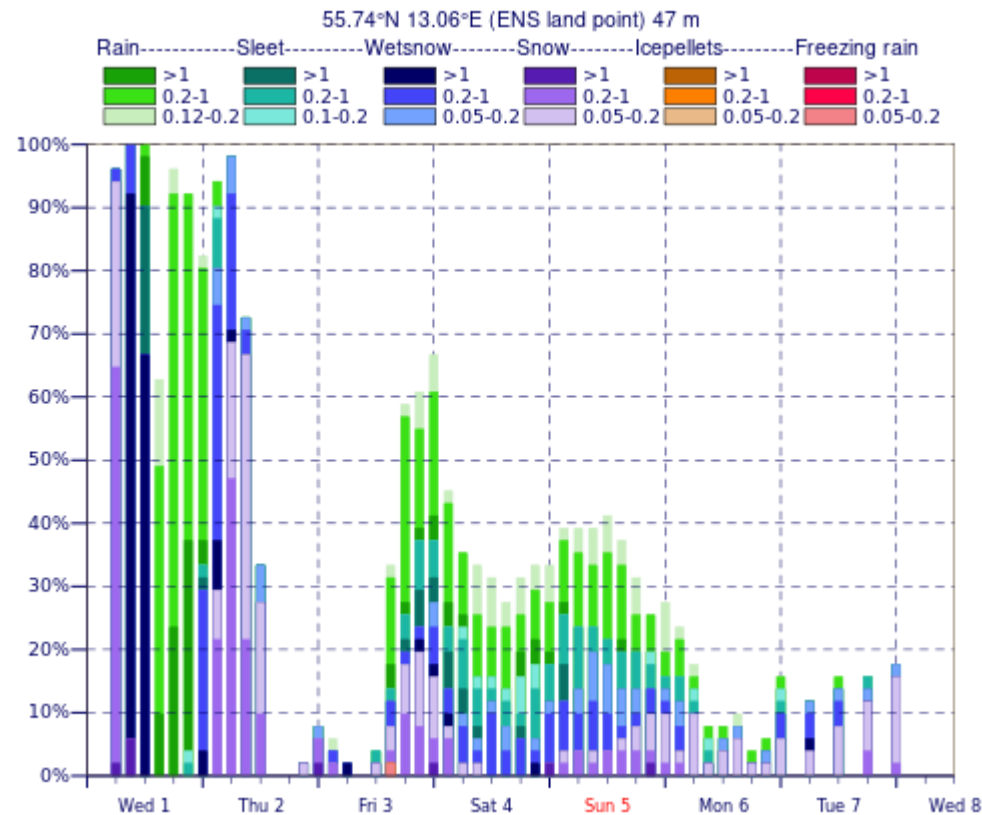
Aalborg - Denmark



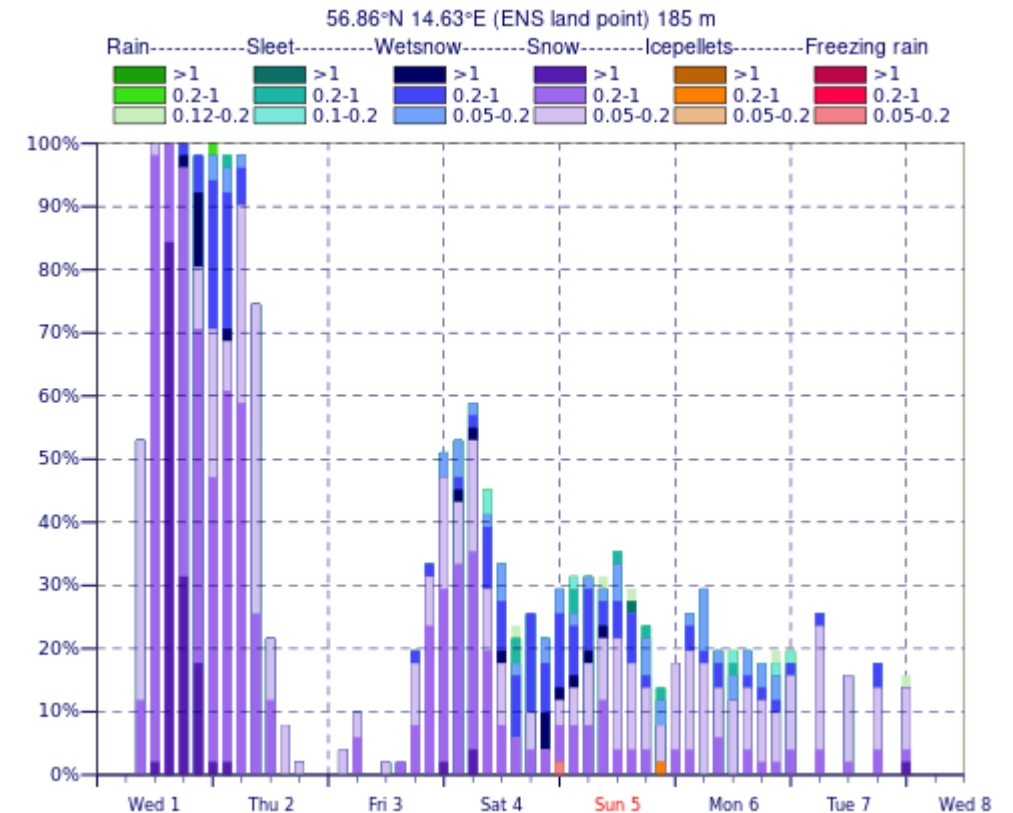
Odense - Denmark

# Case Study: Snowstorm - December 2021

1 December 00UTC



Lund - Sweden

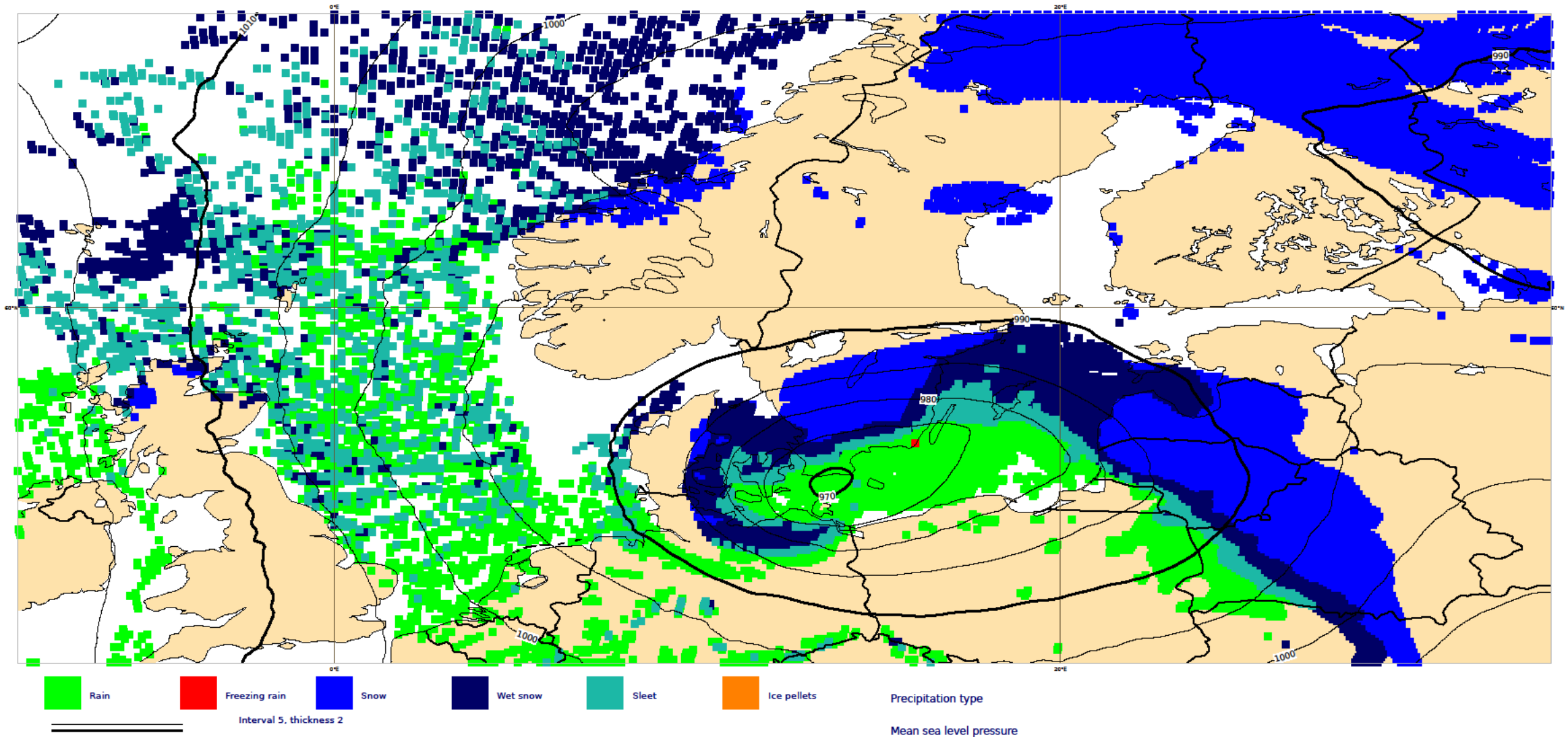


Vaxjo - Sweden

# Case Study: Snowstorm - December 2021

1 December 00UTC

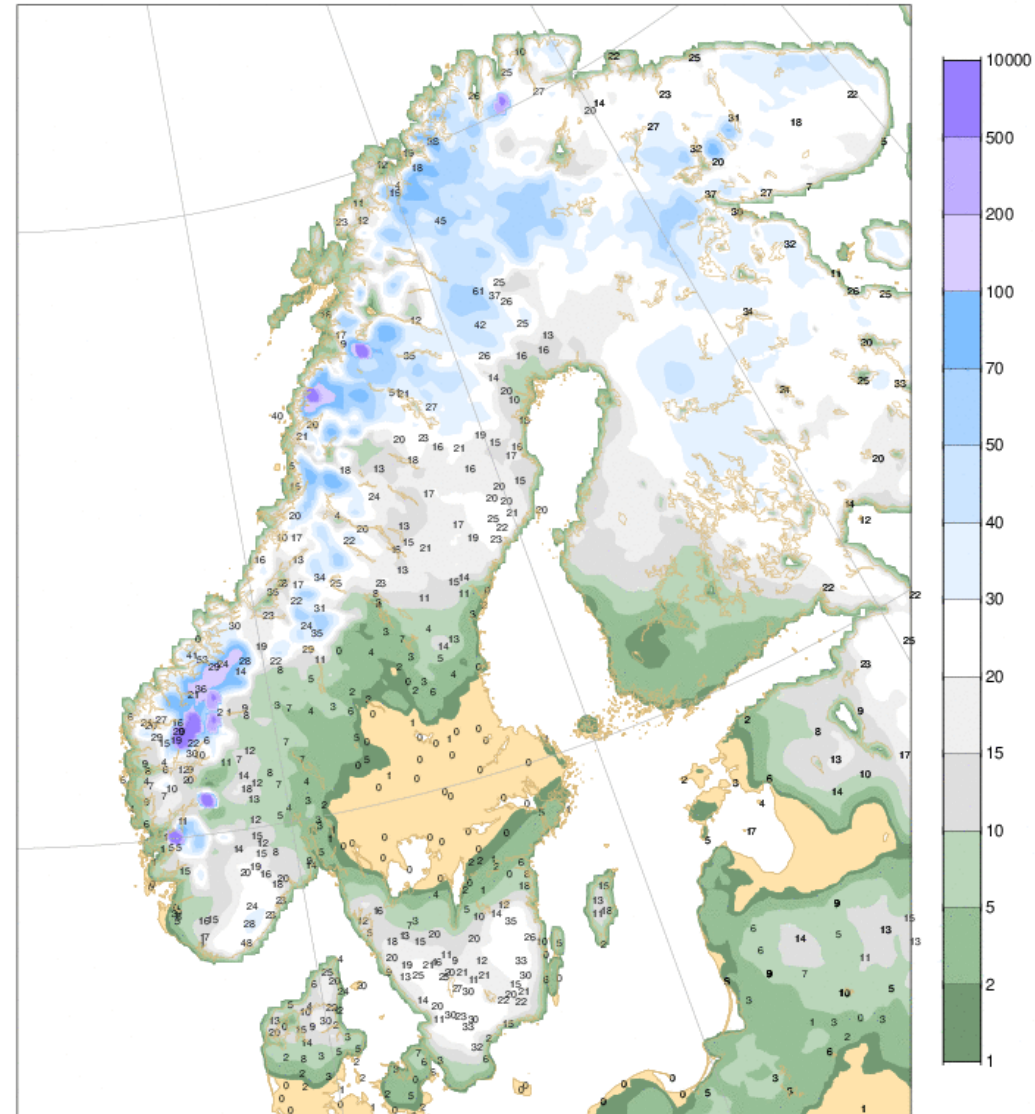
Untitled - Wednesday 1 Dec 2021, 00 UTC VT Thursday 2 Dec 2021, 00 UTC Step 24  
© ECMWF 2021





# Case Study: Snowstorm - December 2021

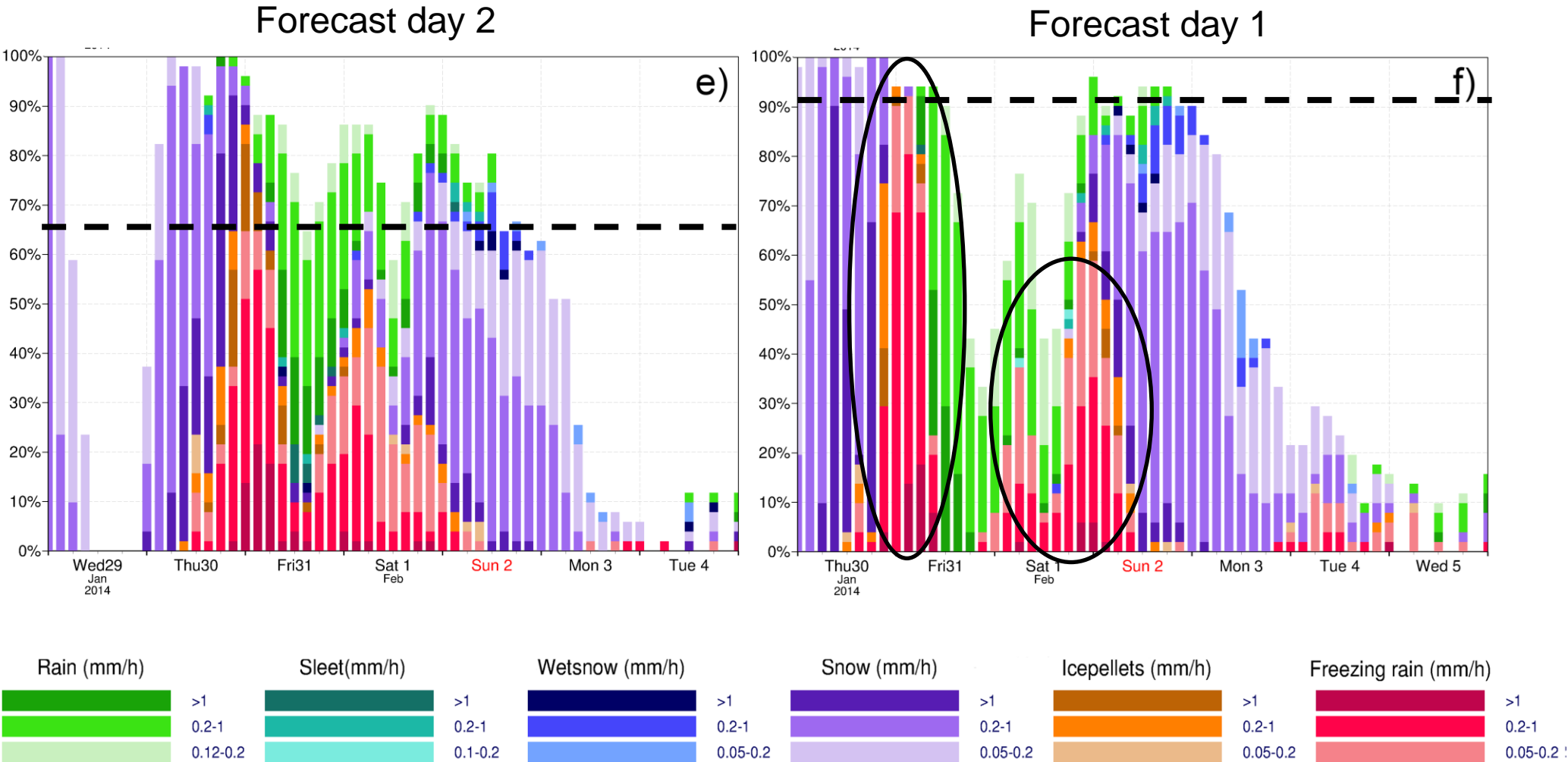
Thursday 02 December 2021 0600 UTC ECMWF 1-0 VT: Thursday 02 December 2021 0600 UTC  
SNOW Depth (cm of snow using varying snow density) ANALYSIS vs. SYNOP observations



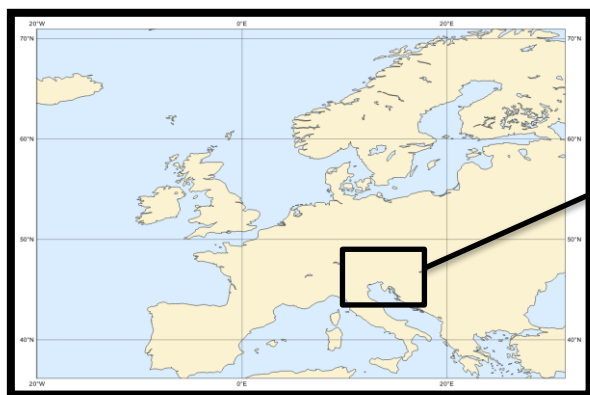
# Case Study: Freezing rain in Slovenia 2014 (Jan-Feb)



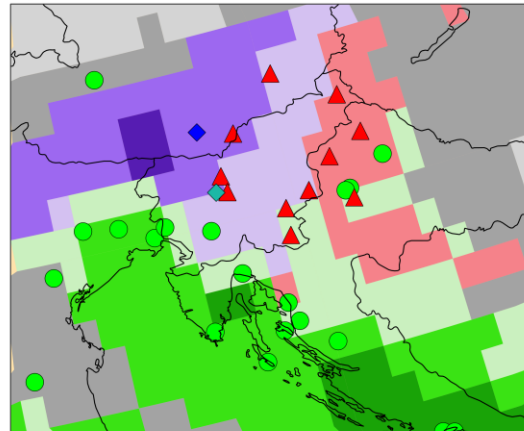
# Case Study: Probabilities, meteogram for Postojna



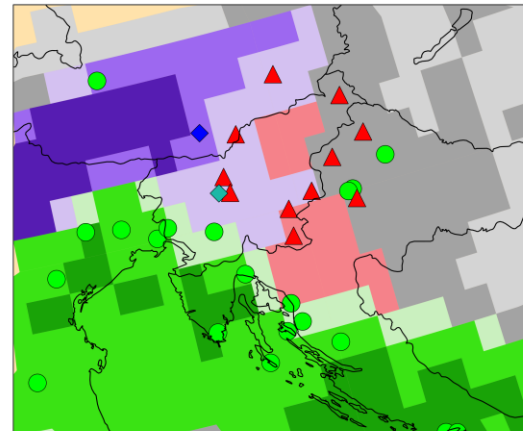
# Case Study: Most probable precipitation type



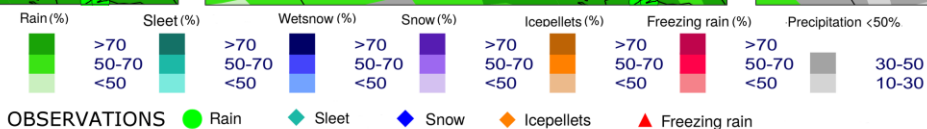
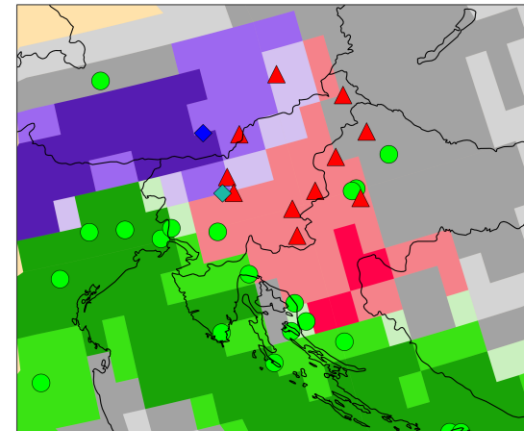
a) t+ 150 h



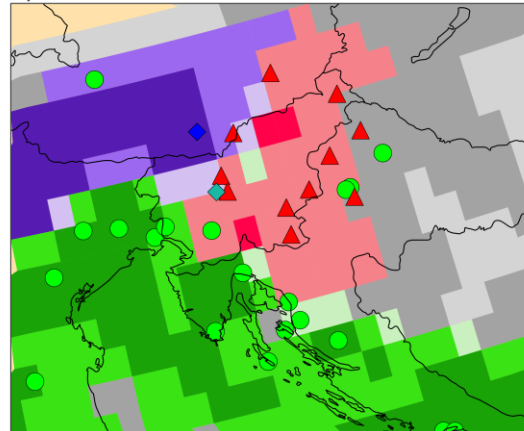
b) t+ 126 h



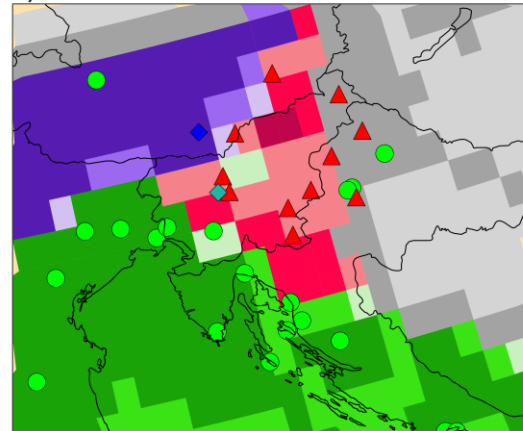
c) t+ 102 h



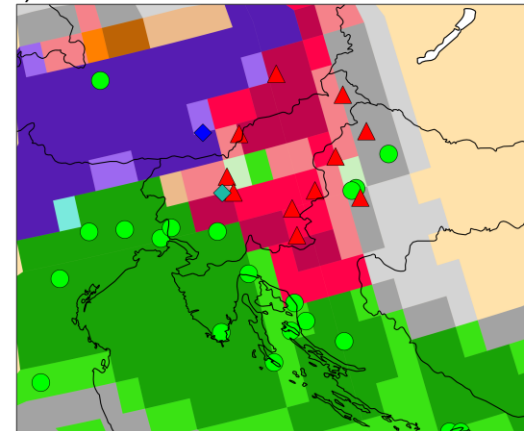
d) t+ 78 h



e) t+ 54 h



f) t+ 30 h



Freezing rain (%)



>70  
50-70  
<50

# Tips for how to use Precipitation Type

- Take into account the **height of the ENS in your meteogram location** (in the title of precipitation type meteogram), because the observation height can be very different, specially in mountainous areas
- In the **meteogram, the bars are stacked** in such a way that the nominally **most hazardous** type (freezing rain in the high intensity category) is shown at **the bottom**, and the least hazardous (low intensity rain) at the top
- Whenever the **lightest shade**, of a given colour (except grey) appears on **the map**, the user immediately knows that more than one precipitation type has been predicted at that time, which can serve as **an initial alarm bell for “uncertainty”**



# Summary – Precipitation Type

- The **most probable precipitation type** provides a first guess of the precipitation type while the probability of precipitation type analyses all the probabilities in a specific location and help to make better decisions about a particular event
- Different **precipitation rates thresholds** have been applied to each precipitation type enforce **bias=1**
- Both products are **very skilful** in forecasting **rain and snow** but it is only **moderately skilful for freezing rain and sleet** and **unskilful for ice pellets (but with 47r3 that may have improved!)**
- The advantage of use **ENS forecast** is that it consistently produces a better spread of its (FAR, POD) pairs. This provides information for a wider range of FAR scores and thus may be useful for users with different levels of false alarm tolerance
- Further Reading:
  - Gascón, E., T. Hewson, and T. Haiden, 2018: Improving Predictions of Precipitation Type at the Surface: Description and Verification of Two New Products from the ECMWF Ensemble. Wea. Forecasting, 33, 89–108
  - ECMWF 2017-2018 winter Newsletter article: “New products for precipitation type probabilities”





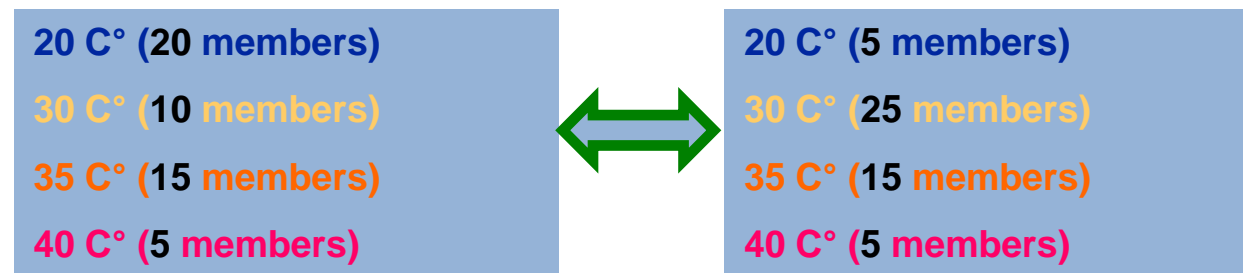
# Extreme Forecast Index (EFI) and Shift Of Tails (SOT)

Ivan Tsonevsky

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# Extreme Forecast Index (EFI)

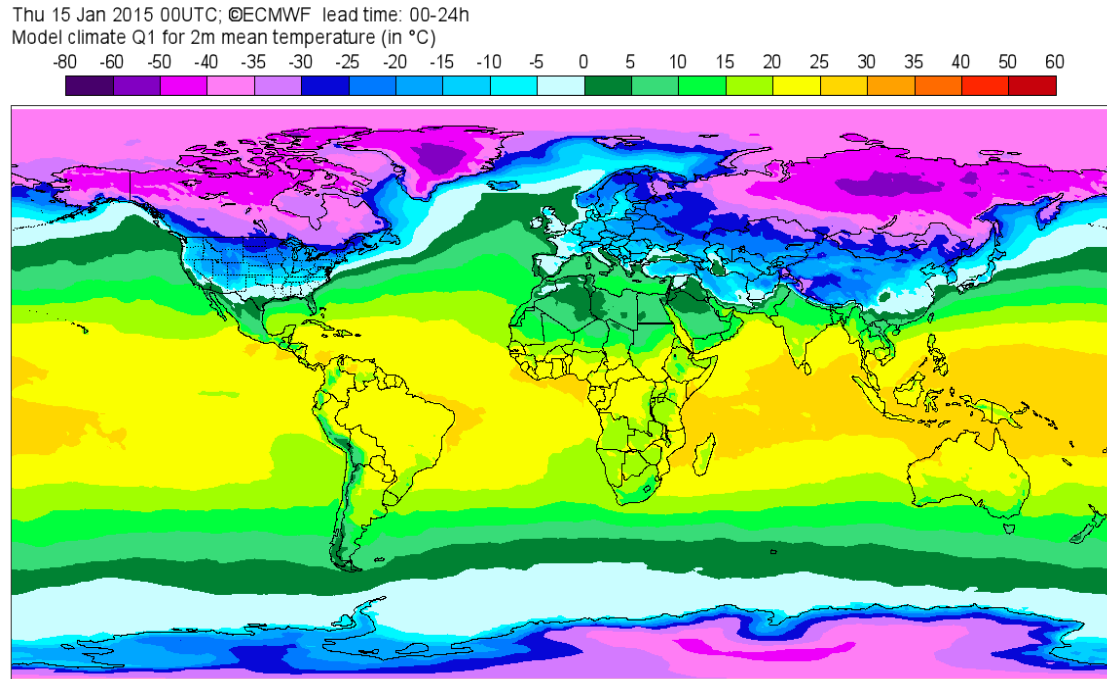
- **Extreme Forecast Index (EFI)** is designed to measure how extreme a given ensemble forecast is.
- EFI is a measure of the difference between the ensemble forecast distribution and a reference distribution - **model climate (M-climate)**.
- EFI delivers model-climate-related information, therefore it can be used as an “alarm bell” for extreme weather situations over any area without defining different space- and time-dependent thresholds.
- Simple probabilities (e.g.  $> 32^{\circ}\text{C}$ ) will not highlight the differences in the distributions below. EFI will, by accounting for the distribution of all the ensemble members



# The Model climate (M-climate)

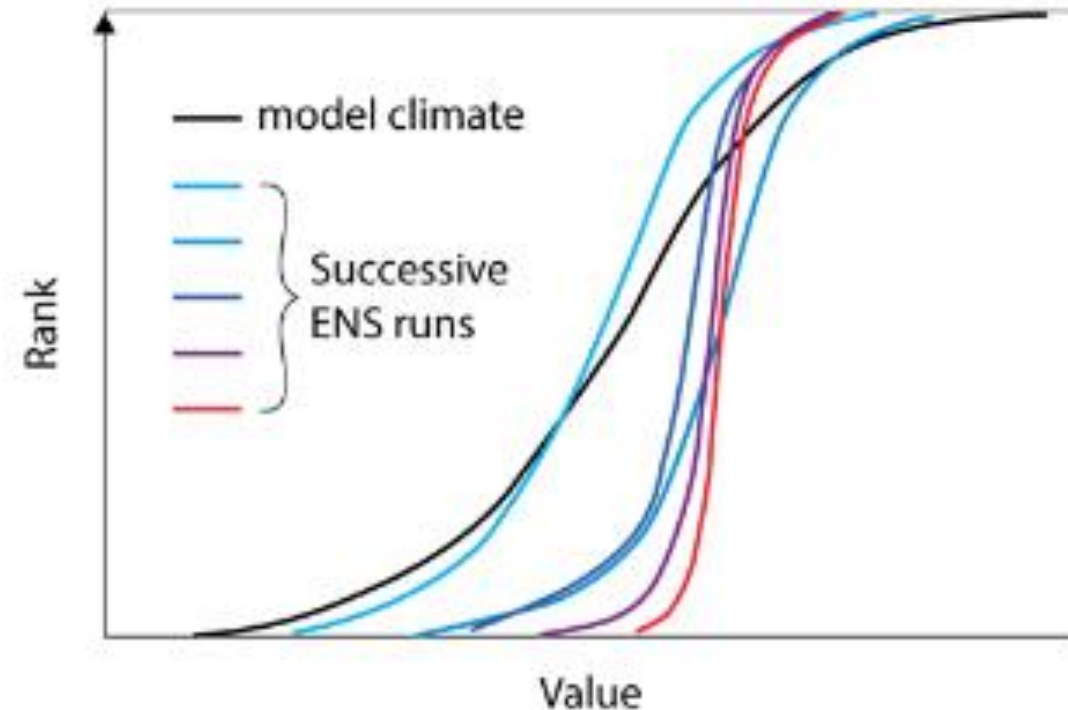
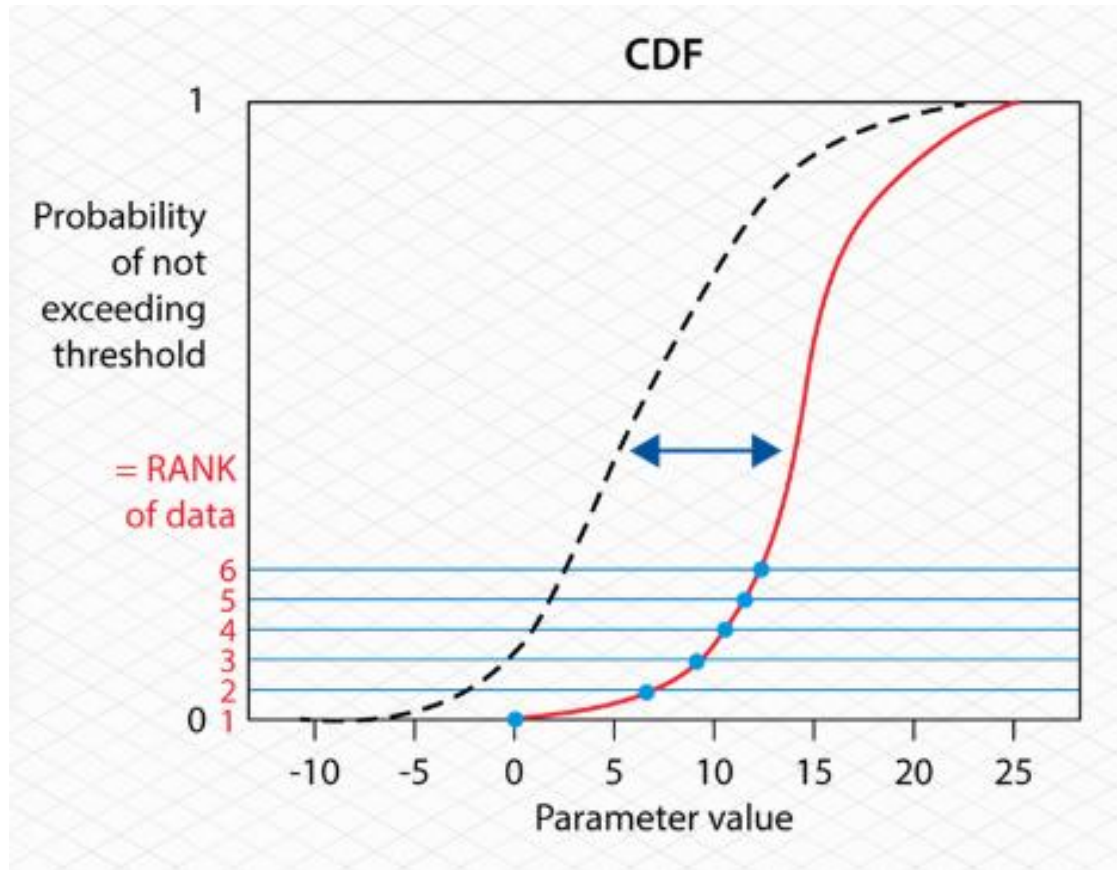
- For climate related products like the EFI a reliable model climate is essential.
- *Ideally* the model climate (M-Climate) is a large set of ensemble re-forecasts with the latest model configuration (used operationally) for a long enough period (e.g. 30 years).
- The current M-climate:
  - Running an ensemble re-forecast suite with 10 perturbed ensemble members and the Control
  - Always for the most recent 20 years with initial conditions taken from the ECMWF global atmospheric reanalysis **ERA5**
  - Re-forecast runs every Monday and every Thursday. Therefore climate files from the closest preceding run are taken.
  - Model run for 46 days, post-processed fields as for ENS (data every 6 hours)
  - Uses the latest model cycle (resolution/ physics / etc.)
  - Allows an immediate adaptation of the EFI and other model climate related products to any upgrade of ENS

# The Model climate (M-climate)



- To provide a robust, less noisy M-Climate, we do not use just one set of re-forecasts, but all nine sets within 5-week period centred on the week in question; extended-range – 3 sets in a week.
- M-climate sample size is: 20 years \* 11 ensemble members \* 9 re-forecast runs = 1980 re-forecast fields; extended-range: 20 years \* 11 ensemble members \* 3 re-forecast runs = 660 fields
- Large climate size leads to:
  - Decrease of the noise in the tails of the M-climate distribution and considerable increase of the consistency of SOT forecasts;
  - Decrease of the jumpiness of the EFI forecast due to the seasonal trend.

# Cumulative Distribution Functions (CDFs)



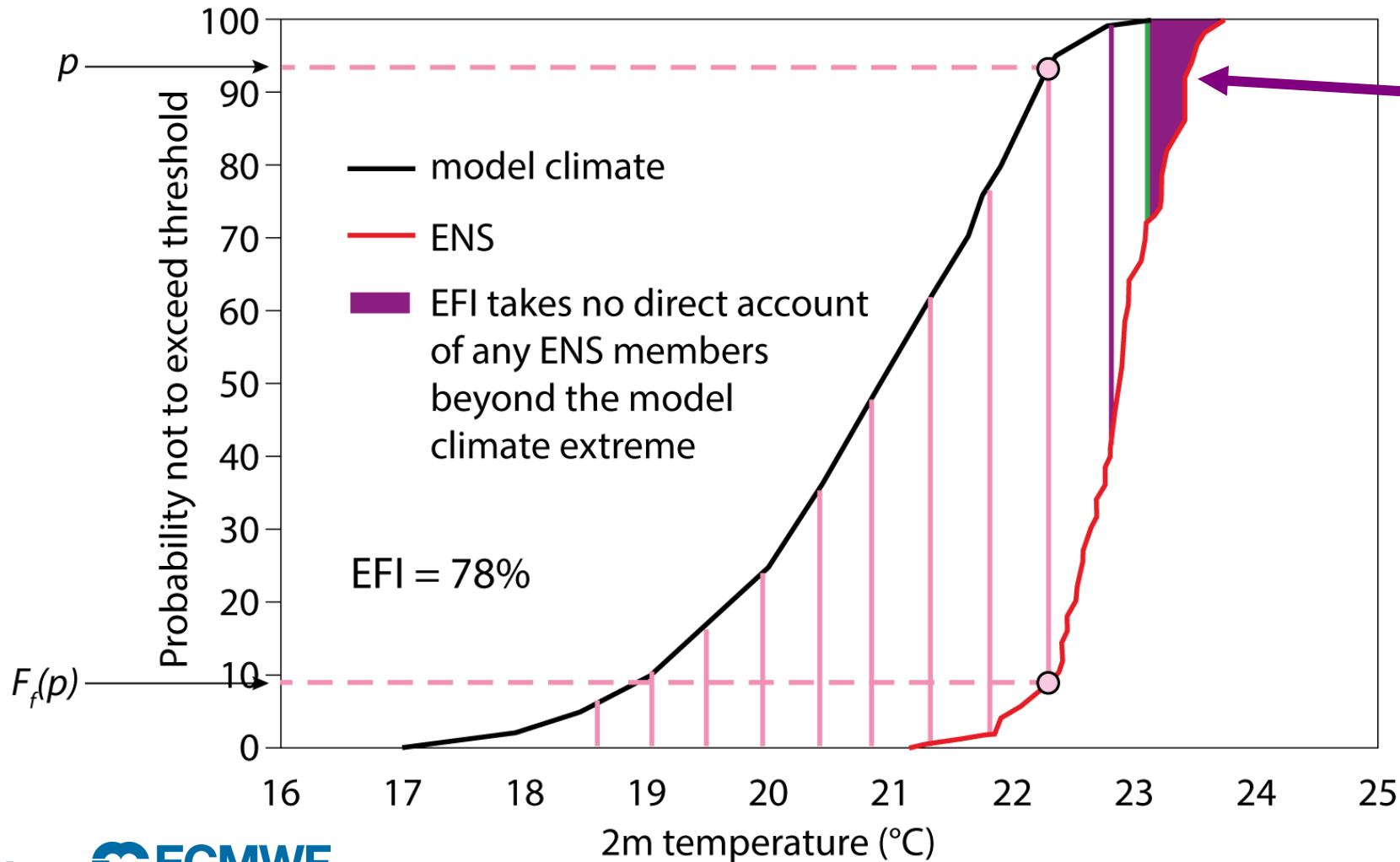
The more vertical the CDF  
the more the ensembles  
members agree



$$EFI = \frac{2}{\pi} \int_0^1 \left( \frac{p - F_f(p)}{\sqrt{p(1-p)}} \right) dp$$

Represented by pink lines below

More weight to extremes of M-climate being a quadratic function of p



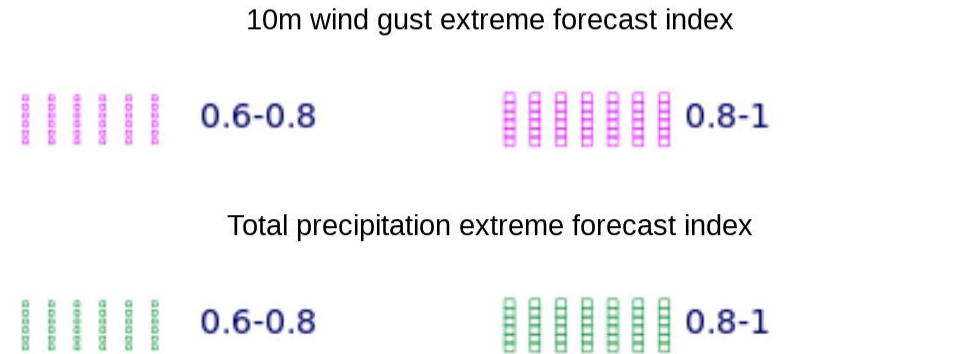
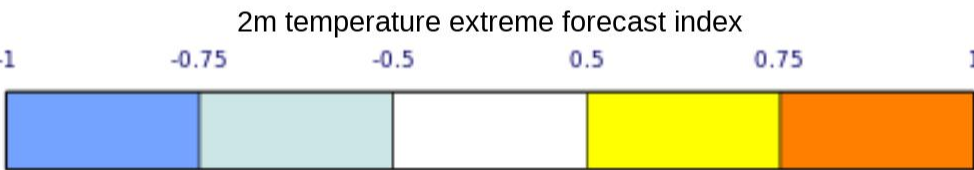
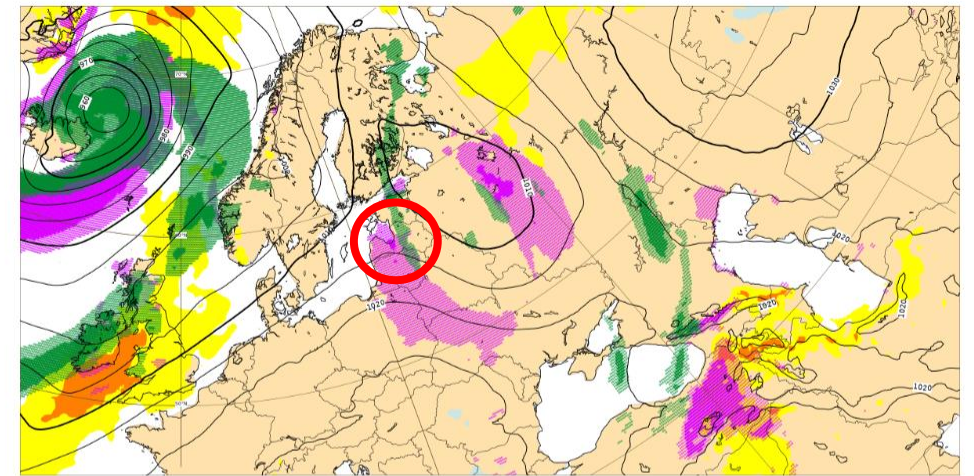
EFI takes no direct account of any ENS members beyond the M-climate extremes

$$-1 \leq EFI \leq 1$$

$$-100\% \leq EFI \leq 100\%$$

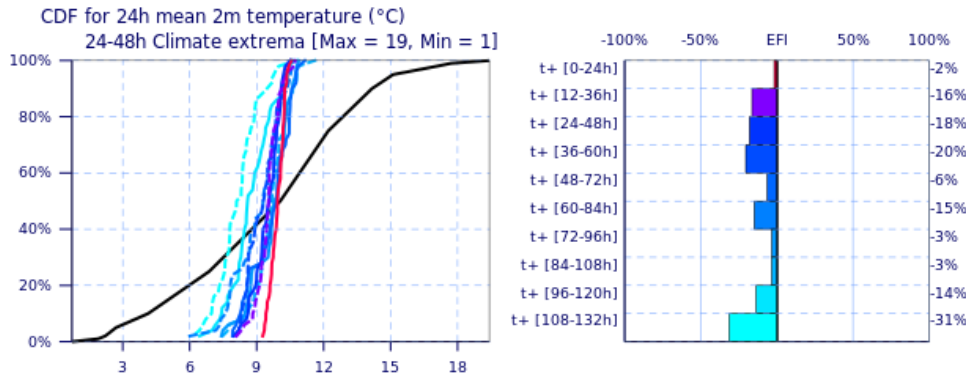
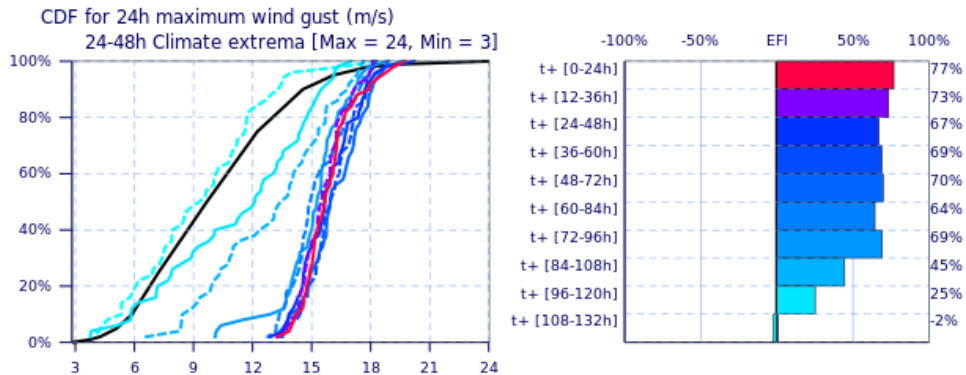
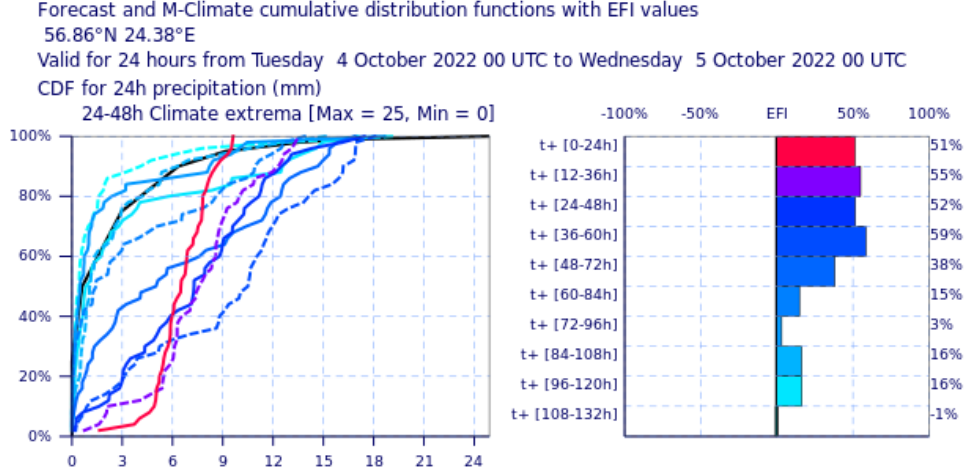
# Multi-parameter EFI during last 24 hours

Base time: Tue 04 Oct 2022 00 UTC Valid time: Wed 05 Oct 2022 00 UTC (+24h) Area : North East Europe



Ensemble mean for mean sea level pressure

Interval 5, thickness 2

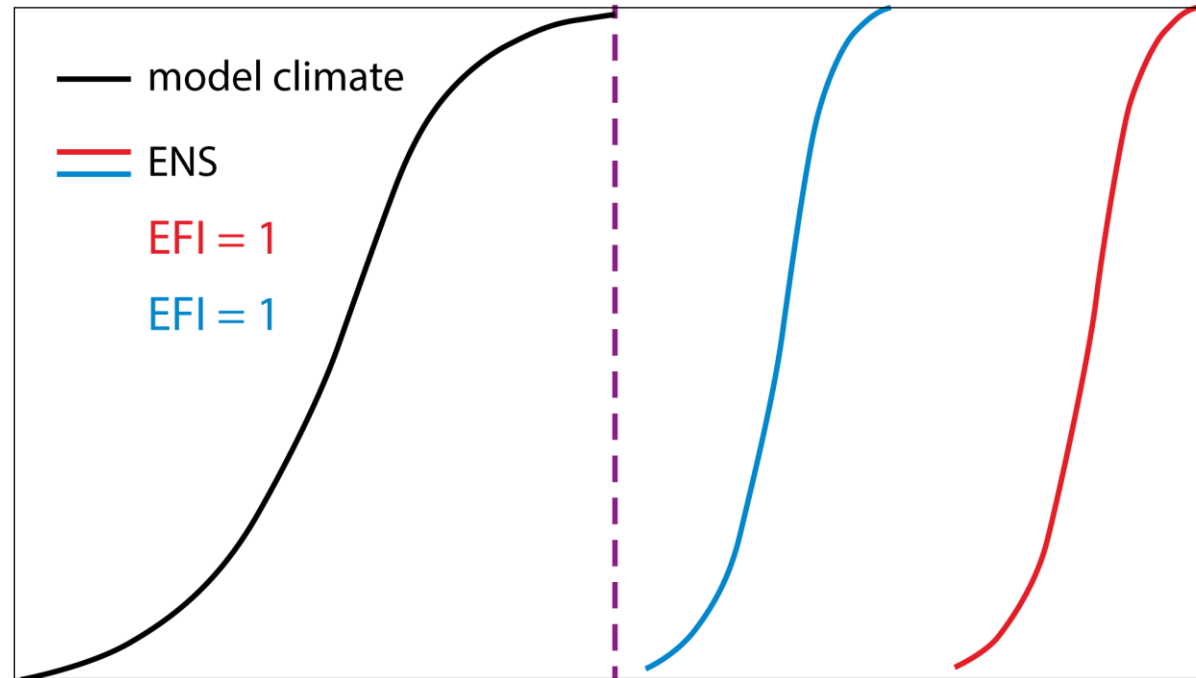


M-Climate: this stands for Model Climate. It is a function of lead time, date (+/-15days), and model version. It is derived by rerunning all member ensemble over the last 20 years twice a week (1980 realisations). M-Climate is always from the same model version as the displayed ENS data. On this page only the 24-48 lead M-Climate is displayed.

# Some limitations of EFI

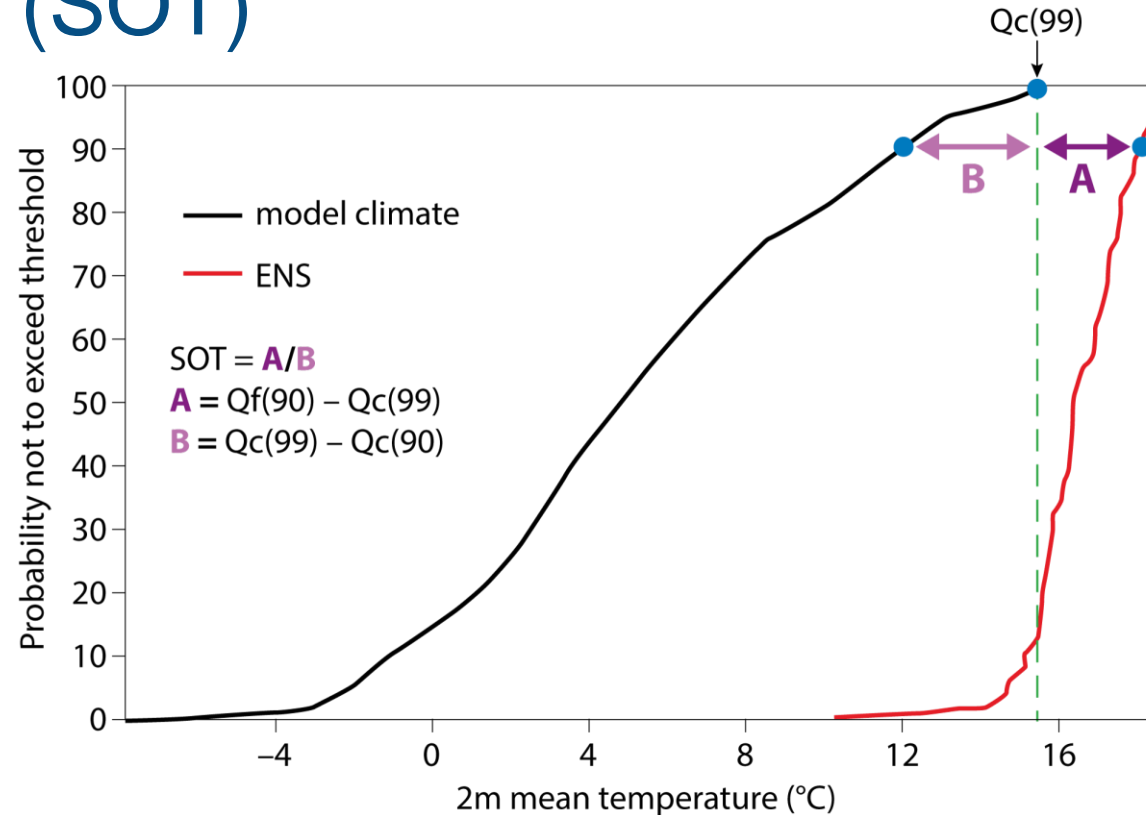
- Extreme does not *necessarily* mean high impact (e.g. 2mm rain in the desert)
- Past history also important but not directly accounted for (e.g. heavy rain when ground saturated)
- Windstorm impact can depend on whether trees are in leaf, whether ground is saturated...
- Products are only as good as the model output, e.g.:
  - Tropical cyclone representation is limited by resolution
  - Threat from intense, *very localised* convection unlikely to be fully captured

# Shift of Tails (SOT)



- As EFI does not take direct account for members which are beyond the M-climate, once EFI reaches its maximum value of 1 or minimum value of -1, it does not provide further information about the magnitude of extremity.
- Shift Of Tails (SOT) has been operational since 19 June 2012 to complement EFI by providing information about **how extreme an extreme event might be**.

# Shift of Tails (SOT)

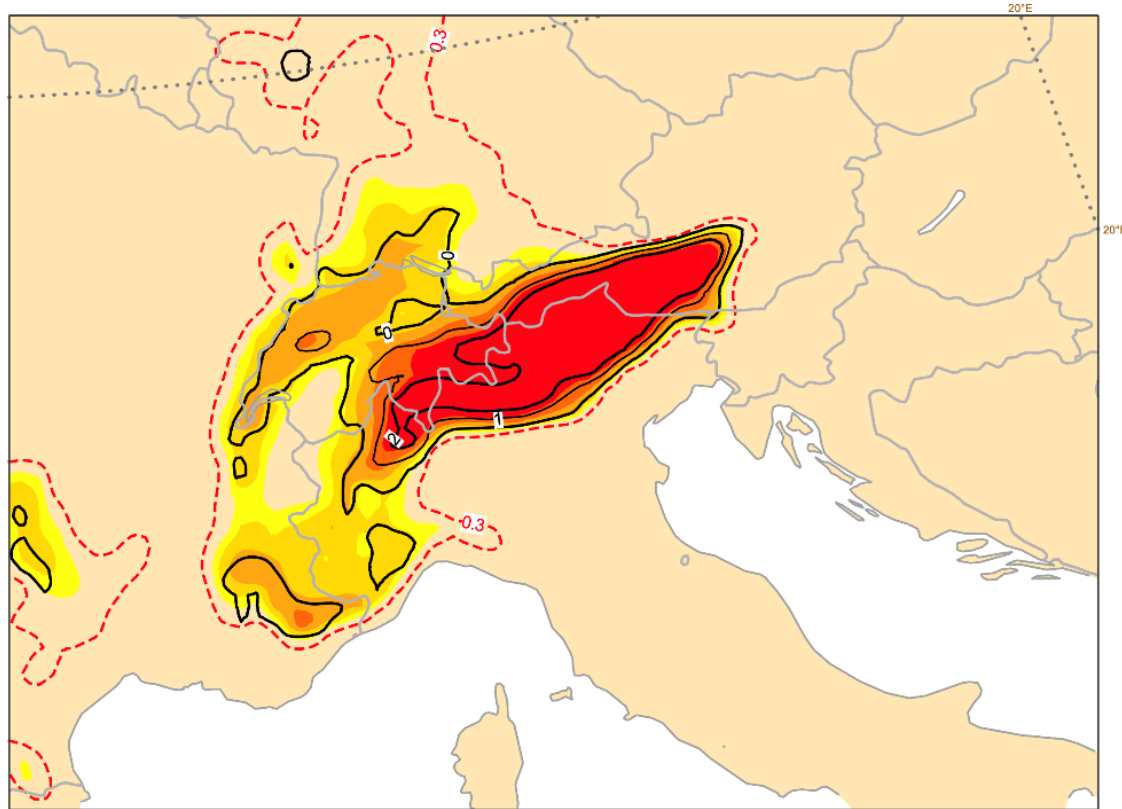


- SOT compares the tails of both distributions M-climate and ENS.
- SOT is based on 90<sup>th</sup> and 99<sup>th</sup> (upper tail) and 1<sup>st</sup> and 10<sup>th</sup> (lower tail for temperature only) percentiles
- **Positive** SOT values indicate that at least 10% of the ensemble is forecasting an extreme event; the higher the SOT the more extreme that top 10% is.

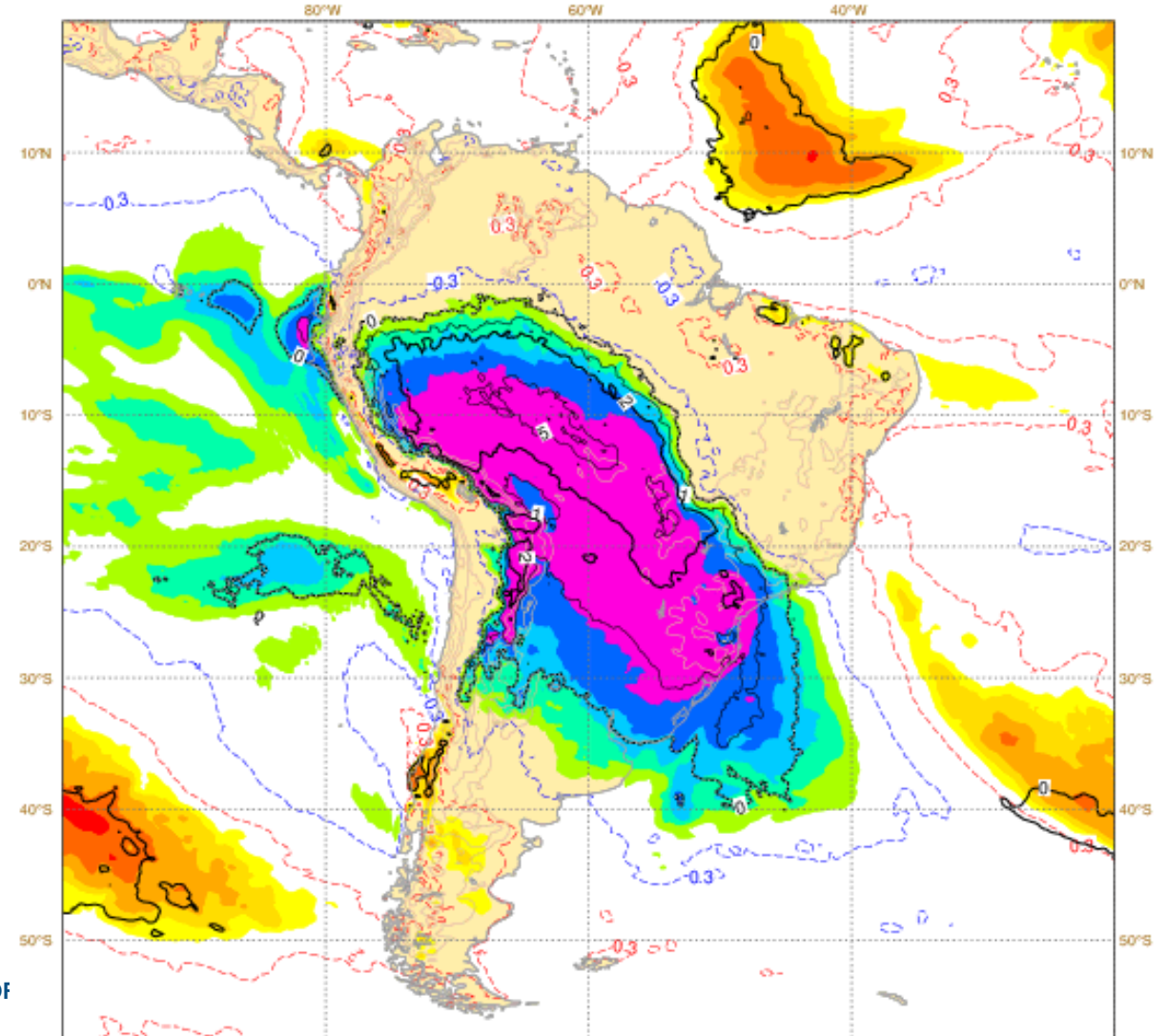
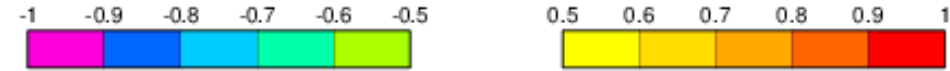


# SOT in Open Charts – denoted by black/blue contouring

Thu 03 Dec 2020 00UTC @ECMWF expver = 1 VT: Fri 04 Dec 2020 00UTC - Mon 07 Dec 2020 00UTC 24-96h  
Extreme forecast index and Shift of Tails (black contours 0,1,2,5,8) for: snowfall

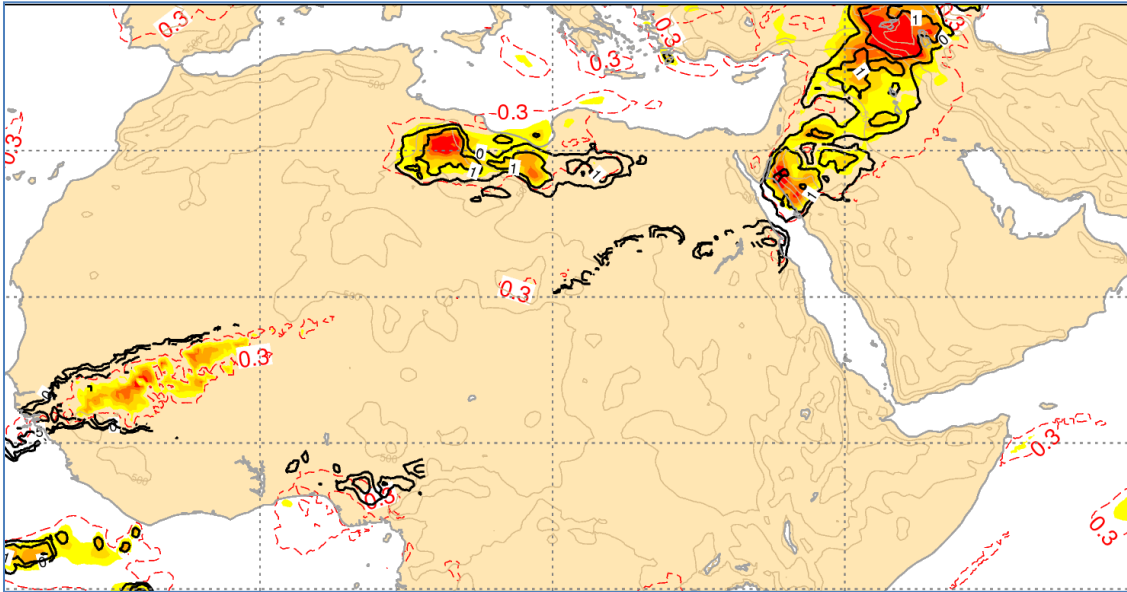


Fri 28 Oct 2022 00UTC @ECMWF t+96-120h VT: Tue 01 Nov 2022 00UTC - Wed 02 Nov 2022 00UTC  
Extreme forecast index and Shift of Tails (black contours 0,1,2,5,8) for 2m mean temperature

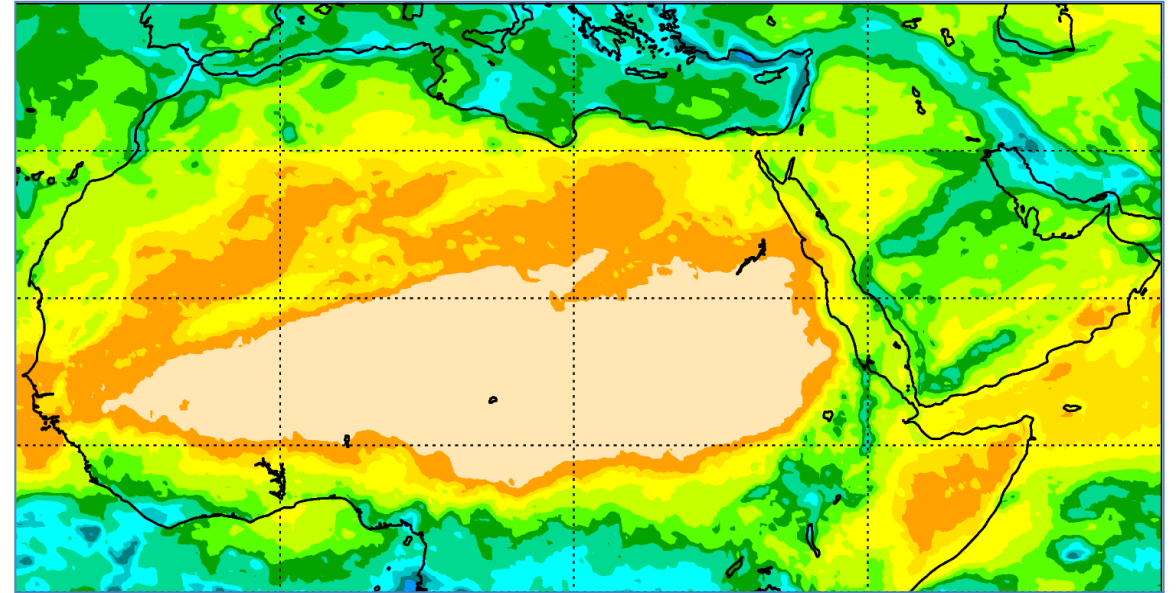


# Shift of Tails (SOT) - Limitations

**EFI & SOT for precipitation**



**M-climate Q99**



SOT is not defined when M-climate  $Q_c(90) = Q_c(99)$  (to avoid division by 0). This leads to some noise on the plots. To avoid this and to close SOT contours for snowfall, SOT is arbitrarily set to -1 where not defined only for plotting purposes.

# EFI Verification

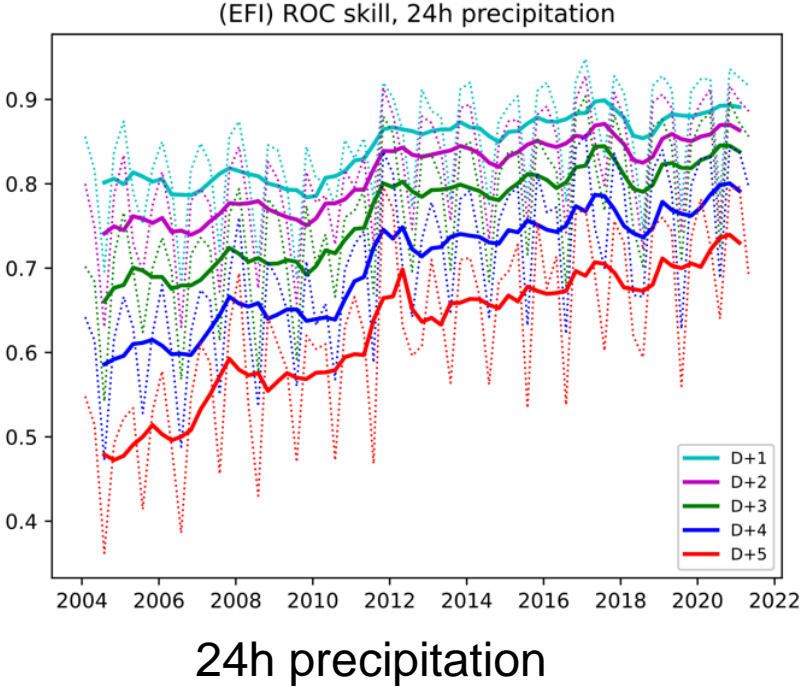
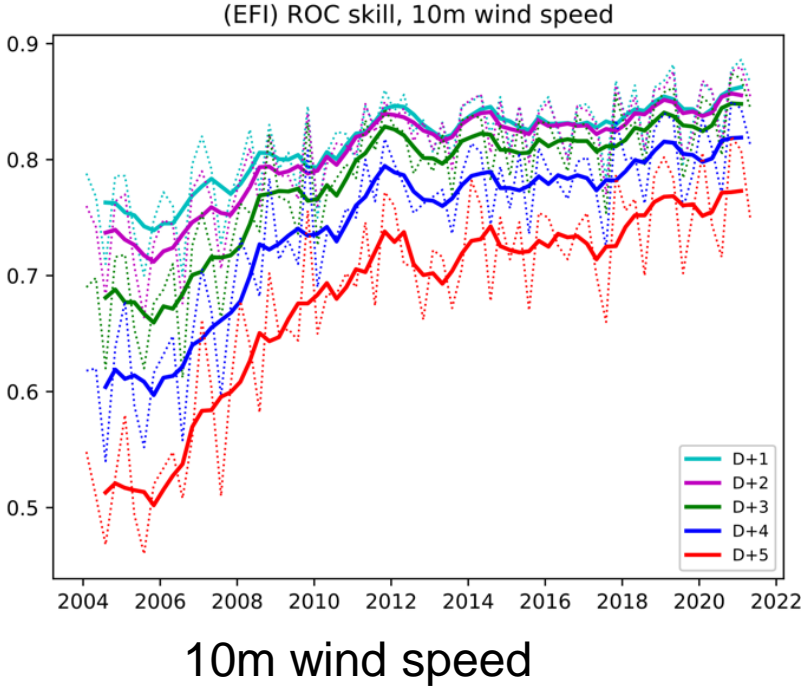
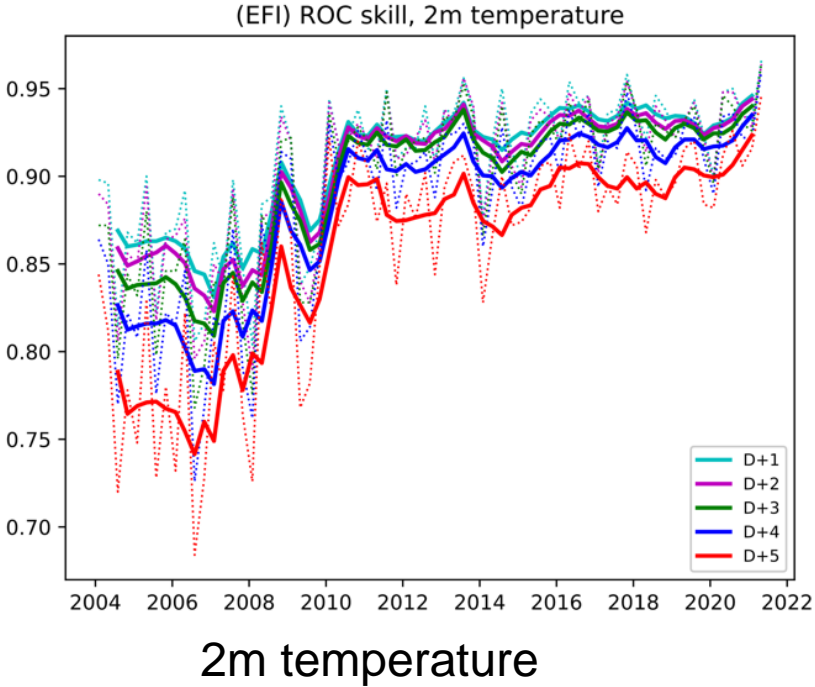
- Verification of the EFI has been done using synoptic observations over Europe available on the GTS.
- An extreme event is defined when the observation exceeds the 95th percentile of the observed climate for that station (calculated from a 15-year sample).
- The ability of the EFI to detect extreme events is assessed using the area under the Relative Operating Characteristic (ROCA). ROCA shows how good the model is at discriminating between severe and non-severe events.

$$EFI \text{ skill score} = \frac{score_{forecast} - score_{reference}}{score_{perfect \text{ forecast}} - score_{reference}} = \frac{ROCA_f - 0.5}{1 - 0.5} = 2ROCA_f - 1$$

0 → no skill, 1 → perfect score

- The verification is done for 3 parameters: 2m mean temperature, 10m mean wind speed and total precipitation

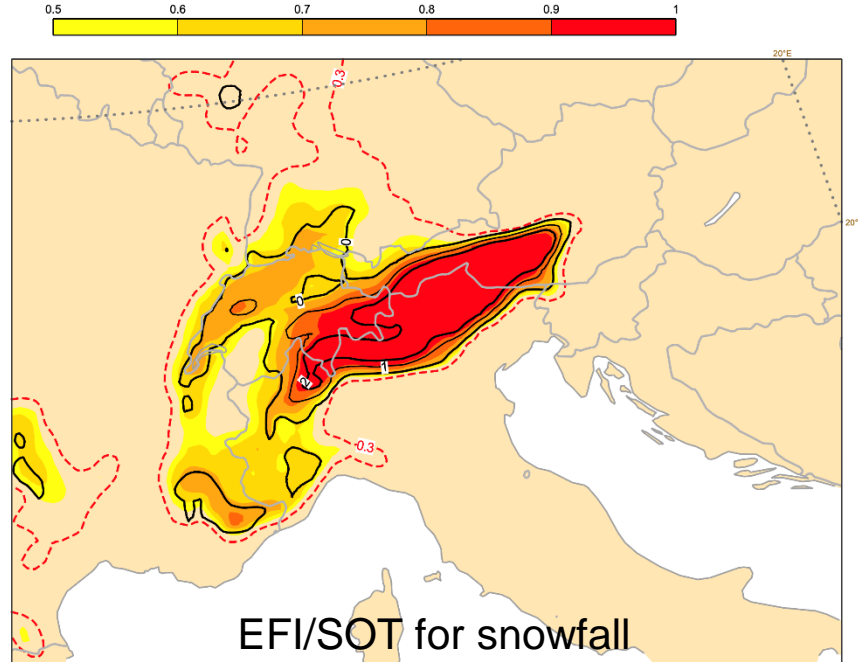
# EFI Verification



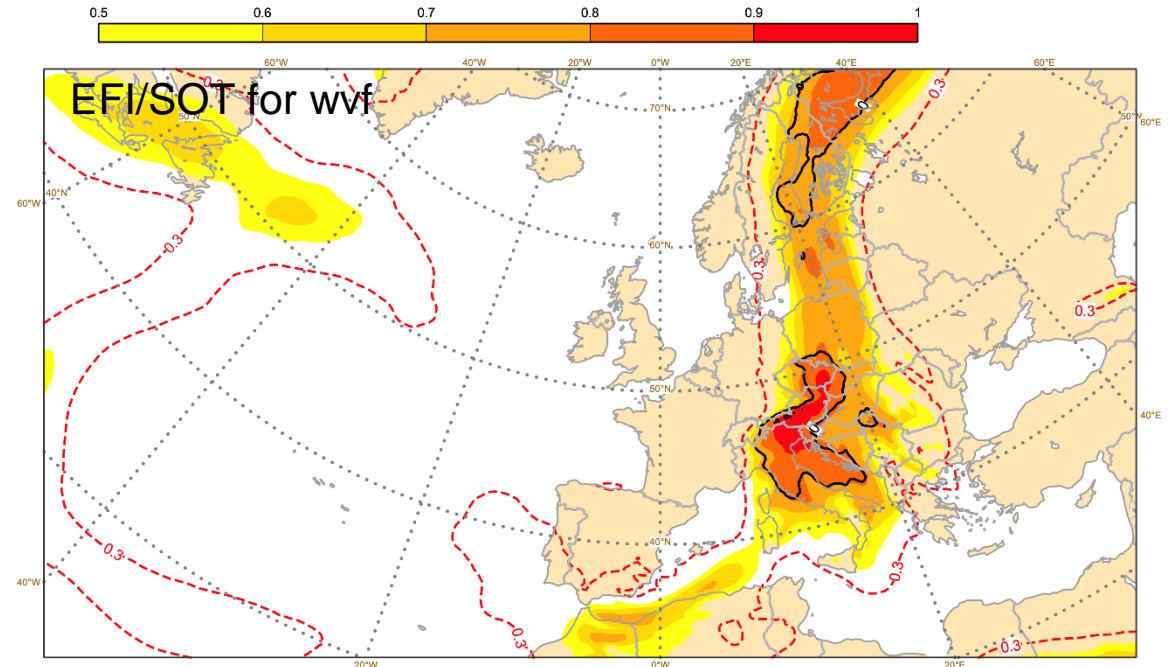


# Water vapour flux and multiday snowfall EFI/SOT

Thu 03 Dec 2020 00UTC @ECMWF expver = 1 VT: Fri 04 Dec 2020 00UTC - Mon 07 Dec 2020 00UTC 24-96h  
Extreme forecast index and Shift of Tails (black contours 0,1,2,5,8) for: snowfall



Thu 03 Dec 2020 00UTC @ECMWF expver = 1 VT: Fri 04 Dec 2020 00UTC - Mon 07 Dec 2020 00UTC 24-96h  
Extreme forecast index and Shift of Tails (black contours 0,1,2,5,8) for: water vapour flux



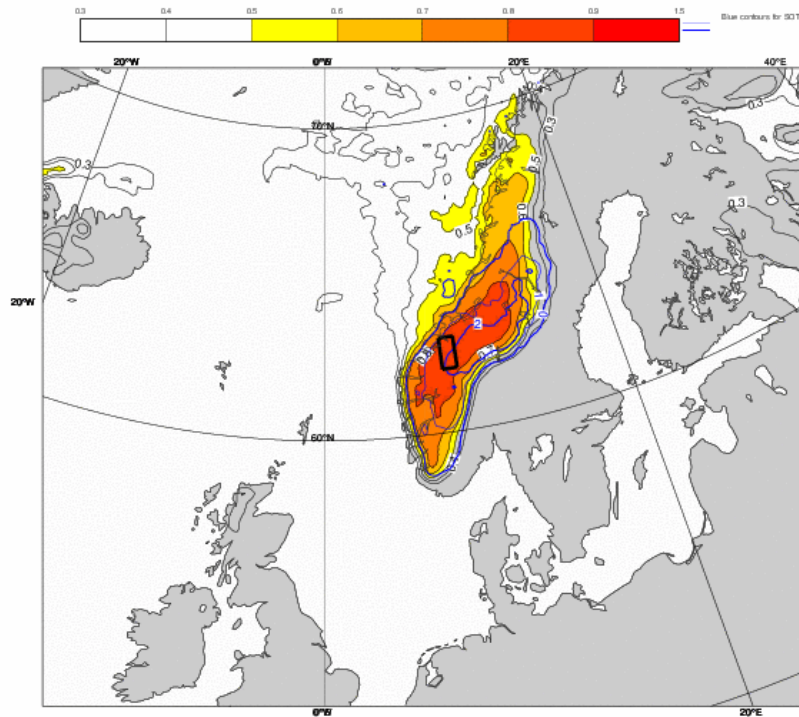
- An extreme snowfall event occurred in the eastern Alps at the beginning of December 2020
- New multiday accumulated snowfall EFI/SOT available operationally matching the same 72h, 120h, 240h and 360h accumulations as for total precipitation



# Case Study: Gyda 12-14 January 2022

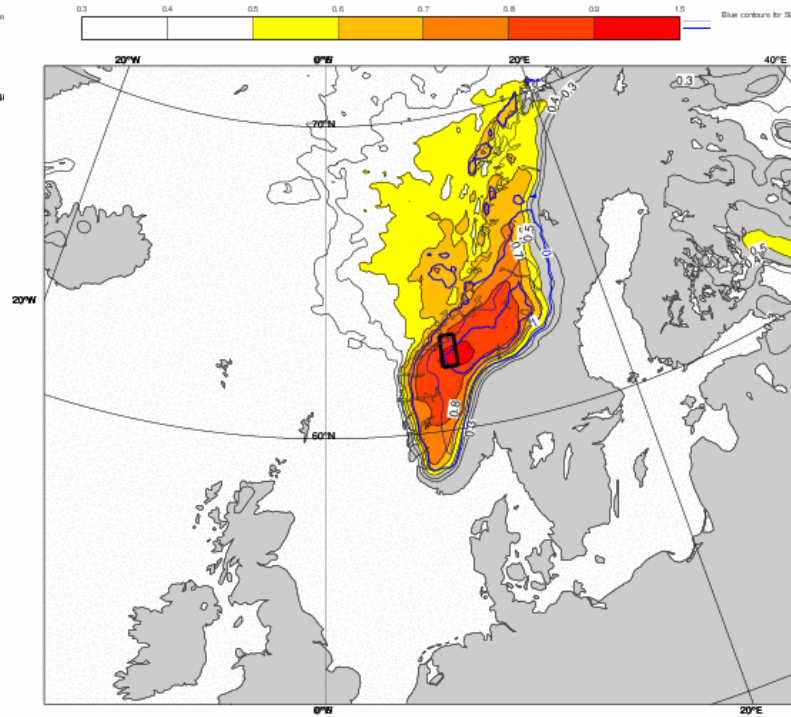
## EFI for 3-day precipitation

efi tp, sot tp, 2022010600 144-216



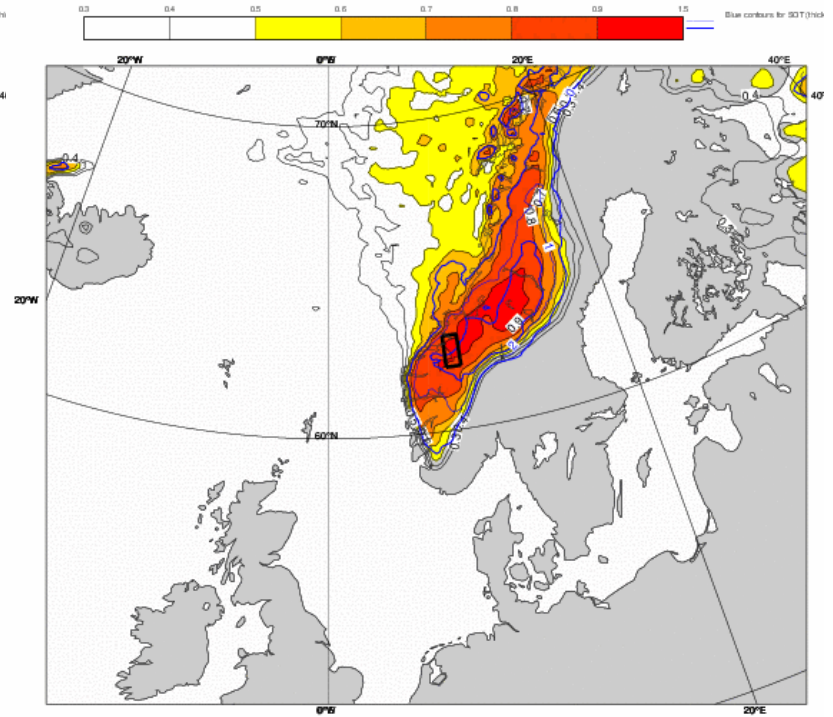
T+144-216 hours  
(6-9 days)

efi tp, sot tp, 2022010700 120-192



T+120-192 hours  
(5-8 days)

efi tp, sot tp, 2022010800 96-168

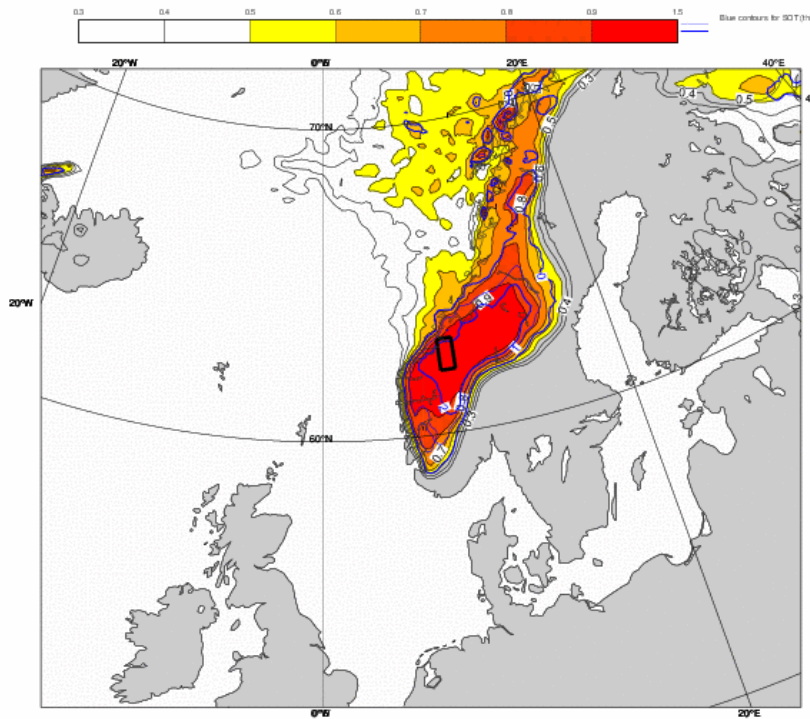


T+96-168 hours  
(4-7 days)

# Case Study: Gyda 12-14 January 2022

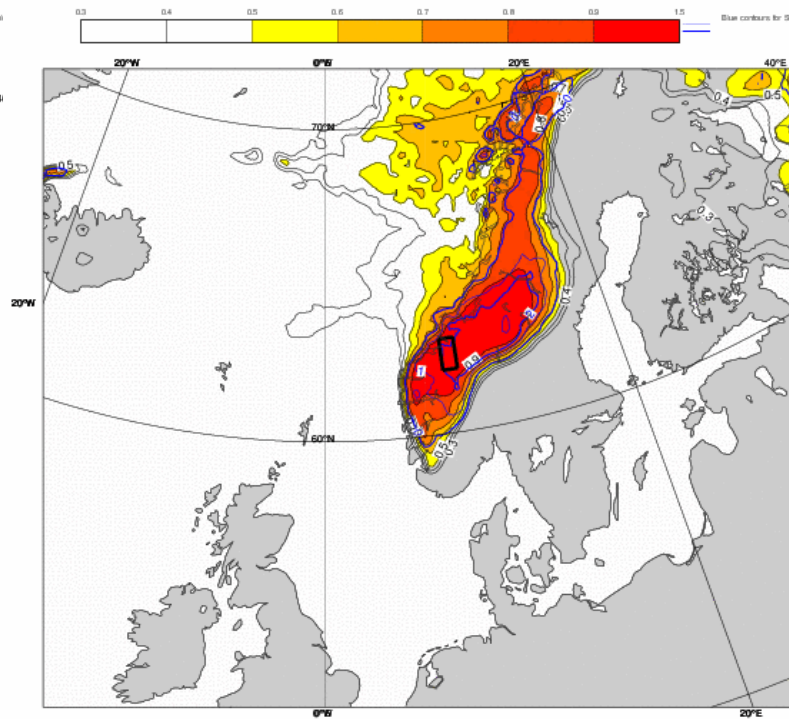
## EFI for 3-day precipitation

efi tp, sot tp, 2022010900 72-144



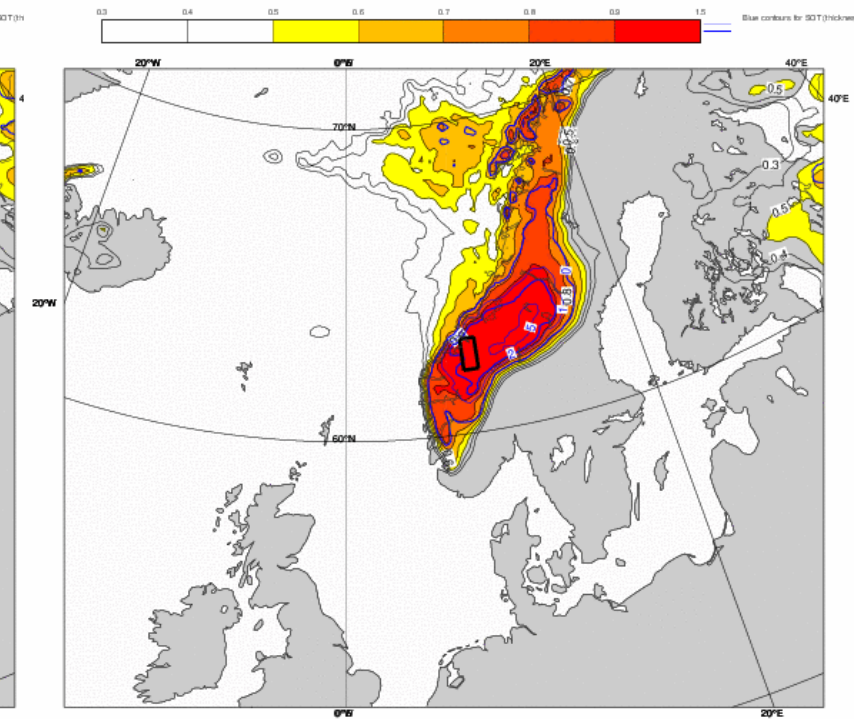
T+72-144 hours  
(3-6 days)

efi tp, sot tp, 2022011000 48-120



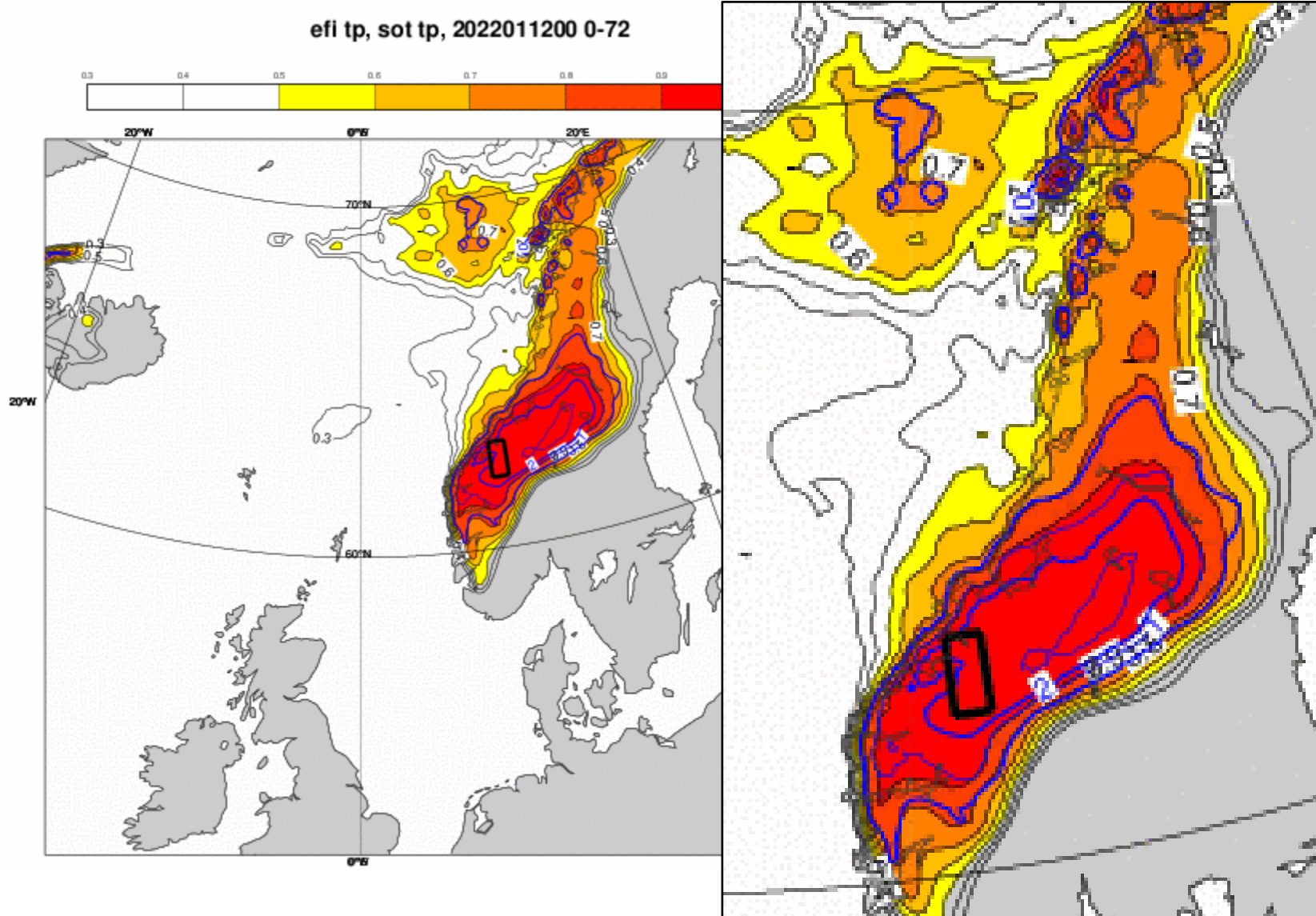
T+48-120 hours  
(2-5 days)

efi tp, sot tp, 2022011100 24-96



T+24-96 hours  
(1-4 days)

# Case Study: Gyda 12-14 January 2022



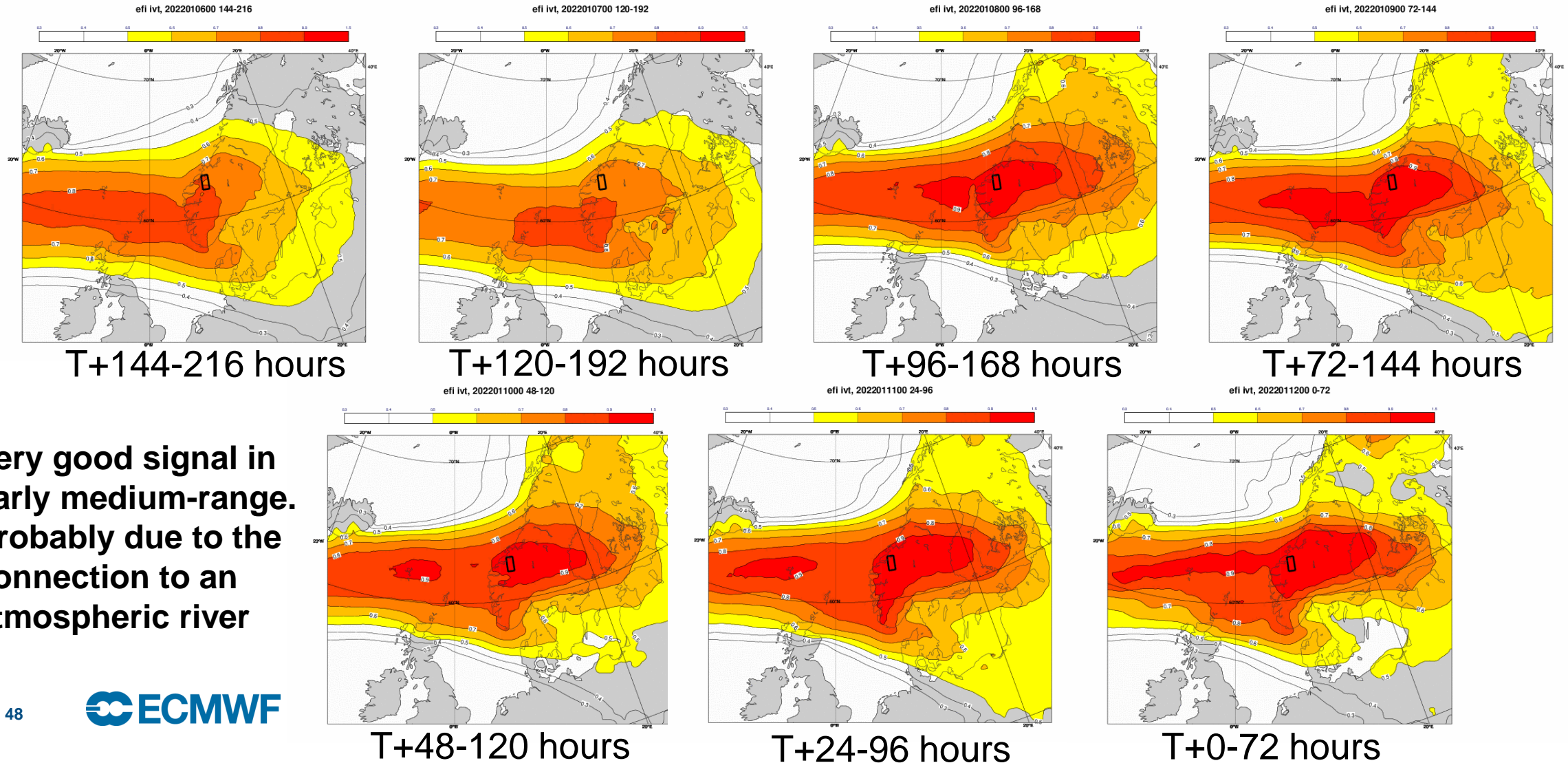
EFI for 3-day  
precipitation

T+0-72 hours  
(0-3 days)



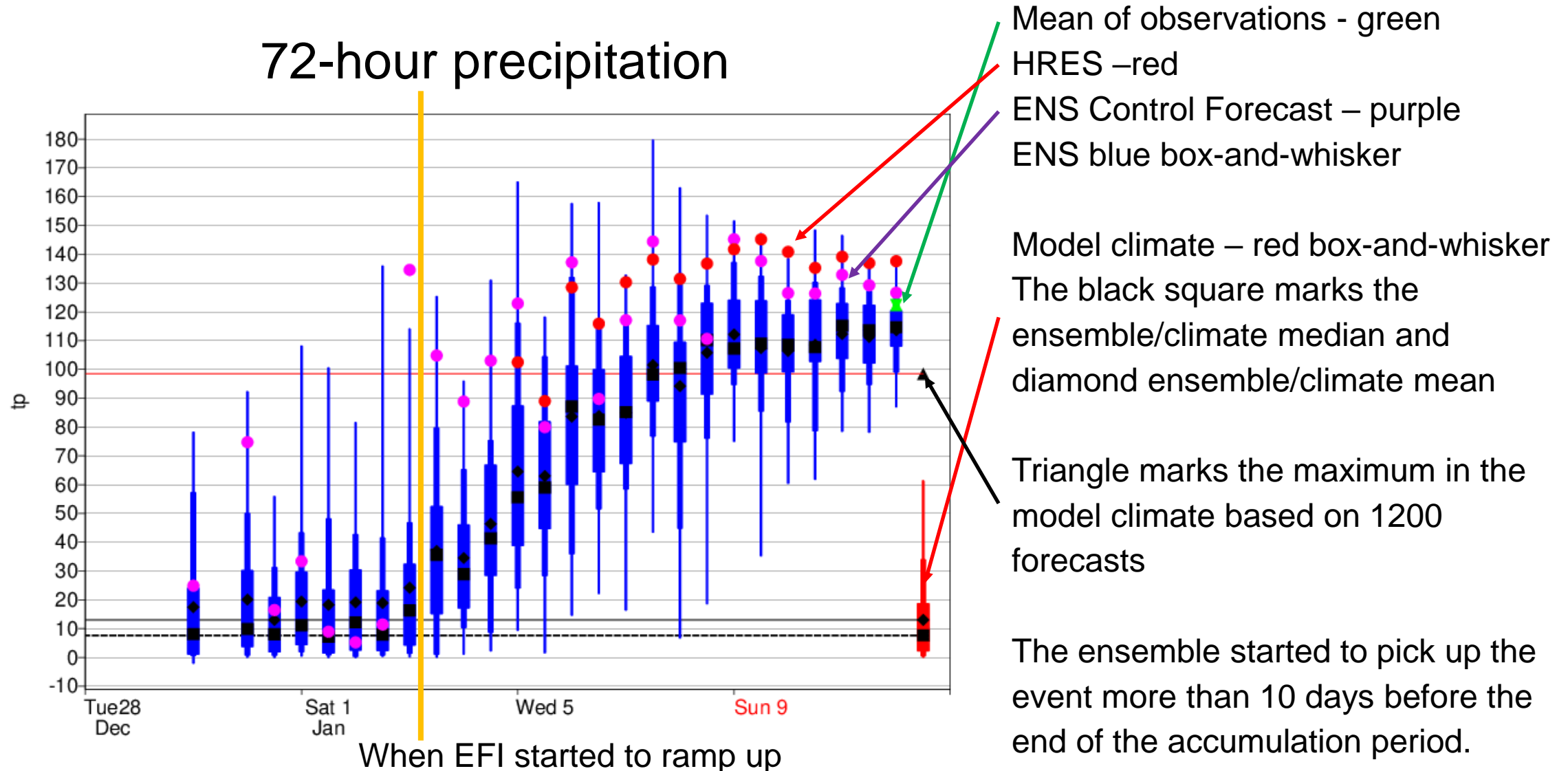
# Case Study: Gyda 12-14 January 2022

## Integrated water-vapor flux as a measure for atmospheric river features



# Case Study: Gyda 12-14 January 2022

## 72-hour precipitation

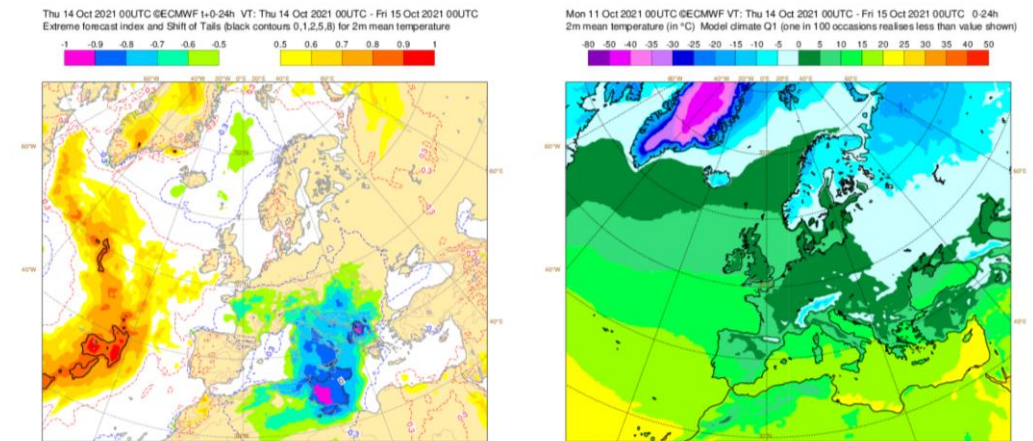
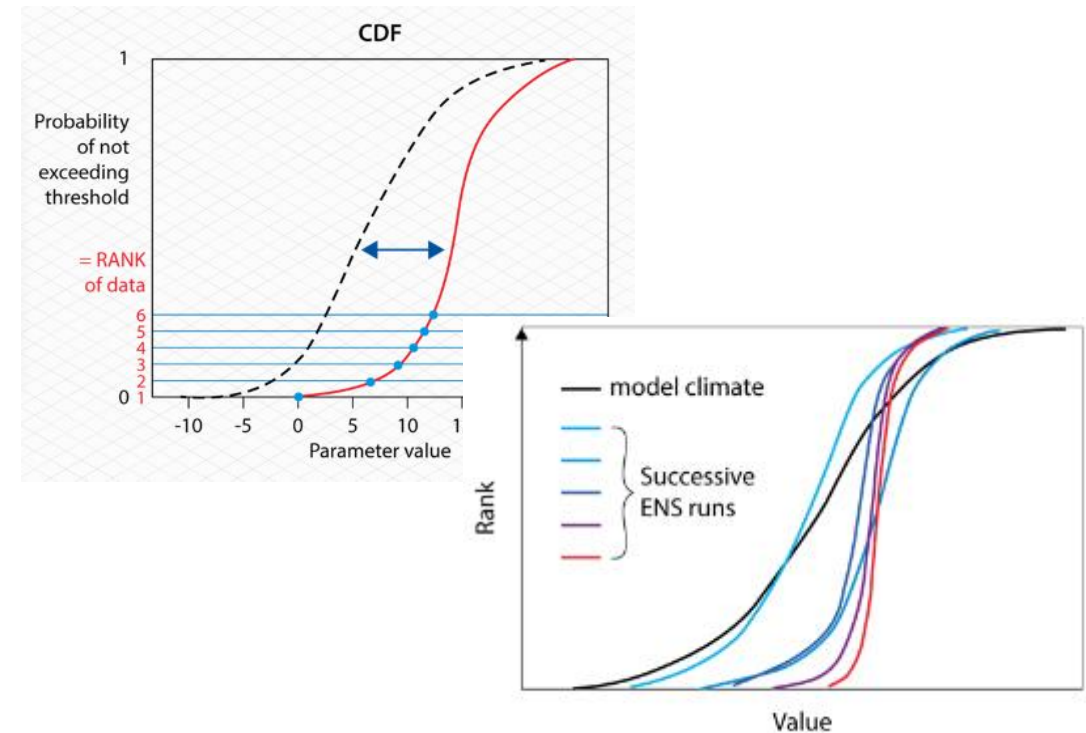




# EFI – Key Points

## Key Points

- Based on ECMWF Ensemble System (ENS) – 51 members
- Model biases removed as EFI is a calibrated product
- Measure of difference between ENS forecast distribution and reference distribution (m\_climate).
- Extremes are relative to model climate but do not necessarily mean high impact (e.g. 2mm rain in the desert)
- Cumulative Distribution Functions (CDFs) are important and facilitate the interpretation of the EFI and SOT
- EFI has limitations / issues
- EFI takes no direct account of ENS members beyond the M-climate extremes -> Shift of Tails (SOT)



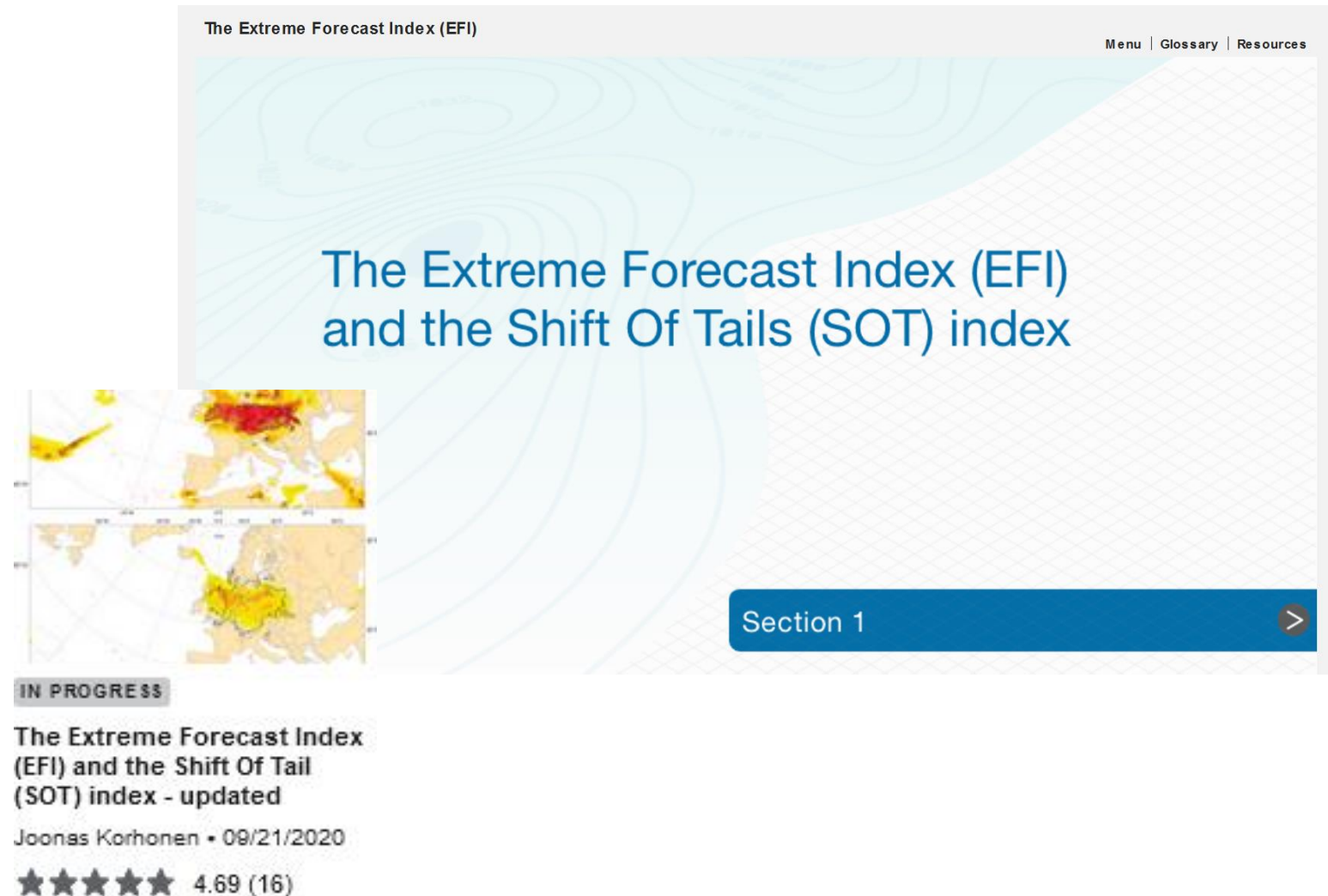
EFI

Model Climate

# Self-Study Module on learning.ecmwf.int

## Learning Objectives

- Explain how EFI, SOT and M-  
climate are built and their  
strengths and weaknesses
- Interpret EFI and SOT when  
used for forecasting real weather  
events.



The Extreme Forecast Index (EFI)

Menu | Glossary | Resources

## The Extreme Forecast Index (EFI) and the Shift Of Tails (SOT) index

Section 1

IN PROGRESS

The Extreme Forecast Index  
(EFI) and the Shift Of Tail  
(SOT) index - updated

Joonas Korhonen • 09/21/2020

★★★★★ 4.69 (16)

# Further Reading

- User Guide to ECMWF forecast products:  
<https://confluence.ecmwf.int/display/FUG/Forecast+User+Guide>
- **Tsonevsky, I., D., Richardson**, 2012: Application of the new EFI products to a case of early snowfall in Central Europe, *ECMWF Newsletter*, **No. 133**, 4.
- **Tsonevsky, I.**, 2015: New EFI parameters for forecasting severe convection. *ECMWF Newsletter*, **No. 144**, 27-32.
- **Tsonevsky, I.**, C. A. Doswell III, H. E. Brooks, 2018: Early Warnings of Severe Convection Using the ECMWF Extreme Forecast Index, *Wea. Forecasting*, 33, 857-871. (Open Access)



<http://www.ecmwf.int/sites/default/files/NL-144.pdf>



<https://journals.ametsoc.org/doi/pdf/10.1175/WAF-D-18-0030.1>

## How to access:

- **Extreme Forecast Index (EFI)**  
**and Shift of Tails (SOT)**
- **Precipitation Type**

## OpenCharts / ecCharts

ECMWF's web charts applications



# OpenCharts – free to access

<https://charts.ecmwf.int/>

Info on forecasts and charts:

<https://www.ecmwf.int/en/forecasts>



Home / Charts catalogue

Search products...

Range

- ☐ Medium (15 days)
- ☐ Extended (42 days)
- ☐ Long (Months)

Type

- ☐ Forecasts
- ☐ Verification

Component

- ☐ Surface
- ☐ Atmosphere

Product type

- ☐ High resolution forecast (HRES)
- ☐ Ensemble forecast (ENS)
- ☐ Combined (ENS + HRES)
- ☐ Extreme forecast index
- ☐ Point-based products

Parameters

- ☐ Wind
- ☐ Mean sea level pressure
- ☐ Temperature
- ☐ Geopotential
- ☐ Precipitation

Latest forecast

**Mean sea level pressure and wind speed at 850 hPa**

Graphical products catalogue of ECMWF medium/extended/long range products that are presented with ...

ADD TO CHARTSET

Latest forecast

**Geopotential 500 hPa and temperature at 850 hPa**

Graphical products catalogue of ECMWF medium/extended/long range products that are presented with ...

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Latest forecast

**2m temperature and 30m winds**

Graphical products catalogue of ECMWF medium/extended/long range products that are presented with ...

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Latest forecast

**100m wind and mean sea level pressure**

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Latest forecast

**Multi-parameter EFI (24-h up to valid time)**

Graphical products catalogue of ECMWF medium/extended/long range products that are presented with ...

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Latest EFI information

**EFI 2m temperature**

Graphical products catalogue of ECMWF medium/extended/long range products that are presented with ...

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Latest EFI information

**EFI 2m minimum temperature**

Graphical products catalogue of ECMWF medium/extended/long range products that are presented with ...

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Latest EFI information

**EFI 2m maximum temperature**

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Latest EFI information

**EFI wind gust**

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Latest EFI information

**EFI wind speed**

Graphical products catalogue of ECMWF medium/extended/long range products that are presented with ...

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Latest EFI information

**EFI precipitation**

Graphical products catalogue of ECMWF medium/extended/long range products that are presented with ...

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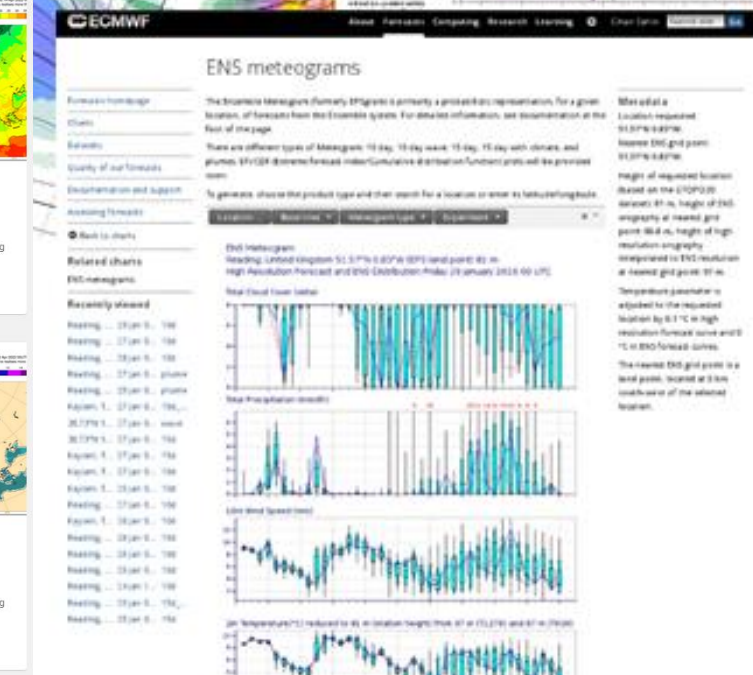
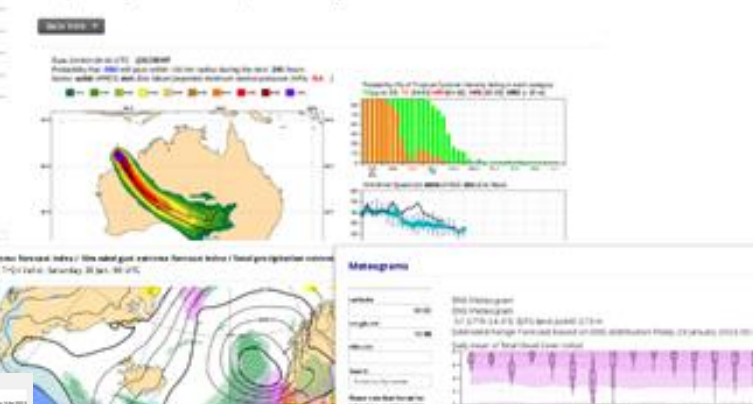
Latest EFI information

**EFI significant wave height**

Graphical products catalogue of ECMWF medium/extended/long range products that are presented with ...

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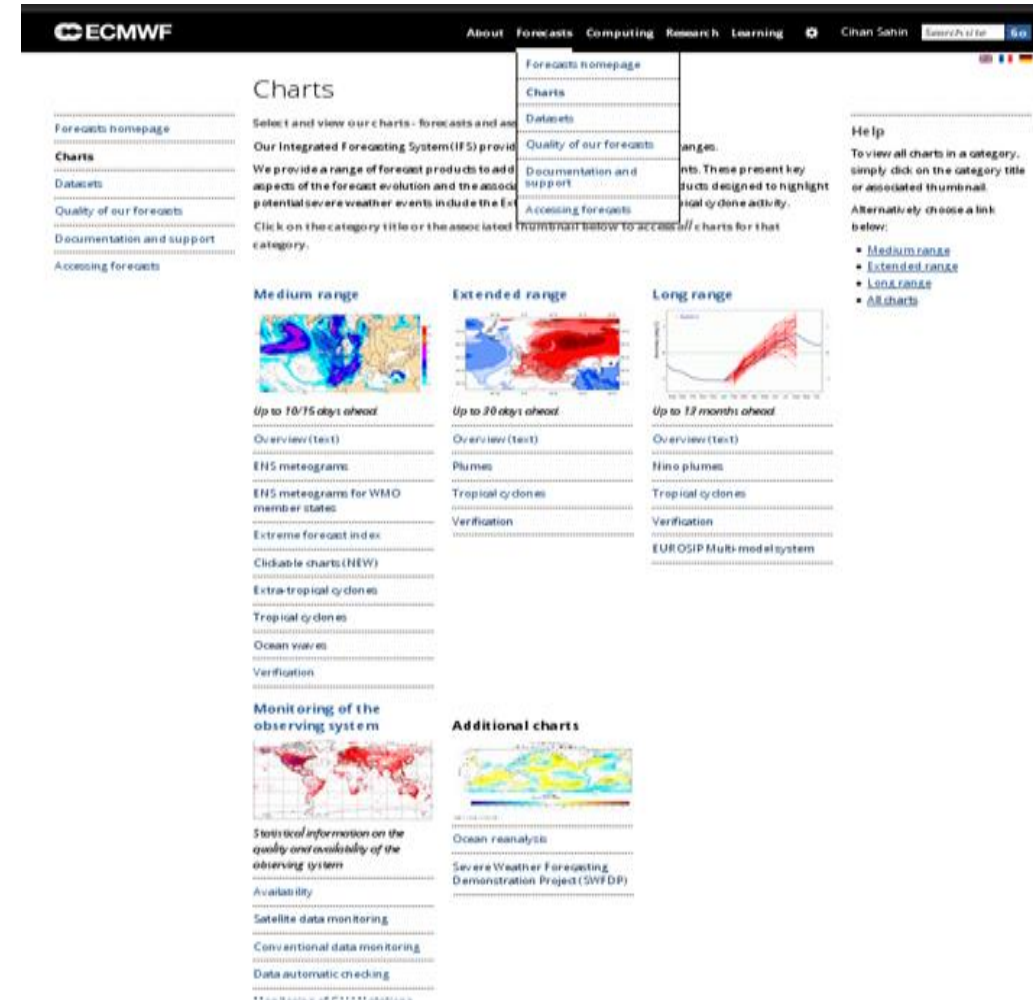
## Tropical cyclone strike probability for 08U





# OpenCharts

- High resolution (HRES) forecast charts (Updated at 06:55 and 18:55)
- Ensemble prediction system (ENS) charts up to 10 days (Updated at 7:20 and 19:20)
- Ensemble prediction system (ENS) charts 10-15 days (Updated at 7:40 and 19:40)
- Point-based time series from Ensemble, so called ENS meteograms/ ENS vertical profiles
- Extended range charts (Every Thursday and Monday)
- Long range (seasonal) charts (once a month)
- Verification charts
- Others (Tropical cyclone tracks, Observation monitoring ...)



# Precipitation Type in OpenCharts

Home / Charts catalogue

type



Range

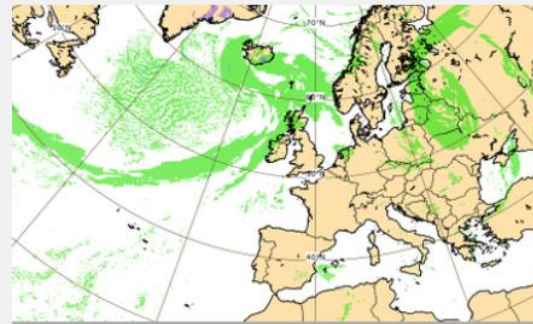
- ☐ Medium (15 days)
- ☐ Extended (42 days)
- ☐ Long (Months)

Type

- ☐ Forecasts
- ☐ Verification

Component

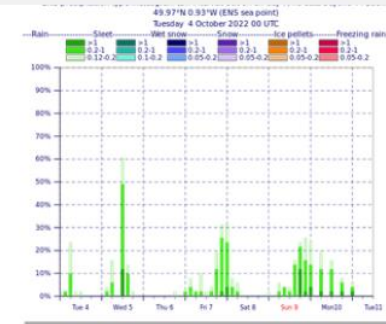
- ☐ Surface



Latest forecast

Precipitation type

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Precipitation type meteogram

Precipitation type  
meteogram

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# EFI in OpenCharts

ECMWF

Charts

Home / Charts catalogue

Search products...

Range

☐ Medium (15 days)

☐ Extended (42 days)

☐ Long (Months)

Type

☐ Forecasts

☐ Verification

Component

☐ Surface

☐ Atmosphere

Product type

☐ High resolution forecast (HRES)

☐ Ensemble forecast (ENS)

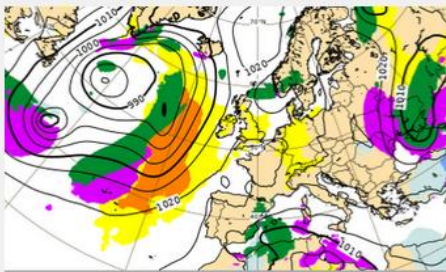
☐ Combined (ENS + HRES)

☒ Extreme forecast index

☐ Point-based products

Parameters

☐ Wind


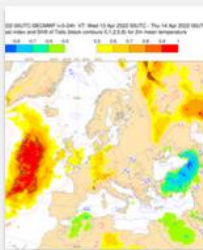


Latest forecast

Multi-parameter EFI (24-h up to valid time)

Graphical products catalogue of ECMWF medium/extended/long range products that are presented with ...

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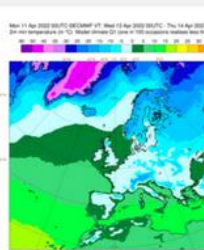
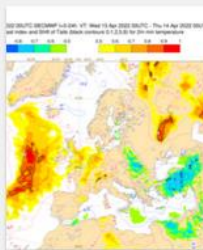


Latest EFI information

EFI 2m temperature

Graphical products catalogue of ECMWF medium/extended/long range products that are presented with ...

ADD TO CHARTSET

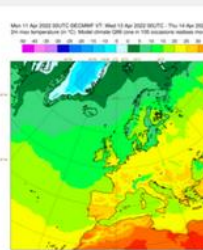
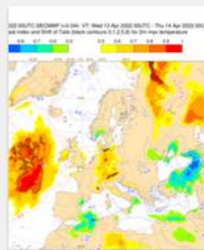


Latest EFI information

EFI 2m minimum temperature

Graphical products catalogue of ECMWF medium/extended/long range products that are presented with ...

ADD TO CHARTSET

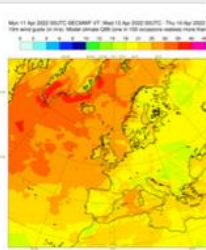
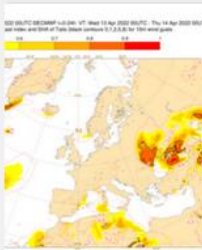


Latest EFI information

EFI 2m maximum temperature

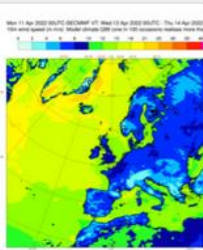
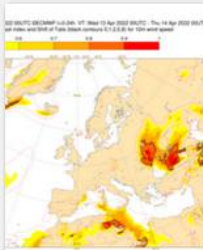
Graphical products catalogue of ECMWF medium/extended/long range products that are presented with ...

ADD TO CHARTSET



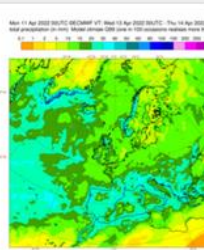
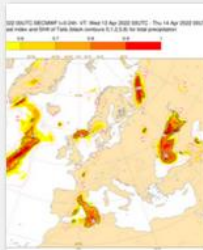
Latest EFI information

EFI wind gust



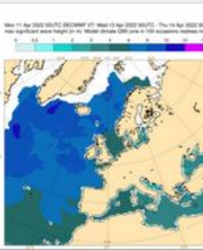
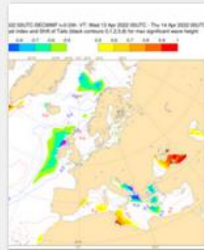
Latest EFI information

EFI wind speed



Latest EFI information


EFI precipitation



Latest EFI information

EFI significant wave height

57



EUROPEAN CENTRE FOR MEDIUM-RANGE WEATHER FORECASTS

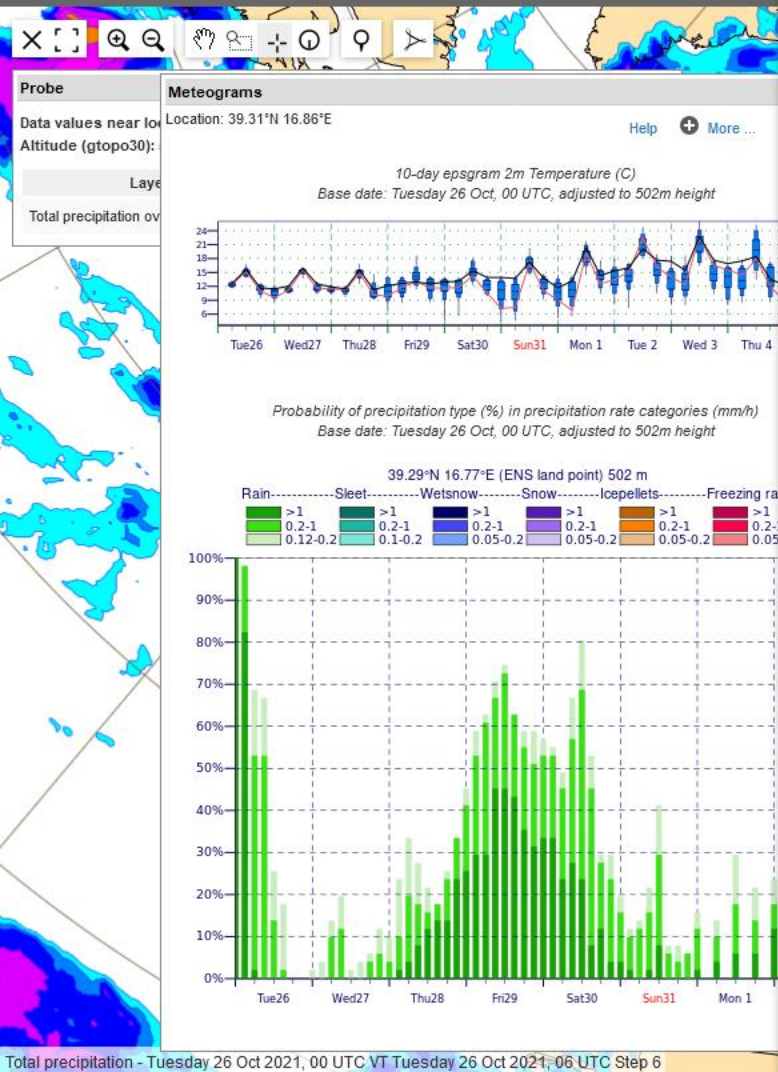
# EFI in OpenCharts

## **Extreme Forecast Index products:**

- Multi-parameter – 2m temperature, 10m wind gusts, total precipitation
- 2m temperature
- 2m minimum temperature
- 2m maximum temperature
- Wind gust
- Wind speed
- Precipitation
- Significant Wave Height
- Snow fall
- CAPE
- CAPE shear
- Water Vapour Flux
- 2m temperature over Extended Range – weekly EFI values for 6 weeks
- Precipitation over Extended Range – weekly EFI values for 6 weeks



# Precipitation Type in ecCharts



## Meteogram select

Select from these ECMWF Meteograms to add to your personal list

Filter

47 matching items

No filters applied

### Meteograms - 10 days



10-day epsgram total cloud cover (okta)



10-day epsgram low cloud cover (okta)



10-day epsgram medium cloud cover



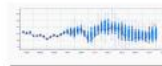
10-day epsgram high cloud cover (okta)



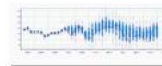
10-day epsgram total precipitation (mm/6h)



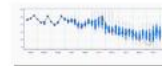
10-day epsgram total snowfall (mm of)



10-day epsgram 10m wind gust (m/s)



10-day epsgram 10m wind speed (m/s)



10-day epsgram 2m Temperature (C)



Probability of precipitation type (%)

### Meteograms - 15 days



15-day epsgram daily mean of total



15-day epsgram total precipitation



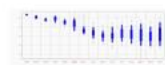
15-day epsgram daily distribution of



15-day epsgram daily mean of 10m



15-day epsgram 2m maximum



15-day epsgram 2m minimum

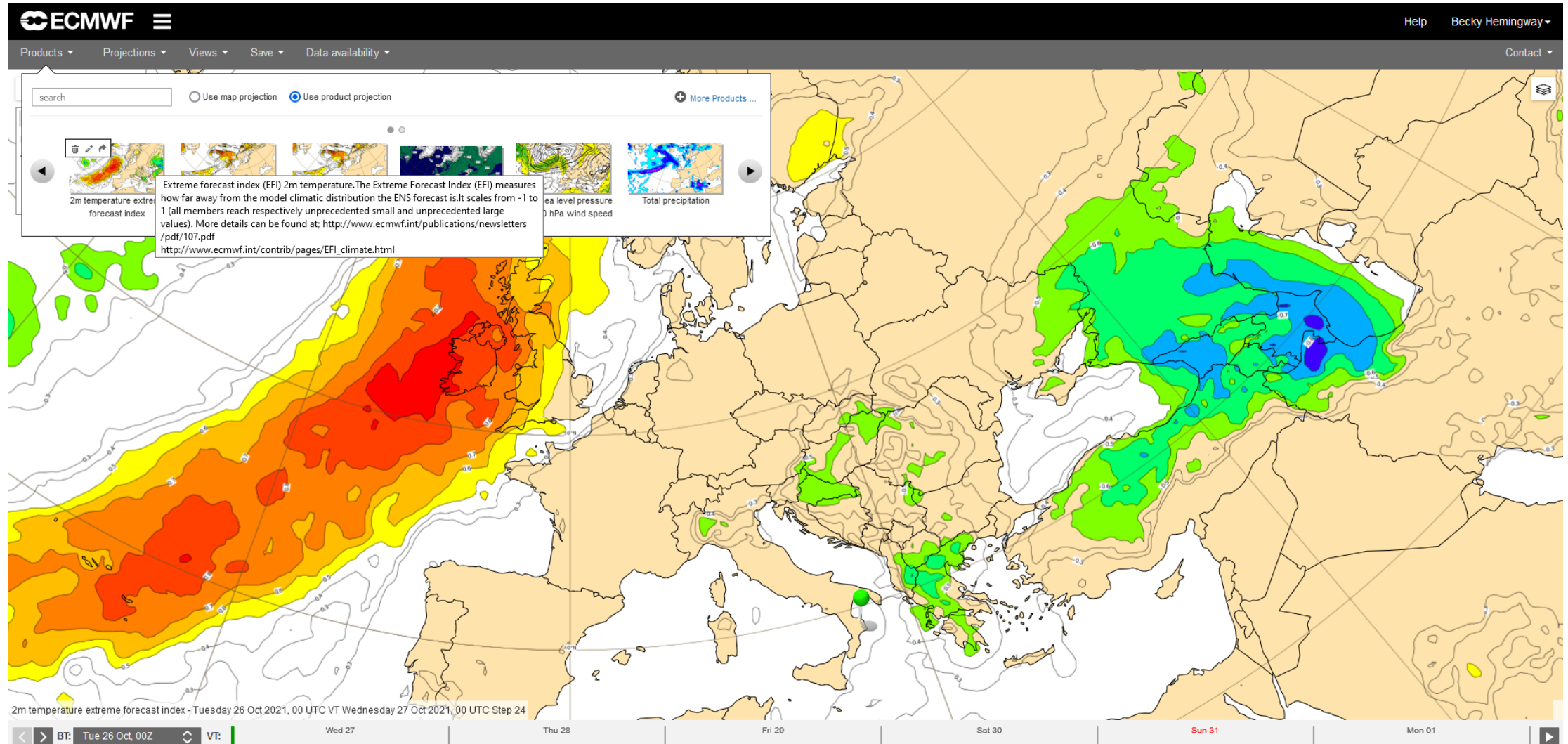
### Meteograms - 10 days wave



# EFI in ecCharts

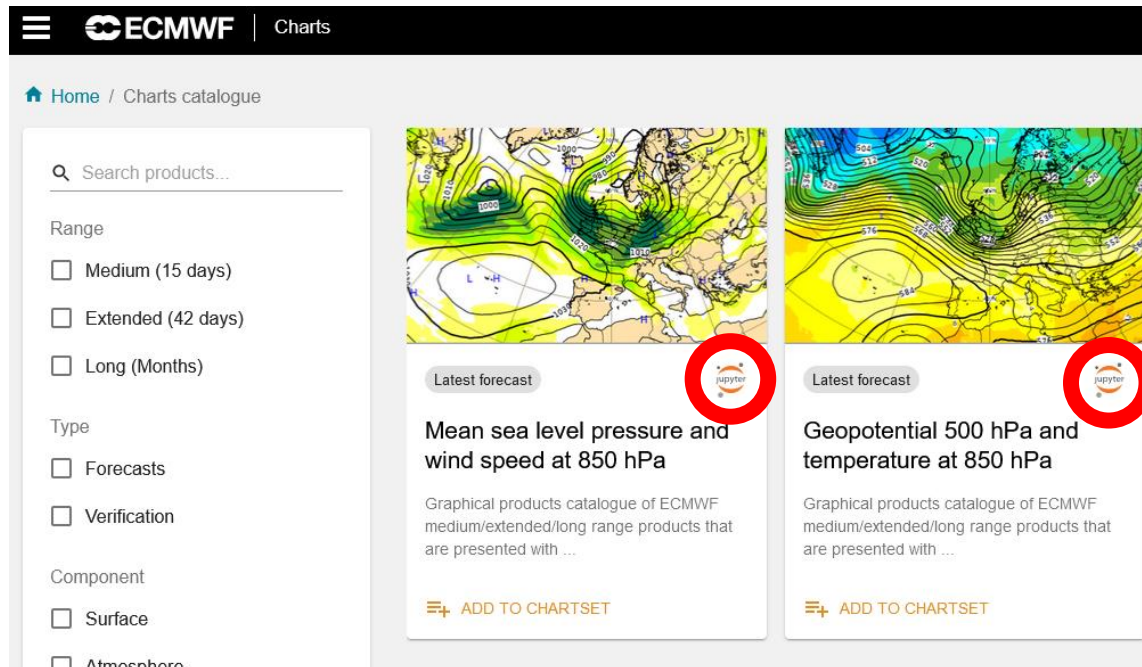
## Extreme Forecast Index products:

- Total precipitation
- 2m temperature
- 10m wind speed
- 10m wind gust



# OpenData – ECMWF data free to access

- From 25 January 2022 a wide range of ECMWF forecast data was made available to anyone
- Prepared Jupyter notebooks to help access and visualise the data – OpenCharts shows which data can be accessed this way



ECMWF makes wide range of data openly available

25 January 2022

Share



Credit: NicoElNino / iStock / Getty Images Plus

From 25 January 2022, a wide range of ECMWF's forecast data across the globe will be openly available. This move towards 'open data' comes after a [large range of forecast charts](#) were earlier made available to anybody interested in them.

# Added Jupyter Notebook functions



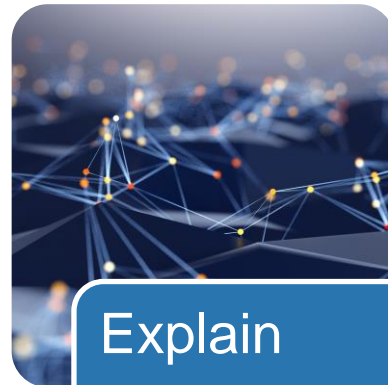
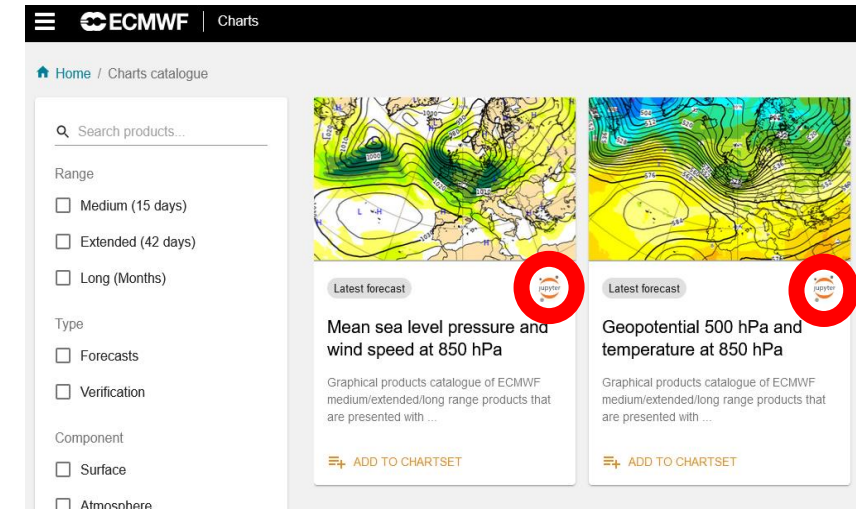
## The problem

Many users ask us **how to reproduce** the open charts



## The solution

Jupyter notebook for each product to reproduce it using archived data



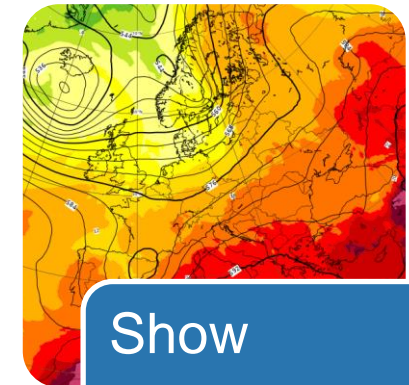
### Explain

- Which data is used
- Where to find it
- How to **download** it



### Provide

- Calculations for the product




### Show


- How to **plot** it



# Information on ECMWF Forecasts and data

<https://www.ecmwf.int/en/forecasts>

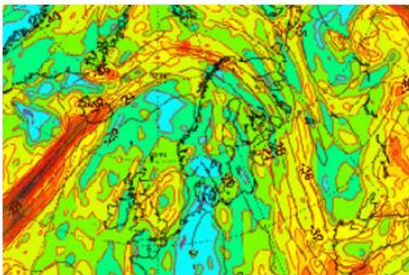


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ChartsDatasetsQuality of our forecastsAbout our forecastsAccess to forecasts



### Charts

Our Integrated Forecasting System (IFS) provides forecasts and associated verification at different resolutions and for multiple time ranges. The verification provides essential feedback on the [quality of the forecasting system](#).


Medium range

Extended range

Long range

Quick access:

Public Datasets



### Datasets

Real-time and archive forecasts, analyses, climate re-analyses, reforecasts and multi-model datasets.

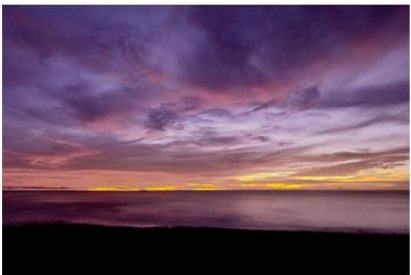
Real-time datasets

Archive datasets

Open data

Quick access:

Public Datasets



### Monitoring of the observing system

We continually monitor the quality and availability of the different components of the global observing system used at ECMWF.

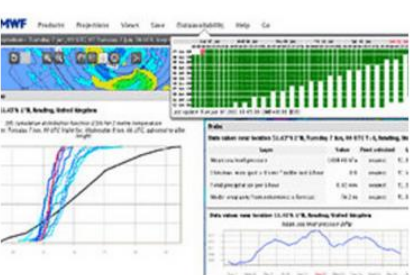
Availability

Satellite data monitoring

Conventional data monitoring

Ocean observation monitoring

Automatic data checking



### The Integrated Forecasting System

Key characteristics of the Integrated Forecasting System (IFS), documentation on specific areas, and description of our forecasts.

Medium range overview

Extended range overview

Long range overview

Changes in the IFS

IFS documentation

# Forecast User Guide

<https://confluence.ecmwf.int/display/FUG>

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Forecast User Portal

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› 4 NWP Evolution versus Reality

› 5 Forecast Ensemble (ENS) - Rationale and Use

› 6 Using Deterministic and Probabilistic Forecasts

› 7 ENS Products - Dealing with Uncertainty

› 8 ENS Products - What they are and how to use them

› 9 Physical Considerations when Interpreting Forecasts

› 10 Interfaces for displaying Model Output

• 11 Conclusion

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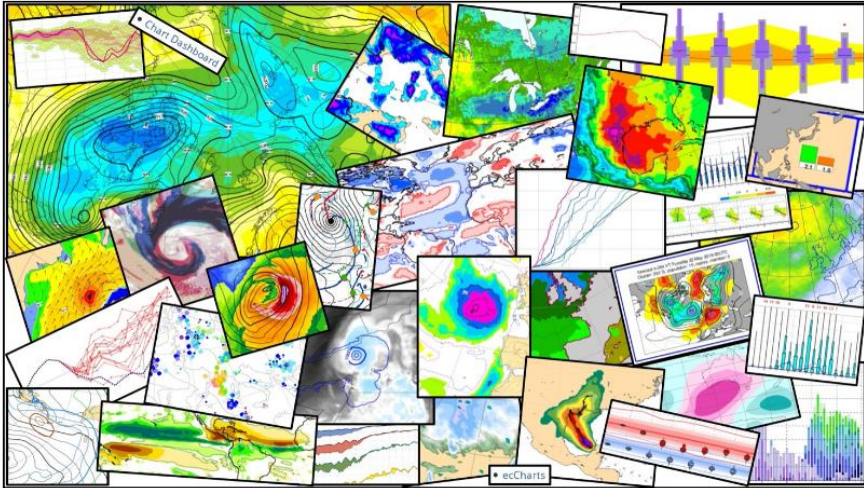
Space tools

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Forecast User Guide

Search this user guide for ...

"Behind good forecast practices are often hidden good theories; equally, good theories should provide a basis for good forecast practices." Professor Tor Bergeron, personal communication, 1974




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 that dealing with short-range or seasonal NWP. Extended range forecast (days 16 to 42) output concentrates on the probabilities of anomalies from the norm during a 5-7day forecast period at a location and the time of year. Seasonal forecasts give an indication of likely conditions beyond 6 weeks ahead. These are run monthly giving forecasts to 7 months ahead, and run quarterly with forecasts extended to 12 months ahead. Output concentrates on the anomalies relative to the seasonal climate.

New products increasingly aid early warning of severe or hazardous weather.

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

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 EUROPEAN CENTRE FOR MEDIUM-RANGE WEATHER FORECASTS



# Forecast User Forum

 [confluence.ecmwf.int/display/FUF](https://confluence.ecmwf.int/display/FUF)

- A discussion platform for users of ECMWF forecasts to interact with other users and ECMWF experts, and post comments on topics of interest related to weather and forecasts, and to provide feedback to ECMWF.
- ECMWF will be monitoring discussions, joining conversations and considering comments and feedback in ongoing research and diagnostic work.

• **3 forum categories:**

- Current and Recent Weather
- Featured Feedback Topics
- UEF Events & Training

## Forecast User Forum

Created by Helene Blanchonnet, last modified by Rebecca Emerton about 4 hours ago

This forum is a discussion platform for users of ECMWF's forecasts to interact with other users and ECMWF experts, and post comments on topics of interest related to weather and forecasts, and to provide feedback to ECMWF.

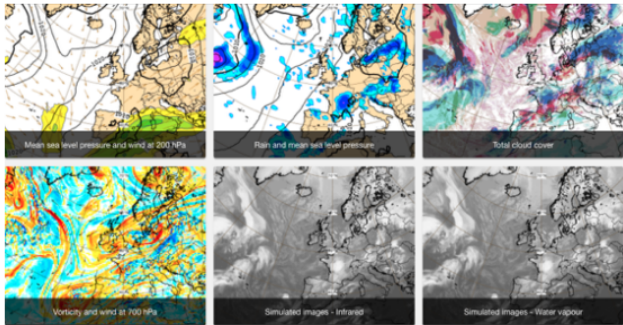
Within the forecast user forum space, we have three forum categories: [current and recent weather](#) (please note ECMWF cannot provide any guidance on model output related to ongoing weather events), [featured feedback topics](#) where forecast users can provide feedback on current topics of interest related to forecast products and performance, and [UEF events and training](#).

ECMWF are always interested in the experiences and feedback of our forecast users. We will be monitoring these forum discussions, joining the conversations and considering feedback and comments in our ongoing research and diagnostic work, but we cannot guarantee a response to every topic or question. If your comment or question requires a direct response from ECMWF staff, please head to the [ECMWF support portal](#) to contact the relevant department.

This forum is not designed provide answers to technical questions regarding the access to and use of ECMWF forecasts and data. For questions of this nature, please visit the [ECMWF support portal](#) for more information or to contact someone who can help with your query.


For users of OpenIFS, and the Copernicus C3S and CAMS services, you may also be interested in the [OpenIFS User Forums](#) and [Copernicus User Support Forum](#).

 [Log in or register to post on the Forecast User Forum](#)






### Quick Links

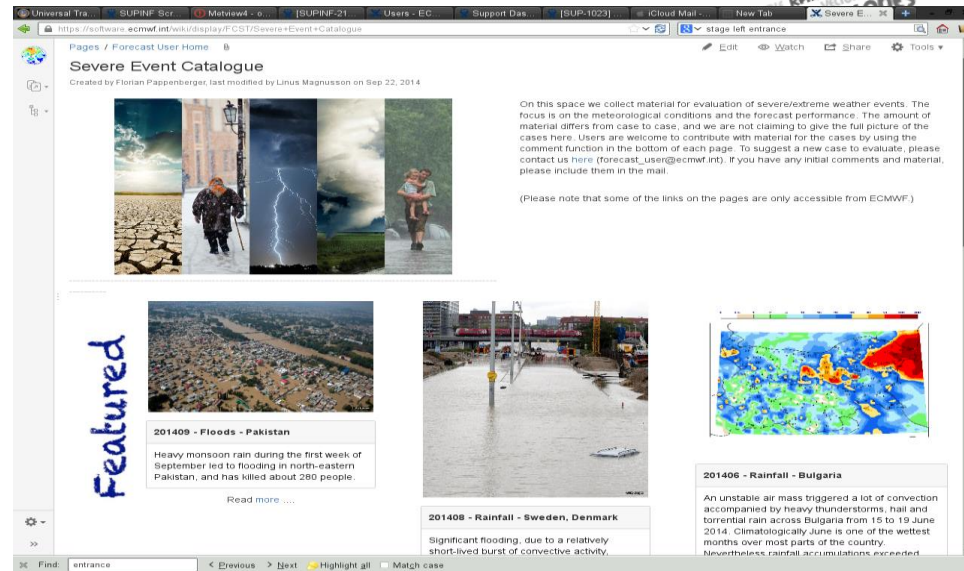
- [Forecast User Guide](#)
- [Forecast Charts and Maps](#)
- [Severe Event Catalogue](#)
- [Known Forecasting Issues](#)
- [ECMWF Support Portal](#)
- [News and Science Blog](#)

 Please see the [FAQs](#) and [how to post](#) for more information and guidance on posting in the Forecast User Forum. This is a public forum; an account is required to post a new topic or comment, but anyone is able to browse and read the forum.

We welcome comments and posts in a range of languages, and encourage forum visitors to explore browser translation options to follow discussions that may take place in languages they may not be familiar with.

Forums	Topics / Replies	Last Reply
<a href="#">Current and Recent Weather</a>	0 / 0	12 days ago  <a href="#">Rebecca Emerton</a>
<a href="#">Featured Feedback Topics</a>	2 / 0	14 days ago  <a href="#">Rebecca Emerton</a>
<a href="#">UEF Events &amp; Training</a>	1 / 0	14 days ago  <a href="#">Rebecca Emerton</a>

# Severe Event Catalogue



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

# Forecasting Issues

Pages / Forecast User Home

Known IFS forecasting issues

Created by Timothy Hewson, last modified on Dec 12, 2017

Please note that numbering/ordering 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 be relevant when examining archived forecasts.

Topic / title	Description	Related activities
2m Temperature		
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 screen temperature in inversion situations than in unstable situations, because the energy change is commuted through a much smaller depth of the atmosphere (e.g. metres rather than kilometres). The lower the inversion, the larger is the potential error. There is also sensitivity here to the method we use to interpolate between air temperature at the lowest model level (~10m) and skin temperature (2m temperature is a diagnostic, not direct model output).	New reporting practices for radiosonde data ("BUFR" 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 grid being larger than the model grid (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 $T^4$ , and at near-coast points $T$ is approximately the average temperature of the land and (warmer) ocean. As a result screen temperatures drop too much - related 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 41R2 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 screen temperatures assumes a standard lapse rate (6.5C drop per km increase in altitude), and so if the difference in height between the site chosen, and the nearest model gridpoint (as shown in the ENSogram title) is large, the scope for large errors/biases increases. This is especially true in winter-time when inversions are more common: by definition an inversion implies a temperature increase with height, not a decrease, so the temperature correction applied could even be in the wrong direction. This issue is compounded by 2m Temperature issue T1 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 EF 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

Created by Umberto Modighi, last modified by Dominique Lucas on Mar 27, 2018

On these pages you can find information about planned changes to the IFS forecasting system and documentation describing previous changes. Please note that for planned changes this information is subject to revisions as we proceed with experimentation.

Formal announcements of the implementation schedules for new model cycles will still be made by email, and relevant information will then be posted on dedicated 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 in Terminology for IFS testing.

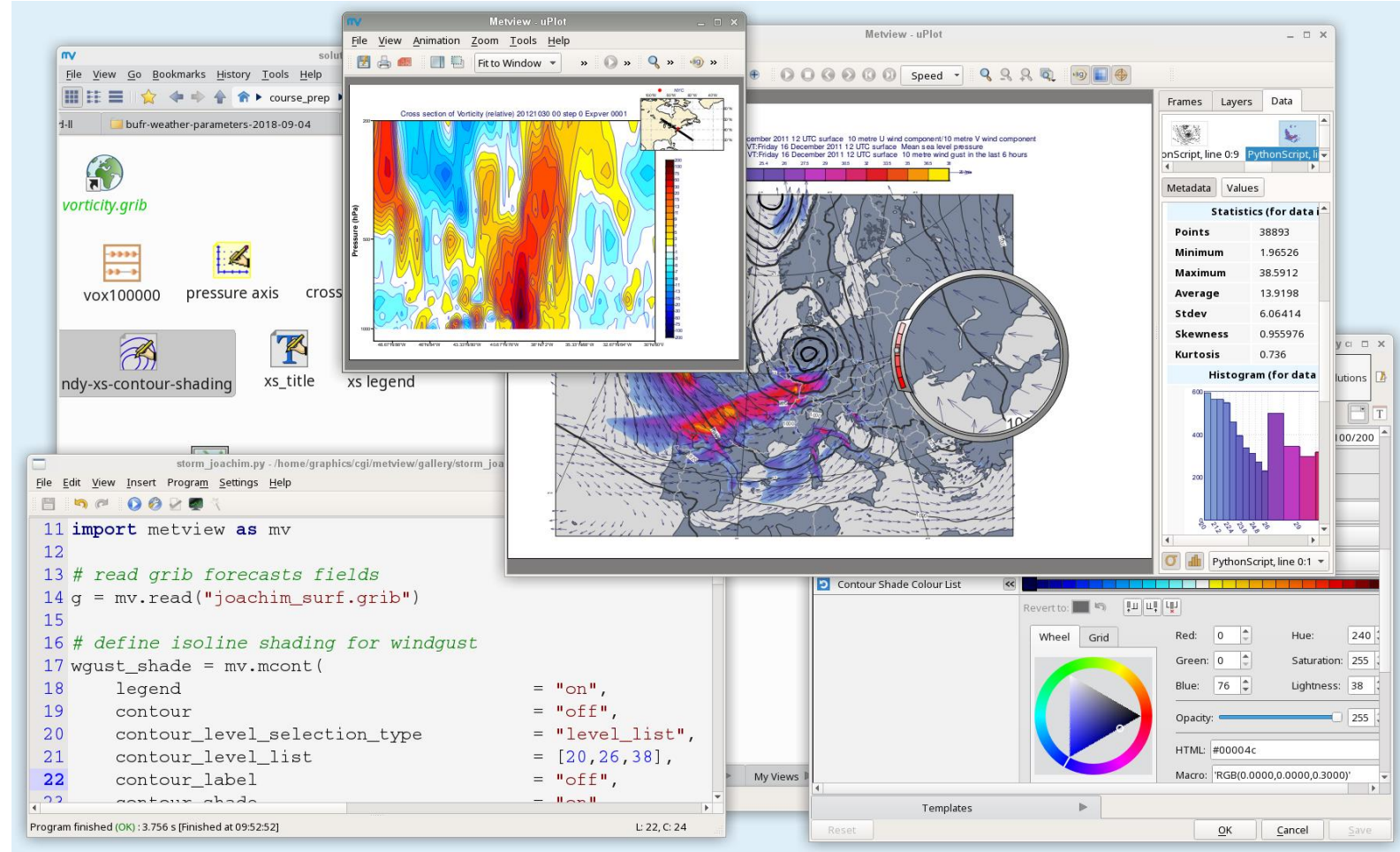
<p><b>Planned changes</b></p> <ul style="list-style-type: none"> <li>Implementation of IFS Cycle 45r1 - IFS Cycle 45r1 planned implementation date 5 June 2018</li> </ul> <p><b>Past changes</b></p> <ul style="list-style-type: none"> <li>Implementation of Seasonal Forecast SEAS5 - SEAS5 implemented 5 November 2017</li> <li>Implementation of IFS Cycle 43r3 - IFS Cycle 43r3 implemented 11 July 2017</li> <li>Implementation of IFS Cycle 43r1 - IFS Cycle 43r1 implemented 22 November 2016</li> <li>Horizontal resolution increase - IFS Cycle 41R2 implemented 8 March 2016</li> <li>Boundary-Condition Programme ENS at 06 and 18 UTC - Implemented 8 July 2015</li> </ul>	<p><b>Mailing list</b></p> <p>A mailing list has been created to inform interested parties about IFS changes.</p> <p>To subscribe to or unsubscribe, please send an email to <a href="mailto:forecast_changes-request@lists.ecmwf.int">forecast_changes-request@lists.ecmwf.int</a> with the word subscribe or unsubscribe as Subject or click <a href="#">subscribe</a></p> <p>Alternatively access <a href="http://www.ecmwf.int/publications/maillist/subscribe/forecast_changes">http://www.ecmwf.int/publications/maillist/subscribe/forecast_changes</a>, enter your email address and click Subscribe</p>
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# Metview

**Metview** is a meteorological workstation application designed to be a complete working environment for both the operational and research meteorologist.

Its capabilities include powerful data access, processing and visualisation.

It features both a powerful **icon-based user interface** for interactive work and a **Python** interface for batch processing.



## More information:

<https://metview.readthedocs.io/en/latest/>

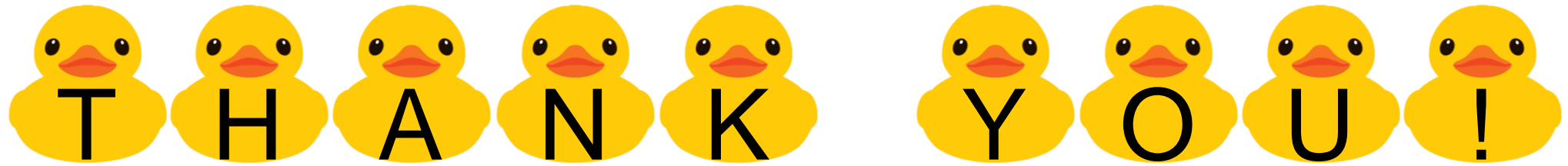
ECMWF has lots of Software and Applications for meteorological, hydrological and climate data. Please ask you've like to know more!



# Useful Links

- Open Charts: <https://apps.ecmwf.int/webapps/opencharts/>
- Forecast User Guide: <https://confluence.ecmwf.int/display/FUG/Forecast+User+Guide>
- Forecast User Forum: <https://confluence.ecmwf.int/display/FUF/Forecast+User+Forum>
- Severe Event Catalogue:  
<https://confluence.ecmwf.int/display/FCST/Severe+Event+Catalogue>
- Forecast System Changes:  
<https://confluence.ecmwf.int/display/FCST/Changes+to+the+forecasting+system>
- Forecasting Issues:  
<https://confluence.ecmwf.int/display/FCST/Known+IFS+forecasting+issues>
- Newsletters: <https://www.ecmwf.int/en/publications/newsletters>
- Learning Resources: <https://learning.ecmwf.int/en-US/web/guest/public-channel>
- MetView: <https://metview.readthedocs.io/en/latest/>





Any Questions?