

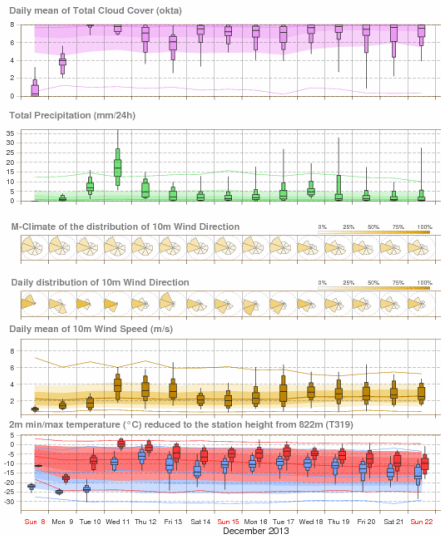
# Estimation of the model climate (reforecasts)

Linus Magnusson



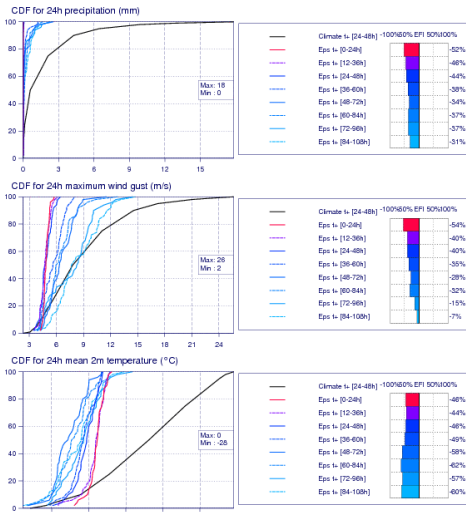
# Model climate from reforecasts

EPS Metogram  
67.68°N 18.67°E (EPS land point) 836 m (T639)  
Extended Range Forecast based on EPS Distribution Sunday, 8 December 2013 00 UTC



**M-Climate:** this stands for "Model Climate". It is a function of lead time, date (+/-15 days), and model version. It is derived by rerunning a 5 member ensemble over the last 20 years, once per week (500 realisations). M-Climate is always from the same model version as the displayed EPS data.

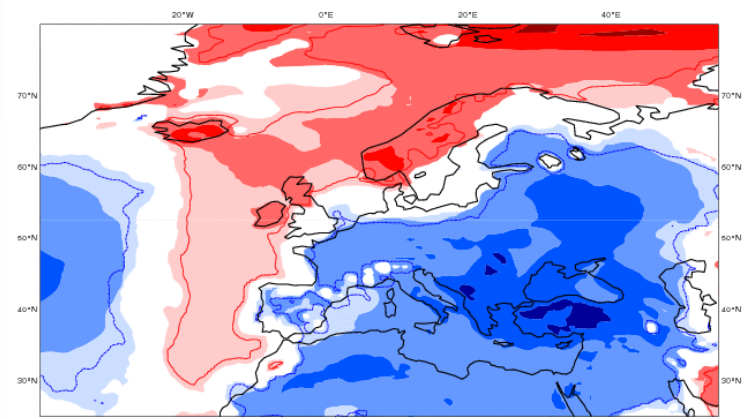
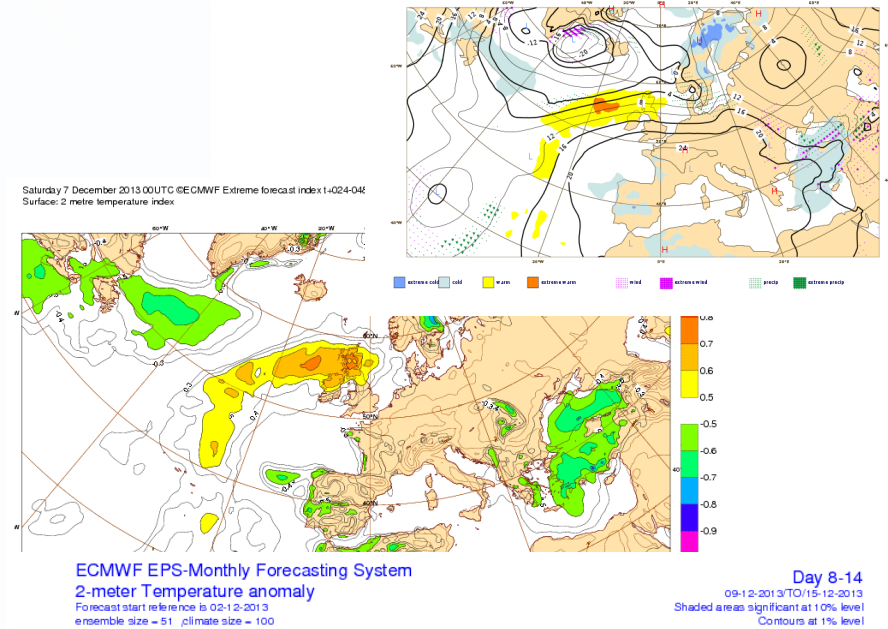
Forecast and M-Climate cumulative distribution functions with EFI values at 67.5°N/19°E valid for 24 hours from Sunday 8 December 2013 00 UTC to Monday 9 December 2013 00 UTC



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Max: 24-48h M-Climate extrema  
Mn:

Anomalous weather predicted by EPS: Sunday 08 December 2013 at 00 UTC  
1000 hPa Z ensemble mean ( Sunday 08 December 2013 at 12 UTC )  
and EFI values for Total precipitation, maximum 10m wind gust and mean 2m temperature (all 24h)  
valid for 24 hours from Sunday 08 December 2013 at 00 UTC to Monday 09 December 2013 at 00 UTC





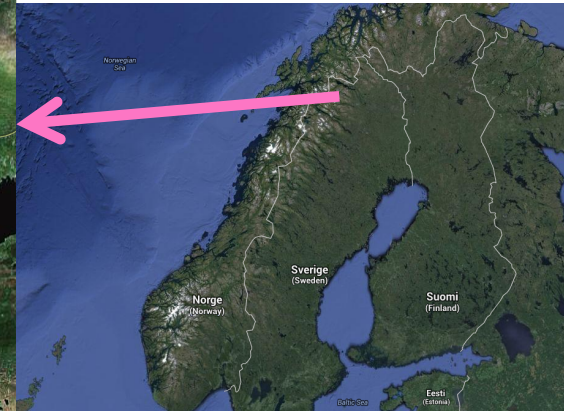
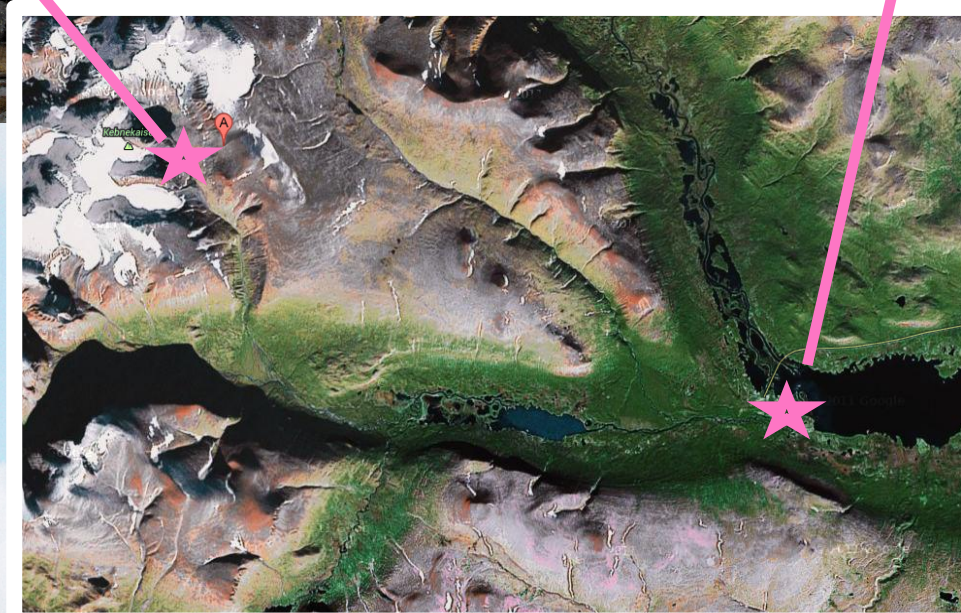
# Why do we need reforecasts?



Motivation 1:

Tarfala

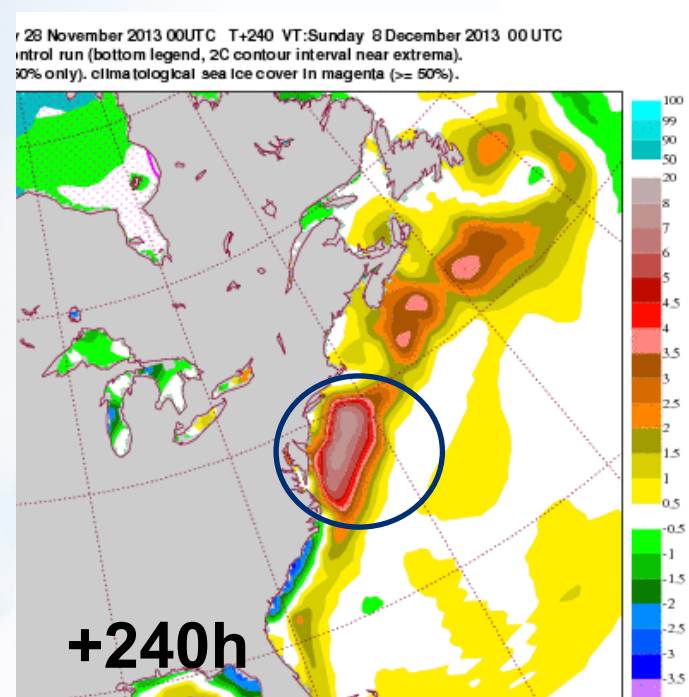
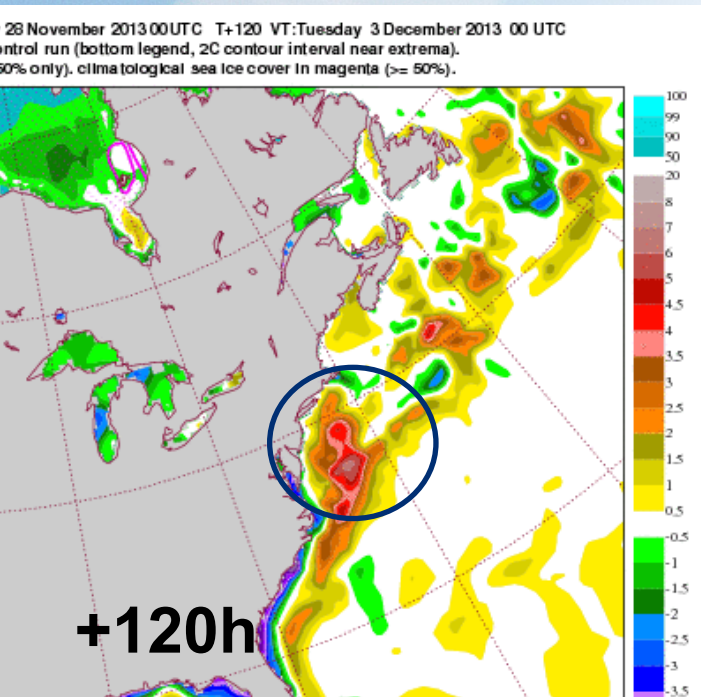
Nikkaloukta



17 km between the stations, ENS resolution 32 km..



## Motivation 2:

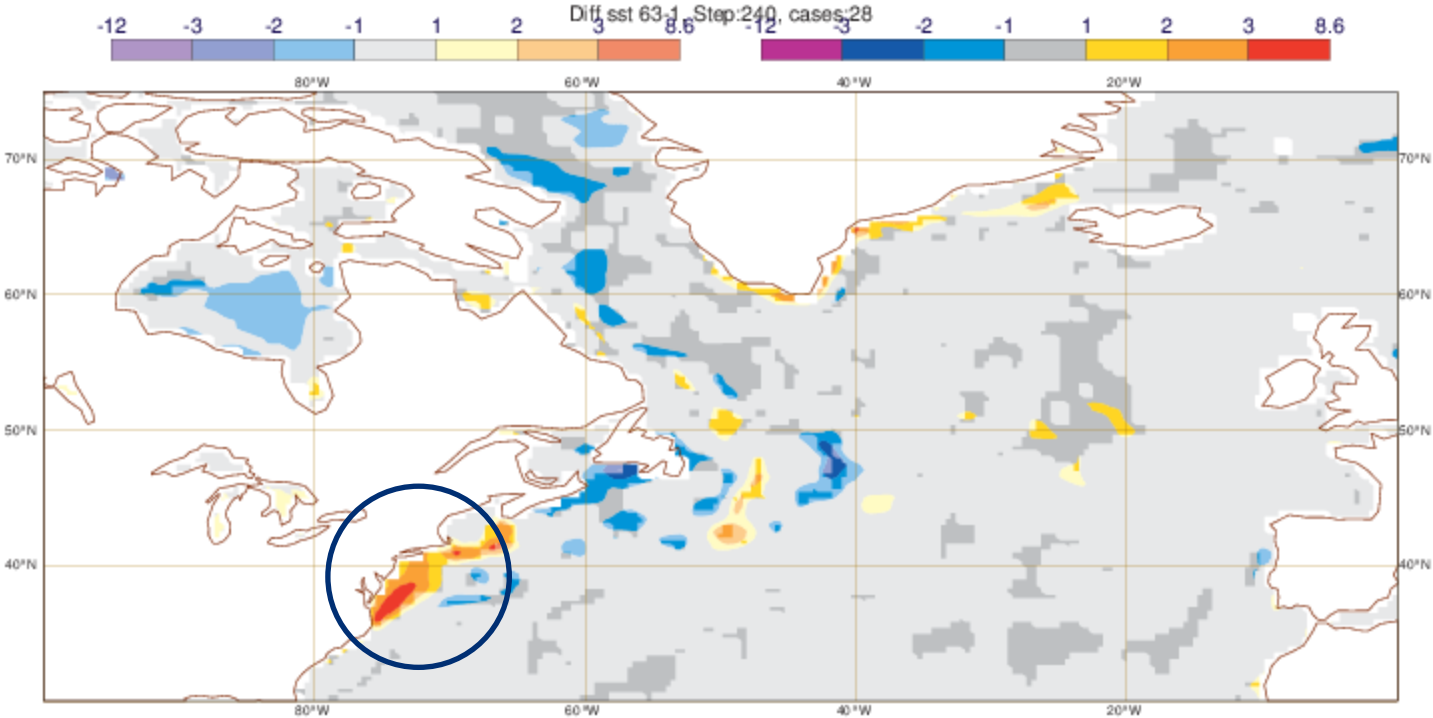


SST anomaly  
(from the obs.  
climatology)

Forecasts from 28  
Nov 0 UTC

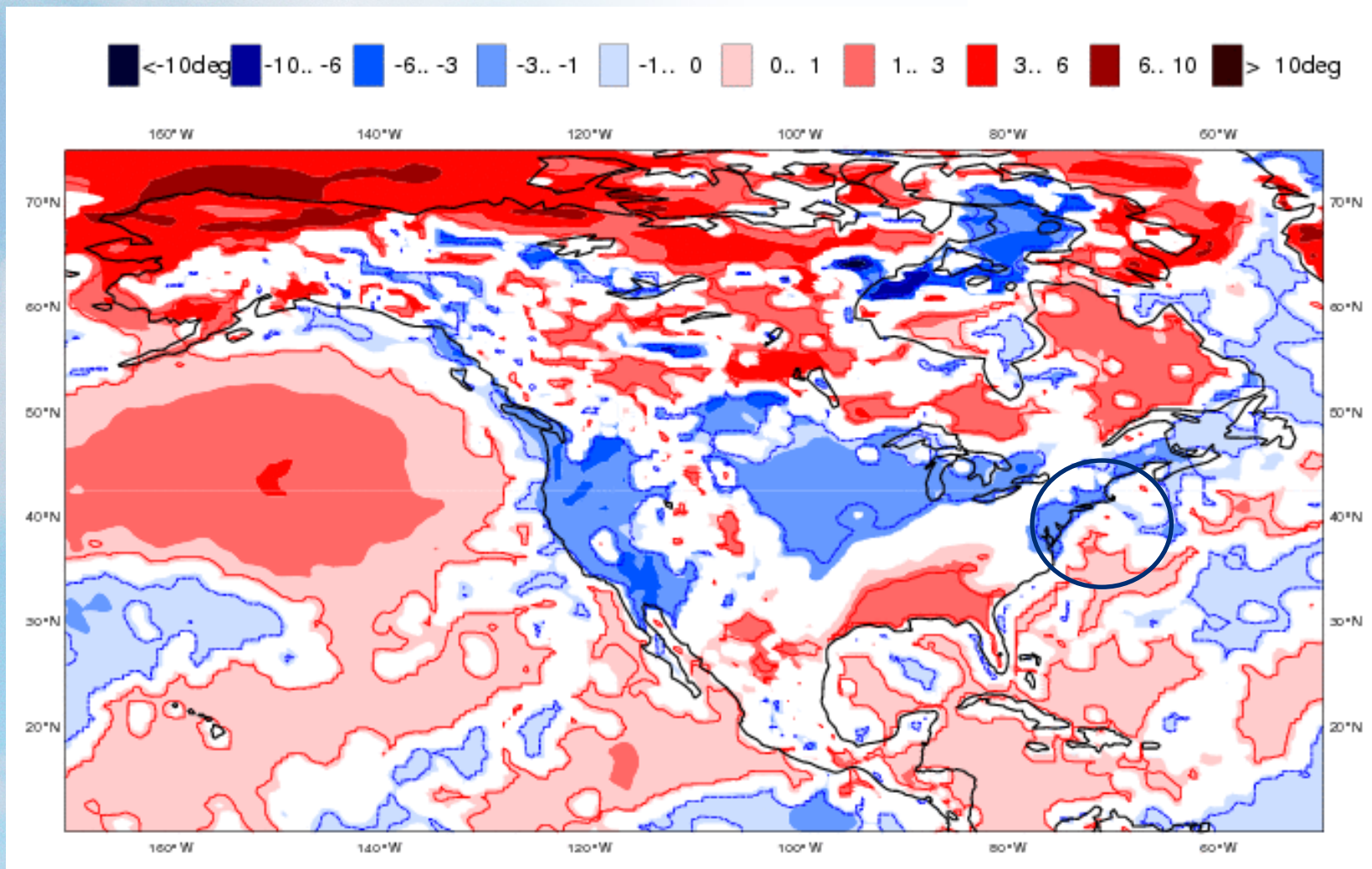


# Model bias day 10





# Anomaly in respect to model climate (weekly mean)





# Why do we need reforecasts?

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- Local conditions that is not covered by the model grid (look at anomalies to the model climate)
- Account for systematic errors in the model
- Account for model drift (change in systematic error with lead time)



**Aim of reforecasts:  
Sampling the climatology of the current model version**

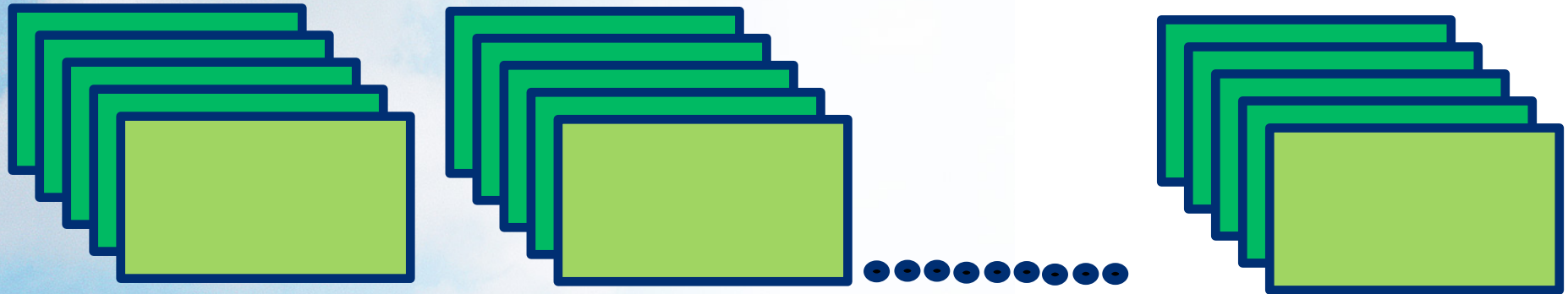
# Configuration of reforecasts

Example: Thursday 12 December 2013:

12 December 1993:

12 December 1994:

12 December 2012:



20 years x 5 forecasts = 100 forecasts

Present model version

Ensemble configuration to 32 days

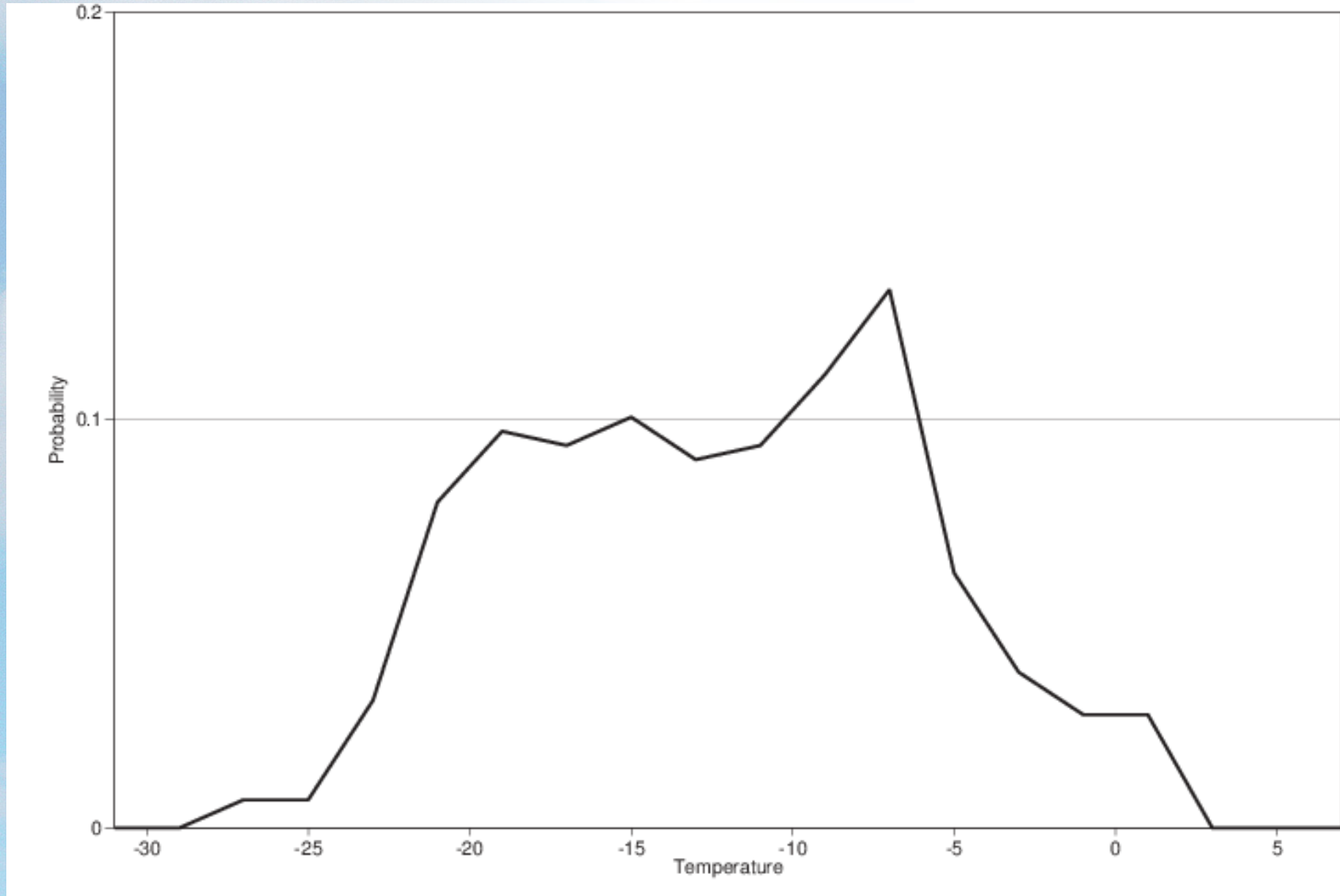
Initialised from ERA Interim



# Example: 2-metre temperature values for 132-hour reforecasts

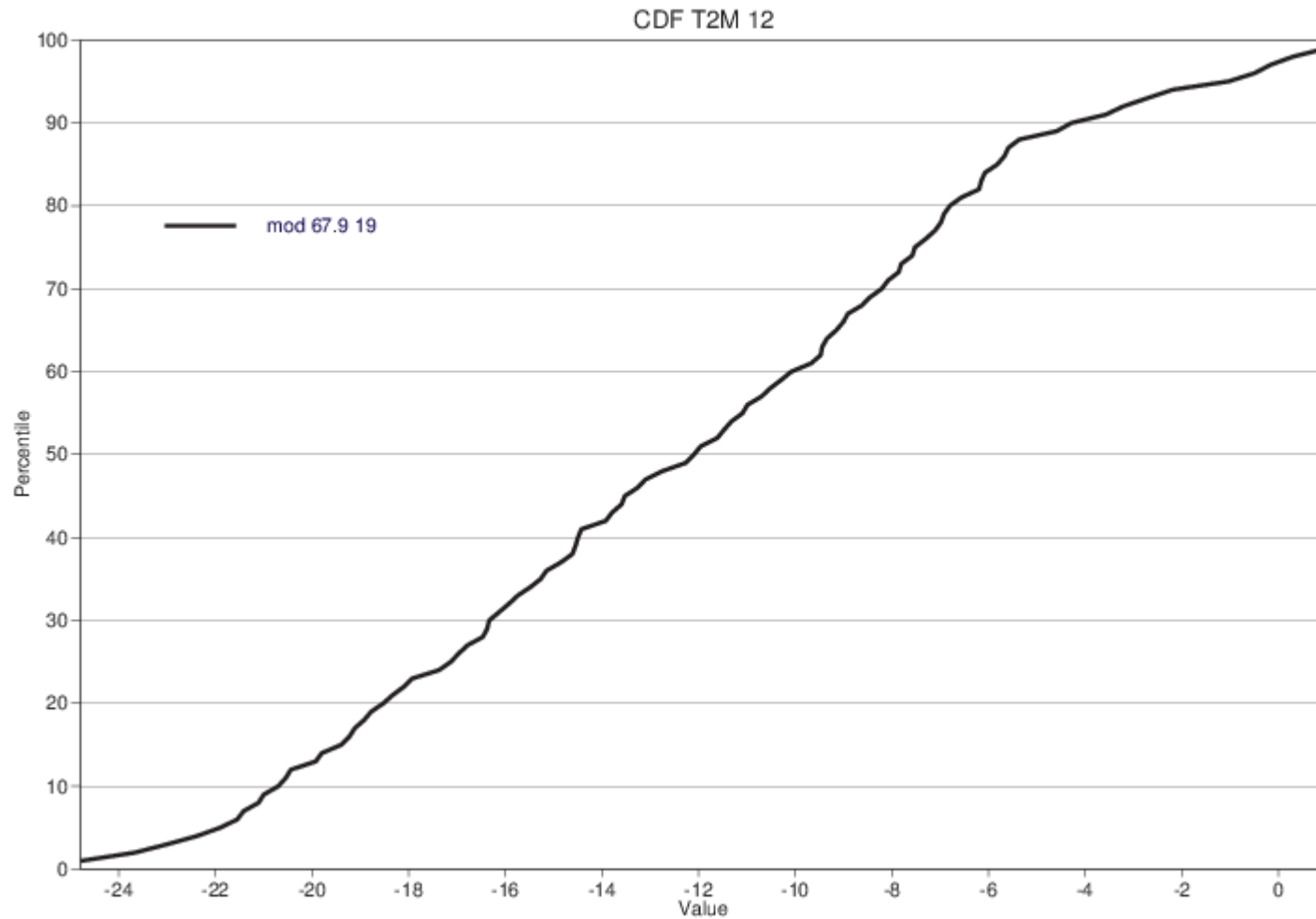
-11	-16	-16	-23	-22	-19	-19	-12
-17	-11	-13	-18	-18	-21	-18	-20
-12	-17	-22	-22	-21	-19	-7.6	-6.2
-8.9	-6.7	-24	-21	-26	-18	-8.2	-8.4
-11	-13	-19	-11	-13	-9.7	-24	-18
-20	-25	-6.8	-9.1	-6.9	-6.9	-15	-15
-15	-16	-21	-11	-15	-19	-24	-21
-26	-22	-15	-15	-17	-15	-18	-21
-5.4	-20	-3	-5.7	-8.8	-5.4	-21	-12
-9.4	-17	-8.6	-7.3	-9	-10	-17	-21
-16	-19	-19	-23	-16	-18	-22	-21
-20	-24	-15	-16	-13	-21	-17	-20
-21	-19	-4.6	-3.7	-6.8	-5.9	-8.1	-11
-7.7	-9.6	-10	-9.9	-12	-12	-12	-7.1
-20	-15	-9.5	-19	-12	-14		

# Probability distribution function (PDF)

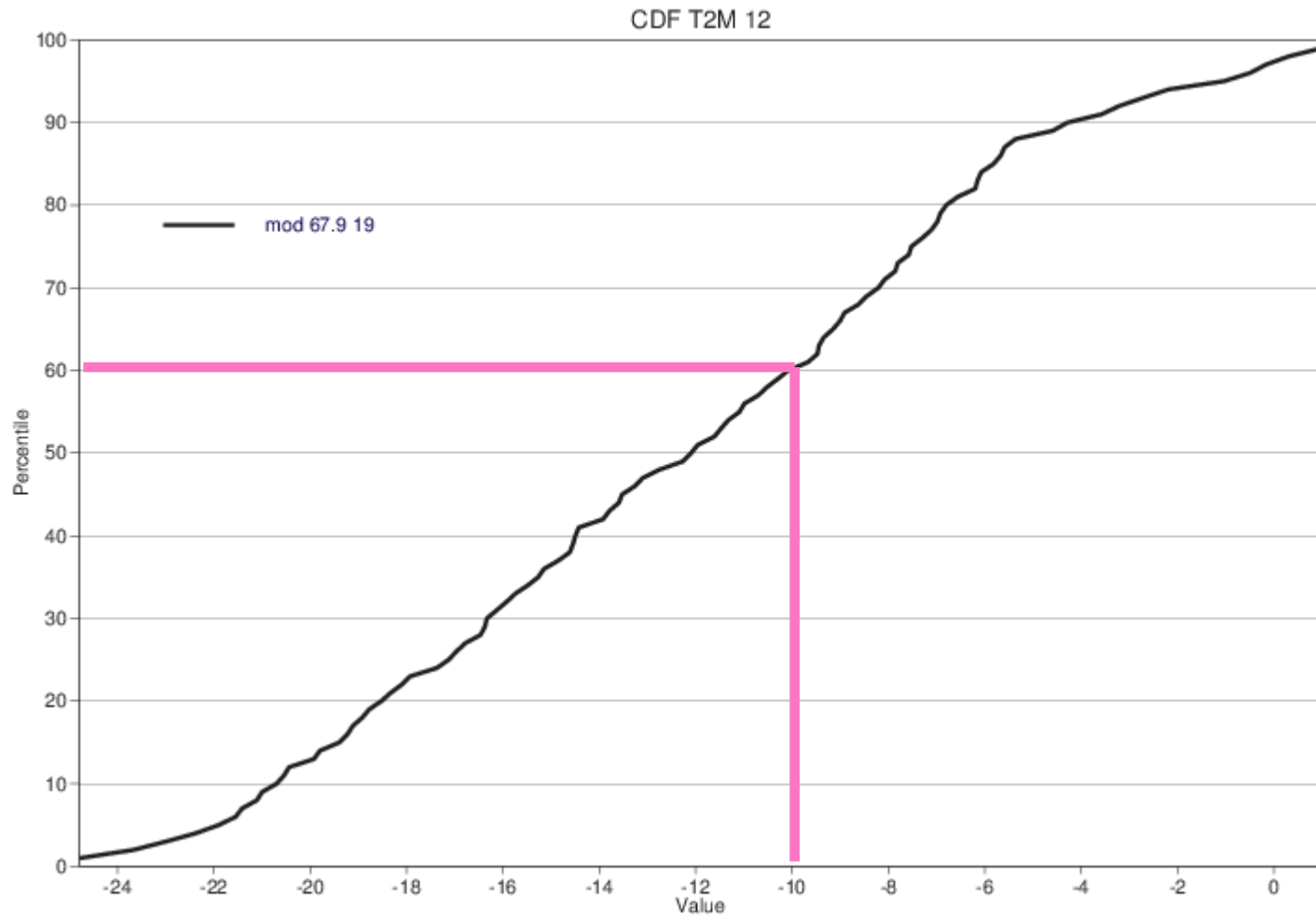




# Cumulative distribution function (CDF)

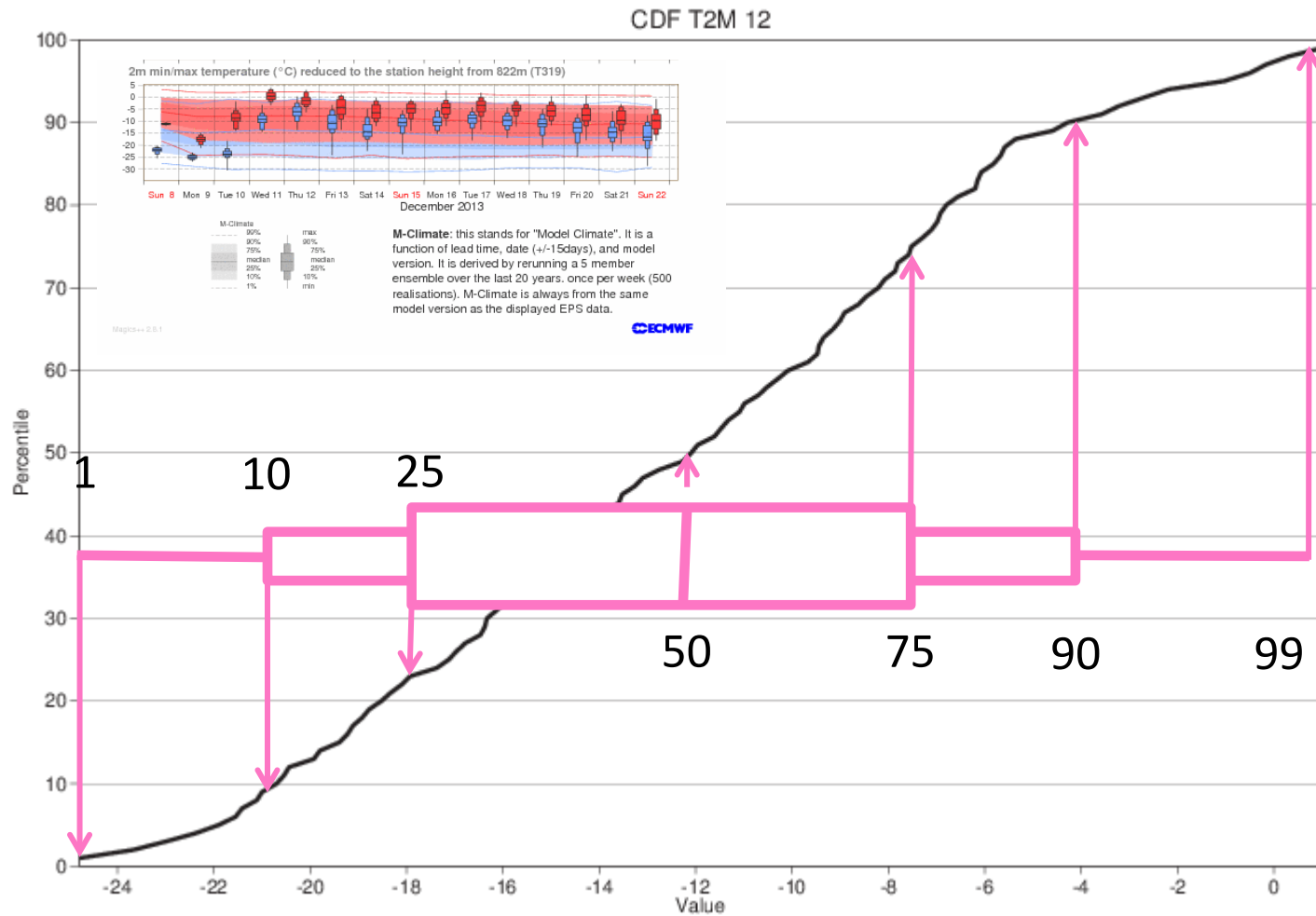


# What is the probability for temperature < -10 ?

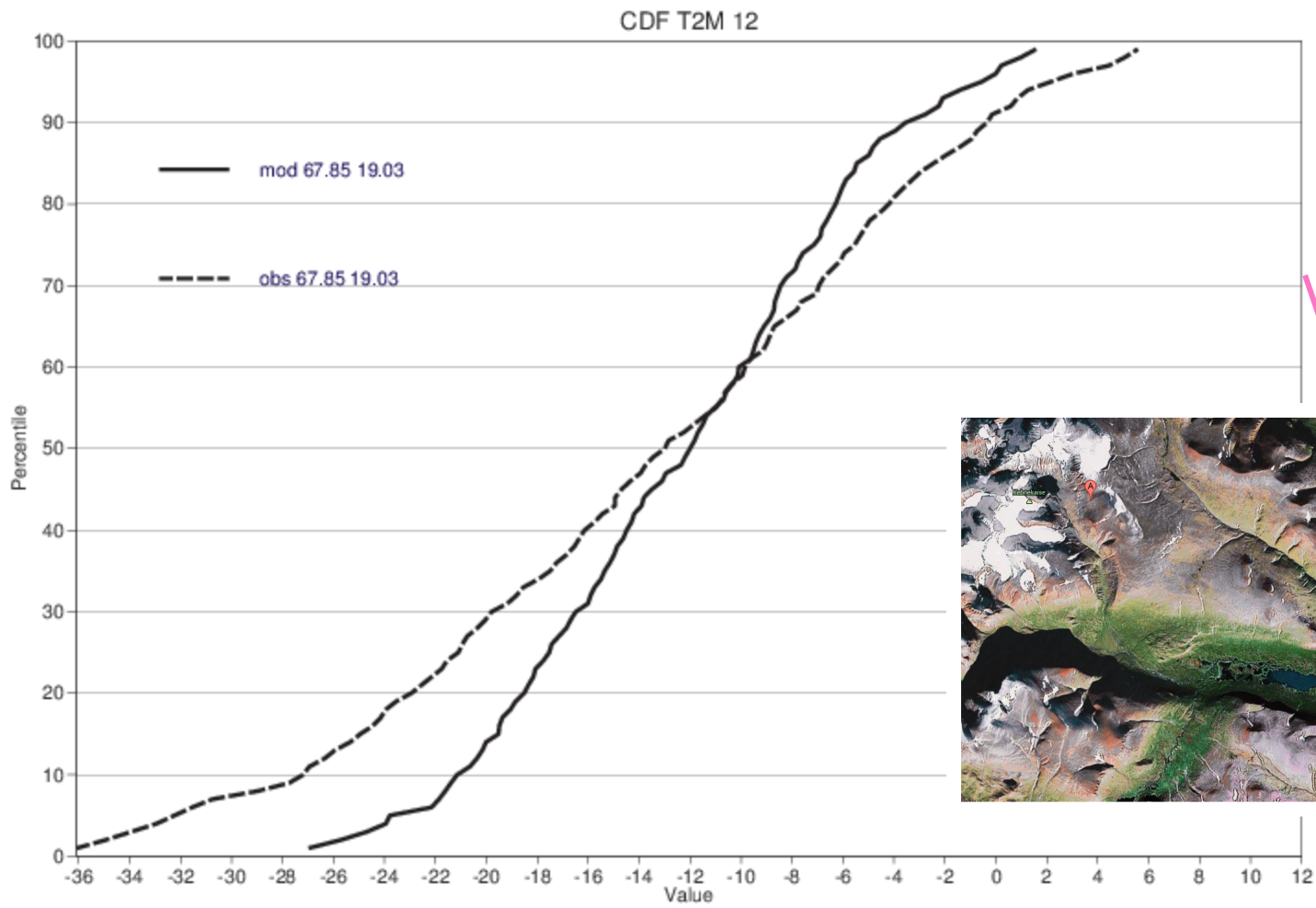




# Cumulative distribution function

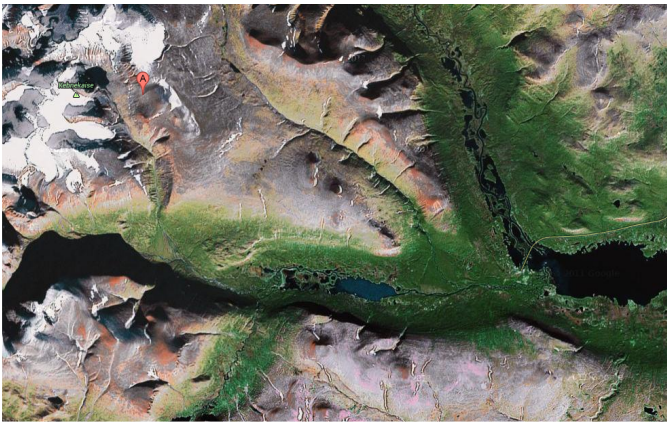
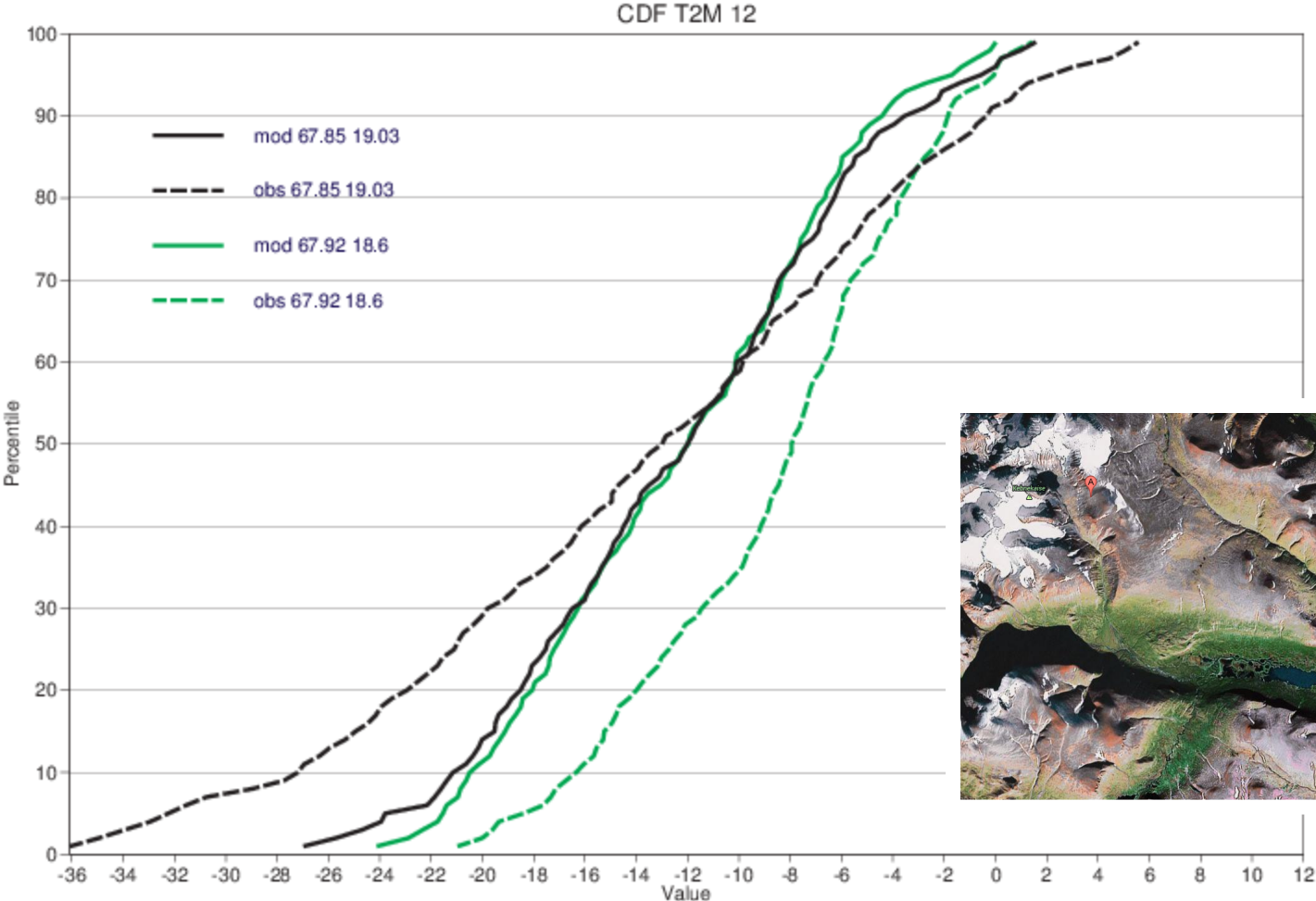


# Model climate and observed climate (Nikkaloukta)



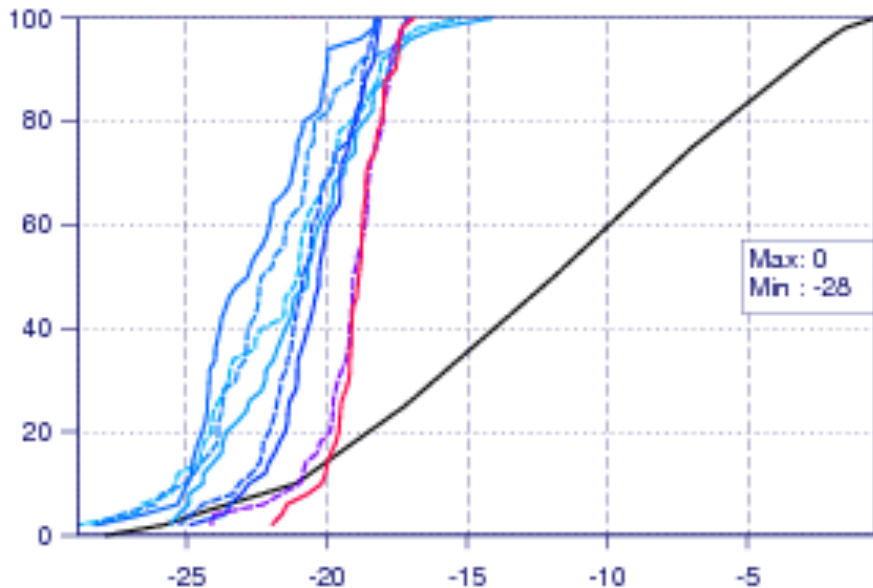


# Nearby stations (Nikkaloukta –black, Tarfala – green)



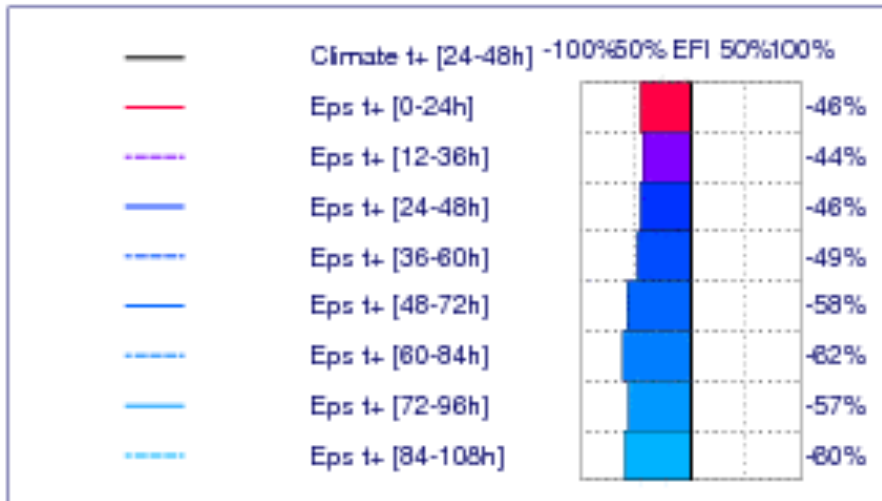
# How to use the reforecast data set?

CDF for 24h mean 2m temperature (°C)



Max:  
Min:

24-48h M-Climate extrema



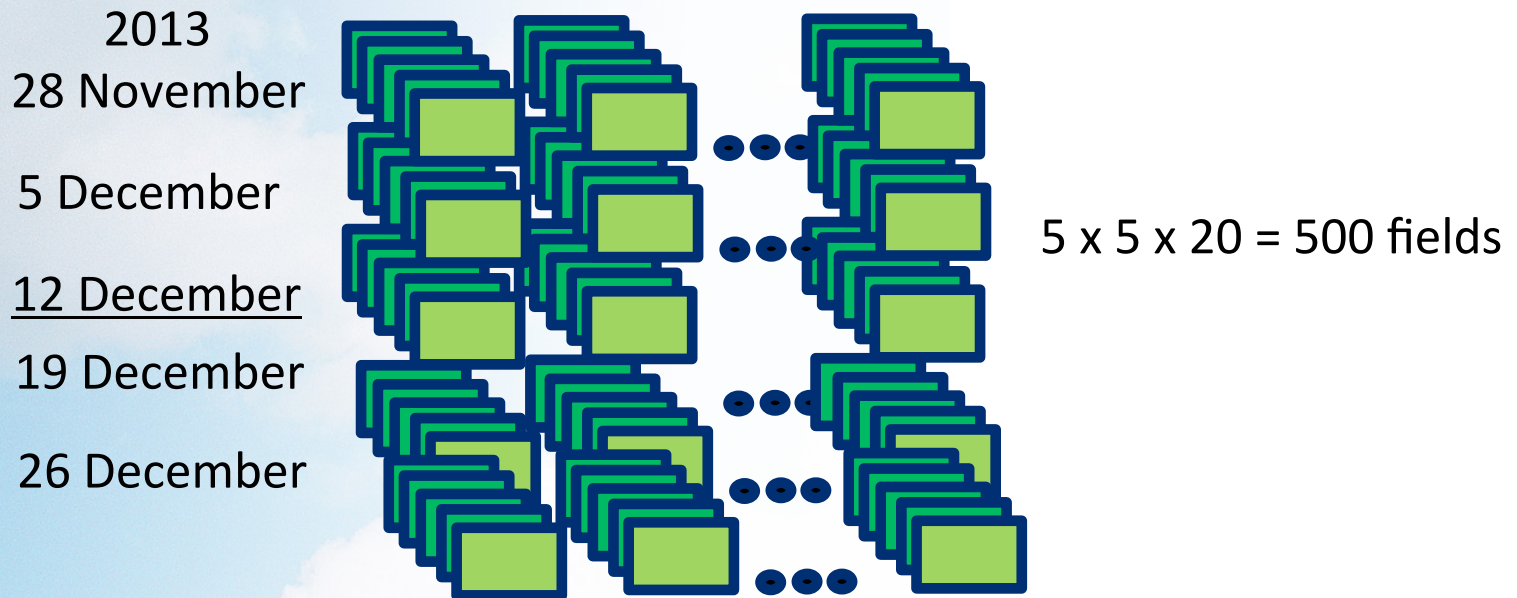
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# Sampling issues: Extreme forecasts

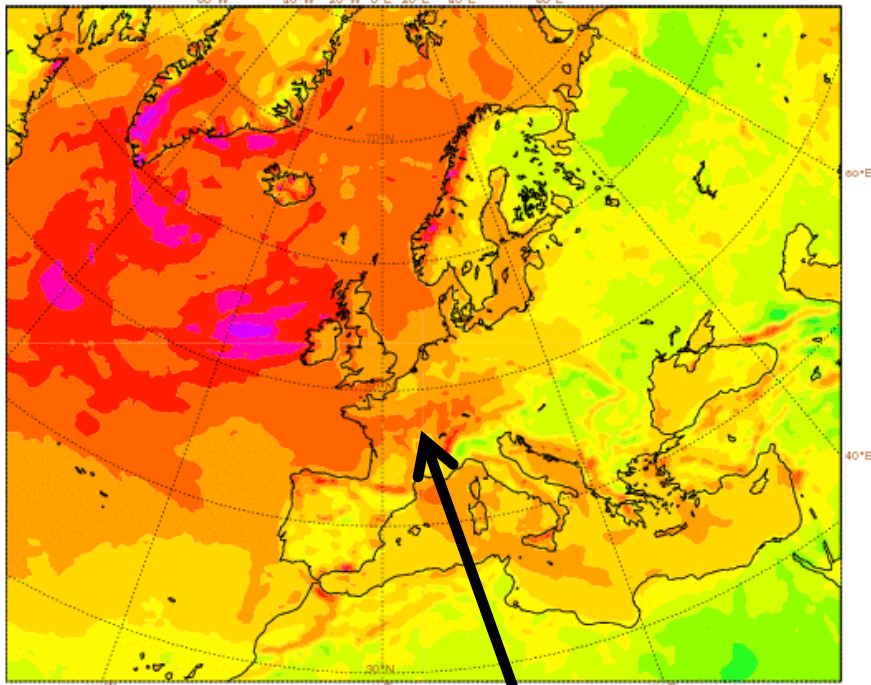
- Need to sample the tails of the distribution
- Focus on short to medium range
- Problems with correlated forecasts (members, steps)



# 99<sup>th</sup> percentile of climate (24-hour max. wind gusts)

Day 1

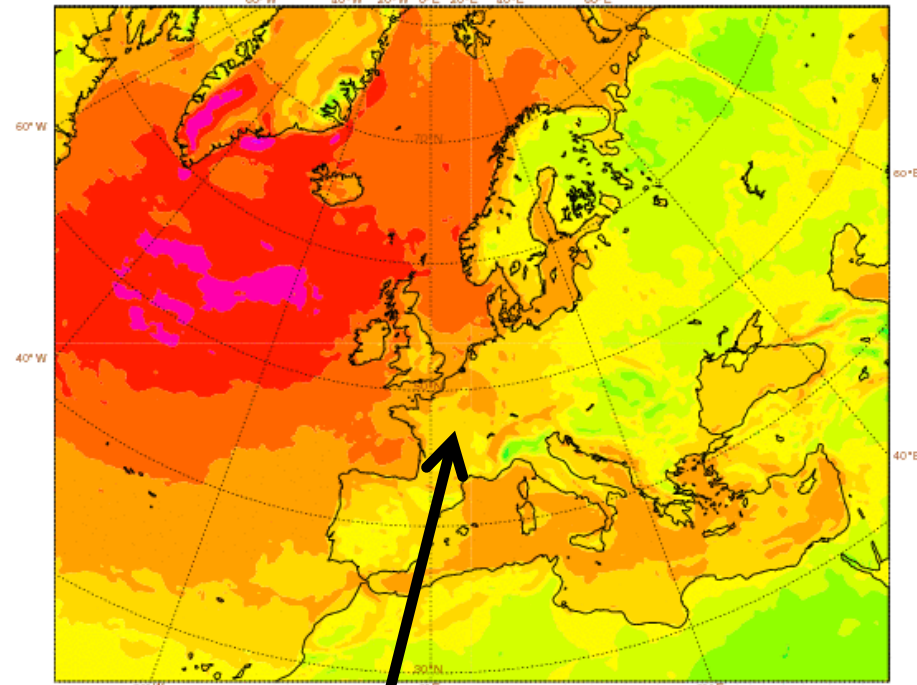
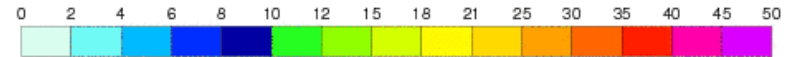
Thu 19 Dec 2013 00UTC ©ECMWF VT: Fri 20 Dec 2013 00UTC - Sat 21 Dec 2013 00UTC 0-24h  
10m wind gusts (in m/s) Model climate Q99 (one in 100 occasions realises more than value shown)



30-35 m/s

Day 7

Thu 19 Dec 2013 00UTC ©ECMWF VT: Thu 26 Dec 2013 00UTC - Fri 27 Dec 2013 00UTC 144-168h  
10m wind gusts (in m/s) Model climate Q99 (one in 100 occasions realises more than value shown)

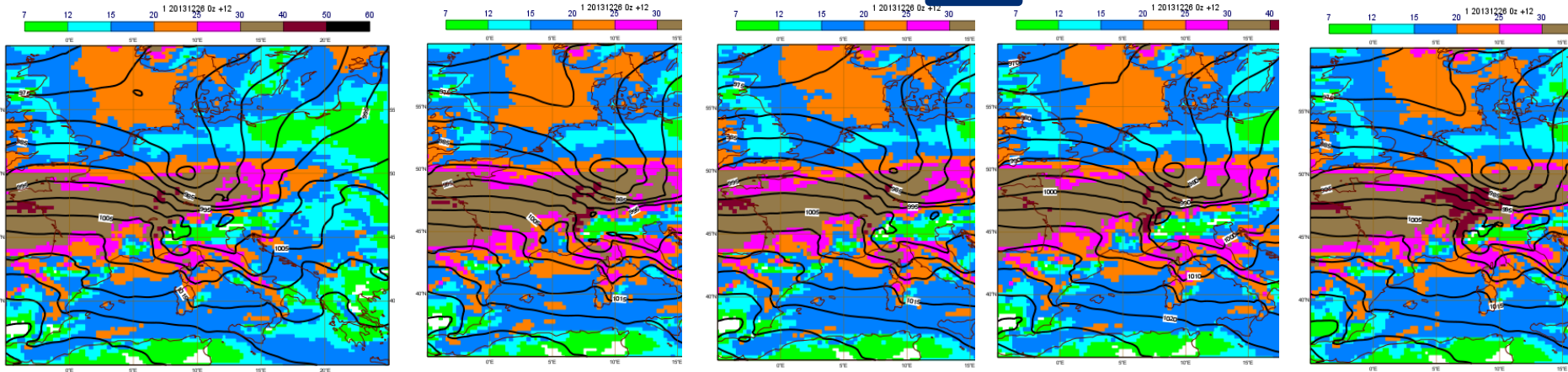


21-25 m/s

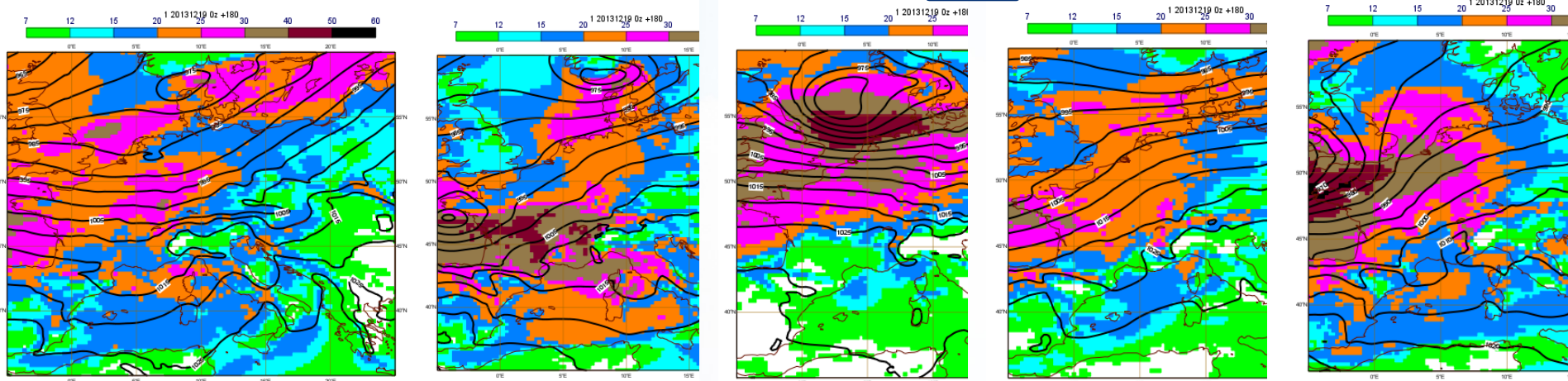


# Reforecasts valid 26 December 1999 (Max. wind gusts and MSLP)

From 26 December 1999 +12h



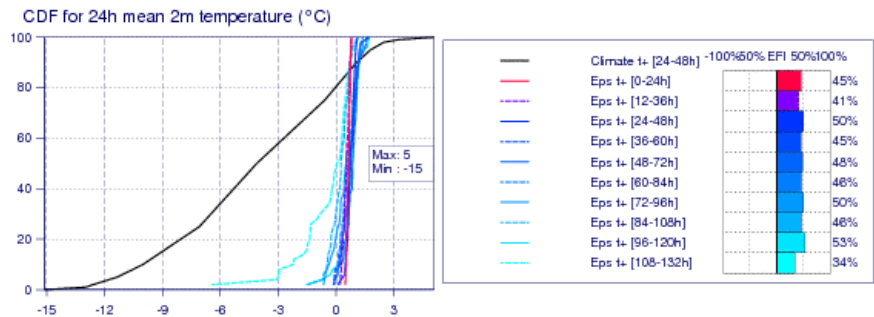
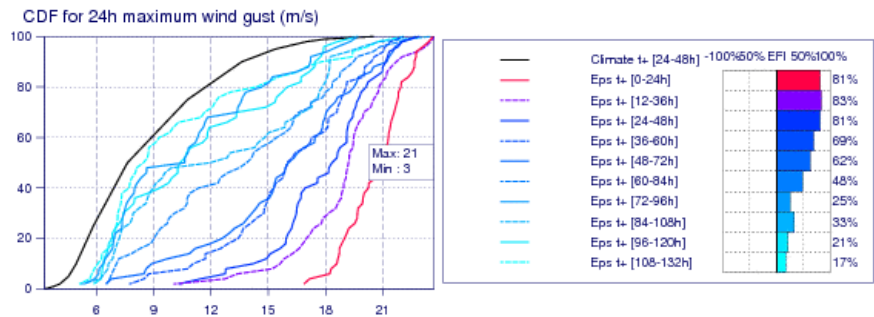
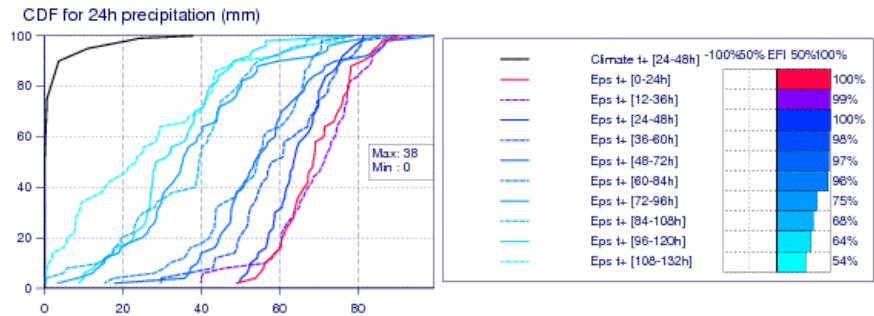
From 19 December 1999 +180h





# Forecast outside the model climate:

Forecast and M-Climate cumulative distribution functions with EFI values at 46.33°N/12.48°E valid for 24 hours from Friday 31 January 2014 00 UTC to Saturday 1 February 2014 00 UTC



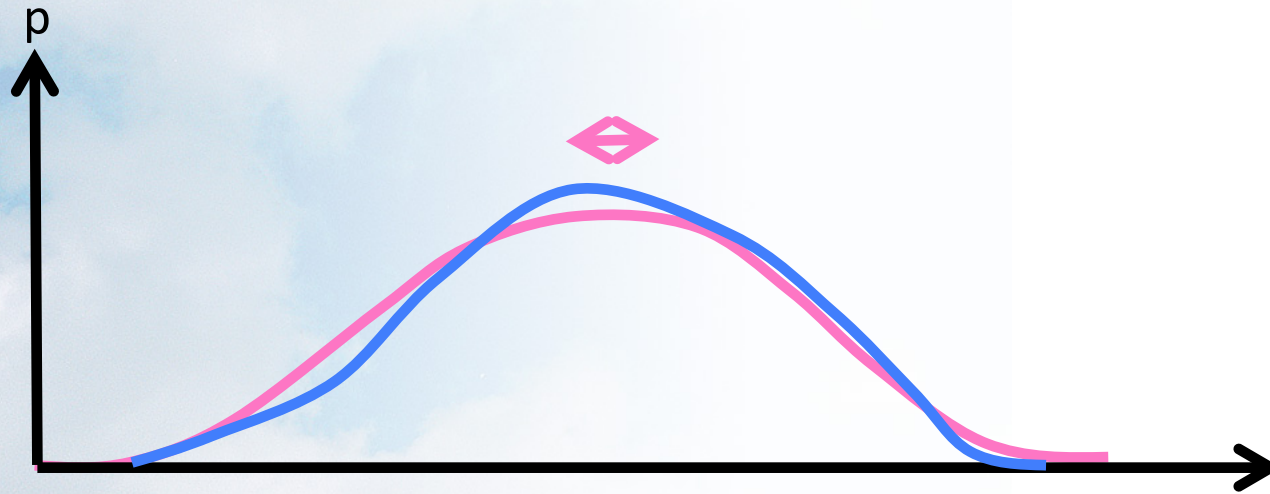
Max: 24-48h M-Climate extrema  
Min:

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Magps++ 2.5.1

# Long forecast (monthly, seasonal)

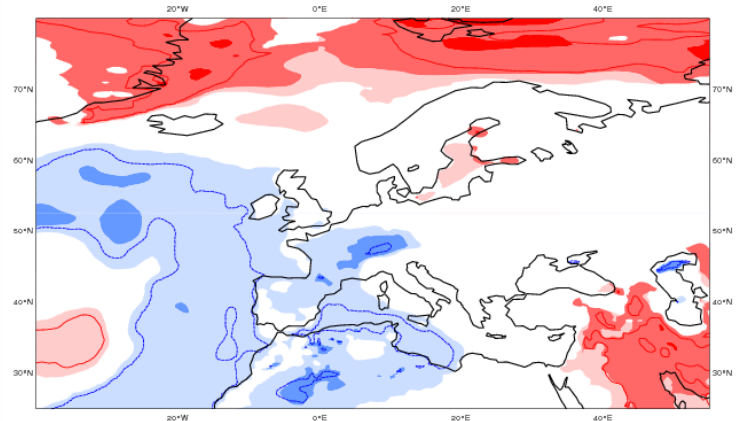


Normally weak signals

ECMWF EPS-Monthly Forecasting System  
2-meter Temperature anomaly  
Forecast start reference is 22-01-2015  
ensemble size = 51 climate size = 200

Day 26-32  
16-02-2015/10/22-02-2015  
Shaded areas significant at 10% level  
Contours at 1% level

■ <-10deg ■ -10..-6 ■ -6..-3 ■ -3..-1 ■ -1.. 0 ■ 0.. 1 ■ 1.. 3 ■ 3.. 6 ■ 6.. 10 ■ > 10deg



# Sampling issues: Monthly forecasts

- Need to sample the mean
- Model drift
- Sensitive to subtle difference between real time forecast and reforecast configuration





# Sampling issues: How to extend the number of fields

Use more time steps = correlation on the large scale, model drift



Use more start dates = seasonal cycle issues



# Configuration of reforecasts for seasonal forecasts

Example: 1 November

1 November 1981:

1 November 1982:

1 November 2010:



30 years x 15 forecasts = 450 forecasts

Run once for System 4, Initialised from ERA Interim

Bias correction and estimate of skill

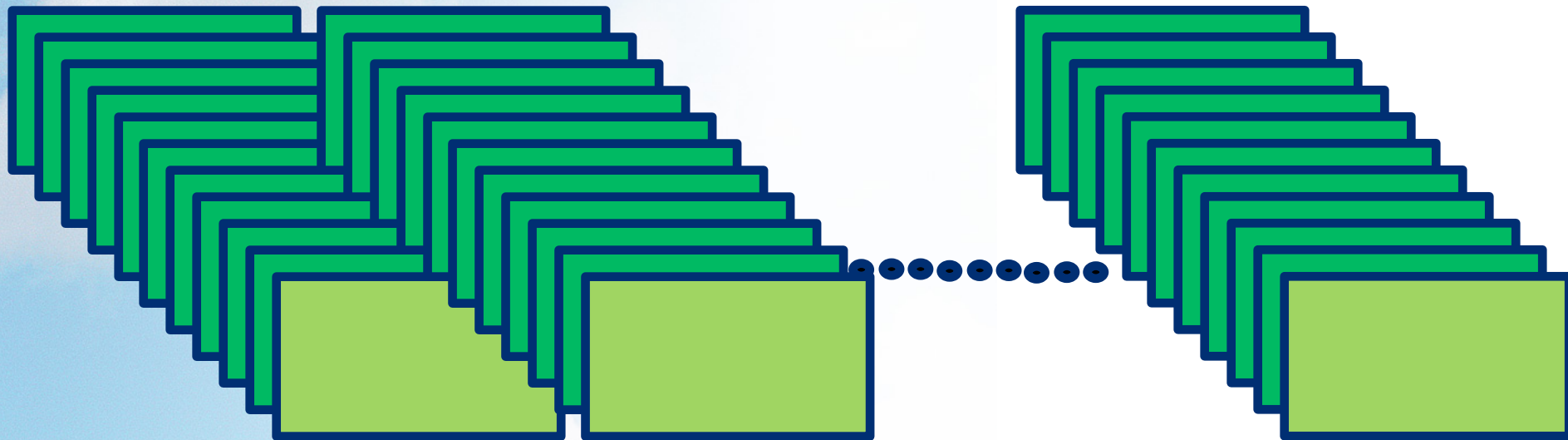
# Configuration of reforecasts (from next model upgrade)

Example: Thursday 12 December 2013:

12 December 1993:

12 December 1994:

12 December 2012:



20 years x 11 forecasts = 220 forecasts

Present model version

Ensemble configuration to 32 days

Initialised from ERA Interim

Twice a week + 5 weeks window for EFI  
= 1980 forecasts



# Monthly forecast anomalies – new configuration

Monday Thursday Monday



20 years x 11 forecasts x 3 dates = 660 forecasts

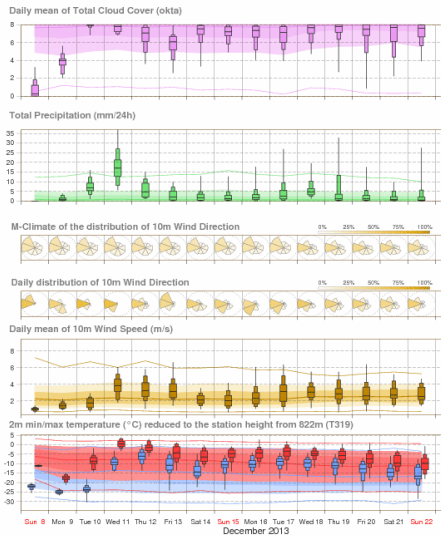
## Summary

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- The model climate can be different from the observed climate
- We need the model climate to determine whether the forecast is anomalous
- Once (twice) a week, forecasts for the 20 last years are rerun to build up the model climate
- Used for several forecast products

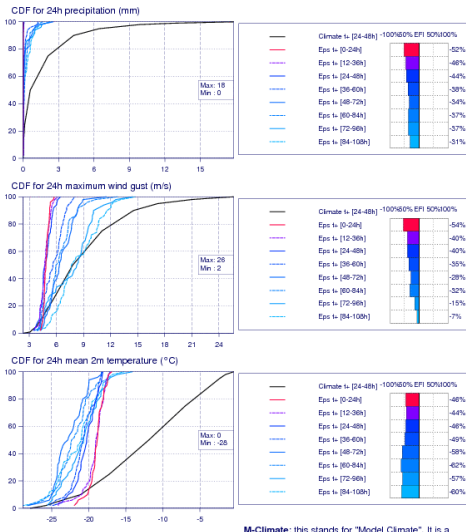
# Model climate from reforecasts

EPS Meteorogram  
67.68°N 18.67°E (EPS land point) 836 m (T639)  
Extended Range Forecast based on EPS Distribution Sunday, 8 December 2013 00 UTC



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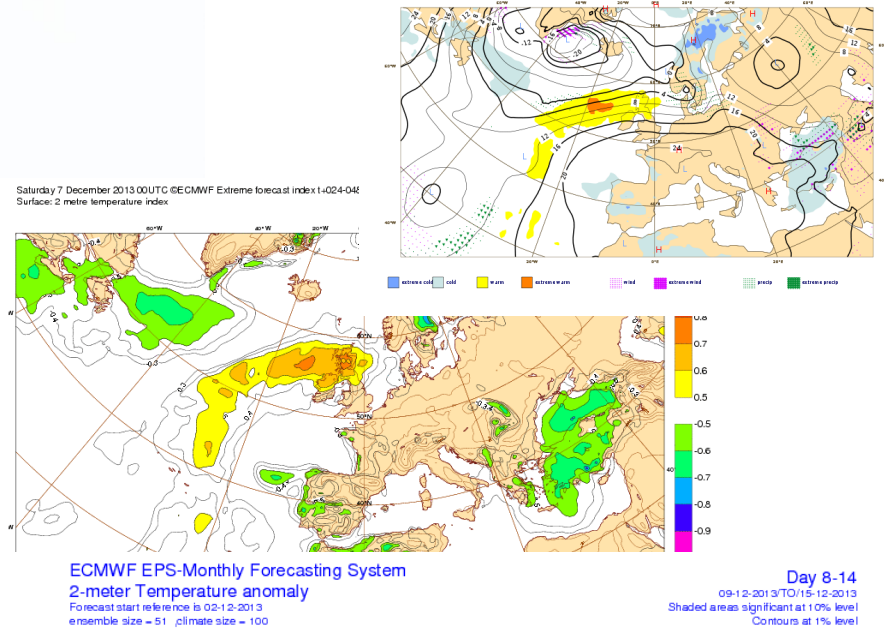
Forecast and M-Climate cumulative distribution functions with EFI values at 67.5°N/19°E valid for 24 hours from Sunday 8 December 2013 00 UTC to Monday 9 December 2013 00 UTC



Max: 24-48h M-Climate extrema  
Min:

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Anomalous weather predicted by EPS: Sunday 08 December 2013 at 00 UTC  
1000 hPa Z ensemble mean ( Sunday 08 December 2013 at 12 UTC )  
and EFI values for Total precipitation, maximum 10m wind gust and mean 2m temperature (all 24h)  
valid for 24 hours from Sunday 08 December 2013 at 00 UTC to Monday 09 December 2013 at 00 UTC



ECMWF EPS-Monthly Forecasting System  
2-metre Temperature anomaly  
Forecast start reference is 02-12-2013  
ensemble size = 51 climate size = 100

Day 8-14  
09-12-2013 15-12-2013  
Shaded areas significant at 10% level  
Contours at 1% level

