

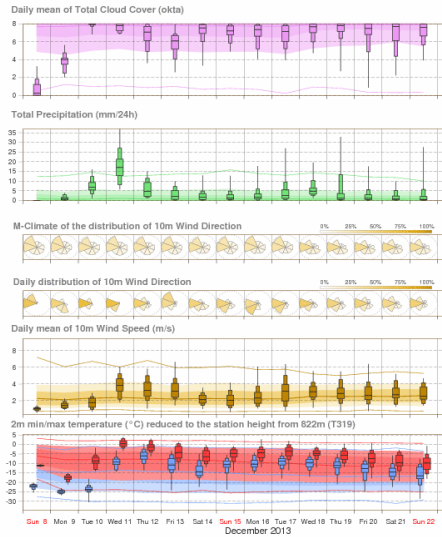
Estimation of the model climate (reforecasts)

Linus Magnusson



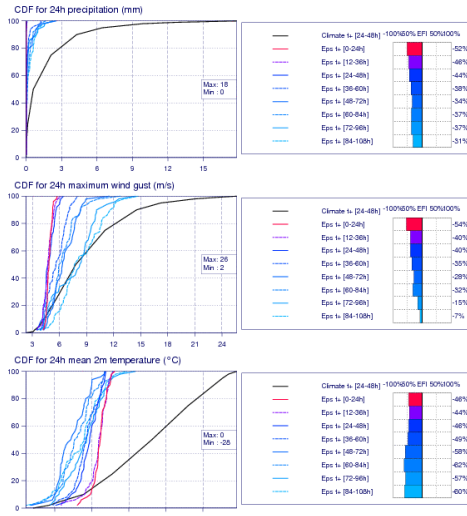
Model climate from reforecasts

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



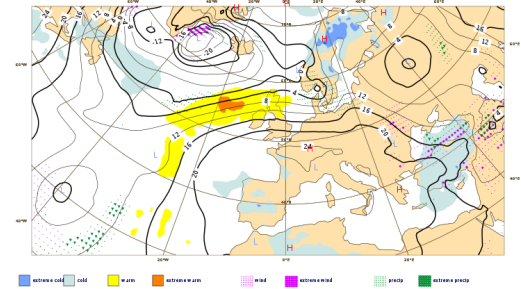
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Forecast and M-Climate cumulative distribution functions with EFI values at 67.5°N19°E valid for 24 hours from Sunday 8 December 2013 00 UTC to Monday 9 December 2013 00 UTC

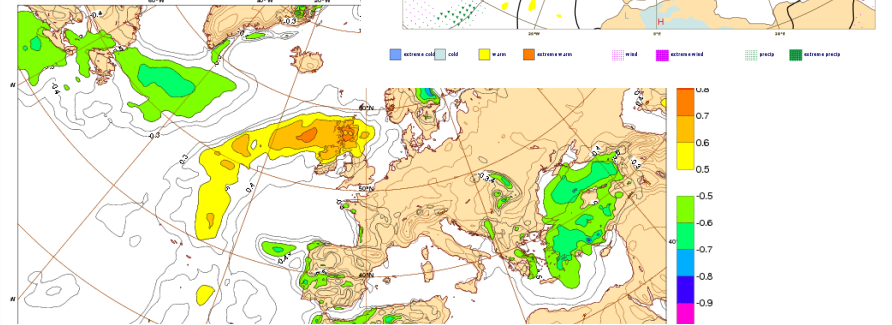


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Anomalous weather predicted by EPS: Sunday 08 December 2013 at 00 UTC
1000 hPa Z ensemble mean (Sunday 08 December 2013 at 12 UTC)
and EFI values for Total precipitation,maximum 10m wind gust and mean 2m temperature (all 24h)
valid for 24hours from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

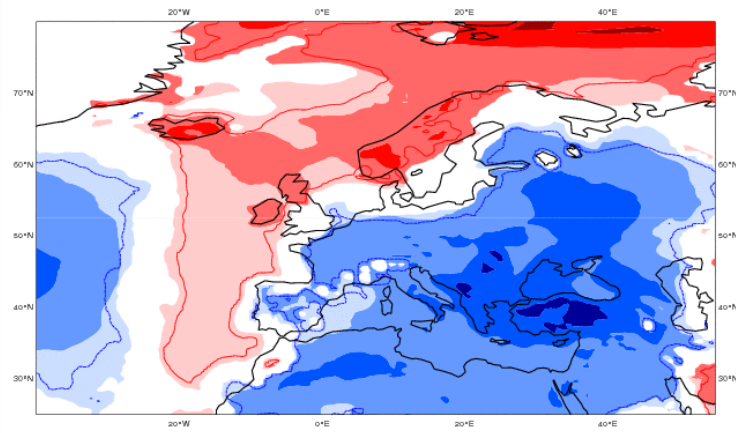


Saturday 7 December 2013 00UTC ©ECMWF Extreme forecast index i-024-04f
Surface: 2 metre temperature index



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

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



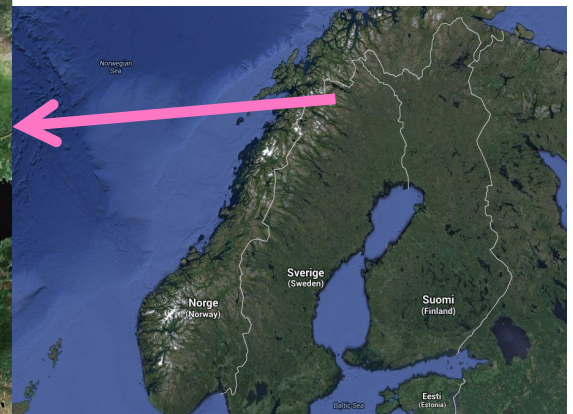
Why do we need reforecasts?



Motivation 1:

Tarfala

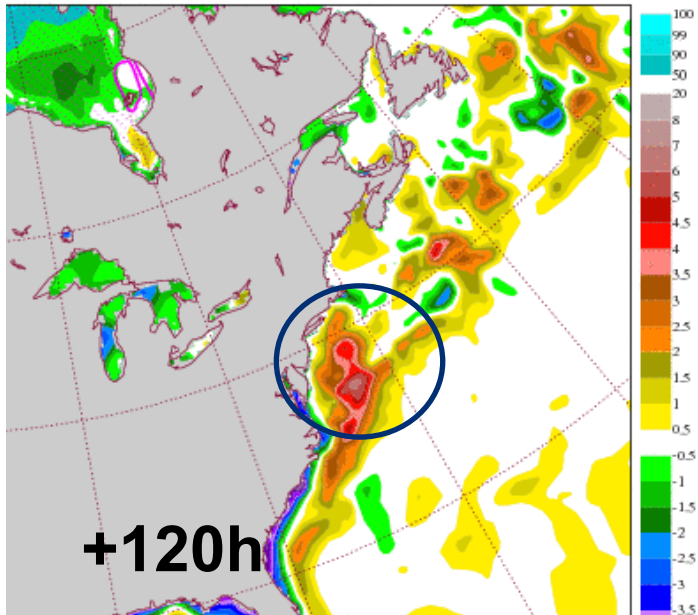
Nikkaloukta



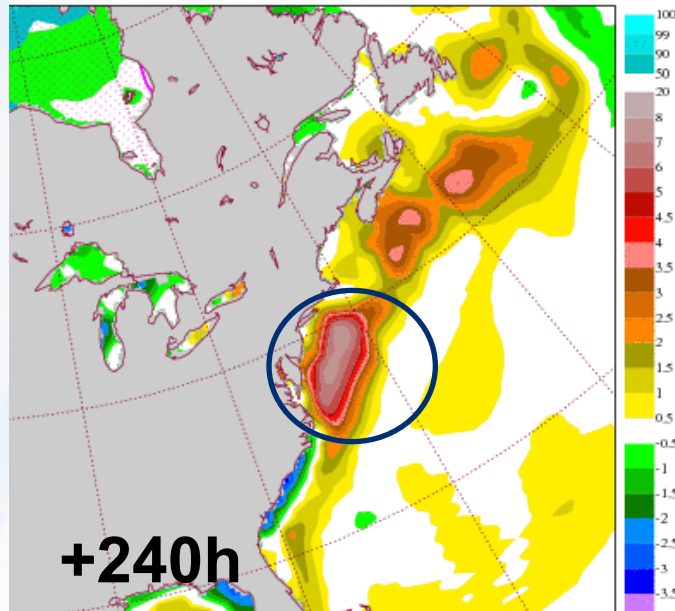
17 km between the stations, ENS resolution 32 km..

Motivation 2:

28 November 2013 00UTC T+120 VT: Tuesday 3 December 2013 00 UTC
control run (bottom legend, 2C contour interval near extrema).
30% only). climatological sea ice cover in magenta (>= 50%).



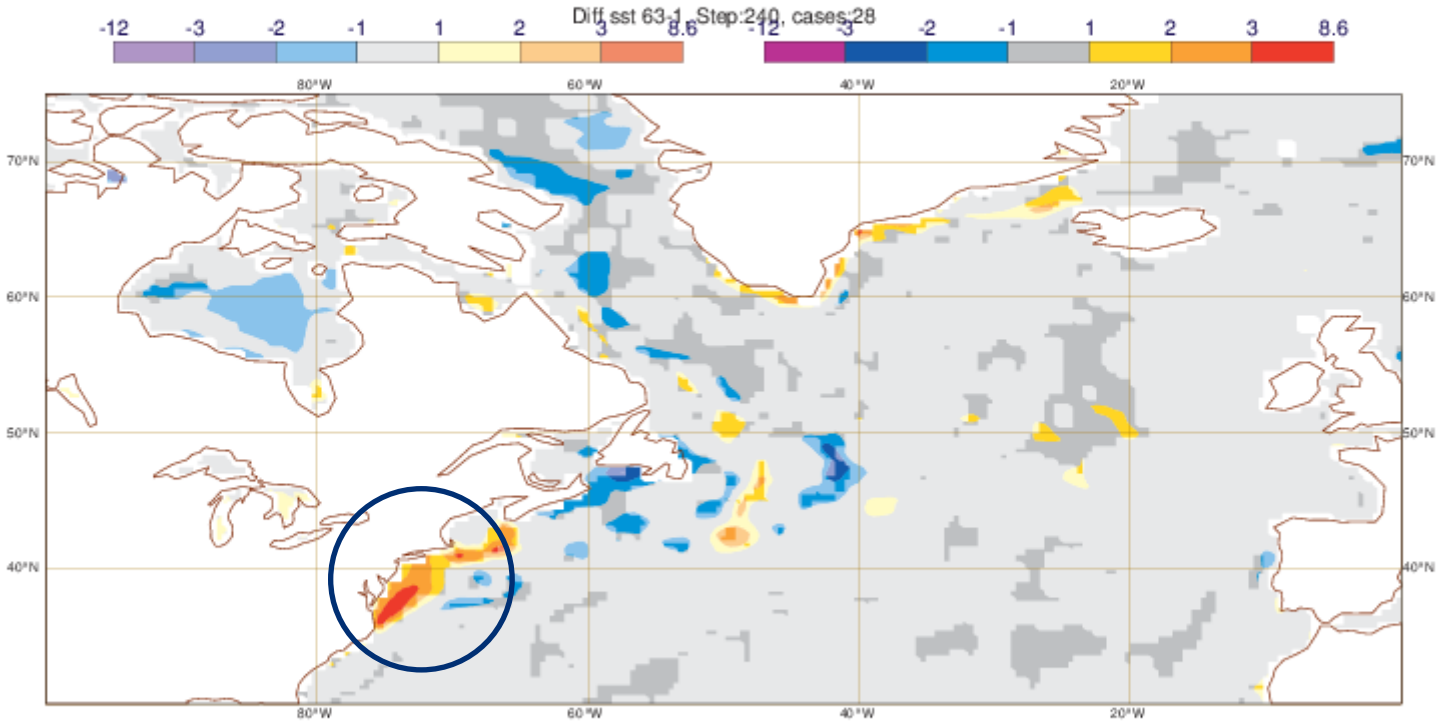
28 November 2013 00UTC T+240 VT: Sunday 8 December 2013 00 UTC
control run (bottom legend, 2C contour interval near extrema).
30% only). climatological sea ice cover in magenta (>= 50%).



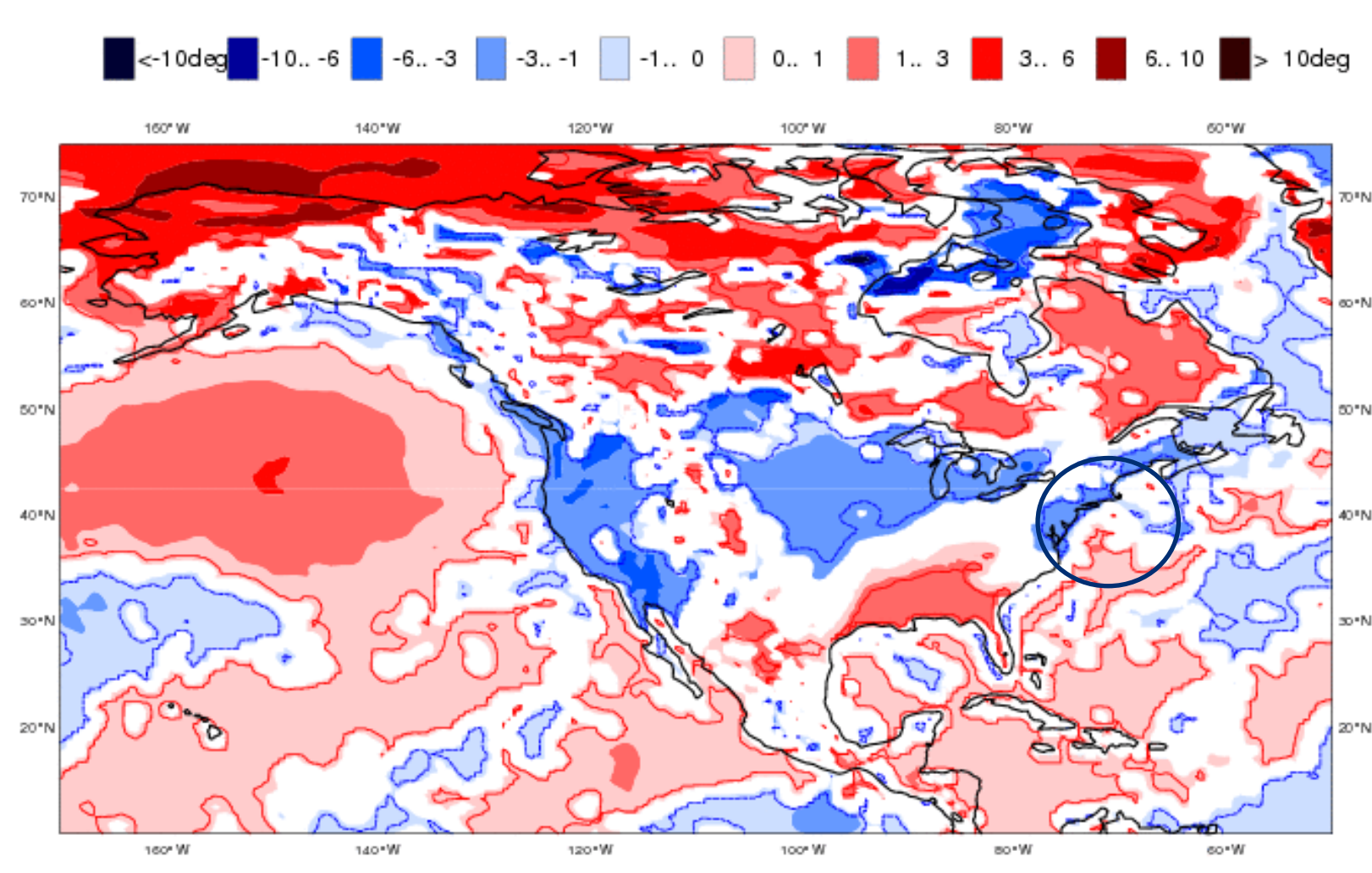
SST anomaly
(from the obs.
climatology)

Forecasts from 28
Nov 0 UTC

Model bias day 10



Anomaly in respect to model climate (weekly mean)



Why do we need reforecasts?

- 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**

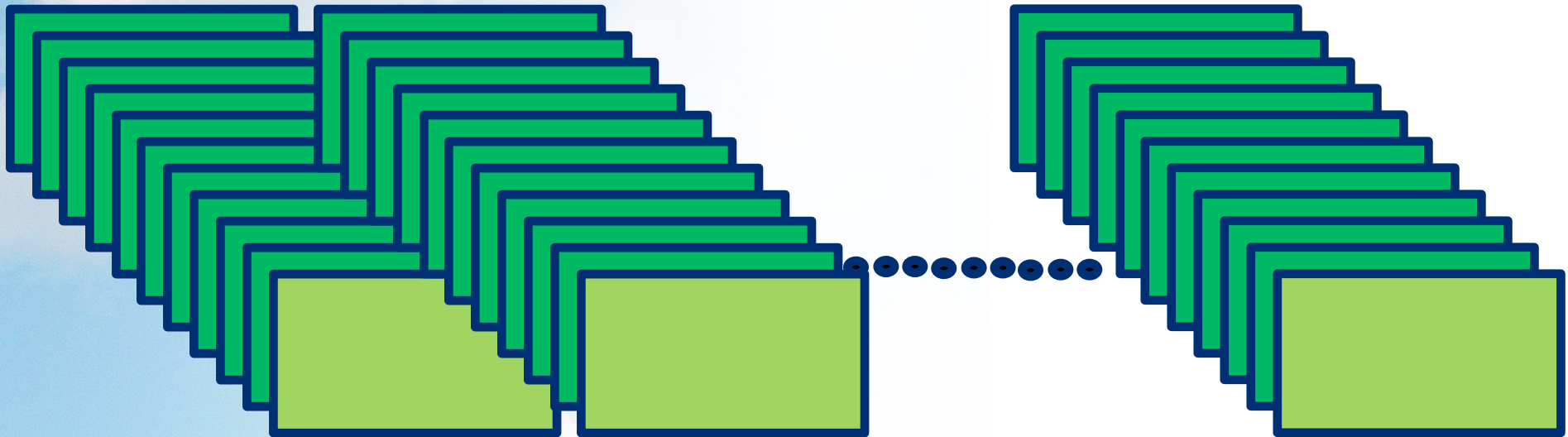
Configuration of reforecasts

Example: Thursday 28 January 2016:

28 January 2016 :

28 January 1997 :

28 January 2015:



20 years x 11 forecasts = 220 forecasts

Present model version

Ensemble configuration to 45 days

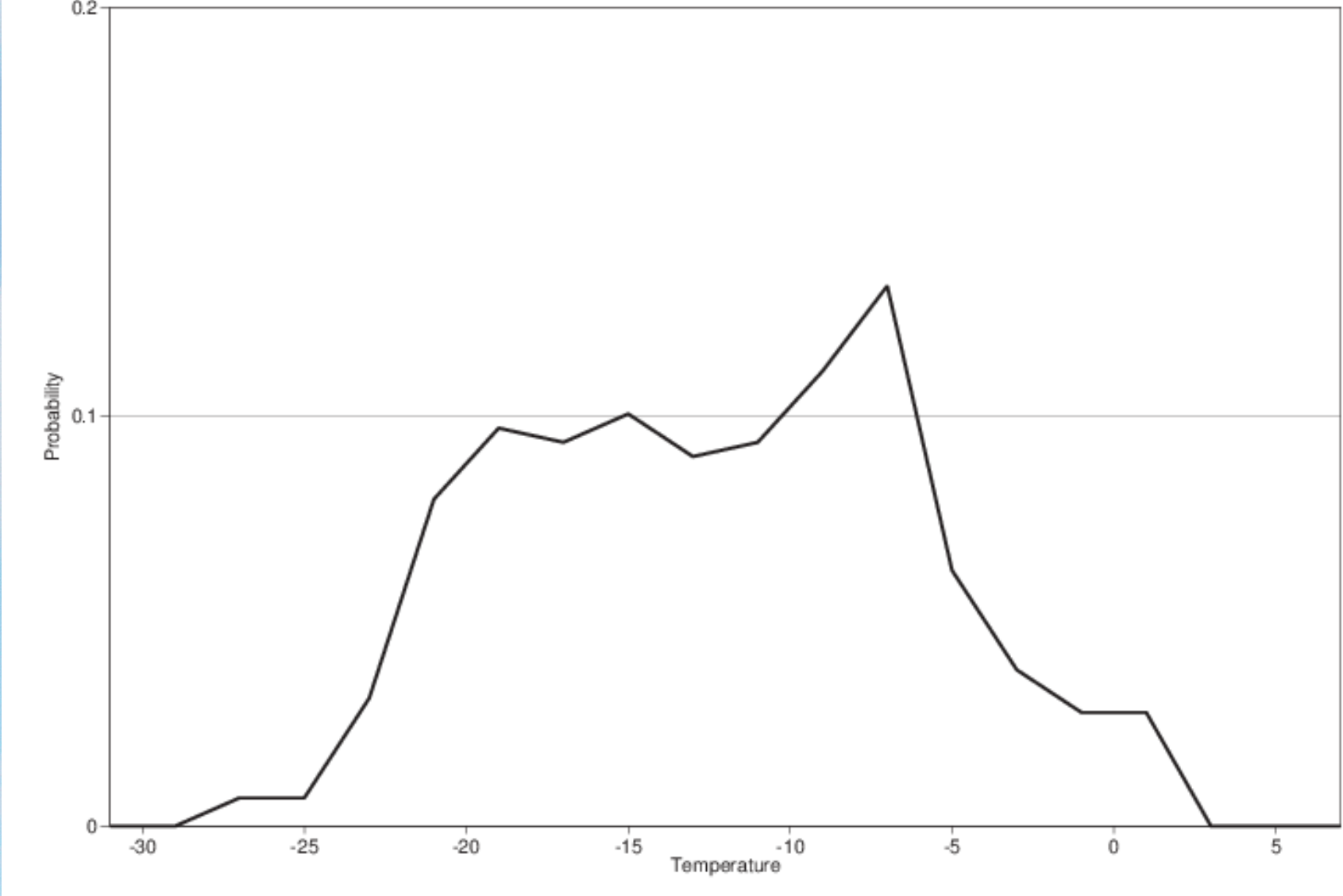
Initialised from ERA Interim

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

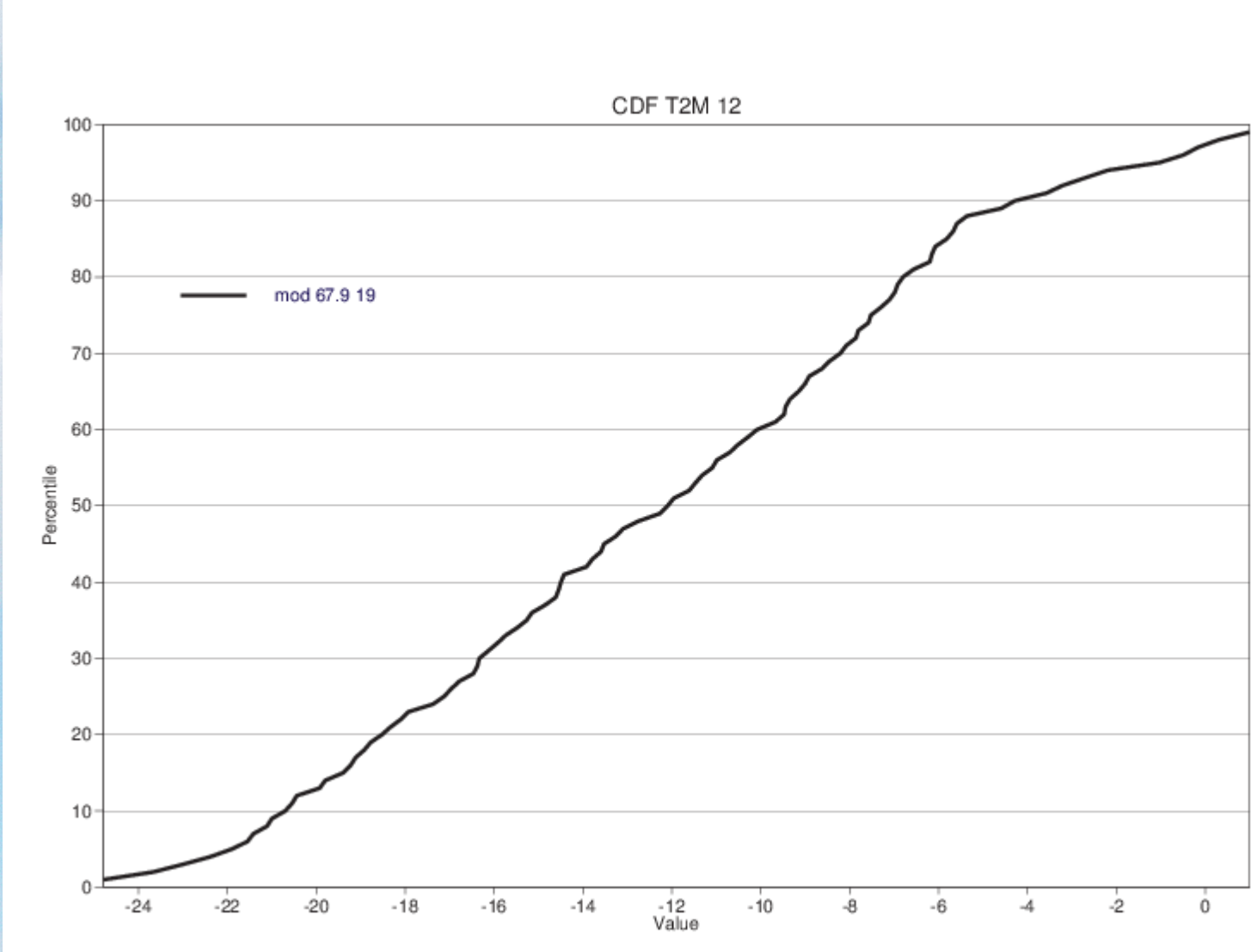
Example: 2-metre temperature values for 132-hour reforecasts

-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		

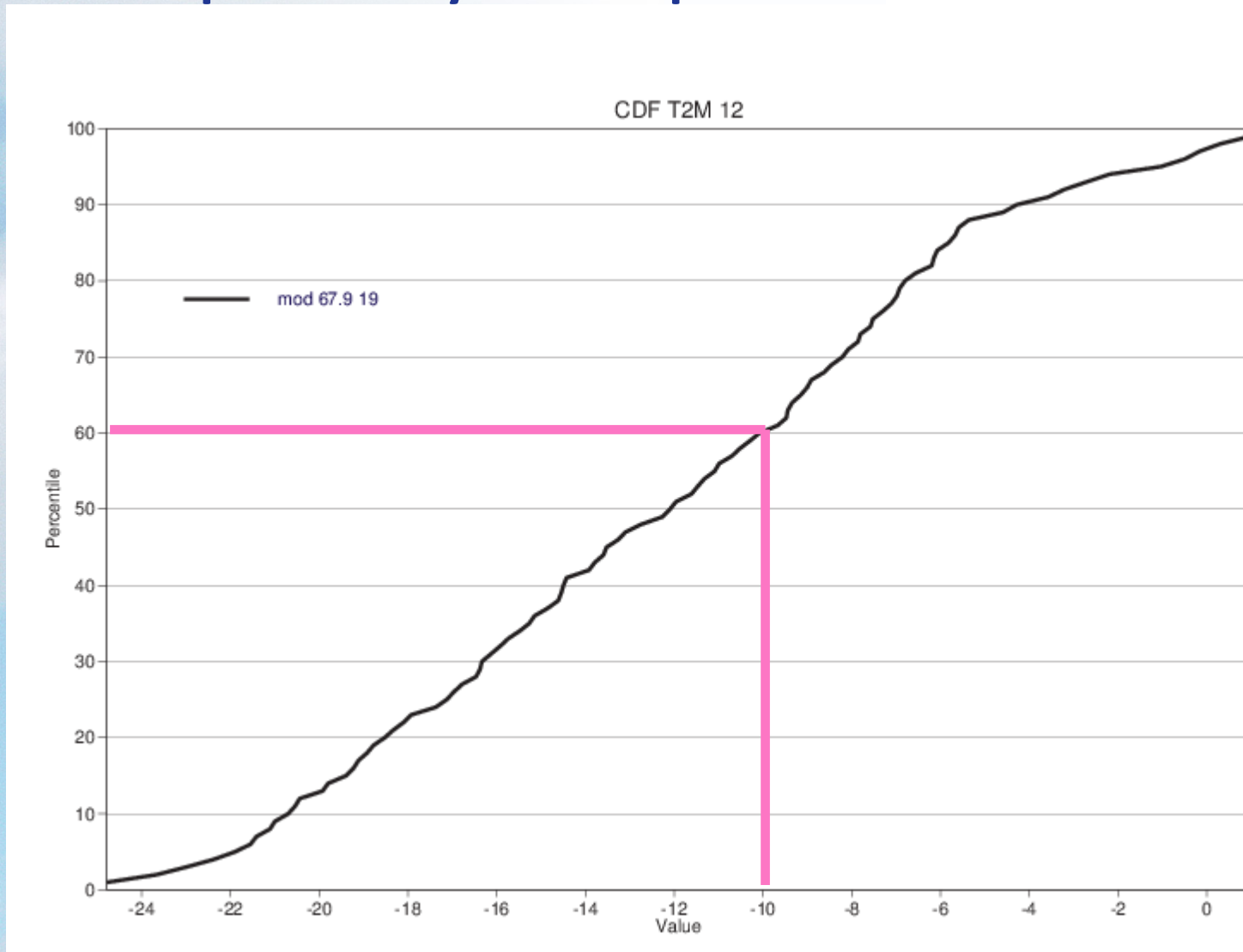
Probability distribution function (PDF)



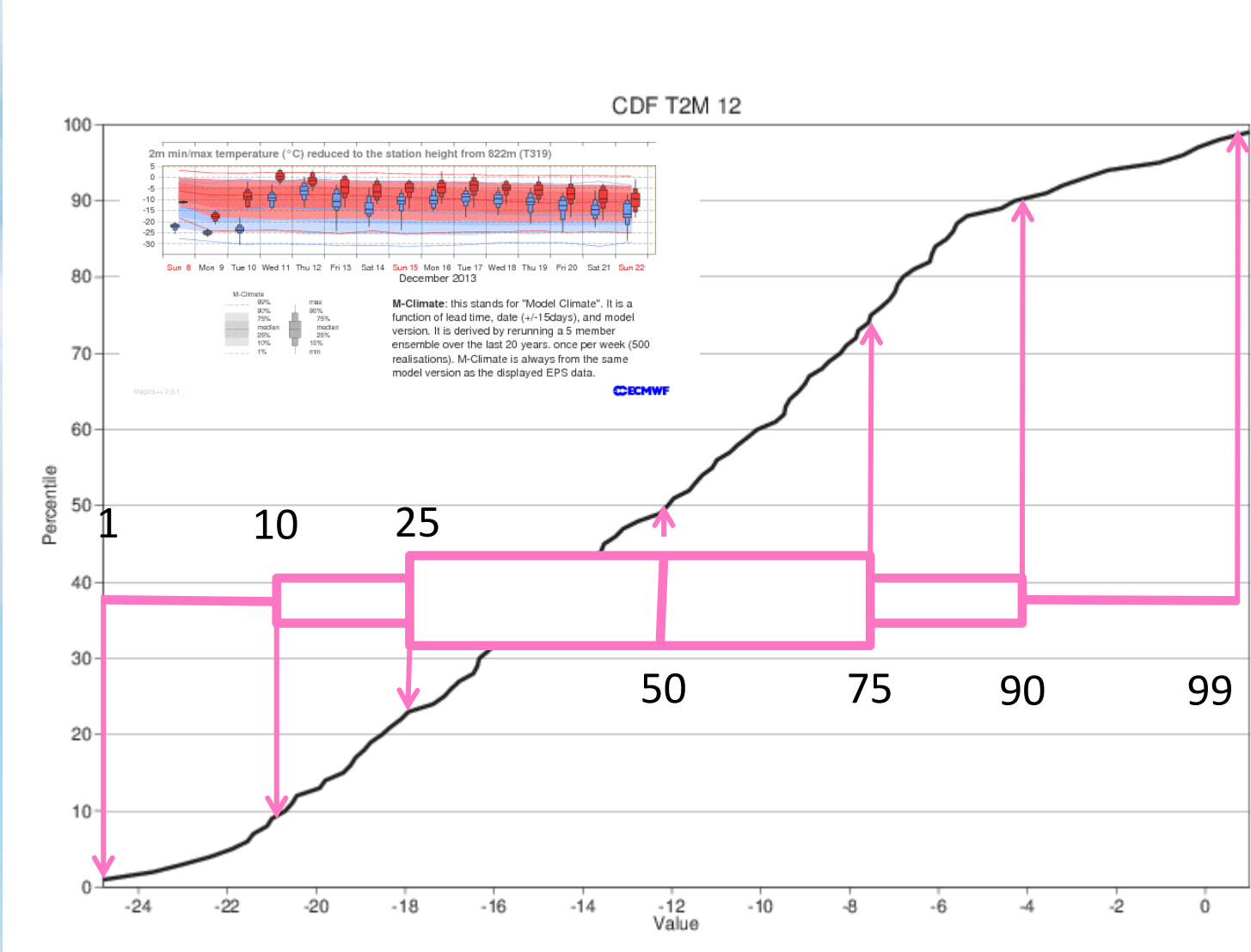
Cumulative distribution function (CDF)



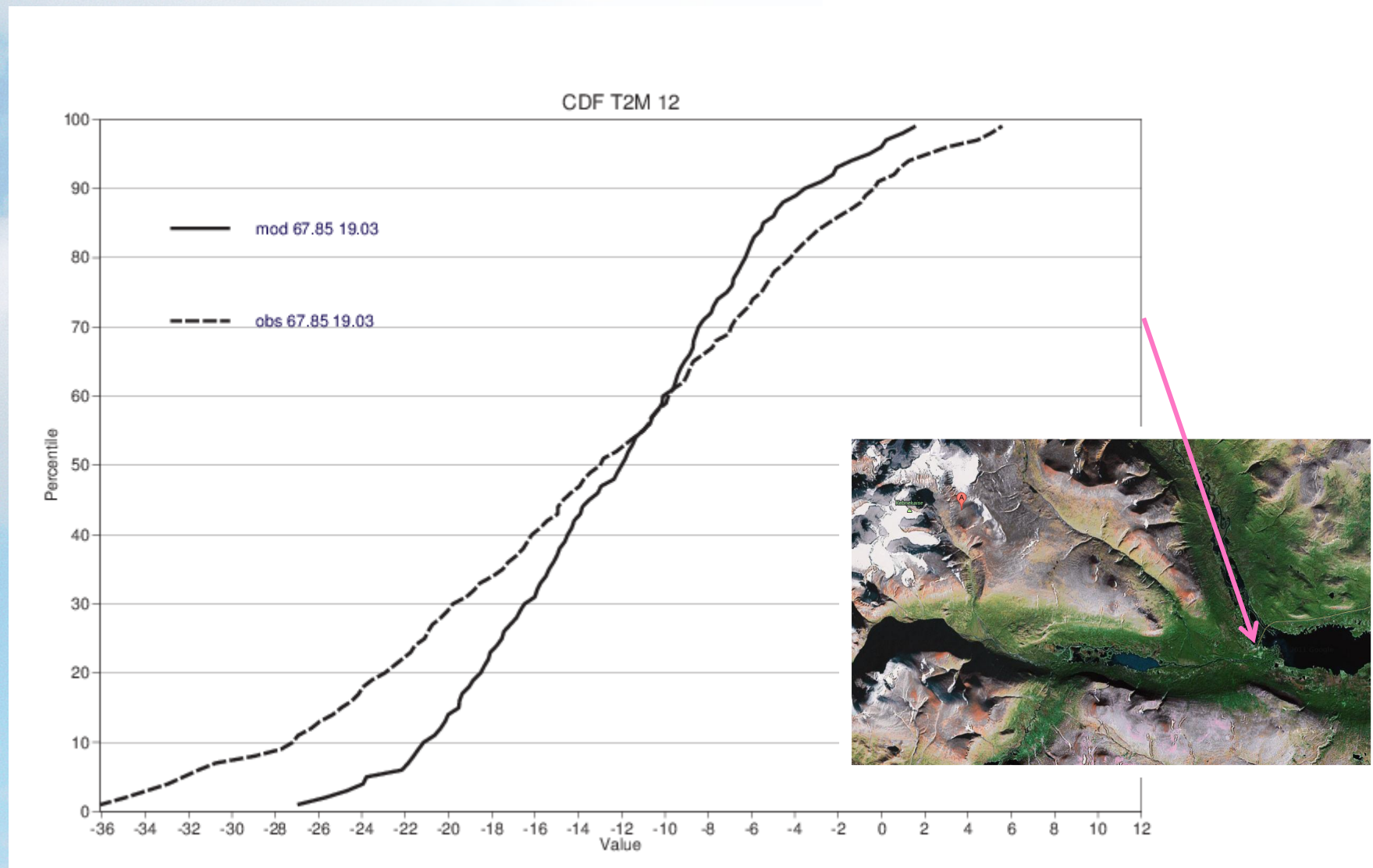
What is the probability for temperature < -10 ?



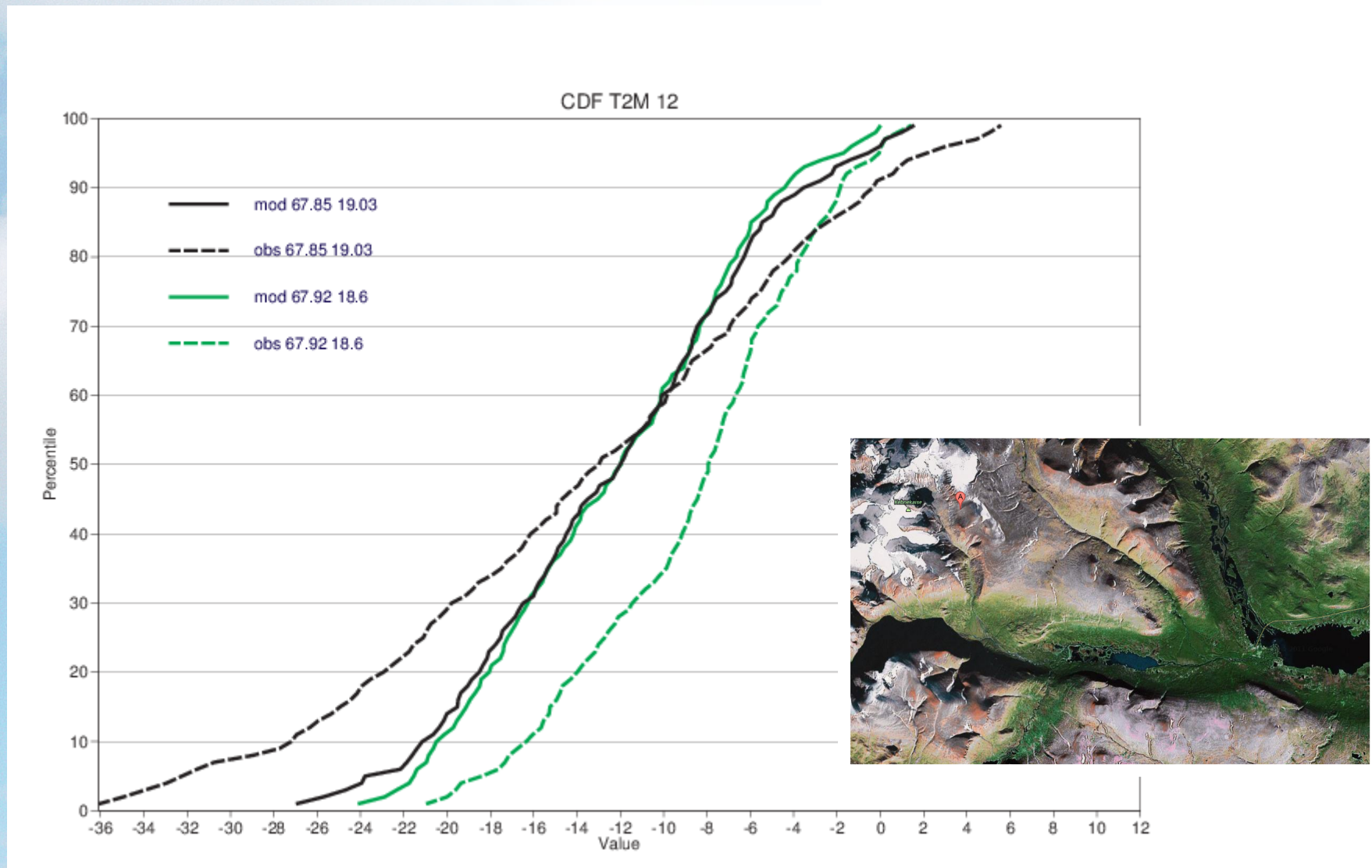
Cumulative distribution function



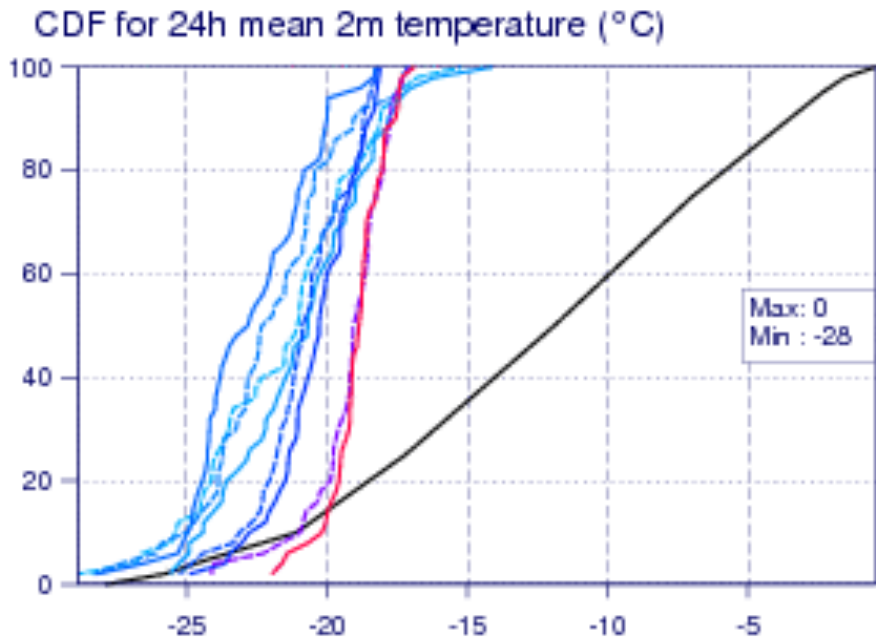
Model climate and observed climate (Nikkaloukta)



Nearby stations (Nikkaloukta –black, Tarfala – green)

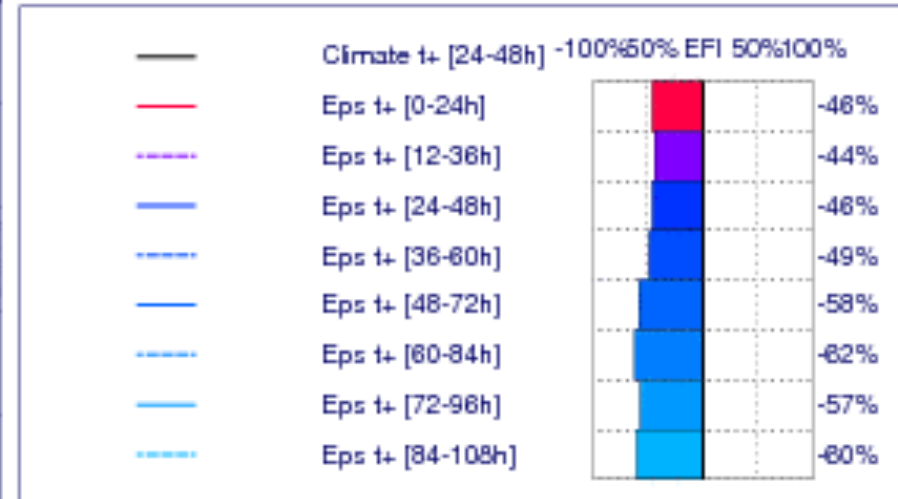


How to use the reforecast data set?



Max:
Min:

24-48h M-Climate extrema

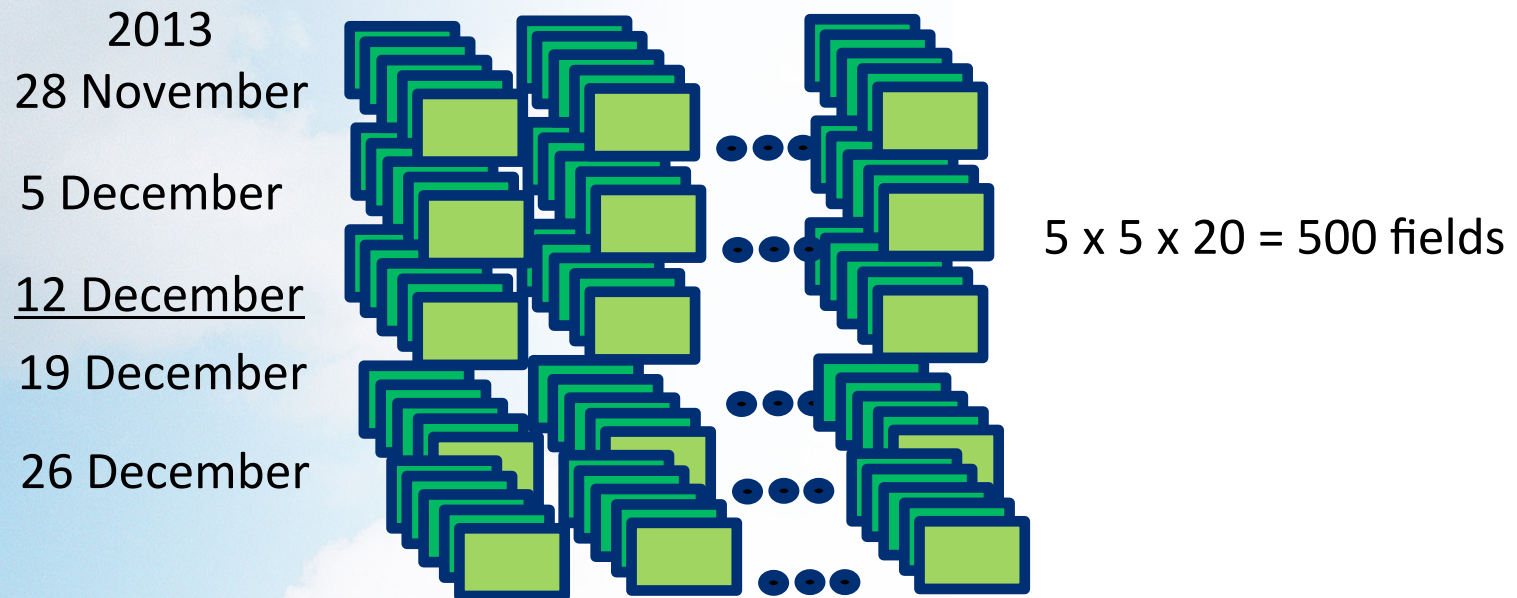


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Sampling issues: Extreme forecasts (example from old configuration – motivation for the new)

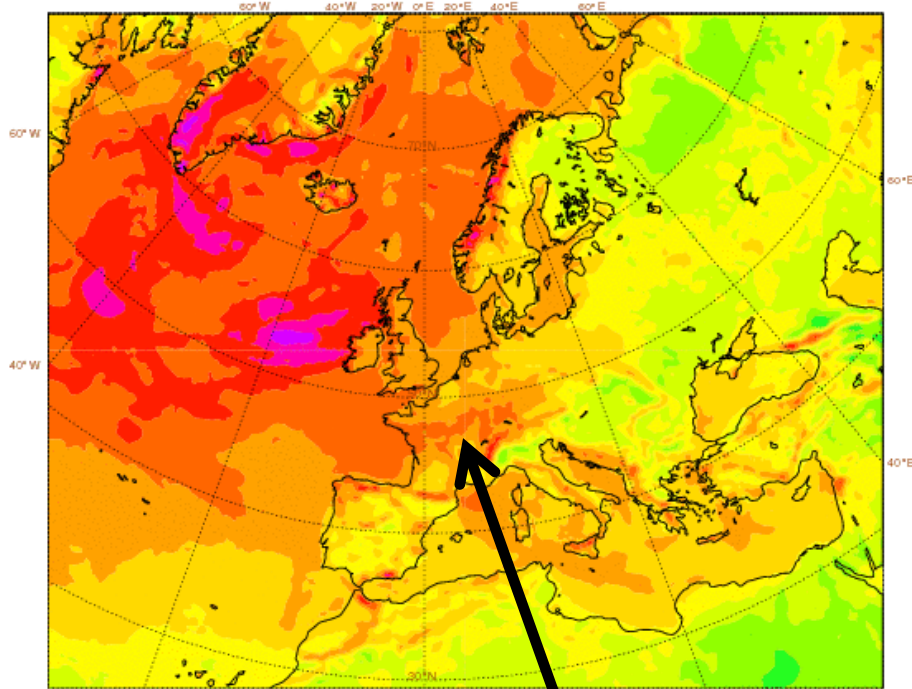
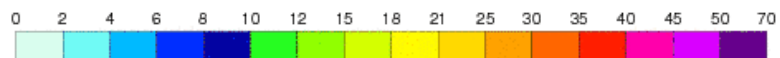
- Need to sample the tails of the distribution
- Focus on short to medium range
- Problems with correlated forecasts (members, steps)



99th percentile of climate (24-hour max. wind gusts)

Day 1

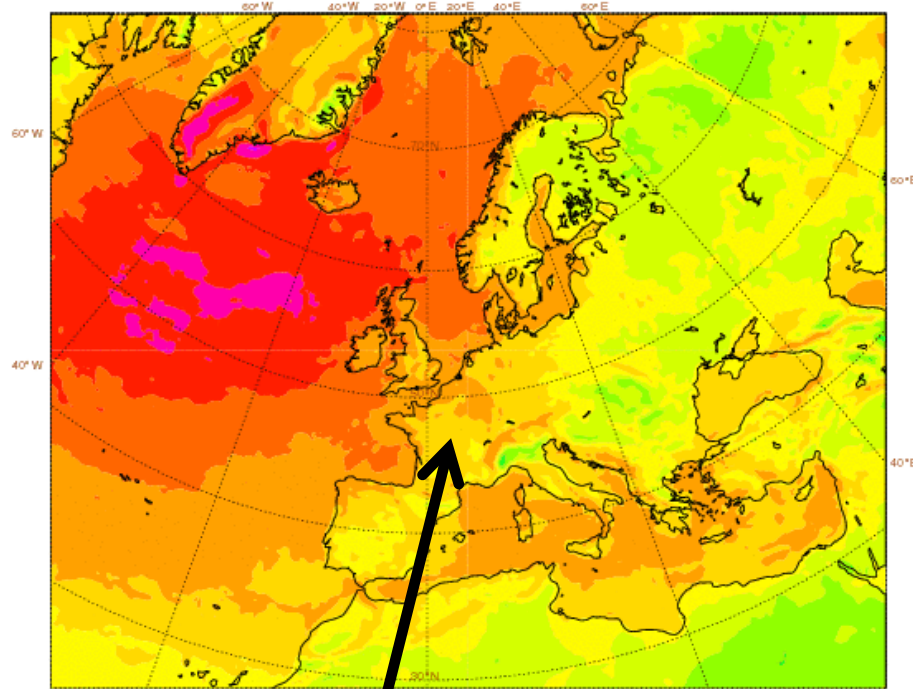
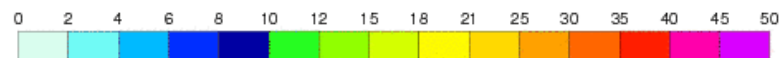
Thu 19 Dec 2013 00UTC ©ECMWF VT: Fri 20 Dec 2013 00UTC - Sat 21 Dec 2013 00UTC 0-24h
10m wind gusts (in m/s) Model climate Q99 (one in 100 occasions realises more than value shown)



30-35 m/s

Day 7

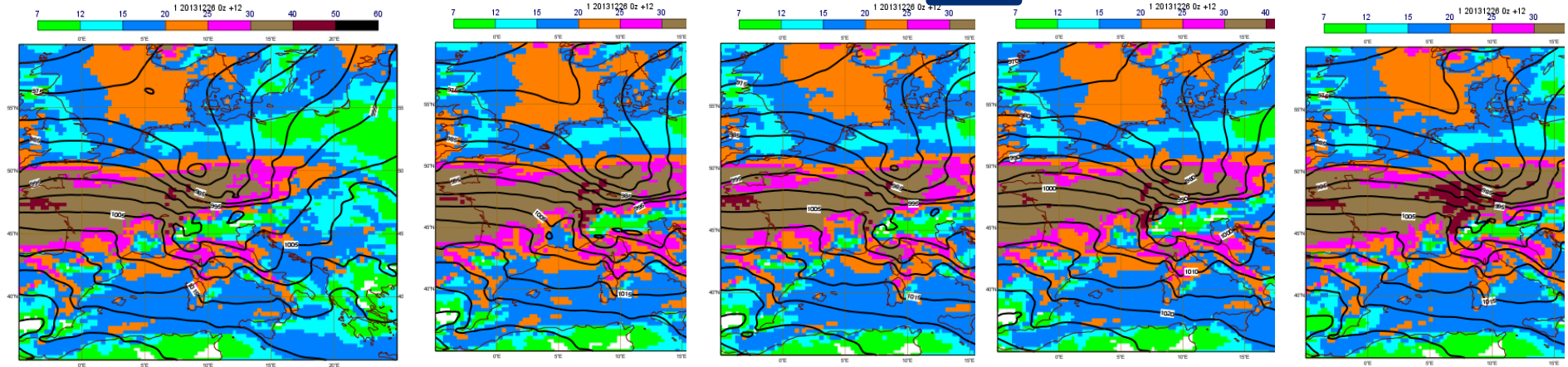
Thu 19 Dec 2013 00UTC ©ECMWF VT: Thu 26 Dec 2013 00UTC - Fri 27 Dec 2013 00UTC 144-168h
10m wind gusts (in m/s) Model climate Q99 (one in 100 occasions realises more than value shown)



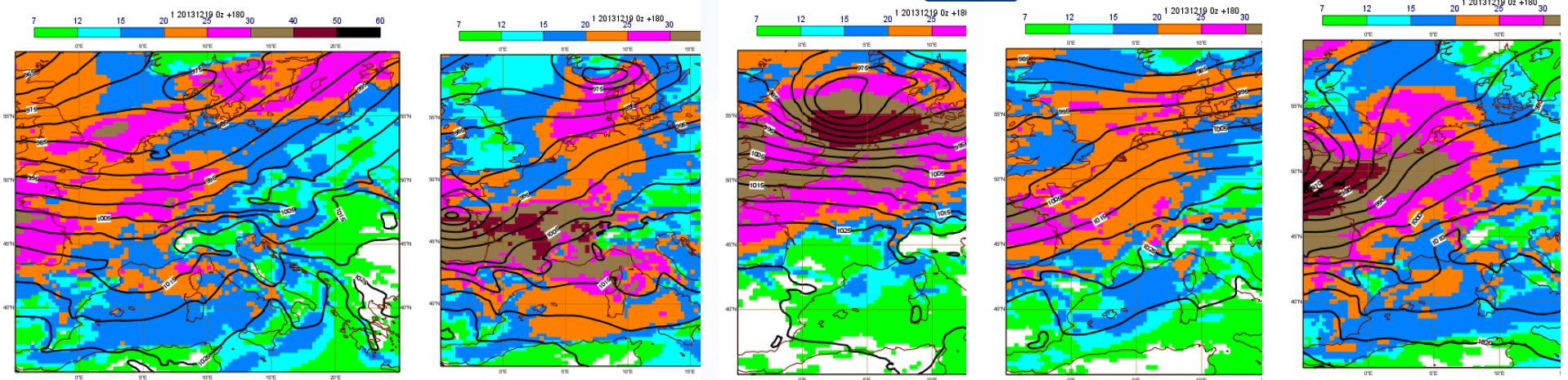
21-25 m/s

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

From 26 December 1999 +12h

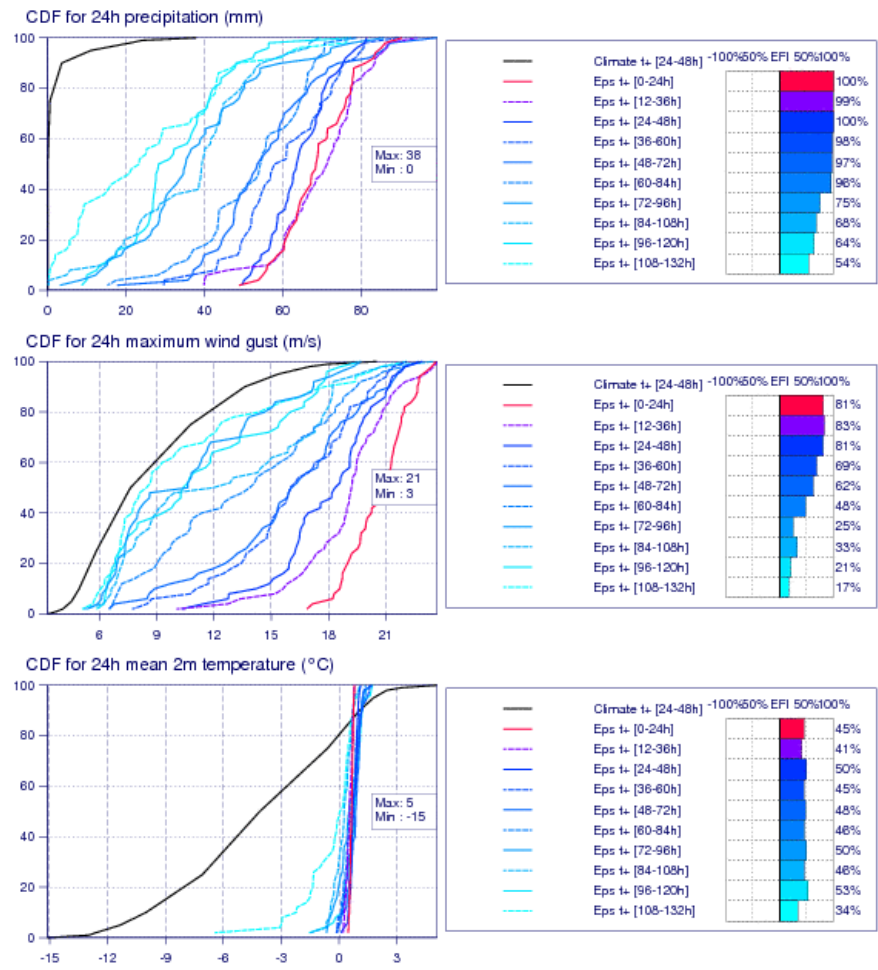


From 19 December 1999 +180h



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: 38
Min: 0

Max: 21
Min: 3

Max: 5
Min: -15

Max: 24-48h M-Climate extrema

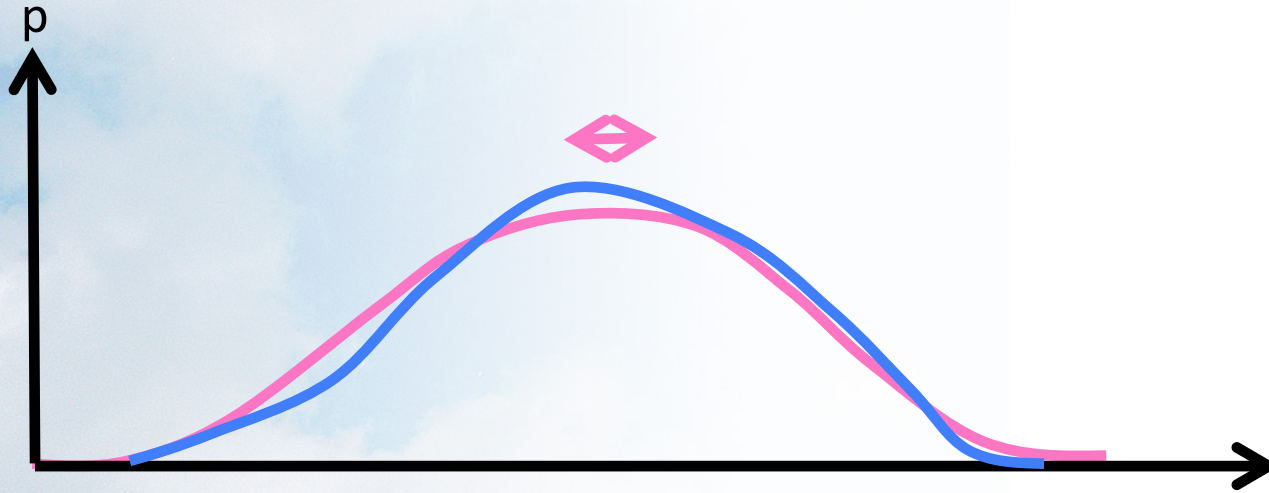
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Magic++ 2.5.1



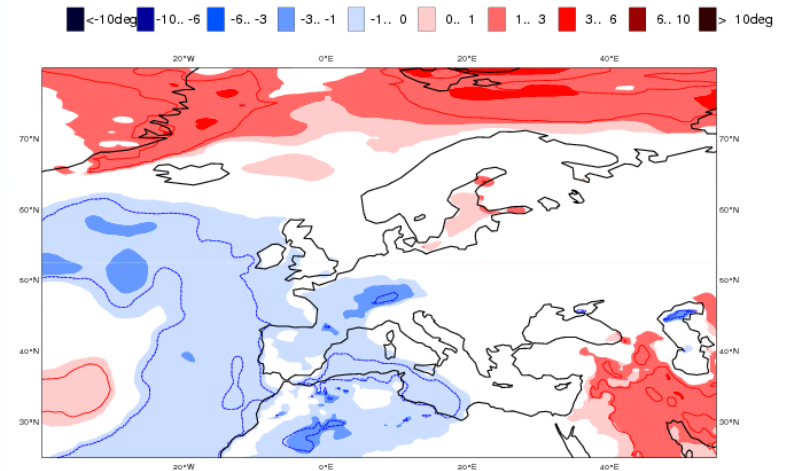
Long forecast (monthly, seasonal)



Normally weak signals

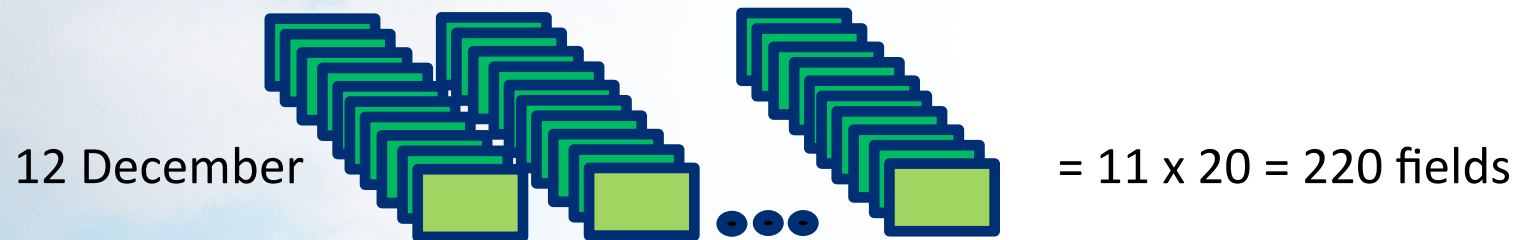
ECMWF EPS-Monthly Forecasting System
2-meter Temperature anomaly
Forecast start reference is 22-01-2015
ensemble size = 51 climate size = 200

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



Sampling issues: Monthly forecasts

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



Monthly forecast anomalies

Monday Thursday Monday



20 years x 11 forecasts x 3 dates = 660 forecasts

Difficulties in constructing reforecasts

Aim: Simulate climate of the real time forecasts...

ECMWF EPS-Monthly Forecasting System

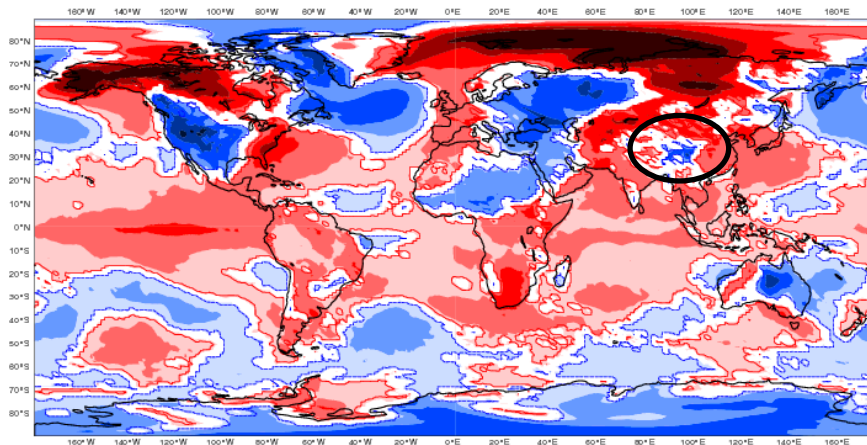
2-meter Temperature anomaly

Forecast start reference is 28-12-2015
ensemble size = 51, climate size = 660

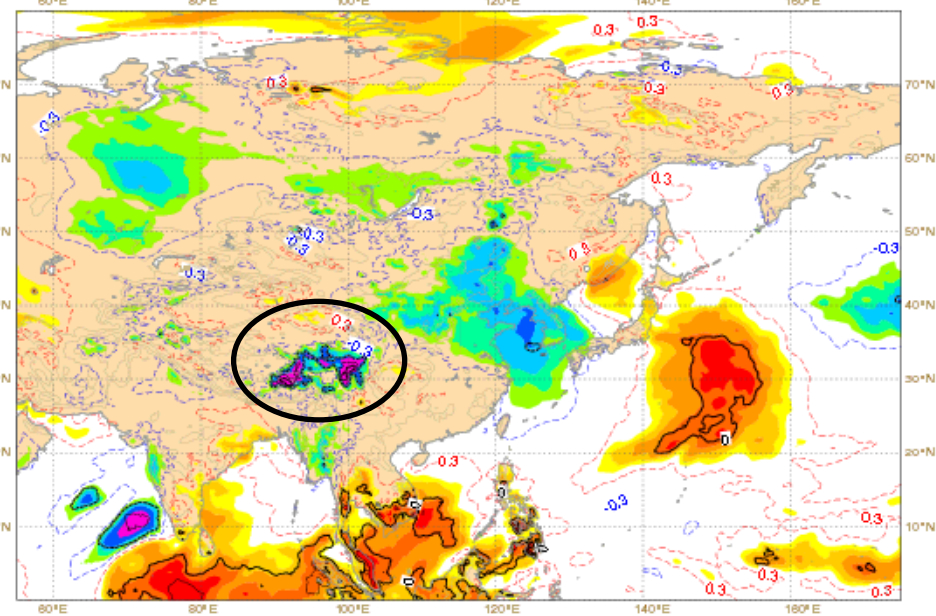
Day 1-7

28-12-2015/TO/03-01-2016

Shaded areas significant at 10% level
Contours at 1% level



Sun 17 Jan 2016 12UTC @ECMWF t+12-36h VT: Mon 18 Jan 2016 00UTC - Tue 19 Jan 2016 00UTC
Extreme forecast index and Shift of Tails (black contours 0,1,2,5,8) for 2m mean temperature



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

Summary

- 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

Configuration of reforecasts

Example: Thursday 12 December 2013:

12 December 1993:

12 December 1994:

12 December 2012:



20 years x 5 forecasts = 100 forecasts

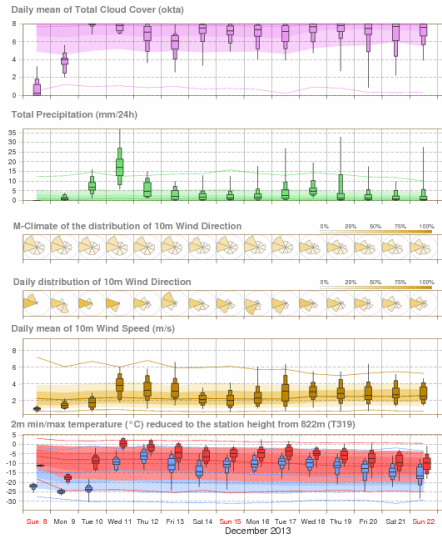
Present model version

Ensemble configuration to 32 days

Initialised from ERA Interim

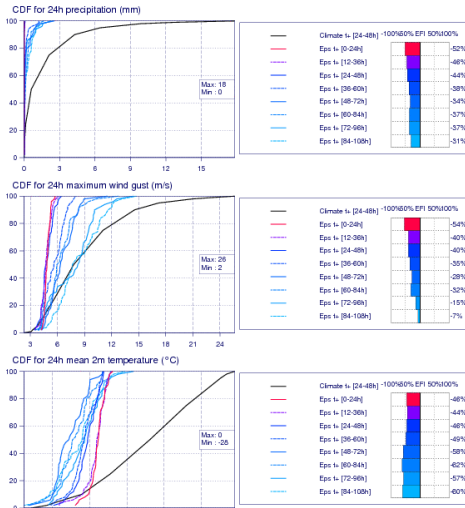
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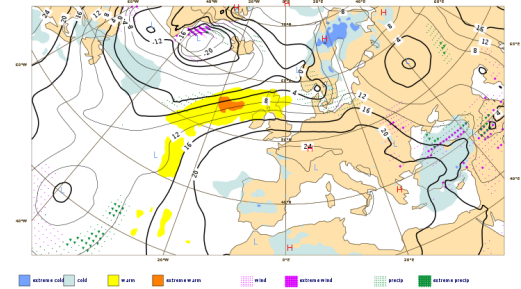
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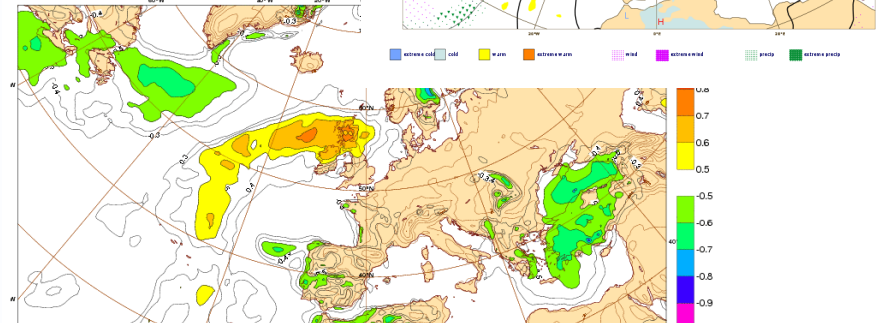
Max: 24-48h M-Climate extrema
Min:

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Saturday 7 December 2013 00UTC ©ECMWF Extreme forecast index i-024-04f
Surface: 2 metre temperature index



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2-metre Temperature anomaly
Forecast start reference is 02-12-2013
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09-12-2013 10:15-12-2013
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