# Estimation of the model climate (reforecasts)

Linus Magnusson







#### **Model climate from reforecasts**

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Anomalous weather predicted by EPS: Sunday 08 December 2013 at 00 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

wheel





precip







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







ė 9 12 15 18 CDF for 24h mean 2m temperature (°C)

24-48h M-Climate extrema

	Climate 1+ [24-48h] -100%50% EFI 50%100%		
	_	Eps 1+ (0-24h)	-46
		Eps 1+ [12-36h]	-44
	_	Eps 1+ (24-48h)	-46
Max: 0 Min: -28		Eps 1+ (36-60h)	-49
		Eps 1+ [48-72h]	-58
		Eps 1+ (60-84h)	-62
		Eps 1+ [72-96h]	-57
		Eps 1+ [84-108h]	-60

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 a week (500 realisations). M-Climate is always from the same model version as the displayed EPS data. On this page only the 24-48h lead M-Climate is displayed. CECMW

M-Climate of the distribution of 10m Wind Direction Daily distribution of 10m Wind Direction Daily mean of 10m Wind Speed (m/s Wed 18 Thu 19 Fri 20 Sat 21 ember 2013 M-Climate: this stands for "Model Climate". It is a

EPS Meteogram

67.68°N 18.67°E (EPS land point) 836 m (T639)

Daily mean of Total Cloud Cover (okta)

Total Precipitation (mm/24h)

Extended Range Forecast based on EPS Distribution Sunday 8 December 2013 00 UTC

function of lead time, date (+/-15days), 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.

CECMW

Max

Min:





### Why do we need reforecasts?















#### Motivation 2:

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



r 28 November 2013 00UTC T+240 VT:Sunday 8 December 2013 00 UTC introl run (bottom legend, 2C contour interval near extrema). i0% only), clima tological sea ice cover in magenta (>= 50%).



SST anomaly (from the obs. climatology)

Forecasts from 28 Nov 0 UTC



#### Model bias day 10





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#### 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 12 December 2013:

12 December 1993:

12 December 1994:

12 December 2012:



Slide 9

20 years x 5 forecasts = 100 forecasts Present model version Ensemble configuration to 32 days Initialised from ERA Interim

**ECMWF** 

## 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)**



Slide 11



### **Cumulative distribution function (CDF)**





#### What is the probability for temperature < -10?





#### **Cumulative distribution function**





#### Model climate and observed climate (Nikkaloukta)





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





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#### How to use the reforecast data set?



24-48h M-Climate extremation

CDF for 24h mean 2m temperature (°C)



**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 a week (500 realisations). M-Climate is always from the same model version as the displayed EPS data. On this page only the 24-48h lead M-Climate is displayed.

Magks++ 2.8.1

Max:

Min:



TECMWE

#### **Sampling issues: Extreme forecasts**

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



#### 5 x 5 x 20 = 500 fields



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



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)



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)







© ECMWF



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



#### **Sampling issues: Monthly anomalies**

- Need to sample the mean
- Model drift
- Sensitive to subtile 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





#### **Summary**

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

Slide 23

Used for several forecast products



#### **Model climate from reforecasts**

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EPS Meteogram

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Daily distribution of 10m Wind Direction

Daily mean of 10m Wind Speed (m/s

Daily mean of Total Cloud Cover (okta)

Total Precipitation (mm/24h)

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9 12 15 6 CDF for 24h maximum wind gust (m/s)



CDF for 24h mean 2m temperature (°C)

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		Chrone to [26-48b] 100980 Eps to [2048] Eps to [2048]	

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Wed 18 Thu 19 Fri 20 Sat 21



#### **Products**





#### **Configuration of reforecasts for seasonal forecasts**

Example: 1 November

1 November 1981:



1 November 2010:



30 years x 15 forecasts = 450 forecasts Run once for System 4Initialised from ERA Interim

Bias correction and estimate of skill









#### **Forecasts for the two startions**



**ECMWF** 

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