Norwegian Meteorological Institute

MET info 17/2013 Meteorology

Verification of Experimental and Operational Weather Prediction Models June to August 2013

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Photo: Einar Egeland

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1 Models

The following models are verified in this report. All except EC are or have been running at MET.

EC	Global model (IFS) at the ECMWF. From 26 January 2010 resolution $T1279$ or approximately $16 \times 16\ km^2$ horizontally. Available resolution for verification at MET is $0.25°$ latitude and longitude. Number of vertical levels increased from $L91$ to $L137$ 25 June 2013.
Hirlam12 (H12)	Version 7.1, horizontal resolution defined by a $12 \times 12\ km^2$ grid since 13 February 2008.
Hirlam8 (H8)	Version 7.1, horizontal resolution defined by a $8 \times 8\ km^2$ grid since 13 February 2008.
UM4	Unified Model (Met Office) run at a $4 \times 4\ km^2$ grid since June 2004.
Harmonie4	HARMONIE cycle 33h1/36h1.1 with ALARO physics run on a $4 \times 4\ km^2$ grid from August 2008 to 3 May 2011.
Harmonie5.5	HARMONIE cycle 36h1.3 with ALARO physics run on a $5.5 \times 5.5\ km^2$ grid from 4 May 2011 to 15 January 2013.
Harmonie2.5	HARMONIE cycle 36h1.3 with AROME physics run on a $2.5 \times 2.5\ km^2$ grid from 4 May 2011 to 26 February 2013.
AROME-Norway	HARMONIE cycle 37h1.1 with AROME physics run on a $2.5 \times 2.5\ km^2$ grid on a larger domain than Harmonie2.5; experimental since 25 October 2012, replacing Harmonie2.5 from 26 February 2013.

Analysis and lead times of forecasts are denoted by e.g. 00+30 UTC which indicates forecast generated at 00 UTC and valid 30 hours later.

2 HARMONIE and AROME-Norway

Experimental HARMONIE models have been run at MET Norway since August 2008, leading to AROME-Norway which on 1 October 2013 was introduced on yr.no. HARMONIE is the acronym for HIRLAM's meso-scale forecast system (Hirlam Aladin Regional/Meso-scale Operational NWP In Europe). The HARMONIE system includes several configuration options. This section presents some of the main components and setups that are or has been used at MET. More documentation is available on http://hirlam.org/index.php/documentation/harmonie.

2.1 ALARO-0 physics

ALARO-0 has physical parameterizations targeted for grey scale resolutions (4-10 km). It is a spin-off of the Météo-France physical parameterizations used in the globale ARPEGE, but with a separate radiation scheme, 3MT micro-physical frame work, and the Toucans turbulence scheme. Much of the development has been done by the RC LACE (Regional Cooperation for Limited Area modeling in Central Europe) community.

2.2 AROME physics

AROME (Applications of Research to Operations at MEsoscale) is targeted for horizontal resolution 2.5 km or finer. It uses physical parameterizations based on the French academia model Meso-NH and the external surface model SURFEX. AROME has been operational at Météo-France since 18 December 2008, with a horizontal resolution of 2.5 km.

2.3 SURFEX as surface model

SURFEX (Surface externalisée) is developed at Météo-France and academia for offline experiments and introduced in NWP models to ensure consistent treatment of processes related to surface. Météo-France is already using SURFEX for some of their configurations and is planning to use it for all their configurations. Surface modelling and assimilation benefits from the possibility to run offline experiments. SURFEX is also used for offline applications in e.g. hydrology, vegetation monitoring and snow avalanche forecasts.

SURFEX includes routines to simulate the exchange of energy and water between the atmosphere and 4 surface types (tiles); land, sea (ocean), lake (inland water) and town. The land or nature tile can be divided further into 12 vegetation types (patches). ISBA (Interaction between Soil Biosphere and Atmosphere) is used for modelling the land surface processes. There are 3 ISBA options; 2- and 3-layer force restore and a diffusive approach, where the first one is used in HIRLAM. Towns may be treated by a separate TEB (Town Energy Balance) module. Seas and lakes are also treated separately. The lake model, FLAKE (Freshwater LAKE), has recently been introduced in SURFEX. A global ECOCLIMAP database which combines land cover maps and satellite information gives information about surface properties on 1 km resolution. The orography is taken from gtopo30.

“SURFEX Scientific Documentation” and “User’s Guide” are available on http://www.cnrm.meteo.fr/surfex/

2.4 Surface analysis

Surface analysis is performed by CANARI (Code d'Analyse Nécessaire à ARPEGE pour ses Rejets et son Initialisation) (Taillefer, 2002). The analysis method is Optimal Interpolation and only conventional synoptic observations are used. 2 meter temperature and relative humidity observations are used to update the surface and soil temperature and moisture. Surface analysis is performed at 00, 06, 12 and 18 UTC.

The snow analysis is also performed with CANARI in analogy with the HIRLAM snow analysis. Snow depth observations are used to update Snow Water Equivalent. The snow fields are analysed only at 06 UTC as there are very few snow depth observations at 00, 12 and 18.

The Sea Surface Temperature is not analysed, but taken from the boundaries. ECMWF uses the OSTIA (Operational Sea Surface Temperature and Sea Ice Analysis) product, including SST from UK Met Office and SIC from MET. The surface temperature over sea ice is taken from the boundary model and remains unchanged through the forecast.

2.5 Boundaries and initialization of upper air fields

Harmonie5.5 and Harmonie2.5 got their boundary values (3-hourly) from the ECMWF model at approximately 16 km resolution. The upper air fields were initialized from ECMWF forecasts each cycle. Harmonie5.5 had 60 vertical levels (ECMWF60 using the ECMWF definition). Harmonie2.5 had also 60 vertical levels (HIRLAM60 using the HIRLAM definition).

AROME-Norway gets its boundary values (1-hourly) from the ECMWF model at approximately 16 km resolution. The upper air fields are initialized from ECMWF forecasts each cycle. AROME-Norway has currently 65 vertical levels. None of the HARMONIE configurations at MET have applied digital filter initialization (DFI).

3 Verification measures

All model forecasts in this report are verified against observations by interpolating (nearest/bilinear) the grid based forecasts to the observational sites. As a consequence, it should be noted that it is the models' abilities to forecast the observations that is being quantifed and assessed. Thus, there is no attempt in this report to verify area averaged precipitation for example.

Verification is carried out both for raw and categorized forecasts. In the following, let $f_1, ..., f_n$ denote the forecasts and $o_1, ..., o_n$ the corresponding observations.

3.1 Forecasts of continuous variables

The verification statistics applied to continuous variables are defined in the table below

Statistic	Acronym	Formula	Range	Optimal score
Mean Error	ME	$\frac{1}{n} \sum_{i=1}^{n}(f_i - o_i)$	$-\infty$ to ∞	0
Mean Absolute Error	MAE	$\frac{1}{n} \sum_{i=1}^{n} \mid f_i - o_i \mid$	0 to ∞	0
Standard Deviation of Error	SDE	$\left(\frac{1}{n} \sum_{i=1}^{n}(f_i - o_i - ME)^2 \right)^{1/2}$	0 to ∞	0
Root Mean Square Error	RMSE	$\left(\frac{1}{n} \sum_{i=1}^{n}(f_i - o_i)^2 \right)^{1/2}$	0 to ∞	0
Correlation	COR	$\frac{\frac{1}{n}\sum_{i=1}^{n}(f_i - \bar{f})(o_i - \bar{o})}{SD(f)SD(o)}$	-1 to 1	1

In the formula for COR the following definitions are used

$$\bar{f} = \frac{1}{n}\sum_{i=1}^{n} f_i, \qquad \bar{o} = \frac{1}{n}\sum_{i=1}^{n} o_i$$

$$SD(f) = \left(\frac{1}{n}\sum_{i=1}^{n}(f_i - \bar{f})^2\right)^{1/2}, \qquad SD(o) = \left(\frac{1}{n}\sum_{i=1}^{n}(o_i - \bar{o})^2\right)^{1/2}$$

for the means and standard deviations of the forecasts and observations.

3.2 Forecasts of categorical variables

All variables in this report are continuous in raw form, but it is possible to categorize them and verify these. For example, wind speed above a given threshold could be of interest which would result in two possible outcomes (yes and no). The verification is then completely summarized by a contingency table as the one shown below

		event observed	
		yes	no
event forecasted	yes	*a*	*b*
	no	*c*	*d*

Verification statistics for such forecasts are listed in the following table

Statistic	Acronym	Formula	Range	Optimal score
Hit rate	HR	$\frac{a}{a+c}$	0 to 1	1
False alarm rate	F	$\frac{b}{b+d}$	0 to 1	0
False alarm ratio	FAR	$\frac{b}{a+b}$	0 to 1	0
Equitable threat score	ETS	$\frac{a-ar}{a+b+c-ar}$	$-1/3$ to 1	1 (0 = no skill)
Hanssen-Kuipers skill score	KSS	HR - F	-1 to 1	1 (0 = no skill)

In the formula for ETS $ar = (a+b)(a+c)/n$.

3.3 Observations

All observations come from Klimadatavarehuset at MET. Only synop stations are used, except for precipitation where all availiable stations are used for better spatial coverage. The model wind speed is verified against the mean wind FF observations. For post processed wind speed, the maxium 10 min mean wind speed last hour, FX, is used.

3.4 Long term forecast

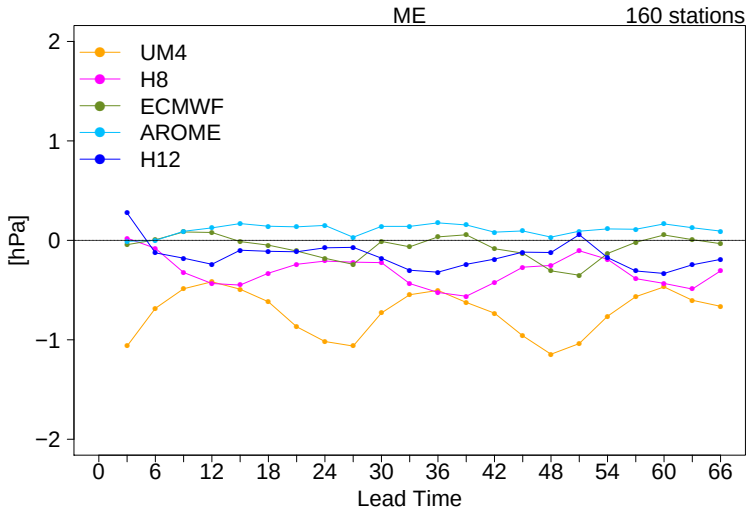
The long term forecast was updated with a new calibration on June 25, so the period of this verification goes from June 25 to August 31 (last verification time on September 9). The long term forecast is based on the 51 member ensemble prediction system from ECMWF. Calibrated and uncalibrated forecasts are shown in the figures with both median and consensus for each. The deterministic ECMWF forecast is also shown in the figures as a reference.

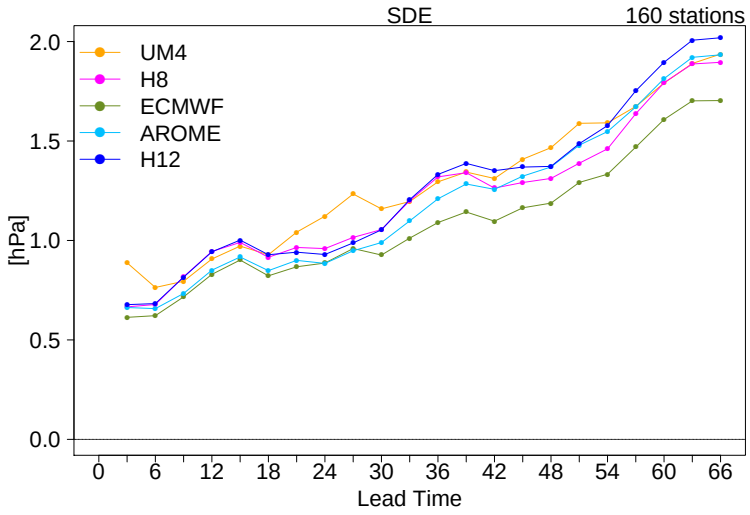
4 Comments to verification results

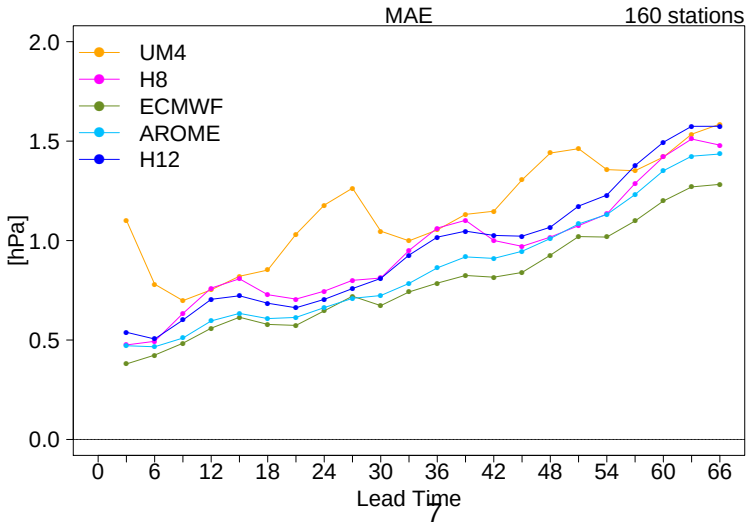
AROME-Norway has a negative bias in wind speed, mostly for low to moderate wind speeds. UM4 scores marginally better in wind speed compared to the rest of the models. AROME-Norway is somewhat too warm during the night, but have the lowest bias amongst the models during daytime. After post-processing, the temperature bias is almost gone. AROME-Norway scores best of the models during daytime on day 1 and 2, apart from that, ECMWF is the best. ECMWF scores best at the surface pressure. AROME-Norway has too many of the high values of precipitation, but has a better distribution of rain/no rain than ECMWF and H8. UM4 has also too many of the high values, but a slightly better rain/no rain distribution. ECMWF scores best on the moderate precipitation values.

5 Norway

5.1 Pressure and variables at pressure levels







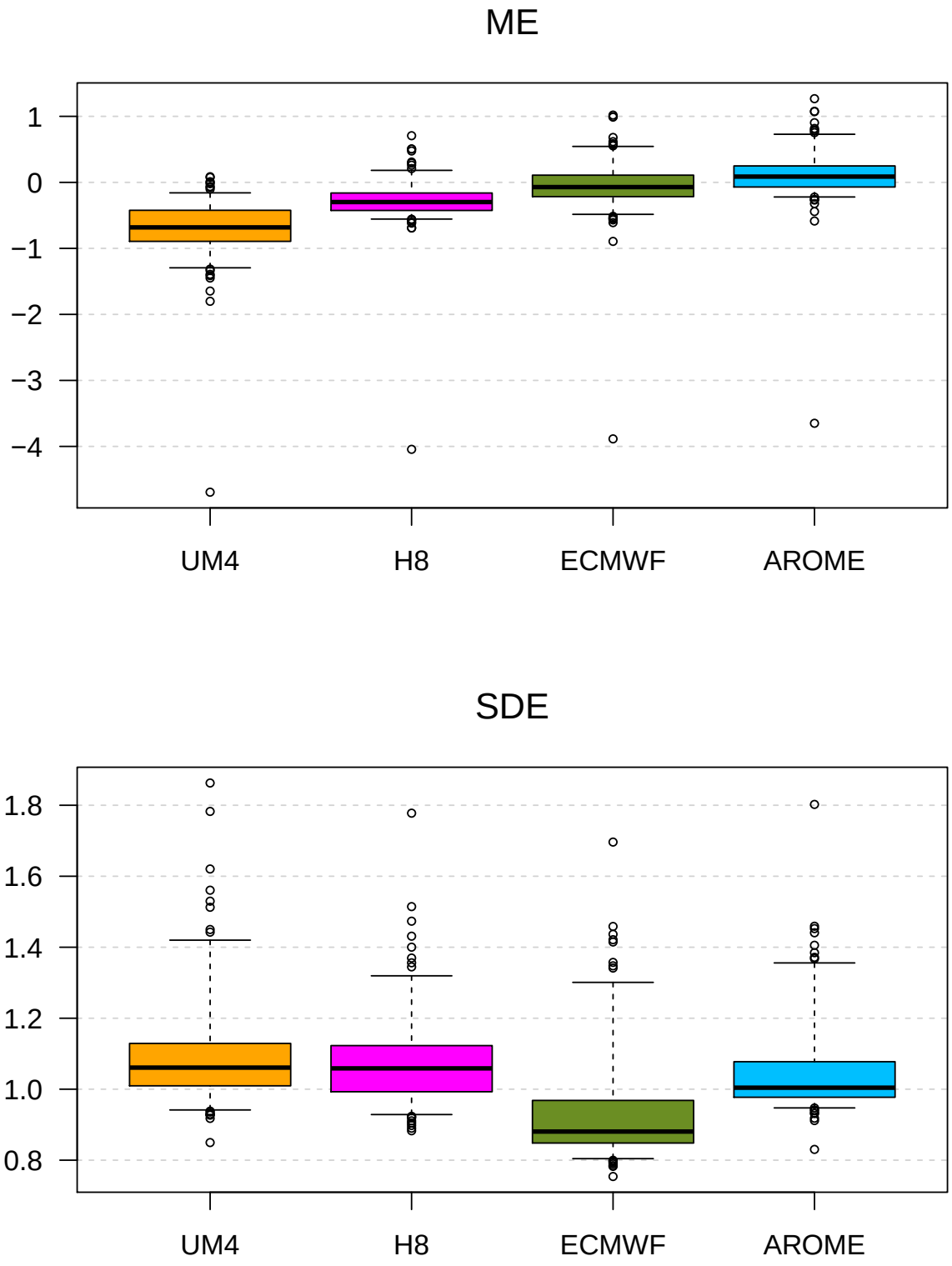
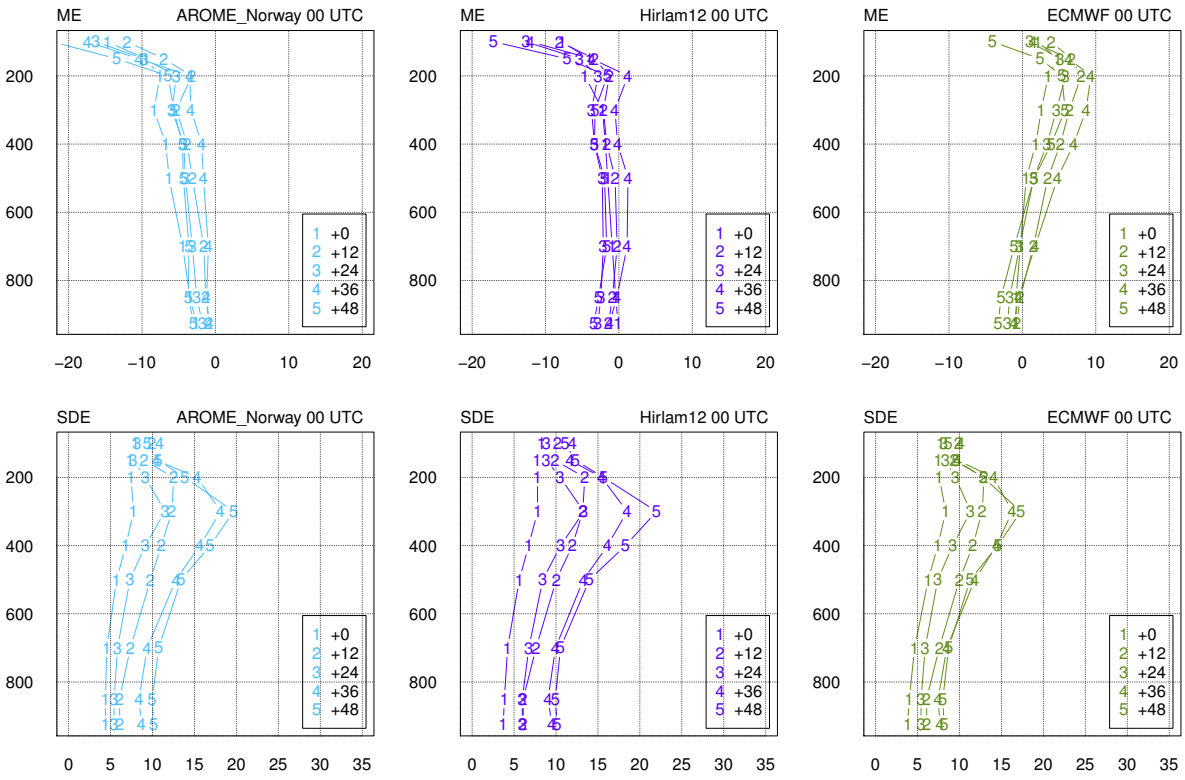
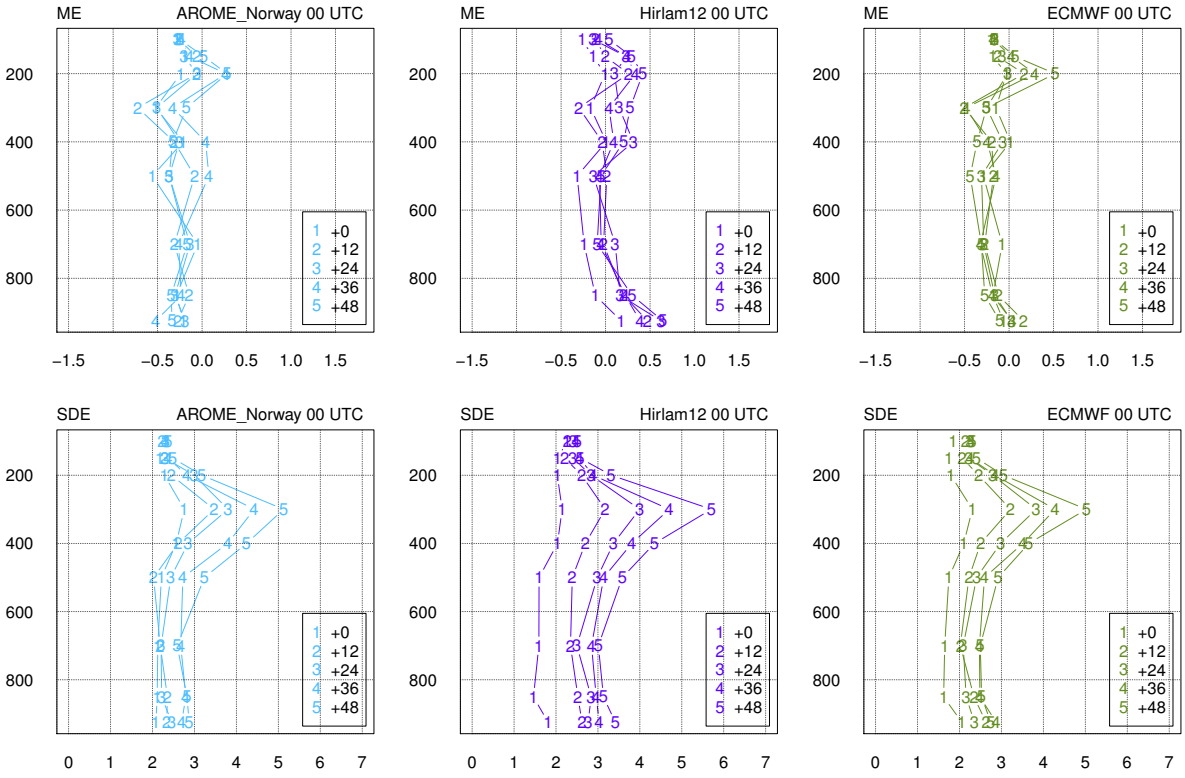


Figure 1: Lead time 00 +3,+6,...,+66

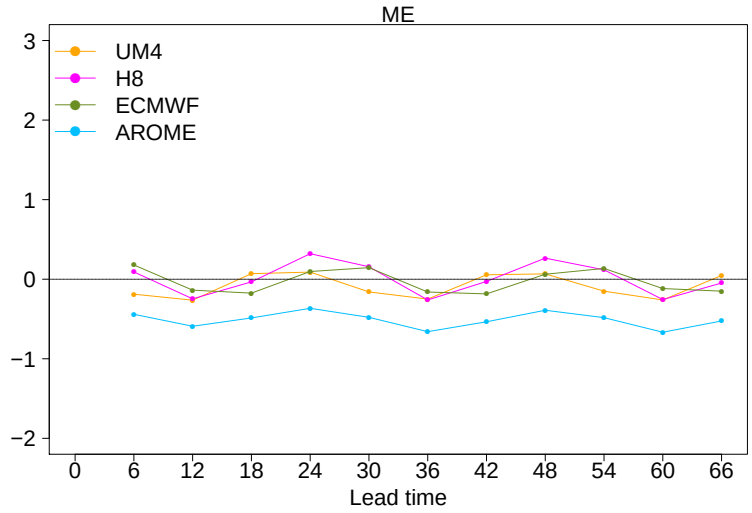
Geopotential height at 4 Norwegian stations

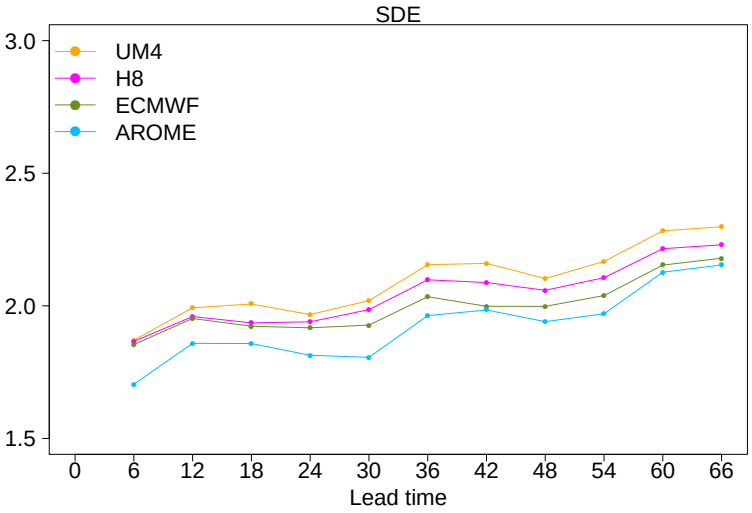


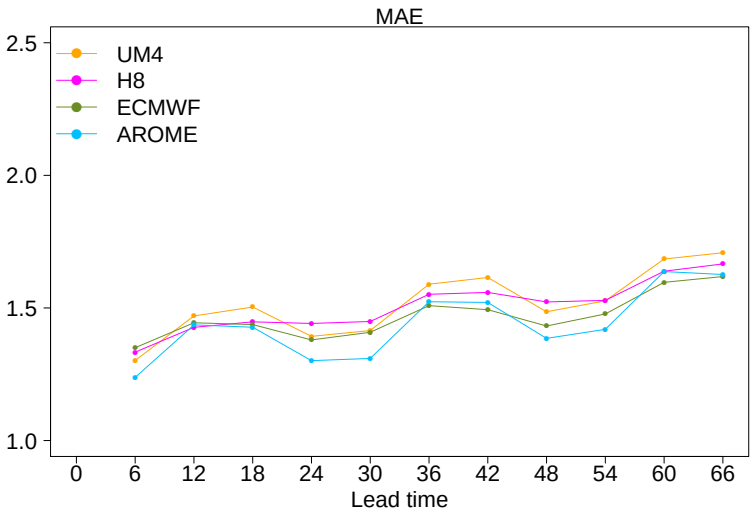
Wind speed at 4 Norwegian stations



5.2 Wind Speed 10m







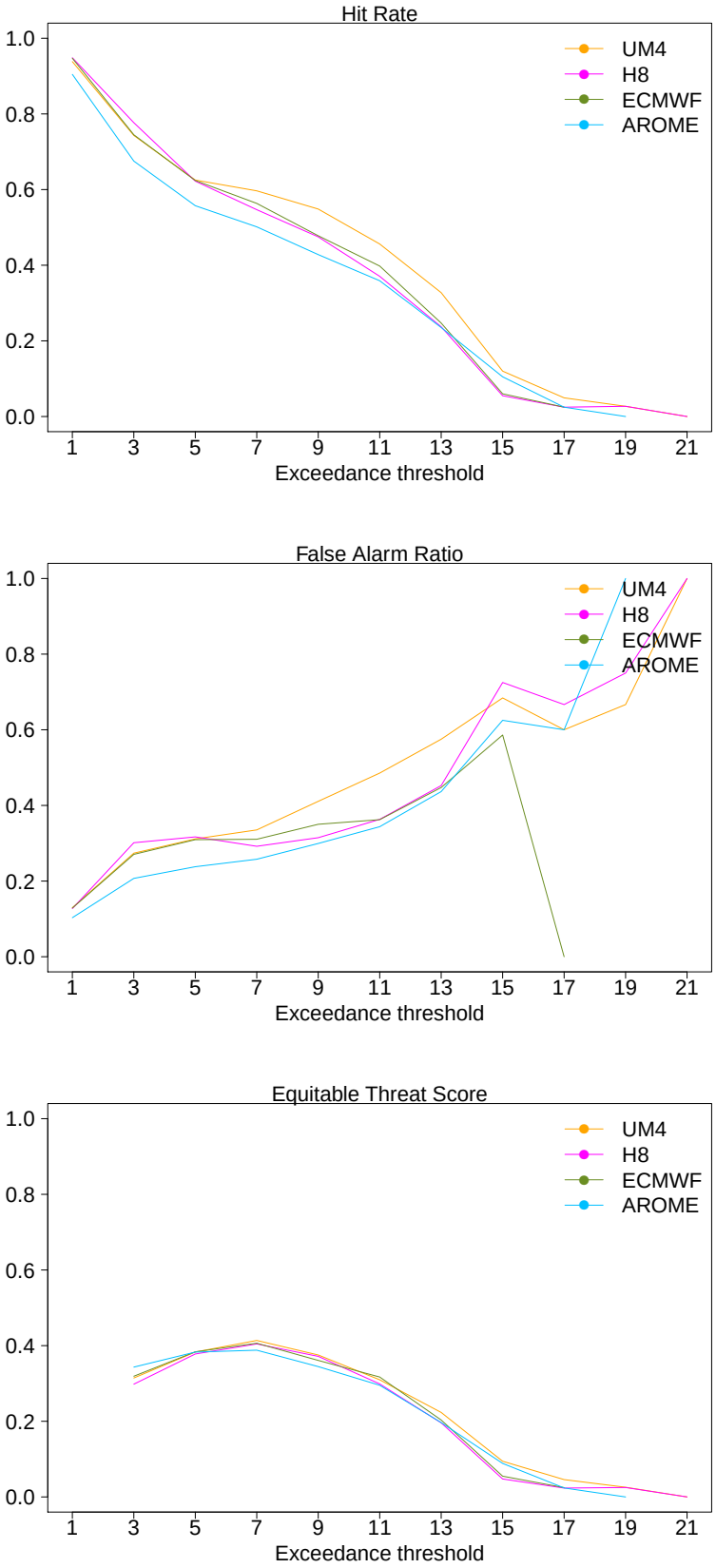
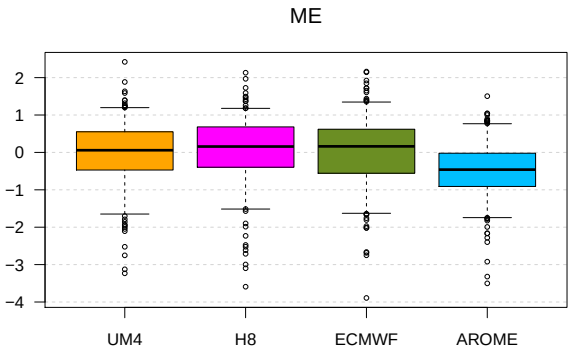
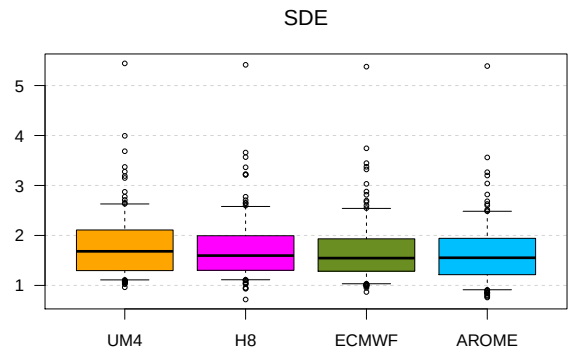


Figure 2: Lead time 00+12,+15,+18,+21,+24





Forecasts:

UM4

	OBS [0,3]	(3,11]	(11,17]	(17,21]	(21,Inf]	Sum
[0,3]	86497	28814	169	10	5	115495
(3,11]	30247	69007	2400	108	13	101775
(11,17]	39	2014	1736	142	16	3947
(17,21]	0	2	13	6	0	21
(21,Inf]	0	0	1	0	0	1
Sum	116783	99837	4319	266	34	221239

H8

	OBS [0,3]	(3,11]	(11,17]	(17,21]	(21,Inf]	Sum
[0,3]	79811	24785	123	1	5	104725
(3,11]	36957	74035	2830	125	13	113960
(11,17]	15	1016	1352	136	16	2535
(17,21]	0	1	14	3	0	18
(21,Inf]	0	0	0	1	0	1
Sum	116783	99837	4319	266	34	221239

ECMWF

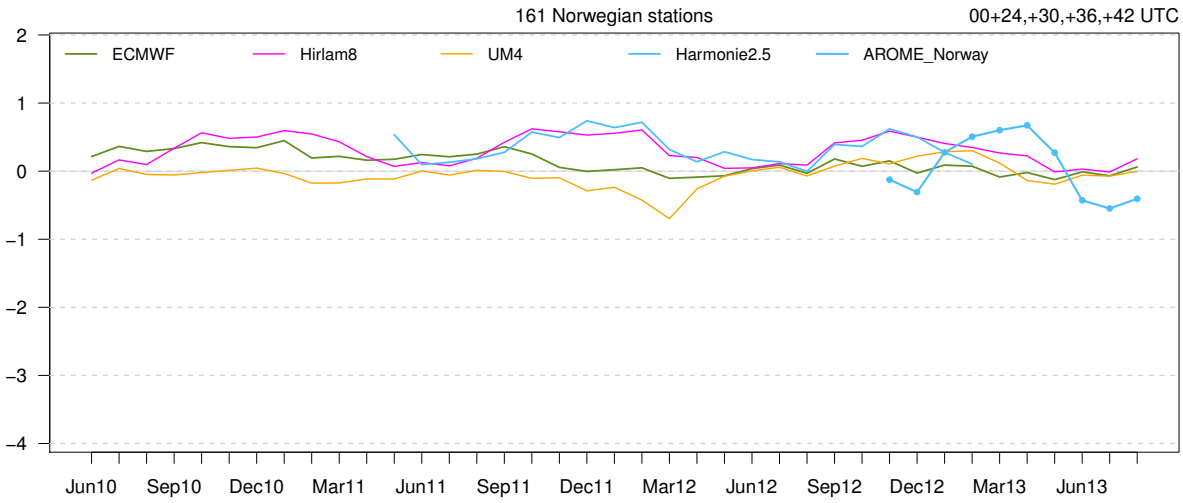
	OBS [0,3]	(3,11]	(11,17]	(17,21]	(21,Inf]	Sum
[0,3]	84715	26443	151	6	5	111320
(3,11]	32048	72212	2638	73	6	106977
(11,17]	20	1181	1527	182	23	2933
(17,21]	0	1	3	5	0	9
(21,Inf]	0	0	0	0	0	0
Sum	116783	99837	4319	266	34	221239

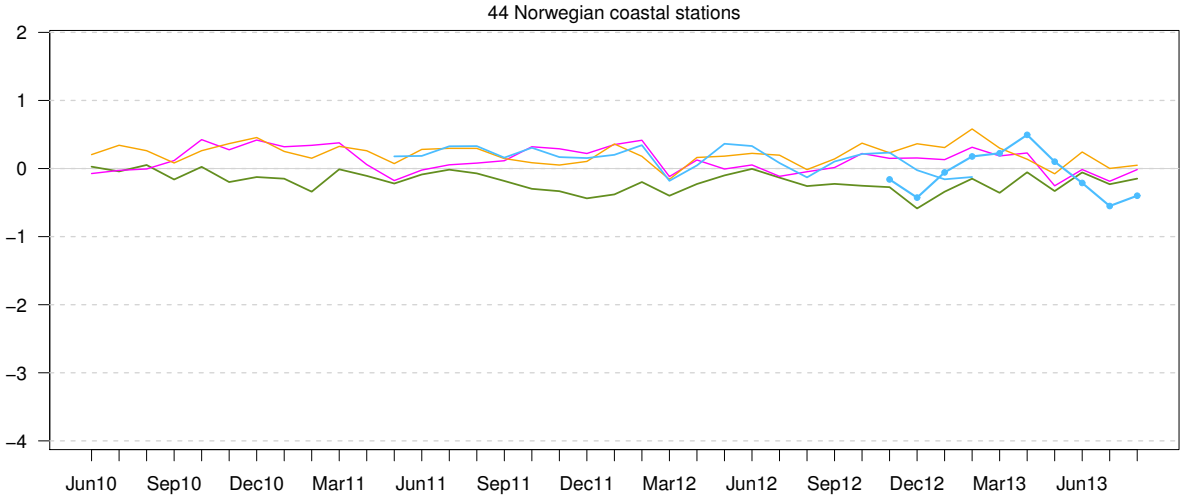
AROME

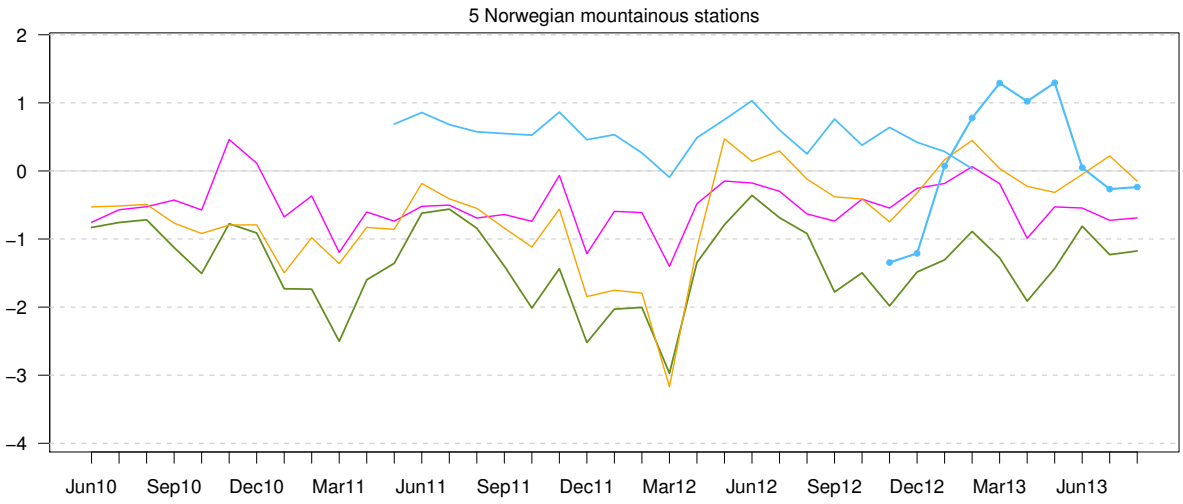
	OBS [0,3]	(3,11]	(11,17]	(17,21]	(21,Inf]	Sum
[0,3]	97764	35661	81	0	5	133511
(3,11]	18994	63242	2916	111	12	85275
(11,17]	25	930	1311	150	17	2433
(17,21]	0	3	11	5	0	19
(21,Inf]	0	1	0	0	0	1
Sum	116783	99837	4319	266	34	221239

Figure 3: Lead time 00+3,+6,..,+66.

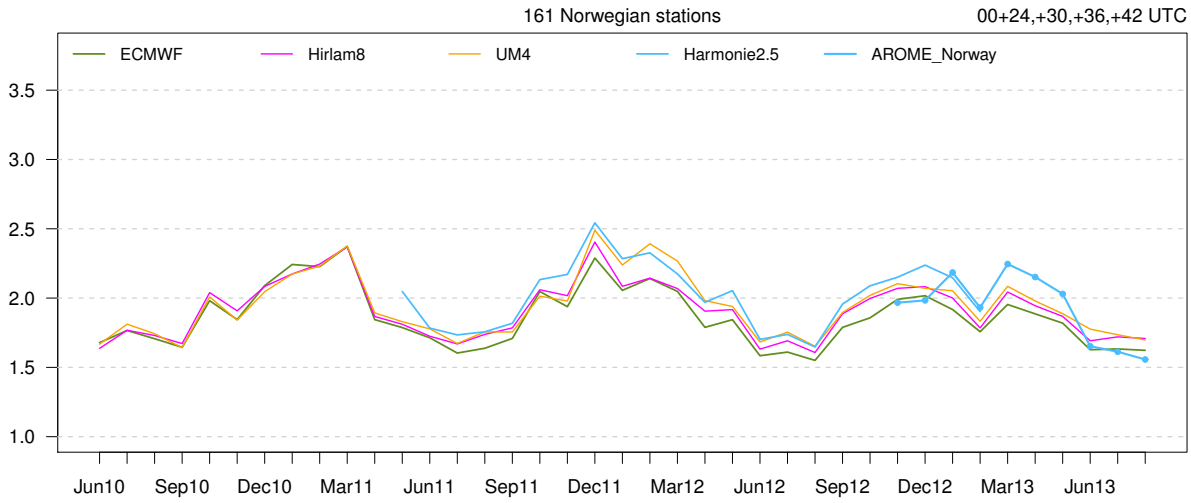
Mean Error

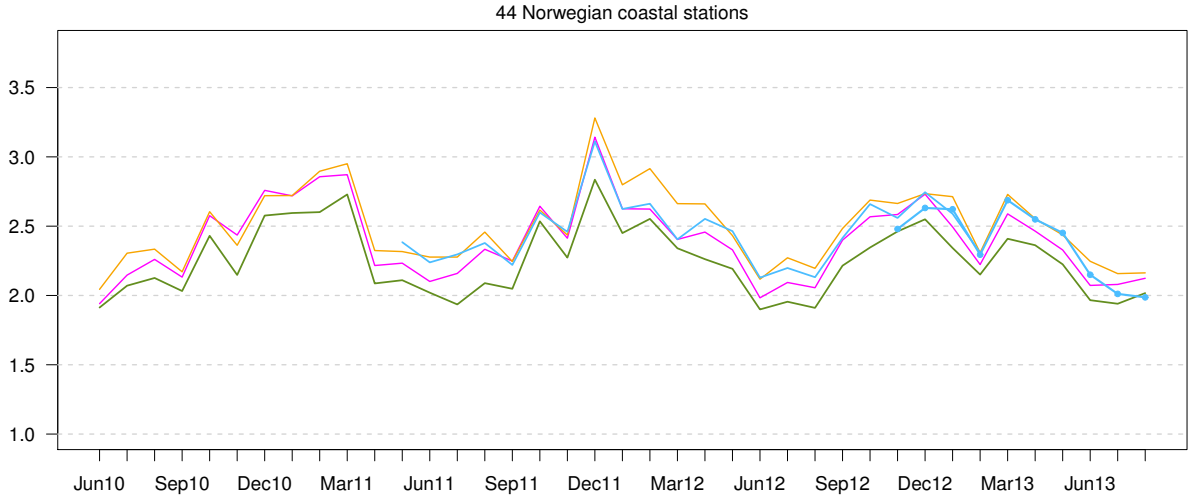

161 Norwegian stations
00+24,+30,+36,+42 UTC
ECMWF
Hirlam8
UM4
Harmonie2.5
AROME_Norway
2
1
0
−1
−2
−3
−4
Jun10
Sep10
Dec10
Mar11
Jun11
Sep11
Dec11
Mar12
Jun12
Sep12
Dec12
Mar13
Jun13

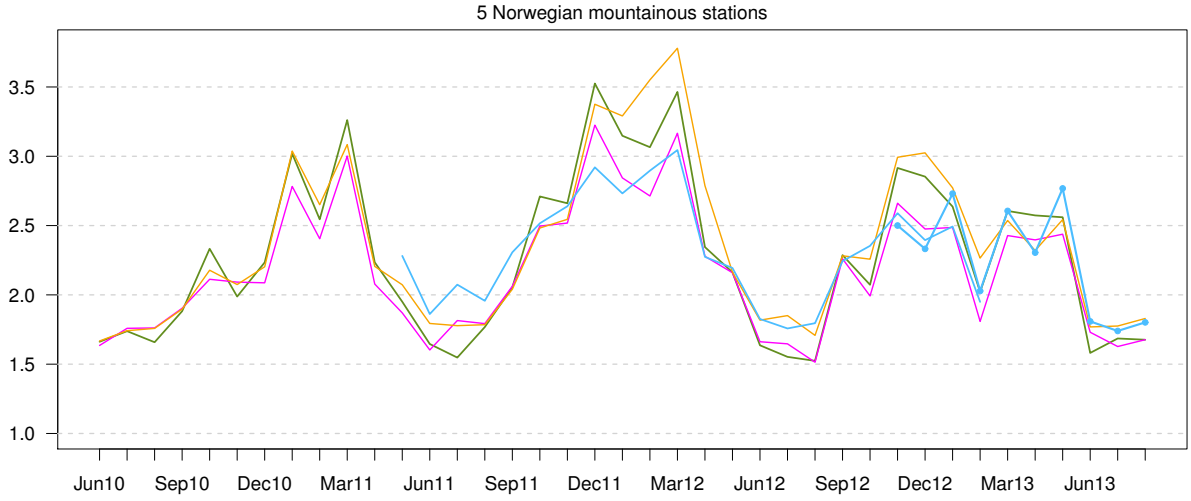

44 Norwegian coastal stations
2
1
0
−1
−2
−3
−4
Jun10
Sep10
Dec10
Mar11
Jun11
Sep11
Dec11
Mar12
Jun12
Sep12
Dec12
Mar13
Jun13


5 Norwegian mountainous stations
2
1
0
−1
−2
−3
−4
Jun10
Sep10
Dec10
Mar11
Jun11
Sep11
Dec11
Mar12
Jun12
Sep12
Dec12
Mar13
Jun13

Standard Deviation of Error

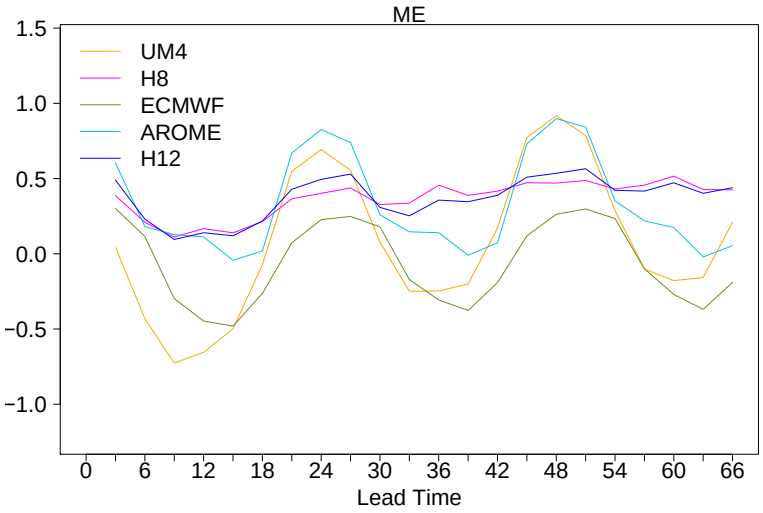


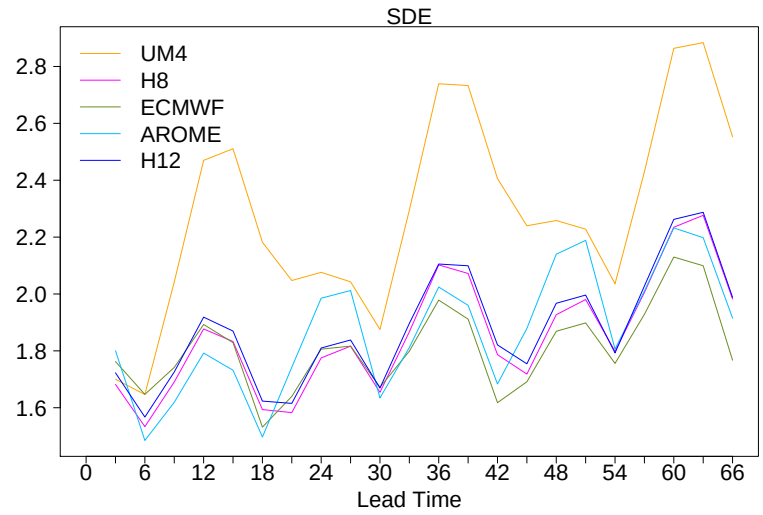


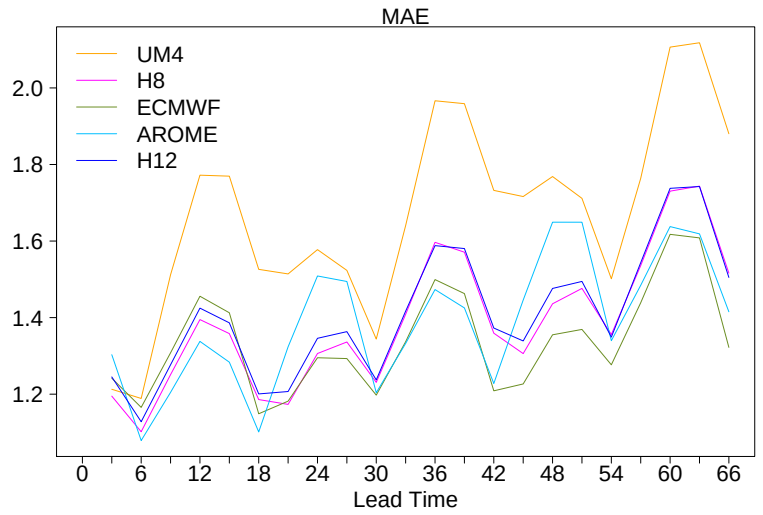


Mean Absolute Error

5.3 Temperature 2m







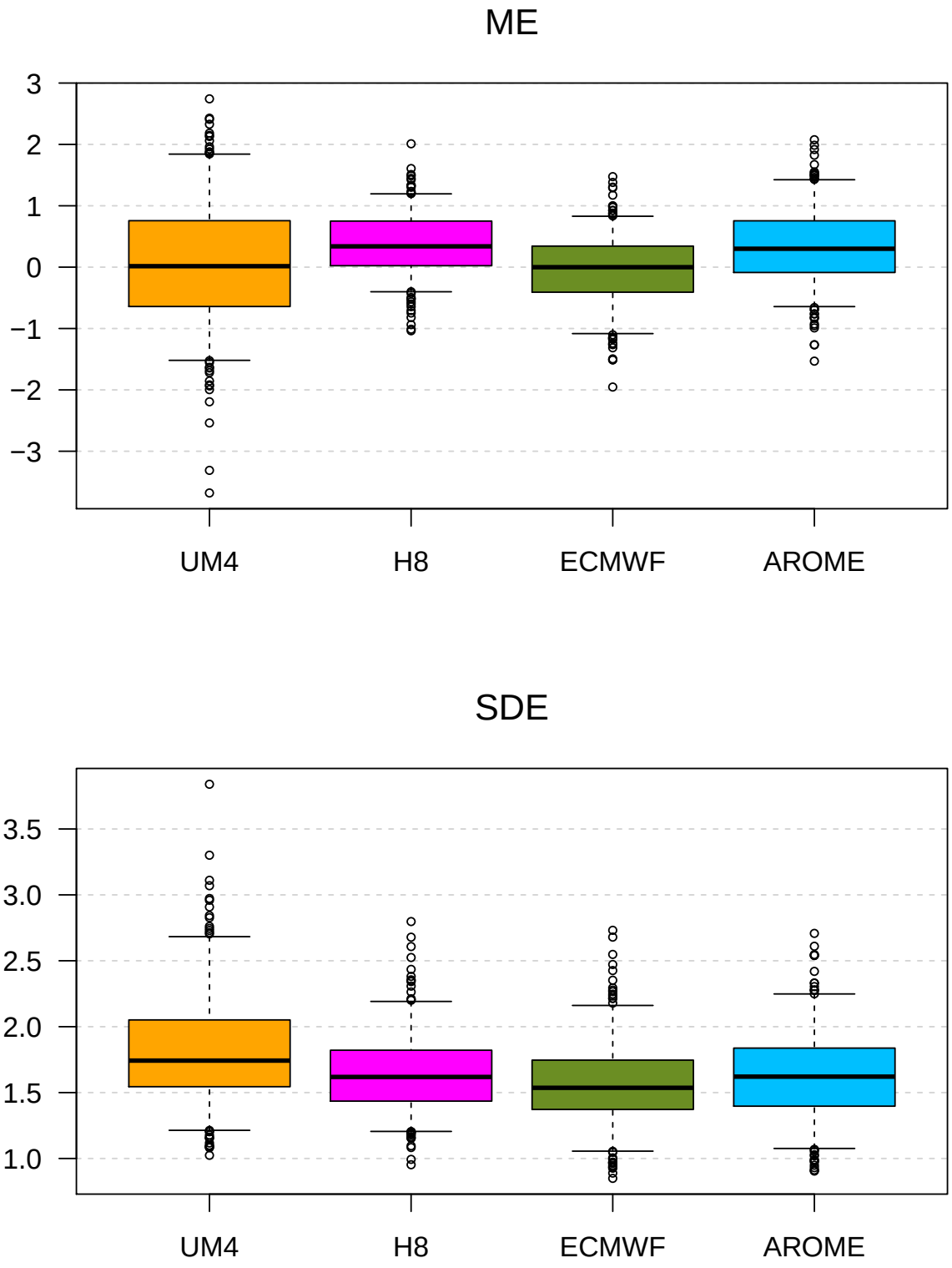
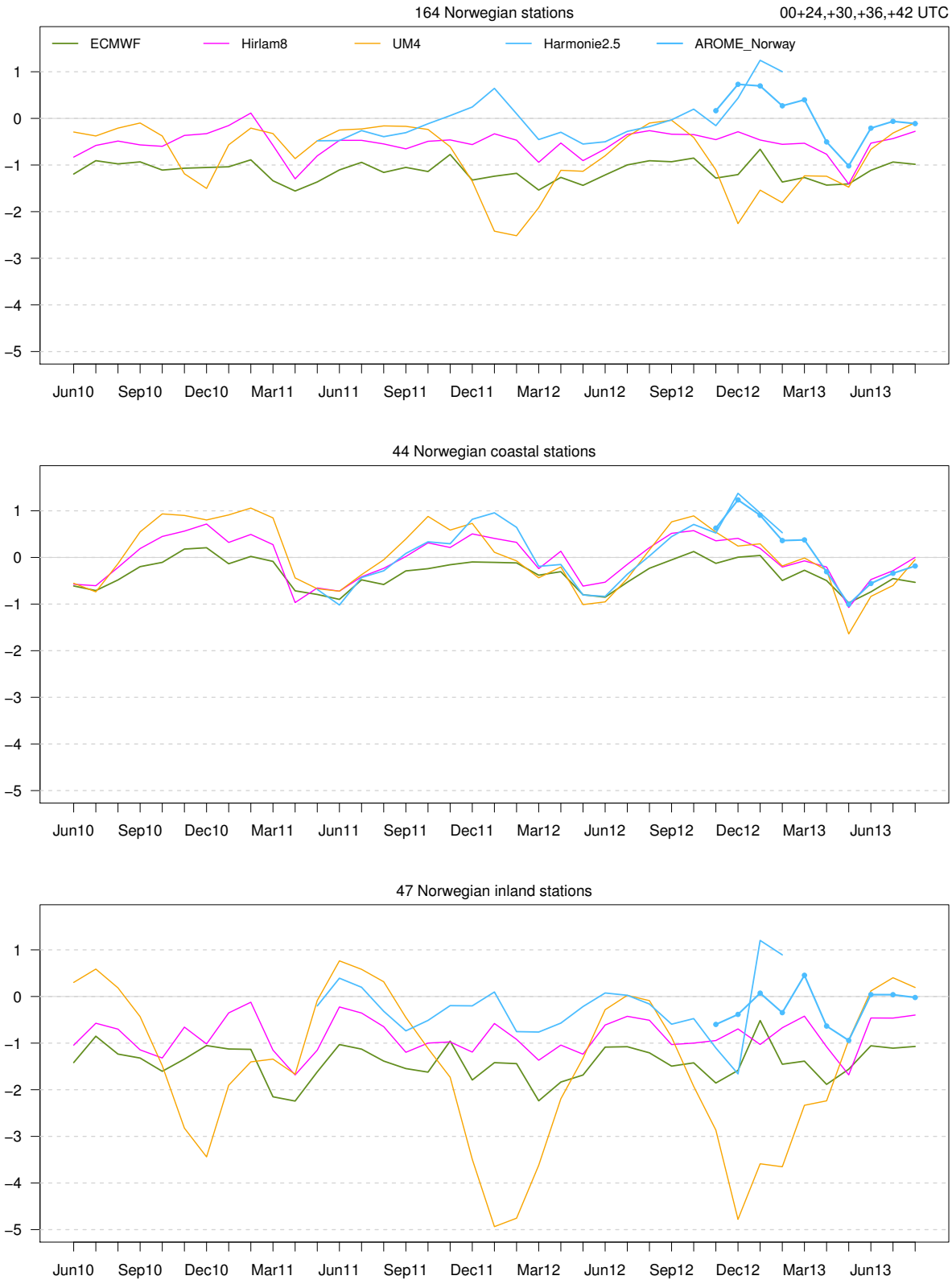
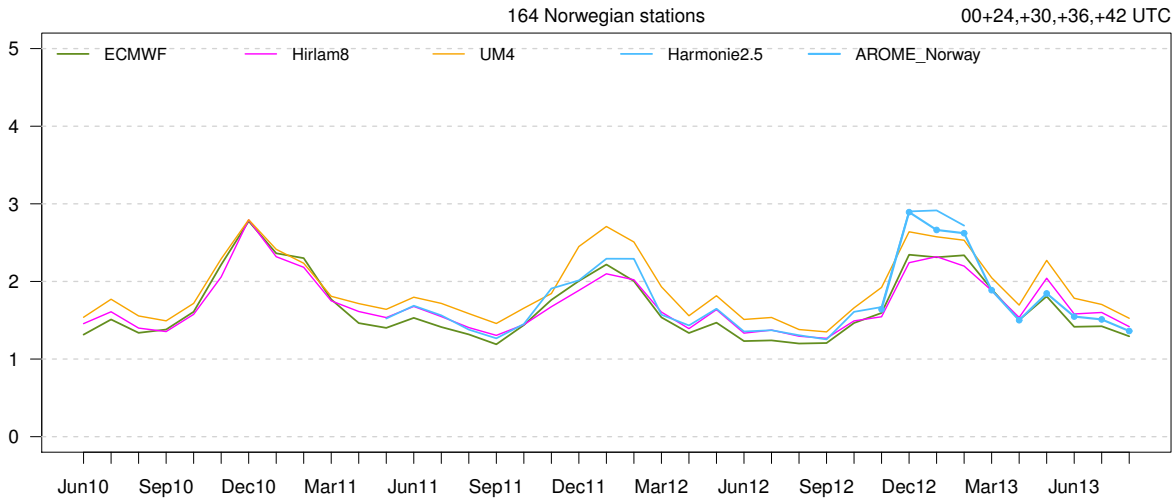


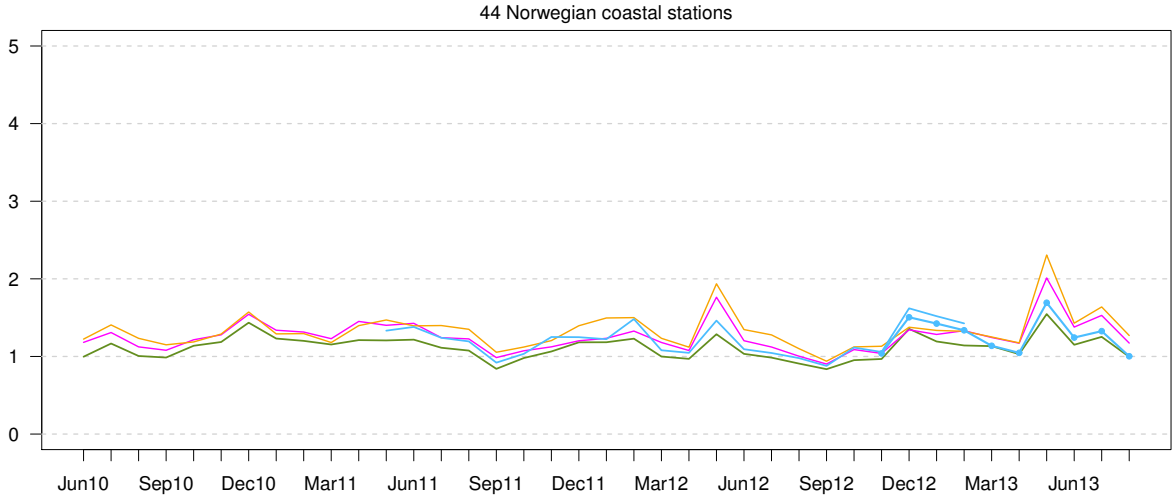
Figure 4: Lead time 00 +3,+6,...,+66

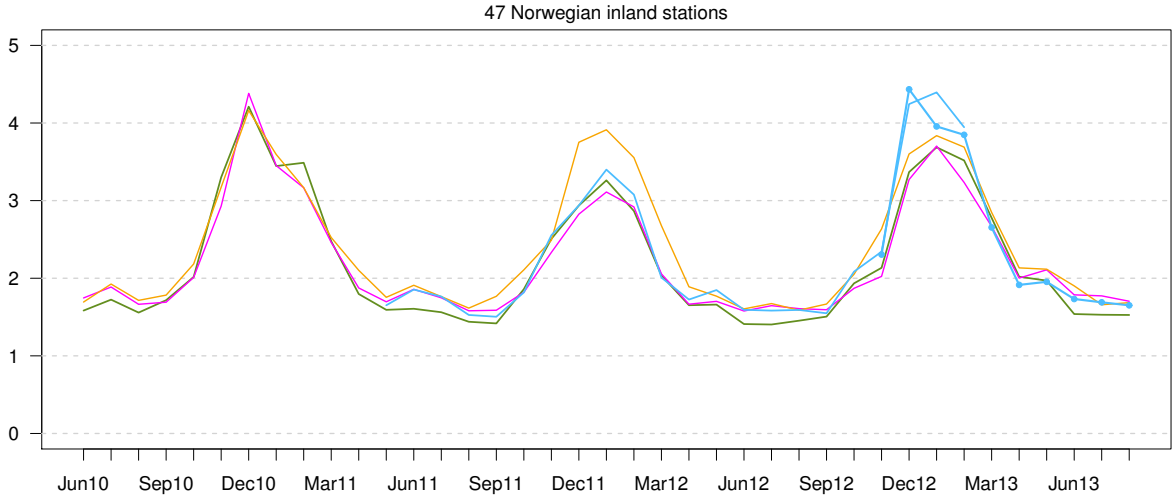
Mean Error


164 Norwegian stations
00+24,+30,+36,+42 UTC
ECMWF
Hirlam8
UM4
Harmonie2.5
AROME_Norway
1
0
−1
−2
−3
−4
−5
Jun10
Sep10
Dec10
Mar11
Jun11
Sep11
Dec11
Mar12
Jun12
Sep12
Dec12
Mar13
Jun13
44 Norwegian coastal stations
47 Norwegian inland stations

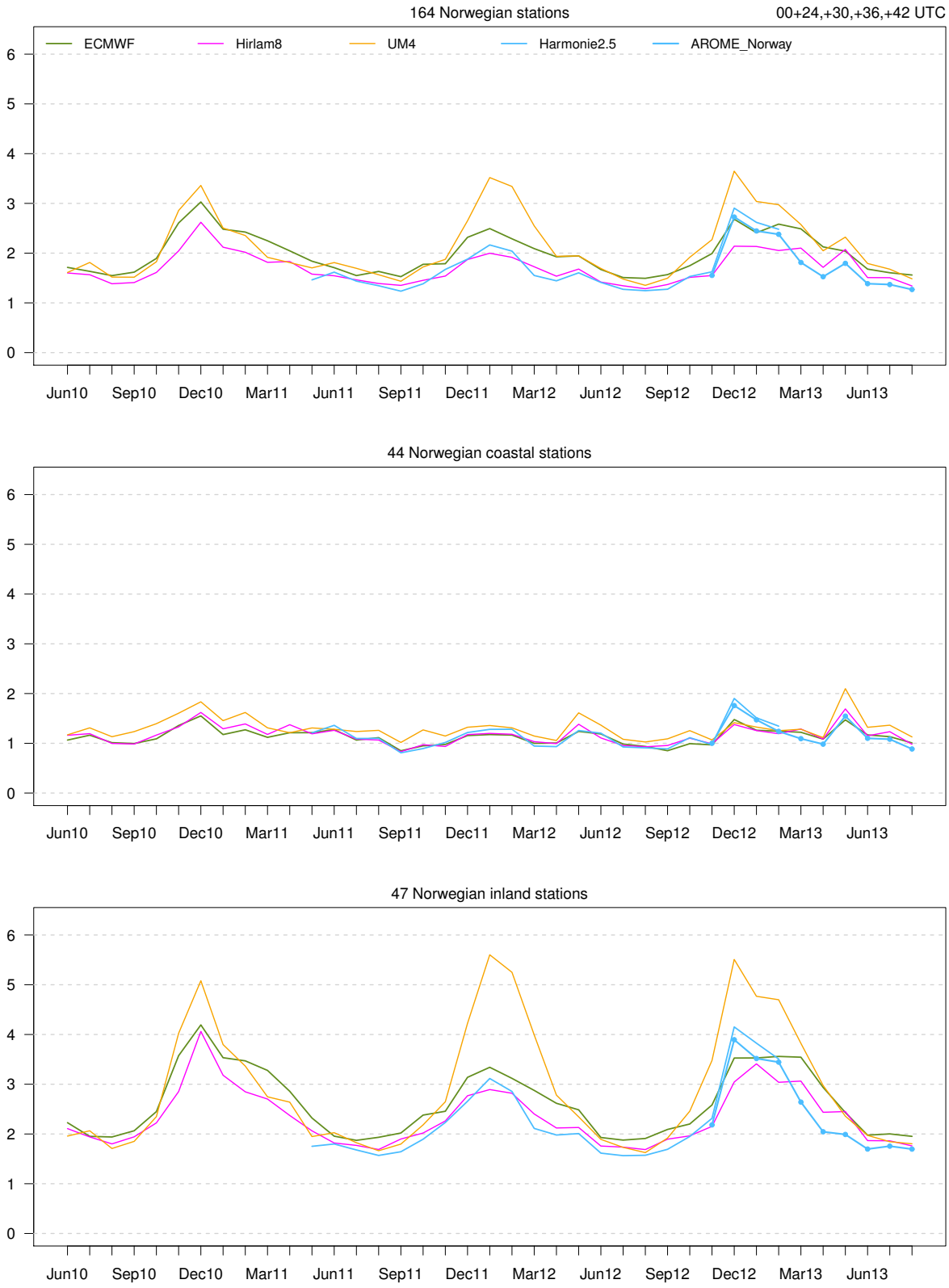
Standard Deviation of Error



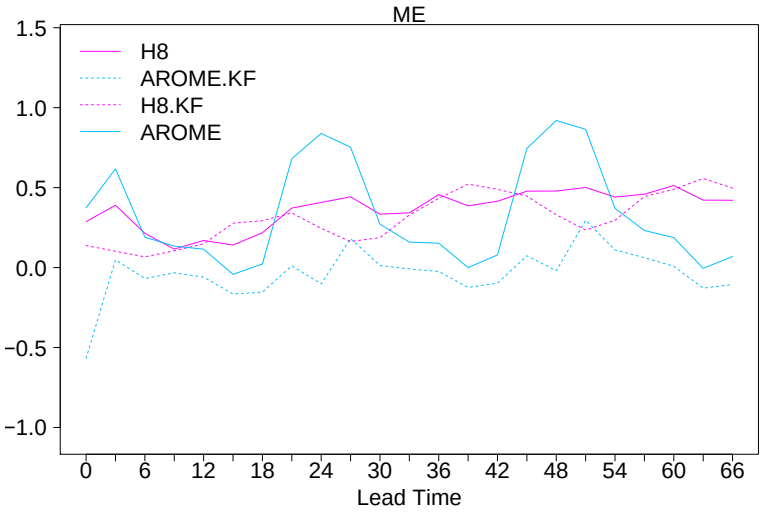


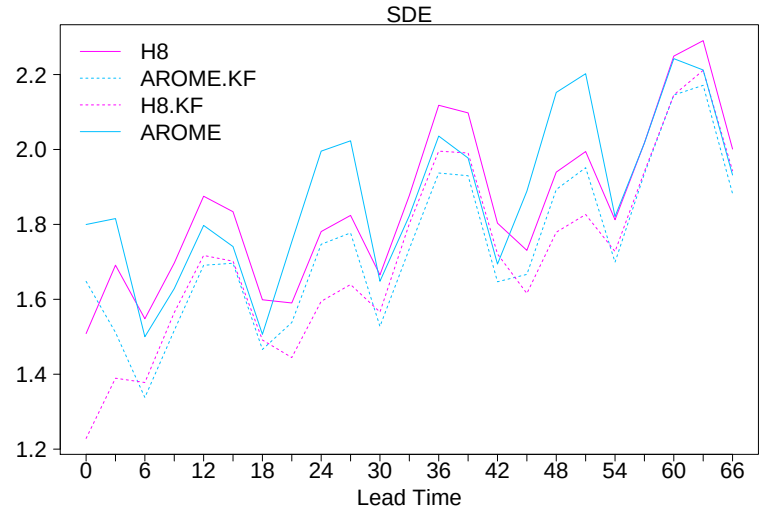


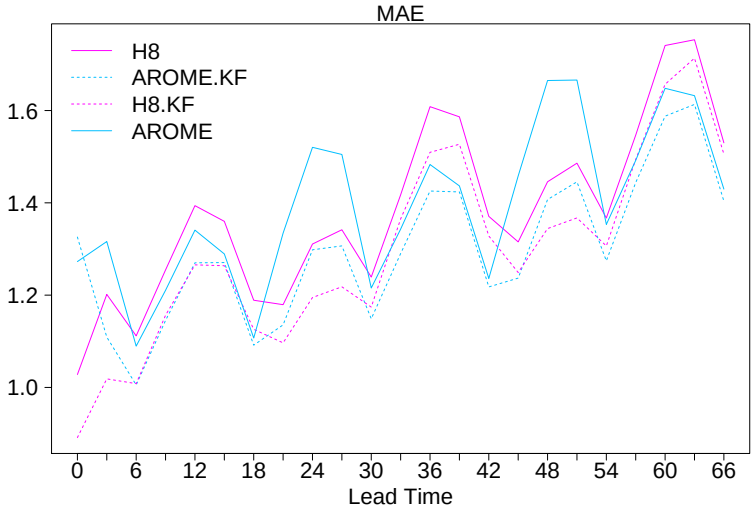
Mean Absolute Error



5.4 Post processed temperature 2m







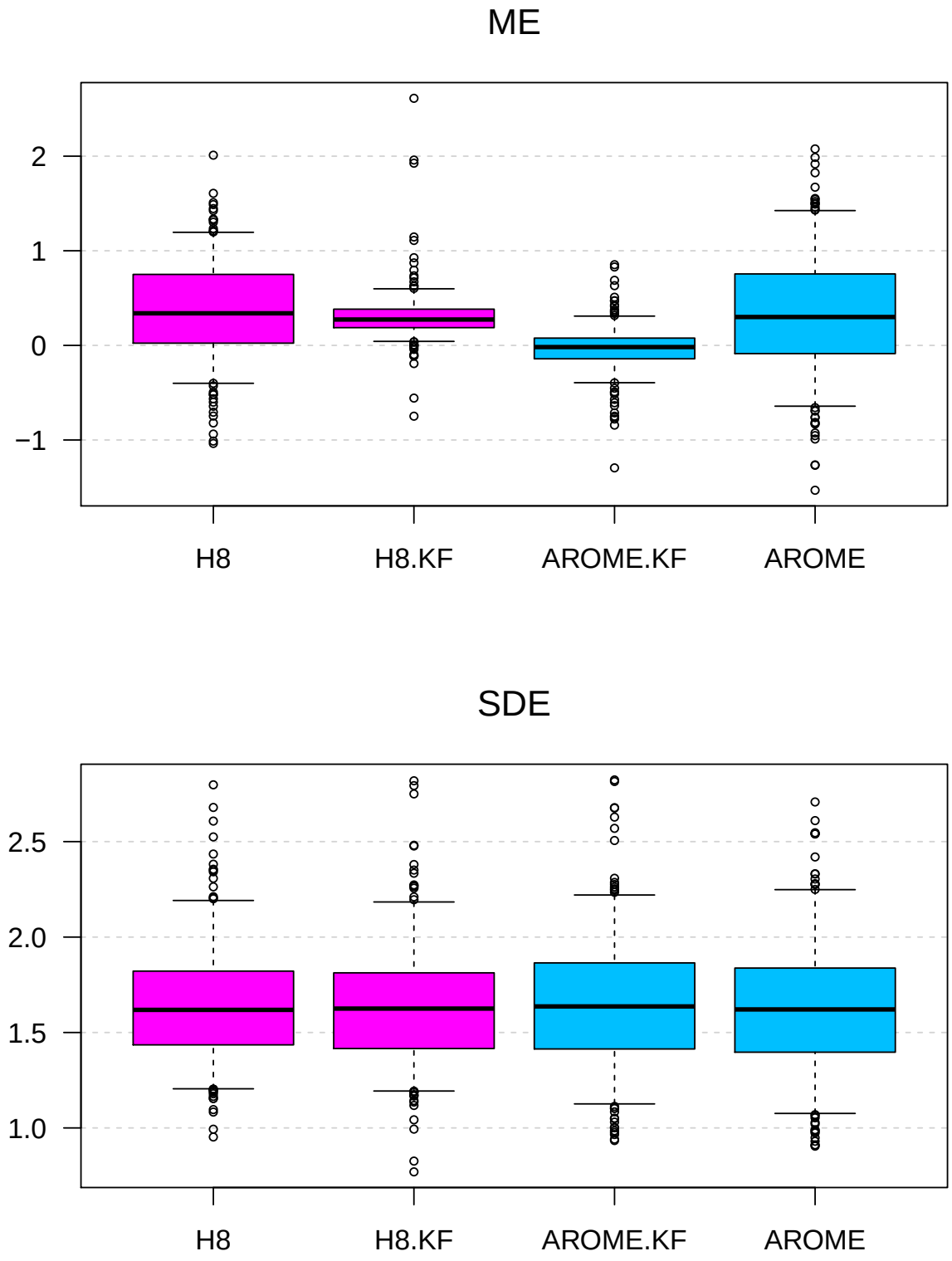
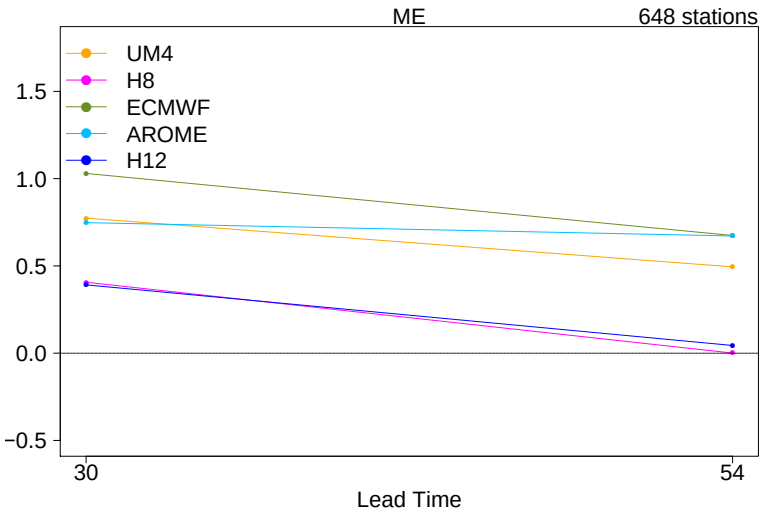
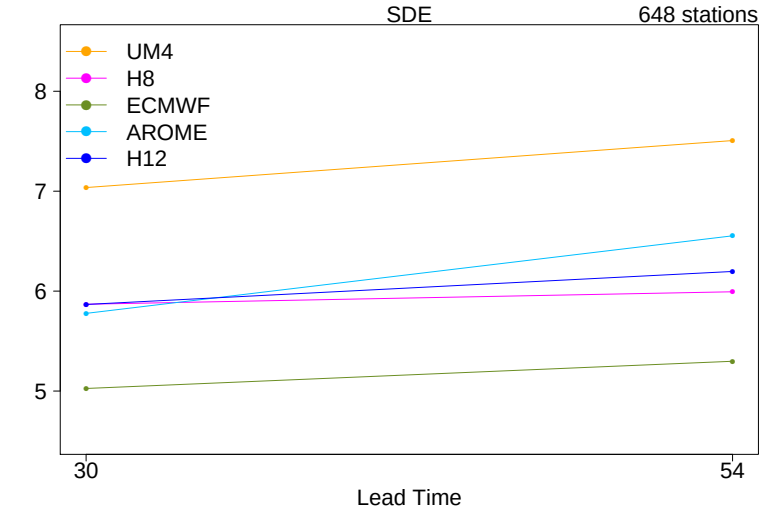
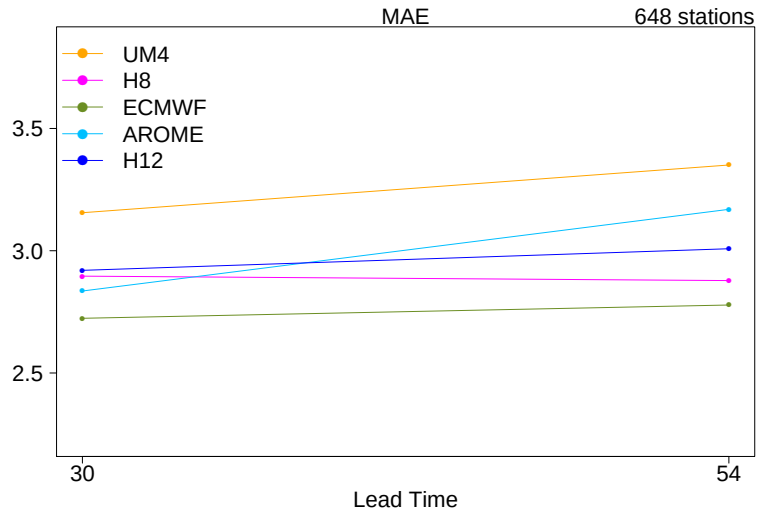


Figure 5: Lead time 00 +3,+6,...,+66

5.5 Daily precipitation







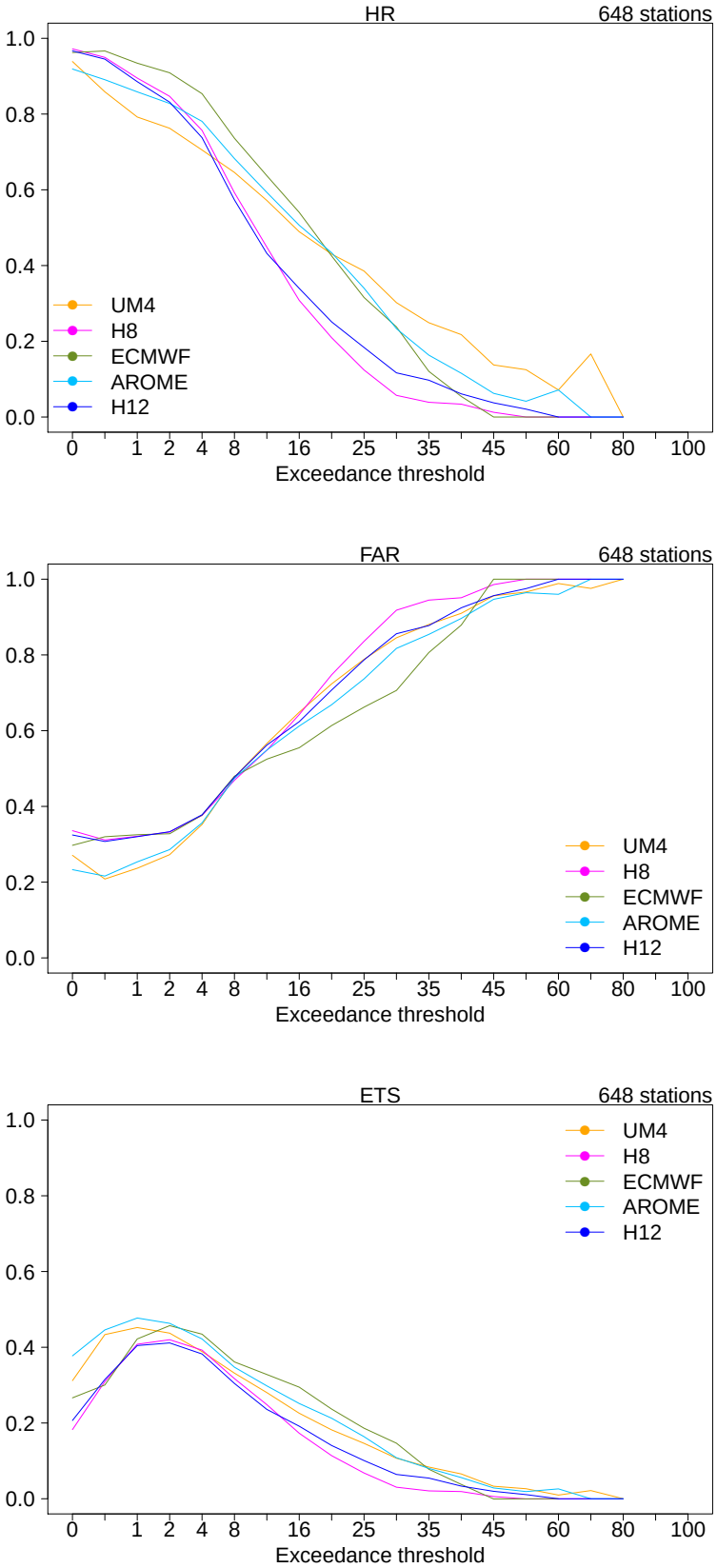
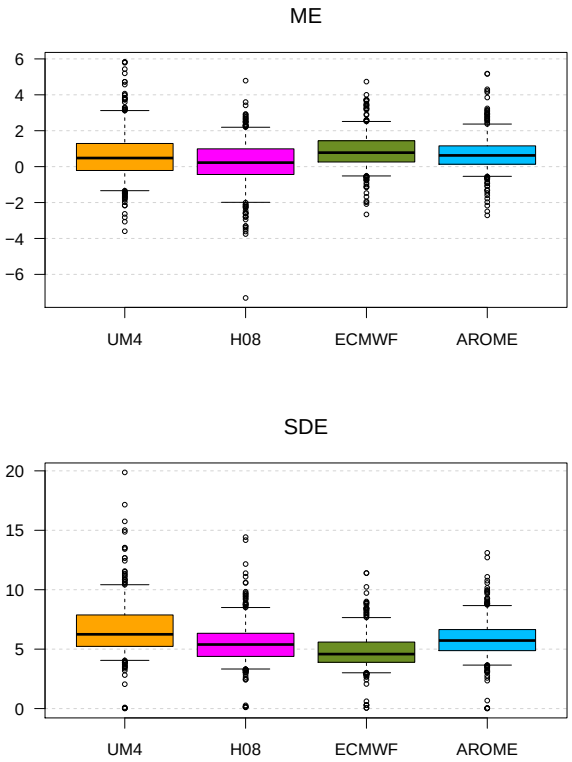


Figure 6: Lead time 00+30.



Forecasts:

UM4

	OBS					
	[0,0.1]	(0.1,5]	(5,20]	(20,50]	(50,Inf]	Sum
[0,0.1]	29526	6193	846	72	5	36642
(0.1,5]	8401	13573	4851	421	10	27256
(5,20]	1238	5596	7190	1231	27	15282
(20,50]	196	707	1918	950	53	3824
(50,Inf]	19	71	160	101	8	359
Sum	39380	26140	14965	2775	103	83363

H08

	OBS					
	[0,0.1]	(0.1,5]	(5,20]	(20,50]	(50,Inf]	Sum
[0,0.1]	21048	2553	248	20	0	23869
(0.1,5]	16851	16924	5090	426	13	39304
(5,20]	1400	6355	8495	1801	70	18121
(20,50]	78	288	1091	499	20	1976
(50,Inf]	3	20	41	29	0	93
Sum	39380	26140	14965	2775	103	83363

ECMWF

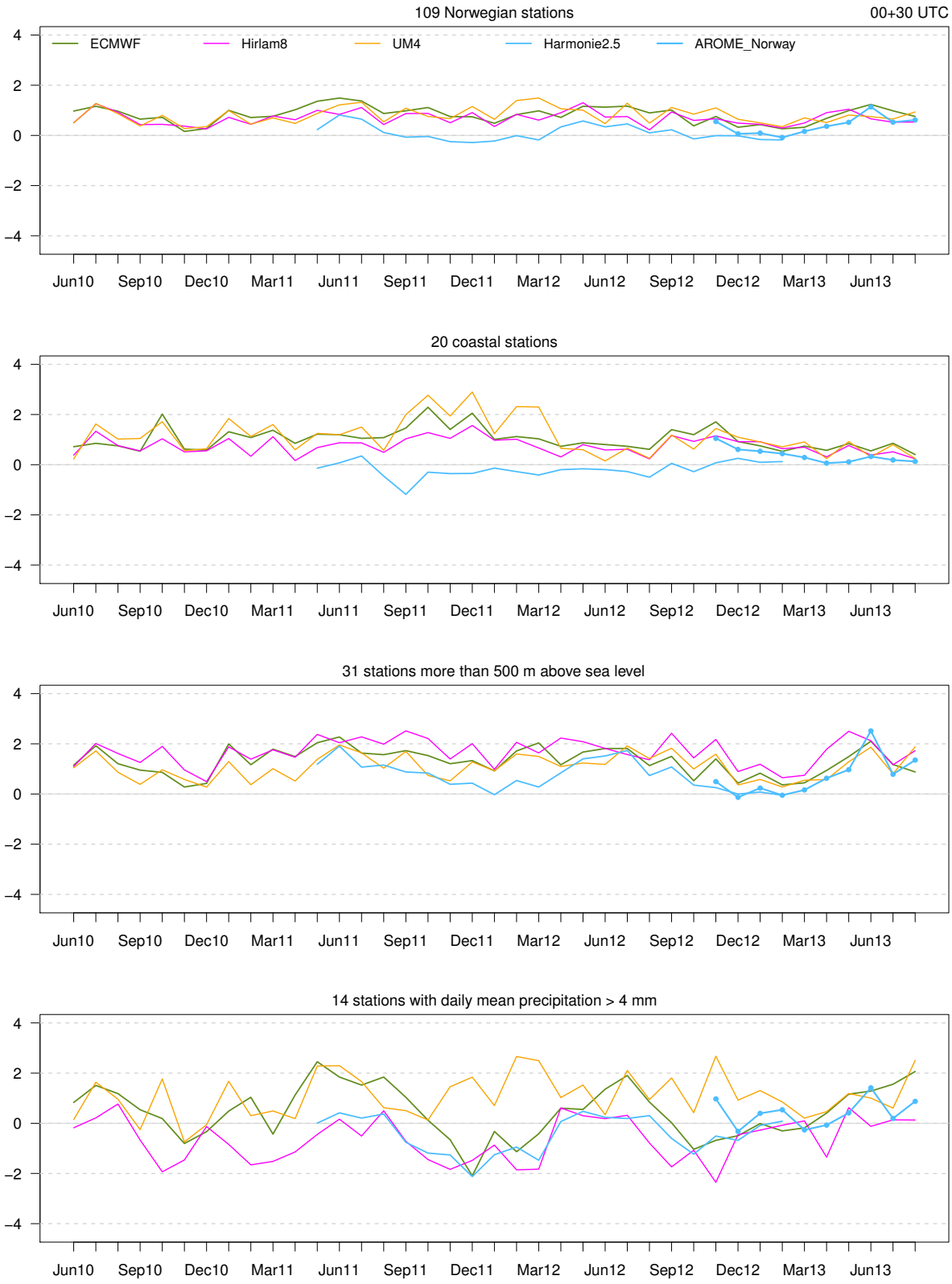
	OBS					
	[0,0.1]	(0.1,5]	(5,20]	(20,50]	(50,Inf]	Sum
[0,0.1]	19424	1703	78	8	0	21213
(0.1,5]	18114	16267	3302	197	1	37881
(5,20]	1757	7897	10200	1593	41	21488
(20,50]	85	272	1380	964	61	2762
(50,Inf]	0	1	5	13	0	19
Sum	39380	26140	14965	2775	103	83363

AROME

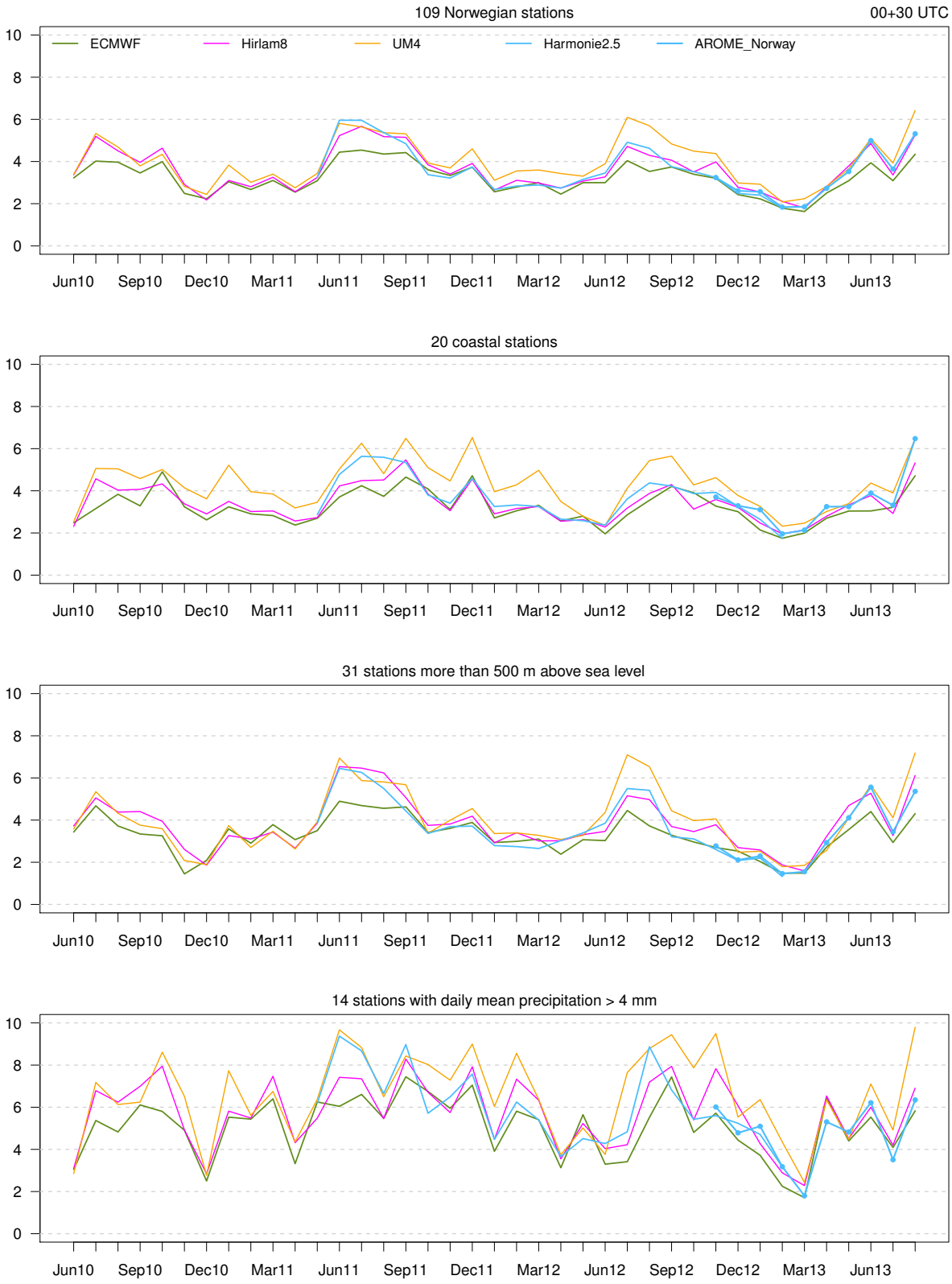
	OBS					
	[0,0.1]	(0.1,5]	(5,20]	(20,50]	(50,Inf]	Sum
[0,0.1]	28227	5016	433	53	0	33729
(0.1,5]	9349	14032	4174	283	6	27844
(5,20]	1615	6483	8522	1388	39	18047
(20,50]	181	597	1780	982	53	3593
(50,Inf]	8	12	56	69	5	150
Sum	39380	26140	14965	2775	103	83363

Figure 7: Lead time 00+30,+54

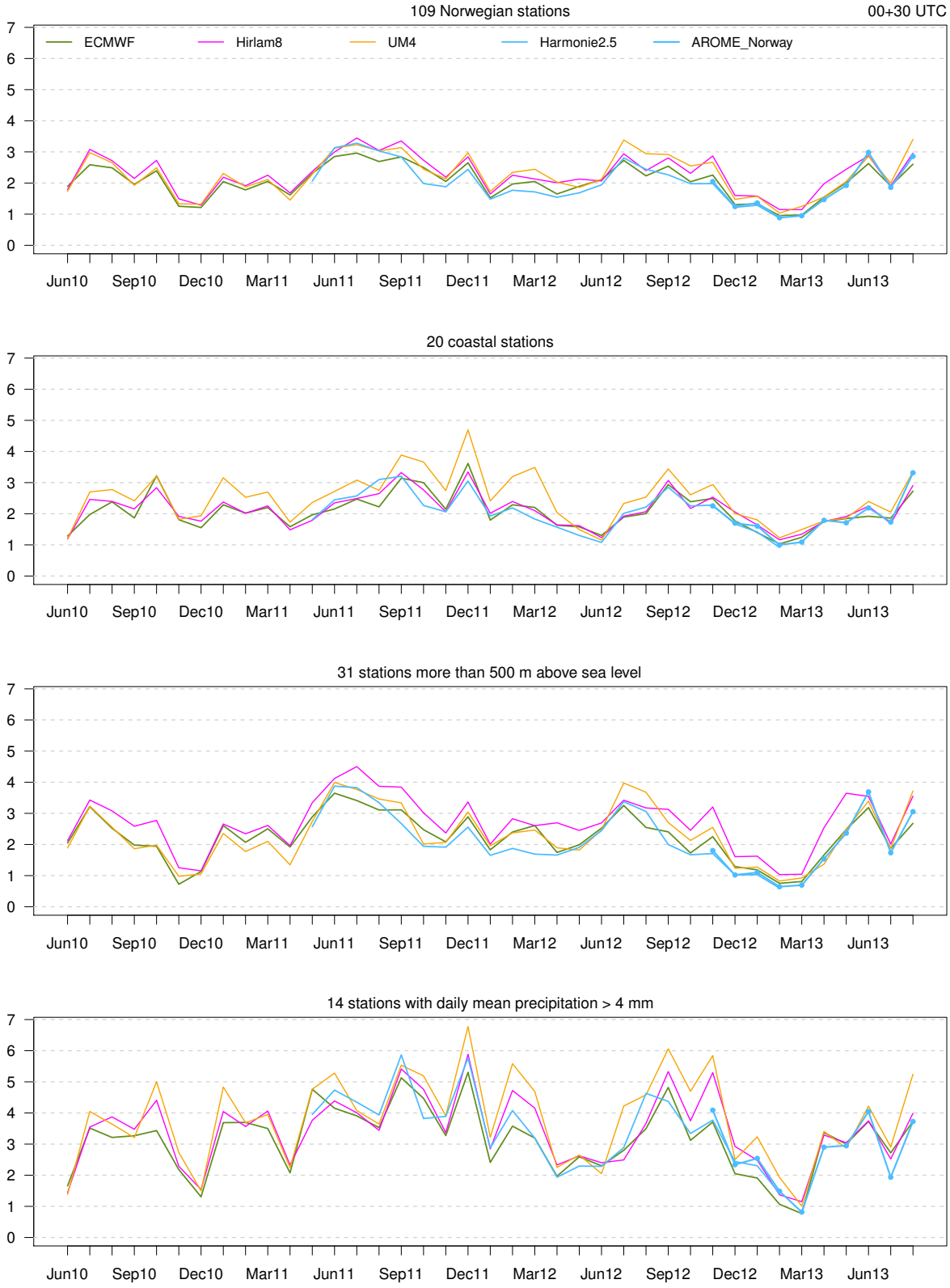
Mean Error


109 Norwegian stations
00+30 UTC
ECMWF
Hirlam8
UM4
Harmonie2.5
AROME_Norway
4
2
0
−2
−4
Jun10
Sep10
Dec10
Mar11
Jun11
Sep11
Dec11
Mar12
Jun12
Sep12
Dec12
Mar13
Jun13
20 coastal stations
31 stations more than 500 m above sea level
14 stations with daily mean precipitation > 4 mm

Standard Deviation of Error

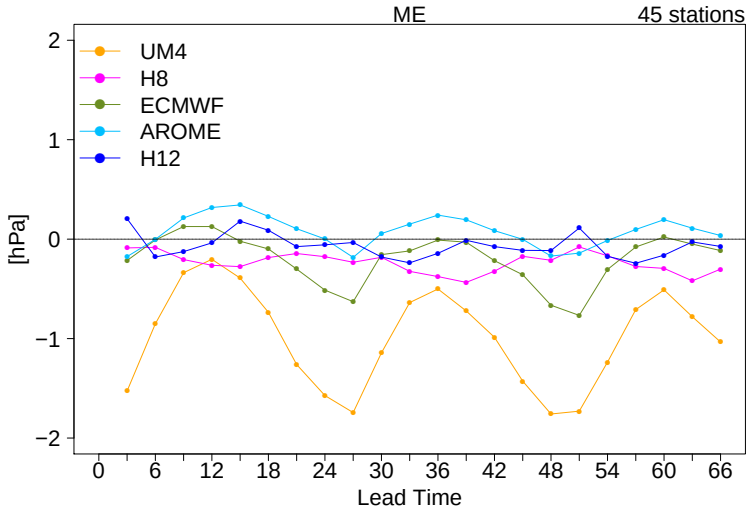


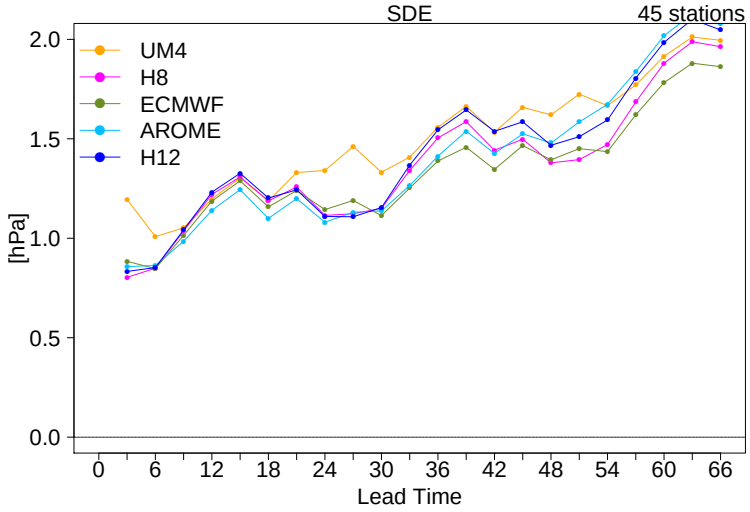
Mean Absolute Error

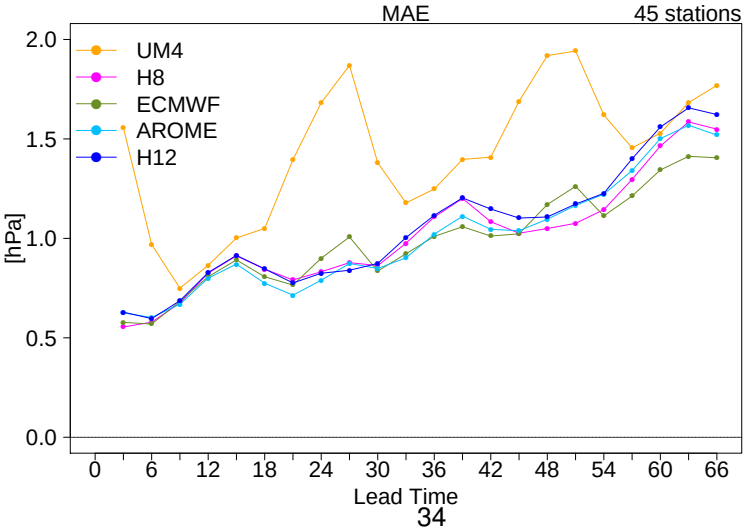


6 Eastern Norway

6.1 Pressure







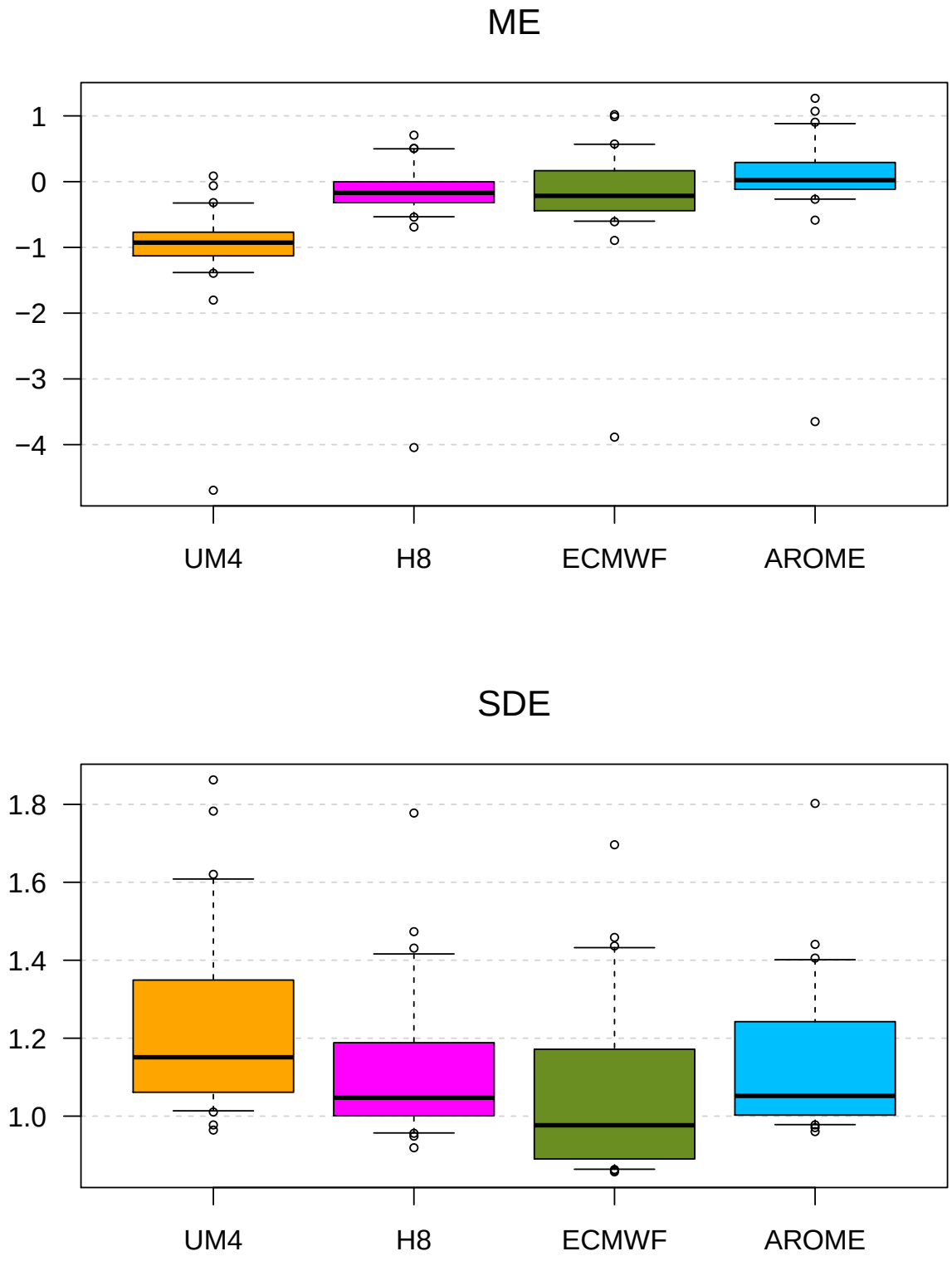
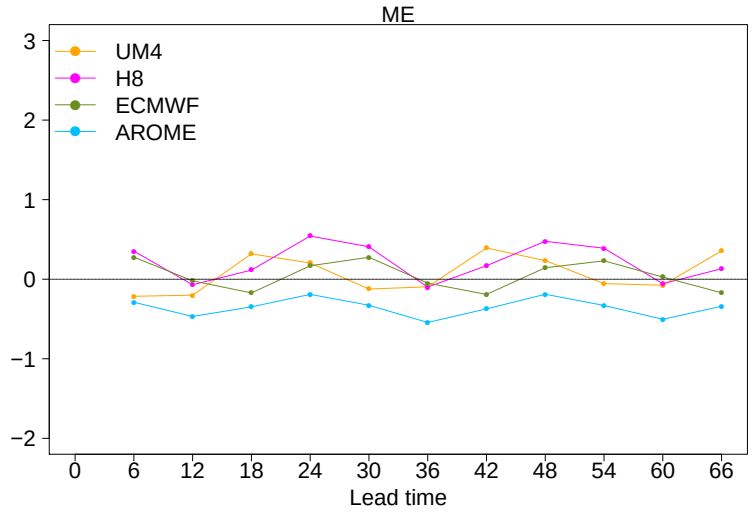
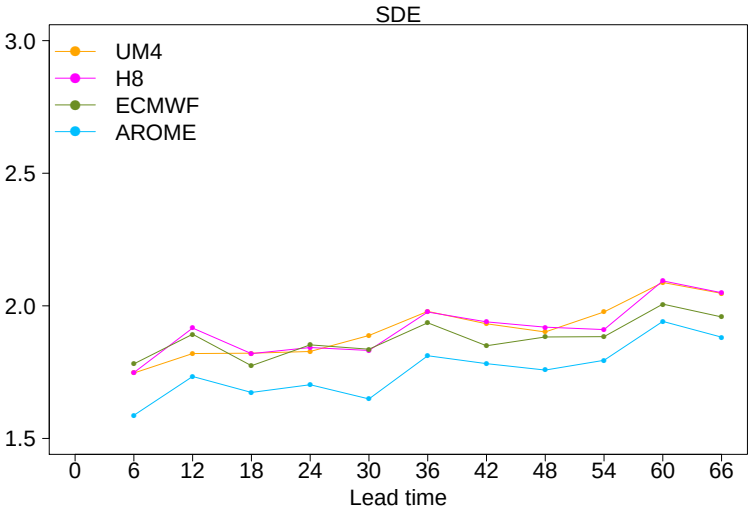
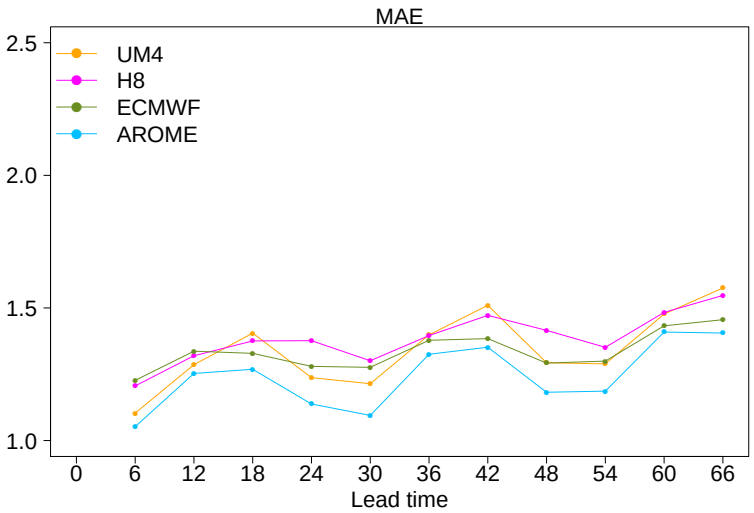


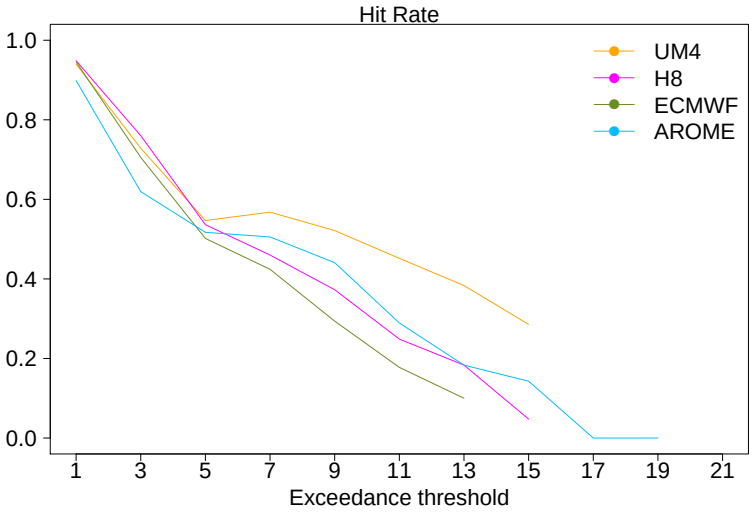
Figure 8: Lead time 00 +3,+6,...,+66

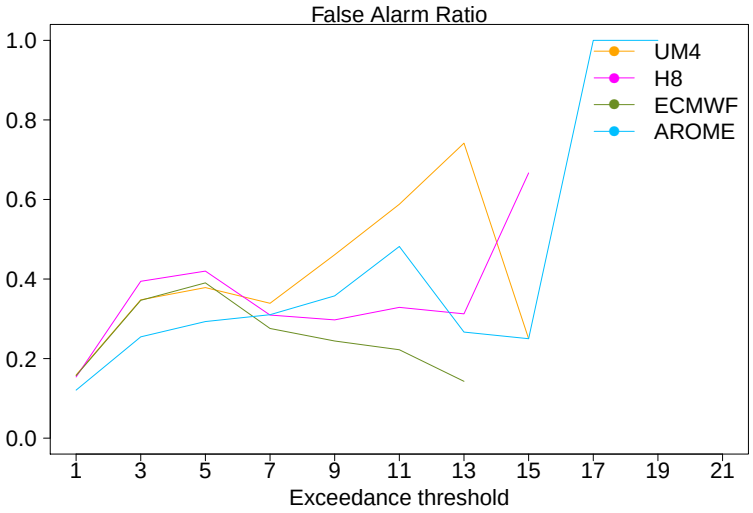
6.2 Wind Speed 10m











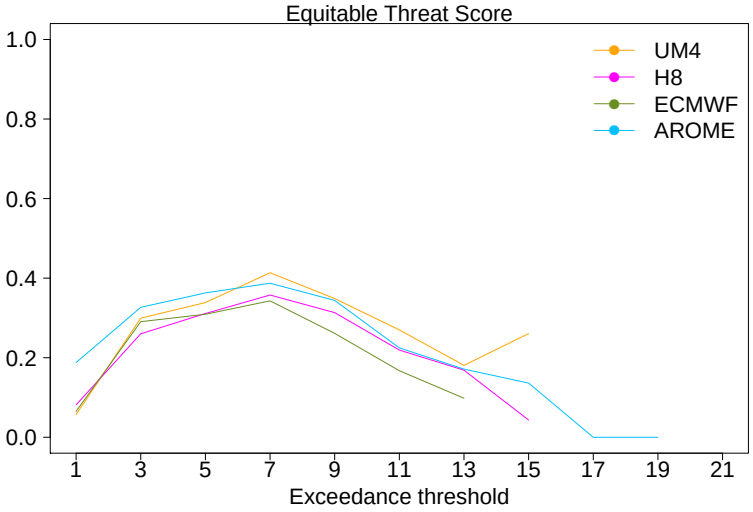
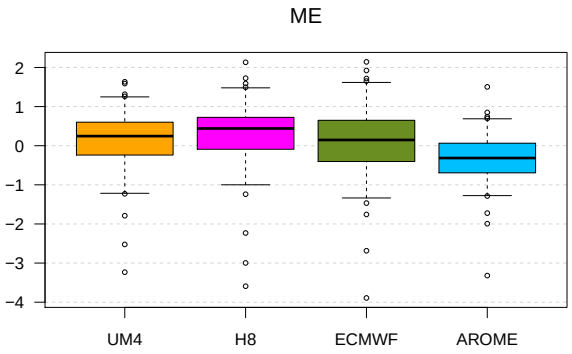
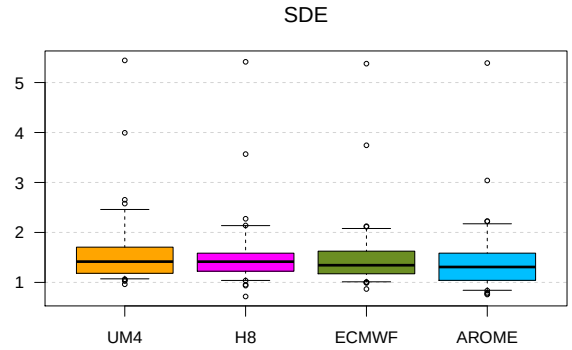


Figure 9: Lead time 00+12,+15,+18,+21,+24





Forecasts:

UM4

	OBS					
	[0,3]	(3,11]	(11,17]	(17,21]	(21,Inf]	Sum
[0,3]	34540	8412	55	8	5	43020
(3,11]	11625	18836	316	20	3	30800
(11,17]	16	471	264	6	0	757
(17,21]	0	0	0	0	0	0
(21,Inf]	0	0	0	0	0	0
Sum	46181	27719	635	34	8	74577

H8

	OBS					
	[0,3]	(3,11]	(11,17]	(17,21]	(21,Inf]	Sum
[0,3]	31299	7299	35	1	5	38639
(3,11]	14880	20317	461	27	3	35688
(11,17]	2	103	139	6	0	250
(17,21]	0	0	0	0	0	0
(21,Inf]	0	0	0	0	0	0
Sum	46181	27719	635	34	8	74577

ECMWF

	OBS					
	[0,3]	(3,11]	(11,17]	(17,21]	(21,Inf]	Sum
[0,3]	33982	8369	68	5	5	42429
(3,11]	12199	19311	466	24	3	32003
(11,17]	0	39	101	5	0	145
(17,21]	0	0	0	0	0	0
(21,Inf]	0	0	0	0	0	0
Sum	46181	27719	635	34	8	74577

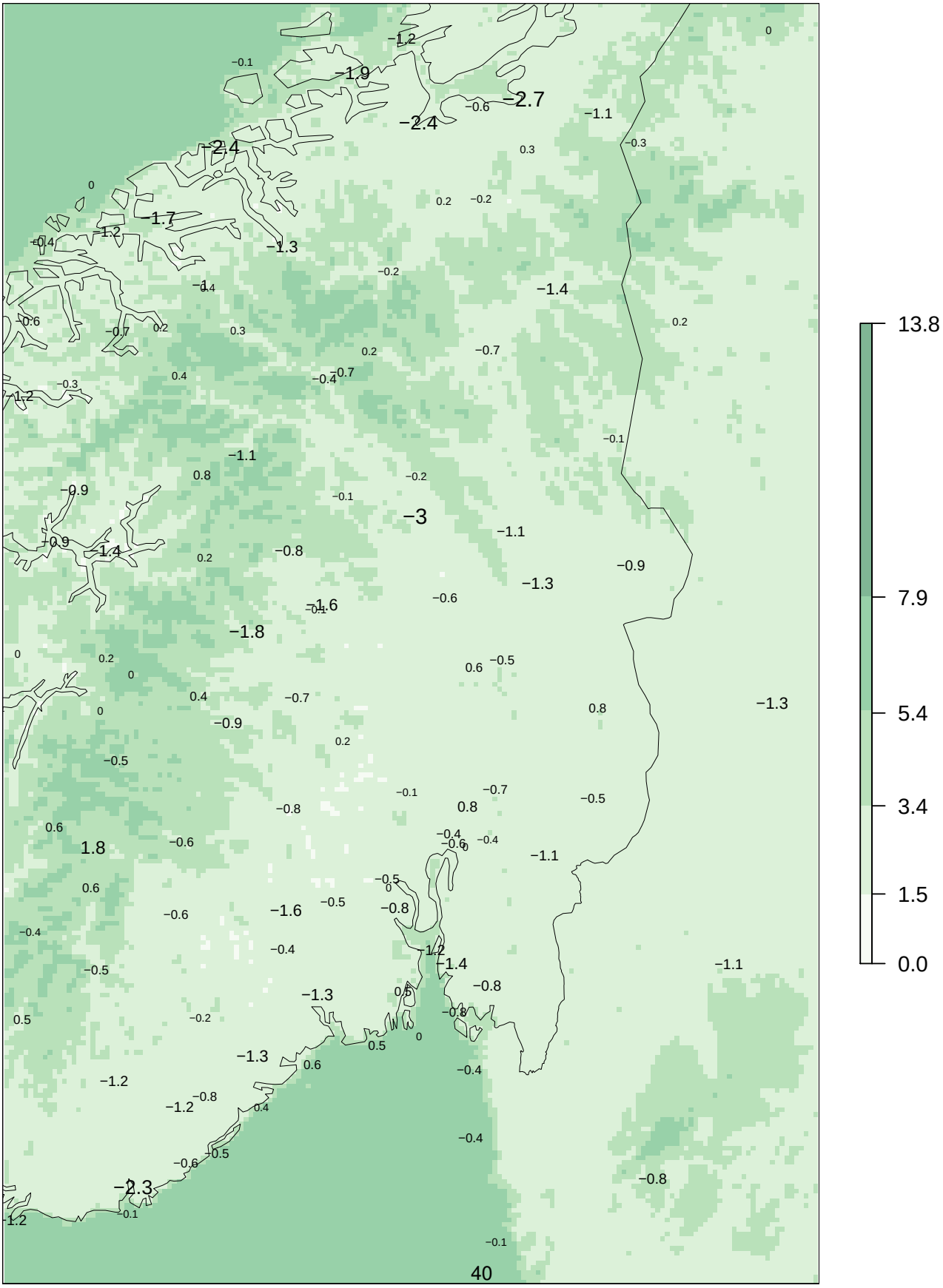
AROME

	OBS					
	[0,3]	(3,11]	(11,17]	(17,21]	(21,Inf]	Sum
[0,3]	39941	11292	28	0	5	51266
(3,11]	6234	16227	444	19	3	22927
(11,17]	6	199	163	15	0	383
(17,21]	0	1	0	0	0	1
(21,Inf]	0	0	0	0	0	0
Sum	46181	27719	635	34	8	74577

Figure 10: Lead time 00+3,+6,..,+66.

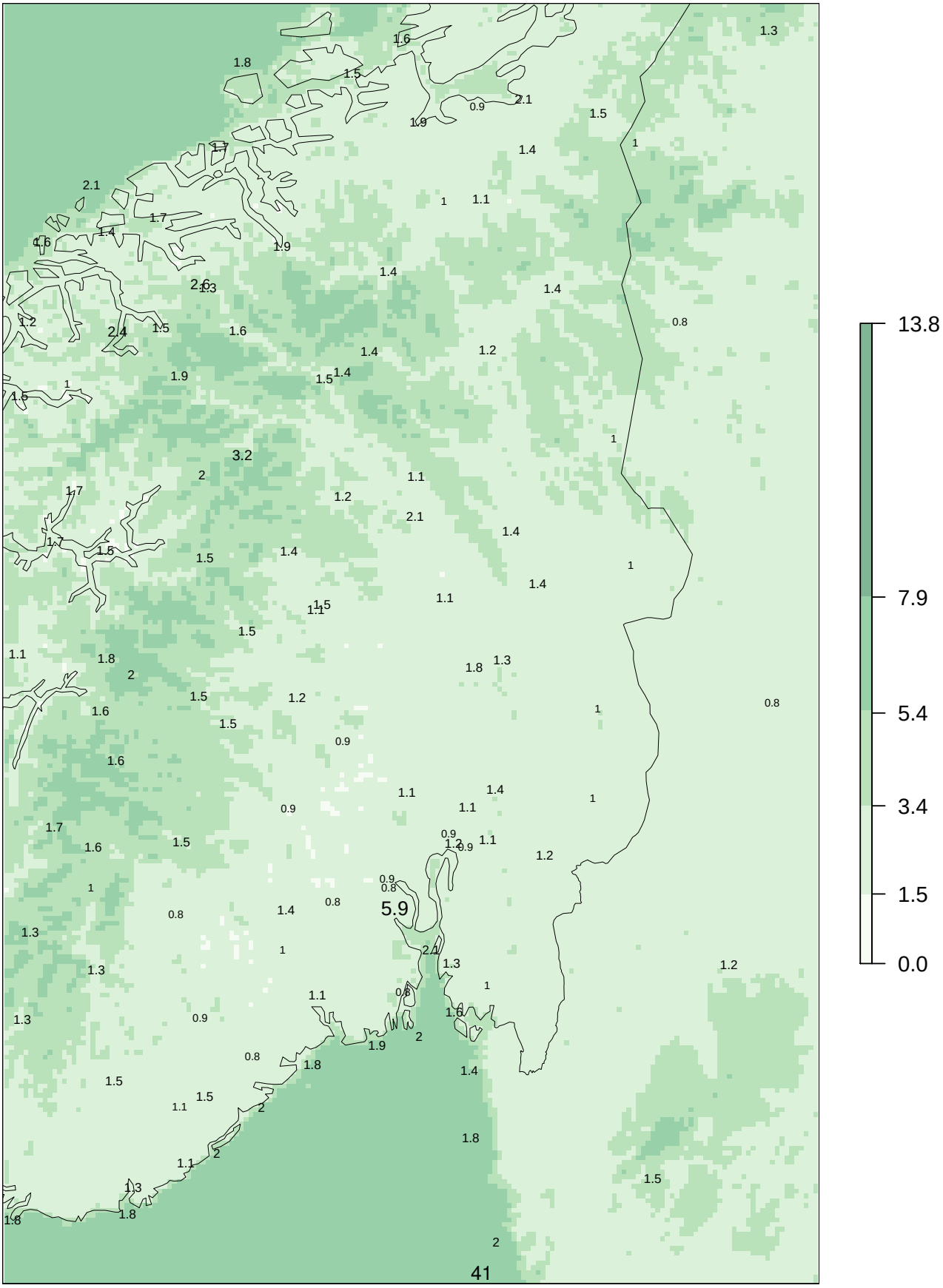
AROME−Norway 00+12

ME at observing sites forecast means 01.06.2013 − 31.08.2013

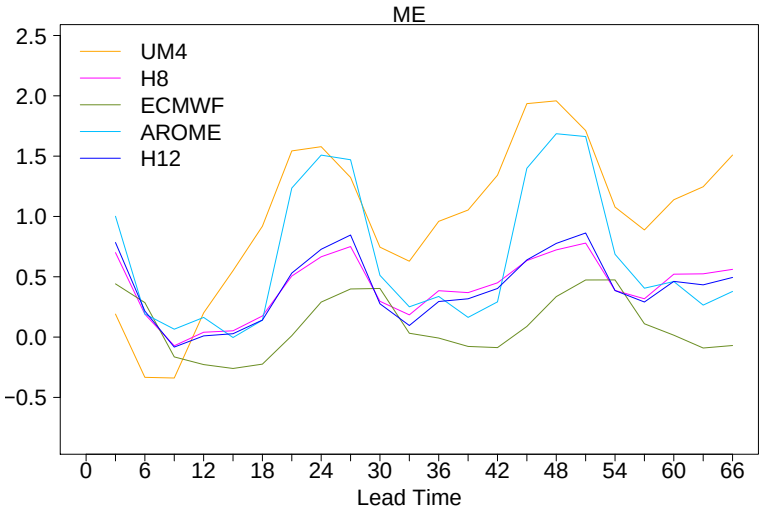


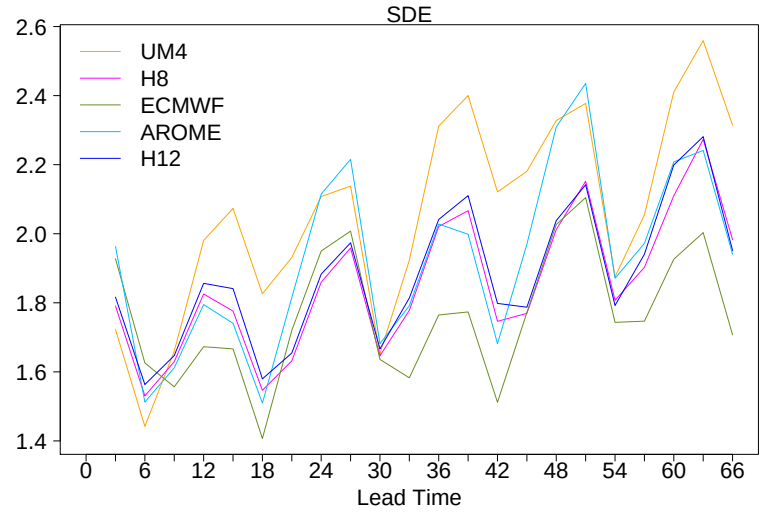
AROME−Norway 00+12

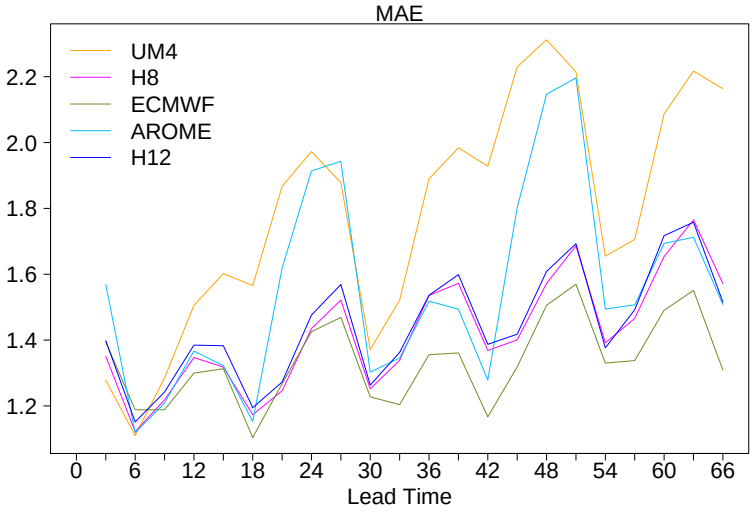
SDE at observing sites forecast means 01.06.2013 − 31.08.2013

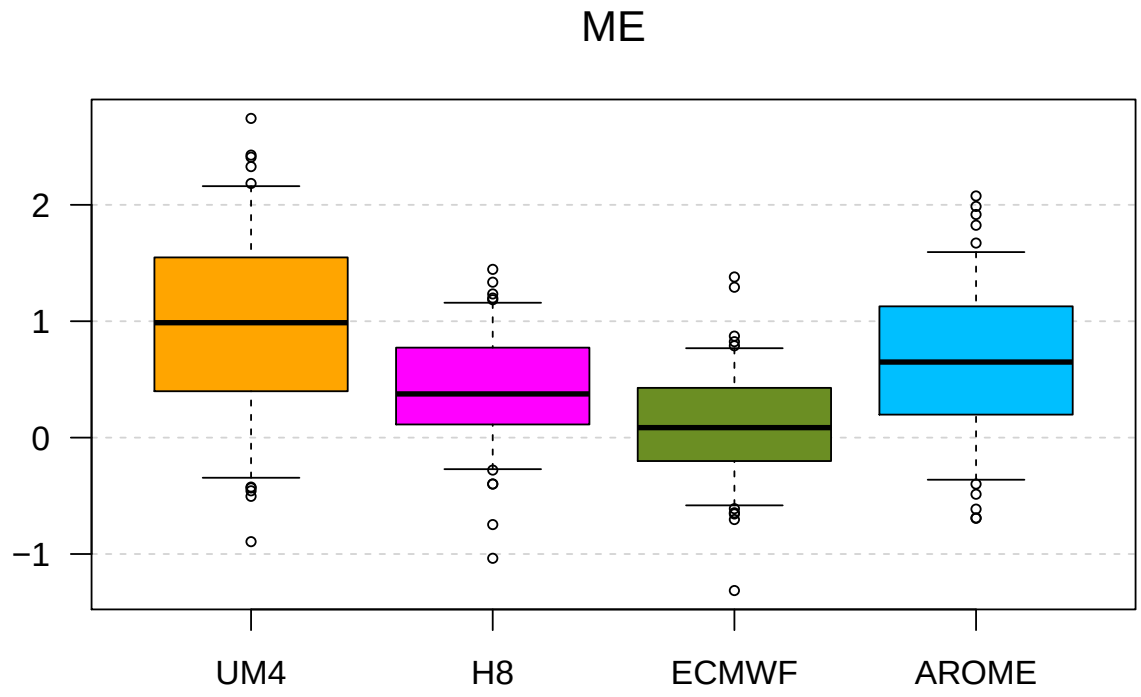


6.3 Temperature 2m









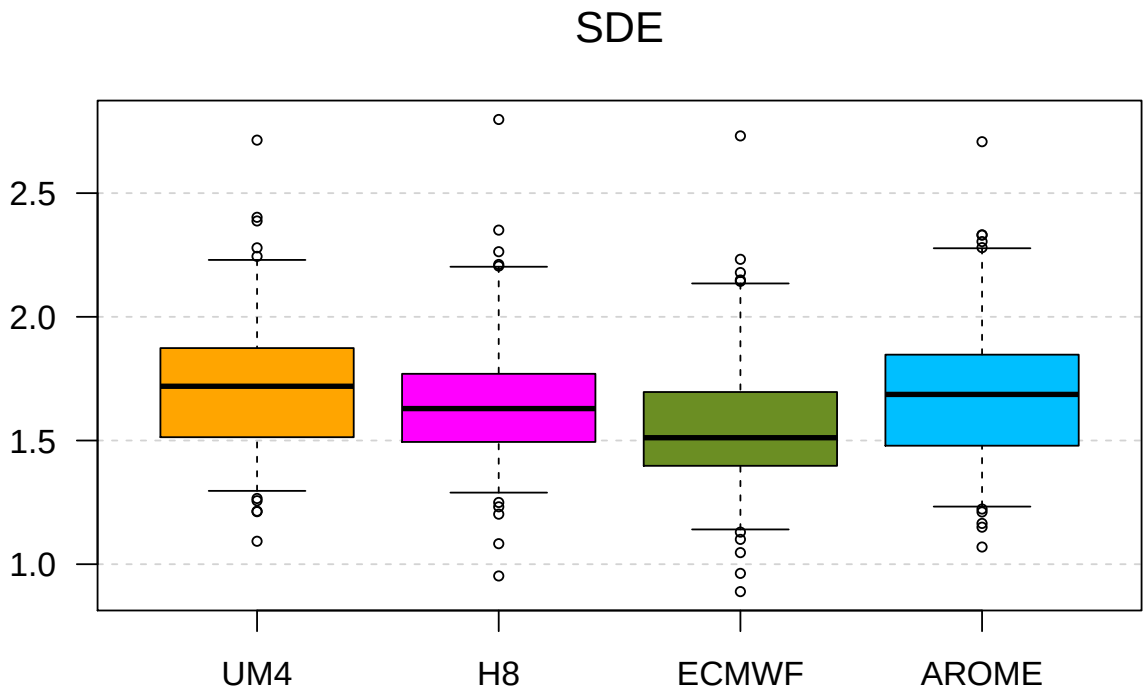
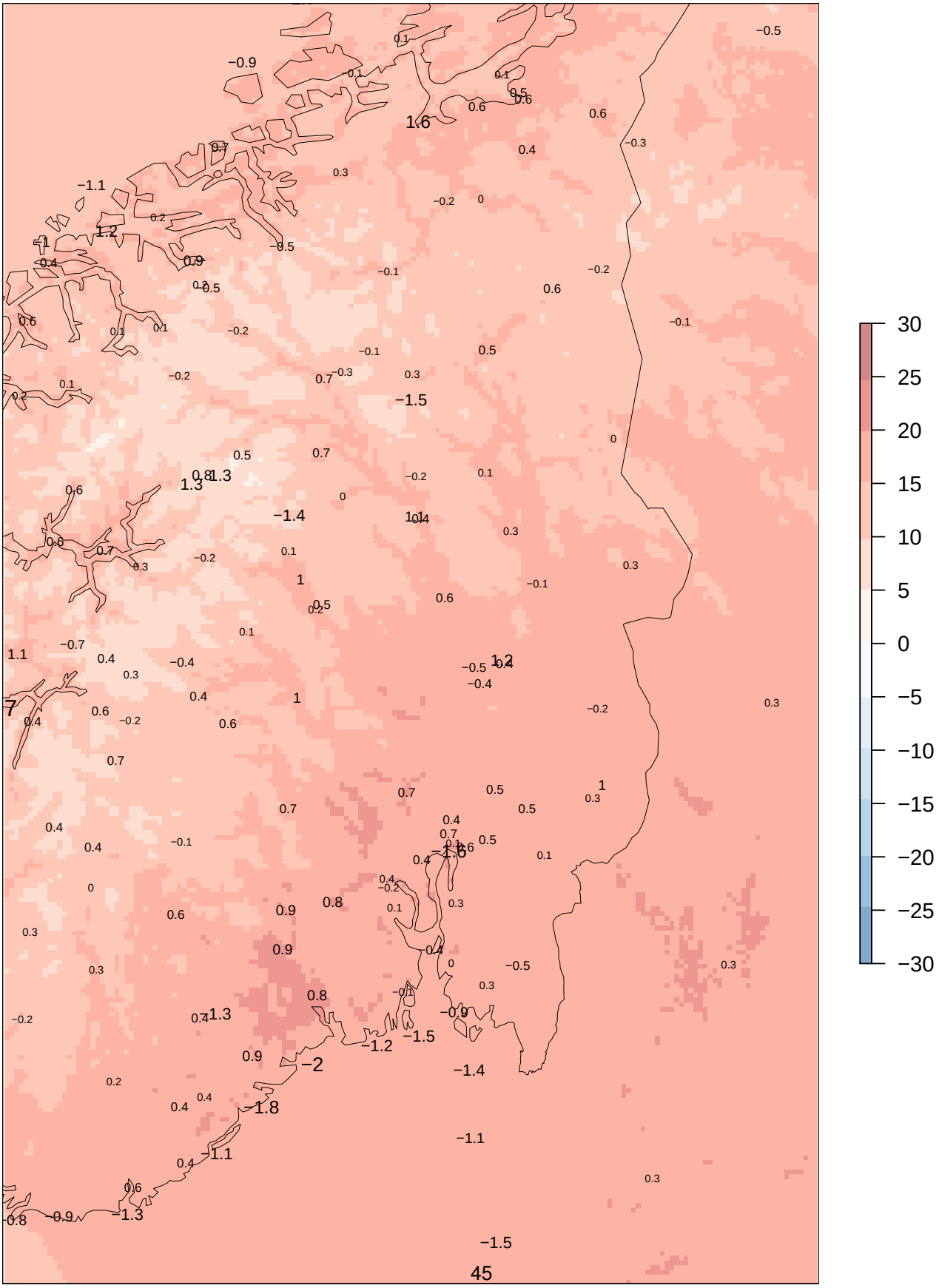


Figure 11: Lead time 00 +3,+6,...,+66

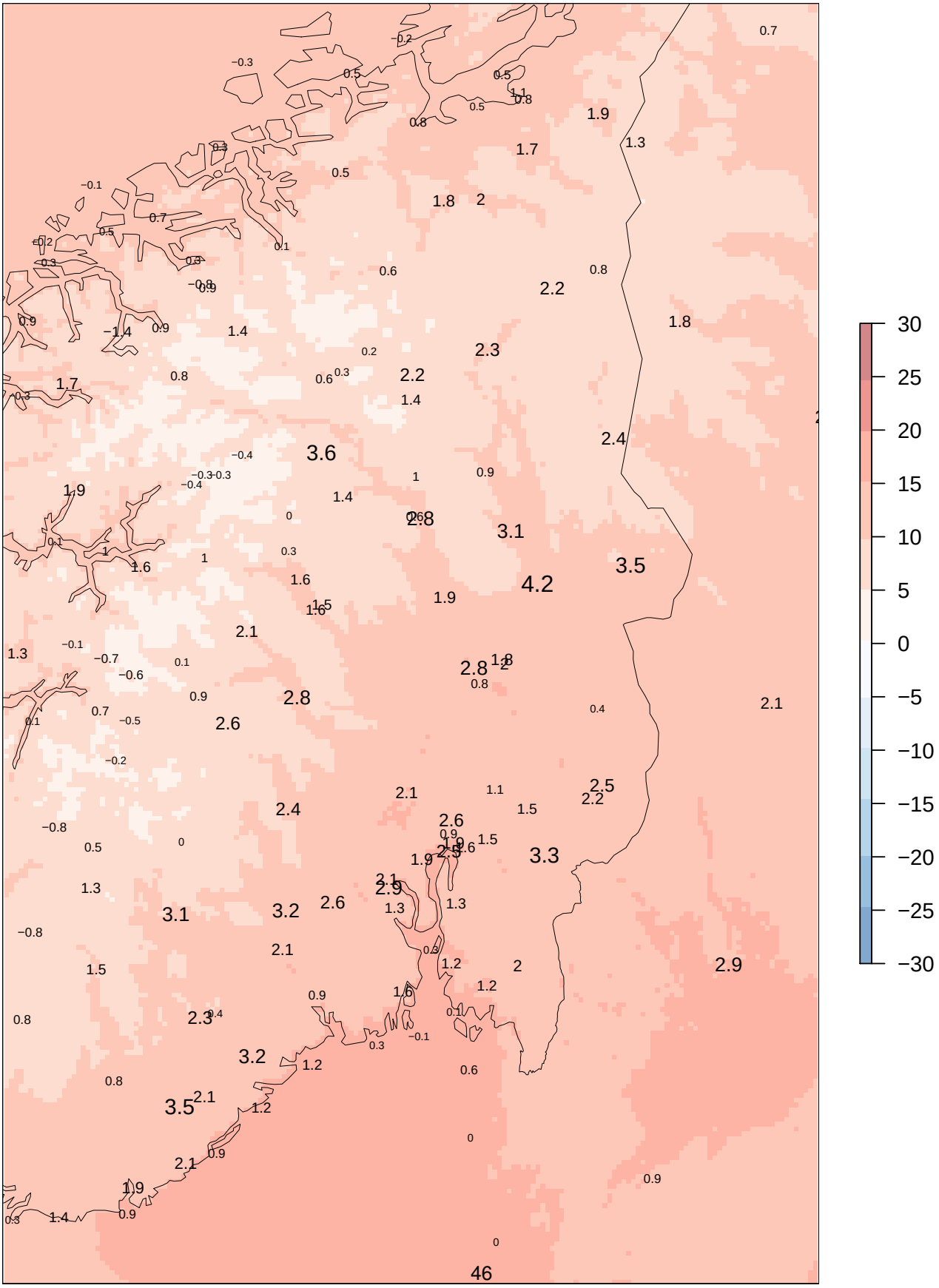
AROME−Norway 00+12

ME at observing sites forecast means 01.06.2013 − 31.08.2013



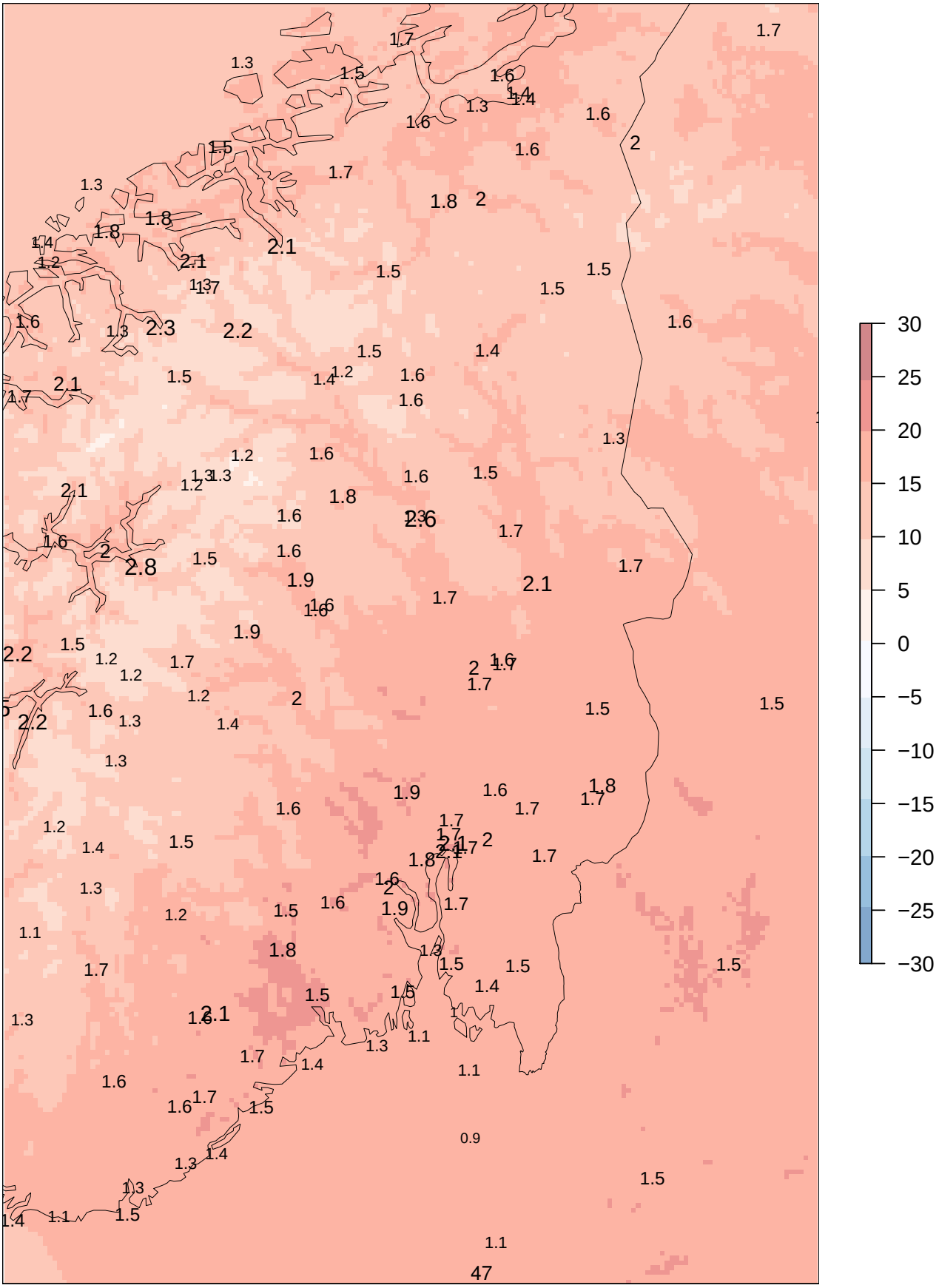
AROME−Norway 00+24

ME at observing sites forecast means 01.06.2013 − 31.08.2013



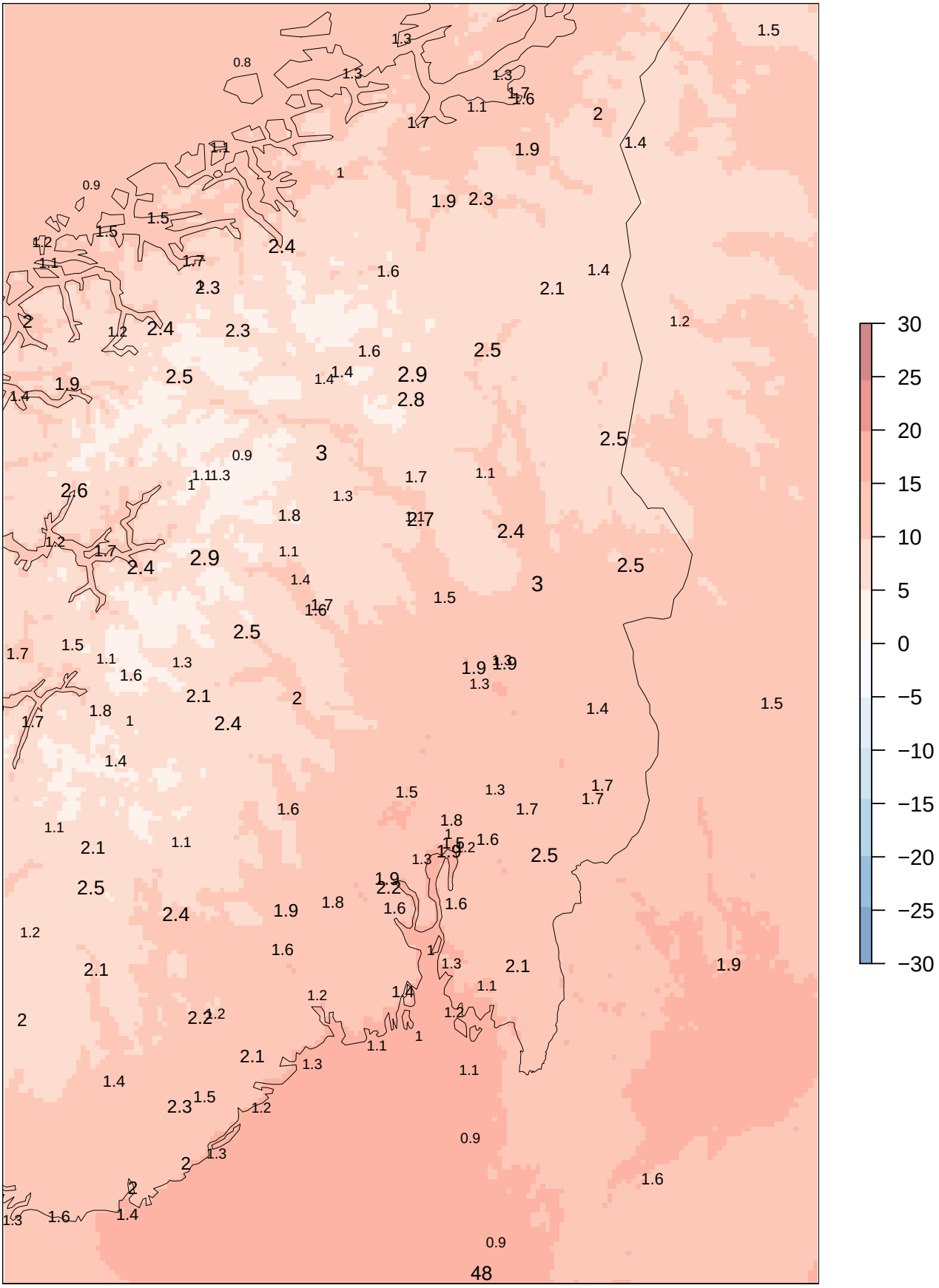
AROME−Norway 00+12

SDE at observing sites forecast means 01.06.2013 − 31.08.2013

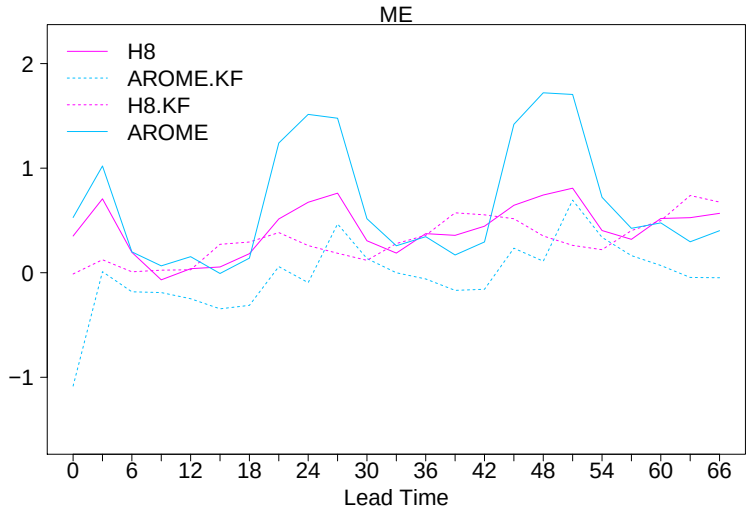


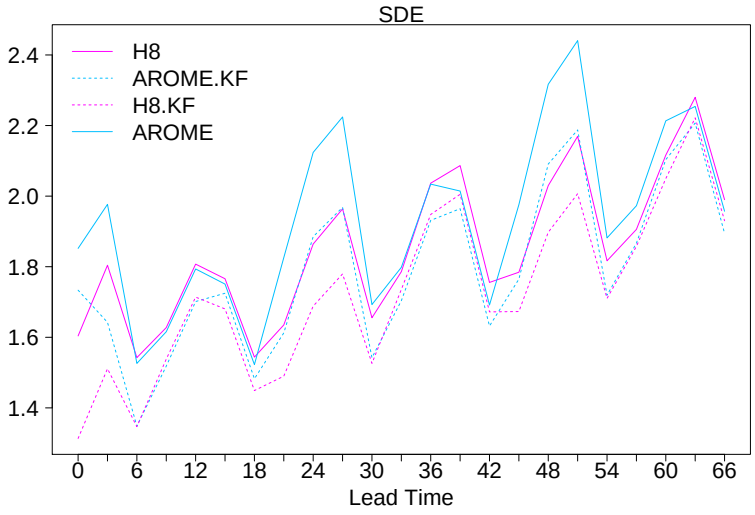
AROME−Norway 00+24

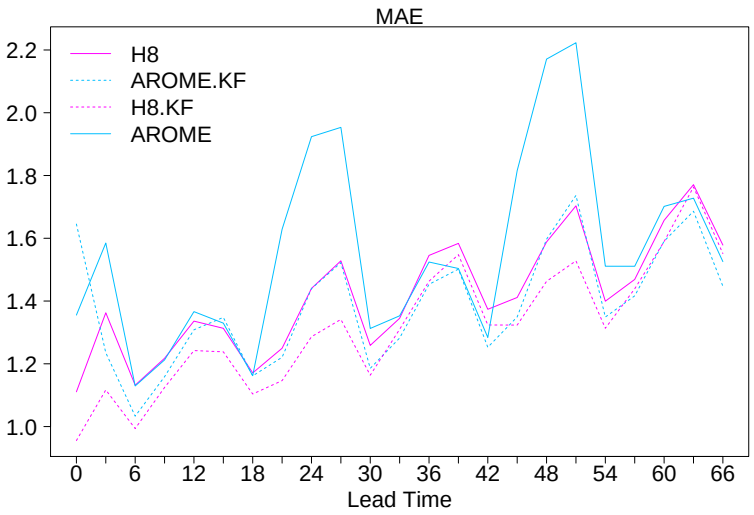
SDE at observing sites forecast means 01.06.2013 − 31.08.2013



6.4 Post processed temperature 2m







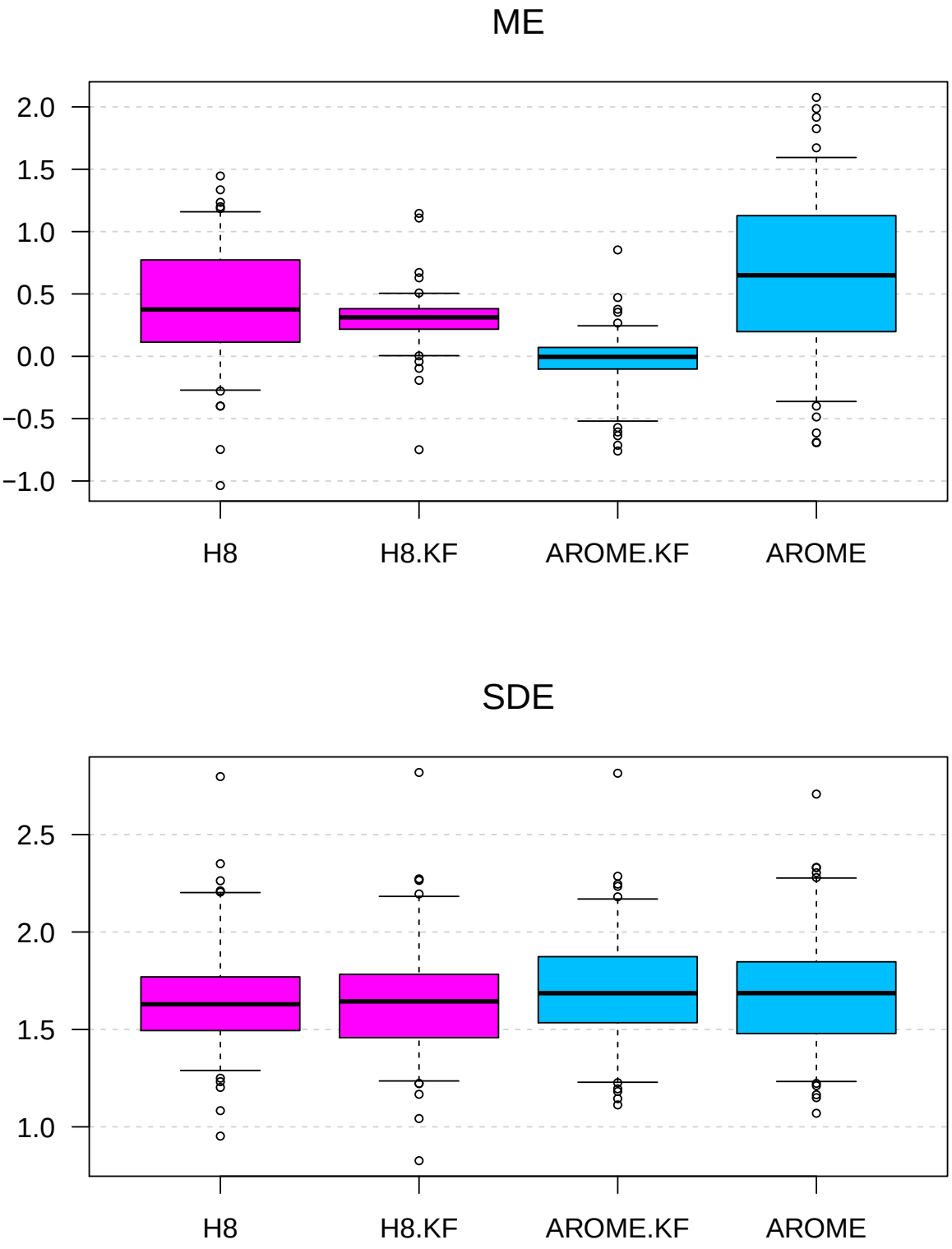
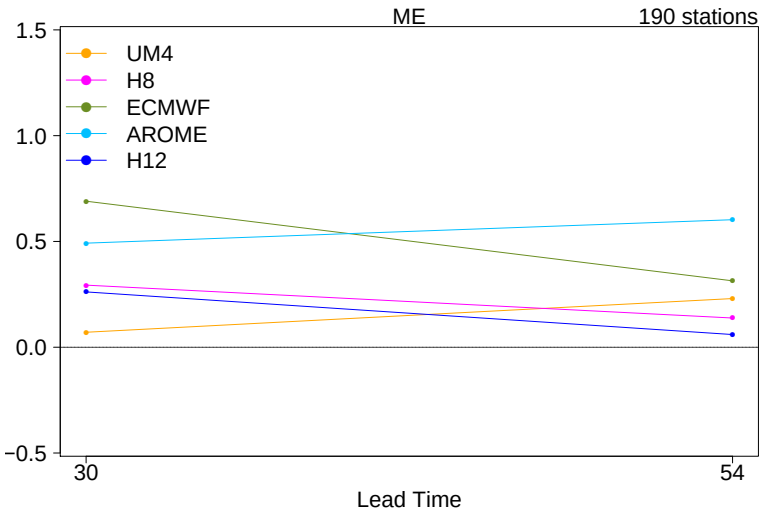
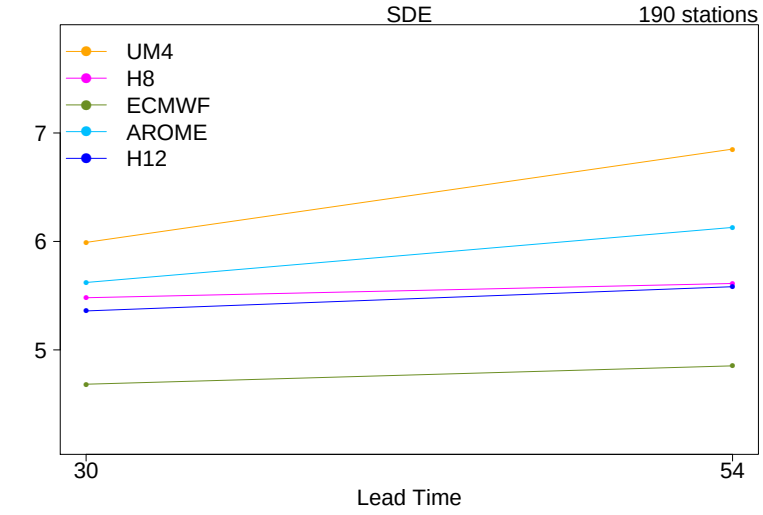
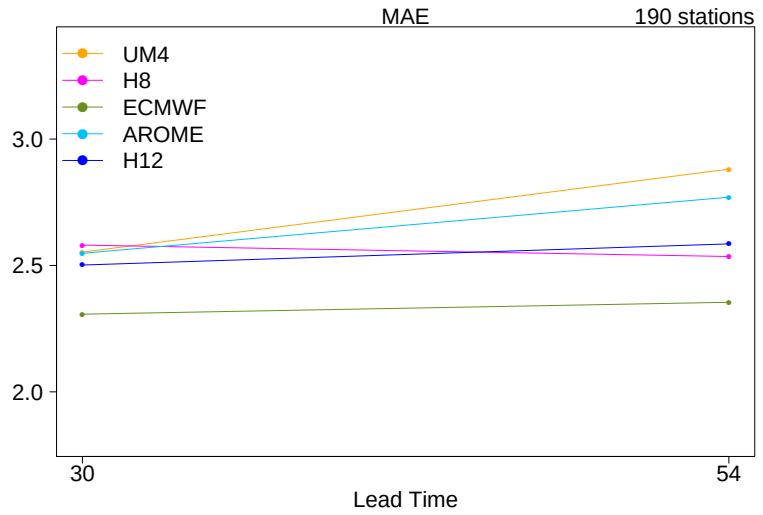


Figure 12: Lead time 00 +3,+6,...,+66

6.5 Daily precipitation







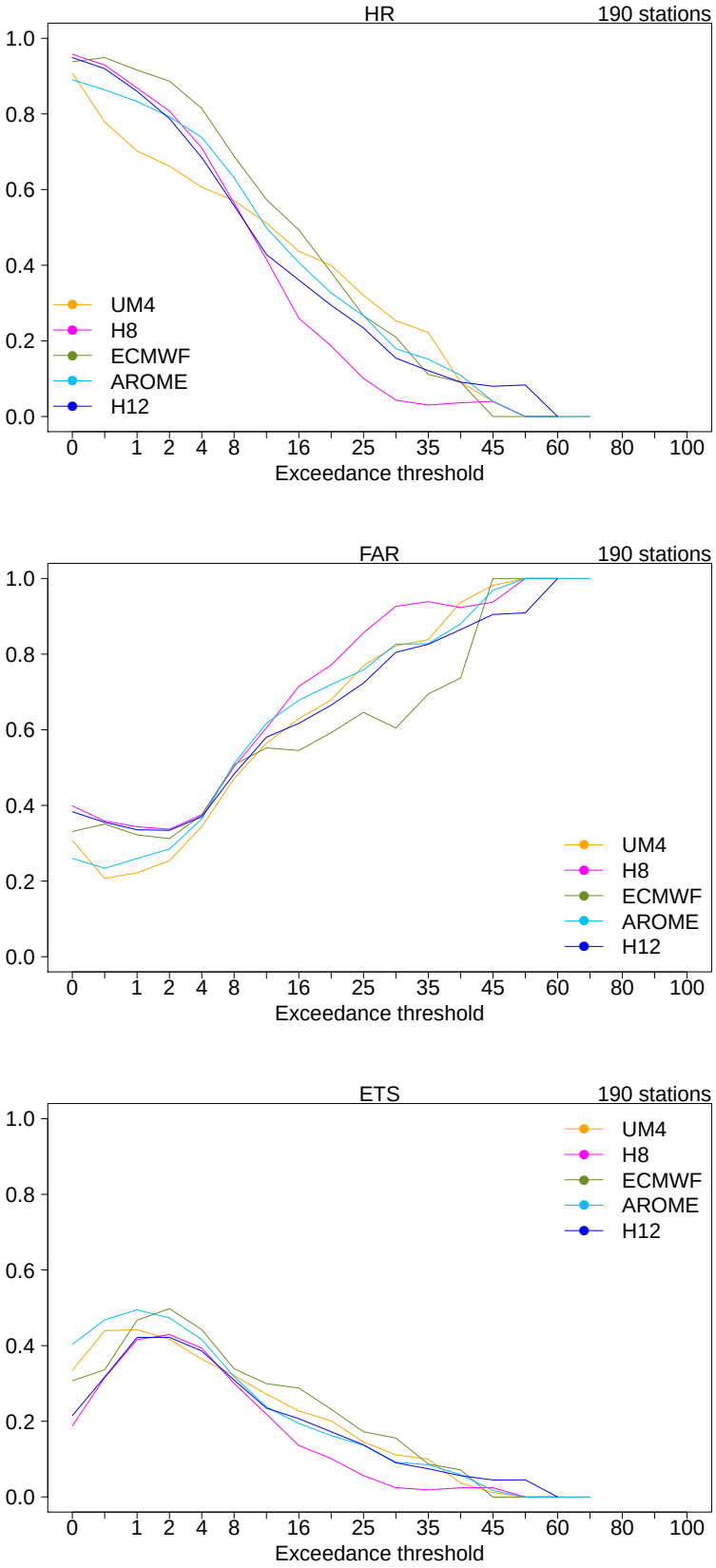
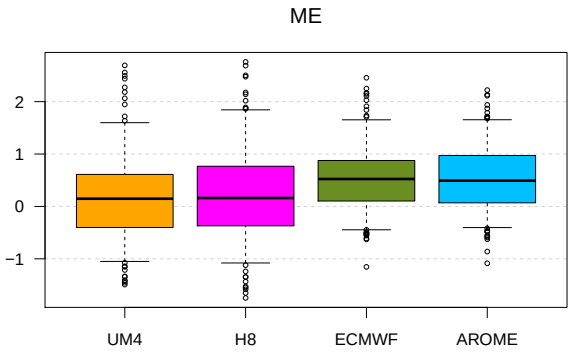
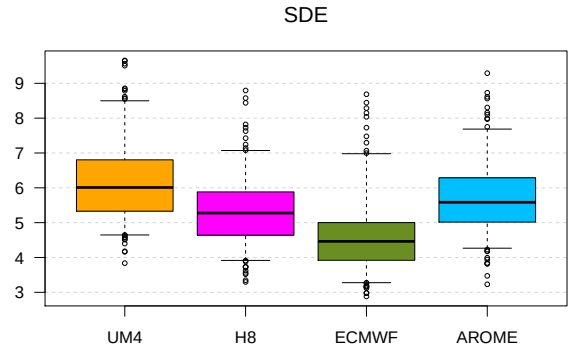


Figure 13: Lead time 00+30.





Forecasts:

UM4

	OBS					
	[0,0.1]	(0.1,5]	(5,20]	(20,50]	(50,Inf]	Sum
[0,0.1]	15664	3115	525	44	0	19348
(0.1,5]	2574	4118	1822	178	2	8694
(5,20]	445	1696	2238	407	8	4794
(20,50]	82	256	528	307	14	1187
(50,Inf]	10	15	30	23	0	78
Sum	18775	9200	5143	959	24	34101

H8

	OBS					
	[0,0.1]	(0.1,5]	(5,20]	(20,50]	(50,Inf]	Sum
[0,0.1]	11092	1218	143	17	0	12470
(0.1,5]	7117	5700	1794	193	0	14804
(5,20]	532	2162	2769	578	18	6059
(20,50]	33	118	429	153	6	739
(50,Inf]	1	2	8	18	0	29
Sum	18775	9200	5143	959	24	34101

ECMWF

	OBS					
	[0,0.1]	(0.1,5]	(5,20]	(20,50]	(50,Inf]	Sum
[0,0.1]	10960	929	44	7	0	11940
(0.1,5]	7123	5510	1398	108	0	14139
(5,20]	662	2669	3374	566	11	7282
(20,50]	30	91	327	274	13	735
(50,Inf]	0	1	0	4	0	5
Sum	18775	9200	5143	959	24	34101

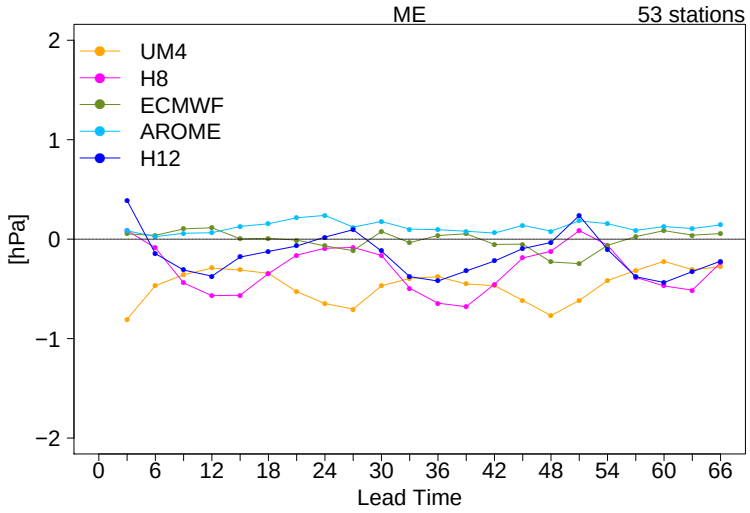
AROME

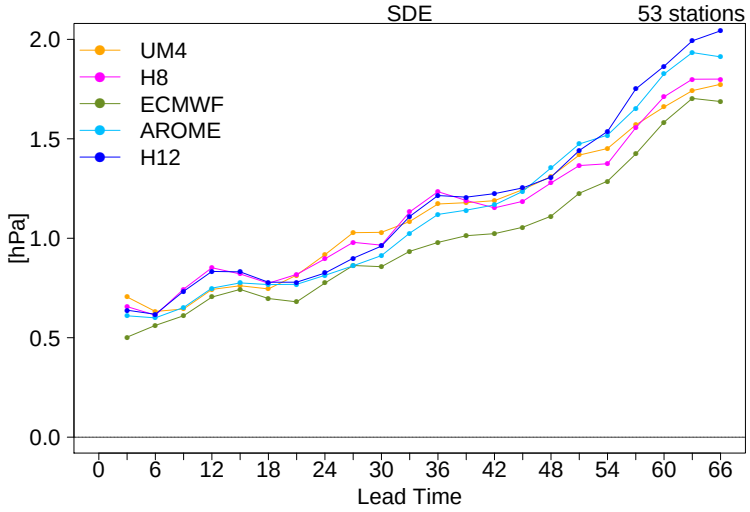
	OBS					
	[0,0.1]	(0.1,5]	(5,20]	(20,50]	(50,Inf]	Sum
[0,0.1]	14616	2127	233	44	0	17020
(0.1,5]	3533	4516	1468	136	0	9653
(5,20]	549	2316	2824	475	14	6178
(20,50]	74	236	602	291	10	1213
(50,Inf]	3	5	16	13	0	37
Sum	18775	9200	5143	959	24	34101

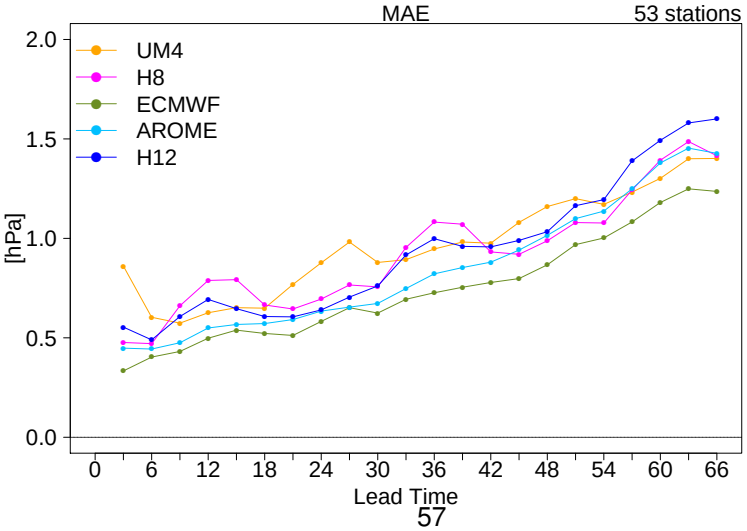
Figure 14: Lead time 00+30,+54.

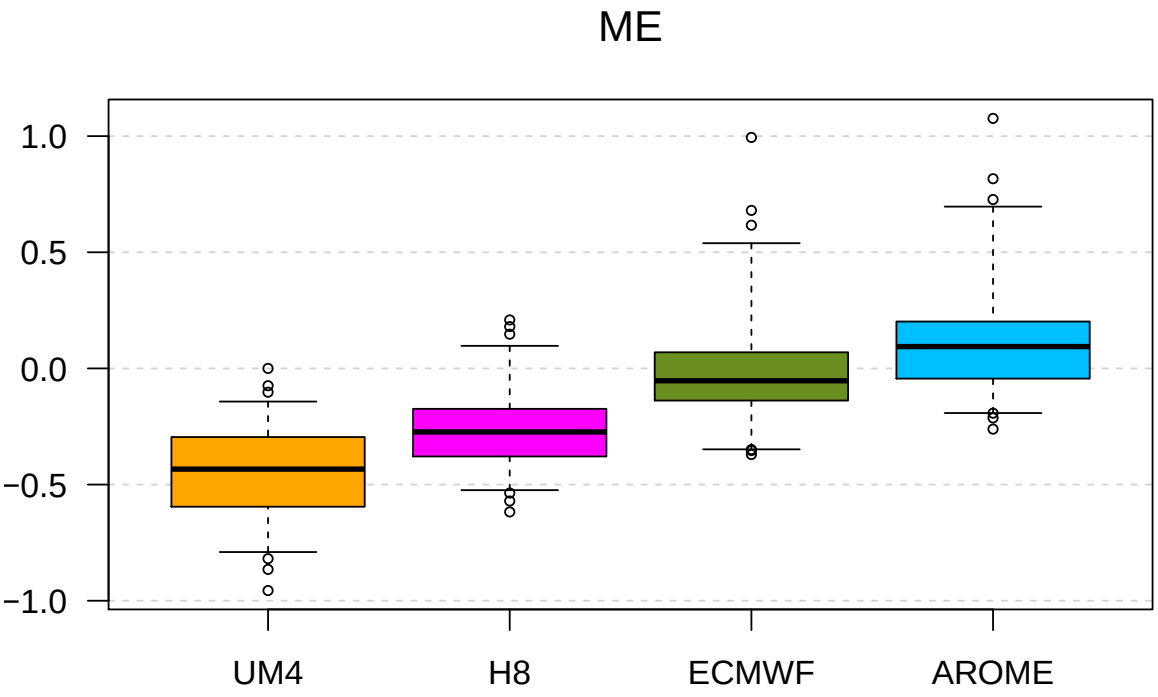
7 Western Norway

7.1 Pressure









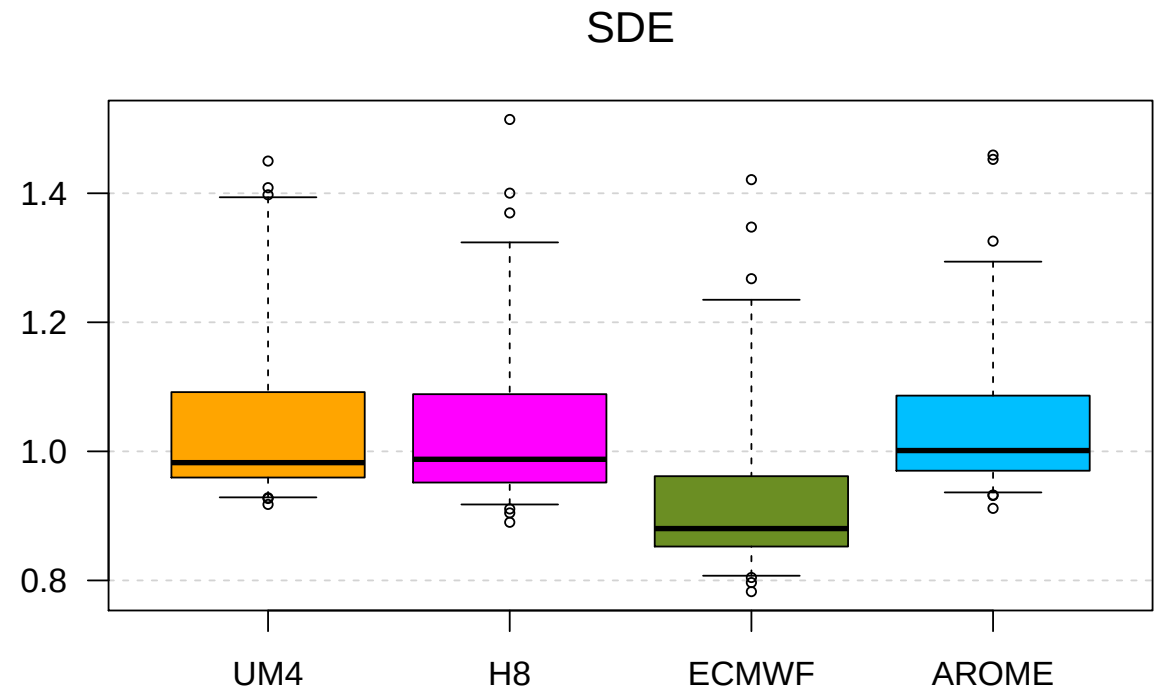
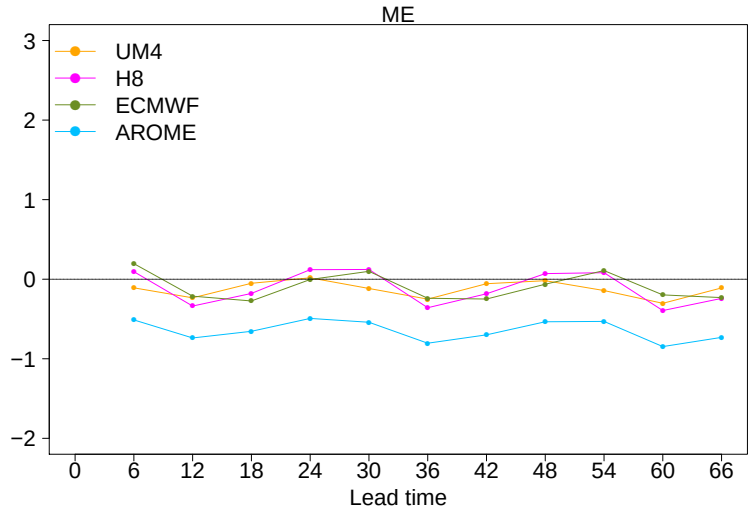
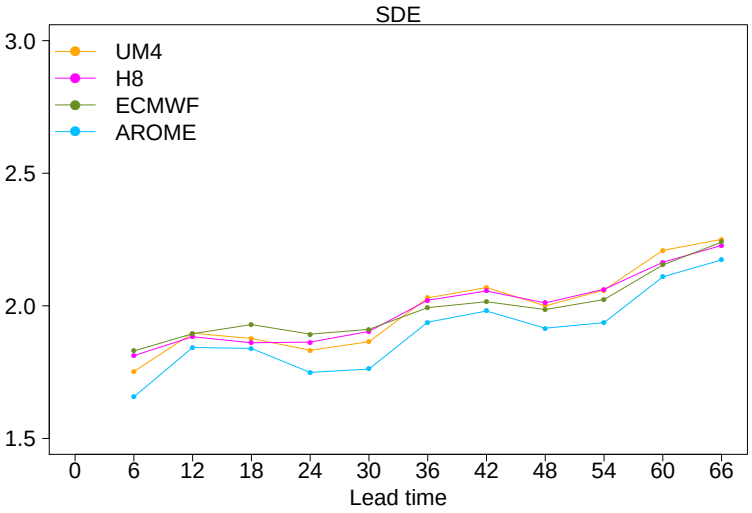
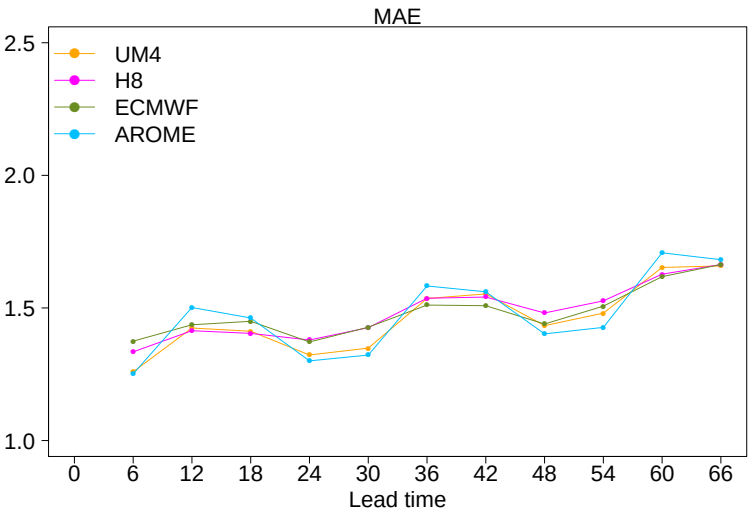


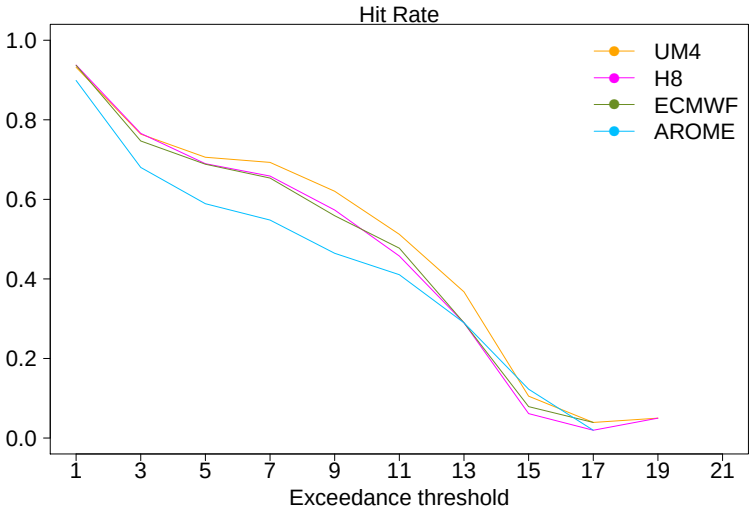
Figure 15: Lead time 00 +3,+6,...,+66

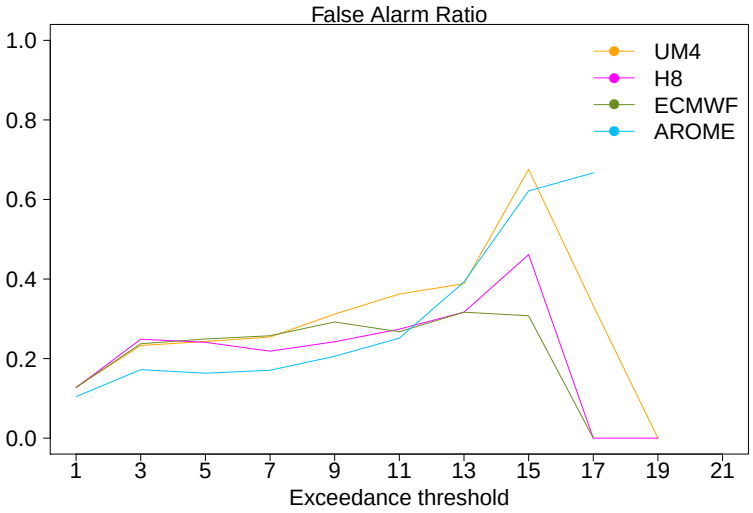
7.2 Wind Speed 10m











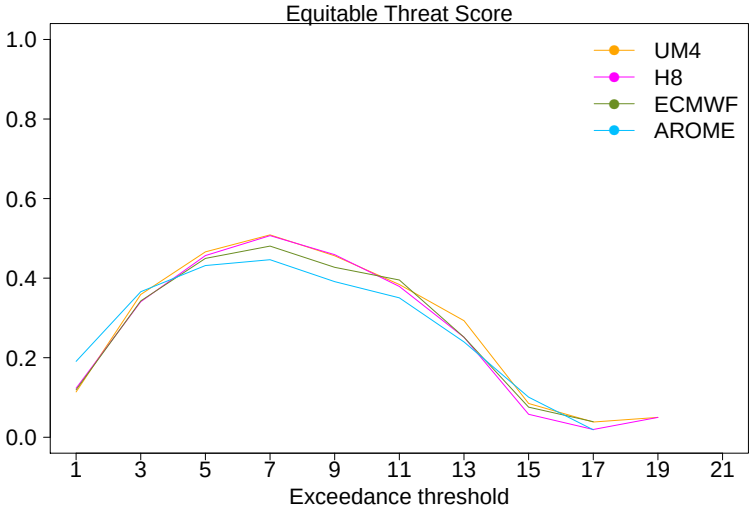
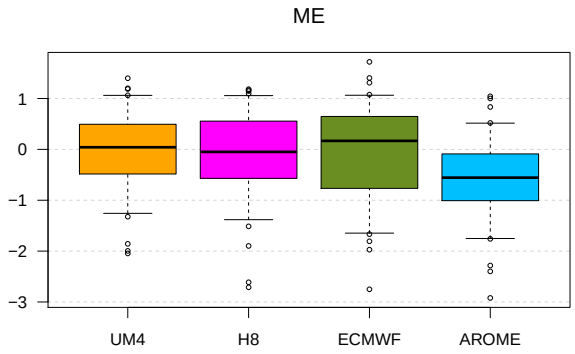
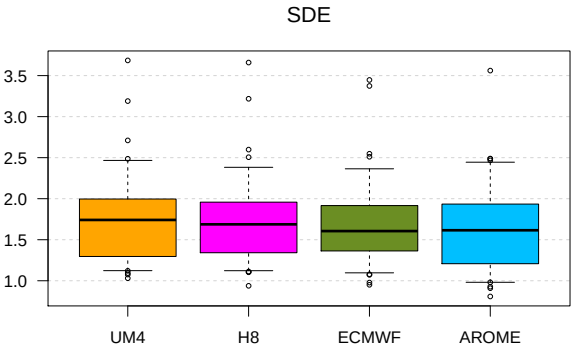


Figure 16: Lead time 00+12,+15,+18,+21,+24





Forecasts:

UM4

	OBS					
	[0,3]	(3,11]	(11,17]	(17,21]	(21,Inf]	Sum
[0,3]	29402	9107	36	1	0	38546
(3,11]	8606	23533	1158	36	2	33335
(11,17]	14	703	942	119	16	1794
(17,21]	0	0	10	4	0	14
(21,Inf]	0	0	0	0	0	0
Sum	38022	33343	2146	160	18	73689

H8

	OBS					
	[0,3]	(3,11]	(11,17]	(17,21]	(21,Inf]	Sum
[0,3]	27964	8796	47	0	0	36807
(3,11]	10051	24101	1278	41	2	35473
(11,17]	7	446	812	116	16	1397
(17,21]	0	0	9	3	0	12
(21,Inf]	0	0	0	0	0	0
Sum	38022	33343	2146	160	18	73689

ECMWF

	OBS					
	[0,3]	(3,11]	(11,17]	(17,21]	(21,Inf]	Sum
[0,3]	28661	9026	64	1	0	37752
(3,11]	9354	23809	1165	25	0	34353
(11,17]	7	507	914	129	18	1575
(17,21]	0	1	3	5	0	9
(21,Inf]	0	0	0	0	0	0
Sum	38022	33343	2146	160	18	73689

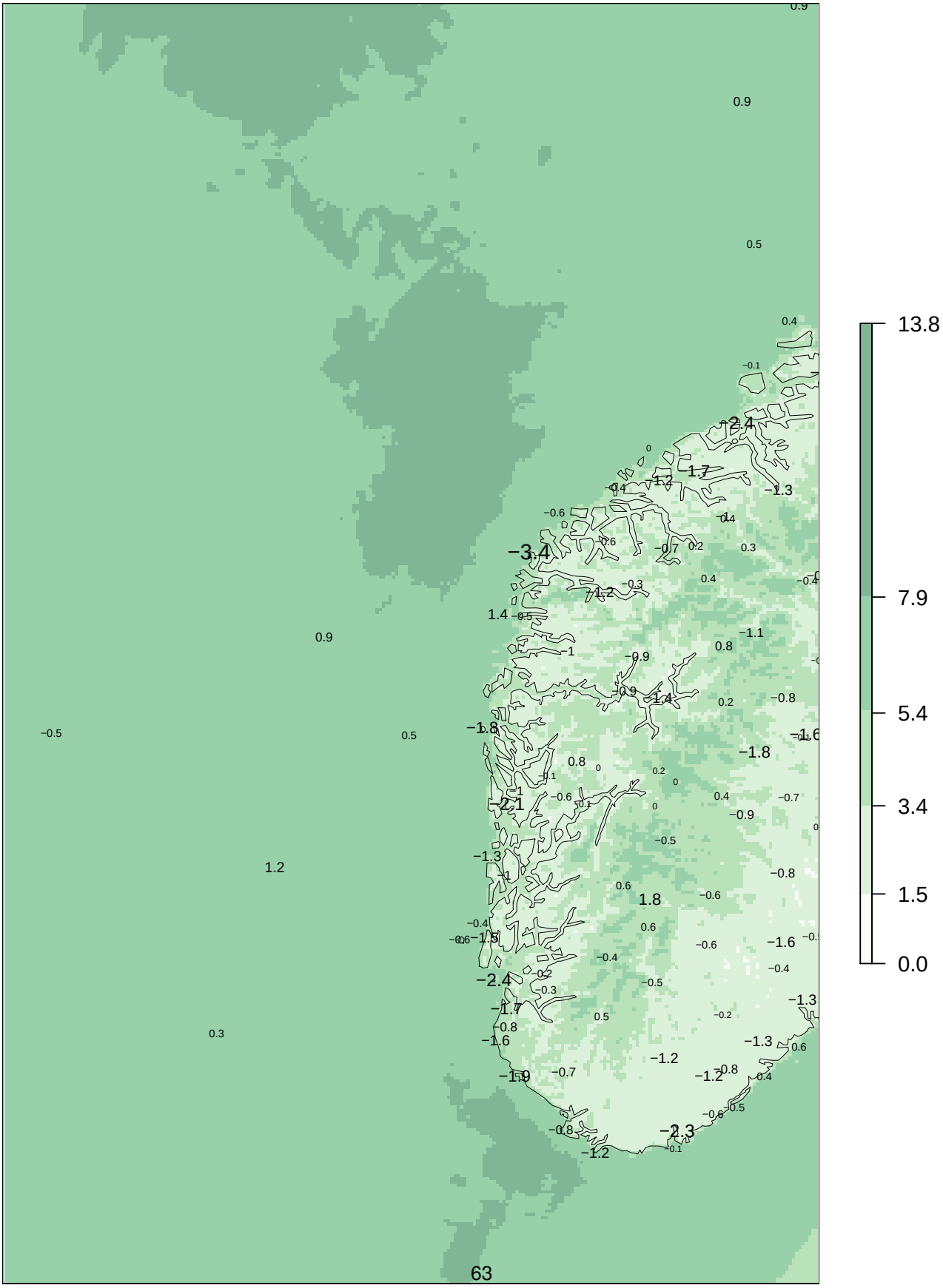
AROME

	OBS					
	[0,3]	(3,11]	(11,17]	(17,21]	(21,Inf]	Sum
[0,3]	32788	12230	14	0	0	45032
(3,11]	5225	20740	1385	50	5	27405
(11,17]	9	370	736	107	13	1235
(17,21]	0	2	11	3	0	16
(21,Inf]	0	1	0	0	0	1
Sum	38022	33343	2146	160	18	73689

Figure 17: Lead time 00+3,+6,..,+66.

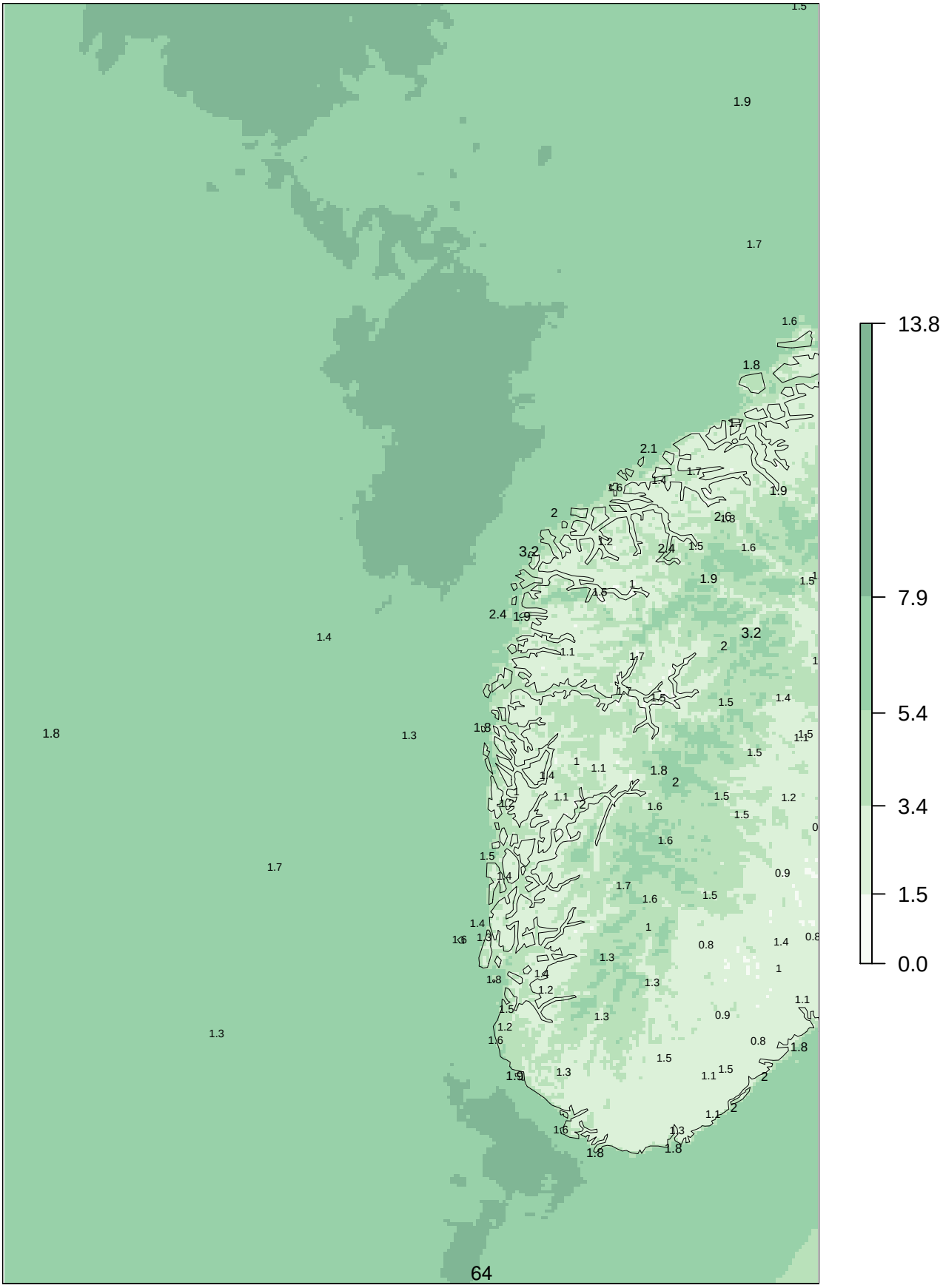
AROME−Norway 00+12

ME at observing sites forecast means 01.06.2013 − 31.08.2013

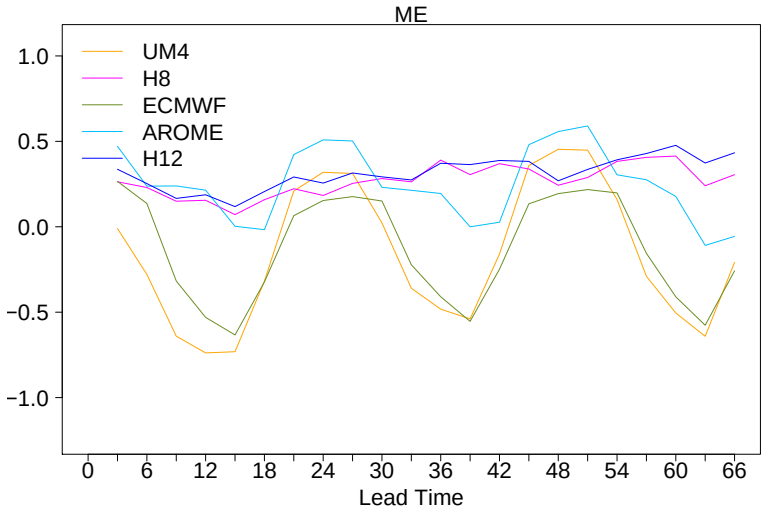


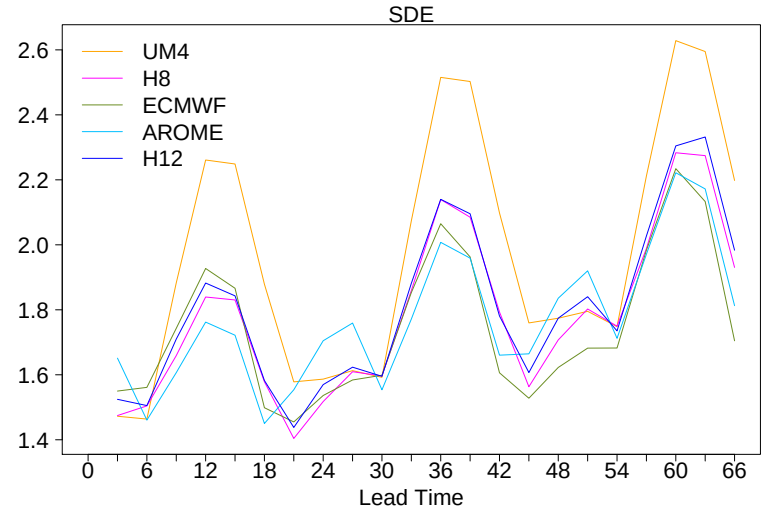
AROME−Norway 00+12

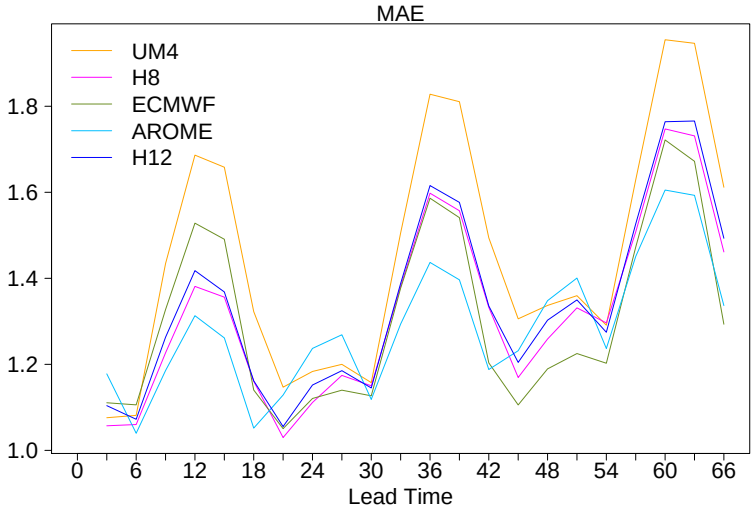
SDE at observing sites forecast means 01.06.2013 − 31.08.2013



7.3 Temperature 2m







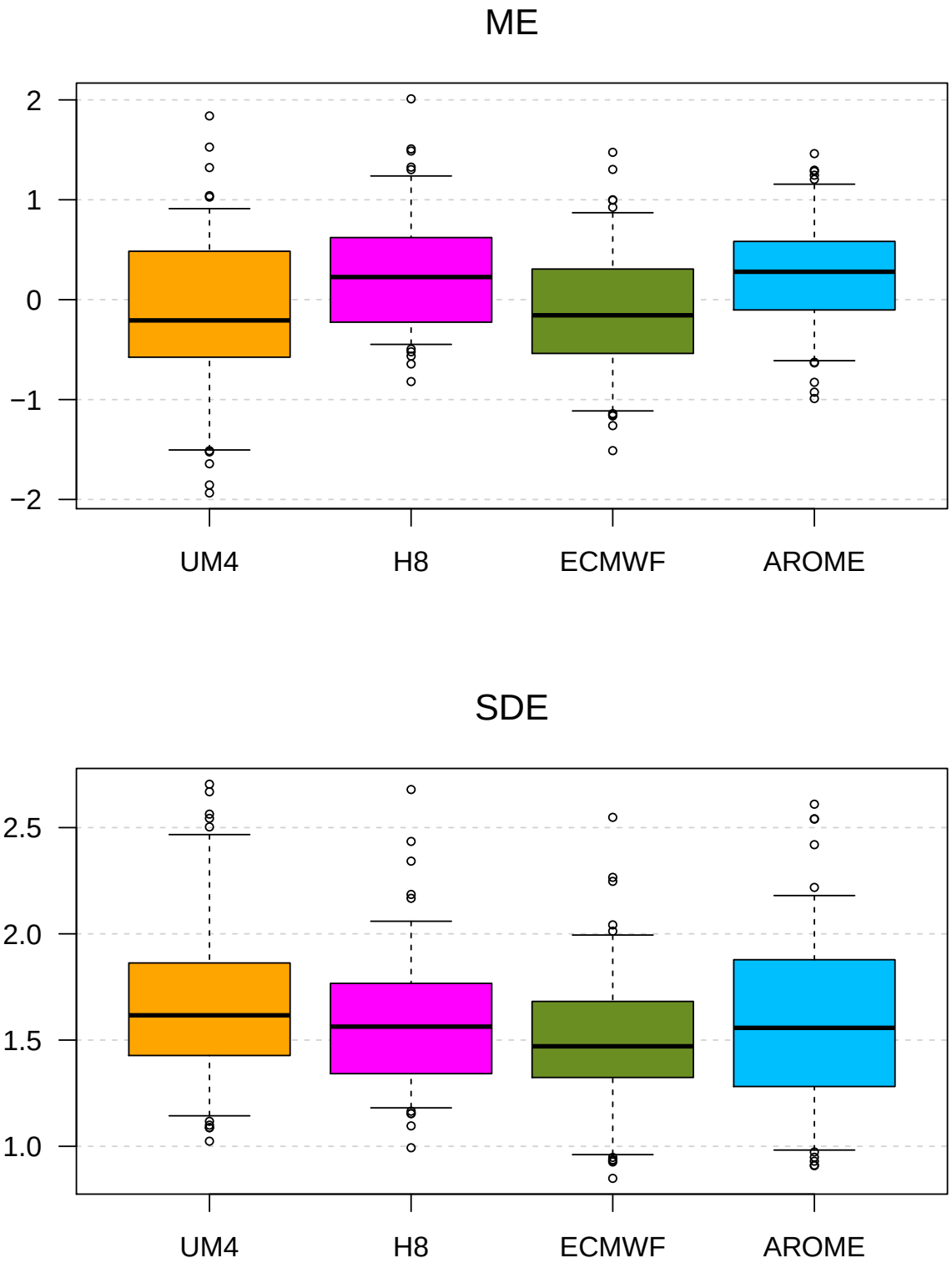
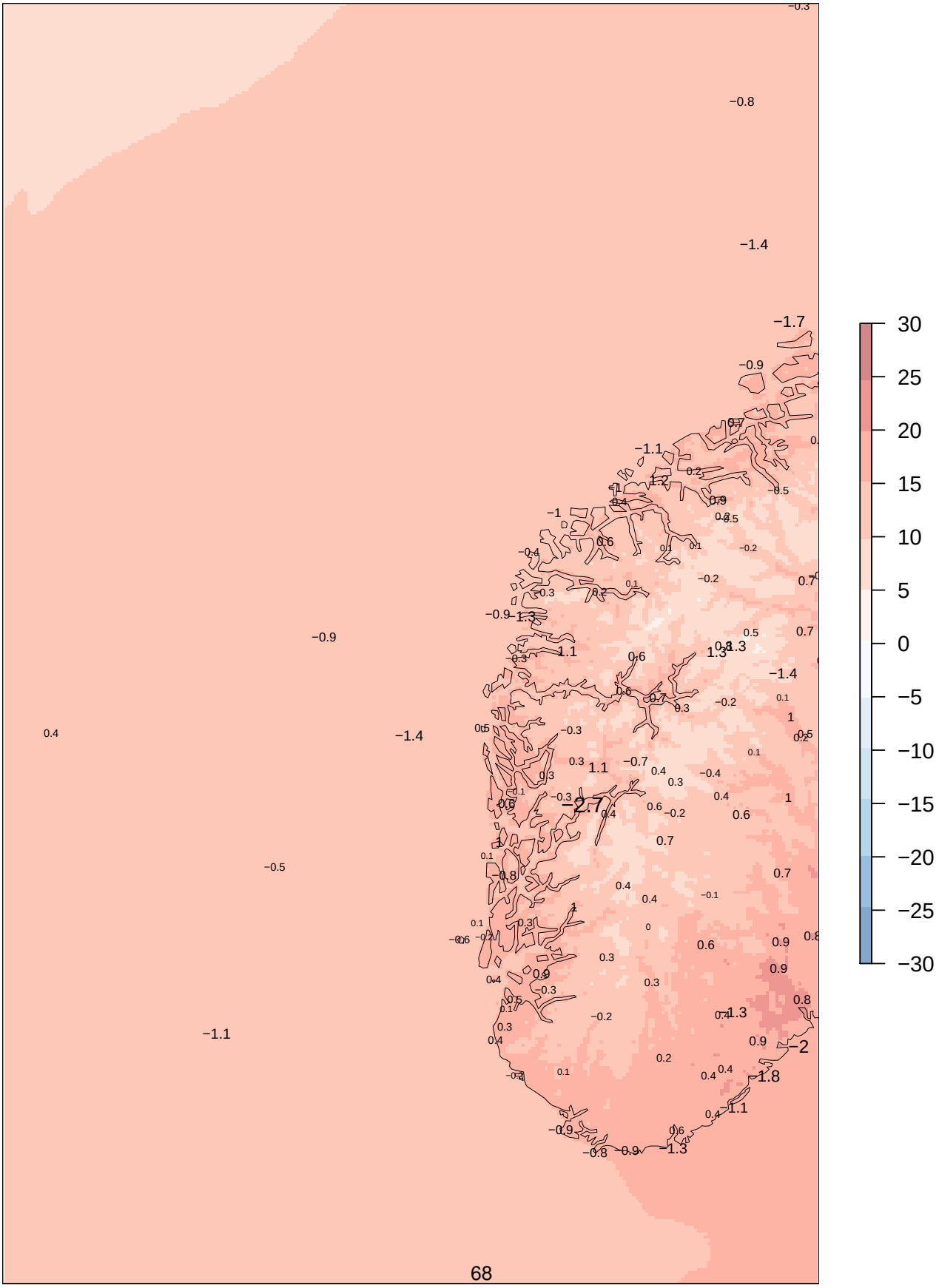


Figure 18: Lead time 00 +3,+6,...,+66

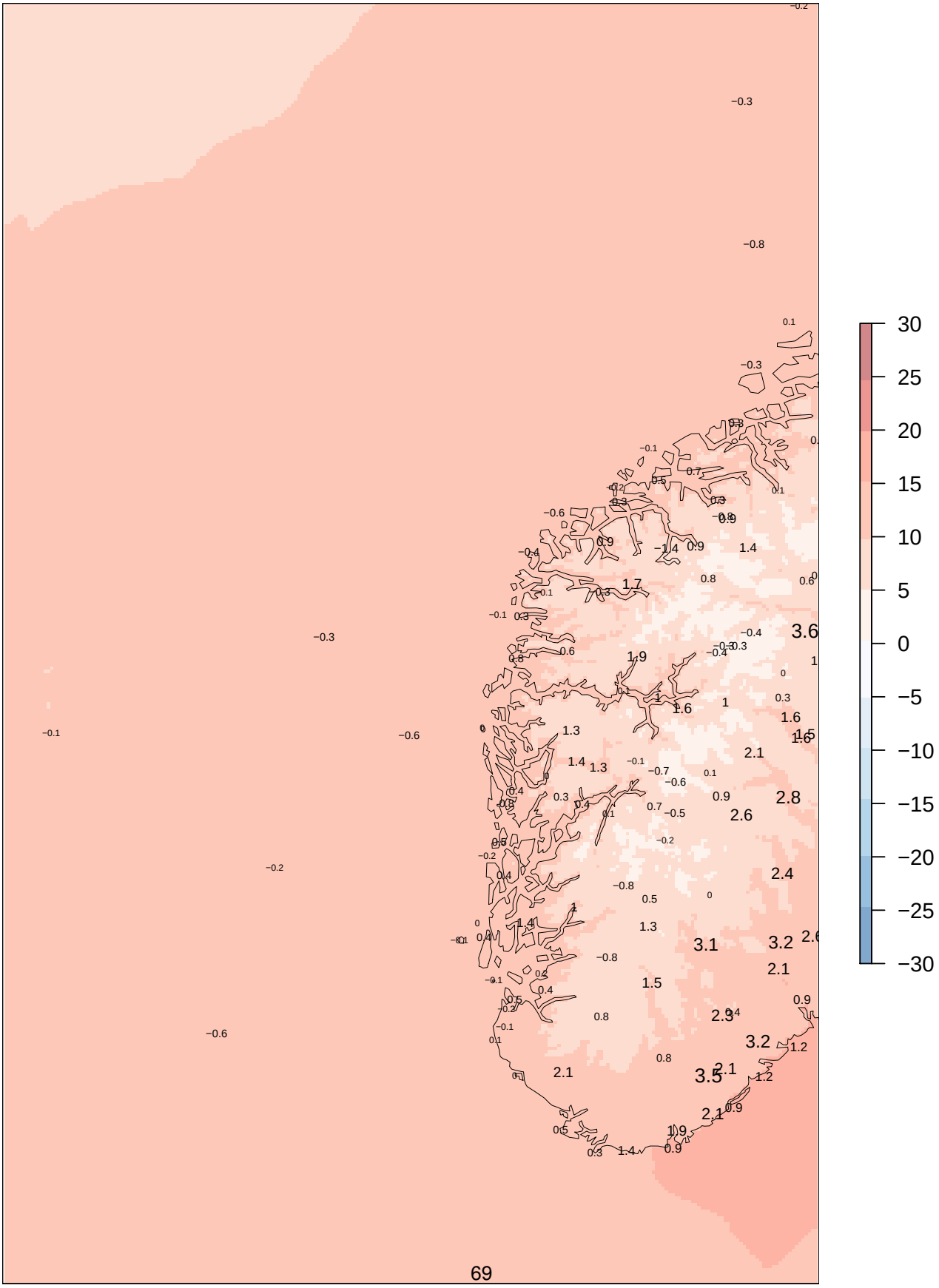
AROME−Norway 00+12

ME at observing sites forecast means 01.06.2013 − 31.08.2013



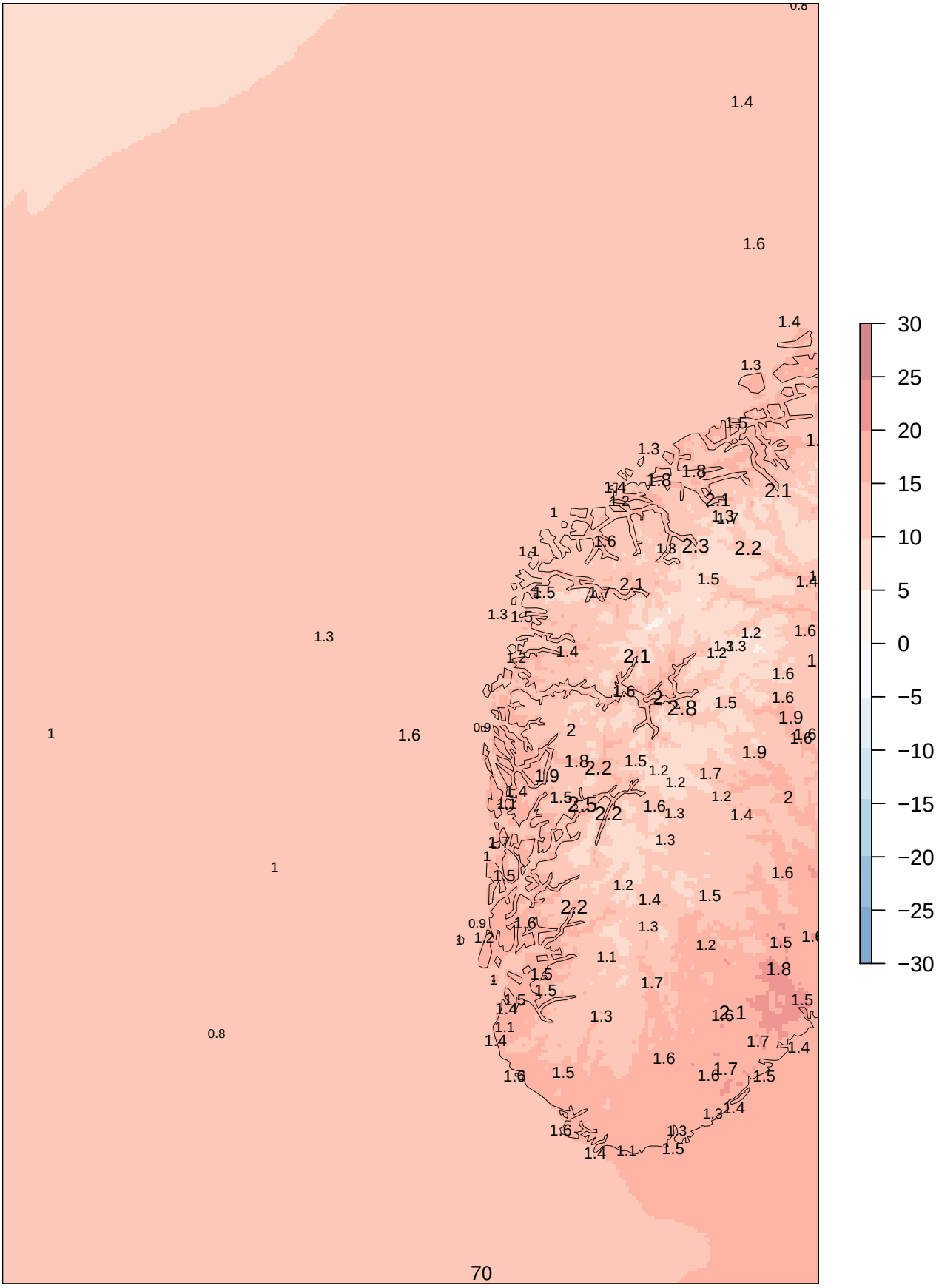
AROME−Norway 00+24

ME at observing sites forecast means 01.06.2013 − 31.08.2013



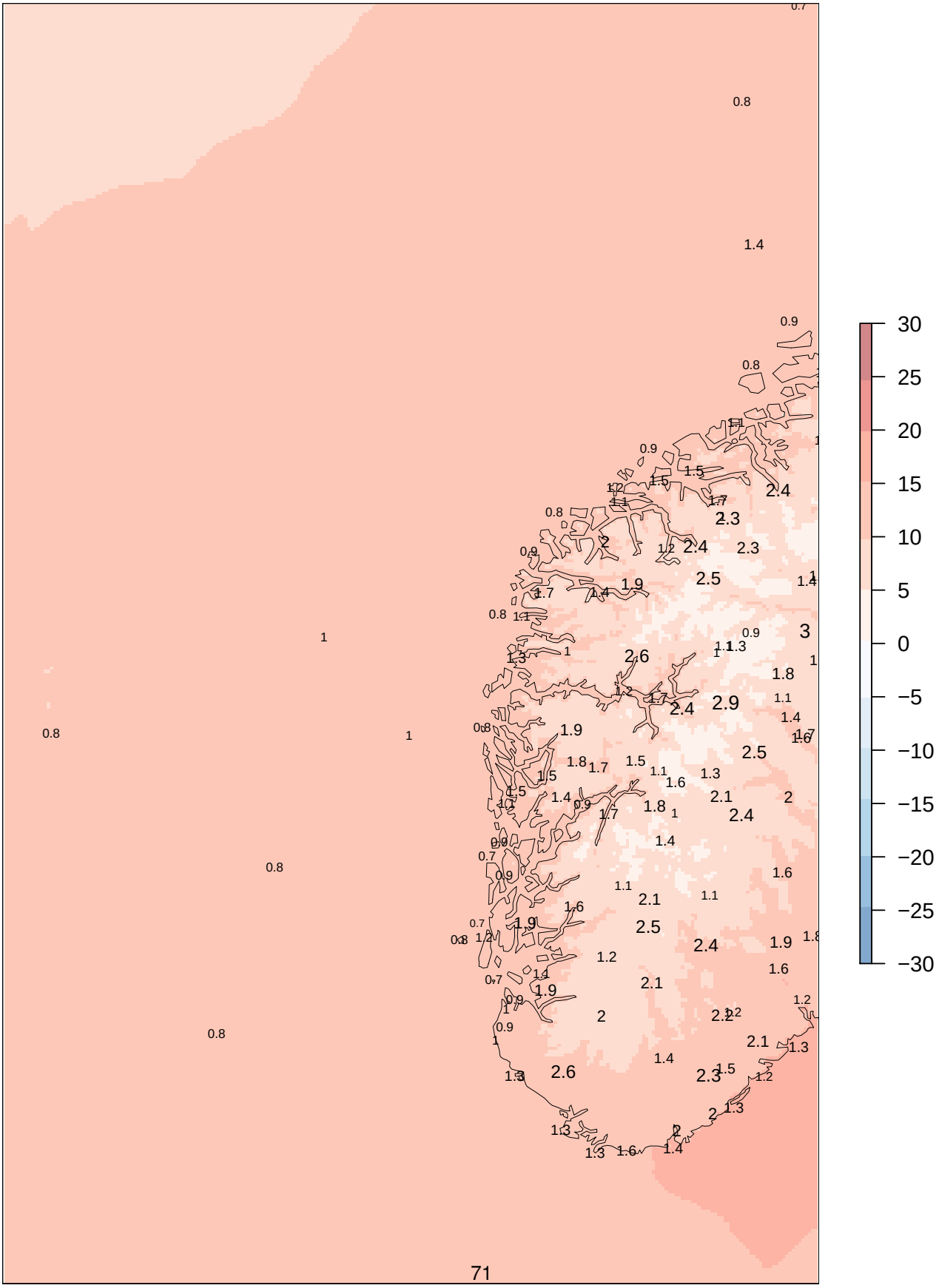
AROME−Norway 00+12

SDE at observing sites forecast means 01.06.2013 − 31.08.2013

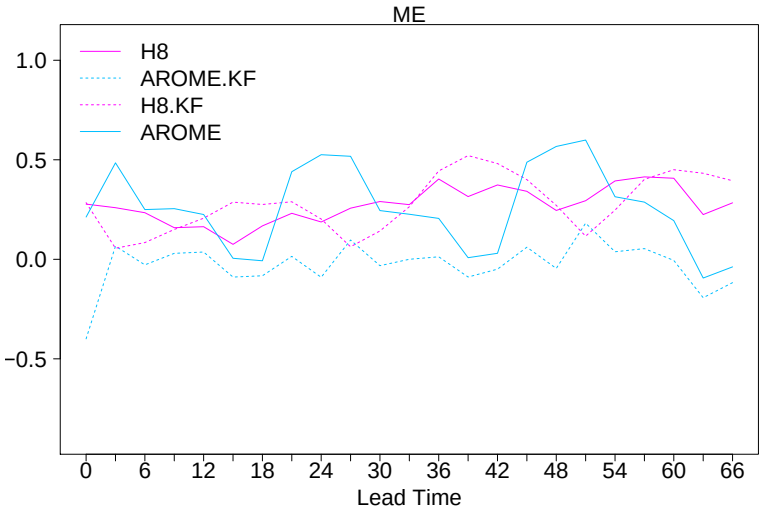


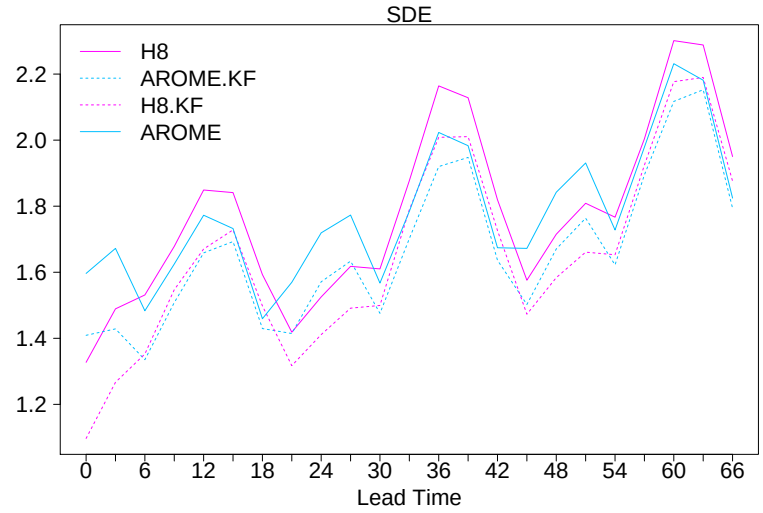
AROME−Norway 00+24

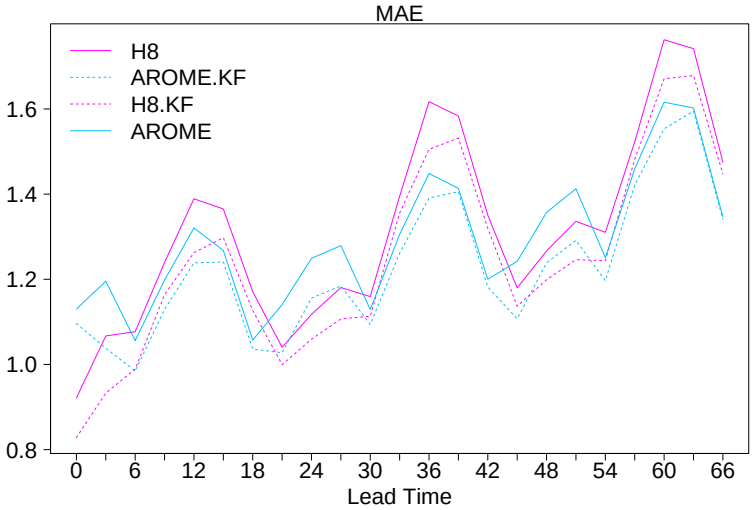
SDE at observing sites forecast means 01.06.2013 − 31.08.2013



7.4 Post processed temperature 2m







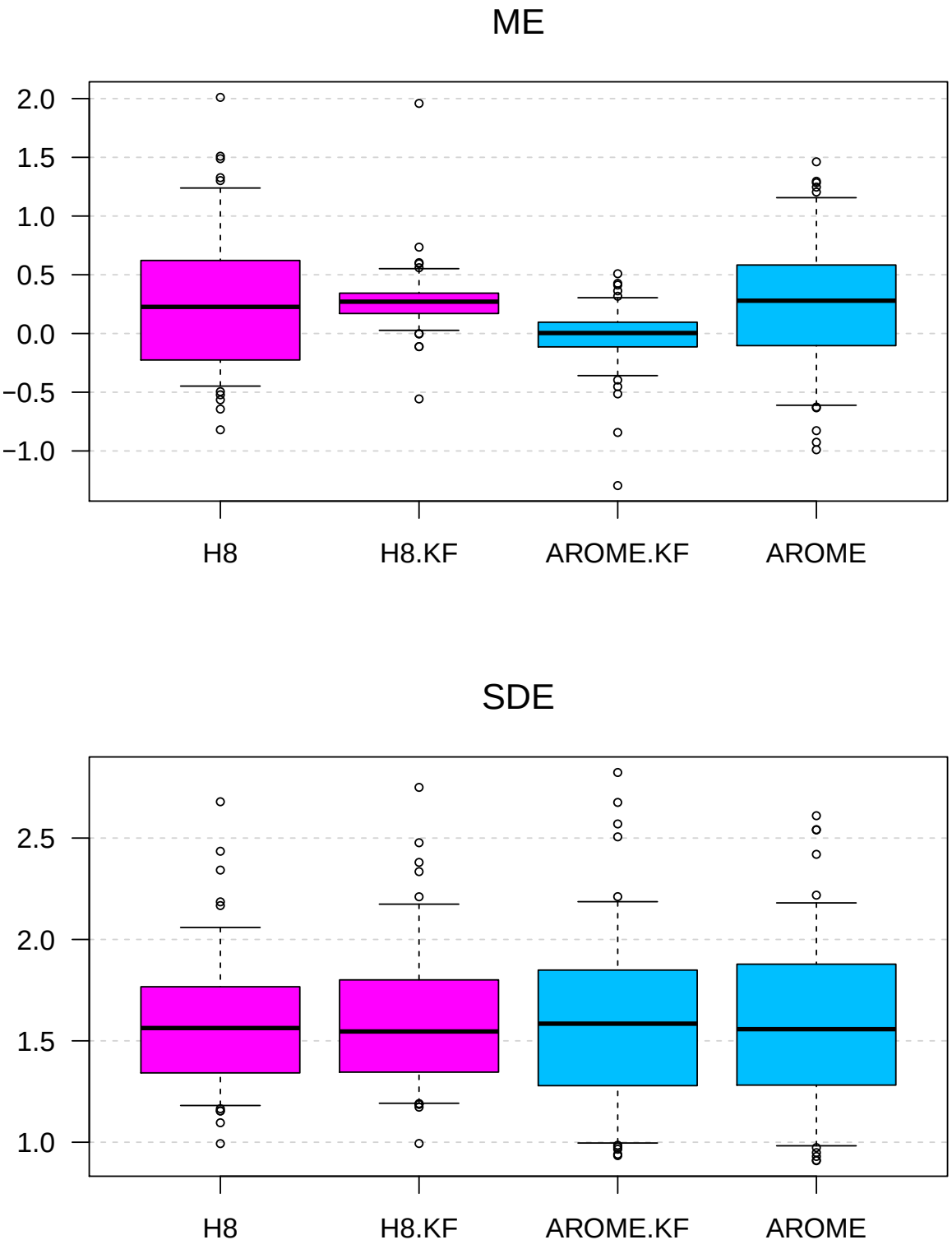
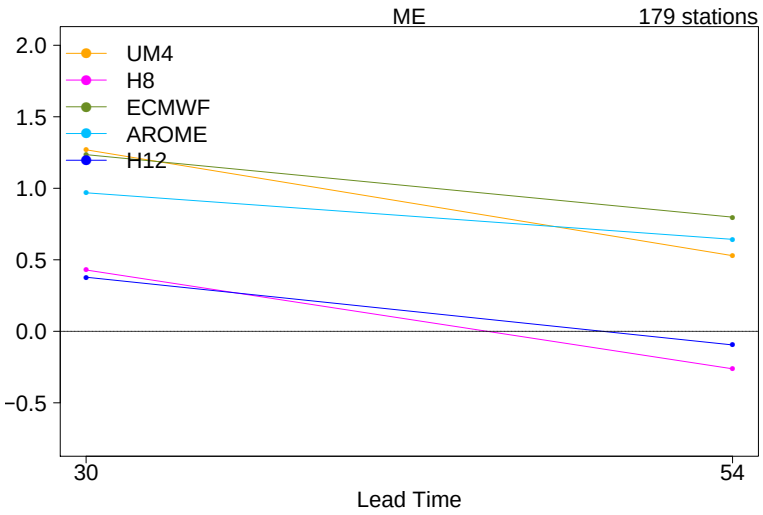
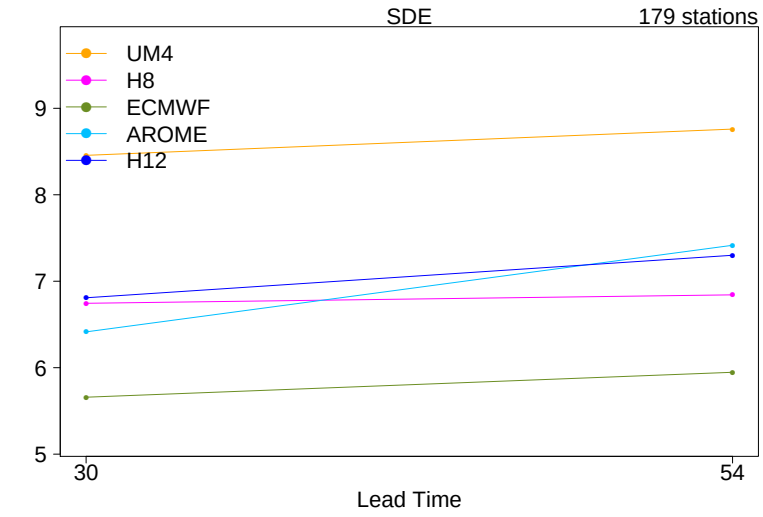
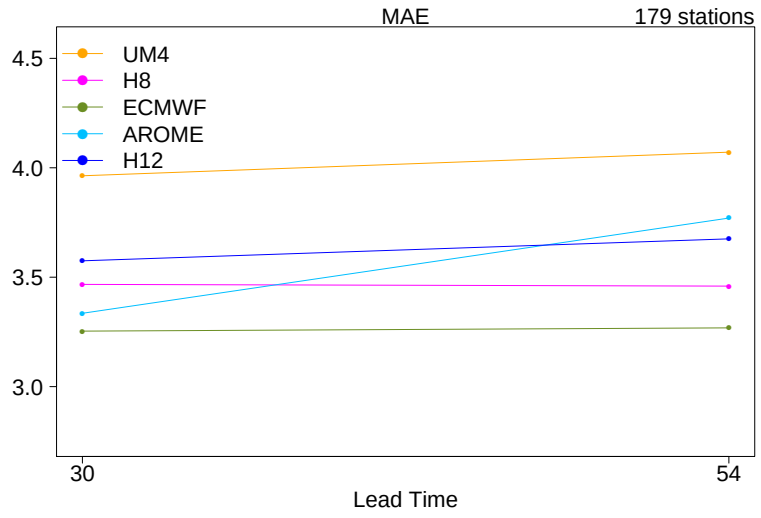


Figure 19: Lead time 00 +3,+6,...,+66

7.5 Daily precipitation







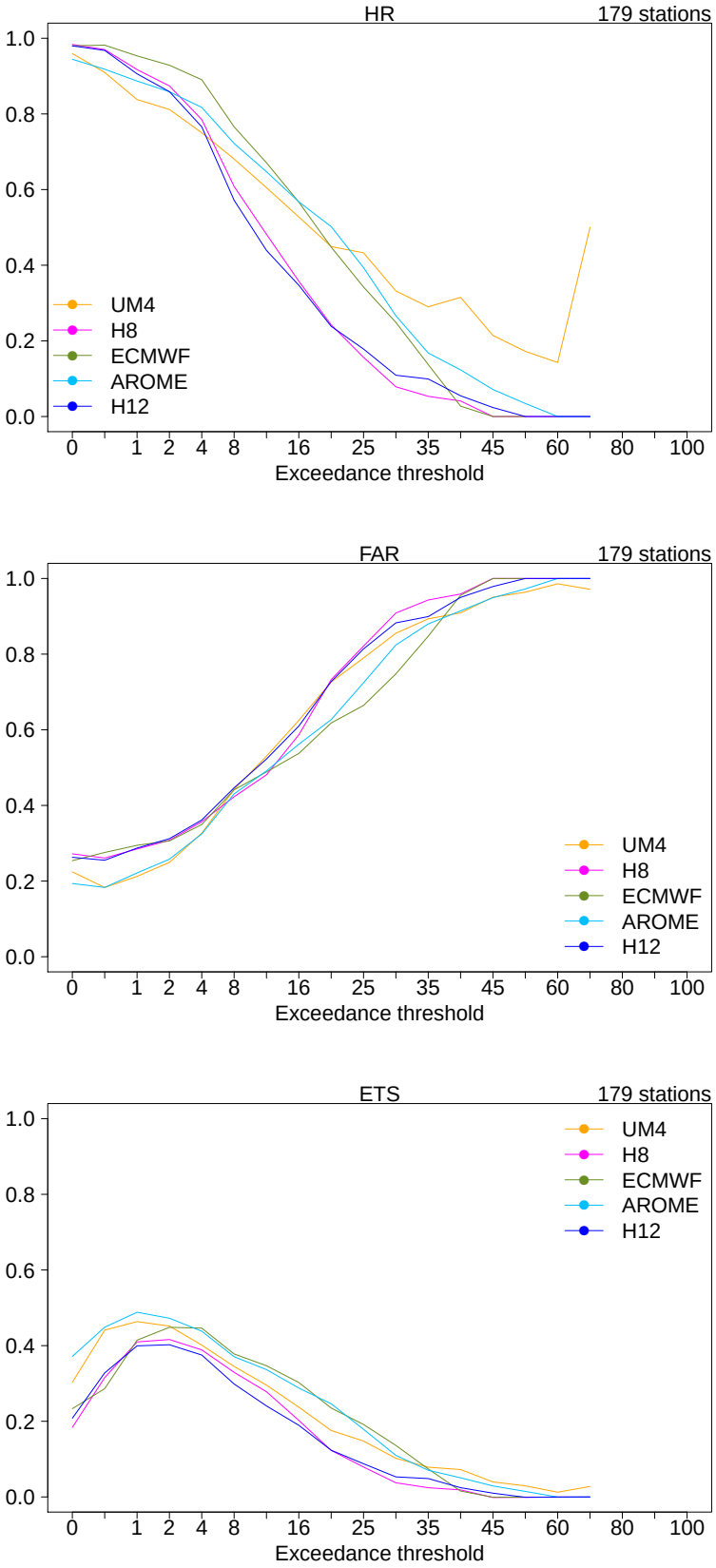
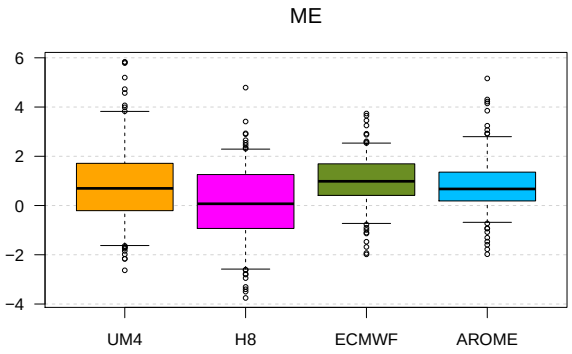
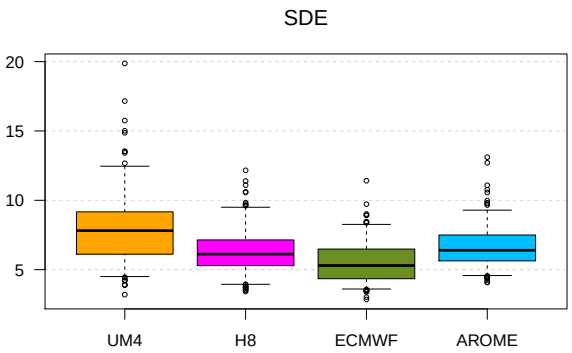


Figure 20: Lead time 00+30.





Forecasts:

UM4

	OBS					
	[0,0.1]	(0.1,5]	(5,20]	(20,50]	(50,Inf]	Sum
[0,0.1]	8936	1952	252	25	5	11170
(0.1,5]	3430	6121	2215	207	8	11981
(5,20]	462	2447	3338	680	17	6944
(20,50]	50	333	1067	519	27	1996
(50,Inf]	3	53	127	73	7	263
Sum	12881	10906	6999	1504	64	32354

H8

	OBS					
	[0,0.1]	(0.1,5]	(5,20]	(20,50]	(50,Inf]	Sum
[0,0.1]	6378	755	71	3	0	7207
(0.1,5]	5956	7144	2352	194	13	15659
(5,20]	519	2841	3959	992	38	8349
(20,50]	28	149	586	306	13	1082
(50,Inf]	0	17	31	9	0	57
Sum	12881	10906	6999	1504	64	32354

ECMWF

	OBS					
	[0,0.1]	(0.1,5]	(5,20]	(20,50]	(50,Inf]	Sum
[0,0.1]	5536	423	28	1	0	5988
(0.1,5]	6685	6827	1263	74	1	14850
(5,20]	632	3501	4848	850	24	9855
(20,50]	28	155	855	572	39	1649
(50,Inf]	0	0	5	7	0	12
Sum	12881	10906	6999	1504	64	32354

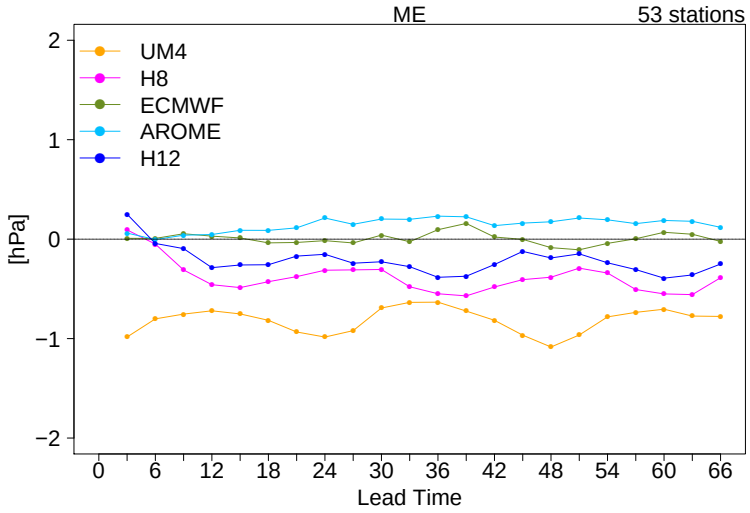
AROME

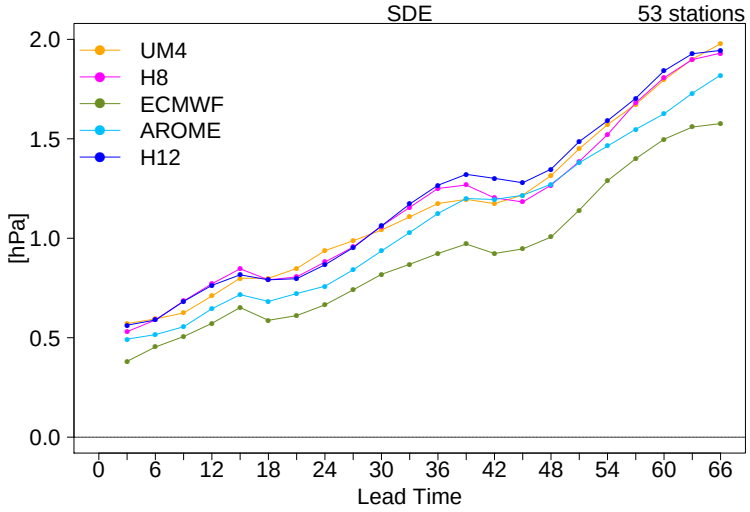
	OBS					
	[0,0.1]	(0.1,5]	(5,20]	(20,50]	(50,Inf]	Sum
[0,0.1]	8674	1770	131	9	0	10584
(0.1,5]	3509	6111	1875	125	6	11626
(5,20]	627	2731	4033	741	20	8152
(20,50]	67	287	923	579	34	1890
(50,Inf]	4	7	37	50	4	102
Sum	12881	10906	6999	1504	64	32354

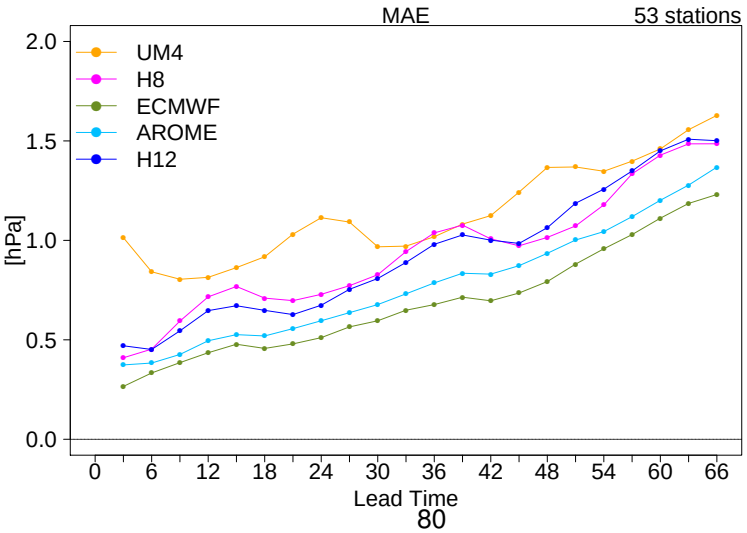
Figure 21: Lead time 00+30,+54.

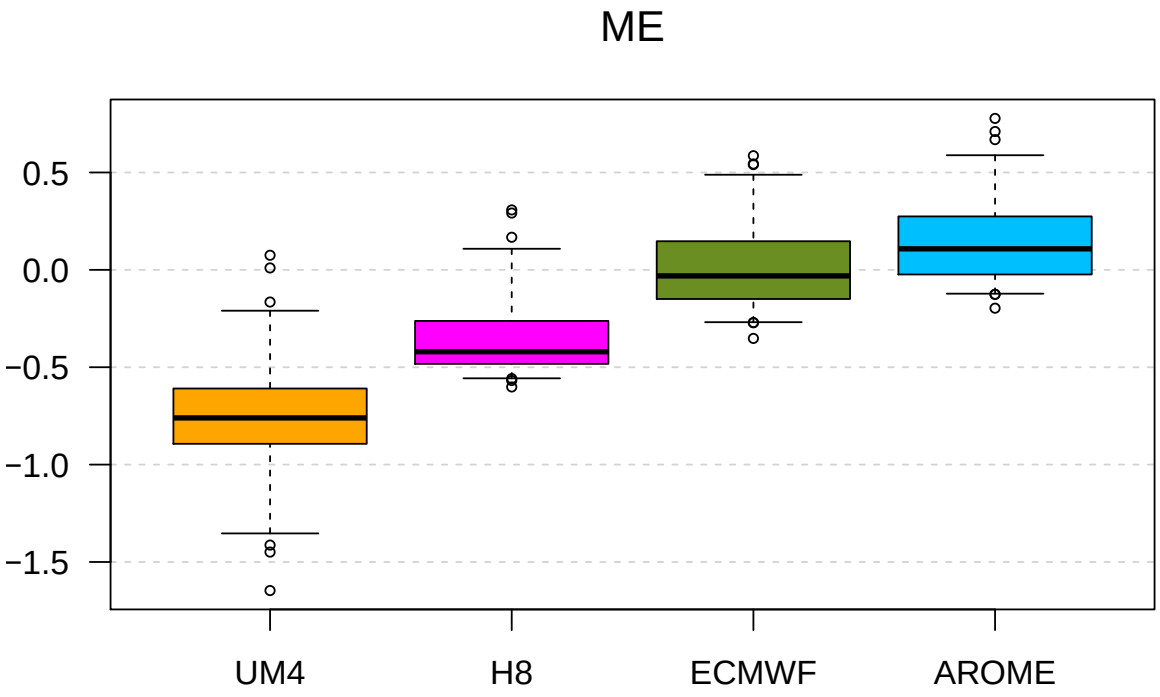
8 Northern Norway

8.1 Pressure









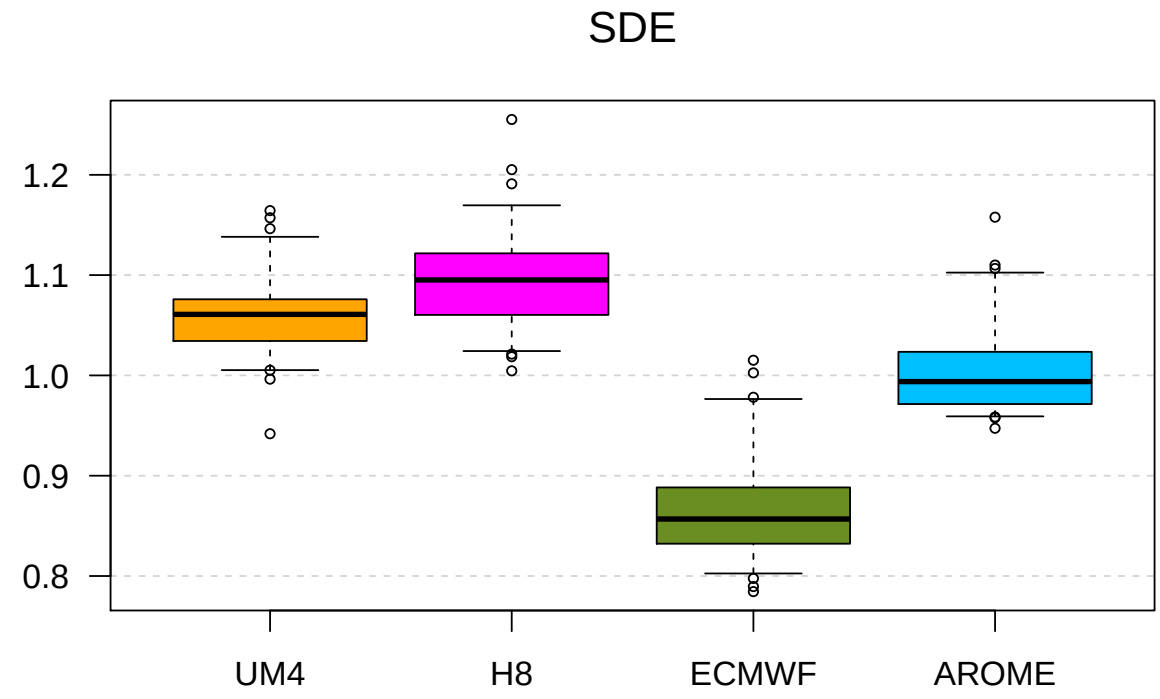
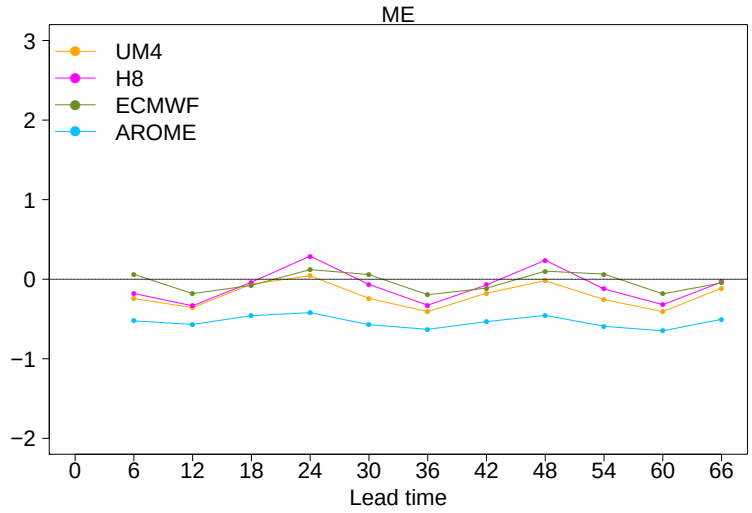
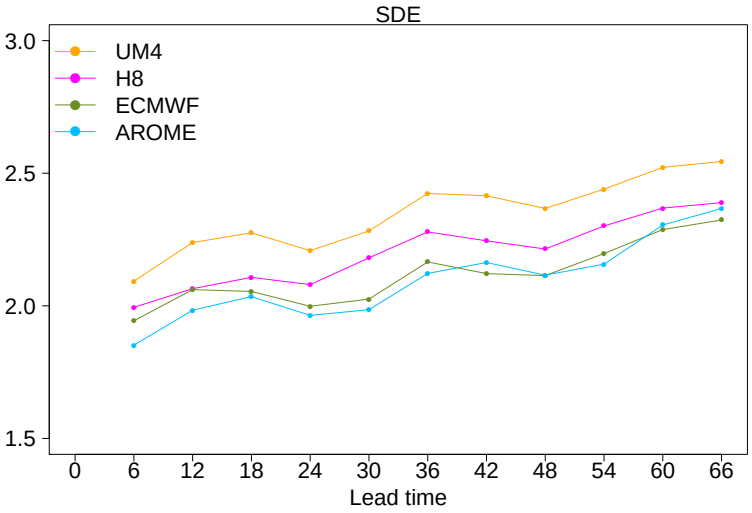
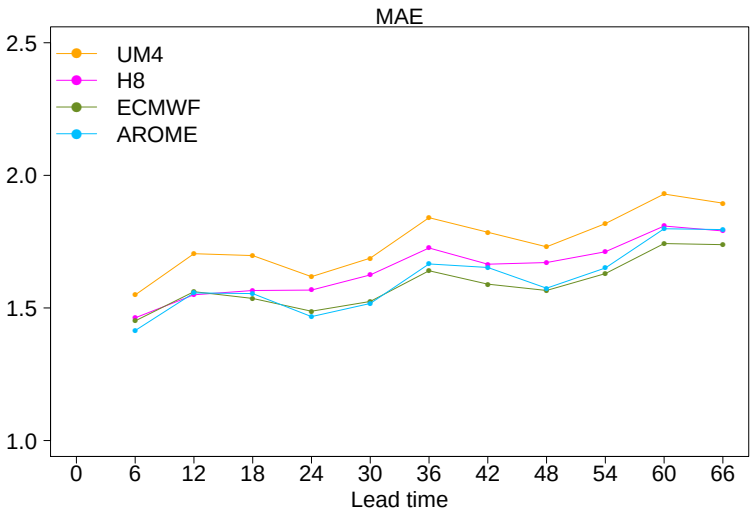


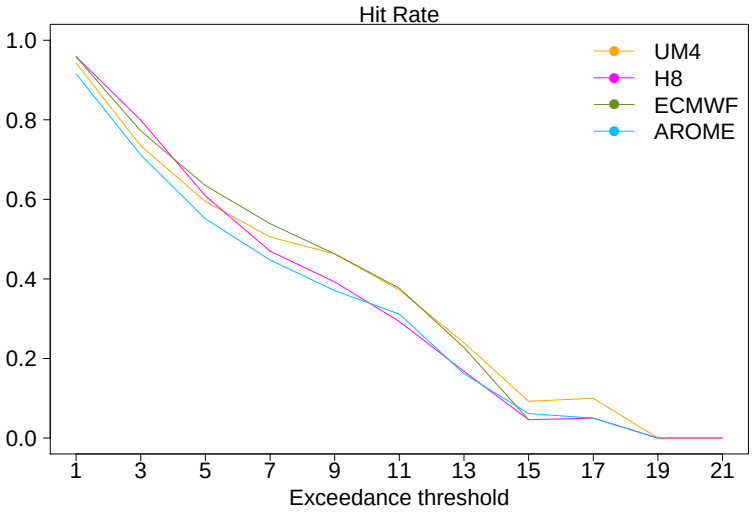
Figure 22: Lead time 00 +3,+6,...,+66.

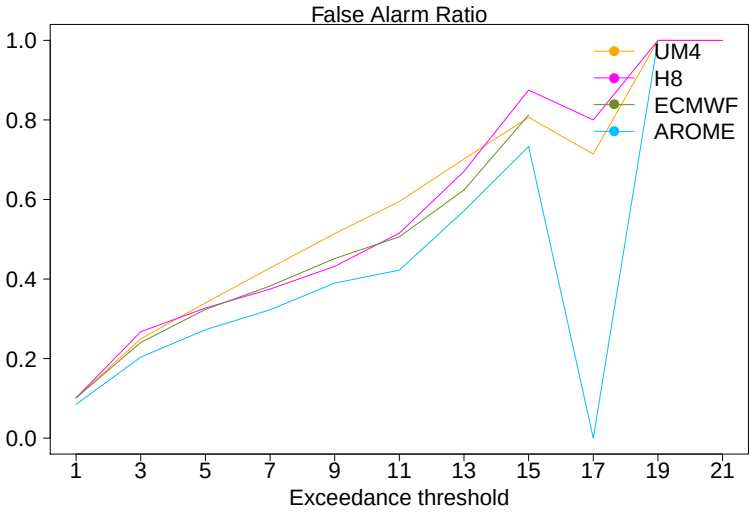
8.2 Wind Speed 10m











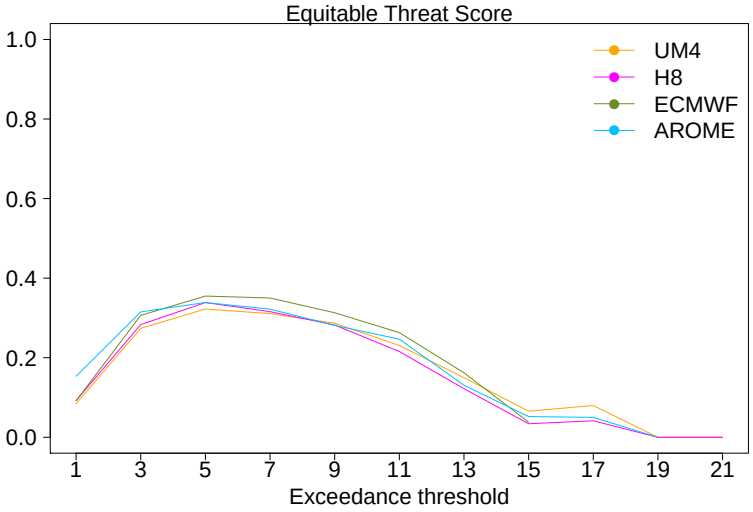
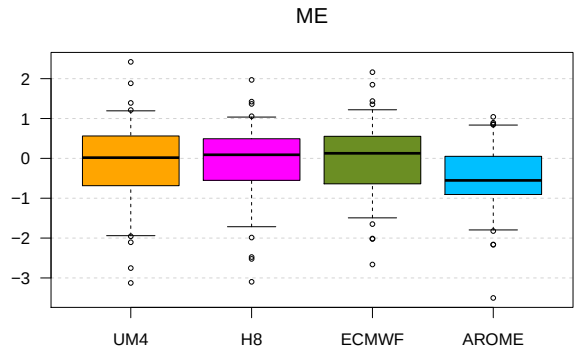
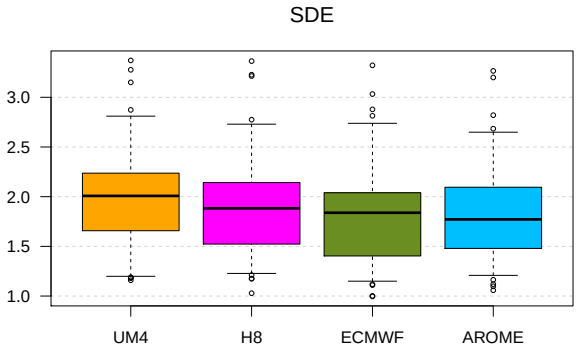


Figure 23: Lead time 00+12,+15,+18,+21,+24





Forecasts:

UM4

	OBS [0,3]	(3,11]	(11,17]	(17,21]	(21,Inf]	Sum
[0,3]	22555	11295	78	1	0	33929
(3,11]	10016	26638	926	52	8	37640
(11,17]	9	840	530	17	0	1396
(17,21]	0	2	3	2	0	7
(21,Inf]	0	0	1	0	0	1
Sum	32580	38775	1538	72	8	72973

H8

	OBS [0,3]	(3,11]	(11,17]	(17,21]	(21,Inf]	Sum
[0,3]	20548	8690	41	0	0	29279
(3,11]	12026	29617	1091	57	8	42799
(11,17]	6	467	401	14	0	888
(17,21]	0	1	5	0	0	6
(21,Inf]	0	0	0	1	0	1
Sum	32580	38775	1538	72	8	72973

ECMWF

	OBS [0,3]	(3,11]	(11,17]	(17,21]	(21,Inf]	Sum
[0,3]	22072	9048	19	0	0	31139
(3,11]	10495	29092	1007	24	3	40621
(11,17]	13	635	512	48	5	1213
(17,21]	0	0	0	0	0	0
(21,Inf]	0	0	0	0	0	0
Sum	32580	38775	1538	72	8	72973

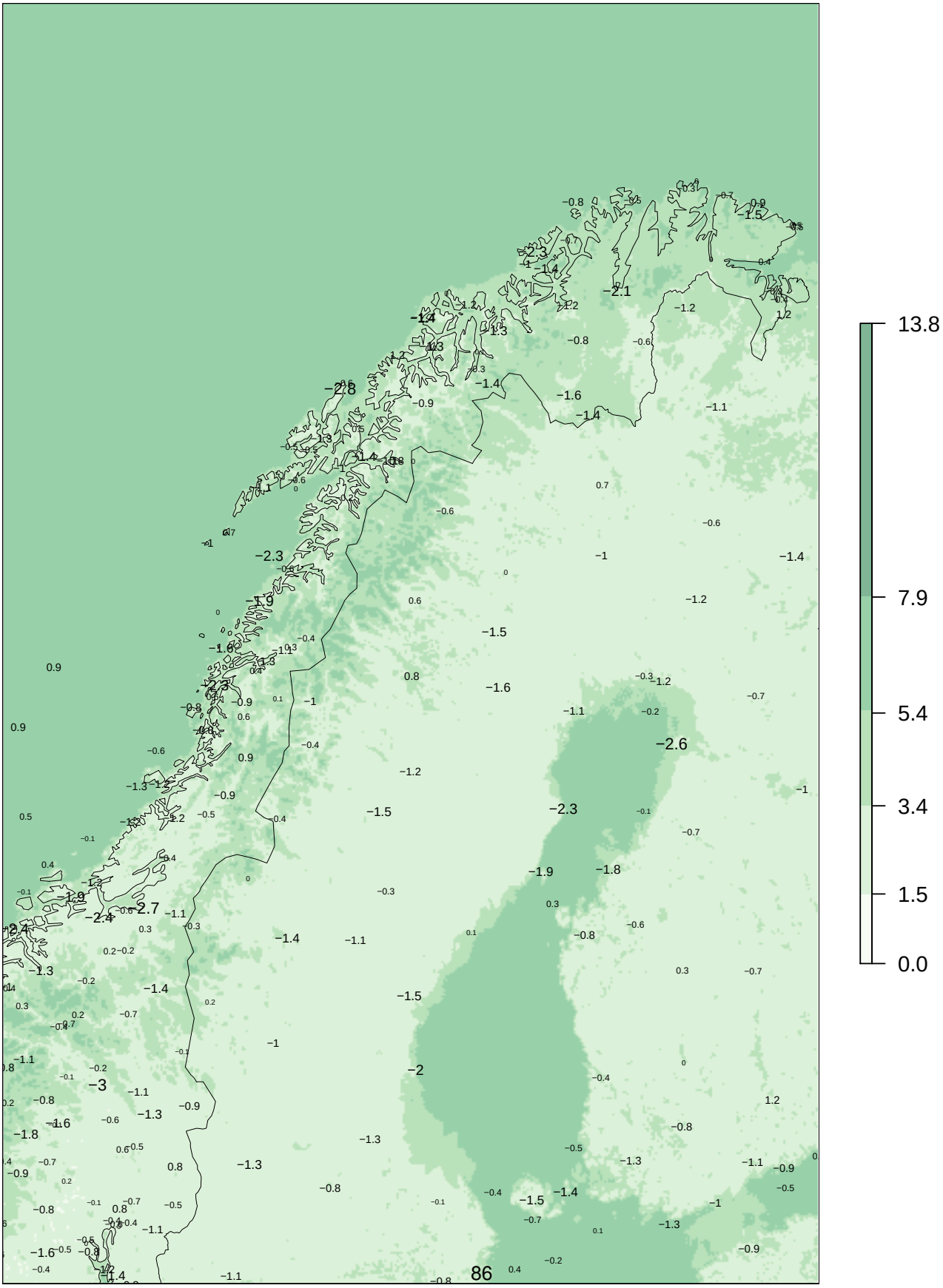
AROME

	OBS [0,3]	(3,11]	(11,17]	(17,21]	(21,Inf]	Sum
[0,3]	25035	12139	39	0	0	37213
(3,11]	7535	26275	1087	42	4	34943
(11,17]	10	361	412	28	4	815
(17,21]	0	0	0	2	0	2
(21,Inf]	0	0	0	0	0	0
Sum	32580	38775	1538	72	8	72973

Figure 24: Lead time 00+3,+6,..,+66.

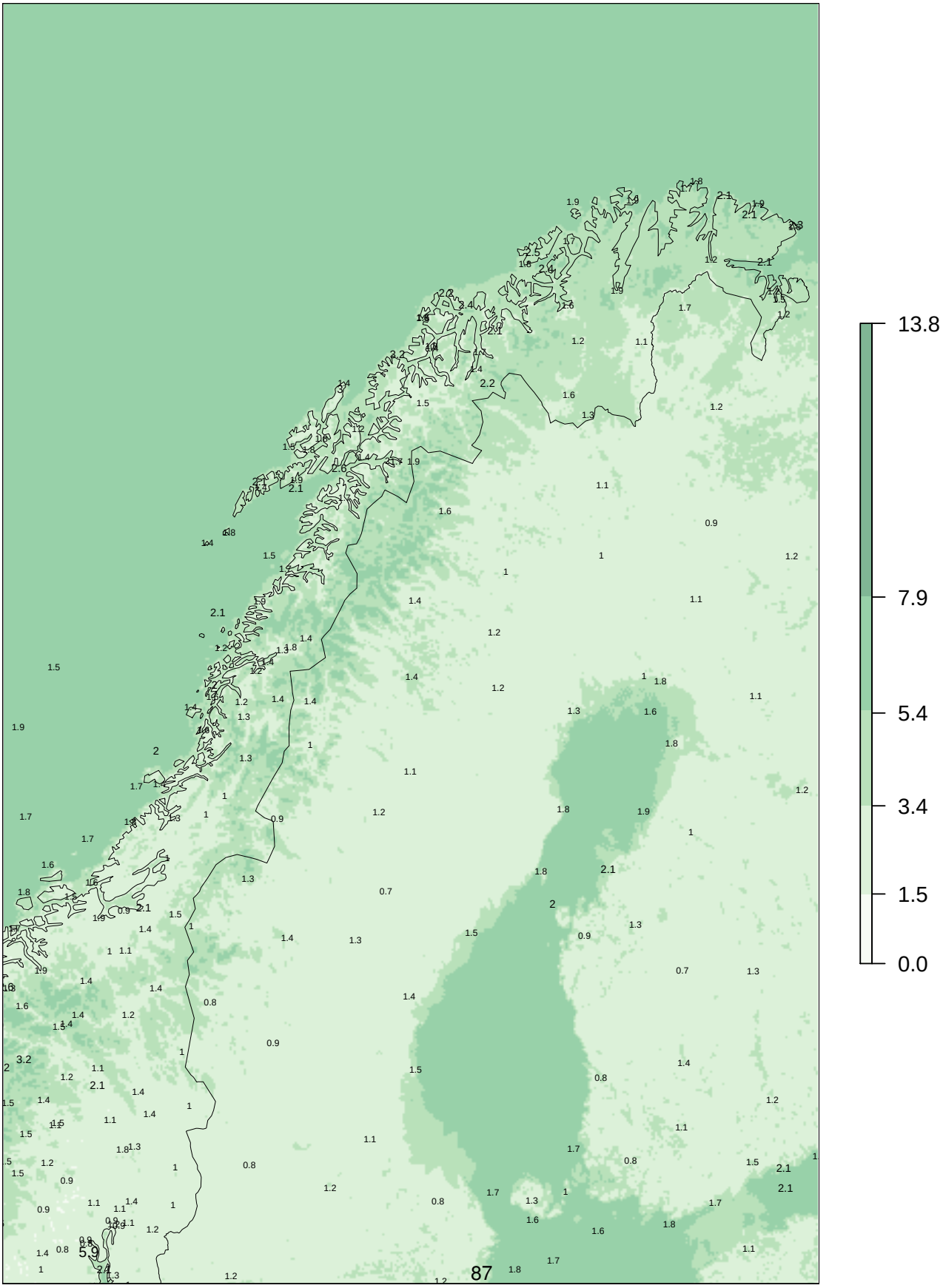
AROME−Norway 00+12

ME at observing sites forecast means 01.06.2013 − 31.08.2013

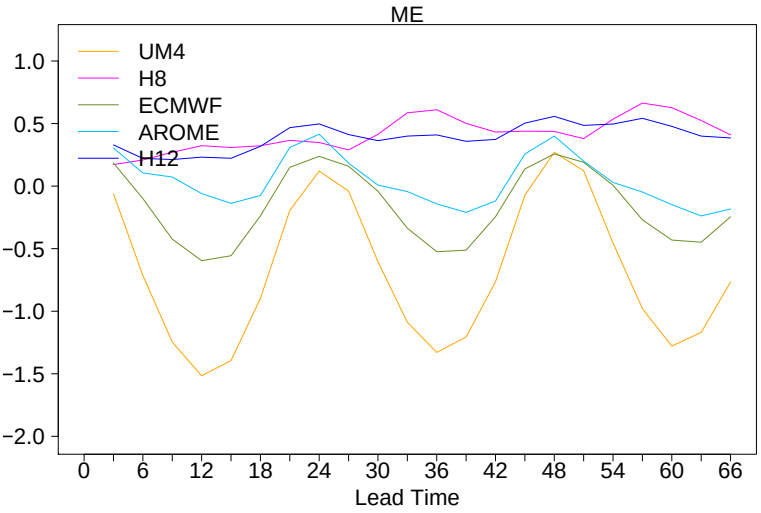


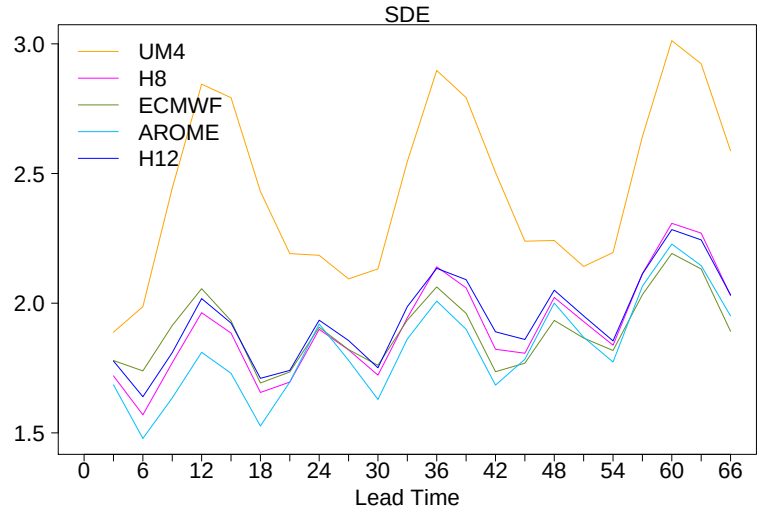
AROME−Norway 00+12

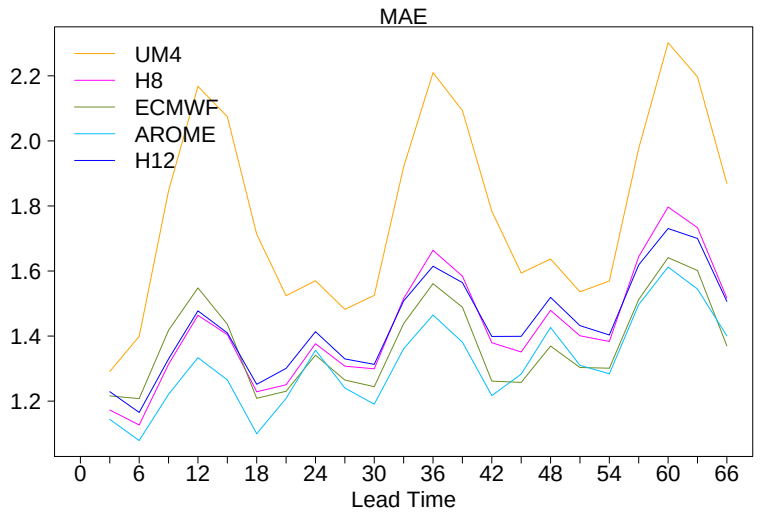
SDE at observing sites forecast means 01.06.2013 − 31.08.2013

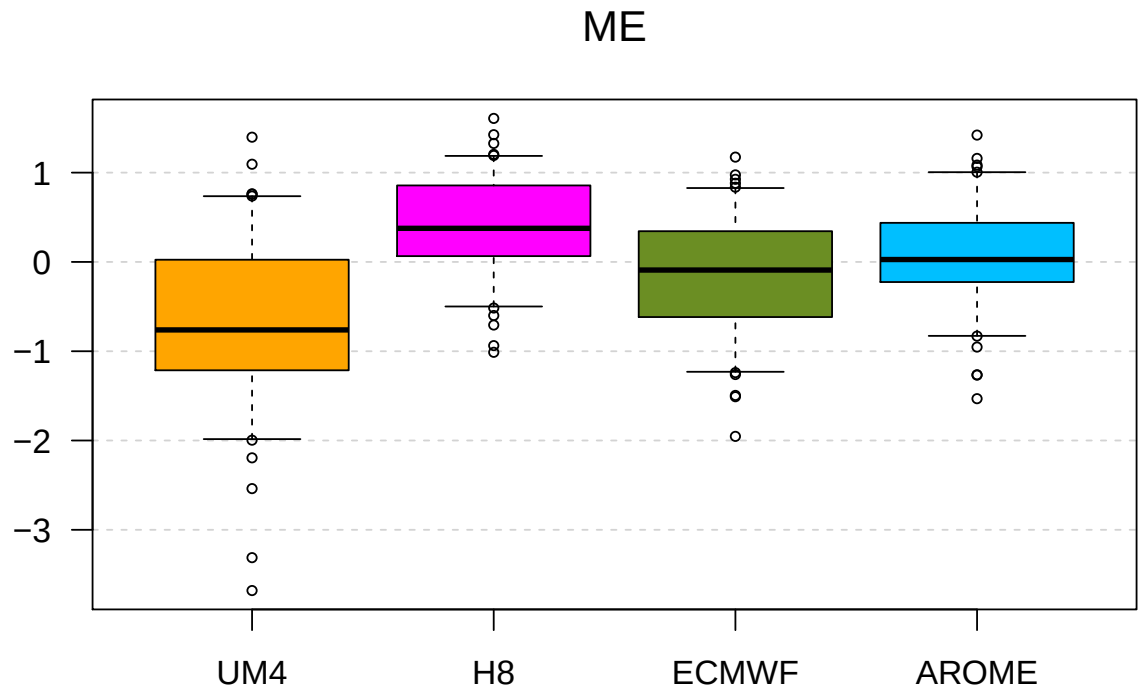


8.3 Temperature 2m









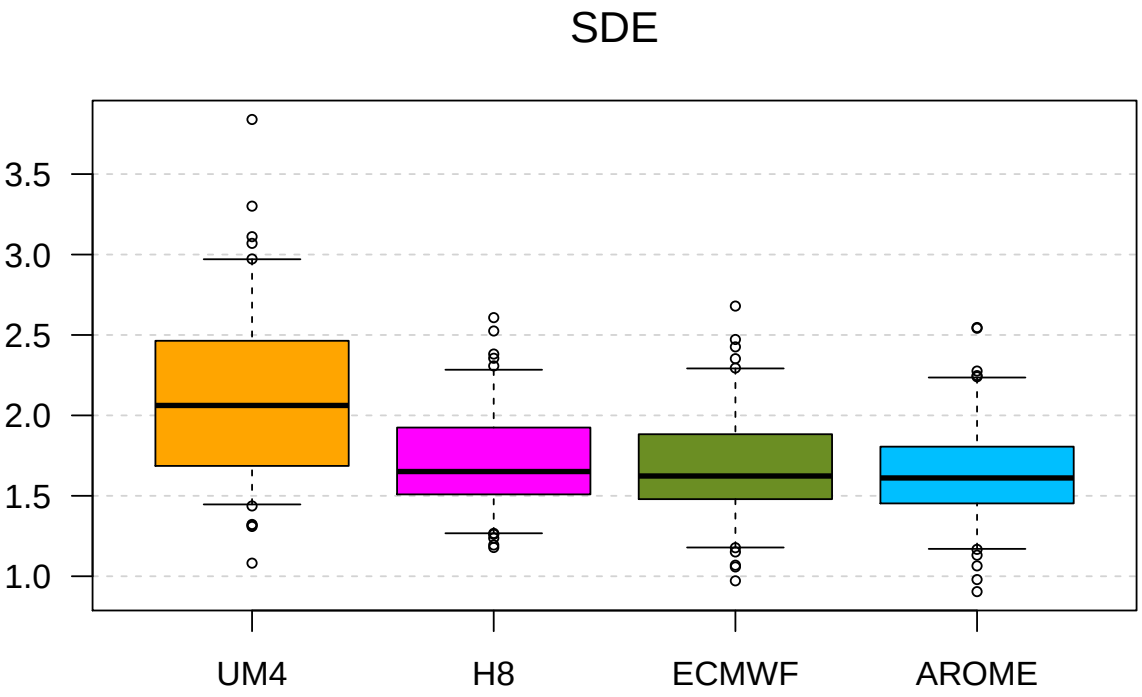
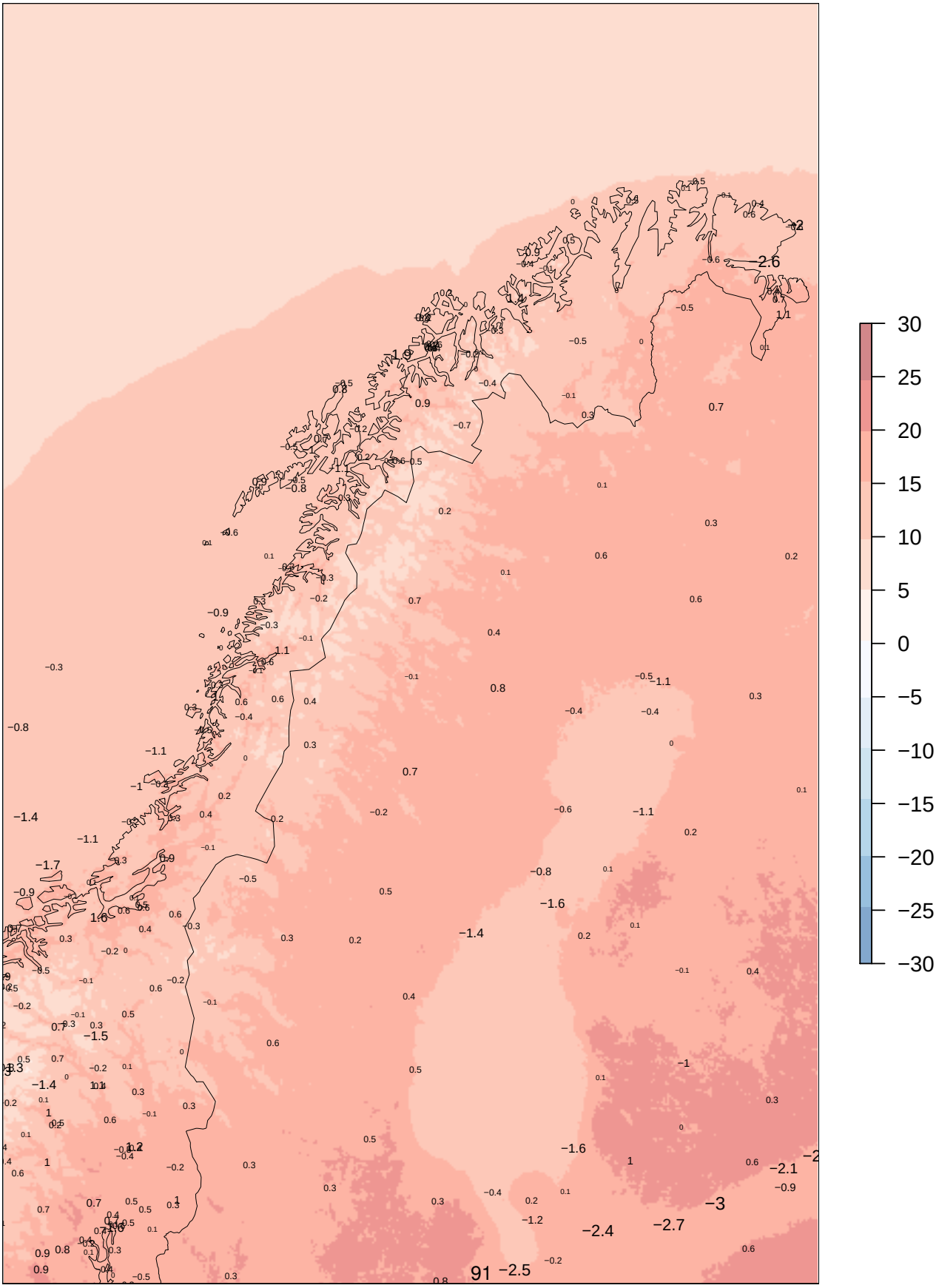


Figure 25: Lead time 00 +3,+6,...,+66

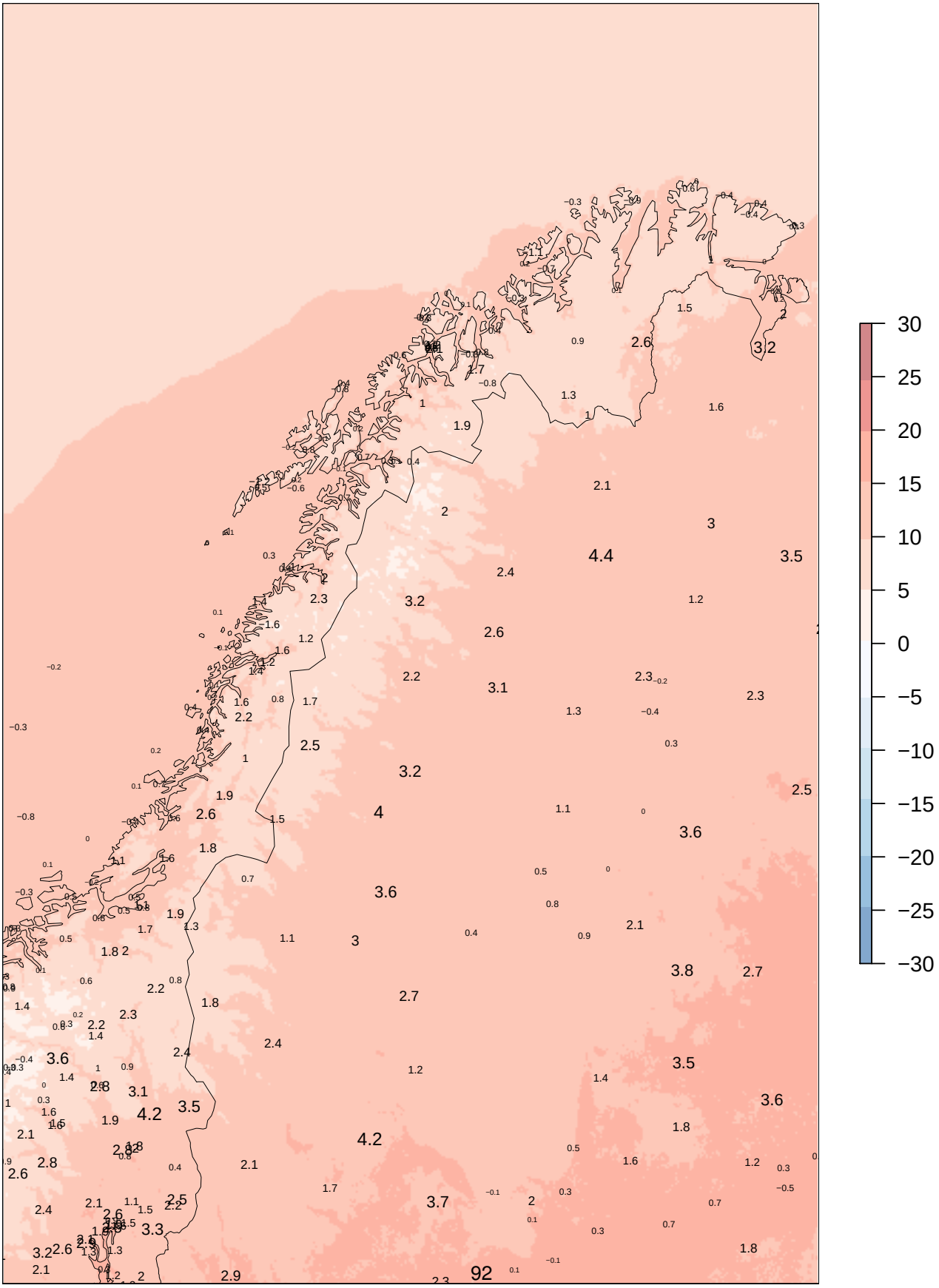
AROME−Norway 00+12

ME at observing sites forecast means 01.06.2013 − 31.08.2013



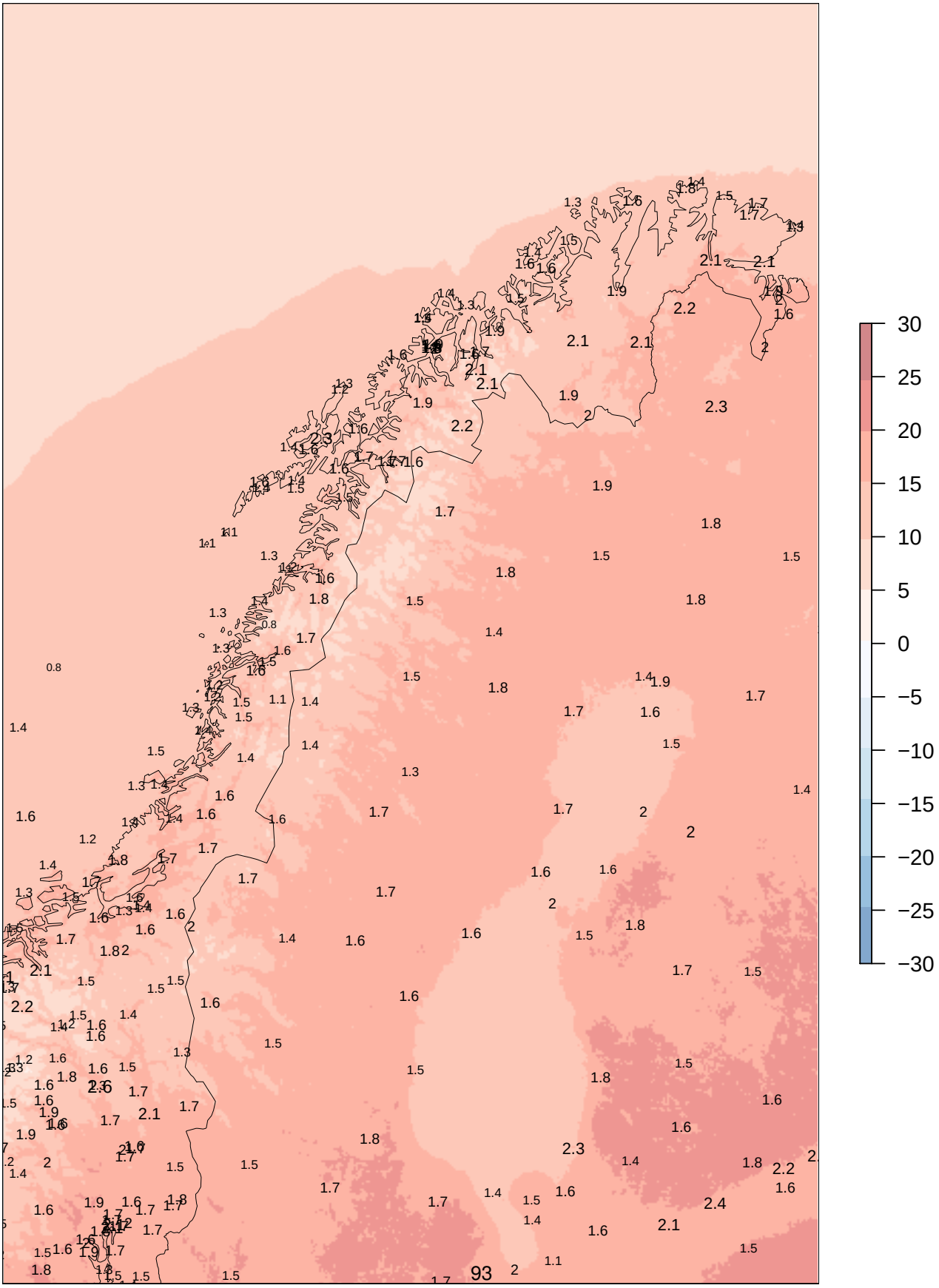
AROME−Norway 00+24

ME at observing sites forecast means 01.06.2013 − 31.08.2013



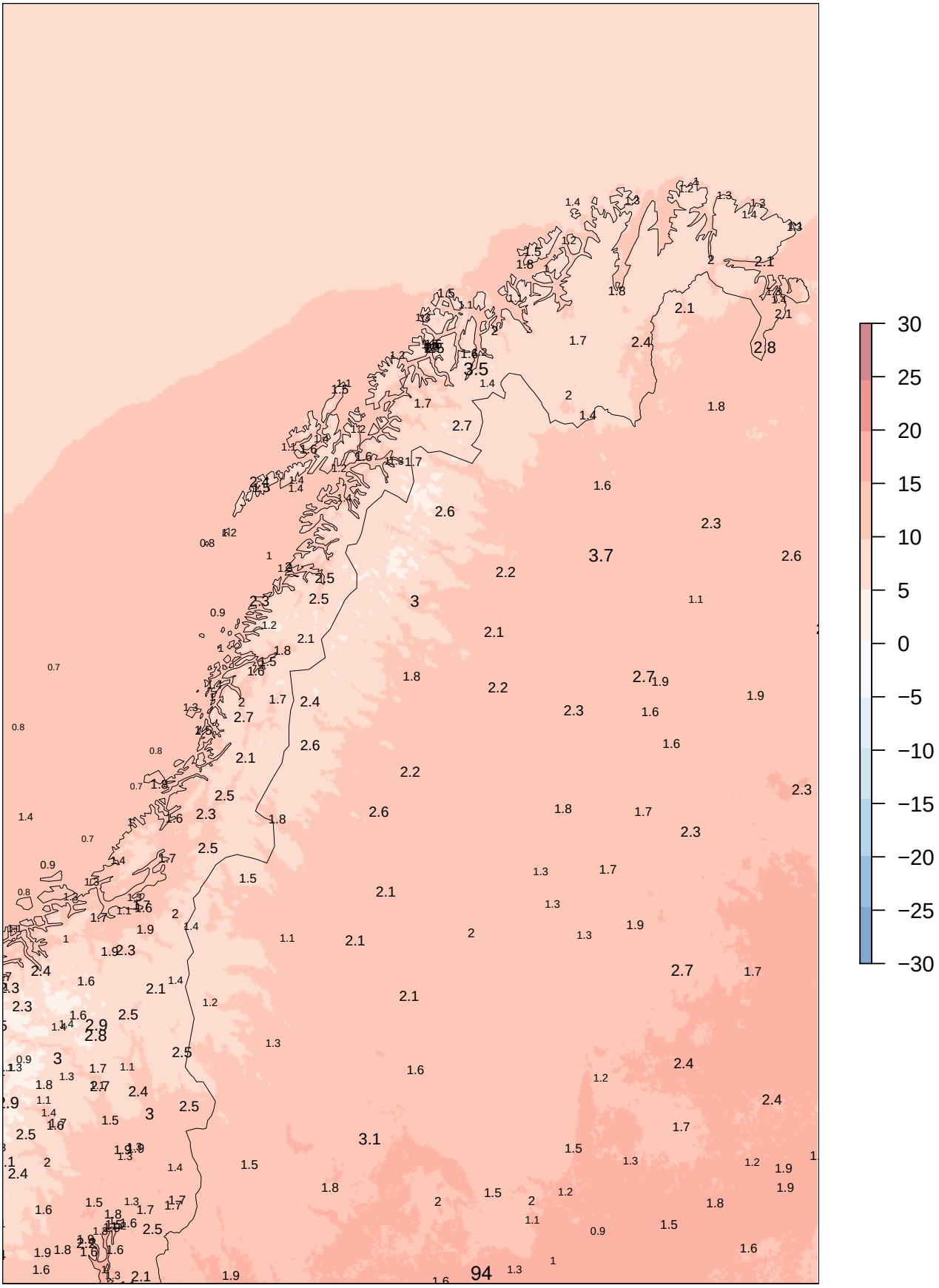
AROME−Norway 00+12

SDE at observing sites forecast means 01.06.2013 − 31.08.2013

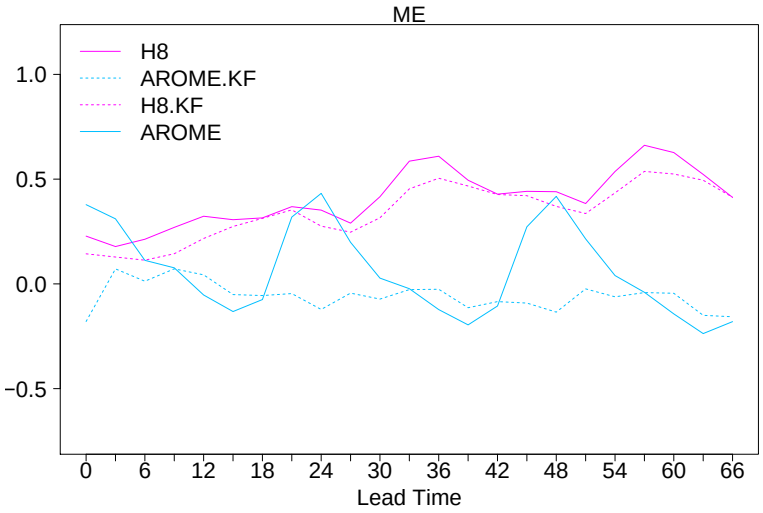


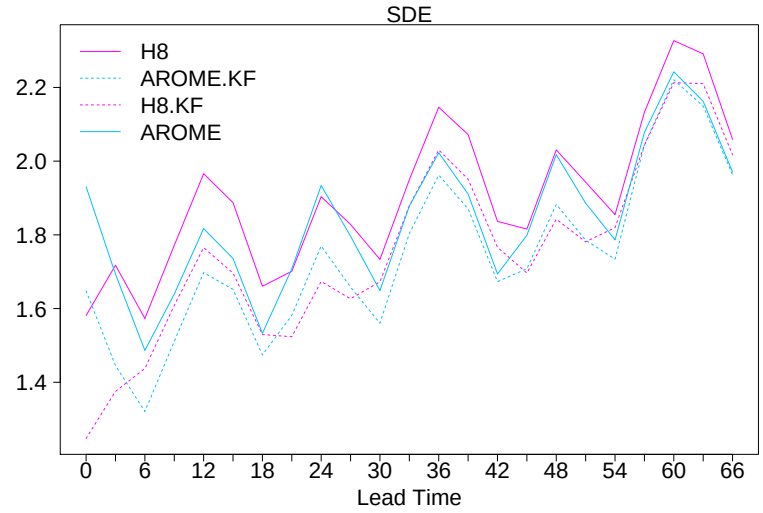
AROME−Norway 00+24

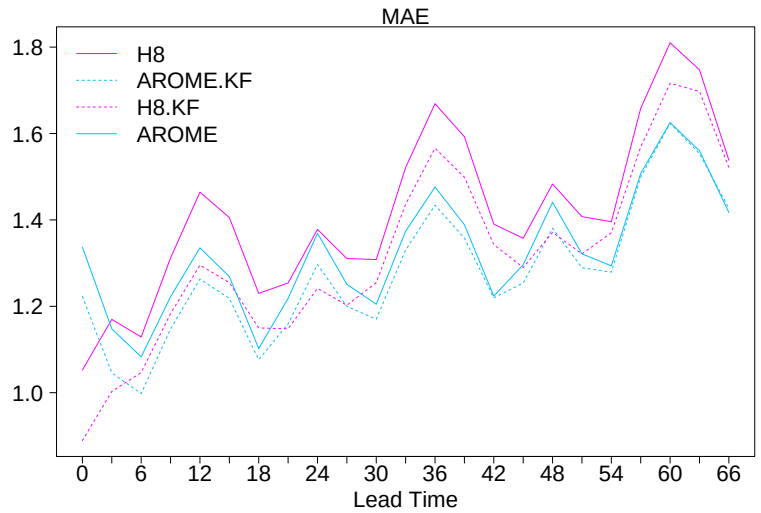
SDE at observing sites forecast means 01.06.2013 − 31.08.2013

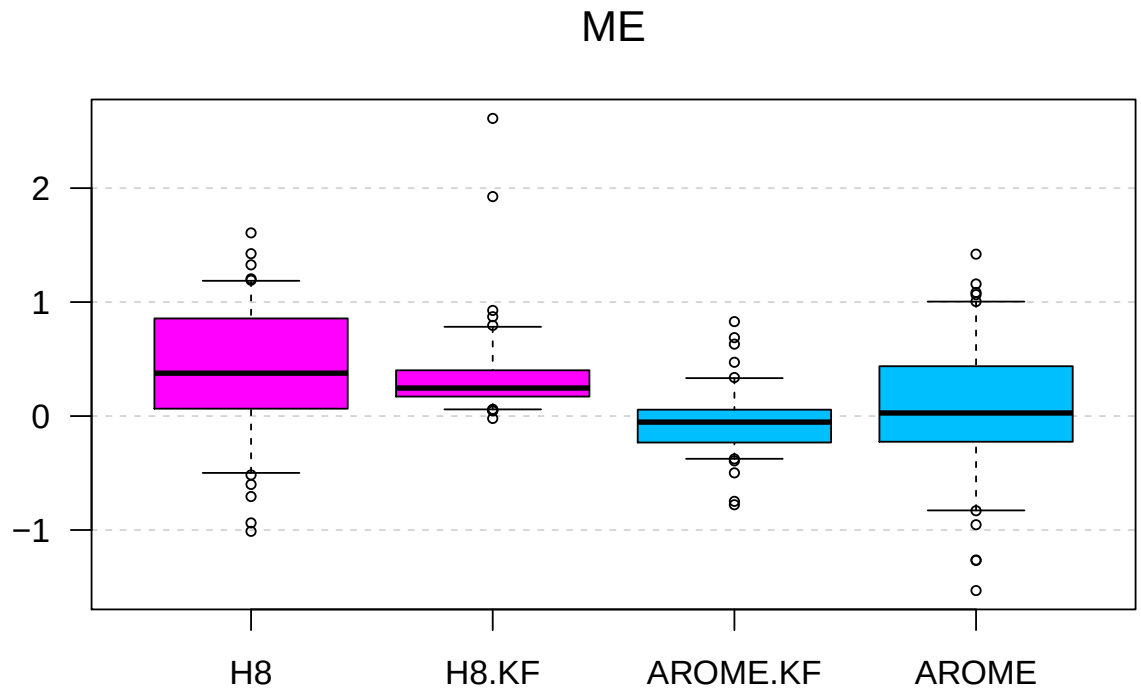


8.4 Post processed temperature 2m









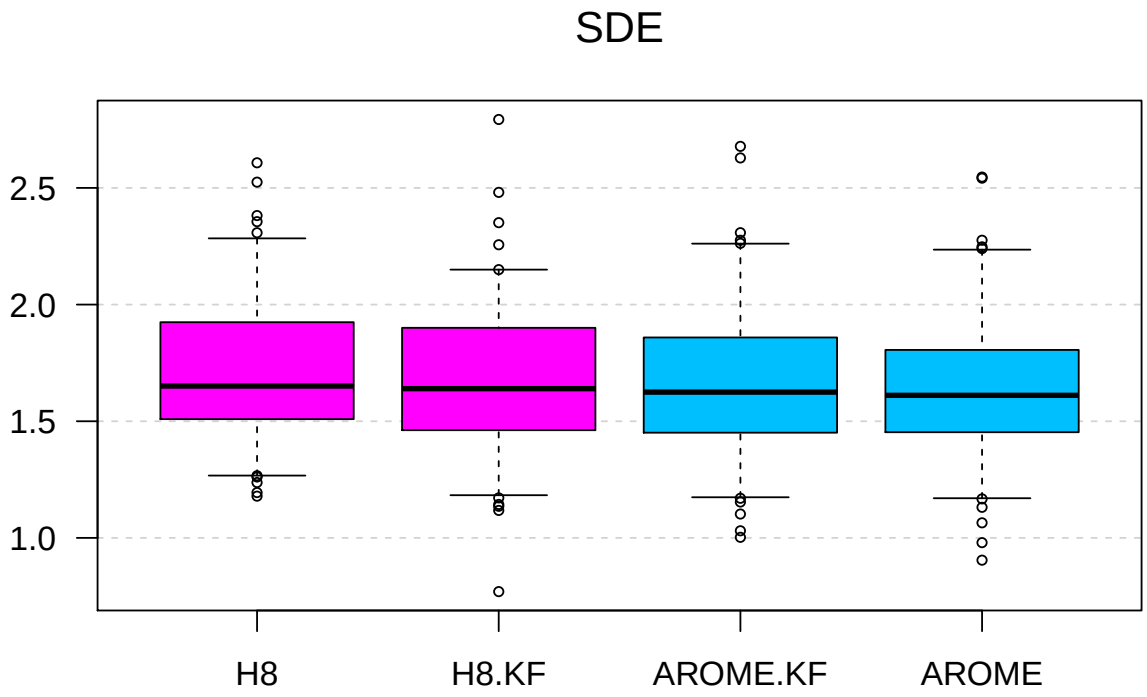
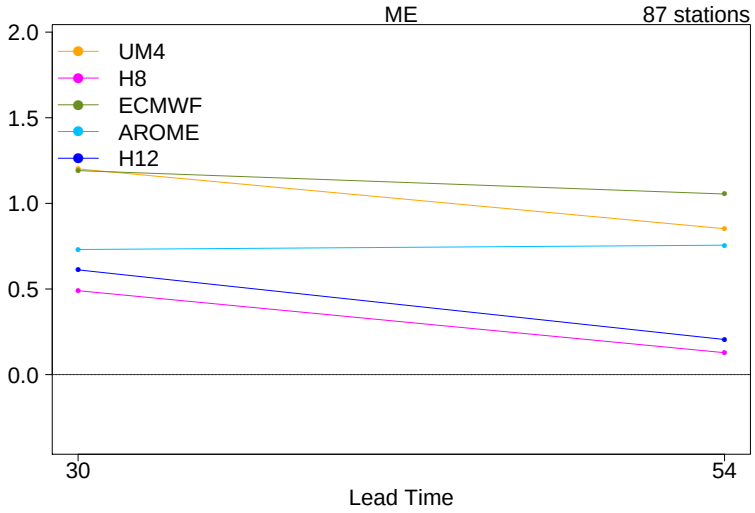
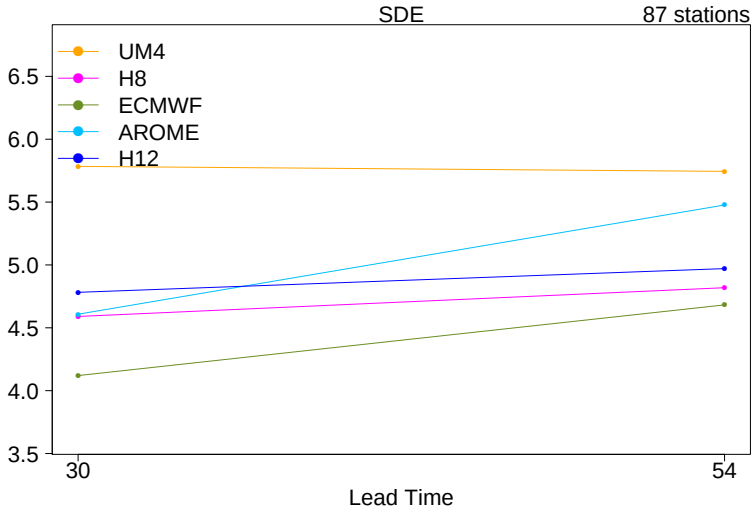
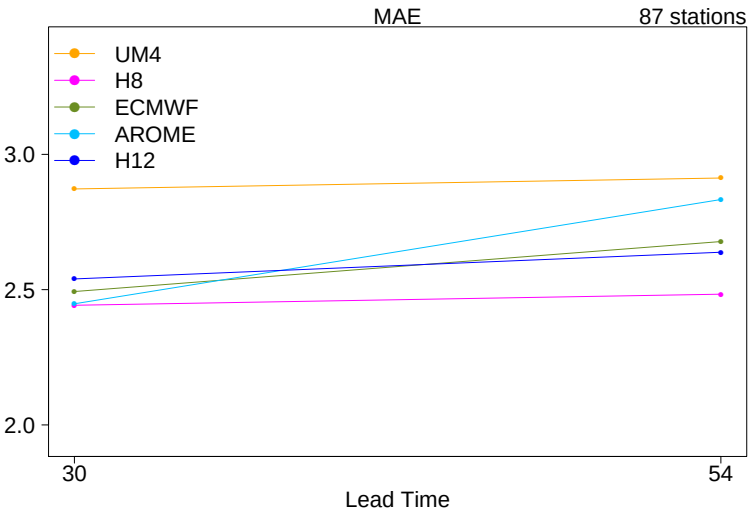


Figure 26: Lead time 00 +3,+6,...,+66

8.5 Daily precipitation







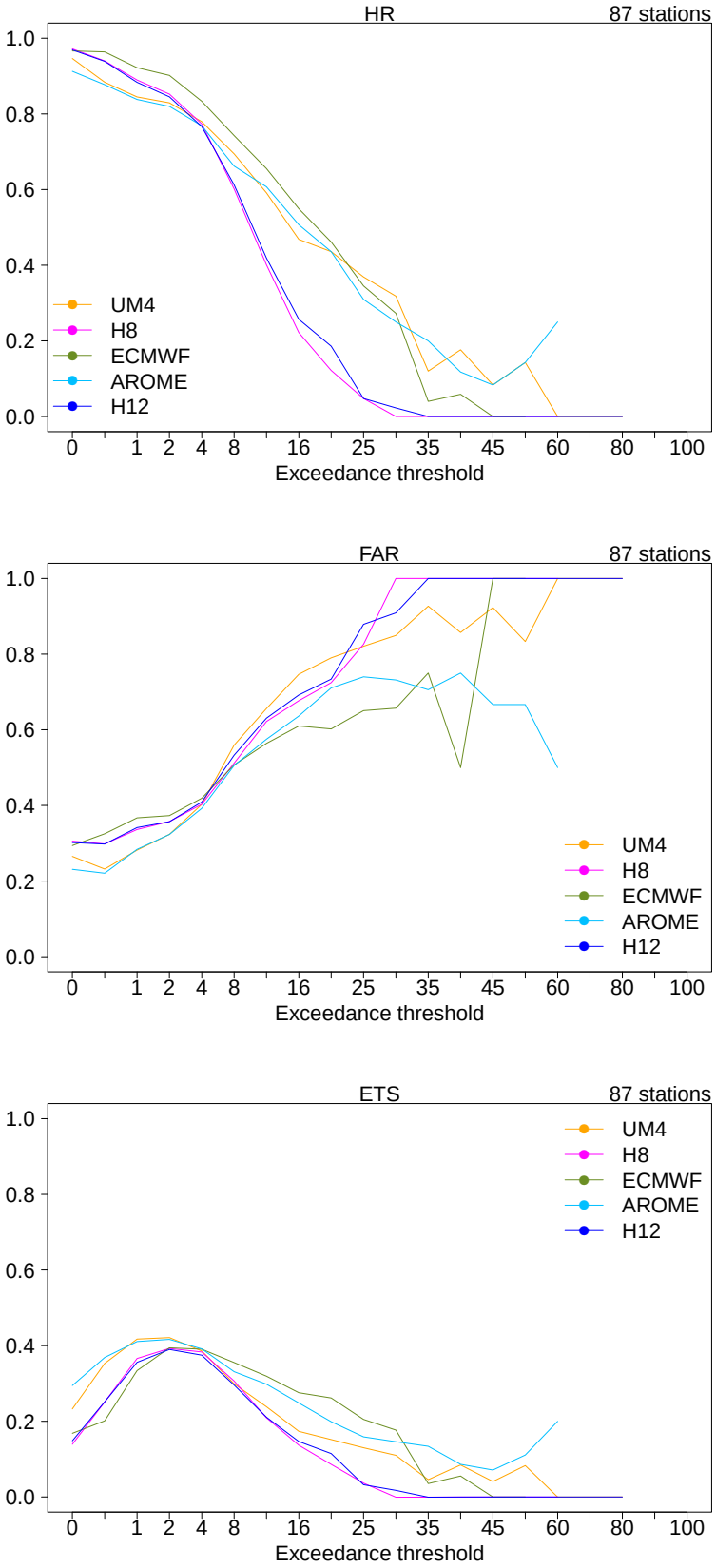
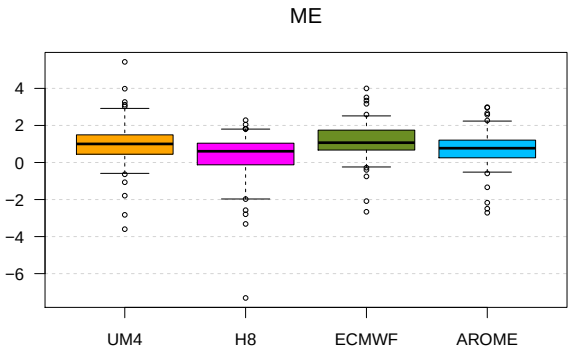
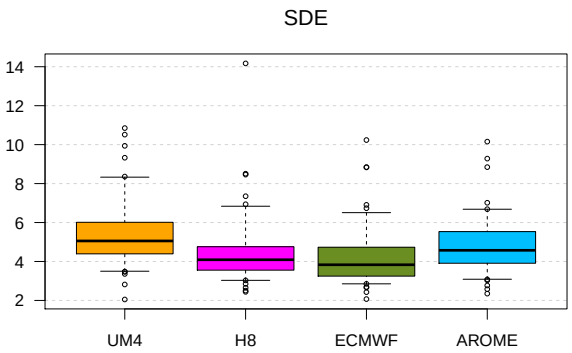


Figure 27: Lead time 00+30.





Forecasts:

UM4

	OBS [0,0.1]	(0.1,5]	(5,20]	(20,50]	(50,Inf]	Sum
[0,0.1]	4170	1126	67	3	0	5366
(0.1,5]	2163	3334	806	36	0	6339
(5,20]	228	1453	1607	137	2	3427
(20,50]	33	118	318	121	12	602
(50,Inf]	1	3	3	5	1	13
Sum	6595	6034	2801	302	15	15747

H8

	OBS [0,0.1]	(0.1,5]	(5,20]	(20,50]	(50,Inf]	Sum
[0,0.1]	3021	580	34	0	0	3635
(0.1,5]	3349	4080	934	37	0	8400
(5,20]	221	1352	1759	225	14	3571
(20,50]	4	21	73	38	1	137
(50,Inf]	0	1	1	2	0	4
Sum	6595	6034	2801	302	15	15747

ECMWF

	OBS [0,0.1]	(0.1,5]	(5,20]	(20,50]	(50,Inf]	Sum
[0,0.1]	2385	351	6	0	0	2742
(0.1,5]	3943	3930	639	15	0	8527
(5,20]	266	1727	1967	169	6	4135
(20,50]	1	26	189	116	9	341
(50,Inf]	0	0	0	2	0	2
Sum	6595	6034	2801	302	15	15747

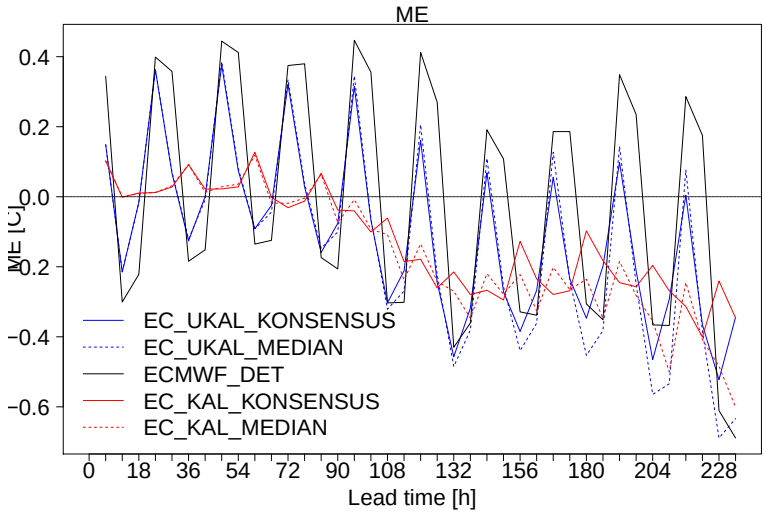
AROME

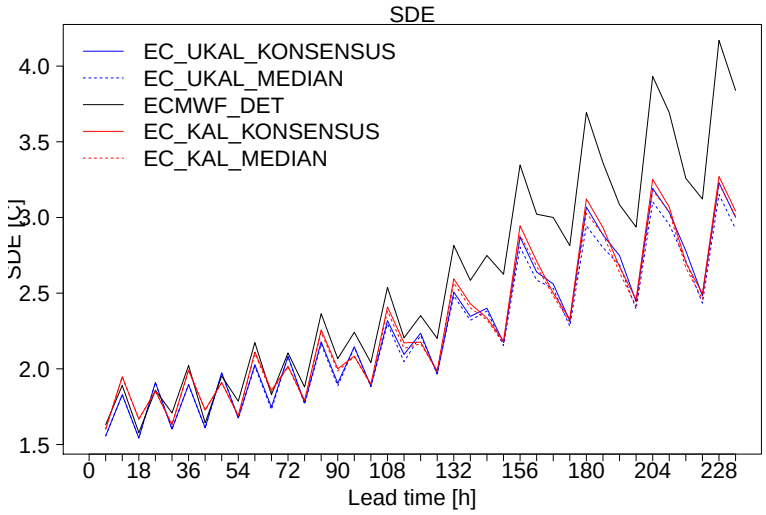
	OBS [0,0.1]	(0.1,5]	(5,20]	(20,50]	(50,Inf]	Sum
[0,0.1]	4276	1119	68	0	0	5463
(0.1,5]	2031	3405	824	22	0	6282
(5,20]	275	1436	1658	168	5	3542
(20,50]	13	74	248	106	9	450
(50,Inf]	0	0	3	6	1	10
Sum	6595	6034	2801	302	15	15747

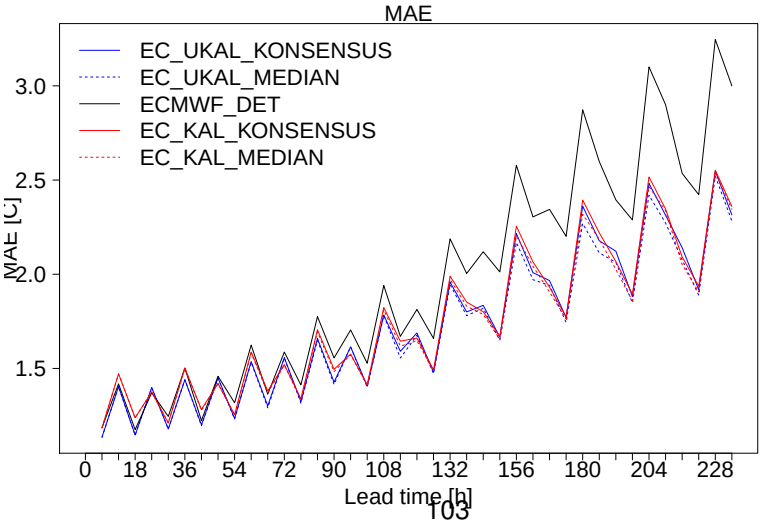
Figure 28: Lead time 00+30,+54.

9 Long term forecast

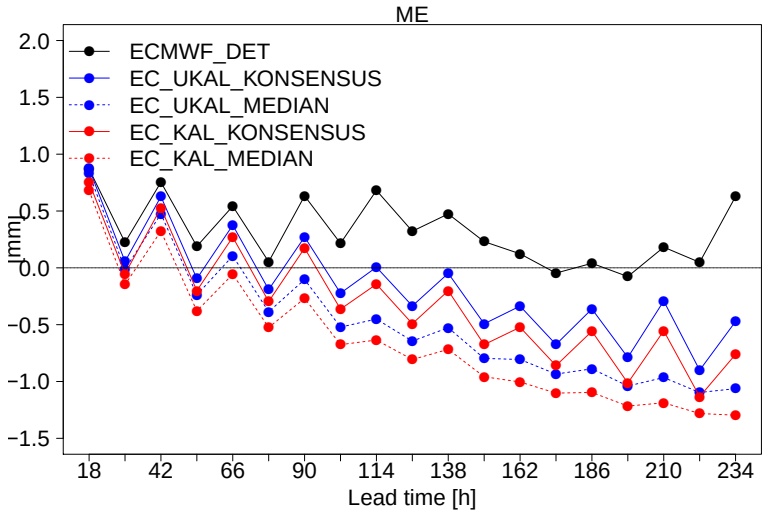
9.1 Temperature 2m

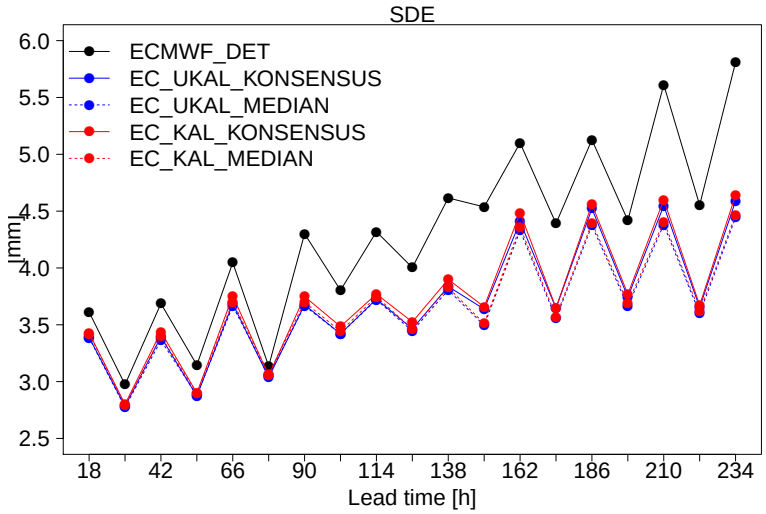


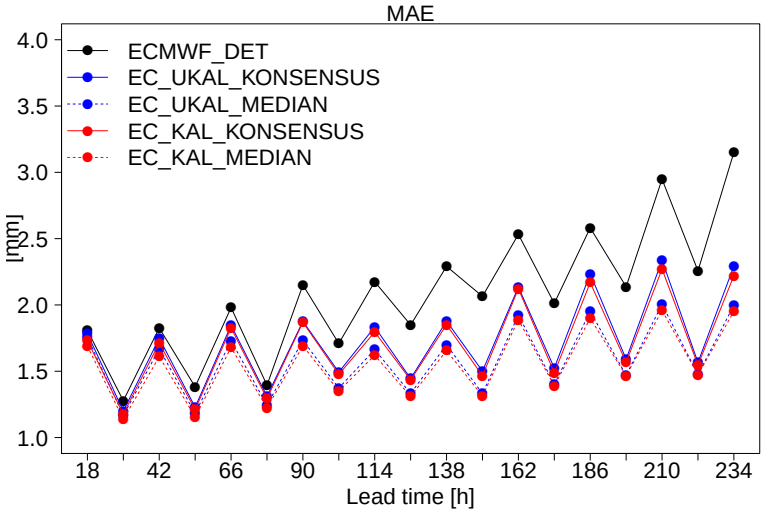


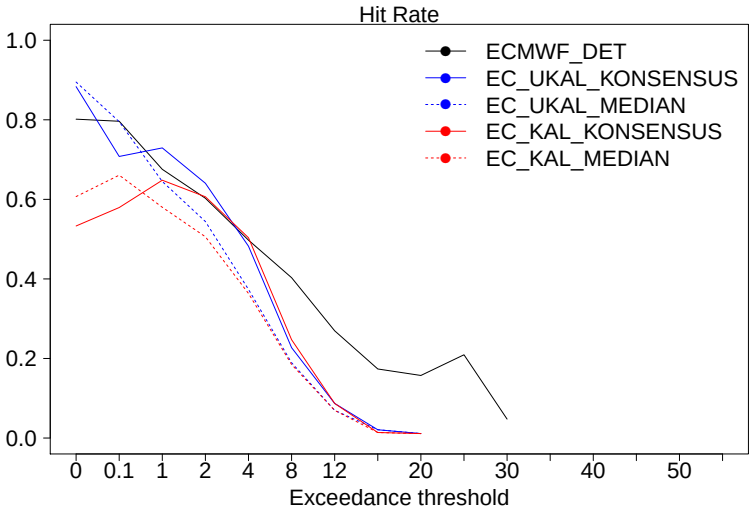


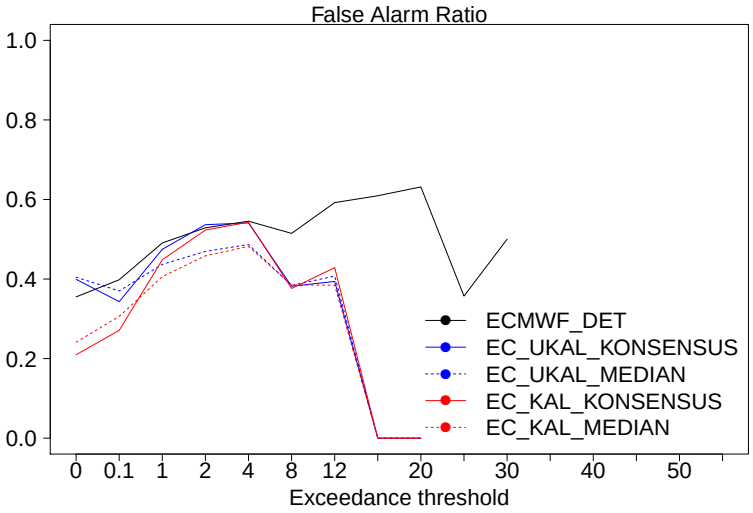
9.2 12h Precipitation











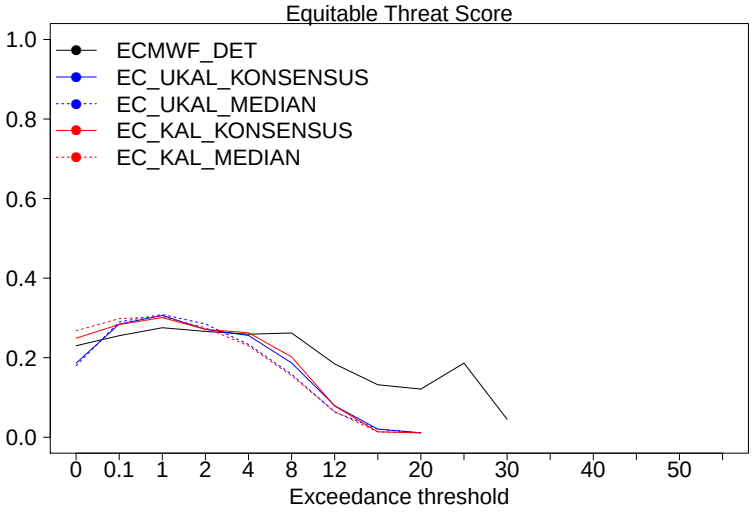
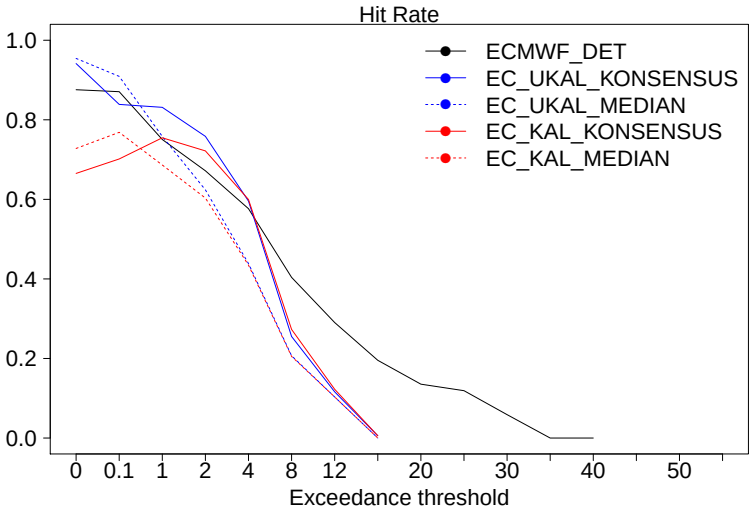
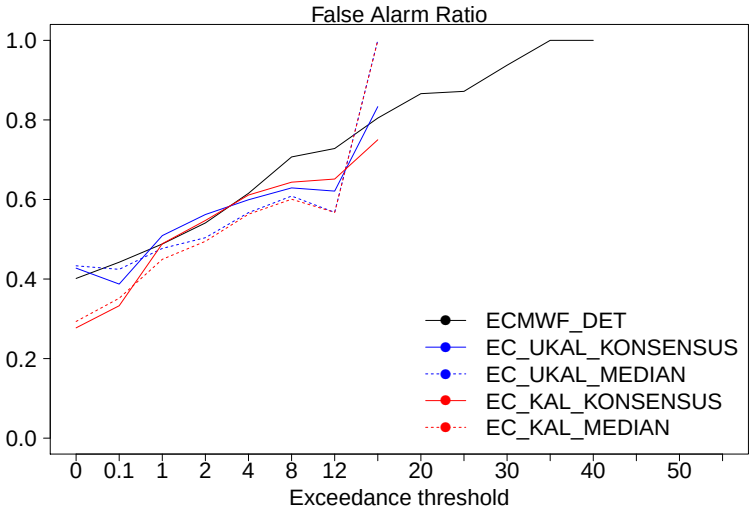


Figure 29: Lead time 00+78h (night time)





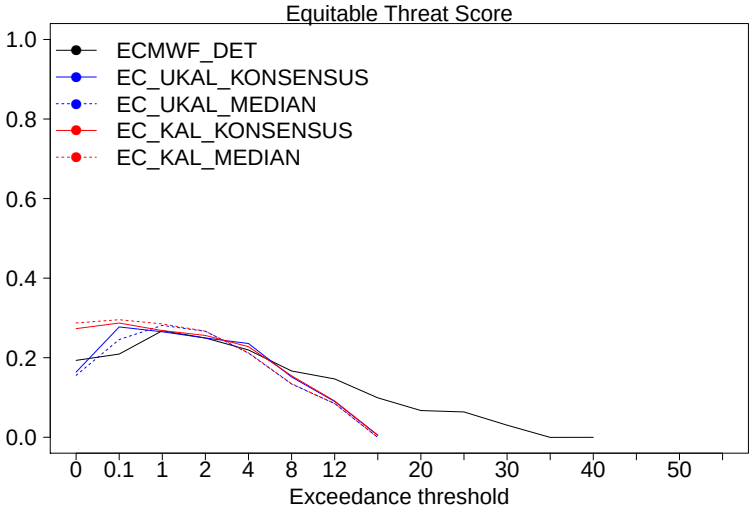
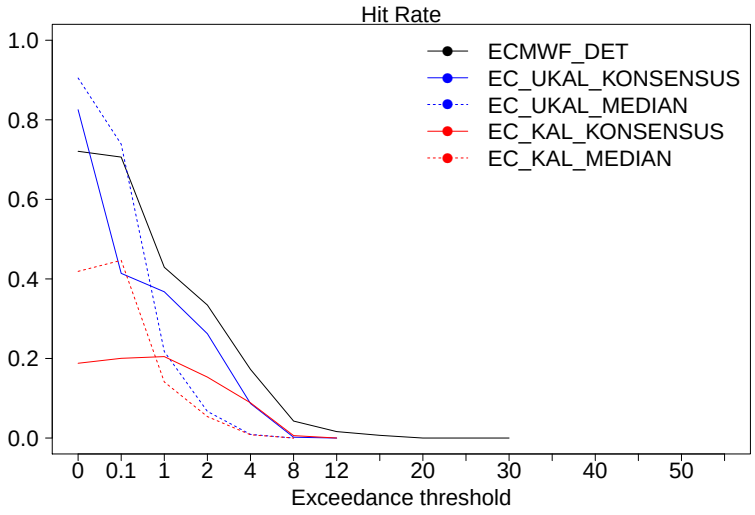
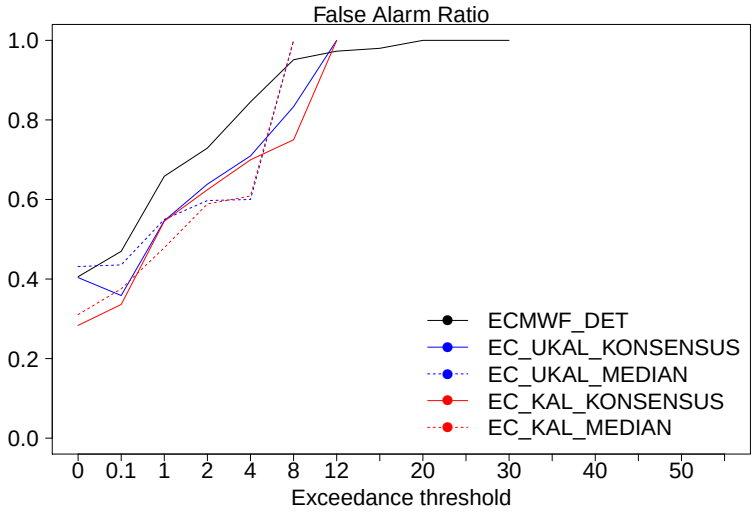


Figure 30: Lead time 00+90h (day time)





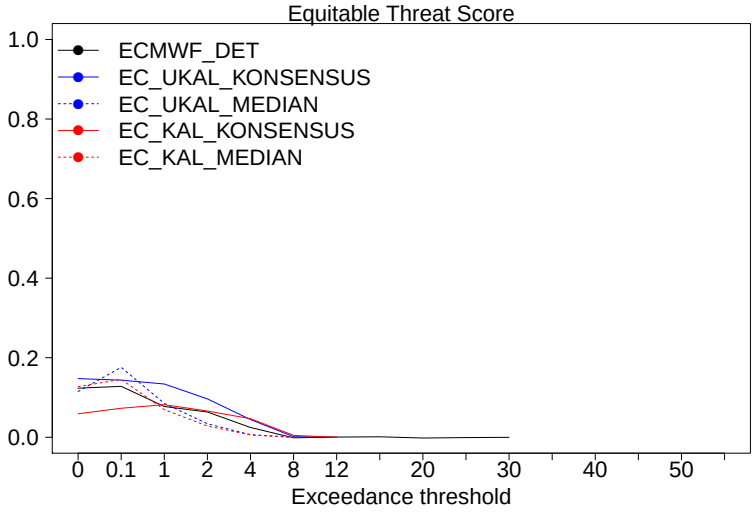
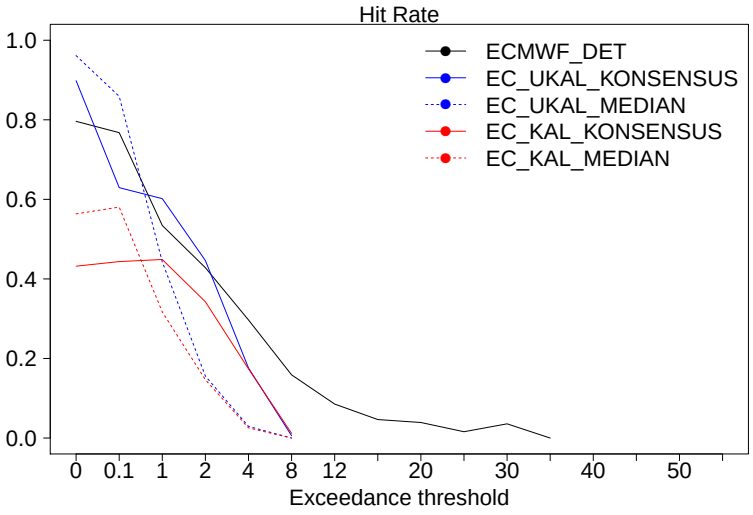
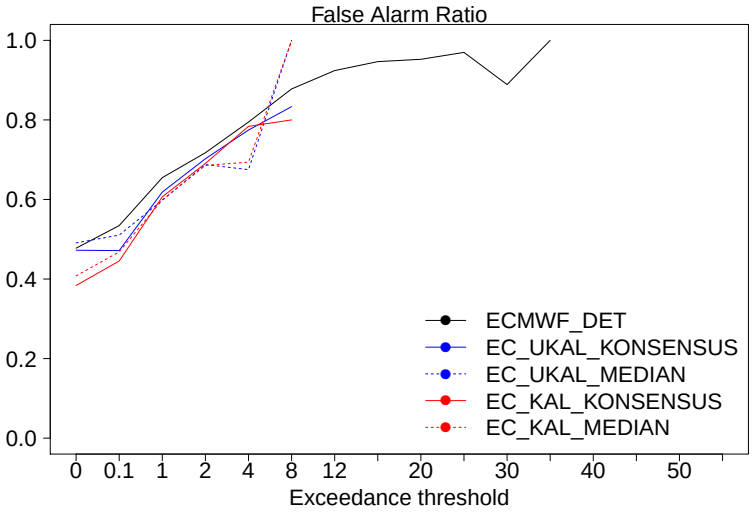


Figure 31: Lead time 00+222h (night time)





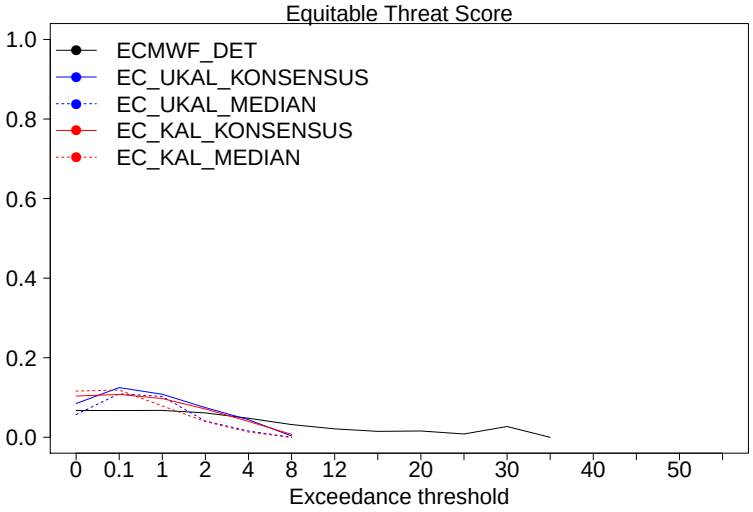
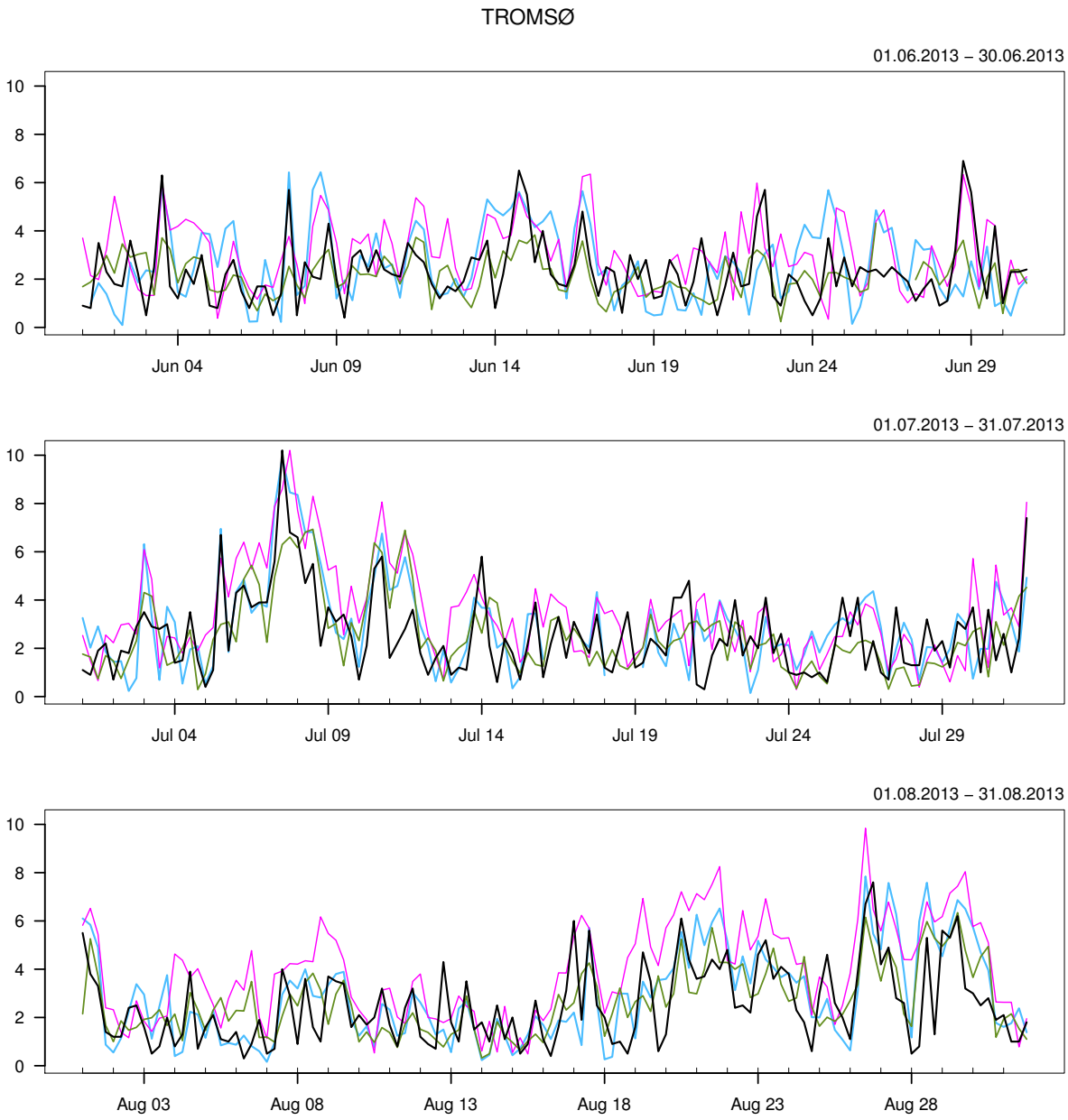


Figure 32: Lead time 00+234h (day time)

10 Appendix

10.1 10m Wind speed

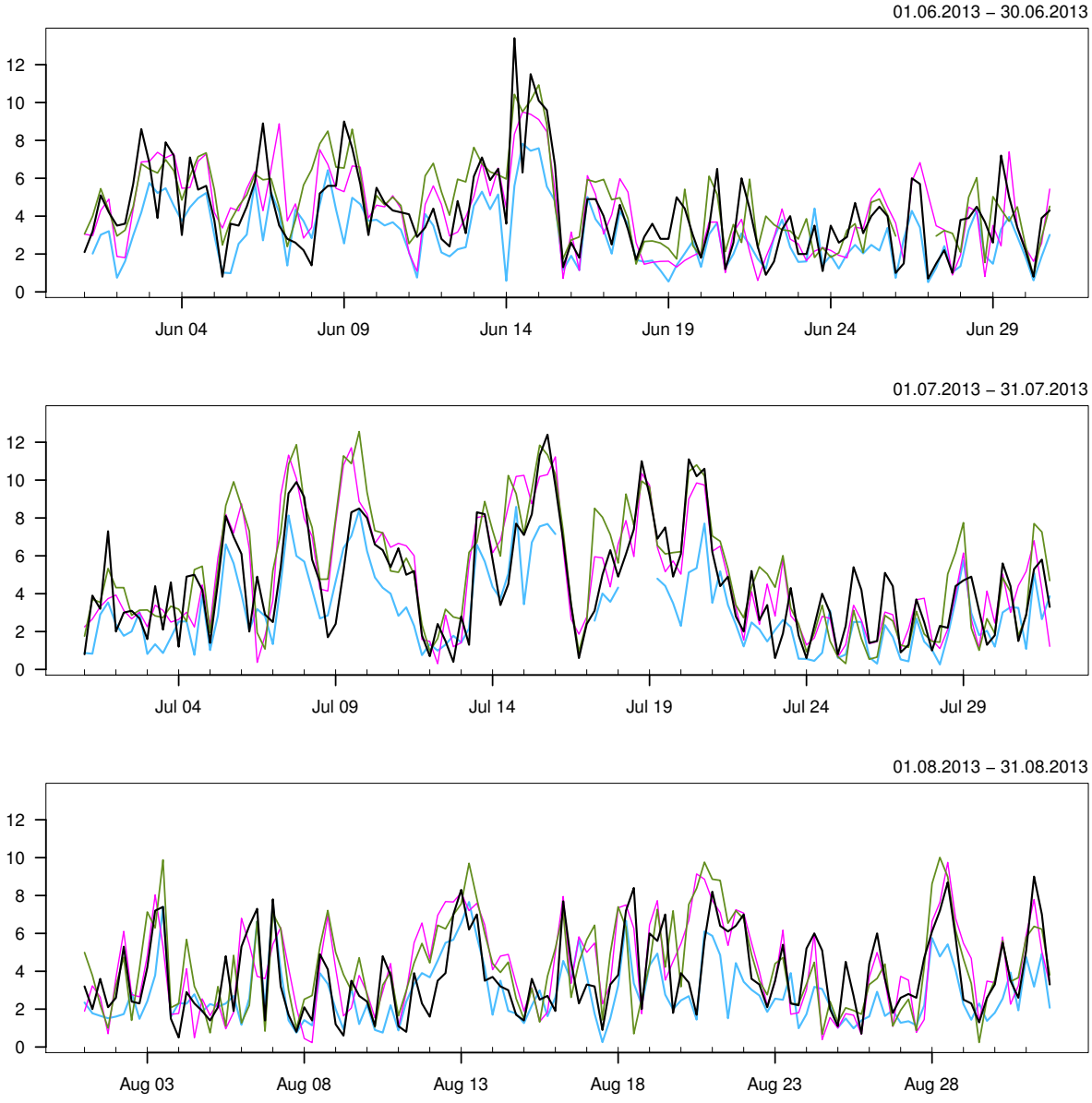


01.06.2013 – 31.08.2013

	Min	Mean	Max	Std	N
synop: 00,06,12,18	0.3	2.5	10.2	1.5	368
AROME_Norway: 12+18,+24,+30,+36	0.1	2.8	9.9	1.8	359
Hirlam8: 12+18,+24,+30,+36	0.3	3.5	10.2	1.8	368
ECMWF: 12+18,+24,+30,+36	0.2	2.5	6.9	1.3	364

	ME	SDE	RMSE	MAE	Max.abs.err.	N
AROME_Norway – synop	0.3	1.5	1.5	1.2	5.6	359
Hirlam8 – synop	1	1.6	1.9	1.5	5.2	368
ECMWF – synop	0	1.4	1.4	1.1	4.2	364

ØRLAND



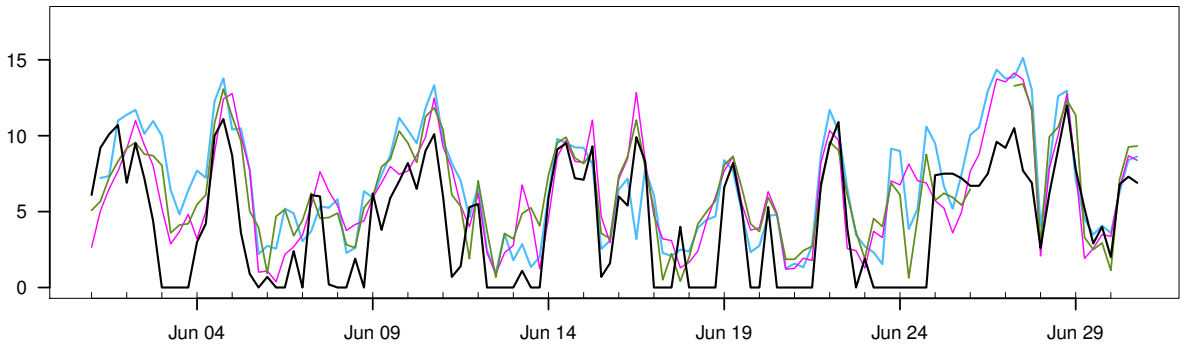
01.06.2013 – 31.08.2013

	Min	Mean	Max	Std	N
synop: 00,06,12,18	0.4	4.2	13.4	2.4	368
AROME_Norway: 12+18,+24,+30,+36	0.3	3	8.6	1.8	359
Hirlam8: 12+18,+24,+30,+36	0.2	4.4	11.7	2.5	368
ECMWF: 12+18,+24,+30,+36	0.2	4.7	12.6	2.6	364

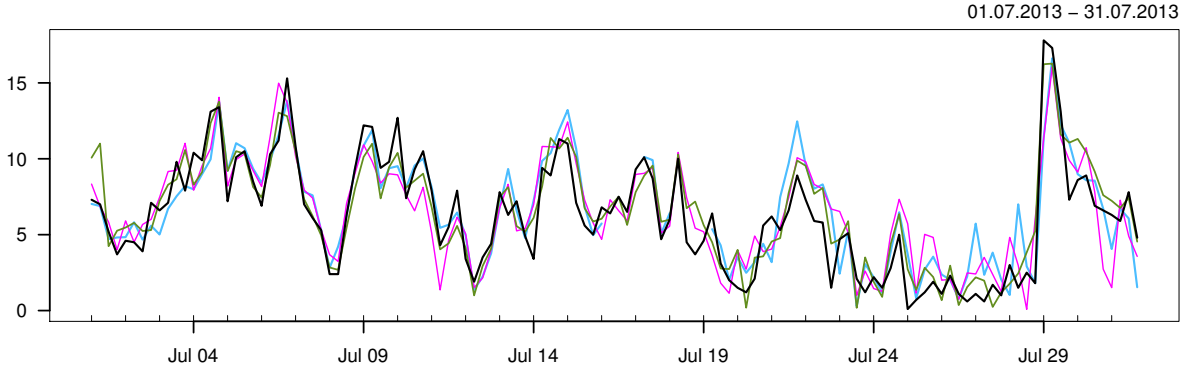
	ME	SDE	RMSE	MAE	Max.abs.err.	N
AROME_Norway – synop	−1.1	1.6	1.9	1.5	7.8	359
Hirlam8 – synop	0.2	1.8	1.8	1.4	7.4	368
ECMWF – synop	0.5	1.8	1.9	1.4	7.7	364

YTTERØYANE FYR

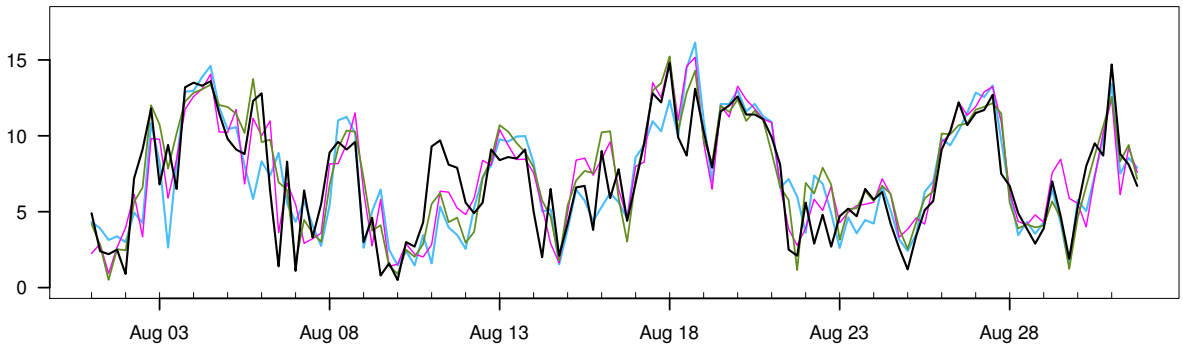
01.06.2013 – 30.06.2013



01.07.2013 – 31.07.2013



01.08.2013 – 31.08.2013



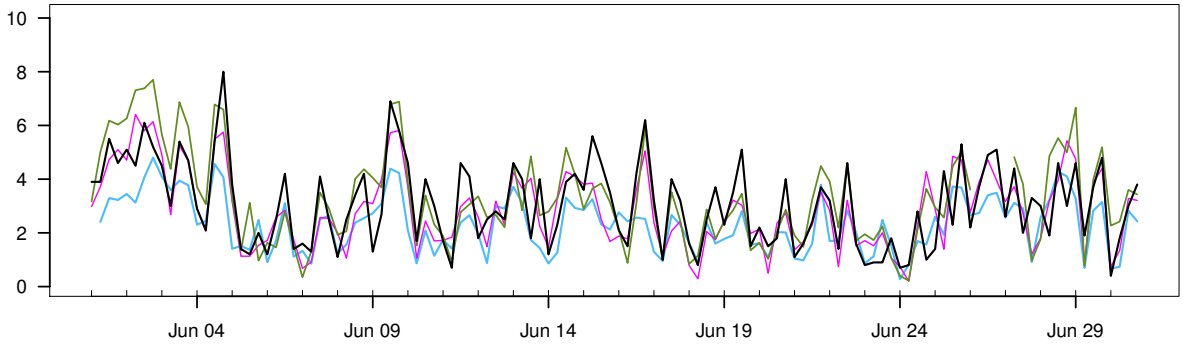
01.06.2013 – 31.08.2013

	Min	Mean	Max	Std	N
synop: 00,06,12,18	0	5.9	17.8	3.9	368
AROME_Norway: 12+18,+24,+30,+36	0.3	6.8	16.6	3.5	359
Hirlam8: 12+18,+24,+30,+36	0.1	6.7	16	3.4	368
ECMWF: 12+18,+24,+30,+36	0.2	6.8	16.3	3.4	364

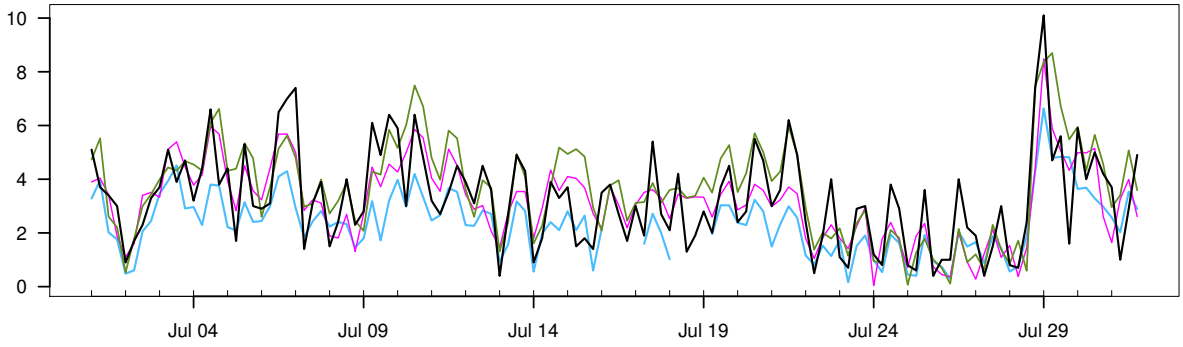
	ME	SDE	RMSE	MAE	Max.abs.err.	N
AROME_Norway – synop	0.9	2.6	2.7	2	10.6	359
Hirlam8 – synop	0.8	2.4	2.5	1.9	8.1	368
ECMWF – synop	0.9	2.1	2.3	1.8	8.8	364

BERGEN – FLORIDA

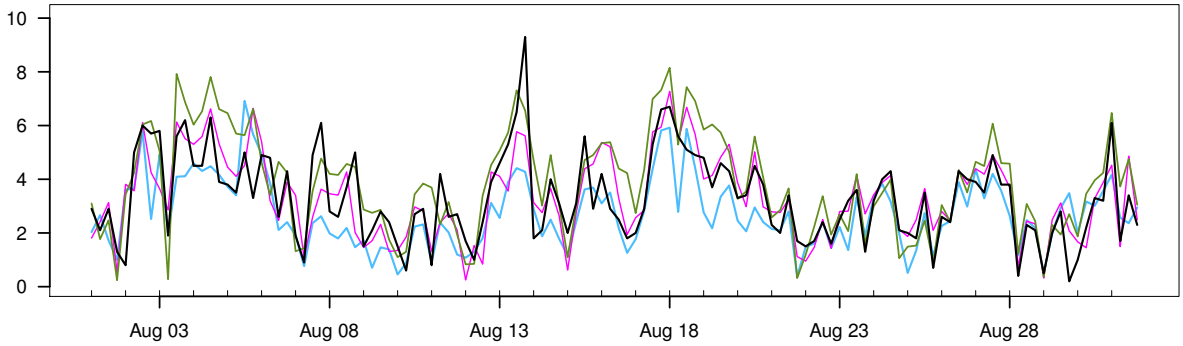
01.06.2013 – 30.06.2013



01.07.2013 – 31.07.2013



01.08.2013 – 31.08.2013



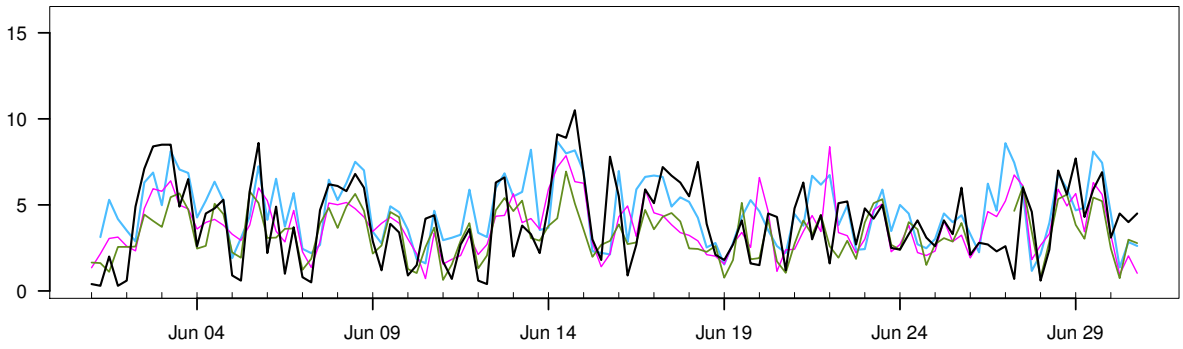
01.06.2013 – 31.08.2013

	Min	Mean	Max	Std	N
synop: 00,06,12,18	0.2	3.2	10.1	1.7	368
AROME_Norway: 12+18,+24,+30,+36	0.2	2.5	6.9	1.2	359
Hirlam8: 12+18,+24,+30,+36	0	3.1	8.5	1.5	368
ECMWF: 12+18,+24,+30,+36	0.1	3.6	8.7	1.8	364

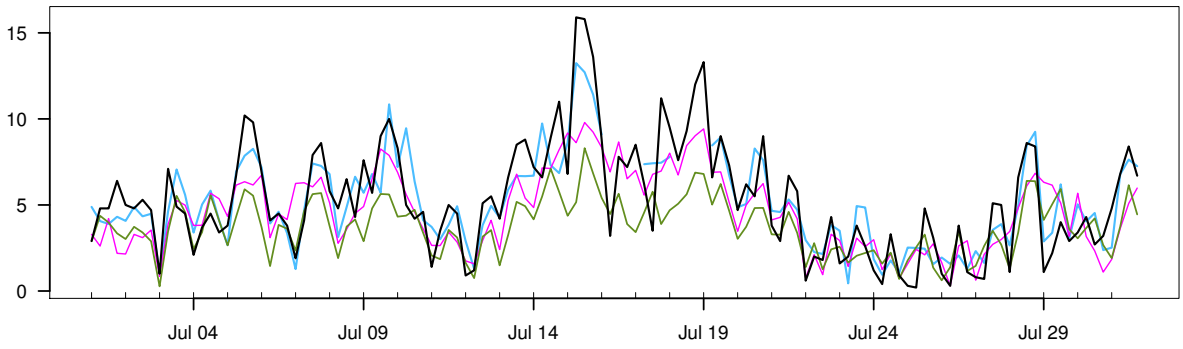
	ME	SDE	RMSE	MAE	Max.abs.err.	N
AROME_Norway – synop	−0.8	1.1	1.4	1	5	359
Hirlam8 – synop	−0.1	1.1	1.1	0.8	3.7	368
ECMWF – synop	0.4	1.2	1.2	1	4	364

FINSEVATN

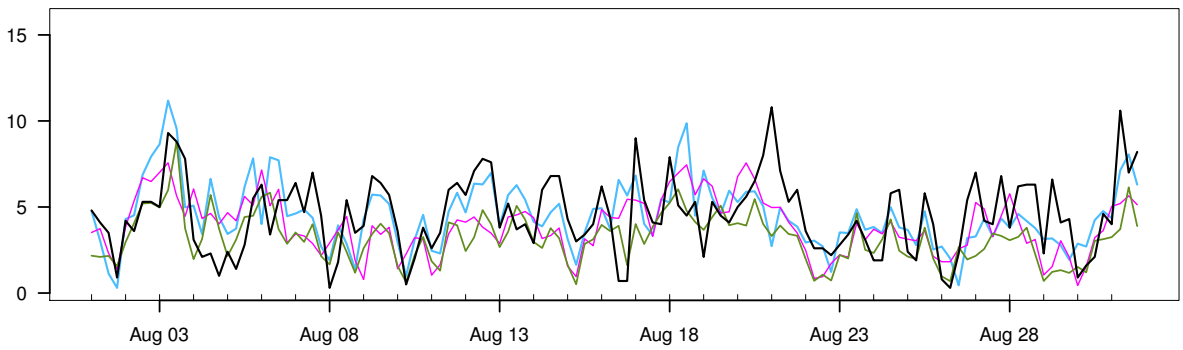
01.06.2013 – 30.06.2013



01.07.2013 – 31.07.2013



01.08.2013 – 31.08.2013



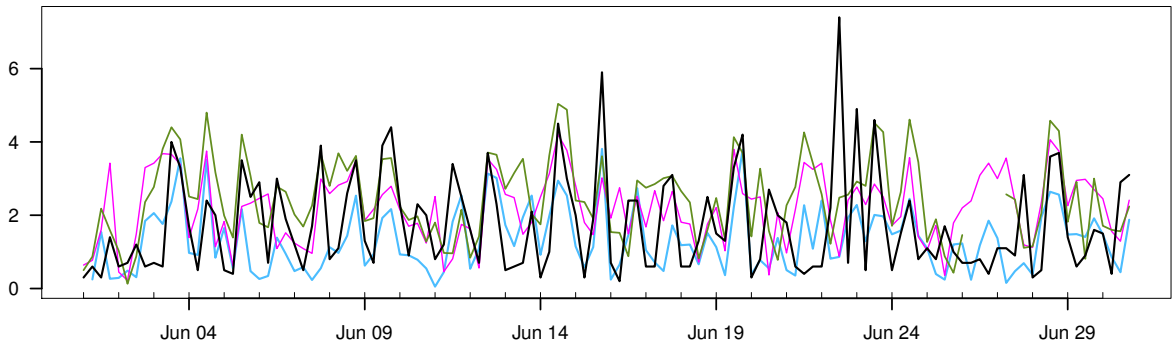
01.06.2013 – 31.08.2013

	Min	Mean	Max	Std	N
synop: 00,06,12,18	0.2	4.6	15.9	2.7	368
AROME_Norway: 12+18,+24,+30,+36	0.3	4.7	13.2	2.2	359
Hirlam8: 12+18,+24,+30,+36	0.3	4.1	9.8	1.9	368
ECMWF: 12+18,+24,+30,+36	0.3	3.4	8.8	1.5	364

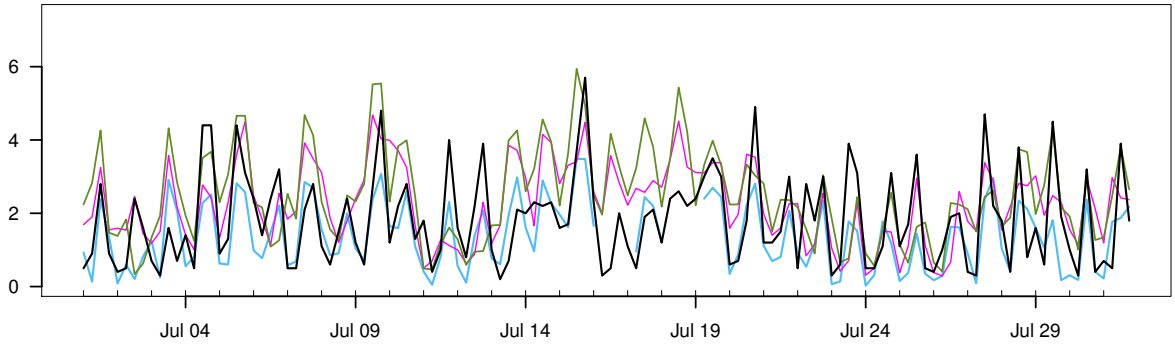
	ME	SDE	RMSE	MAE	Max.abs.err.	N
AROME_Norway – synop	0.2	2	2	1.5	8.1	359
Hirlam8 – synop	–0.5	2.1	2.1	1.7	7.3	368
ECMWF – synop	–1.2	2	2.4	1.8	10.7	364

NESBYEN

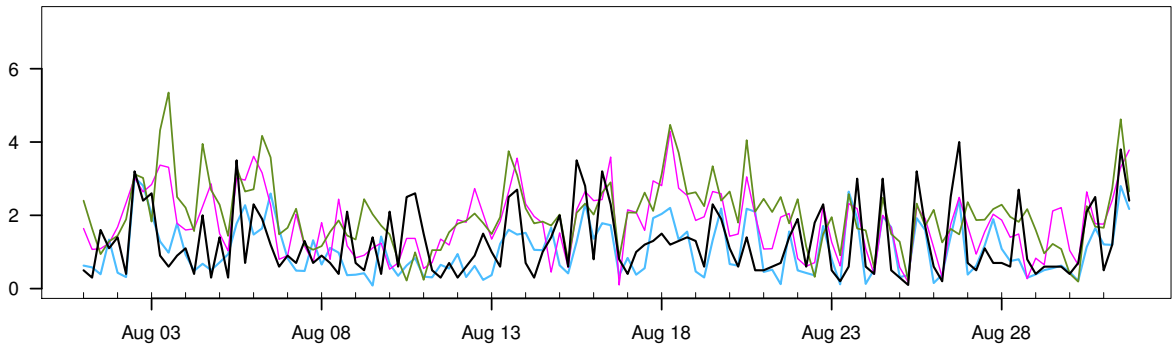
01.06.2013 – 30.06.2013



01.07.2013 – 31.07.2013



01.08.2013 – 31.08.2013



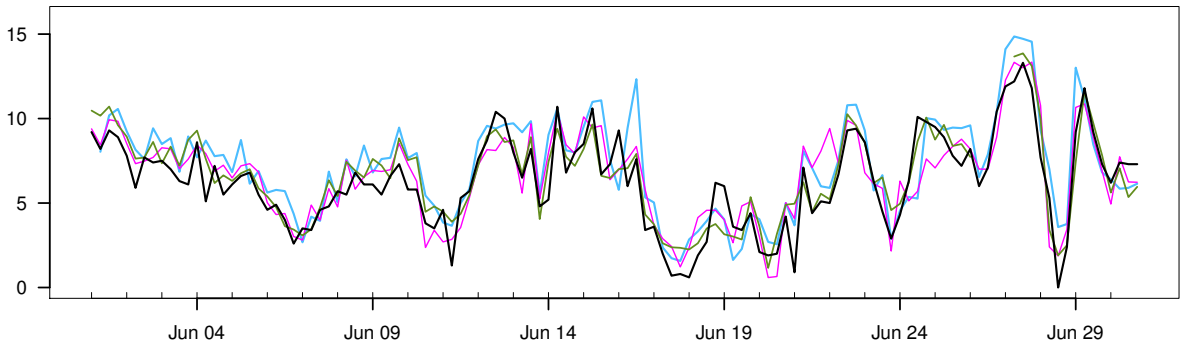
01.06.2013 – 31.08.2013

	Min	Mean	Max	Std	N
synop: 00,06,12,18	0.1	1.6	7.4	1.2	368
AROME_Norway: 12+18,+24,+30,+36	0	1.3	3.8	0.8	359
Hirlam8: 12+18,+24,+30,+36	0.1	2.1	4.7	1	368
ECMWF: 12+18,+24,+30,+36	0.1	2.3	5.9	1.1	364

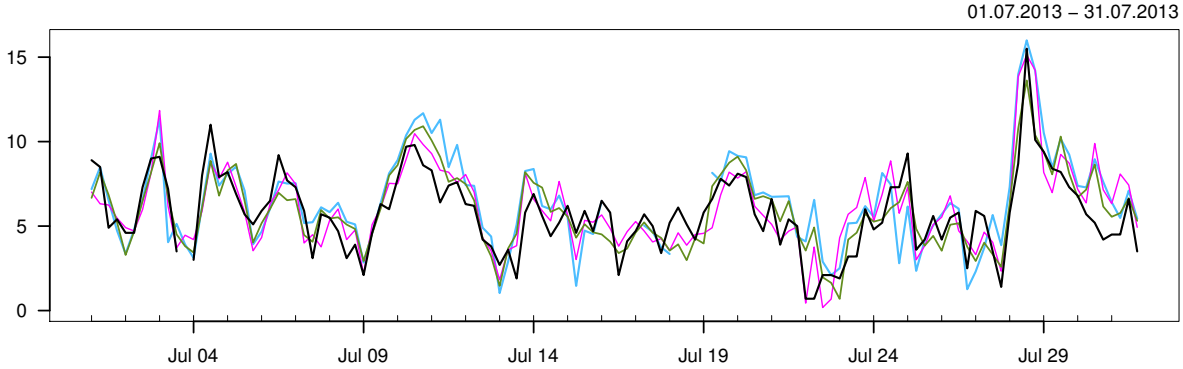
	ME	SDE	RMSE	MAE	Max.abs.err.	N
AROME_Norway – synop	–0.4	1	1.1	0.8	6.5	359
Hirlam8 – synop	0.5	1.2	1.3	1	6.5	368
ECMWF – synop	0.7	1.3	1.4	1.2	4.9	364

EKOFISK

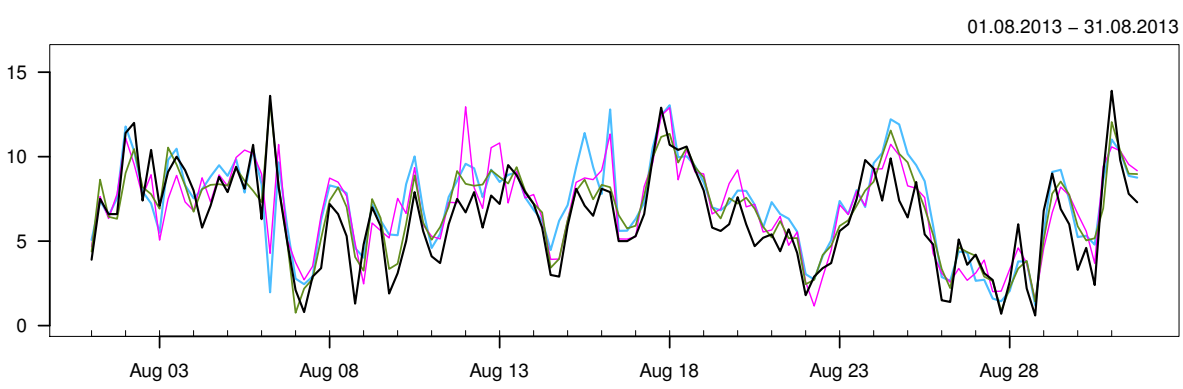
01.06.2013 – 30.06.2013



01.07.2013 – 31.07.2013



01.08.2013 – 31.08.2013

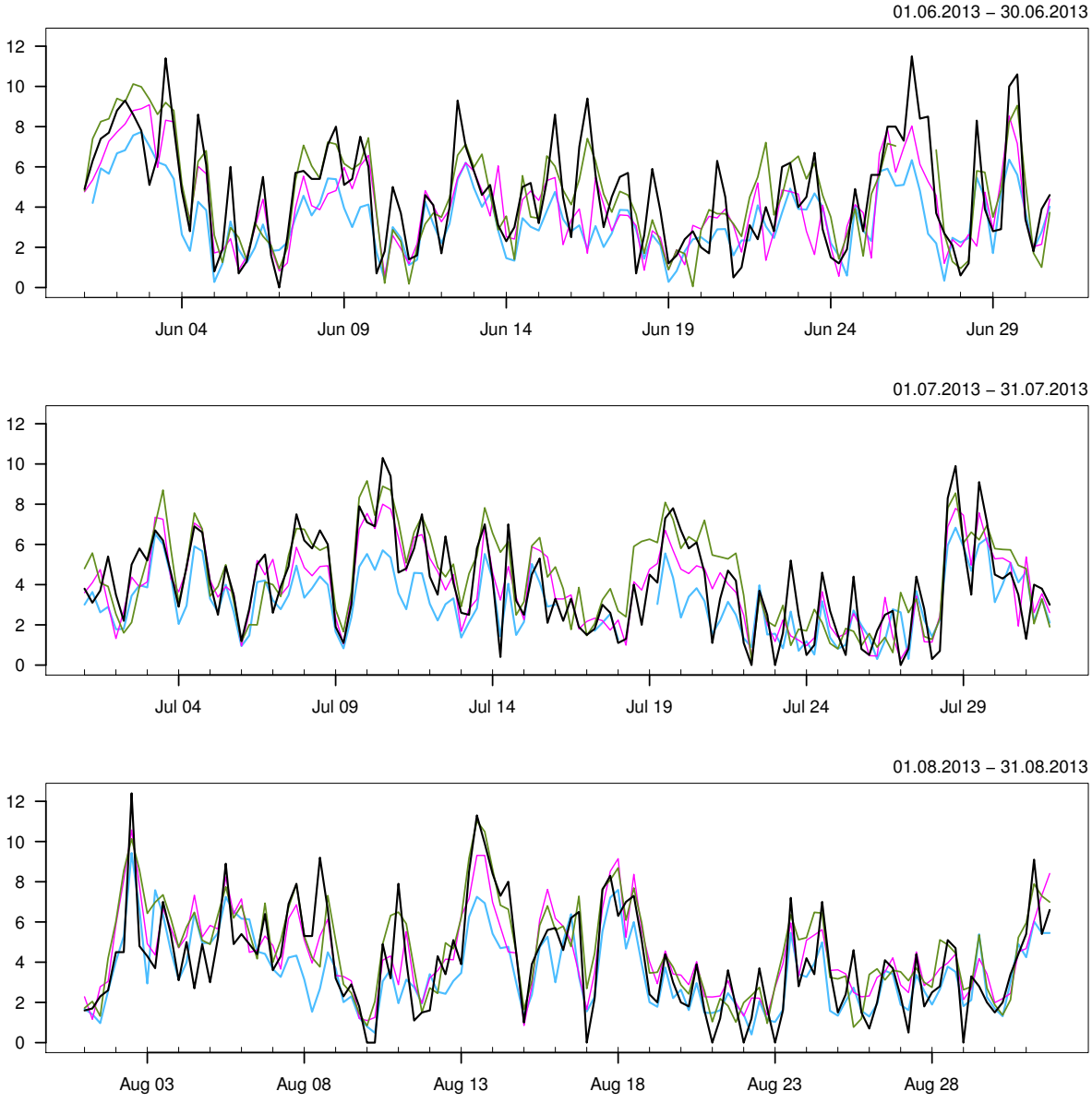


01.06.2013 – 31.08.2013

	Min	Mean	Max	Std	N
synop: 00,06,12,18	0	6.1	15.5	2.6	367
AROME_Norway: 12+18,+24,+30,+36	1	7	16	2.8	359
Hirlam8: 12+18,+24,+30,+36	0.2	6.5	15.1	2.6	368
ECMWF: 12+18,+24,+30,+36	0.7	6.5	13.9	2.5	364

	ME	SDE	RMSE	MAE	Max.abs.err.	N
AROME_Norway – synop	0.8	1.7	1.9	1.4	11.6	358
Hirlam8 – synop	0.4	1.6	1.6	1.3	9.3	367
ECMWF – synop	0.4	1.2	1.3	1	4.2	363

SOLA



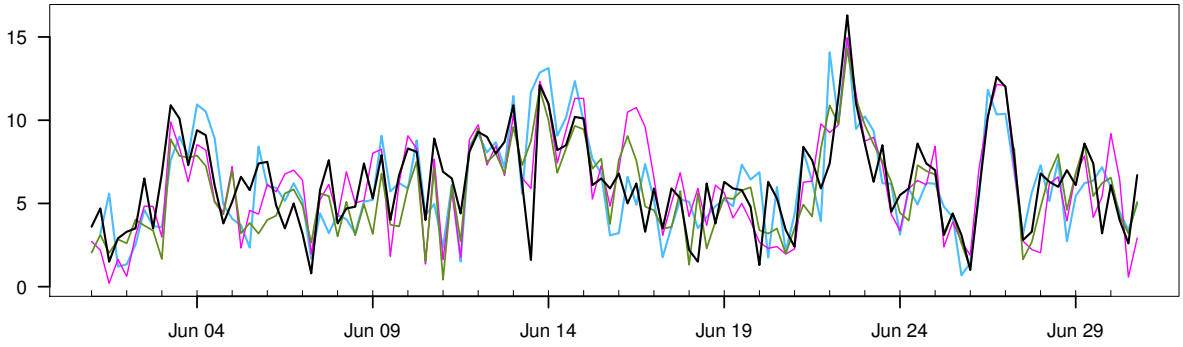
01.06.2013 – 31.08.2013

	Min	Mean	Max	Std	N
synop: 00,06,12,18	0	4.3	12.4	2.5	368
AROME_Norway: 12+18,+24,+30,+36	0.3	3.4	9.4	1.7	359
Hirlam8: 12+18,+24,+30,+36	0.3	4.1	10.6	2	368
ECMWF: 12+18,+24,+30,+36	0	4.6	11	2.3	364

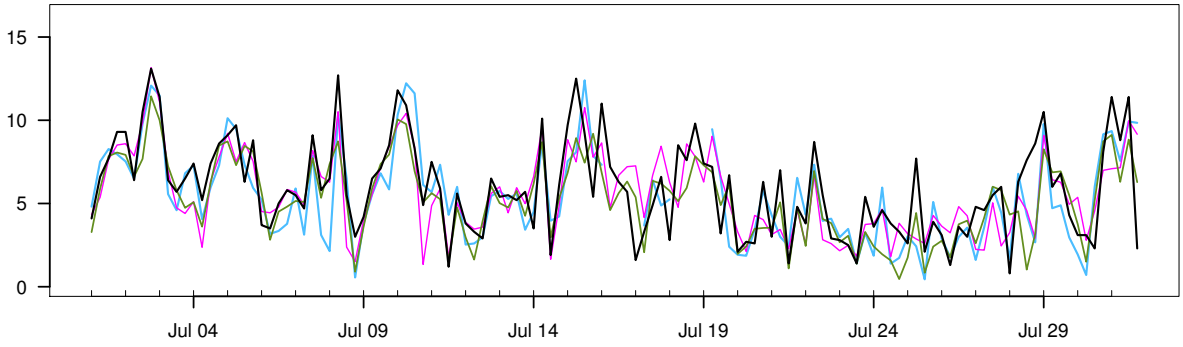
	ME	SDE	RMSE	MAE	Max.abs.err.	N
AROME_Norway – synop	–0.9	1.6	1.8	1.4	7.5	359
Hirlam8 – synop	–0.1	1.6	1.6	1.2	7.7	368
ECMWF – synop	0.4	1.5	1.6	1.3	5.4	364

FERDER FYR

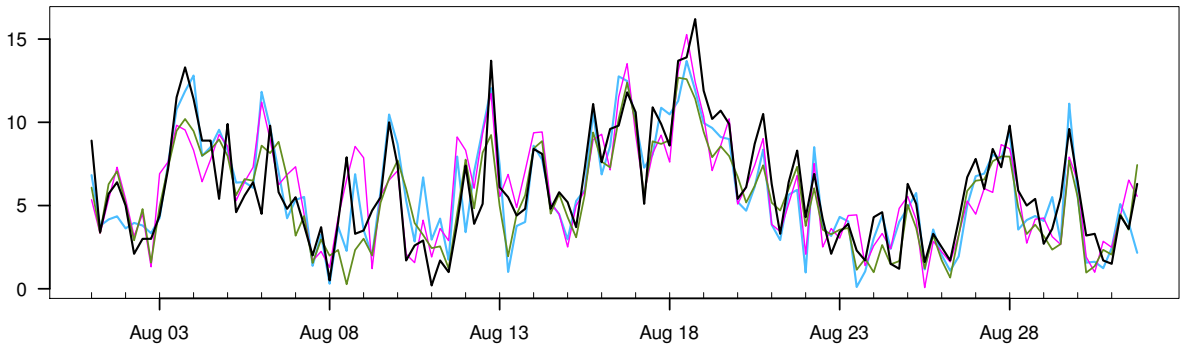
01.06.2013 – 30.06.2013



01.07.2013 – 31.07.2013



01.08.2013 – 31.08.2013

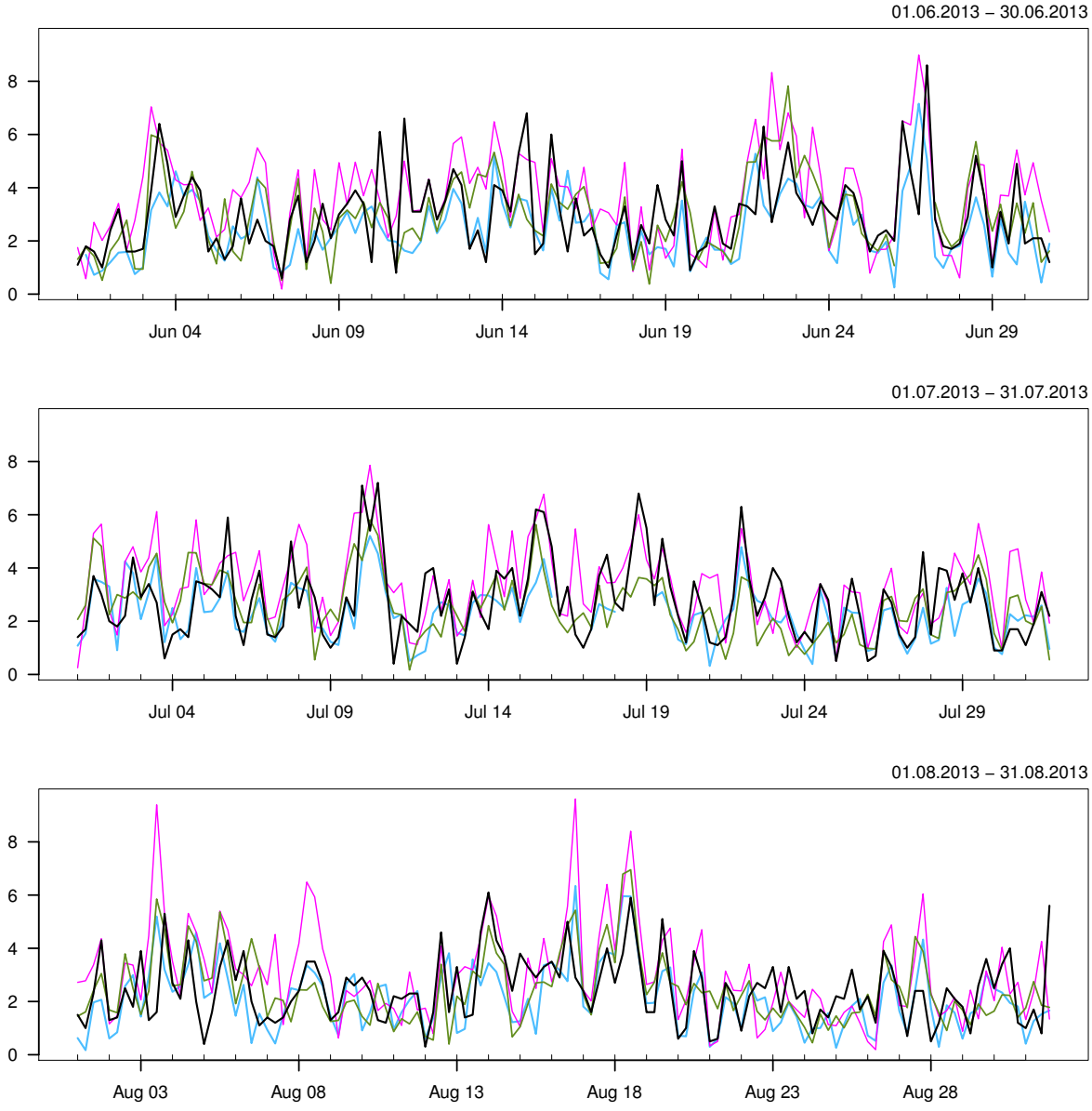


01.06.2013 – 31.08.2013

	Min	Mean	Max	Std	N
synop: 00,06,12,18	0.2	6.1	16.3	3	368
AROME_Norway: 12+18,+24,+30,+36	0.1	5.8	14.9	3	359
Hirlam8: 12+18,+24,+30,+36	0.1	5.8	15.3	2.8	368
ECMWF: 12+18,+24,+30,+36	0.3	5.4	14.3	2.6	364

	ME	SDE	RMSE	MAE	Max.abs.err.	N
AROME_Norway – synop	−0.3	2.1	2.1	1.6	10.1	359
Hirlam8 – synop	−0.2	2	2	1.5	6.9	368
ECMWF – synop	−0.6	1.8	1.9	1.4	7.6	364

OSLO – BLINDERN

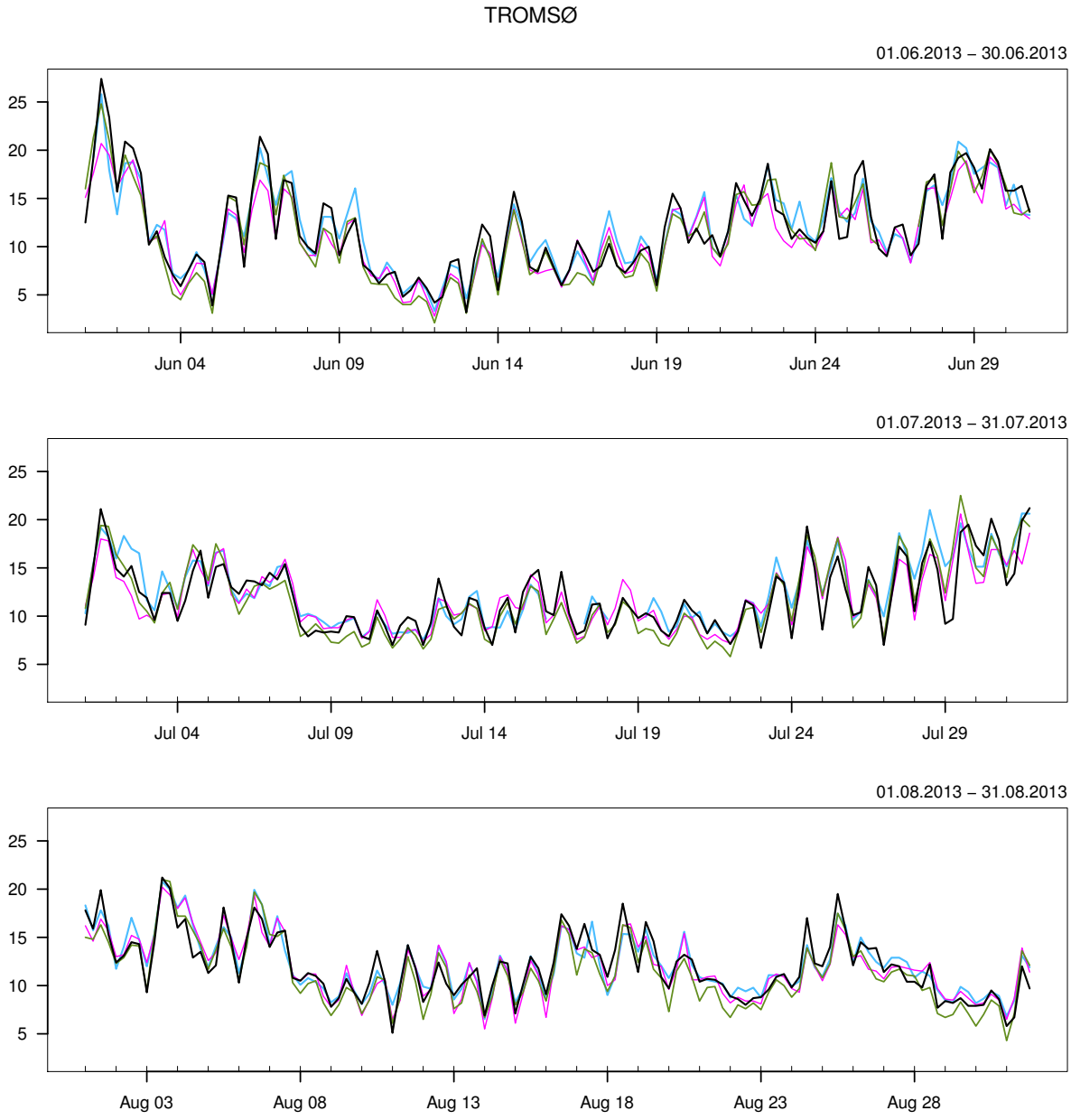


01.06.2013 – 31.08.2013

	Min	Mean	Max	Std	N
synop: 00,06,12,18	0.3	2.7	8.6	1.4	368
AROME_Norway: 12+18,+24,+30,+36	0.2	2.3	7.2	1.2	359
Hirlam8: 12+18,+24,+30,+36	0.2	3.3	9.6	1.7	368
ECMWF: 12+18,+24,+30,+36	0.2	2.6	7.8	1.3	364

	ME	SDE	RMSE	MAE	Max.abs.err.	N
AROME_Norway – synop	−0.4	1.2	1.2	0.9	5	359
Hirlam8 – synop	0.6	1.4	1.6	1.2	7.8	368
ECMWF – synop	−0.1	1.3	1.3	1	4.3	364

10.2 Temperature 2m

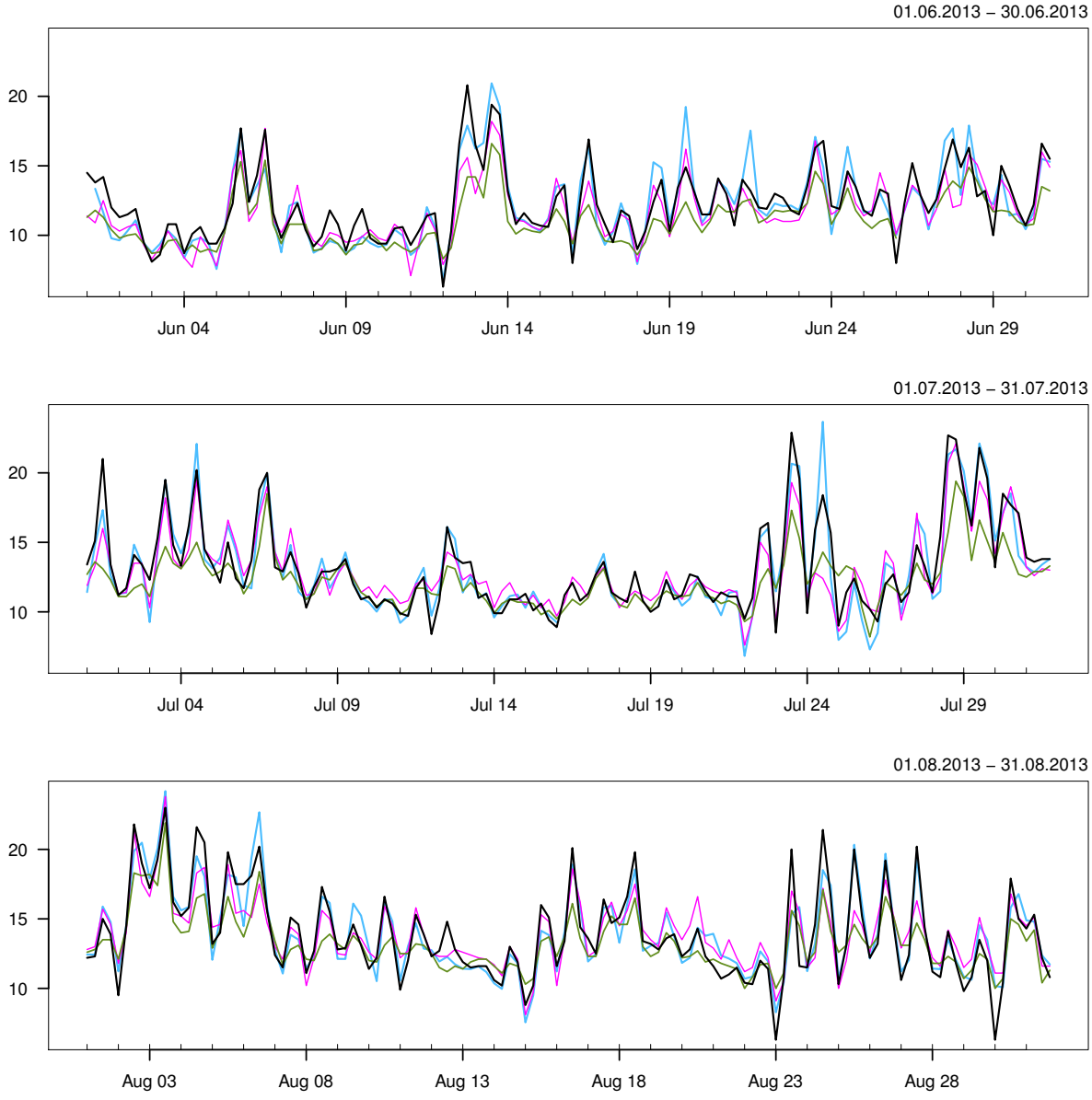


01.06.2013 – 31.08.2013

	Min	Mean	Max	Std	N
synop: 00,06,12,18	3.2	12	27.4	3.8	368
AROME_Norway: 12+18,+24,+30,+36	3.3	12.3	25.8	3.6	359
Hirlam8: 12+18,+24,+30,+36	2.8	11.7	20.7	3.4	368
ECMWF: 12+18,+24,+30,+36	2.1	11.5	24.8	4	364

	ME	SDE	RMSE	MAE	Max.abs.err.	N
AROME_Norway – synop	0.3	1.5	1.6	1.2	6.4	359
Hirlam8 – synop	−0.3	1.6	1.6	1.2	6.7	368
ECMWF – synop	−0.5	1.4	1.5	1.2	7.4	364

ØRLAND

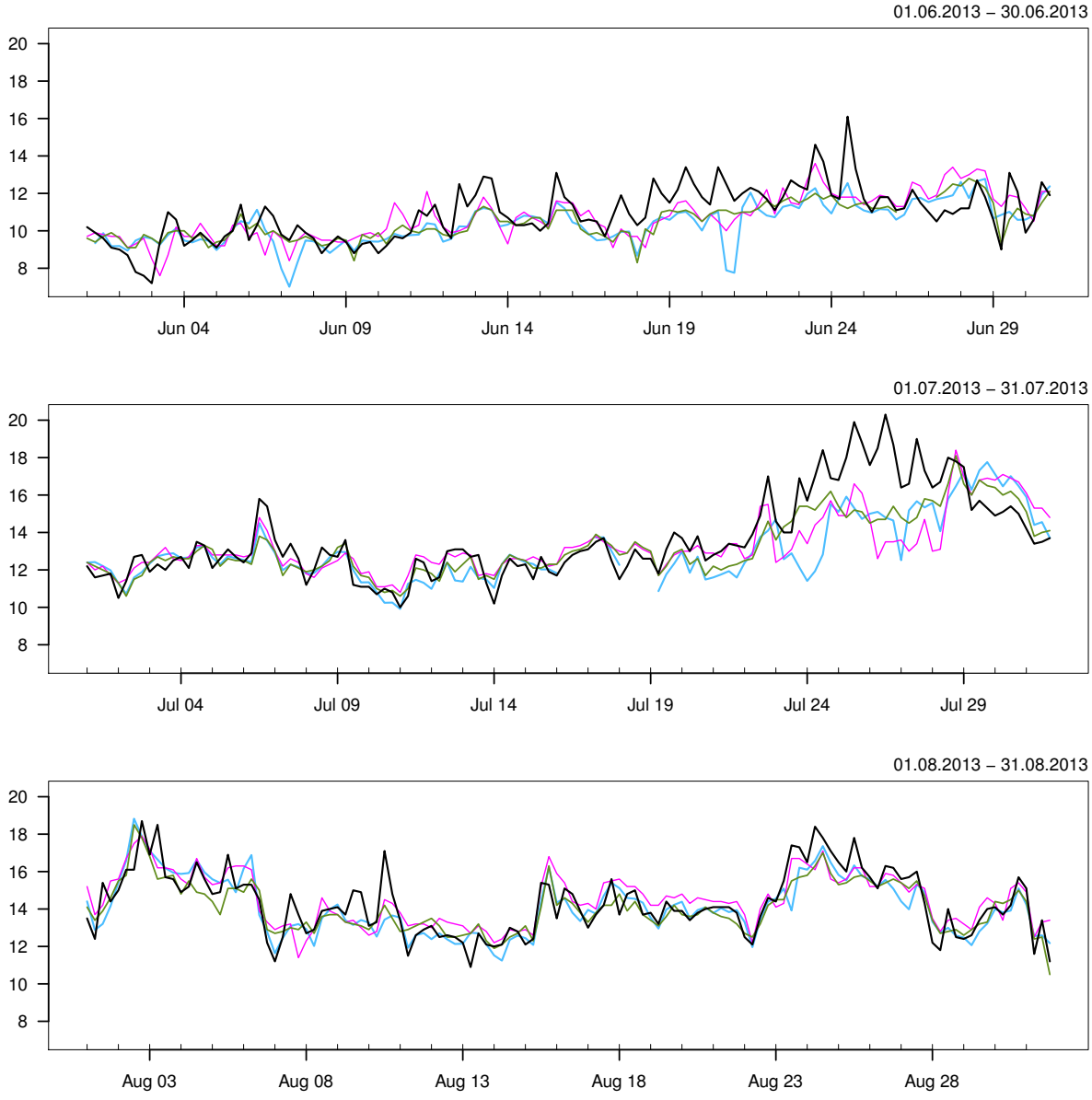


01.06.2013 – 31.08.2013

	Min	Mean	Max	Std	N
synop: 00,06,12,18	6.3	13.1	23	3.1	368
AROME_Norway: 12+18,+24,+30,+36	6.8	13.1	24.2	3.2	359
Hirlam8: 12+18,+24,+30,+36	7.1	12.9	23.8	2.6	368
ECMWF: 12+18,+24,+30,+36	8.2	12.2	21.9	2.1	364

	ME	SDE	RMSE	MAE	Max.abs.err.	N
AROME_Norway – synop	–0.1	1.3	1.3	0.9	5.3	359
Hirlam8 – synop	–0.3	1.4	1.4	1.1	6	368
ECMWF – synop	–0.9	1.7	1.9	1.4	7.9	364

YTTERØYANE FYR

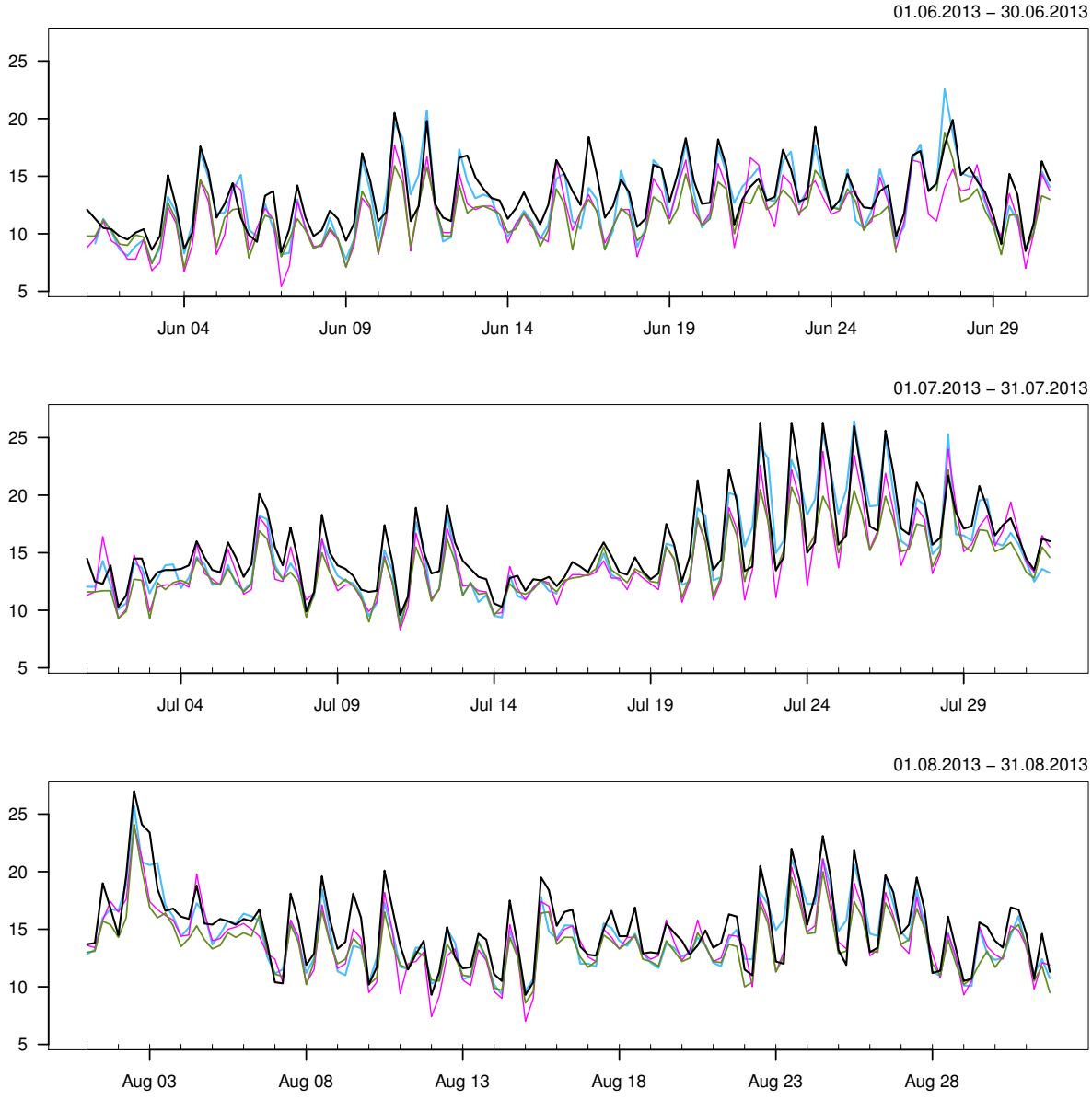


01.06.2013 – 31.08.2013

	Min	Mean	Max	Std	N
synop: 00,06,12,18	7.2	13	20.3	2.3	368
AROME_Norway: 12+18,+24,+30,+36	7	12.5	18.8	2.2	359
Hirlam8: 12+18,+24,+30,+36	7.6	12.9	18.4	2.1	368
ECMWF: 12+18,+24,+30,+36	8.3	12.6	18.5	2	364

	ME	SDE	RMSE	MAE	Max.abs.err.	N
AROME_Norway – synop	−0.5	1.2	1.3	0.9	5.6	359
Hirlam8 – synop	−0.1	1.3	1.3	0.9	6.8	368
ECMWF – synop	−0.4	1.1	1.1	0.8	5.6	364

BERGEN – FLORIDA

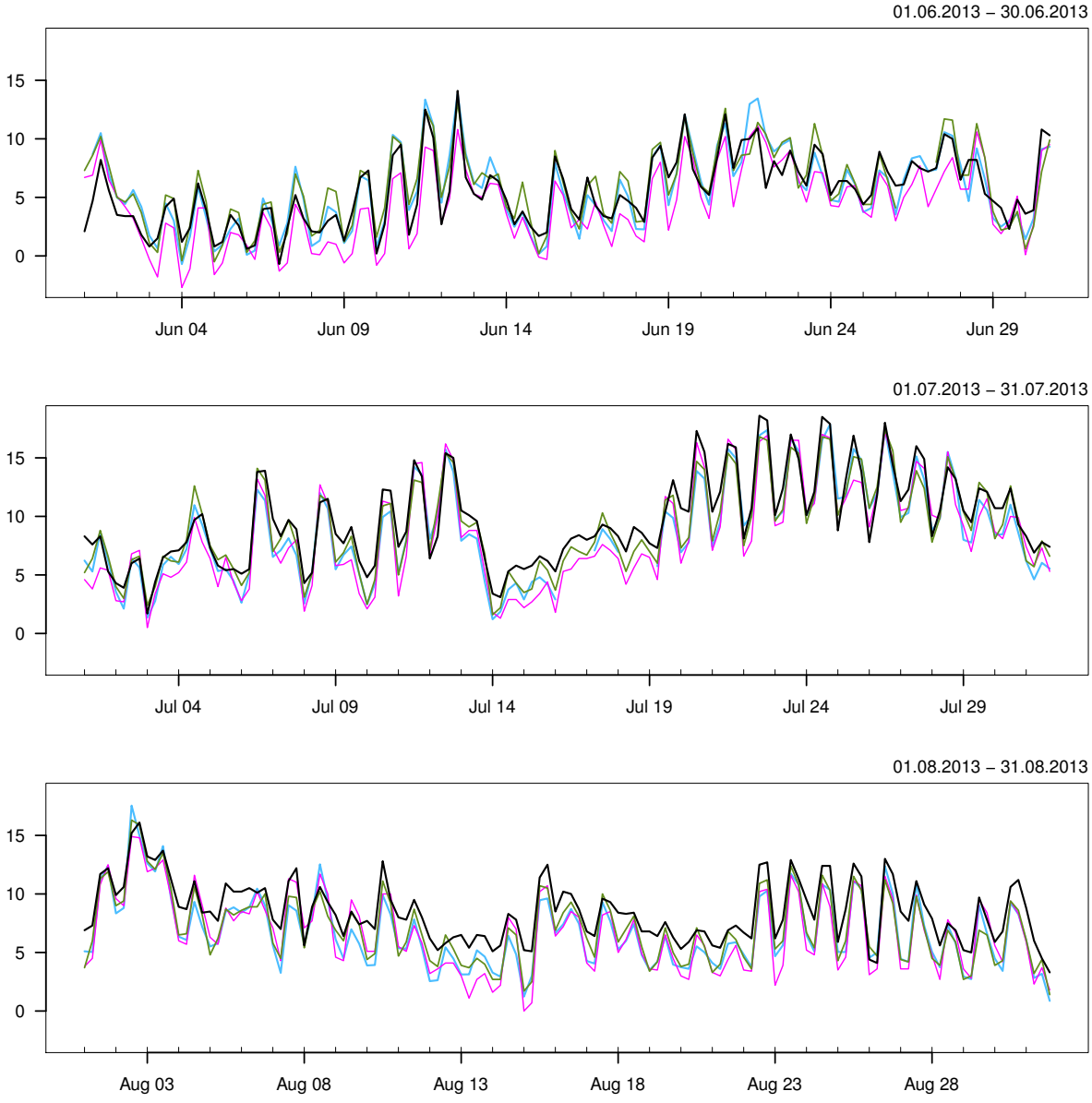


01.06.2013 – 31.08.2013

	Min	Mean	Max	Std	N
synop: 00,06,12,18	8.4	14.7	27	3.3	368
AROME_Norway: 12+18,+24,+30,+36	7.5	14	26.4	3.4	359
Hirlam8: 12+18,+24,+30,+36	5.4	13.3	24	3.1	368
ECMWF: 12+18,+24,+30,+36	7	13	24.1	2.7	364

	ME	SDE	RMSE	MAE	Max.abs.err.	N
AROME_Norway – synop	−0.6	1.4	1.5	1.3	4.9	359
Hirlam8 – synop	−1.3	1.3	1.8	1.6	6	368
ECMWF – synop	−1.6	1.3	2.1	1.7	6.5	364

FINSEVATN



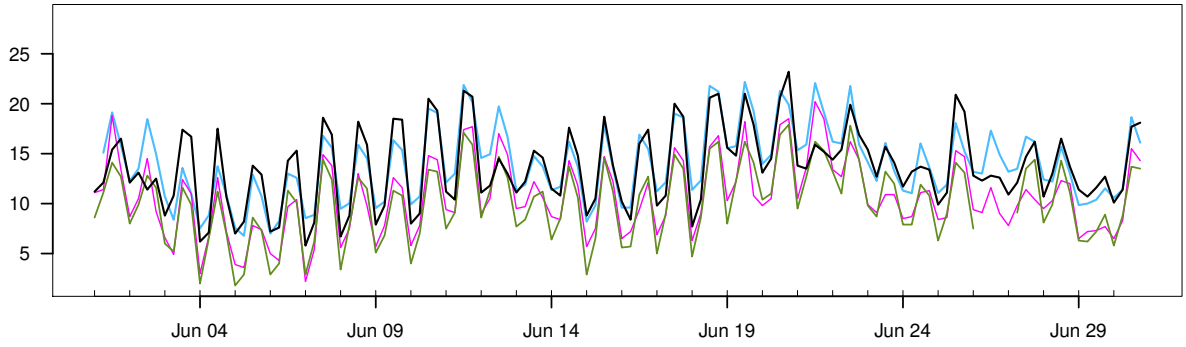
01.06.2013 – 31.08.2013

	Min	Mean	Max	Std	N
synop: 00,06,12,18	−0.7	7.9	18.6	3.6	368
AROME_Norway: 12+18,+24,+30,+36	−0.7	7	17.9	3.7	359
Hirlam8: 12+18,+24,+30,+36	−2.7	6.4	17.2	4	368
ECMWF: 12+18,+24,+30,+36	−0.5	7.4	17.4	3.6	364

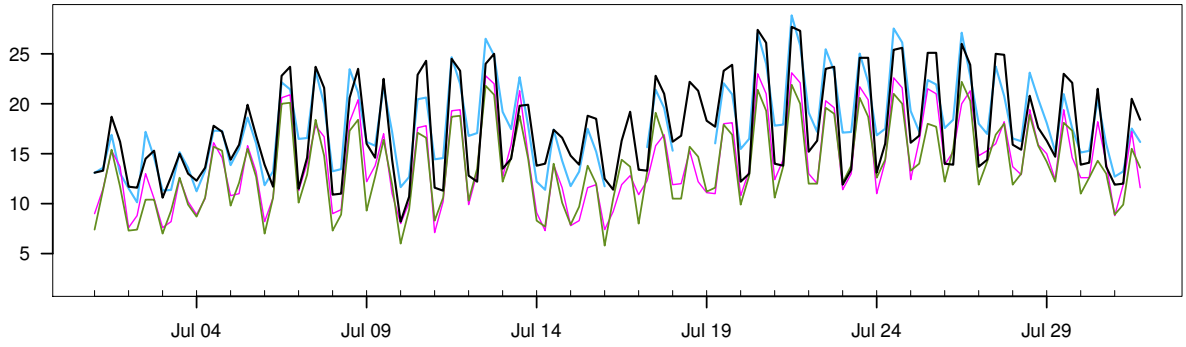
	ME	SDE	RMSE	MAE	Max.abs.err.	N
AROME_Norway – synop	−0.9	1.5	1.8	1.5	4.4	359
Hirlam8 – synop	−1.5	1.5	2.1	1.8	5.2	368
ECMWF – synop	−0.6	1.5	1.6	1.3	5.2	364

NESBYEN

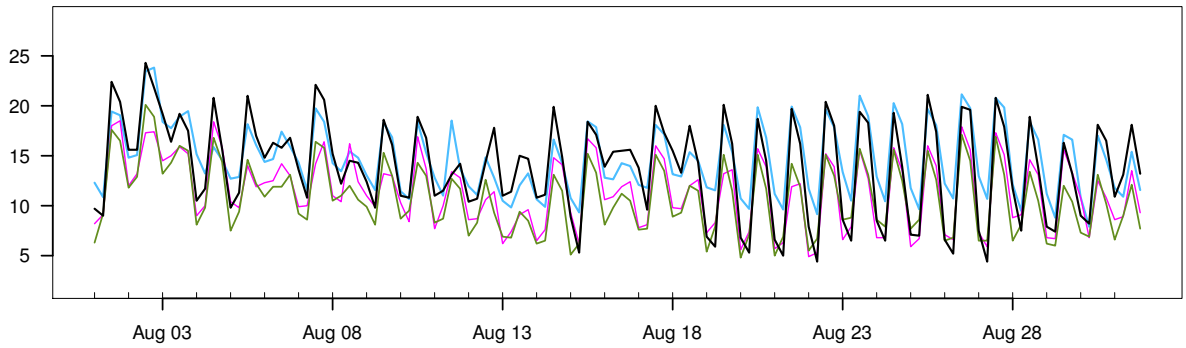
01.06.2013 – 30.06.2013



01.07.2013 – 31.07.2013



01.08.2013 – 31.08.2013

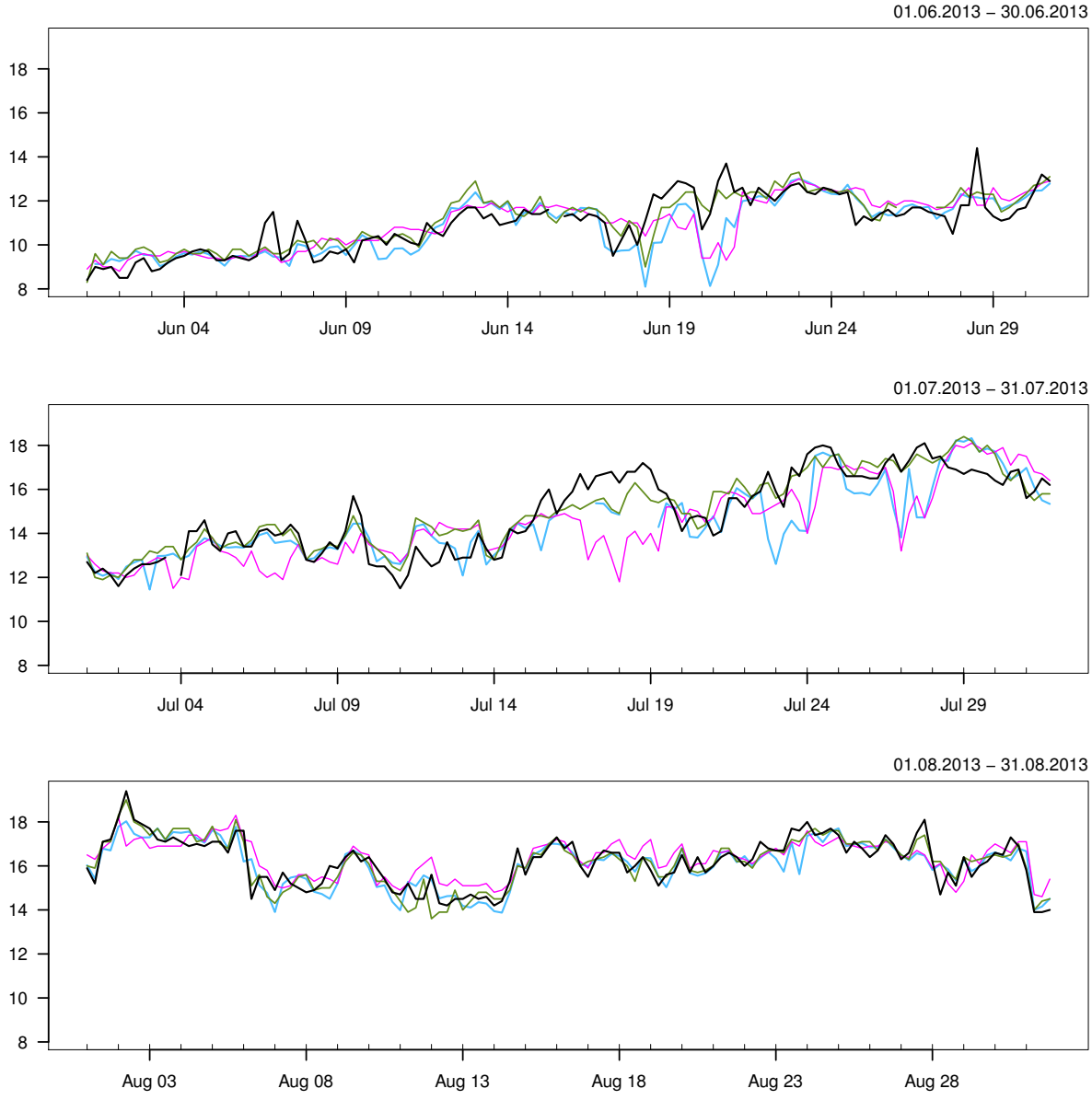


01.06.2013 – 31.08.2013

	Min	Mean	Max	Std	N
synop: 00,06,12,18	4.4	15	27.7	4.9	368
AROME_Norway: 12+18,+24,+30,+36	6.8	15.5	28.8	4.2	359
Hirlam8: 12+18,+24,+30,+36	2.2	12.1	23.1	4.2	368
ECMWF: 12+18,+24,+30,+36	1.8	11.6	22.2	4.1	364

	ME	SDE	RMSE	MAE	Max.abs.err.	N
AROME_Norway – synop	0.5	2.3	2.3	1.8	7.1	359
Hirlam8 – synop	–2.9	2.2	3.7	3.2	9.1	368
ECMWF – synop	–3.5	2.1	4.1	3.6	8.5	364

EKOFISK

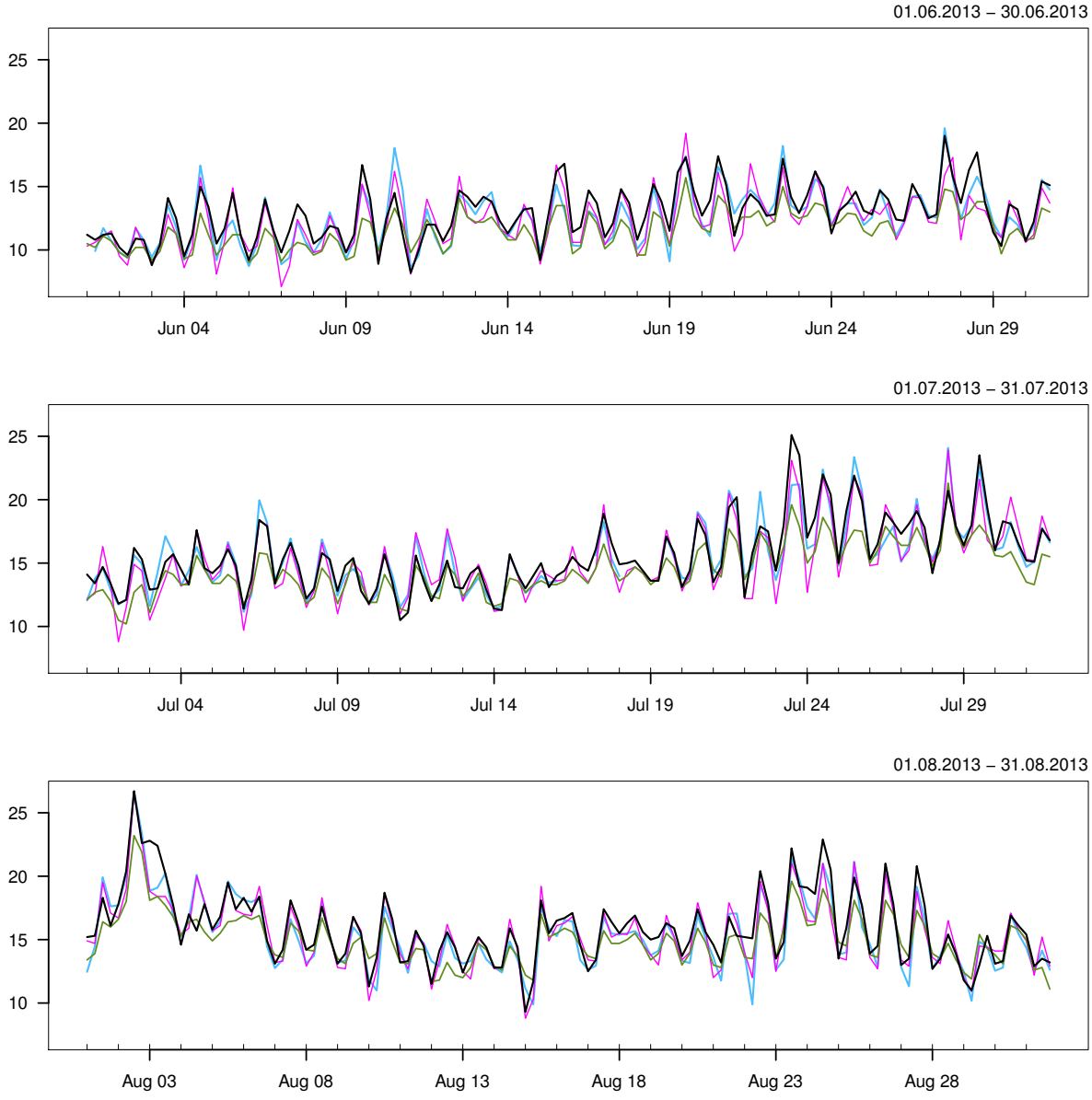


01.06.2013 – 31.08.2013

	Min	Mean	Max	Std	N
synop: 00,06,12,18	8.4	14.1	19.4	2.6	366
AROME_Norway: 12+18,+24,+30,+36	8.1	13.8	18.3	2.6	359
Hirlam8: 12+18,+24,+30,+36	8.8	14	18.3	2.6	368
ECMWF: 12+18,+24,+30,+36	8.3	14.2	19	2.5	364

	ME	SDE	RMSE	MAE	Max.abs.err.	N
AROME_Norway – synop	–0.2	0.9	0.9	0.6	3.8	357
Hirlam8 – synop	–0.1	1.1	1.1	0.7	4.5	366
ECMWF – synop	0.1	0.6	0.6	0.5	2.1	362

SOLA

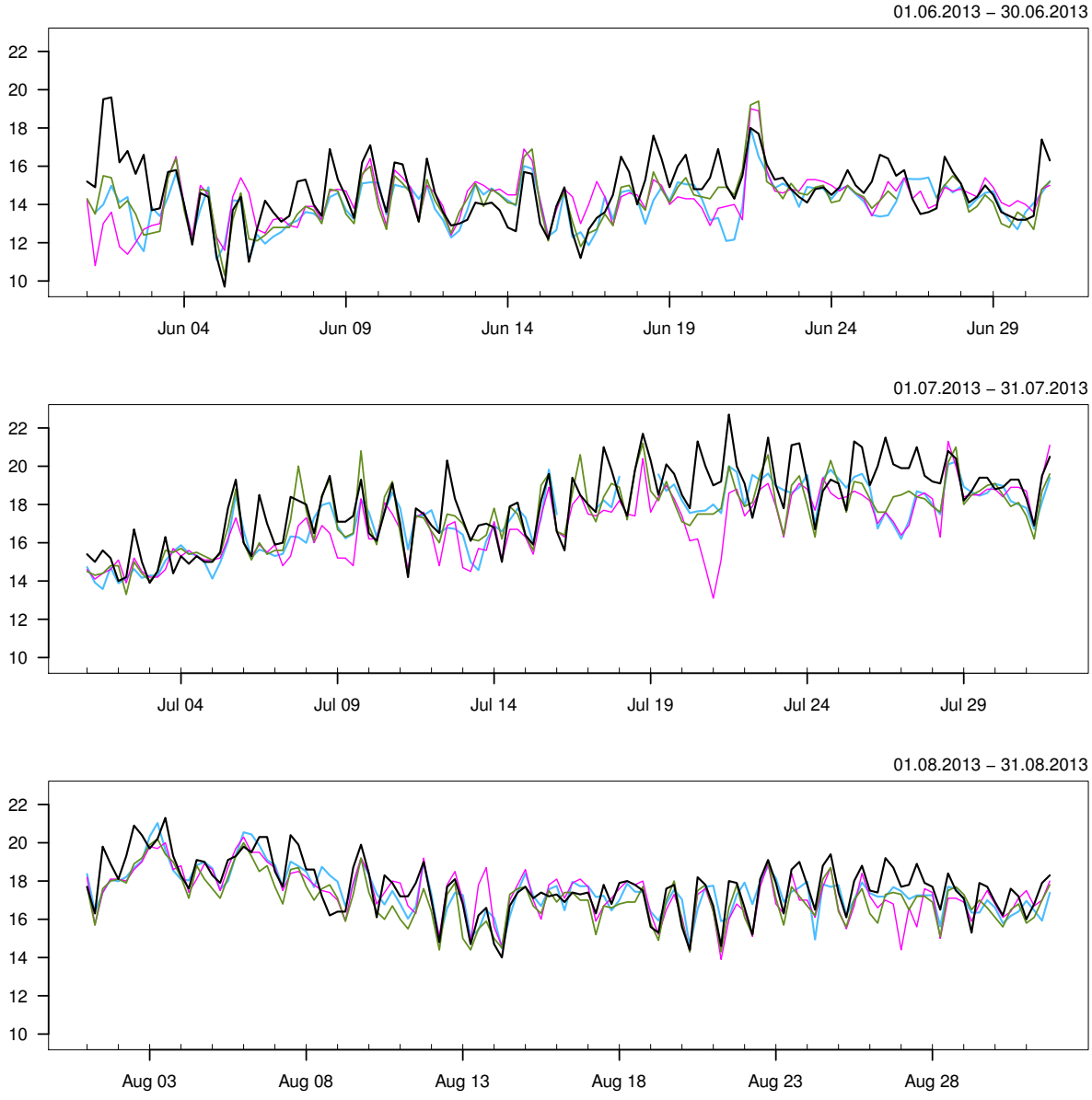


01.06.2013 – 31.08.2013

	Min	Mean	Max	Std	N
synop: 00,06,12,18	8.2	14.8	26.7	2.9	368
AROME_Norway: 12+18,+24,+30,+36	8.6	14.5	26.7	3	359
Hirlam8: 12+18,+24,+30,+36	7.1	14.4	26.6	3	368
ECMWF: 12+18,+24,+30,+36	9	13.7	23.2	2.4	364

	ME	SDE	RMSE	MAE	Max.abs.err.	N
AROME_Norway – synop	–0.3	1.1	1.2	0.9	5.2	359
Hirlam8 – synop	–0.5	1.2	1.2	0.9	4.4	368
ECMWF – synop	–1.1	1.2	1.6	1.3	5.6	364

FERDER FYR

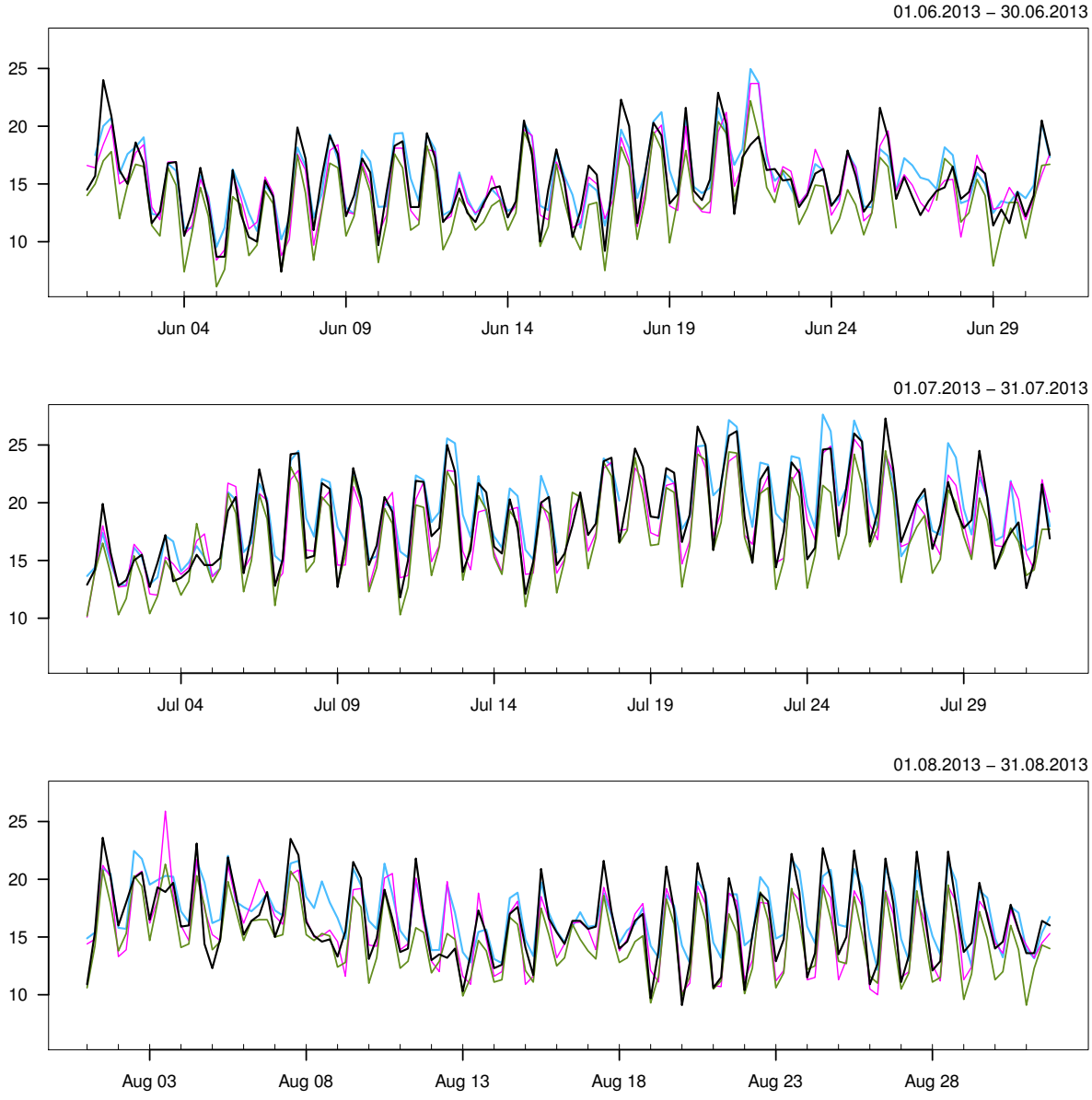


01.06.2013 – 31.08.2013

	Min	Mean	Max	Std	N
synop: 00,06,12,18	9.7	16.8	22.7	2.3	368
AROME_Norway: 12+18,+24,+30,+36	11.1	16.3	21	2.1	359
Hirlam8: 12+18,+24,+30,+36	10.8	16.2	21.3	2	368
ECMWF: 12+18,+24,+30,+36	10.3	16.3	21.2	2	364

	ME	SDE	RMSE	MAE	Max.abs.err.	N
AROME_Norway – synop	−0.5	1.2	1.3	1	5.5	359
Hirlam8 – synop	−0.6	1.4	1.5	1	6.5	368
ECMWF – synop	−0.6	0.9	1.1	0.8	4.2	364

OSLO – BLINDERN

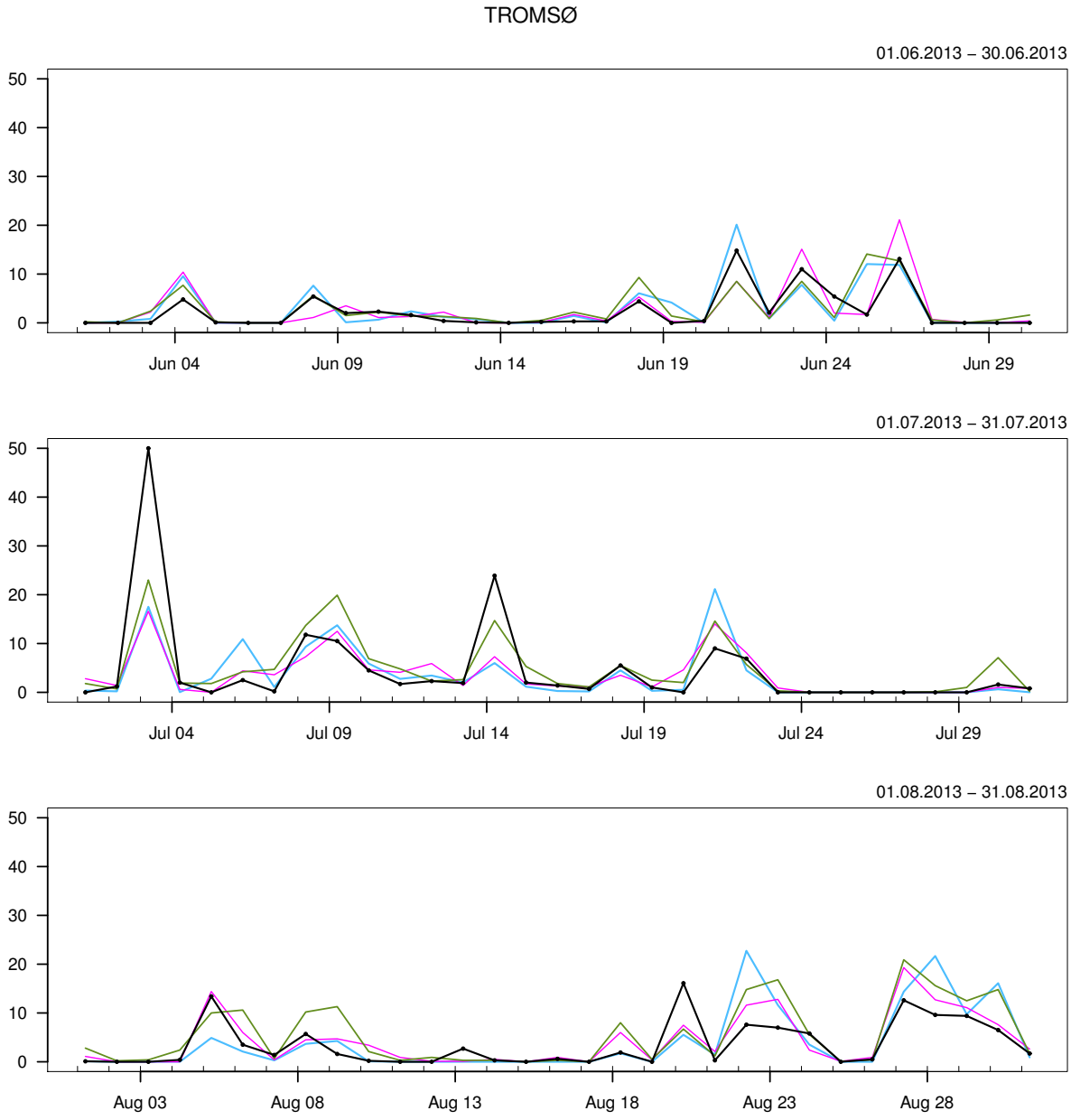


01.06.2013 – 31.08.2013

	Min	Mean	Max	Std	N
synop: 00,06,12,18	7.4	16.7	27.3	3.8	368
AROME_Norway: 12+18,+24,+30,+36	9.5	17.3	27.6	3.4	359
Hirlam8: 12+18,+24,+30,+36	8.4	16.3	25.9	3.6	368
ECMWF: 12+18,+24,+30,+36	6.1	15.2	24.5	3.6	364

	ME	SDE	RMSE	MAE	Max.abs.err.	N
AROME_Norway – synop	0.7	1.7	1.9	1.4	6.6	359
Hirlam8 – synop	−0.4	1.7	1.7	1.3	7	368
ECMWF – synop	−1.5	1.4	2	1.7	7	364

10.3 Daily precipitation



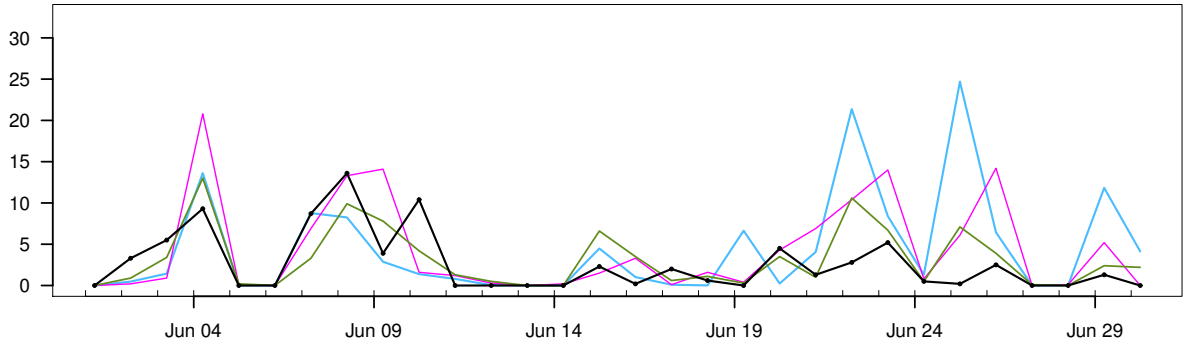
01.06.2013 – 31.08.2013

	Min	Mean	Max	Std	N
synop: 06	0	3.5	50	6.7	92
AROME_Norway: 00+30	0	3.5	22.7	5.7	92
Hirlam8: 00+30	0	3.5	21.1	4.9	92
ECMWF: 00+30	0	4.4	23	5.6	92

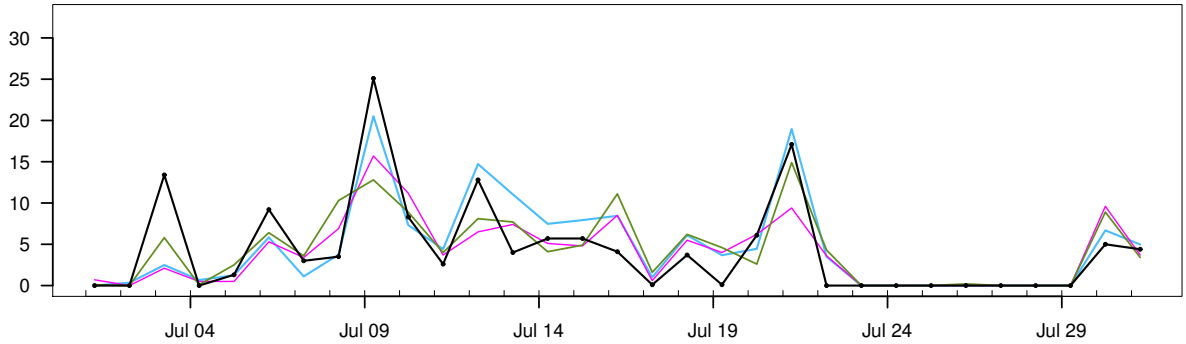
	ME	SDE	RMSE	MAE	Max.abs.err.	N
AROME_Norway – synop	0	5.3	5.3	2.4	32.5	92
Hirlam8 – synop	0	4.6	4.6	2.1	33.4	92
ECMWF – synop	1	4.5	4.6	2.5	27	92

BODØ

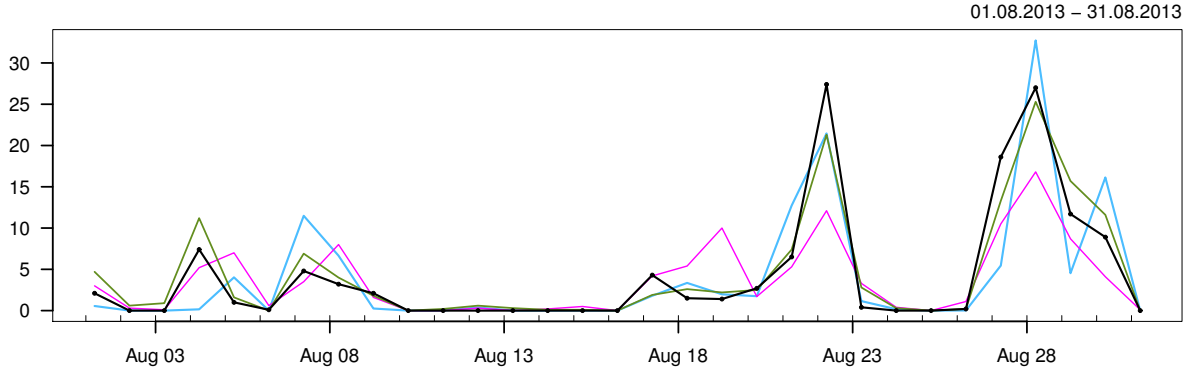
01.06.2013 – 30.06.2013



01.07.2013 – 31.07.2013



01.08.2013 – 31.08.2013

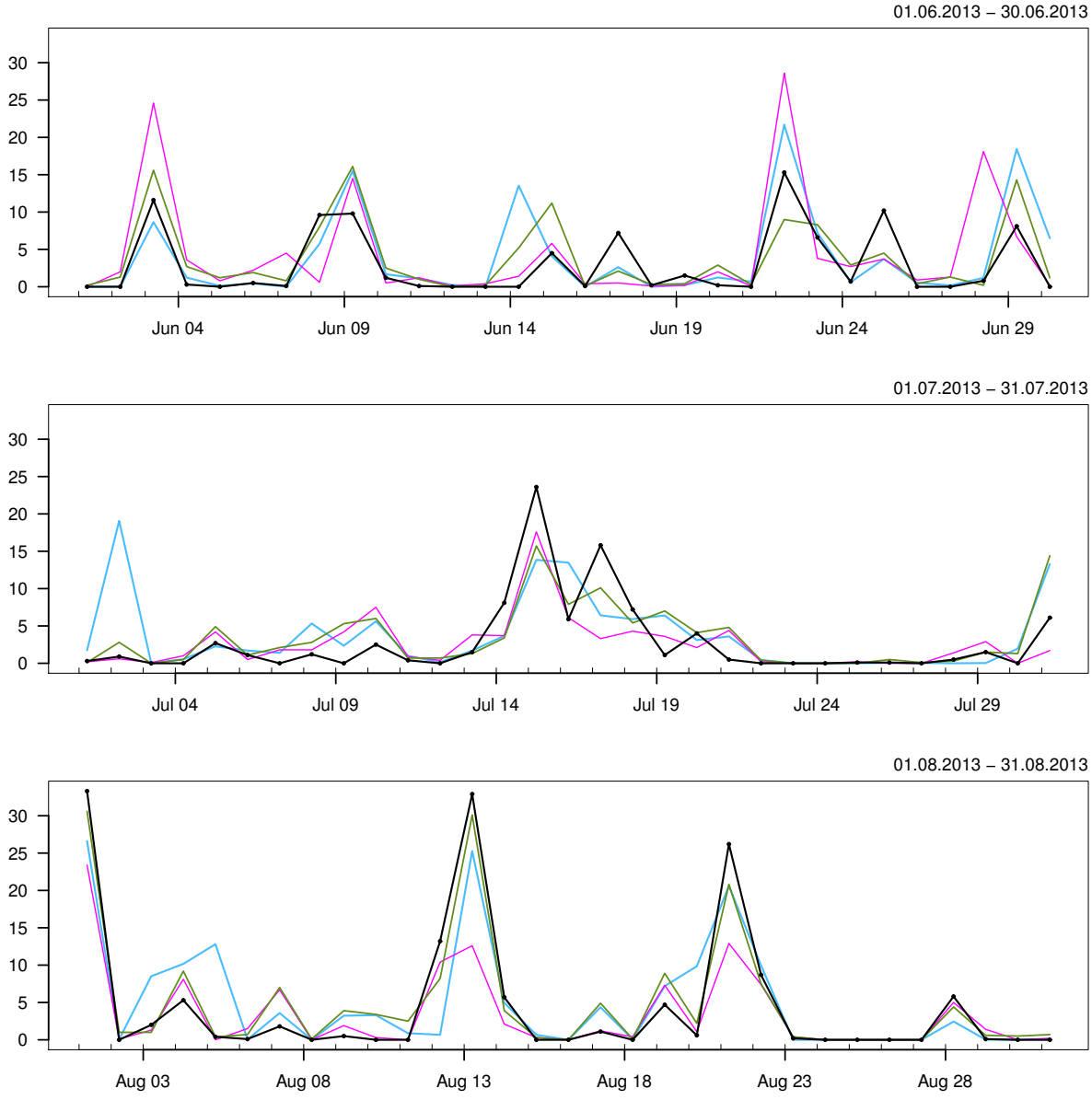


01.06.2013 – 31.08.2013

	Min	Mean	Max	Std	N
synop: 06	0	3.7	27.4	5.9	92
AROME_Norway: 00+30	0	4.4	32.7	6.4	92
Hirlam8: 00+30	0	4	20.8	4.7	92
ECMWF: 00+30	0	4	25.3	5	92

	ME	SDE	RMSE	MAE	Max.abs.err.	N
AROME_Norway – synop	0.7	4.8	4.8	2.7	24.5	92
Hirlam8 – synop	0.2	4.4	4.4	2.7	15.3	92
ECMWF – synop	0.3	3	3	1.9	12.3	92

ØRLAND

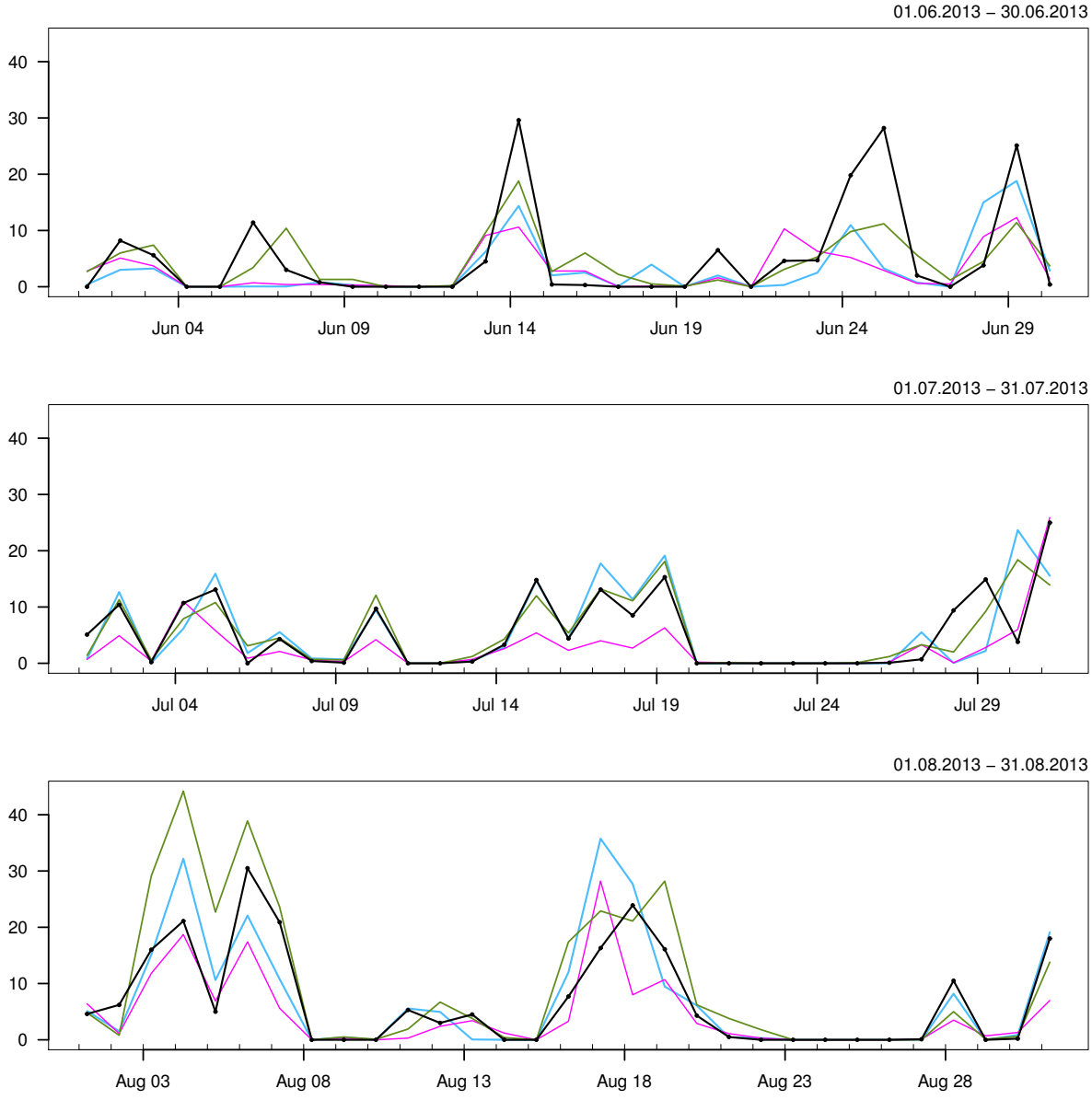


01.06.2013 – 31.08.2013

	Min	Mean	Max	Std	N
synop: 06	0	3.4	33.3	6.7	92
AROME_Norway: 00+30	0	4.2	26.6	6.2	92
Hirlam8: 00+30	0	3.4	28.6	5.6	92
ECMWF: 00+30	0	4.1	30.6	5.9	92

	ME	SDE	RMSE	MAE	Max.abs.err.	N
AROME_Norway – synop	0.8	4.5	4.5	2.6	18.2	92
Hirlam8 – synop	0	4.7	4.7	2.5	20.3	92
ECMWF – synop	0.6	2.9	2.9	2	8.3	92

BERGEN – FLORIDA

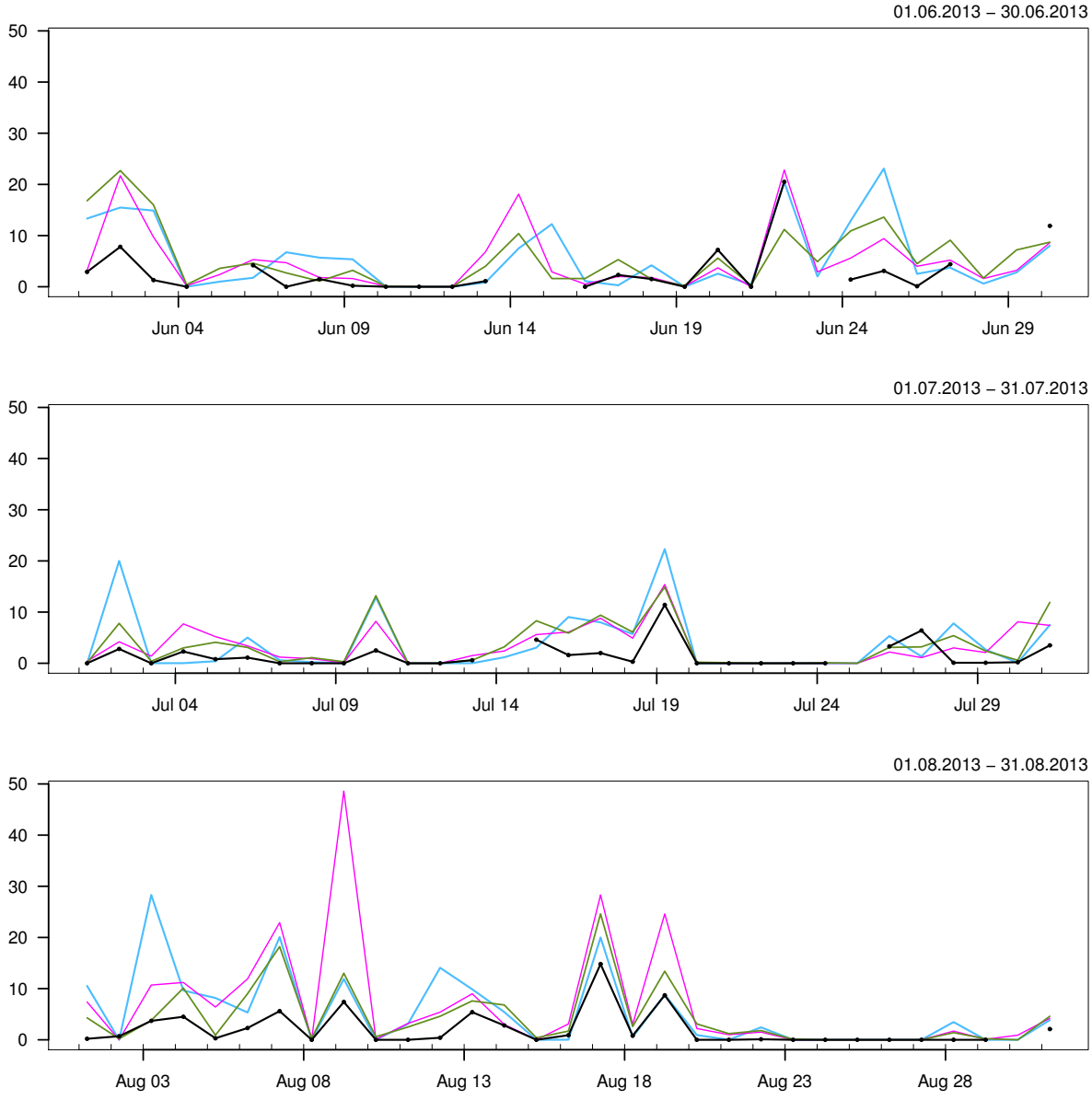


01.06.2013 – 31.08.2013

	Min	Mean	Max	Std	N
synop: 06	0	5.9	30.5	8.1	92
AROME_Norway: 00+30	0	5.4	35.7	7.9	92
Hirlam8: 00+30	0	3.5	28.2	5.3	92
ECMWF: 00+30	0	6.5	44.2	8.8	92

	ME	SDE	RMSE	MAE	Max.abs.err.	N
AROME_Norway – synop	–0.5	5.8	5.8	3.1	24.9	92
Hirlam8 – synop	–2.3	5.7	6.1	3.5	25.3	92
ECMWF – synop	0.6	5.7	5.7	3.3	23.1	92

LÆRDAL

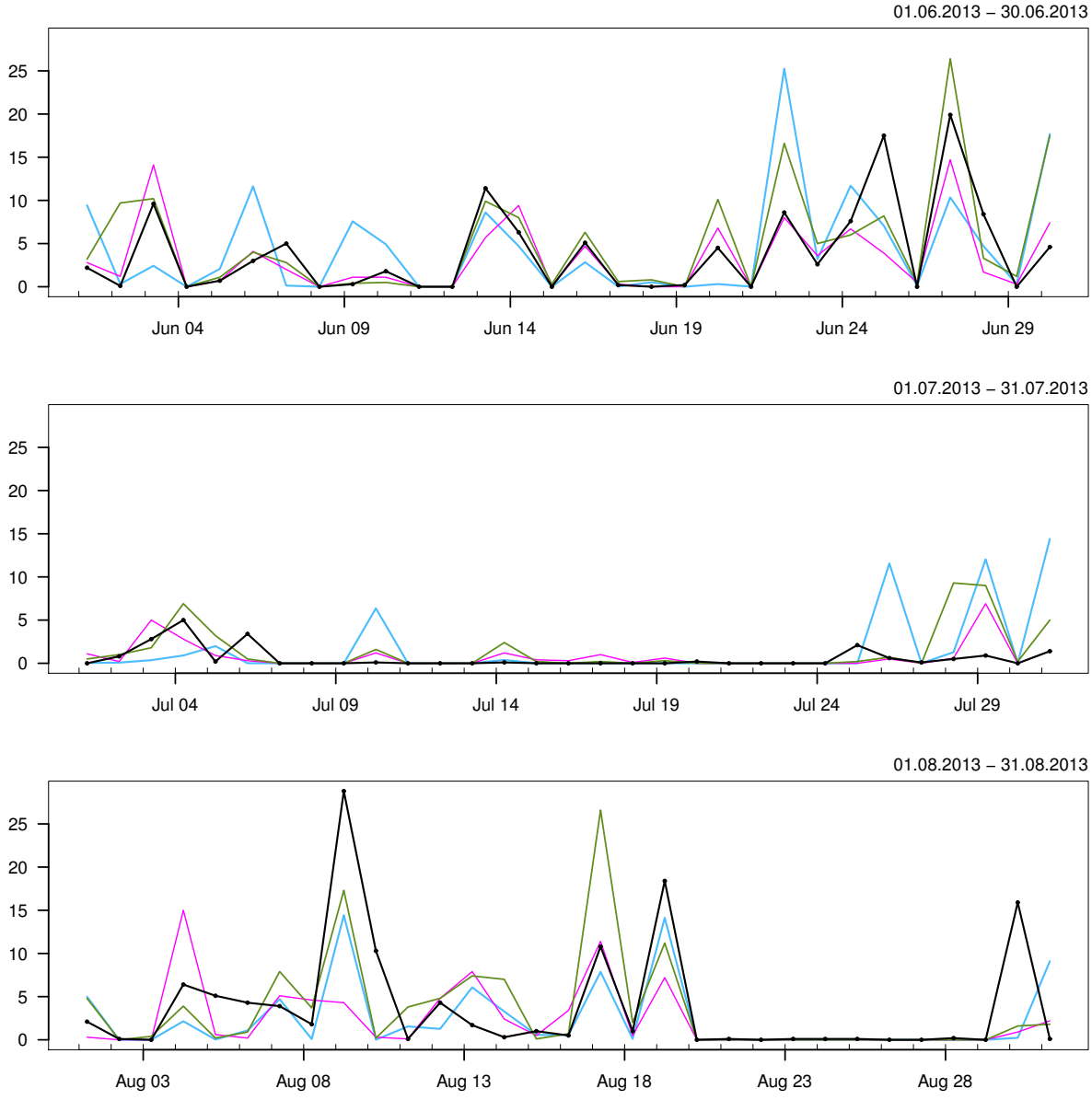


01.06.2013 – 31.08.2013

	Min	Mean	Max	Std	N
synop: 06	0	2.1	20.5	3.6	83
AROME_Norway: 00+30	0	4.9	28.3	6.6	92
Hirlam8: 00+30	0	5	48.6	7.6	92
ECMWF: 00+30	0	4.6	24.6	5.4	92

	ME	SDE	RMSE	MAE	Max.abs.err.	N
AROME_Norway – synop	3	5.4	6.2	3.6	24.6	83
Hirlam8 – synop	3	5.8	6.5	3.4	41.2	83
ECMWF – synop	2.5	4.1	4.8	3	14.9	83

GARDERMOEN

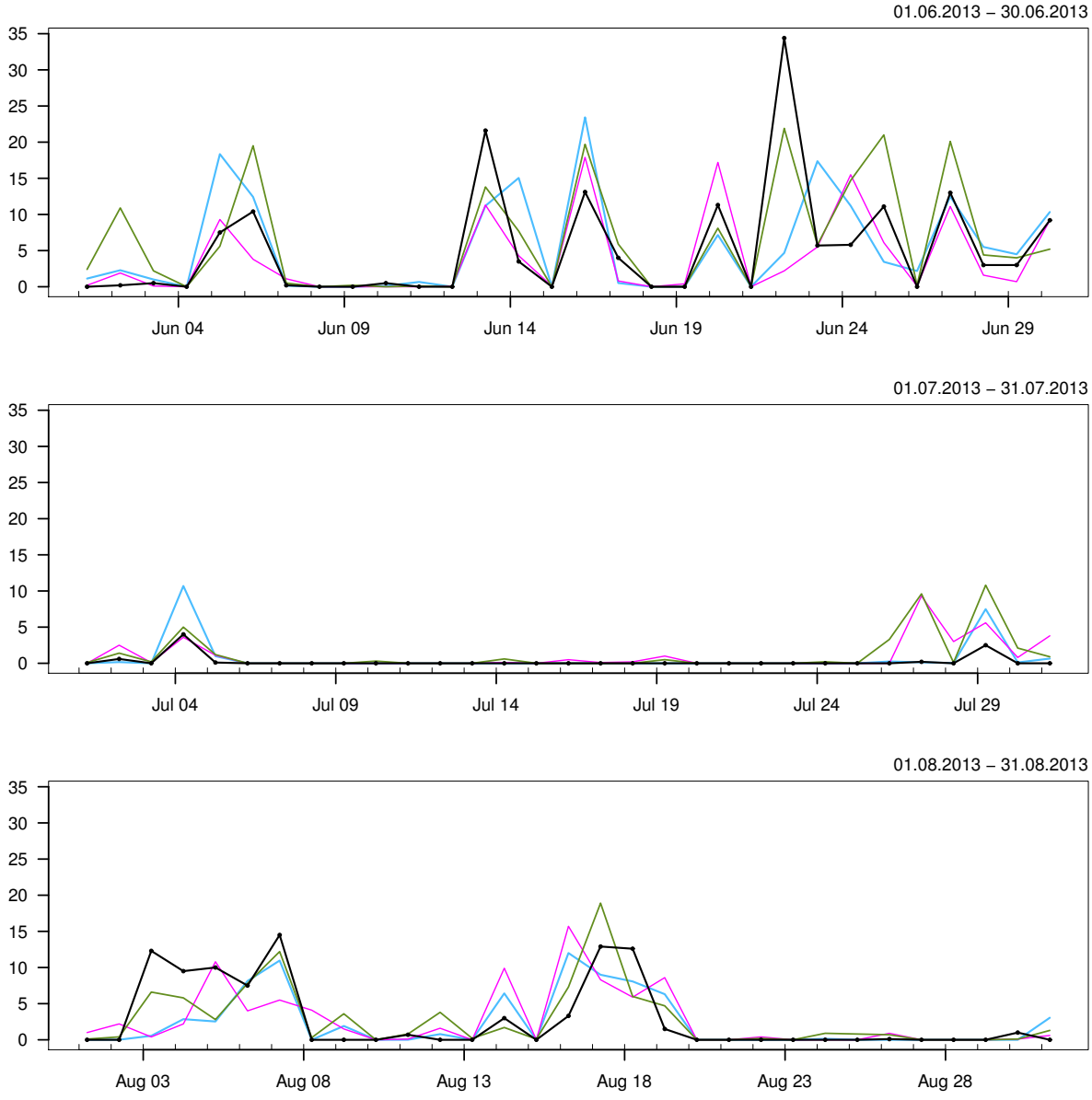


01.06.2013 – 31.08.2013

	Min	Mean	Max	Std	N
synop: 06	0	2.8	28.8	5.1	92
AROME_Norway: 00+30	0	2.8	25.2	4.9	92
Hirlam8: 00+30	0	2.1	15	3.4	92
ECMWF: 00+30	0	3.3	26.6	5.4	92

	ME	SDE	RMSE	MAE	Max.abs.err.	N
AROME_Norway – synop	0	5	5	2.8	16.6	92
Hirlam8 – synop	–0.6	4.2	4.3	1.9	24.5	92
ECMWF – synop	0.5	4.2	4.2	2.3	15.8	92

NELAUG



01.06.2013 – 31.08.2013

	Min	Mean	Max	Std	N
synop: 06	0	2.8	34.4	5.6	92
AROME_Norway: 00+30	0	2.8	23.4	5	92
Hirlam8: 00+30	0	2.6	17.9	4.3	92
ECMWF: 00+30	0	3.4	21.9	5.6	92

	ME	SDE	RMSE	MAE	Max.abs.err.	N
AROME_Norway – synop	0	4.8	4.8	2.1	29.7	92
Hirlam8 – synop	–0.2	4.9	4.9	2.2	32.2	92
ECMWF – synop	0.7	3.5	3.6	1.9	12.5	92