



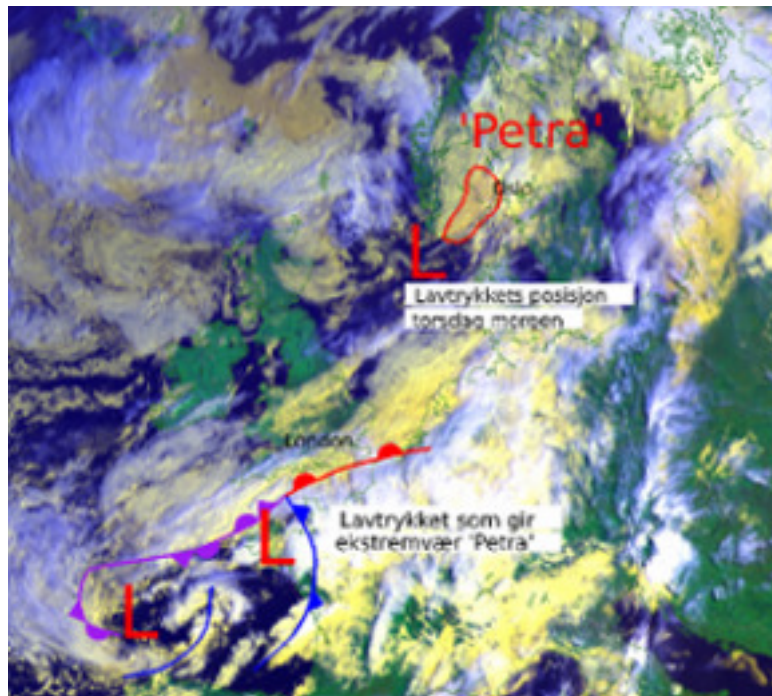
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Verification of Operational Weather Prediction Models September to November 2015

Mariken Homleid and Frank Thomas Tveter



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More information...

Verification results are also available on internal web pages

- <http://metcoop-int.smhi.se/> - AROME-MetCoOp verification - 7 and 30 last days
- <http://verif/vmap/> - timeseries and windroses - on Google map

Models

The following models are verified in this report.

ECMWF	Global model (IFS) at the European Centre for Medium-Range Weather Forecasts. From 26 January 2010 resolution $T_L1279L91$ or approximately $16 \times 16 \text{ km}^2$ horizontally.
Hirlam12	Version 7.1, horizontal resolution defined by a $12 \times 12 \text{ km}^2$ grid. Operational status since 13 February 2008.
Hirlam8	Version 7.1, horizontal resolution defined by a $8 \times 8 \text{ km}^2$ grid. Operational status since 13 February 2008.
Harmonie2.5	HARMONIE cycle 36h1.3 with AROME physics and non-hydrostatic dynamics, horizontal resolution defined by a $2.5 \times 2.5 \text{ km}^2$ grid. Run at MET from 4 May 2011 to 26 February 2013.
AROME-Norway	HARMONIE cycle 37h1.1 with AROME physics and non-hydrostatic dynamics, horizontal resolution defined by a $2.5 \times 2.5 \text{ km}^2$ grid. Experimental since 25 October 2012, replacing Harmonie2.5 from 26 February 2013, on Yr from 1 October 2013.
AROME-MetCoOp (AM25)	HARMONIE with AROME physics, horizontal resolution defined by a $2.5 \times 2.5 \text{ km}^2$ grid on same domain as AROME-Norway. Run in cooperation with Swedish Meteorological and Hydrological Institute (SMHI). Experimental with cycle 38h1.1 since 9 December 2013, operational since 12 March 2014, cycle 38h1.2 since 8 December 2014.

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.

Post processed forecasts

Most of the raw model data are post processed before being published on Yr.

For 2m temperature, the raw data is first adjusted to a fine scale (500 m) topography applying a vertical temperature gradient of -1.6 degrees pr. 100 m. The “height corrected” 2m temperature forecasts (AMHC) are in a next step adapted to observations by a Kalman filter at all observing stations. The Kalman filter corrections are interpolated horizontally to the 500 m grid by kriging, using weights which decrease with increasing distance from the observing stations, both horizontally and vertically. The interpolated Kalman filter corrections are finally added to the height corrected field, giving AMKF.

10 m wind speed is statistically post processed to represent maximum wind speed 10m last hour, and called AMPP.

The precipitation forecasts are post processed by a neighbourhood method giving a median field, AM-median. This field is used to determine the precipitation symbol on Yr.

The HARMONIE system

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 used at MET. More documentation is available on <http://www.cnrm.meteo.fr/gmapdoc/> and <http://hirlam.org/>. A change log for AROME-MetCoOp is found on <https://wiki.met.no/nwp/metcoop/changelog/start>.

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.

AROME physics

AROME (Applications of Research to Operations at MEscale) 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.

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 will benefit from the possibility of running 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. The orography is taken from gtopo30.

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

Data assimilation

NWP models are updated regularly using observations received in real-time from the global observing system. AROME-MetCoOp is updated each third hour; at 00, 03, 06, 09, 12, 15, 18 and 21 UTC.

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.

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 and 18 UTC as there are very few snow depth observations at 00, 03, 09, 12, 15 and 21.

The Sea Surface Temperature (SST) and Sea Ice Concentration (SIC) 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. SST and SIC for the Baltic Sea have since 26 November 2015 been taken from the ocean model HIROMB run at SMHI.

The surface temperature over sea ice was taken from the boundary model and remained unchanged through the forecast. A simple thermodynamical sea ice scheme (SICE) giving prognostic sea ice temperatures in 4 fixed layers was introduced 26 November 2015.

Upper air analysis

AROME-MetCoOp runs three dimensional variational (3D VAR) data assimilation using conventional observations from synop stations, ships, radiosondes and aircrafts and AMSU-A and AMSU-B/MHS data from polar orbiting NOAA and METOP satellites. GNSS were introduced 17 February 2015, radar reflectivities 16 June 2015 and IASI data 26 November 2015.

Boundary fields

AROME-MetCoOp gets its boundary values (1-hourly) from the ECMWF model at approximately 16 km resolution, and has currently 65 vertical levels. None of the HARMONIE configurations at MET have applied digital filter initialization (DFI).

Verification measures

All model forecasts in this report are verified against observations by interpolating (linear) 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 quantified 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, \dots, f_n denote the forecasts and o_1, \dots, o_n the corresponding observations.

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 f_i - o_i $	0 to ∞	0
Standard Deviation of Error	SDE	$\left(\frac{1}{n} \sum_{i=1}^n (f_i - o_i - \text{ME})^2 \right)^{1/2}$	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	$\frac{\frac{1}{n} \sum_{i=1}^n (f_i - \bar{f})(o_i - \bar{o})}{\text{SD}(f)\text{SD}(o)}$	-1 to 1	1

In the formula for COR the following definitions are used

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

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

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

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	<i>a</i>	<i>b</i>
	no	<i>c</i>	<i>d</i>

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)
Heidke skill score	HSS	$\frac{(a+d)/n - ssf}{1 - ssf}$	$-\infty$ to 1	1 (0 = no skill)

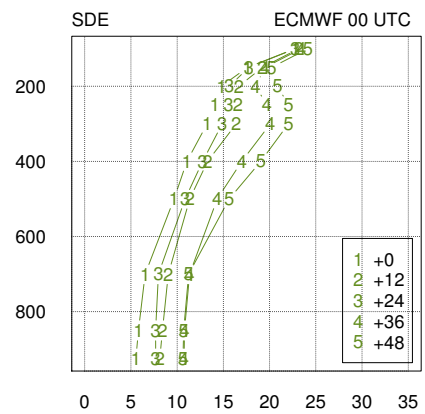
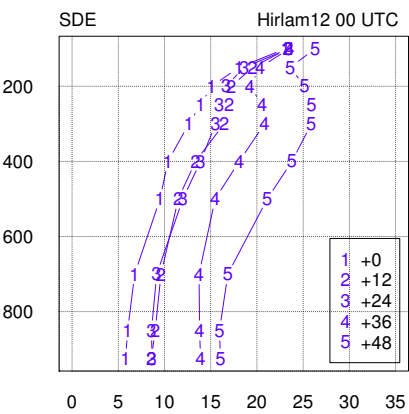
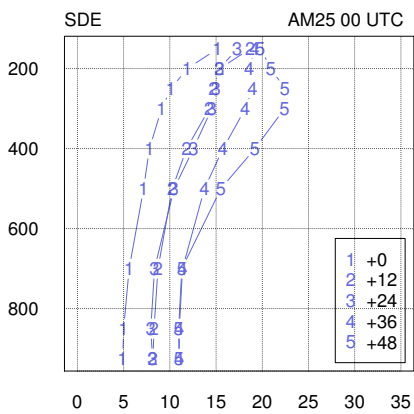
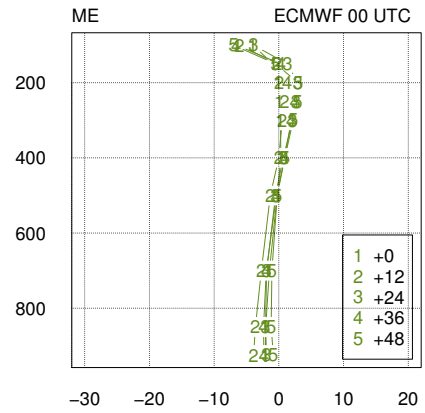
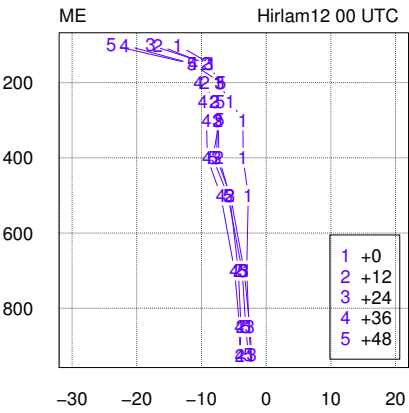
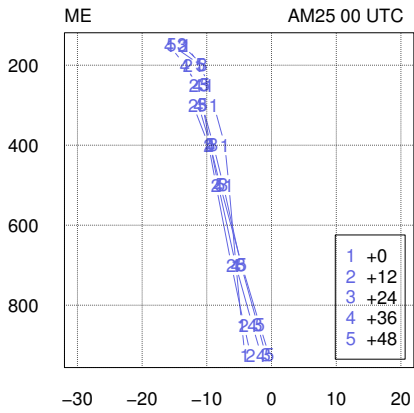
In the formula for ETS $ar = (a+b)(a+c)/n$.

In the formula for HSS the score for the standard forecast $ssf = [(a+b)(a+c) + (b+d)(c+d)]/n^2$.

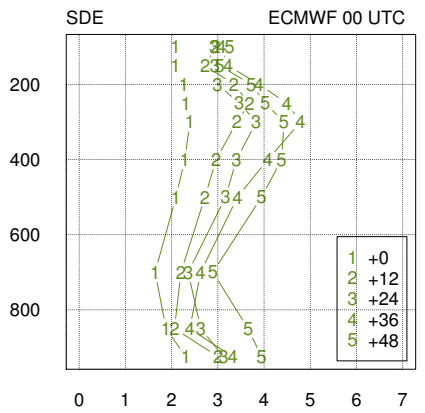
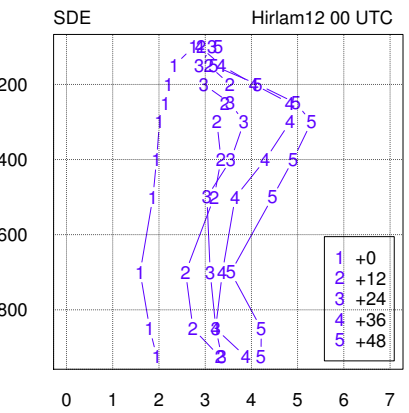
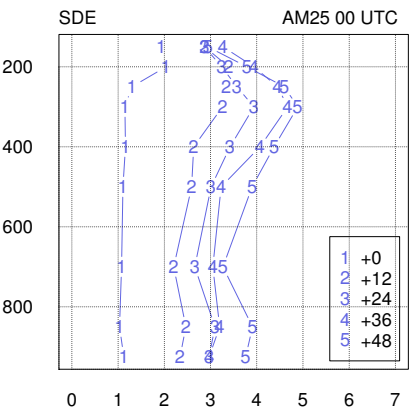
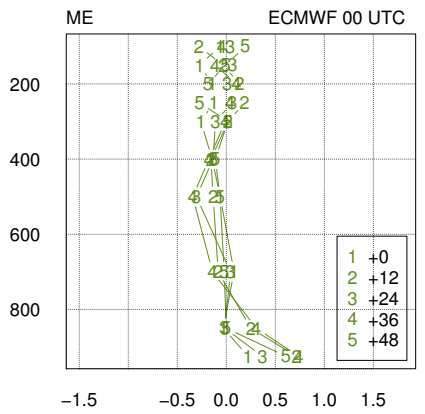
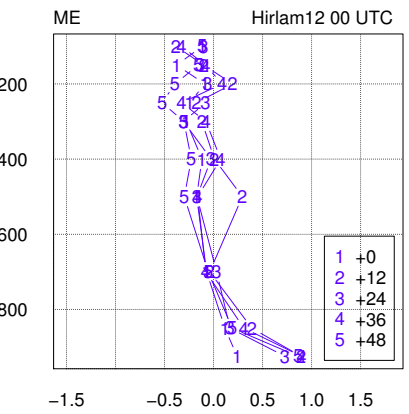
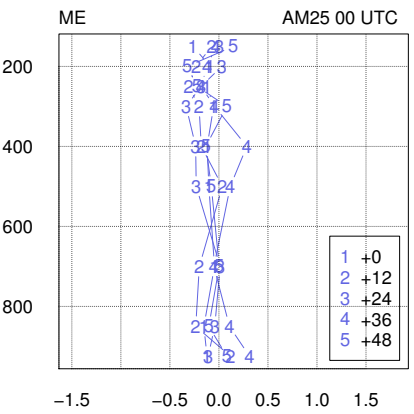
Observations

All observations come from Klimadatavarehuset at MET. Only synop stations are used. The model wind speed is verified against mean wind observations, FF. The post processed wind speed is intended to represent maximum wind speed 10m last hour, and is verified against FX.

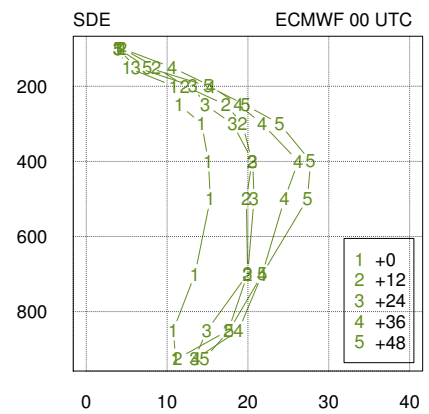
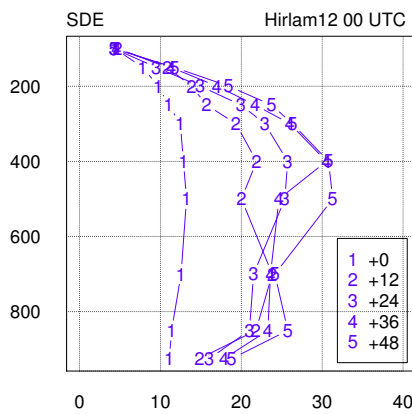
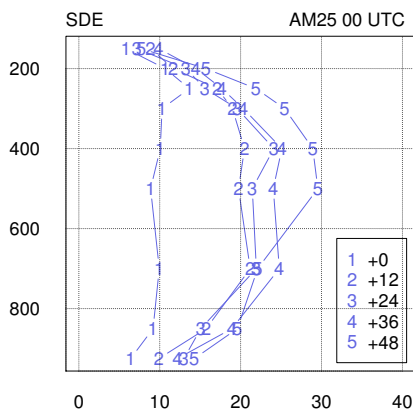
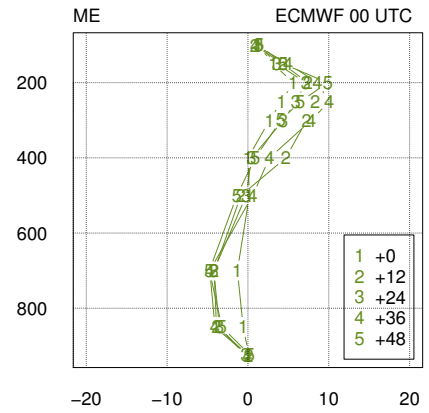
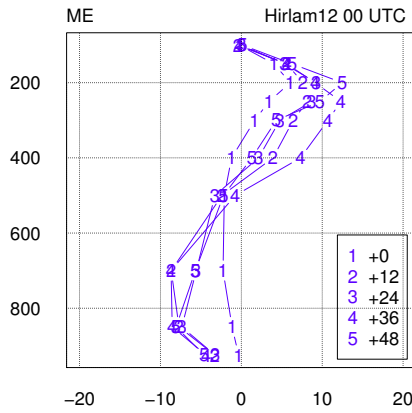
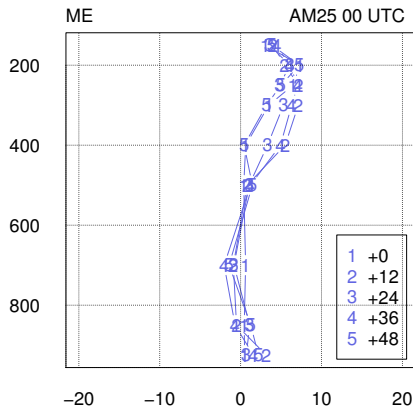
Geopotential height at 3 Norwegian stations



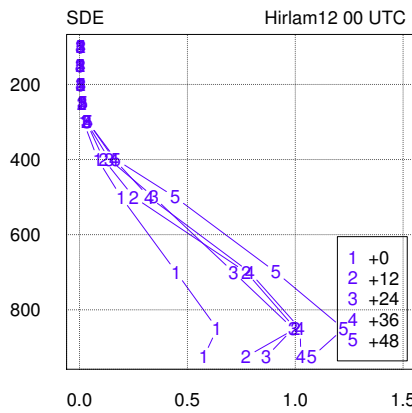
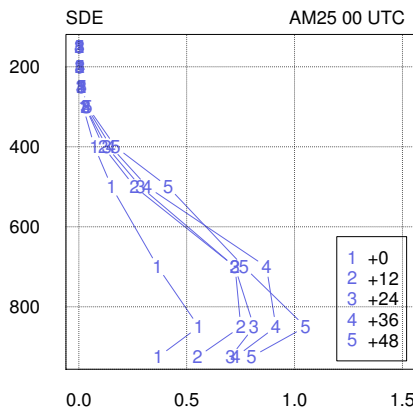
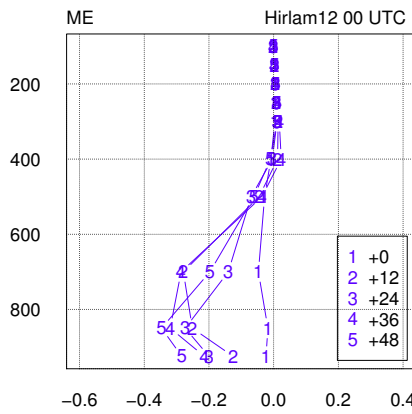
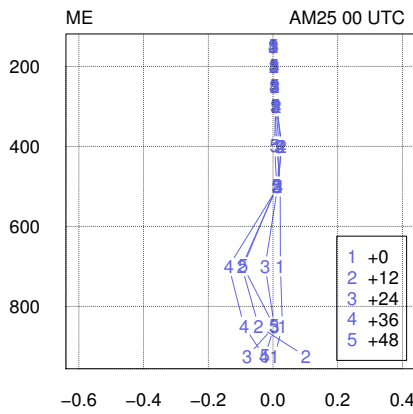
Wind speed at 3 Norwegian stations

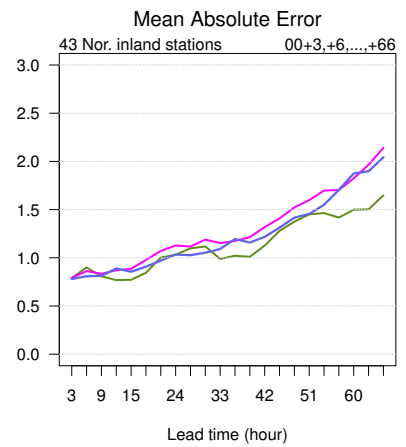
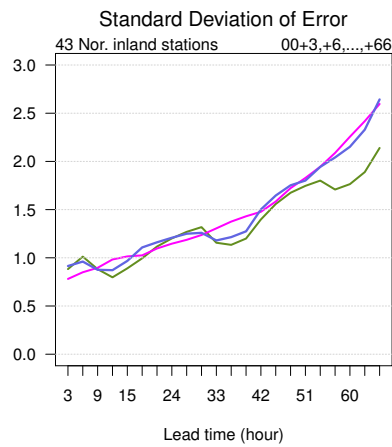
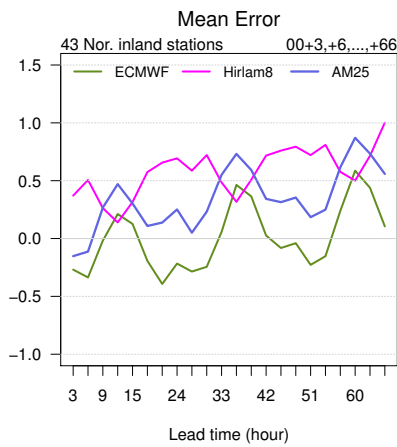
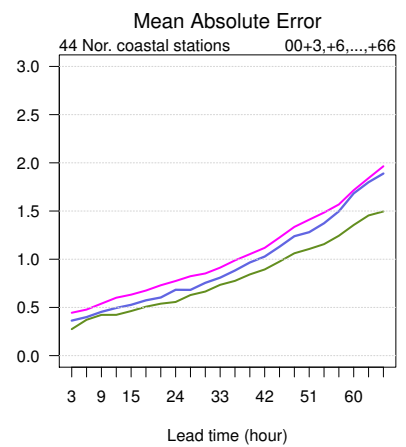
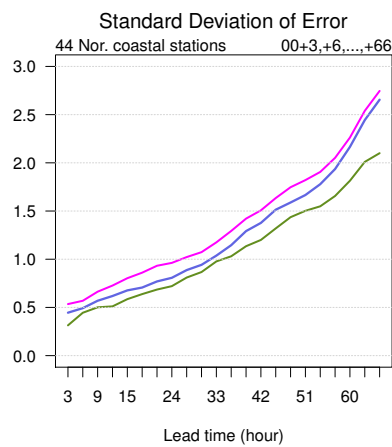
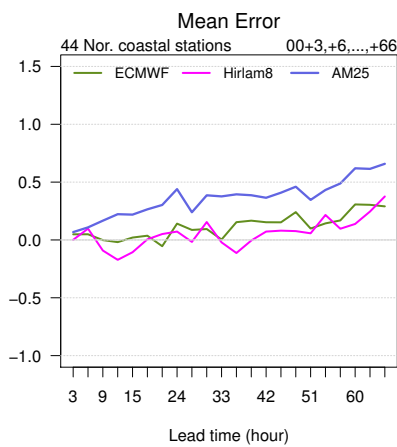
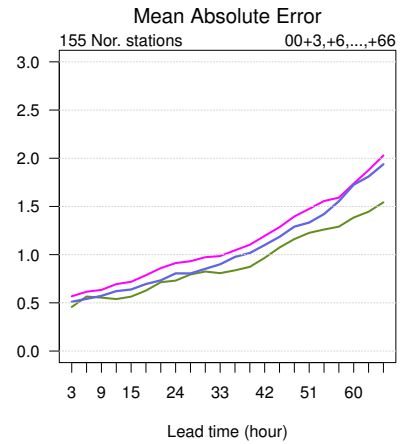
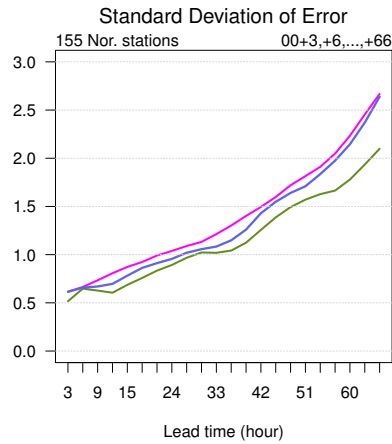
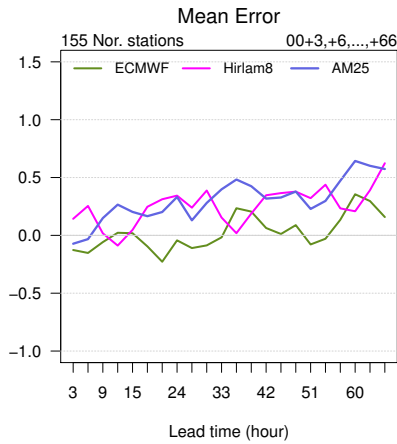


Relative humidity at 3 Norwegian stations



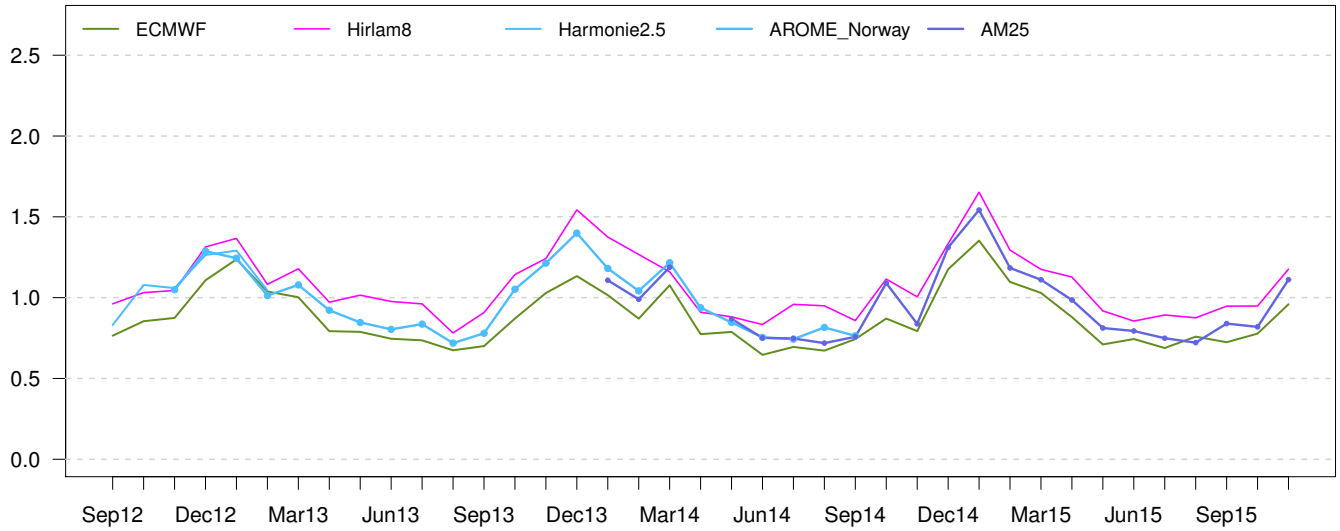
Specific humidity at 3 Norwegian stations



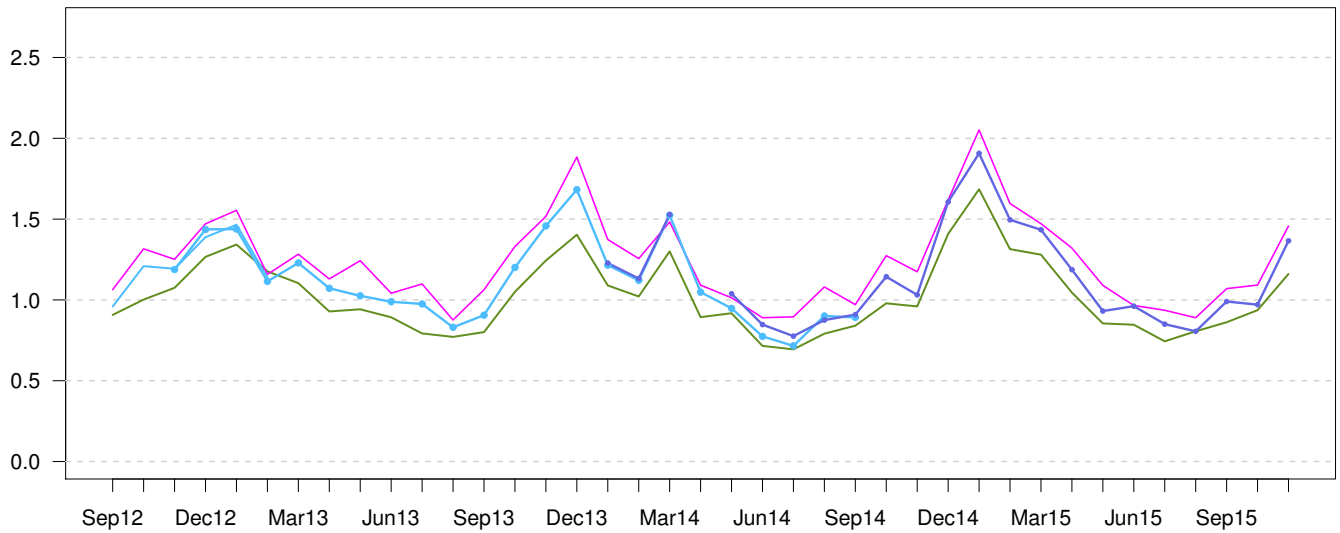


Mean Absolute Error
124 Norwegian stations

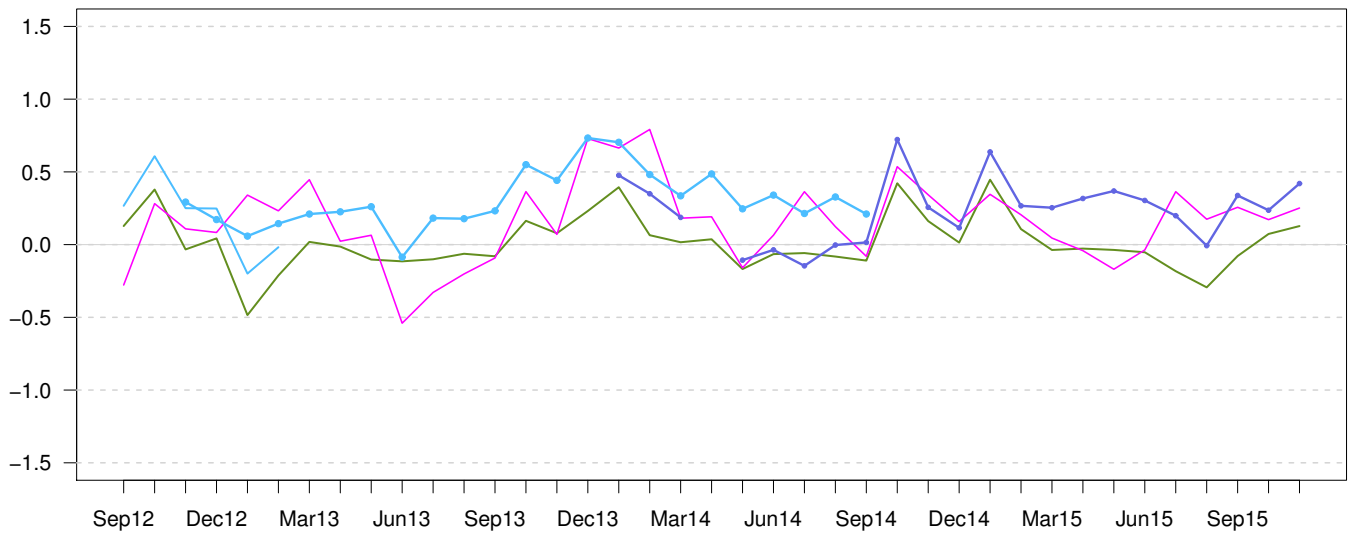
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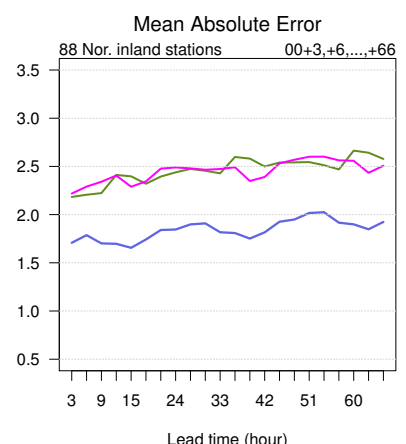
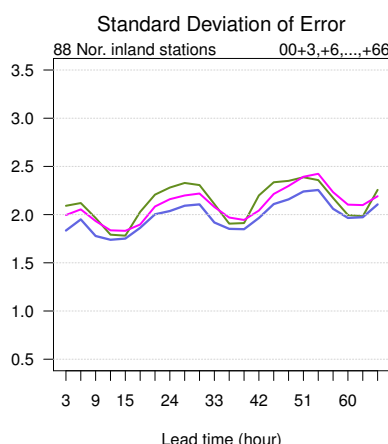
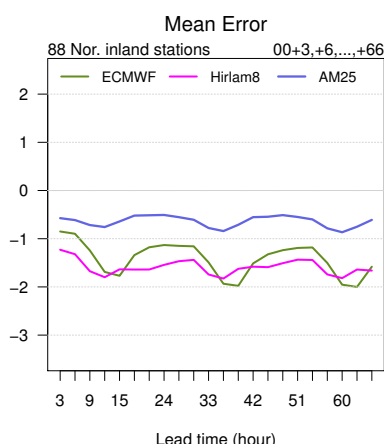
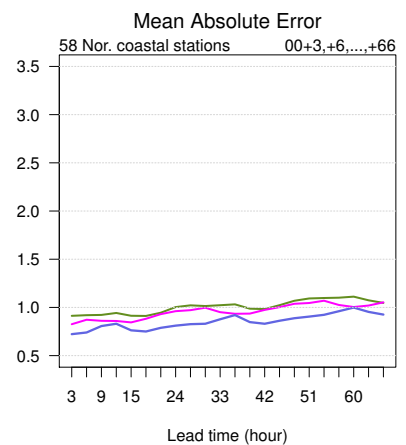
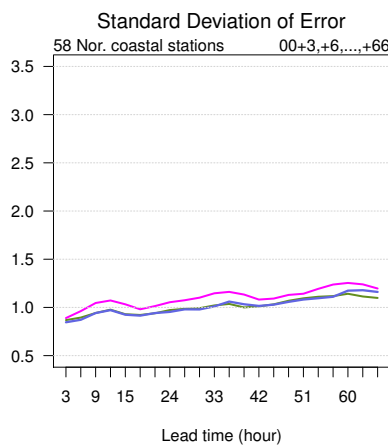
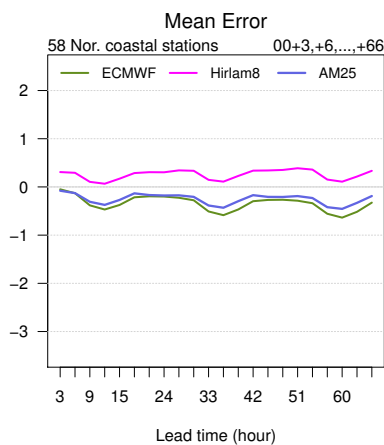
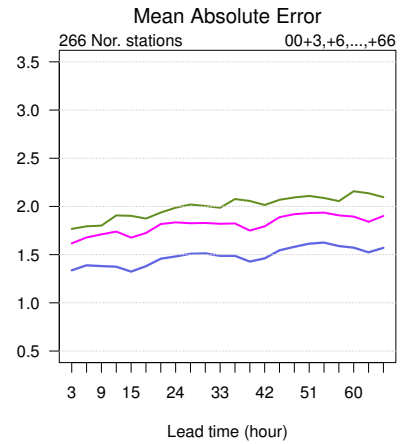
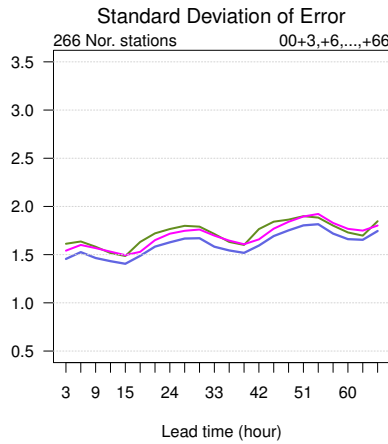
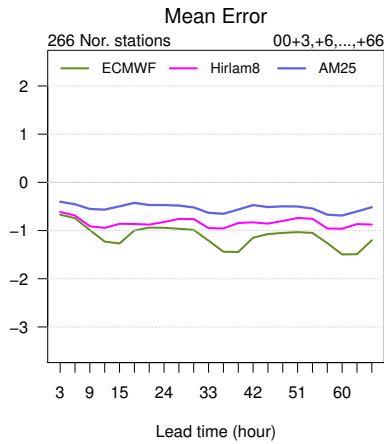


Standard Deviation of Error

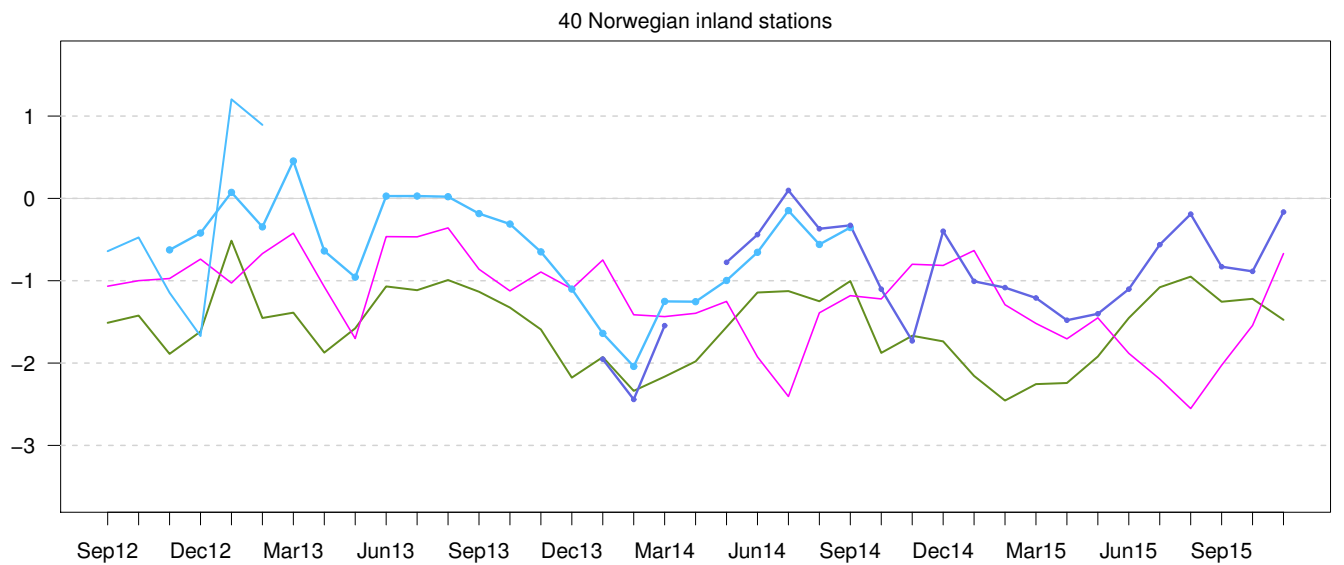
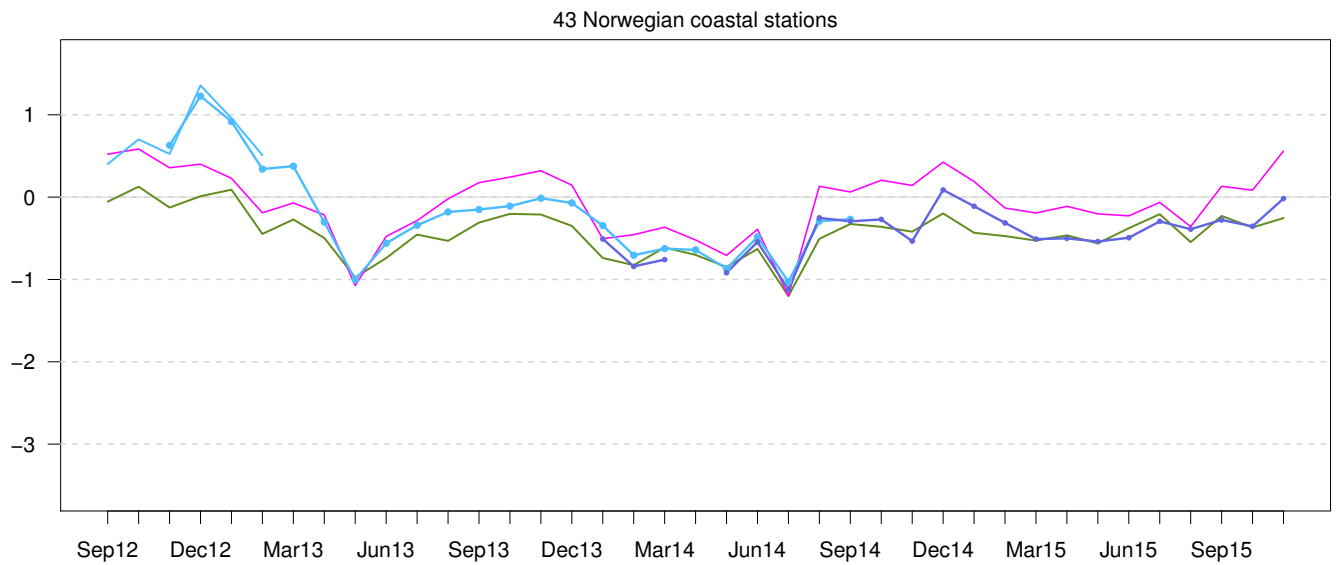
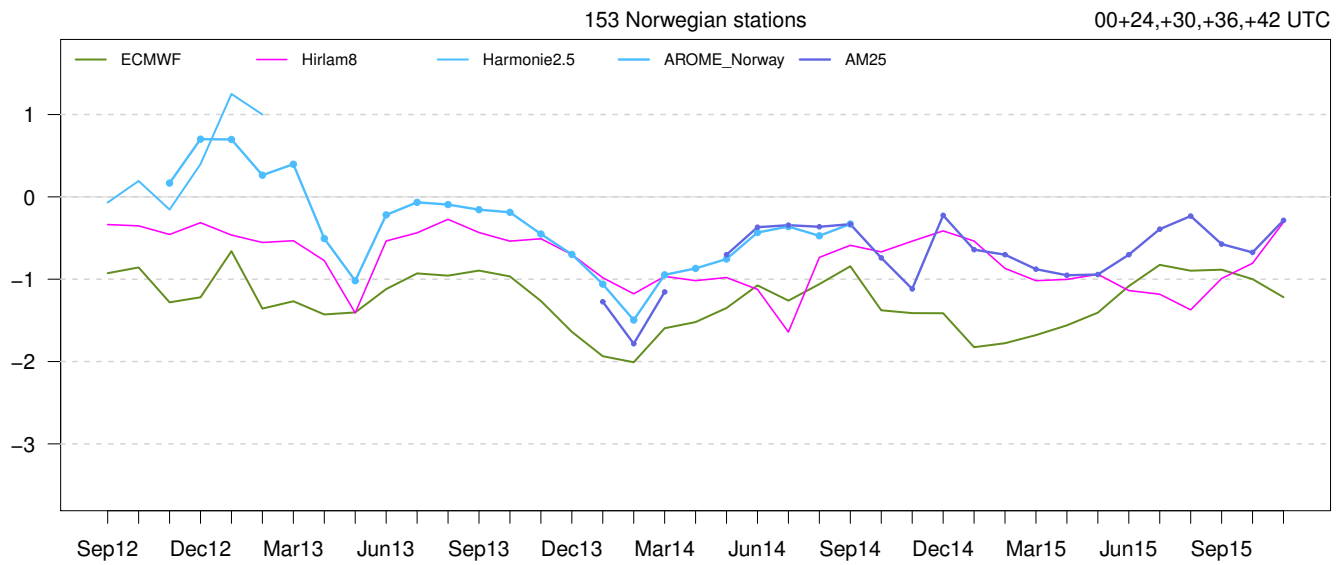


Mean Error

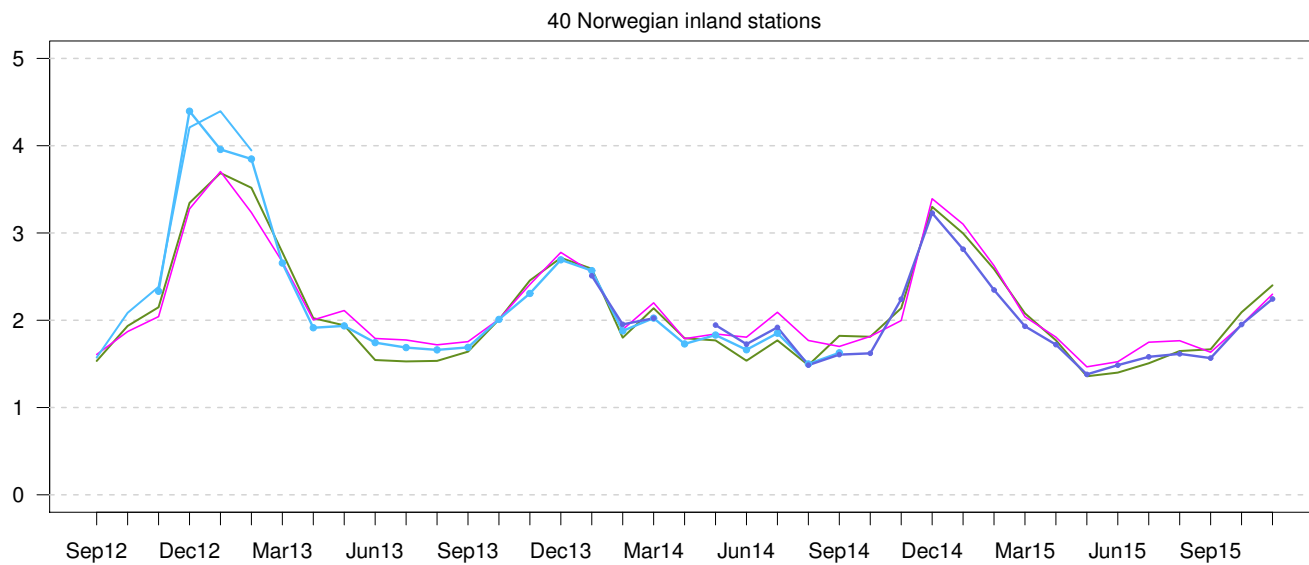
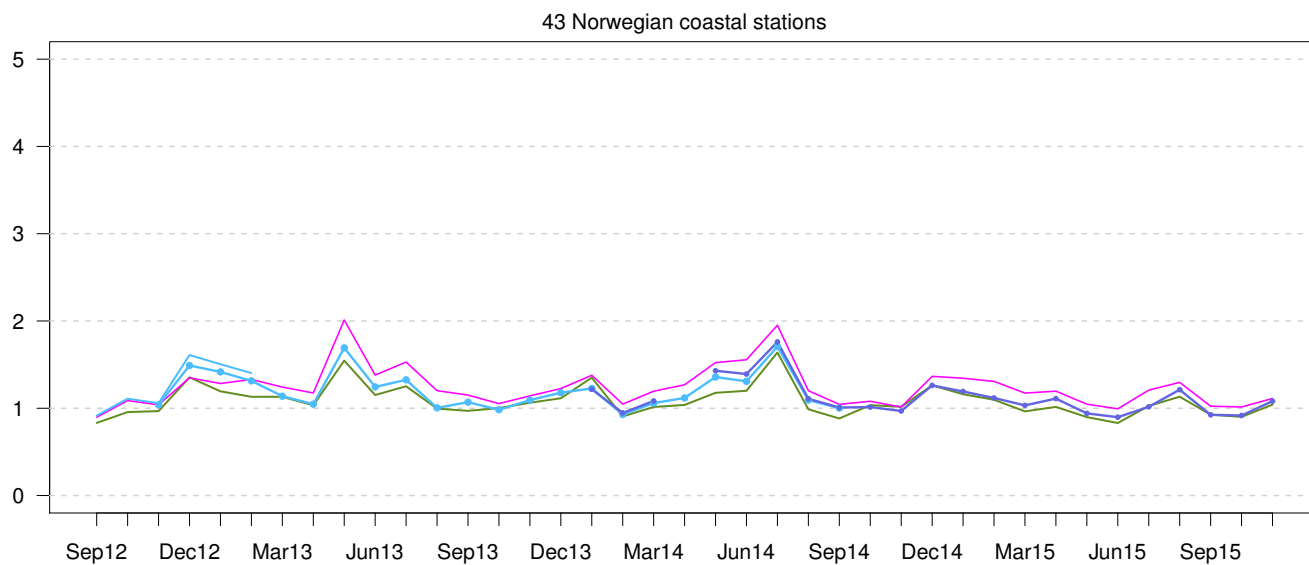
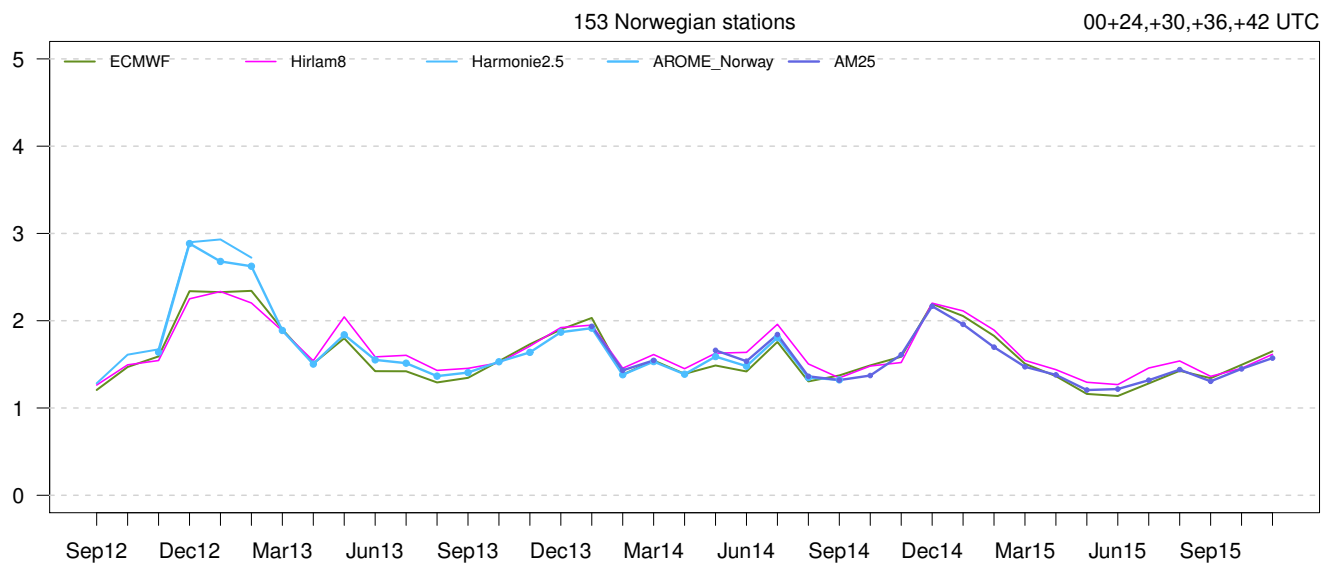




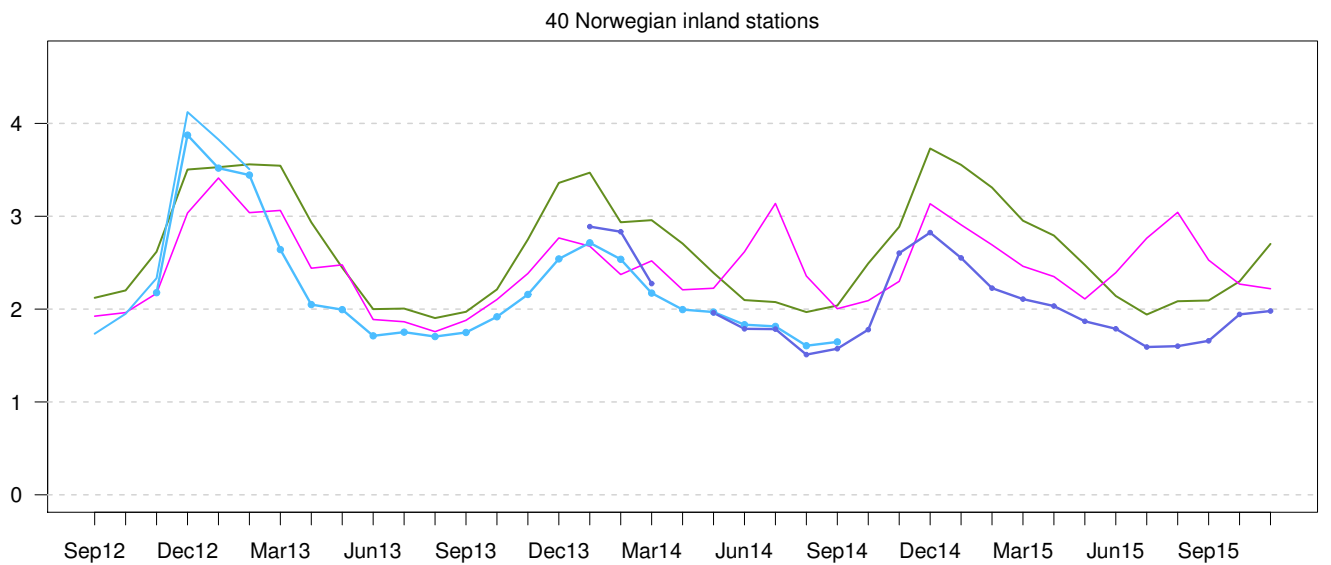
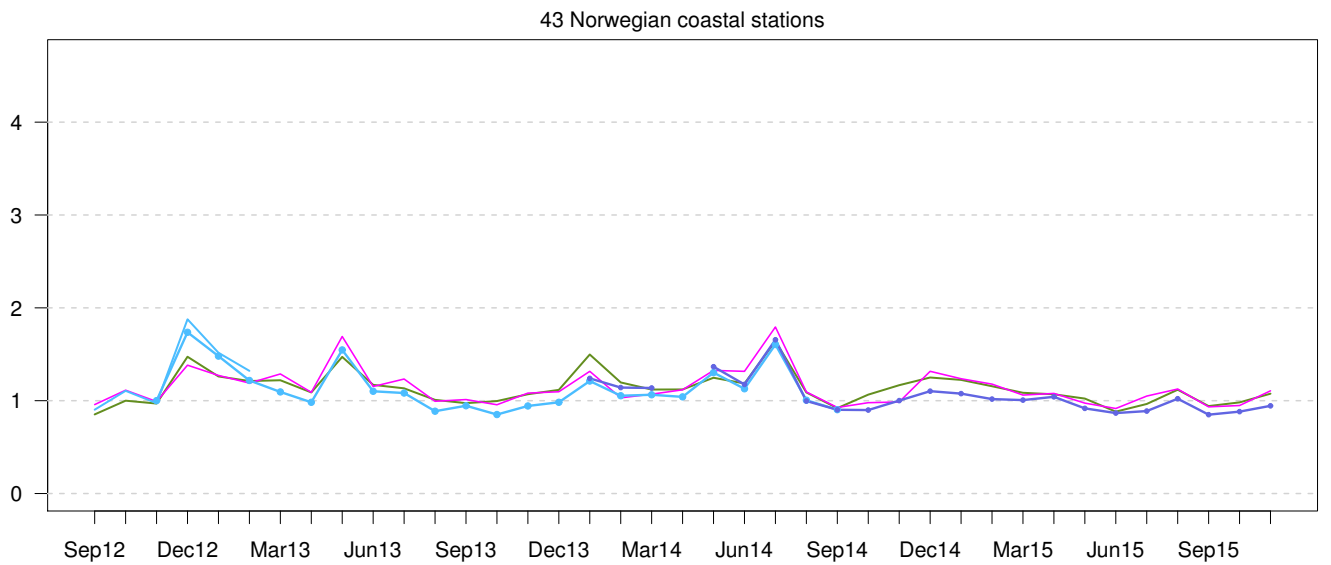
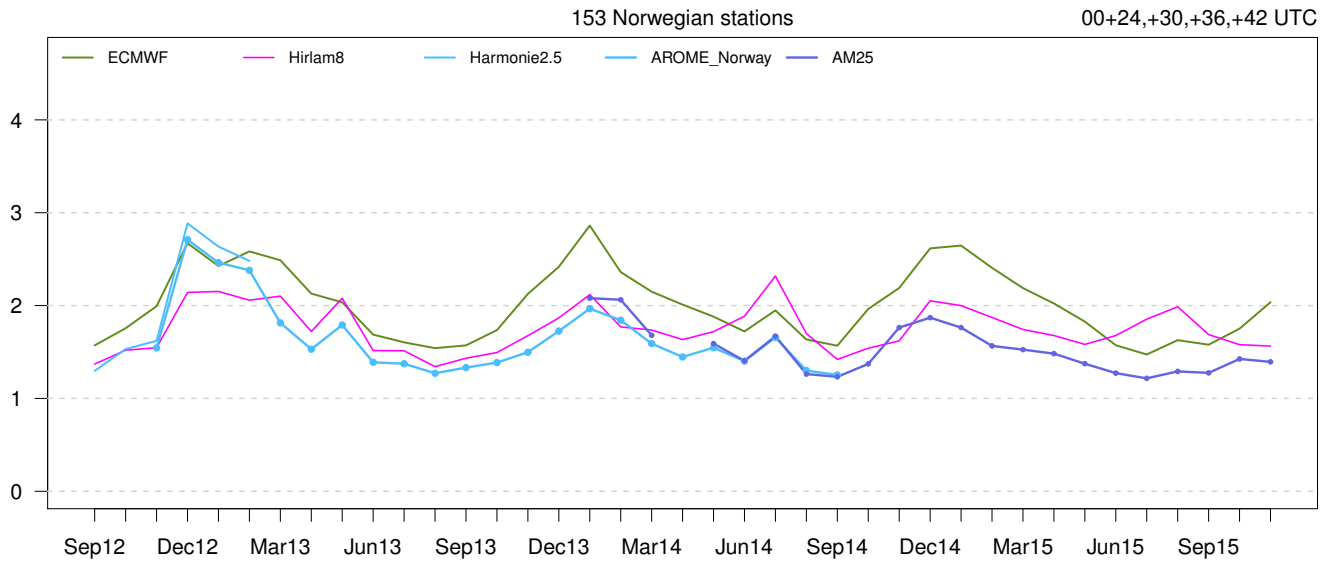
Mean Error



Standard Deviation of Error



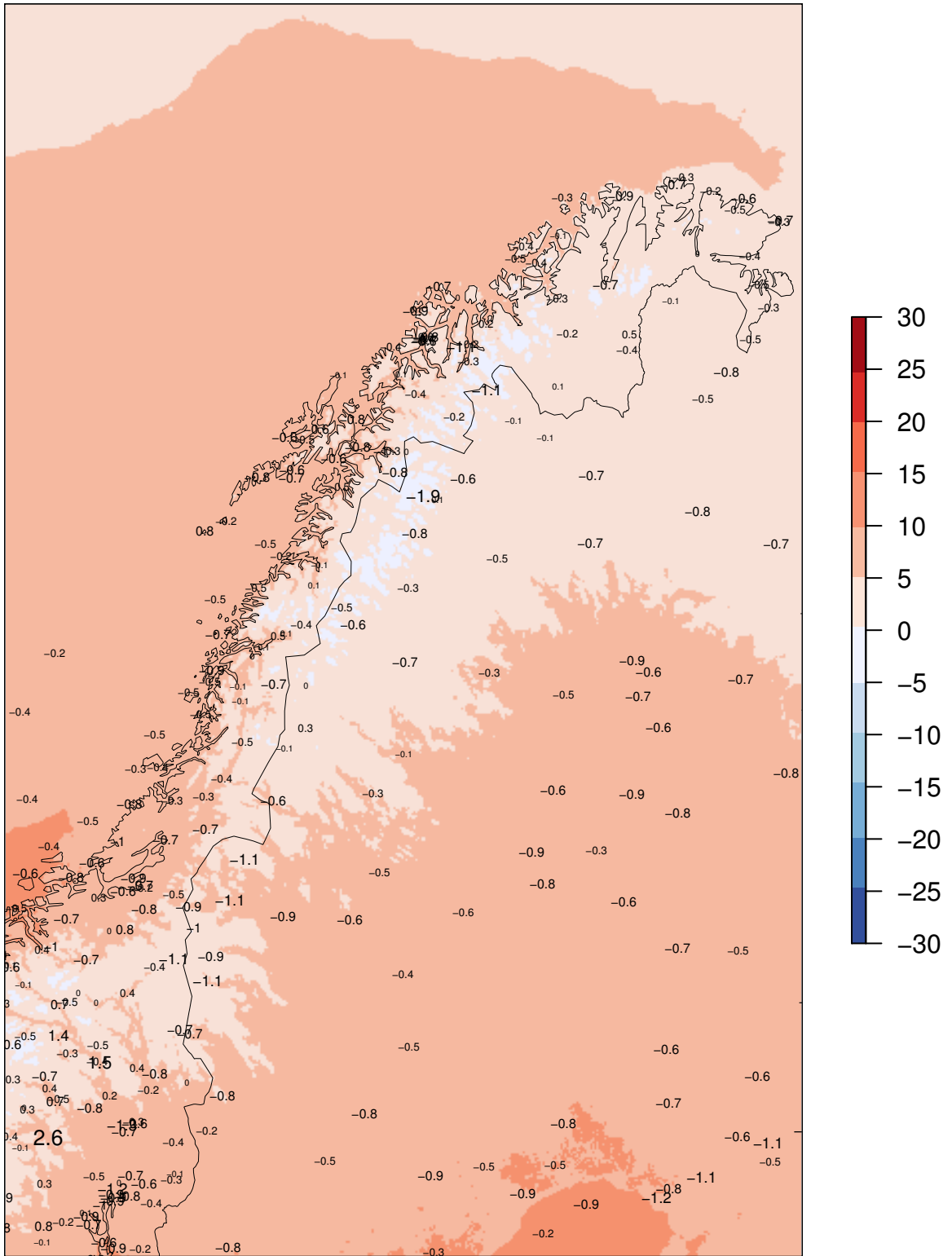
Mean Absolute Error



AM25 00+12

ME at observing sites

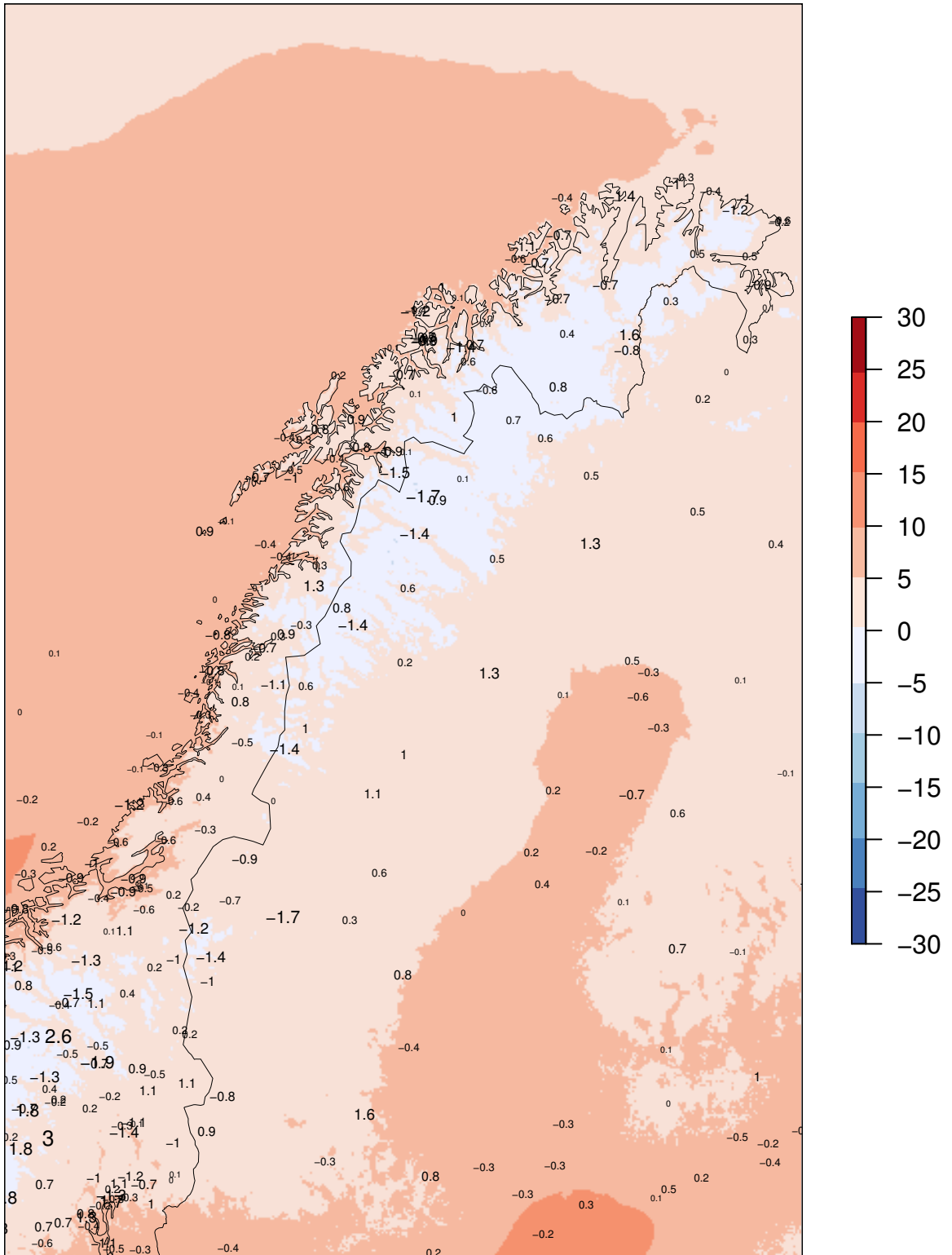
forecast means 01.09.2015 – 30.11.2015



AM25 00+24

ME at observing sites

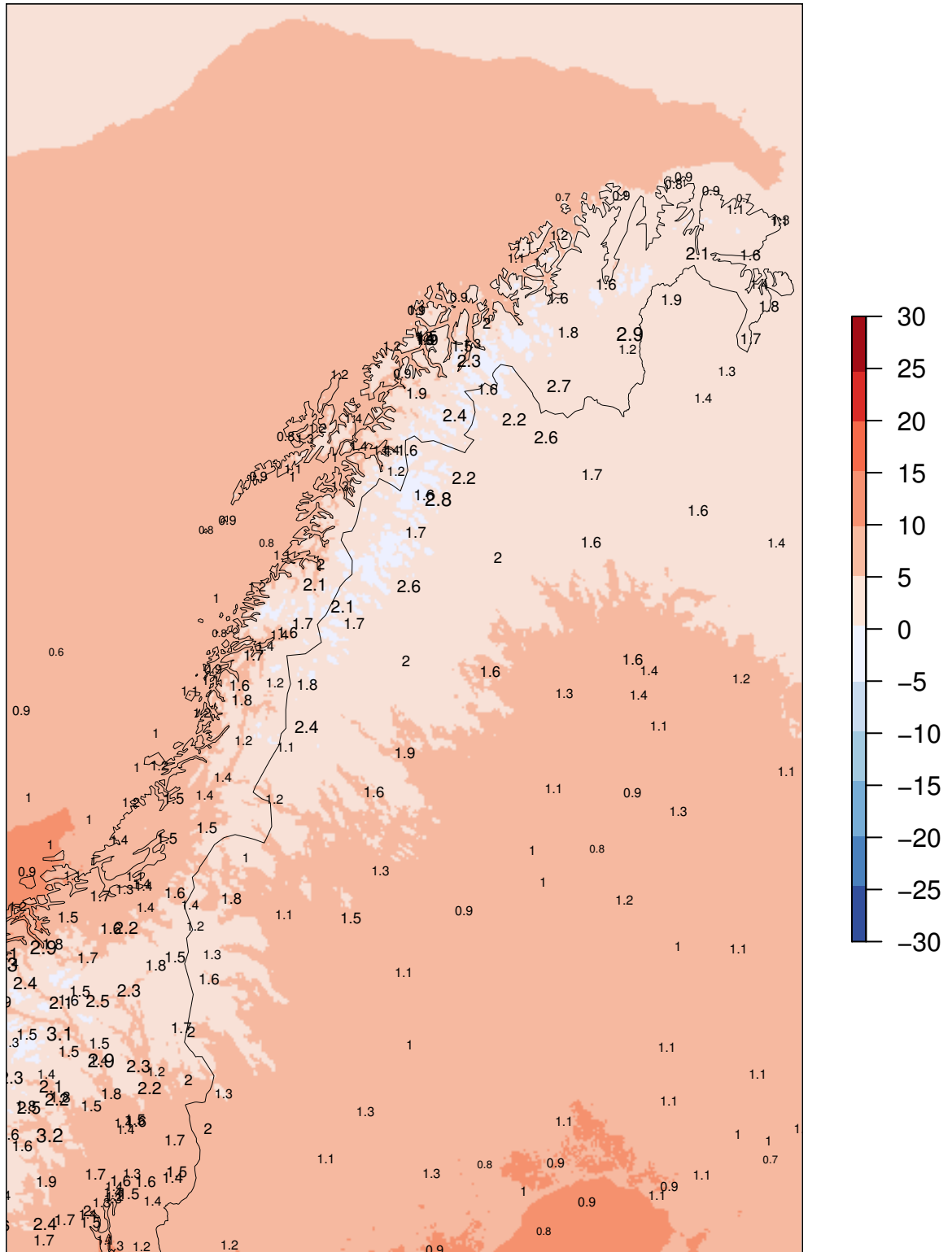
forecast means 01.09.2015 – 30.11.2015



AM25 00+12

SDE at observing sites

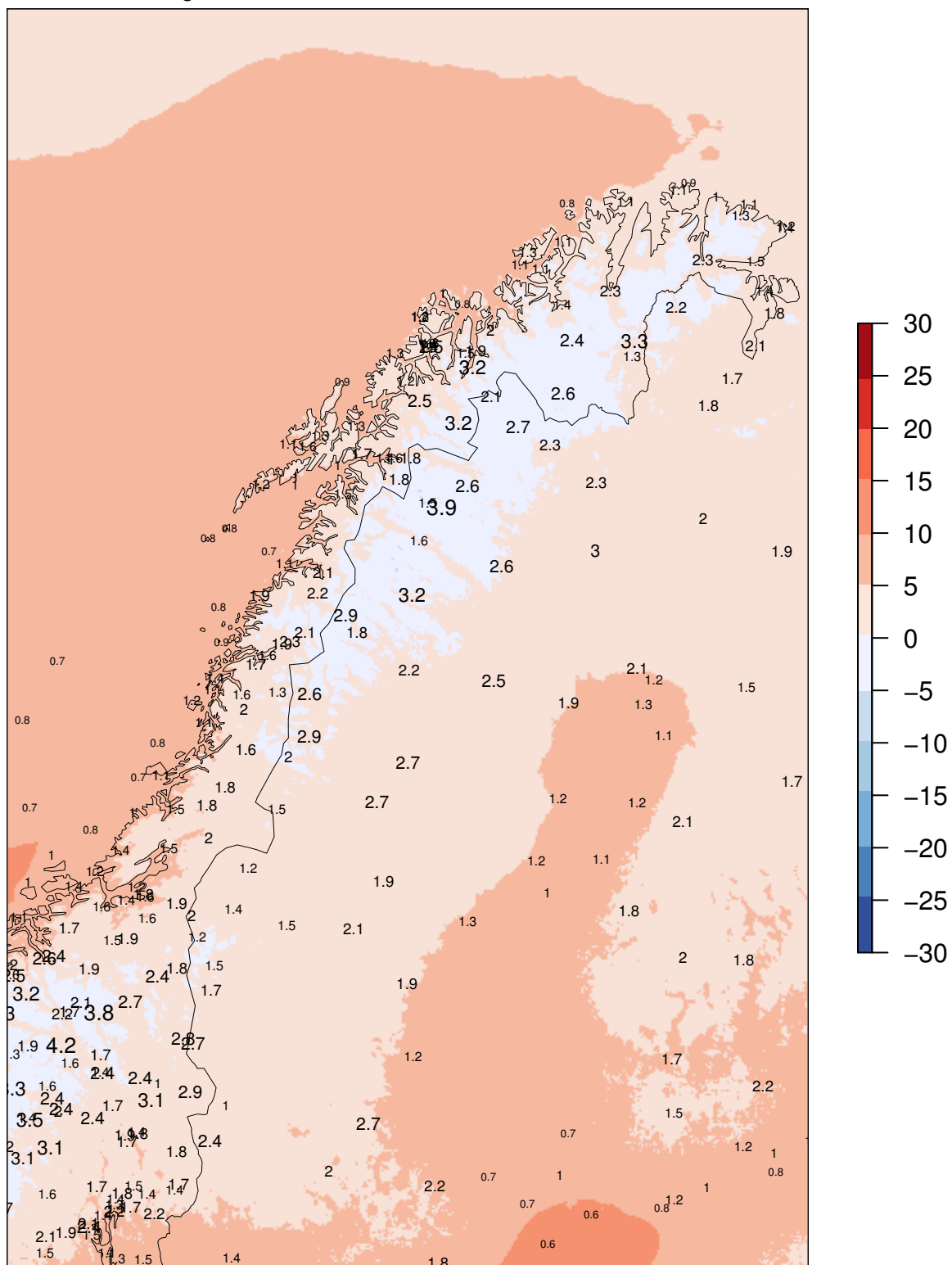
forecast means 01.09.2015 – 30.11.2015



AM25 00+24

SDE at observing sites

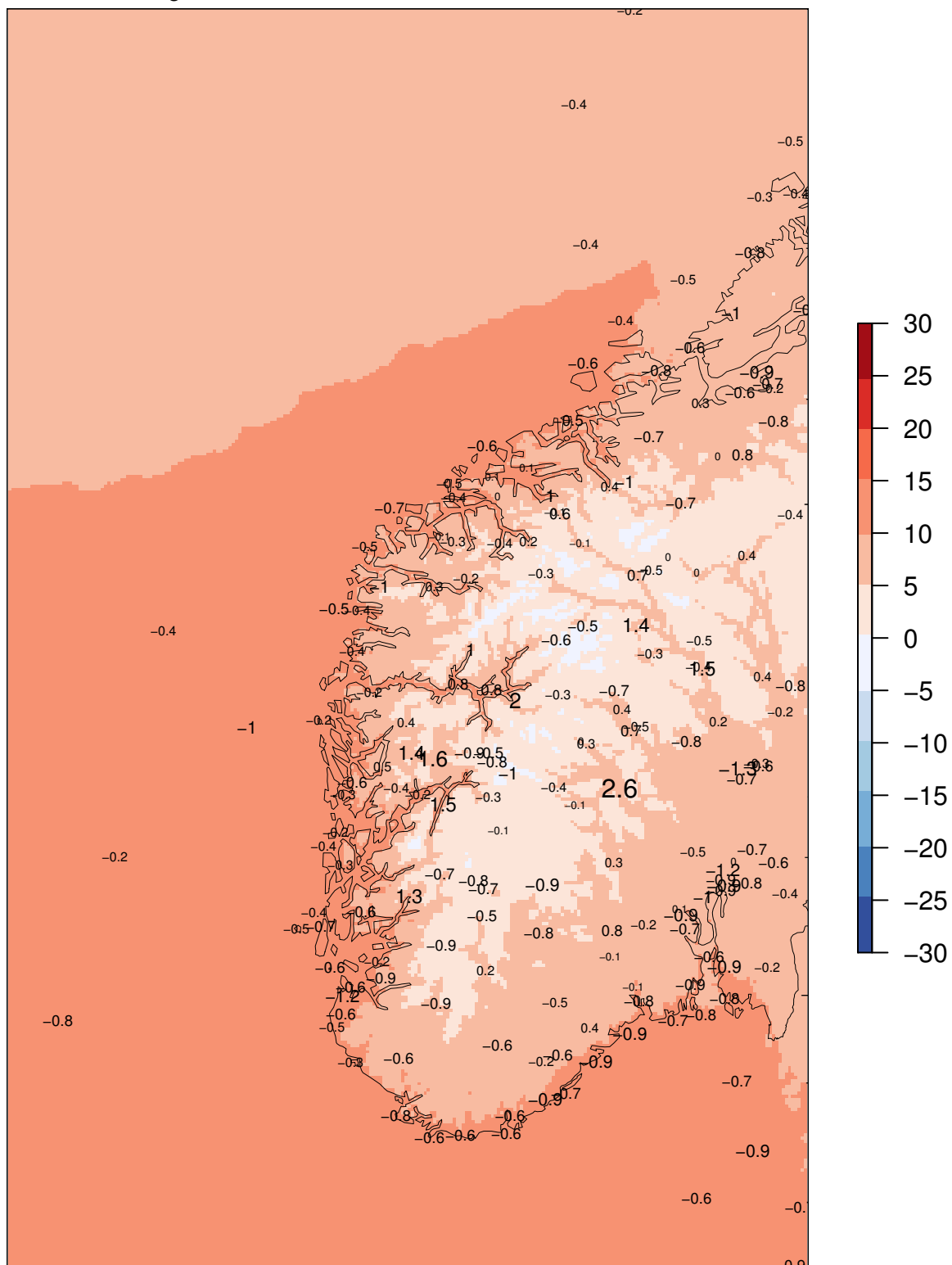
forecast means 01.09.2015 – 30.11.2015



AM25 00+12

ME at observing sites

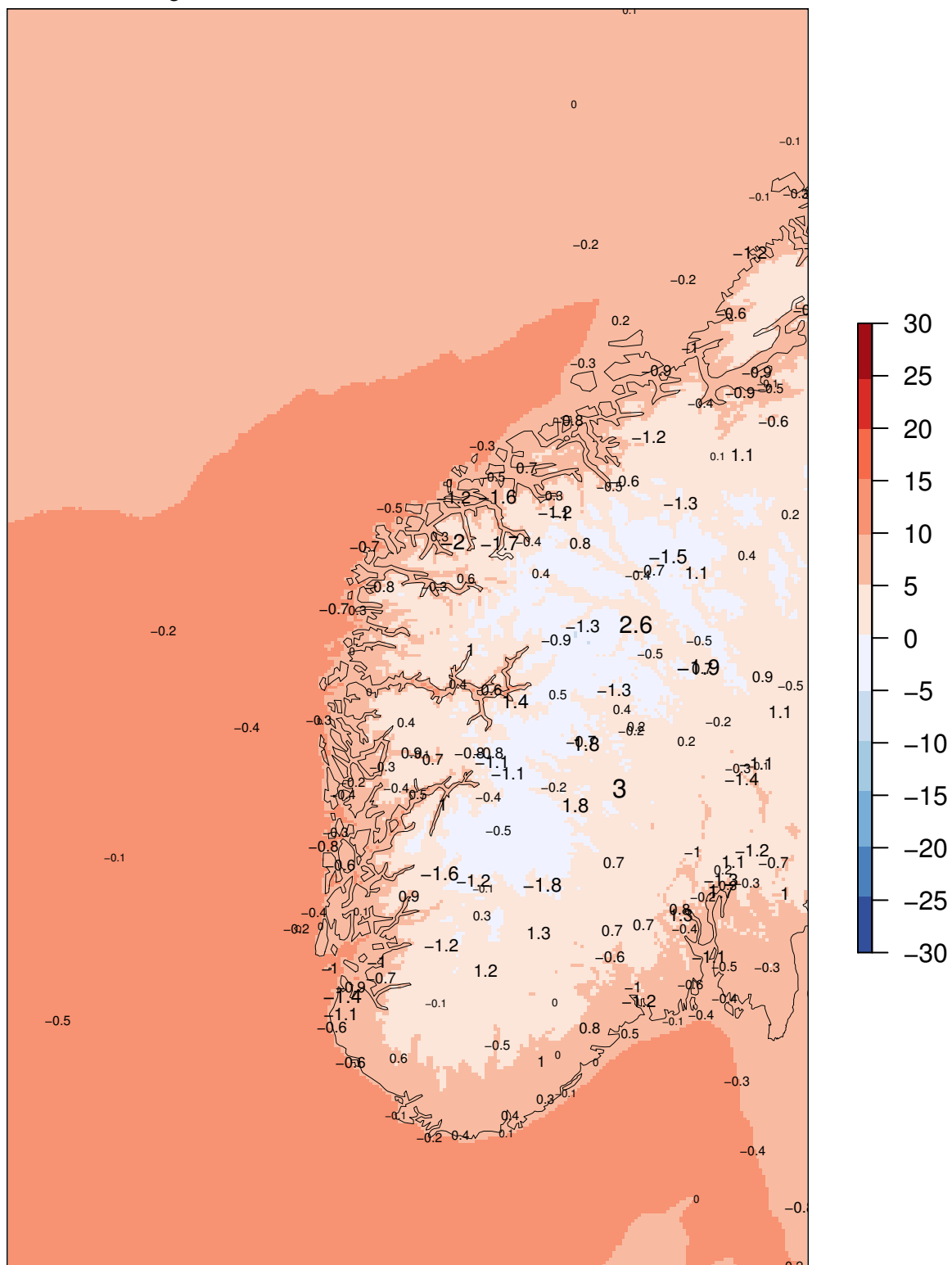
forecast means 01.09.2015 – 30.11.2015



AM25 00+24

ME at observing sites

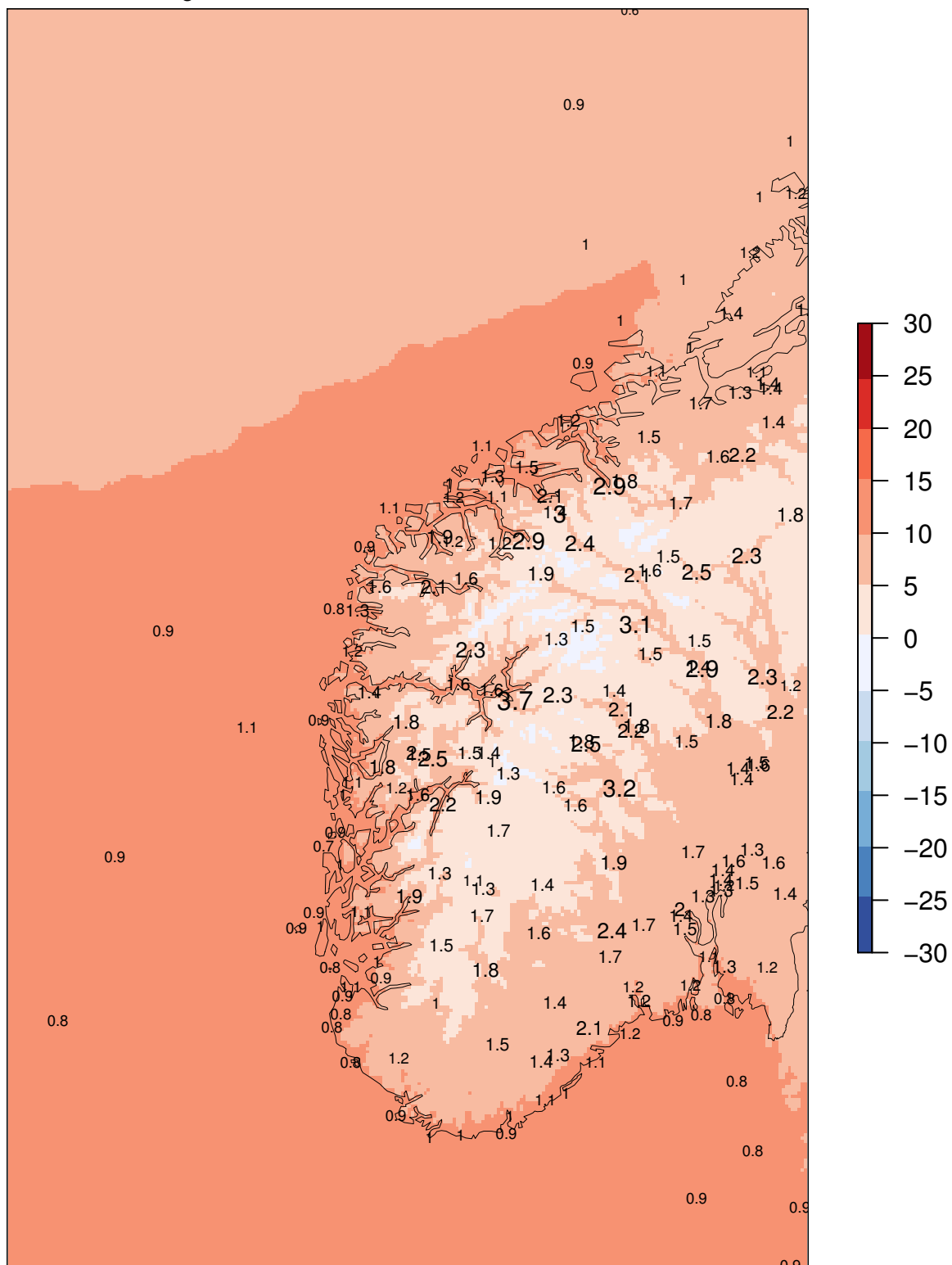
forecast means 01.09.2015 – 30.11.2015



AM25 00+12

SDE at observing sites

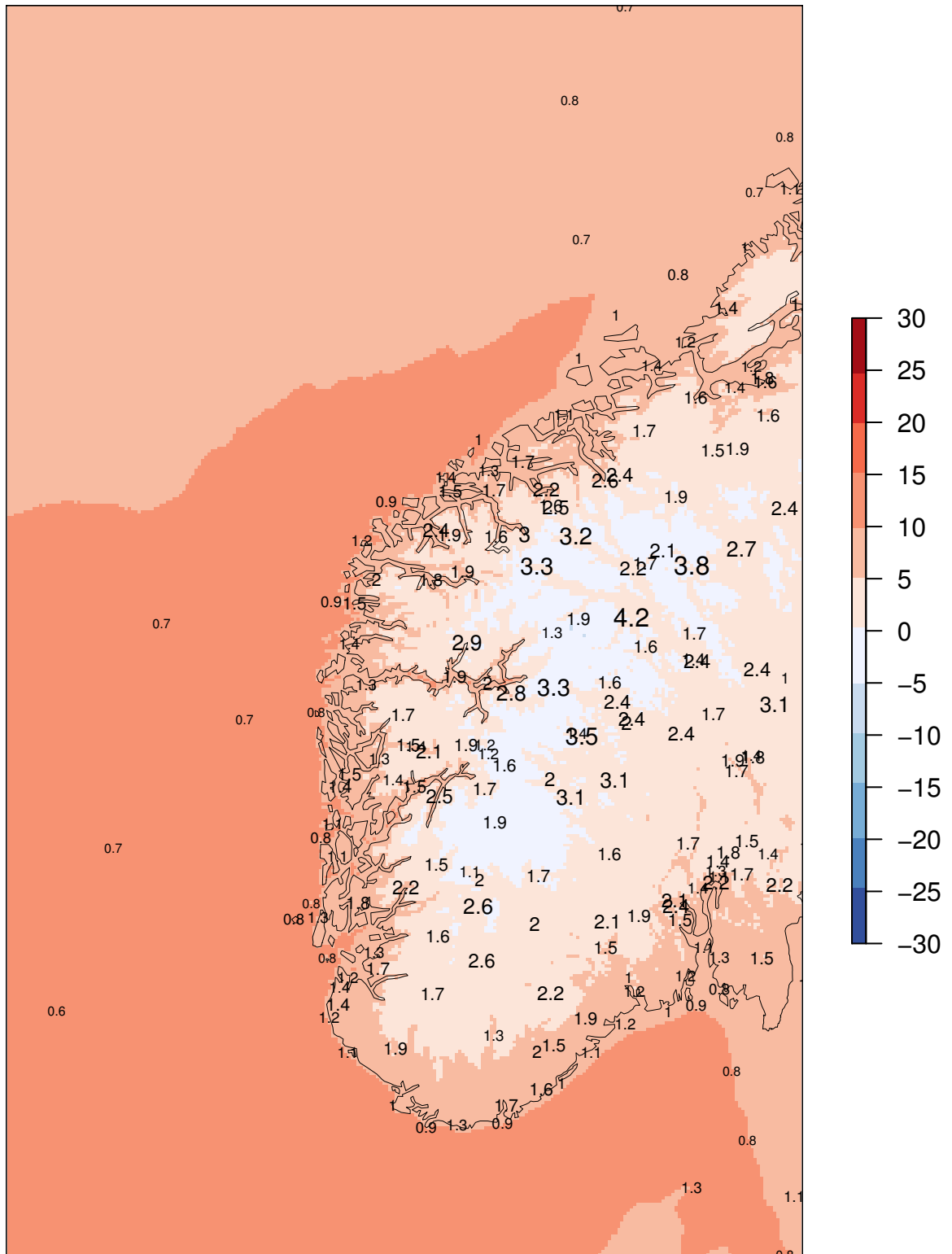
forecast means 01.09.2015 – 30.11.2015



AM25 00+24

SDE at observing sites

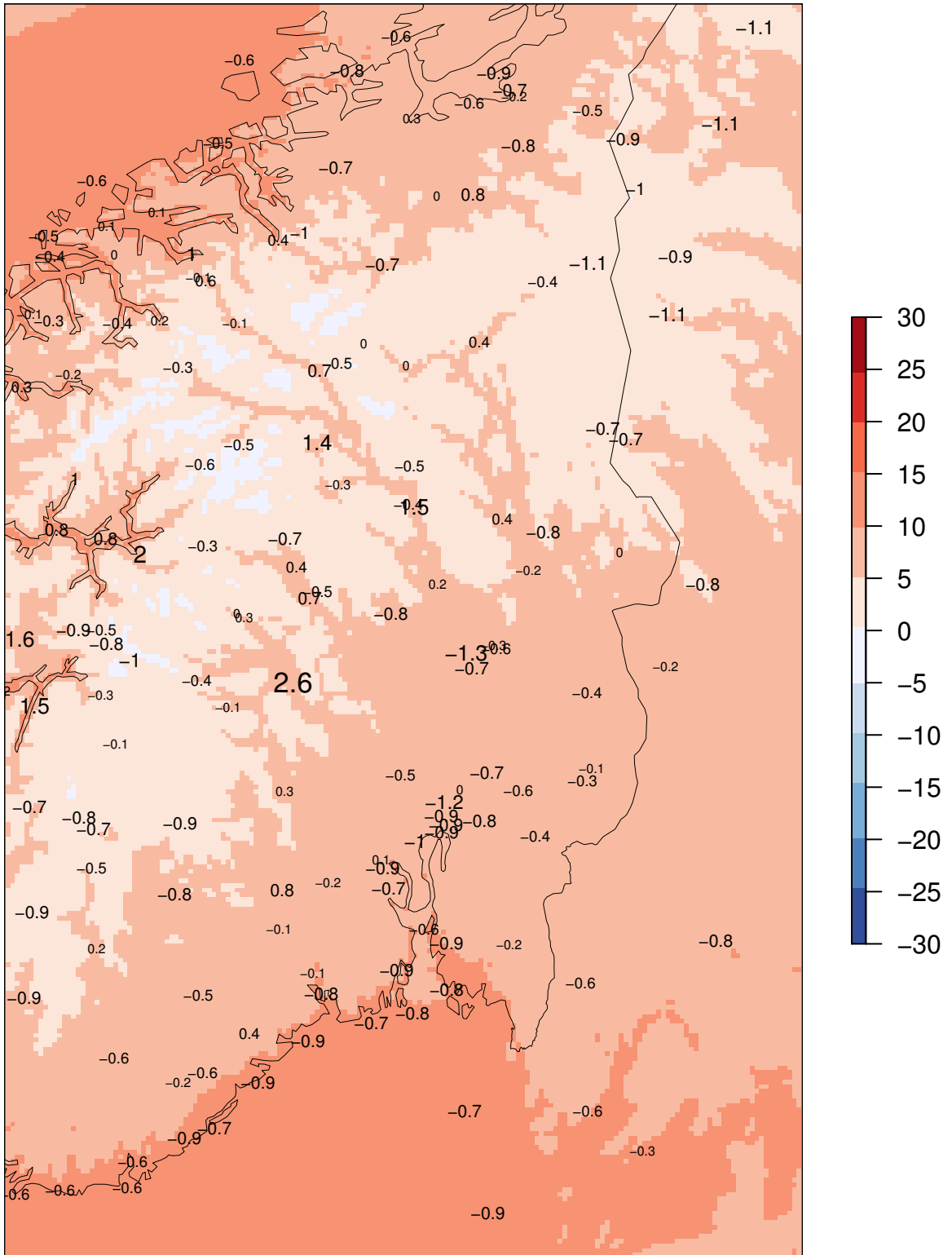
forecast means 01.09.2015 – 30.11.2015



AM25 00+12

ME at observing sites

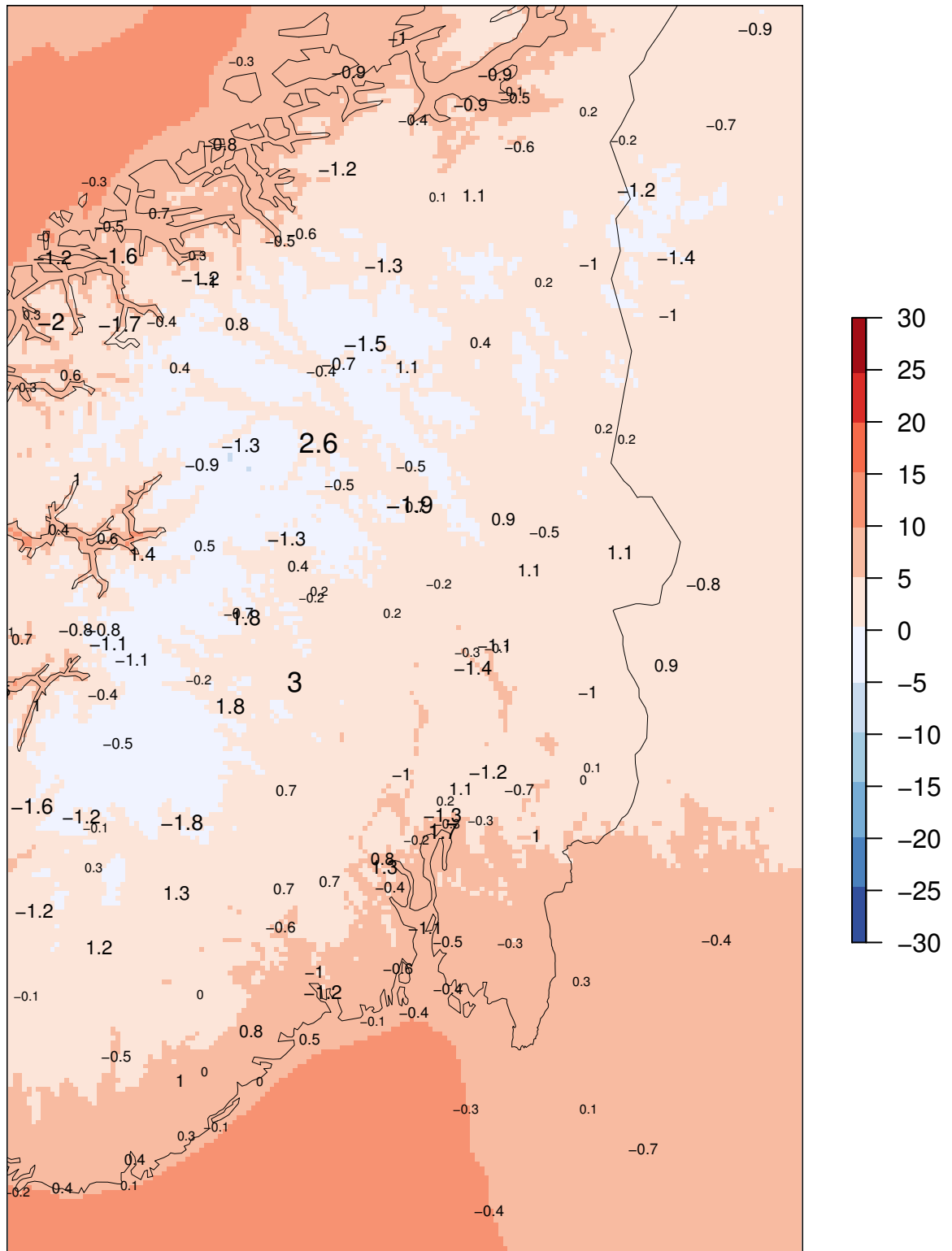
forecast means 01.09.2015 – 30.11.2015



AM25 00+24

ME at observing sites

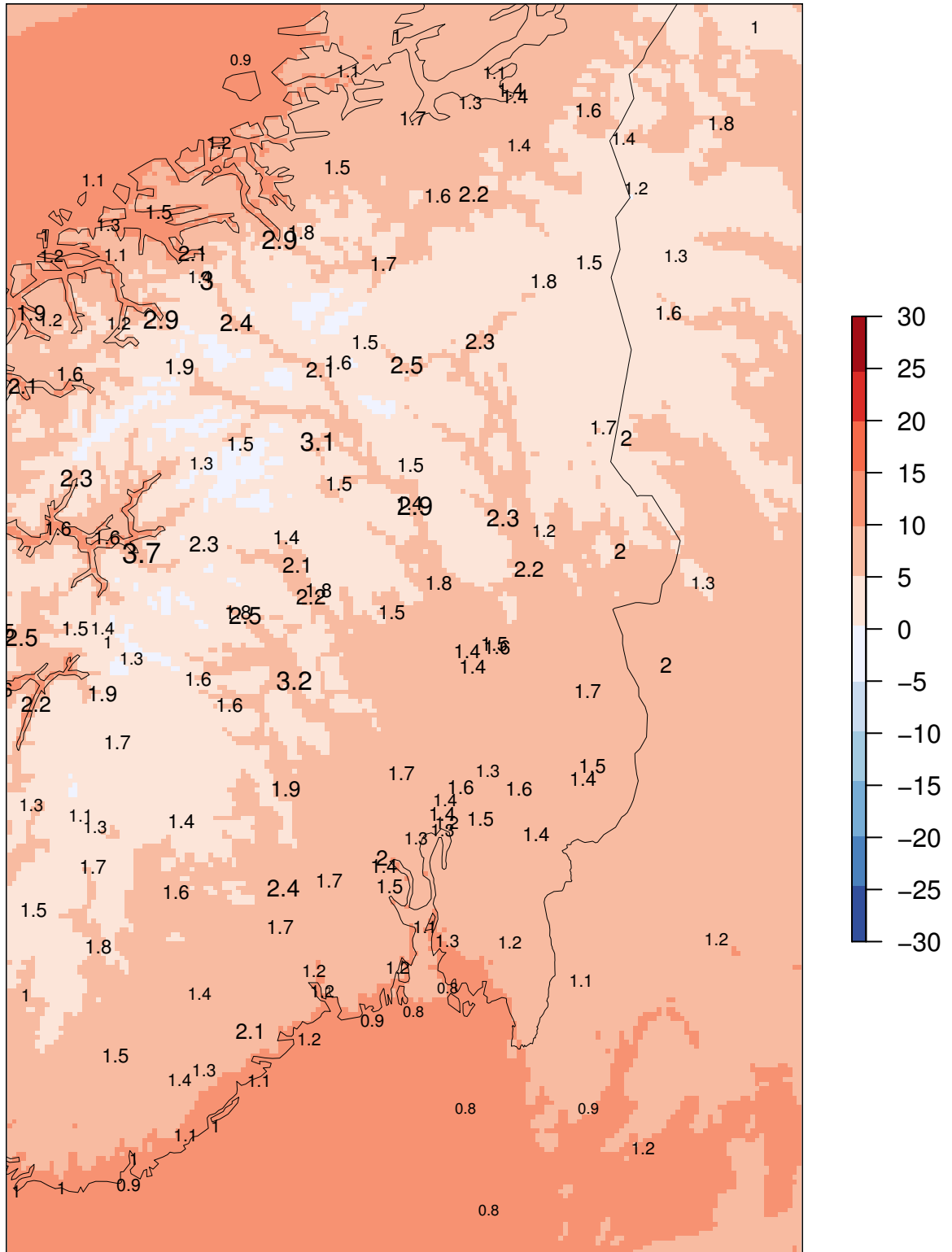
forecast means 01.09.2015 – 30.11.2015



AM25 00+12

SDE at observing sites

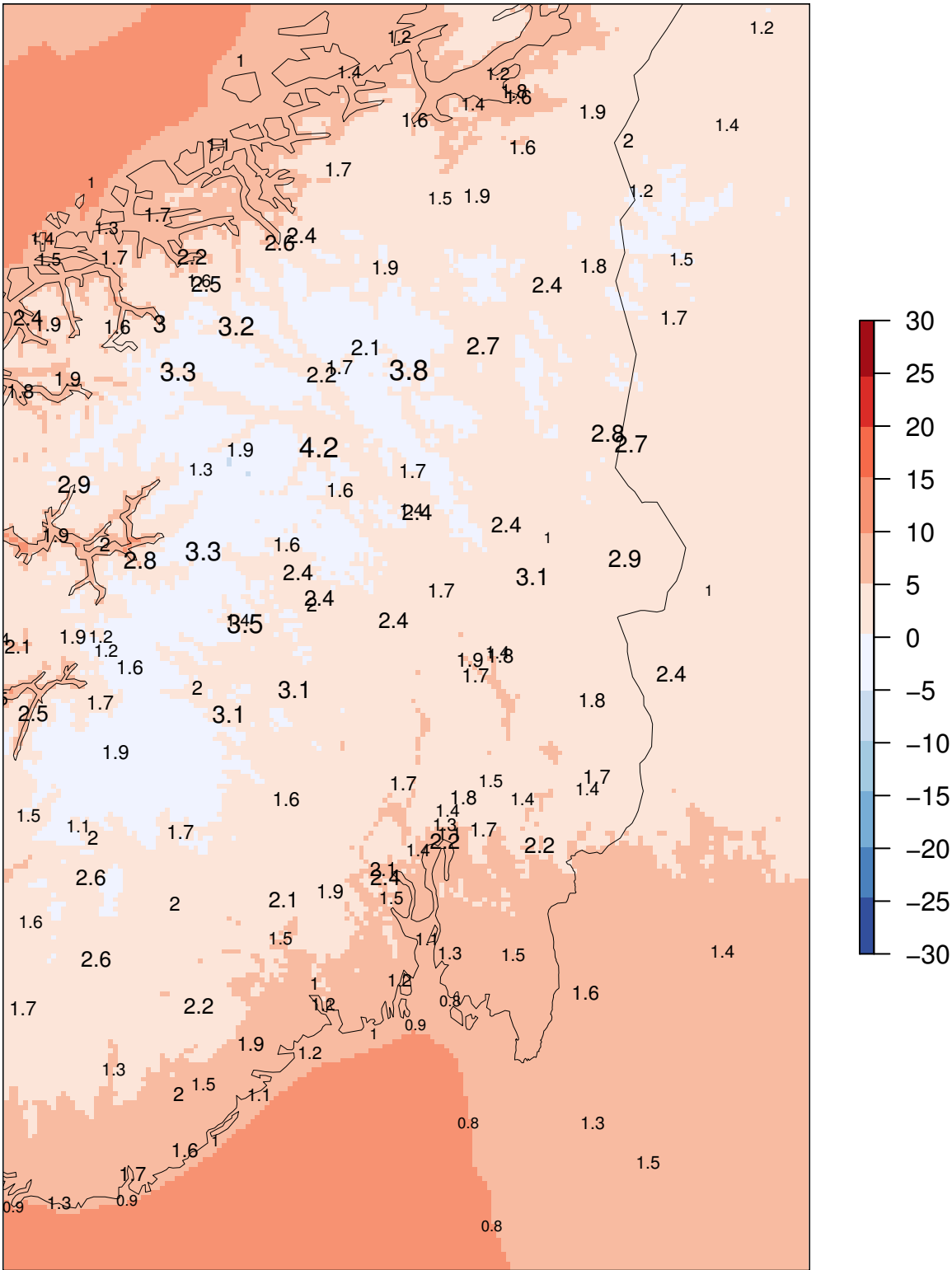
forecast means 01.09.2015 – 30.11.2015



AM25 00+24

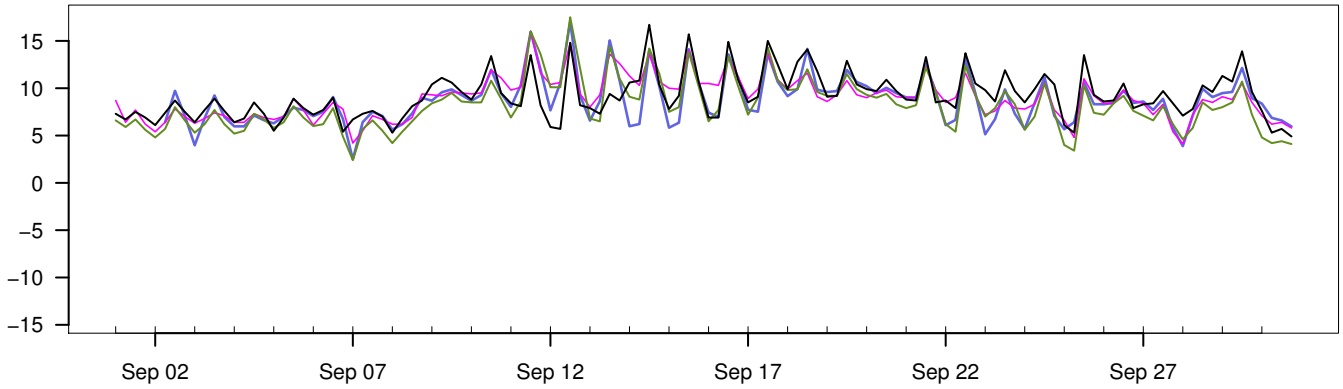
SDE at observing sites

forecast means 01.09.2015 – 30.11.2015

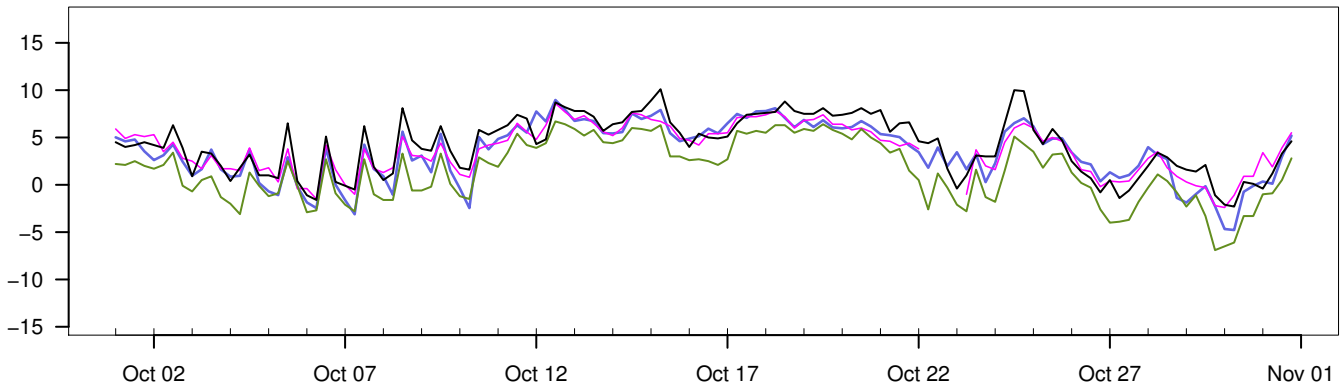


TROMSØ

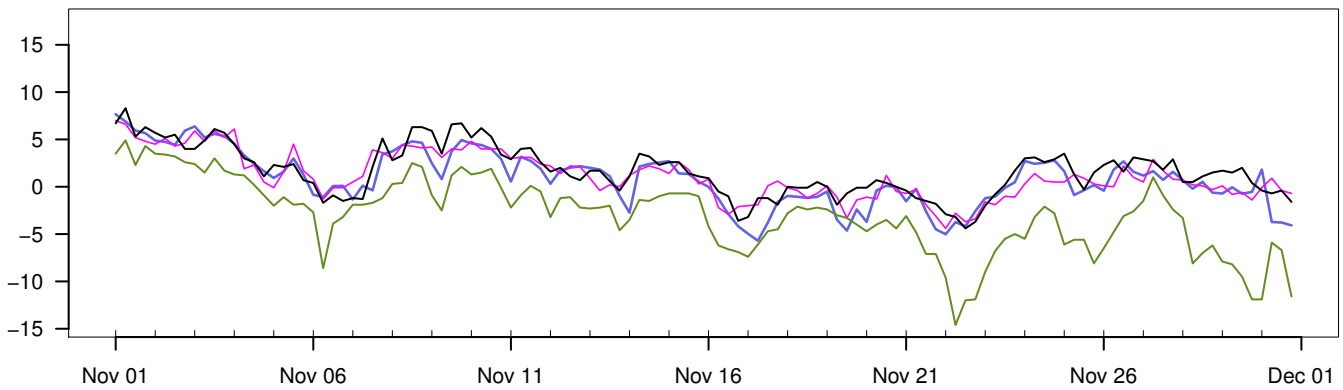
01.09.2015 – 30.09.2015



01.10.2015 – 31.10.2015



01.11.2015 – 30.11.2015



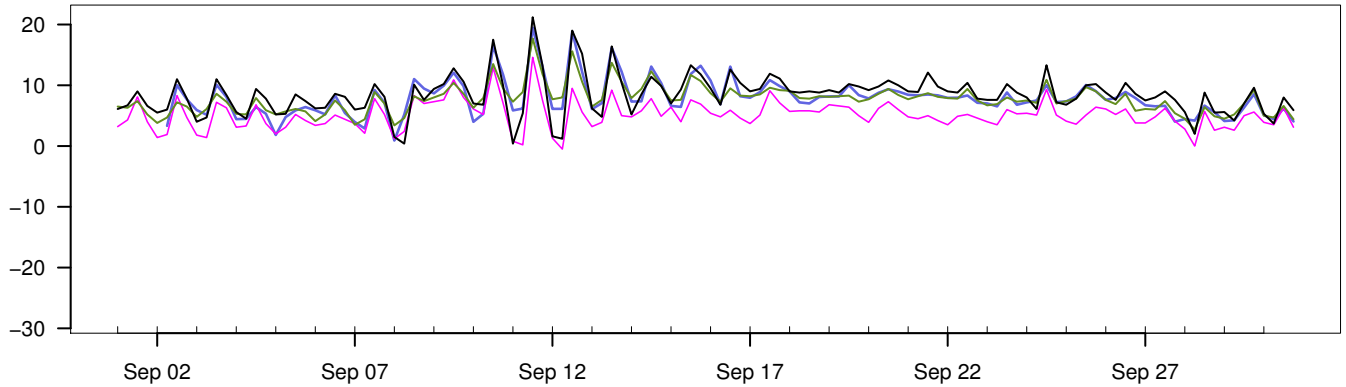
01.09.2015 – 30.11.2015

	Min	Mean	Max	Std	N
— synop: 00,06,12,18	-4.4	5	16.7	4.1	364
— AM25: 12+18,+24,+30,+36	-5.7	4.3	17	4.3	359
— Hirlam8: 12+18,+24,+30,+36	-4.4	4.6	16	4	360
— ECMWF: 12+18,+24,+30,+36	-14.6	2.2	17.5	5.6	364

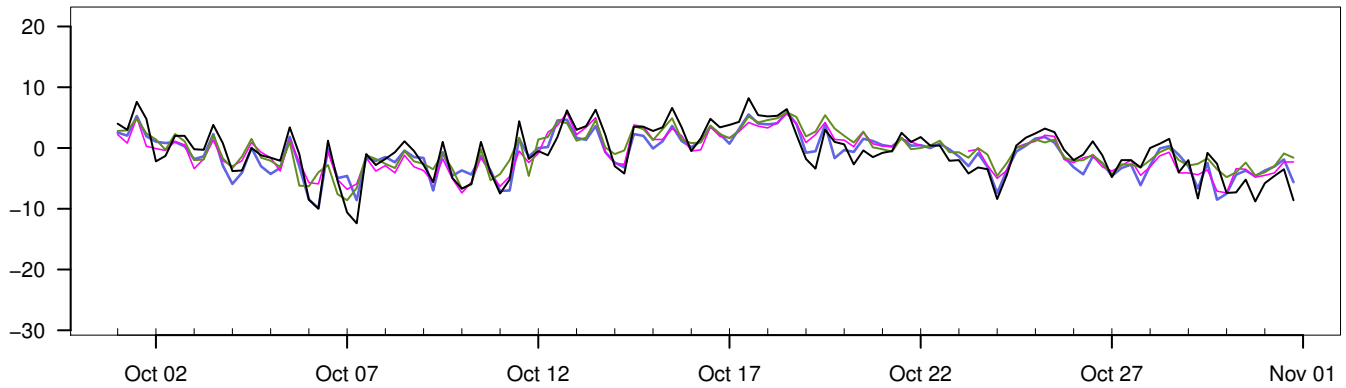
	ME	SDE	RMSE	MAE	Max.abs.err.	N
AM25 – synop	-0.7	1.5	1.6	1.3	5.7	359
Hirlam8 – synop	-0.4	1.4	1.5	1.2	4.9	360
ECMWF – synop	-2.8	2.4	3.6	3	12.3	364

KAUTOKEINO

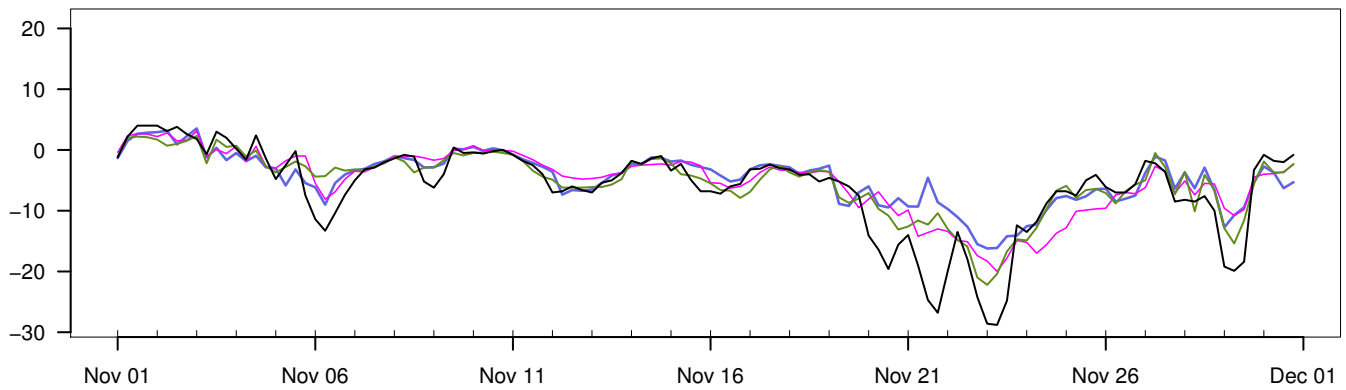
01.09.2015 – 30.09.2015



01.10.2015 – 31.10.2015



01.11.2015 – 30.11.2015



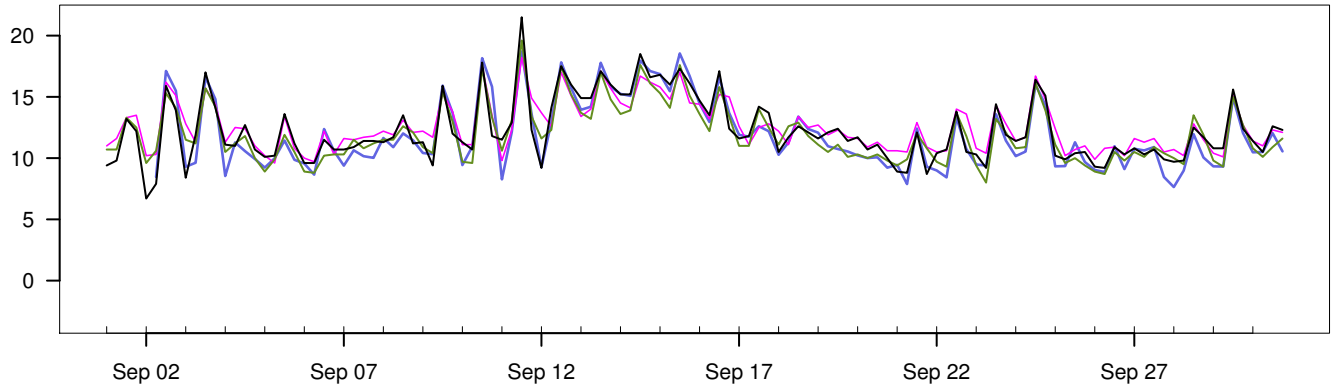
01.09.2015 – 30.11.2015

	Min	Mean	Max	Std	N
— synop: 00,06,12,18	-28.8	0.5	21.2	7.9	364
— AM25: 12+18,+24,+30,+36	-16.2	0.6	19.5	6.3	359
— Hirlam8: 12+18,+24,+30,+36	-20	-0.3	14.6	5.6	360
— ECMWF: 12+18,+24,+30,+36	-22.2	0.6	17.7	6.4	364

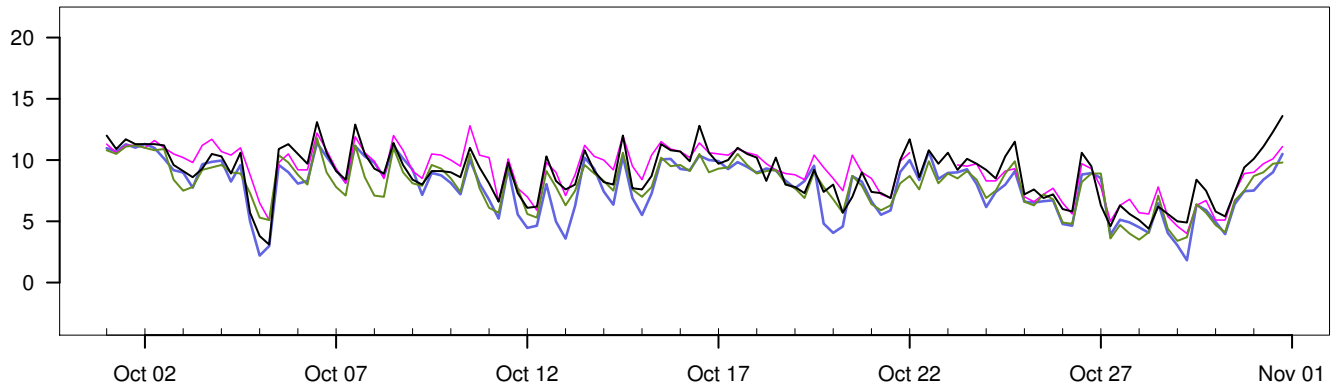
	ME	SDE	RMSE	MAE	Max.abs.err.	N
AM25 – synop	0.2	3	3	1.9	20.1	359
Hirlam8 – synop	-0.8	3.3	3.4	2.6	13.8	360
ECMWF – synop	0.1	2.7	2.7	1.9	16.4	364

ØRLAND

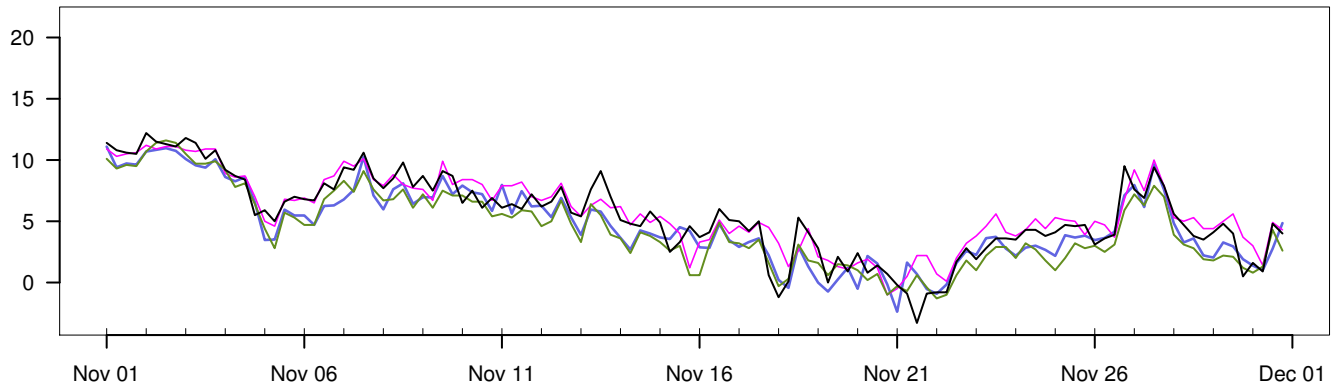
01.09.2015 – 30.09.2015



01.10.2015 – 31.10.2015



01.11.2015 – 30.11.2015



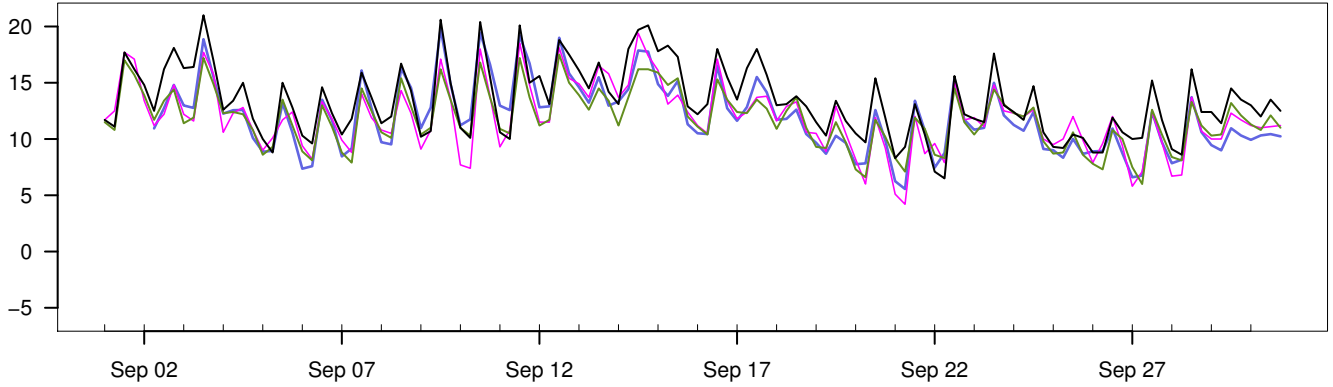
01.09.2015 – 30.11.2015

	Min	Mean	Max	Std	N
— synop: 00,06,12,18	-3.3	8.9	21.5	3.9	364
— AM25: 12+18,+24,+30,+36	-2.4	8.1	18.7	4	359
— Hirlam8: 12+18,+24,+30,+36	-1	9.2	18.2	3.6	360
— ECMWF: 12+18,+24,+30,+36	-1.3	8.1	19.6	4	364

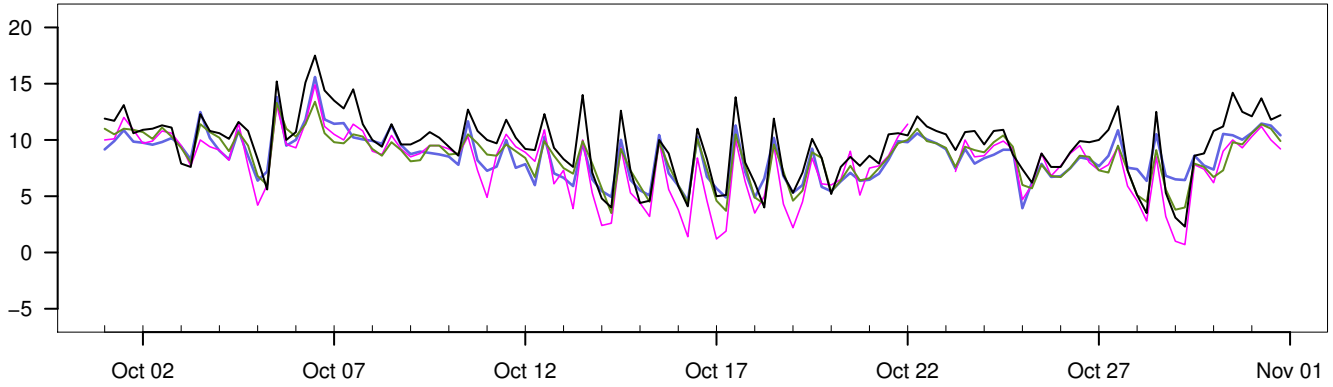
	ME	SDE	RMSE	MAE	Max.abs.err.	N
AM25 – synop	-0.7	1.1	1.3	1.1	4	359
Hirlam8 – synop	0.3	1.2	1.2	0.9	5.5	360
ECMWF – synop	-0.8	1.1	1.3	1.1	4	364

BERGEN – FLORIDA

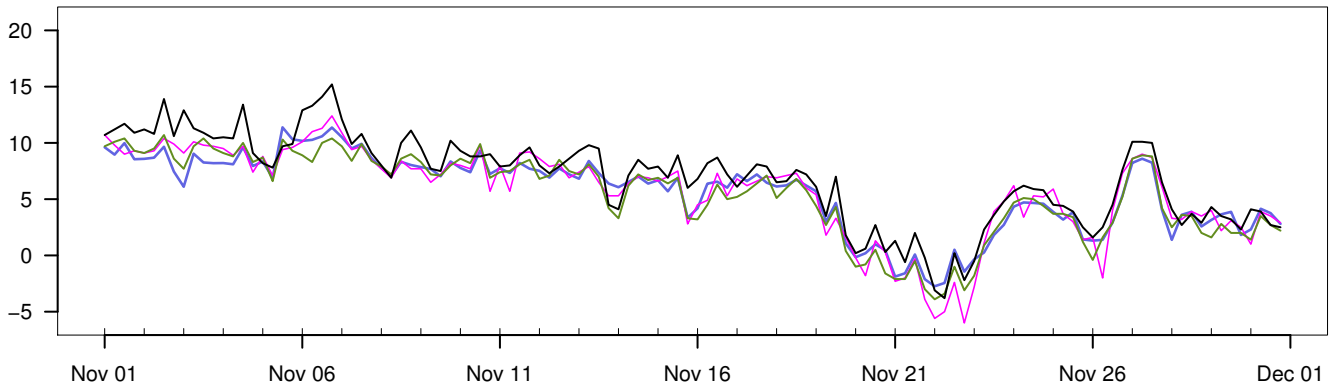
01.09.2015 – 30.09.2015



01.10.2015 – 31.10.2015



01.11.2015 – 30.11.2015



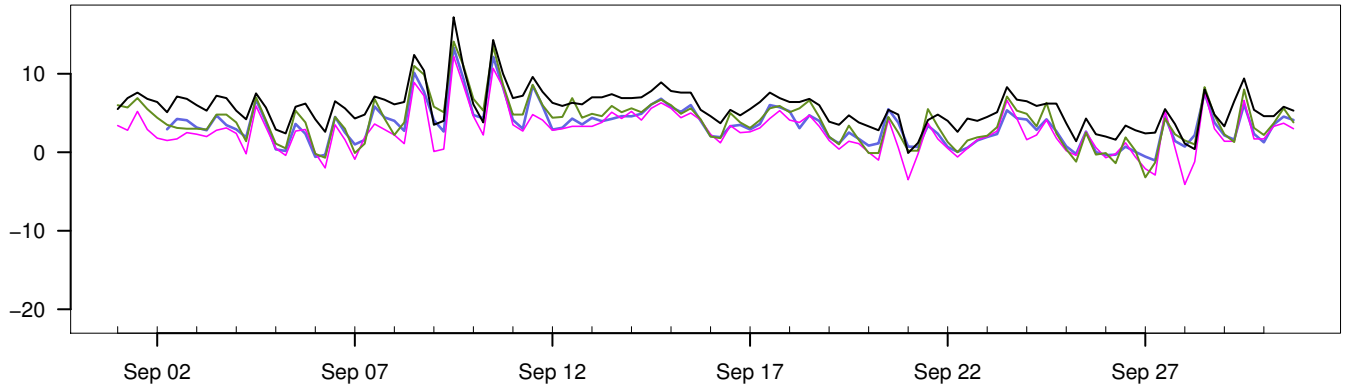
01.09.2015 – 30.11.2015

	Min	Mean	Max	Std	N
— synop: 00,06,12,18	-3.8	9.9	21	4.3	364
— AM25: 12+18,+24,+30,+36	-2.7	8.6	19.8	3.8	359
— Hirlam8: 12+18,+24,+30,+36	-6	8.5	19.4	4.1	360
— ECMWF: 12+18,+24,+30,+36	-3.9	8.5	17.5	3.8	364

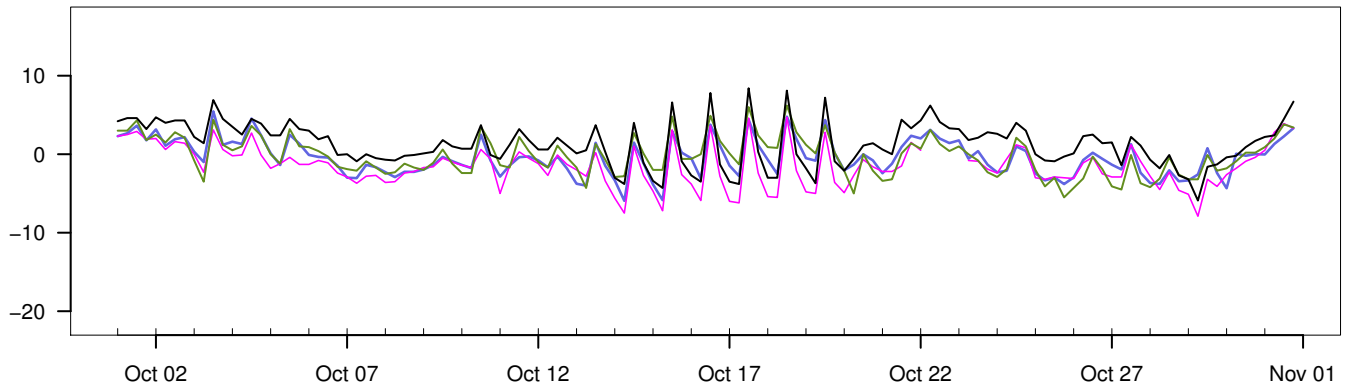
	ME	SDE	RMSE	MAE	Max.abs.err.	N
AM25 – synop	-1.2	1.4	1.9	1.6	6.8	359
Hirlam8 – synop	-1.4	1.4	2	1.6	5.2	360
ECMWF – synop	-1.4	1.3	1.9	1.5	5.2	364

FINSEVATN

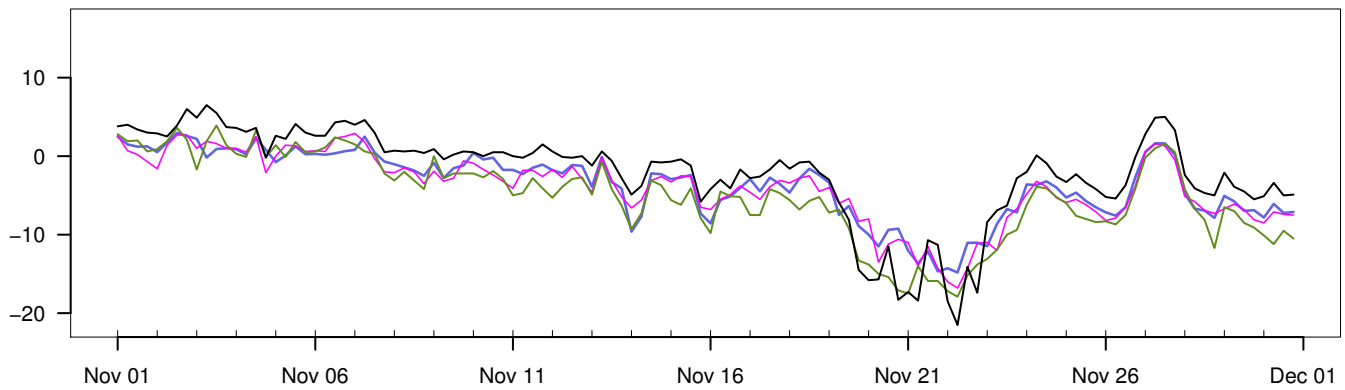
01.09.2015 – 30.09.2015



01.10.2015 – 31.10.2015



01.11.2015 – 30.11.2015



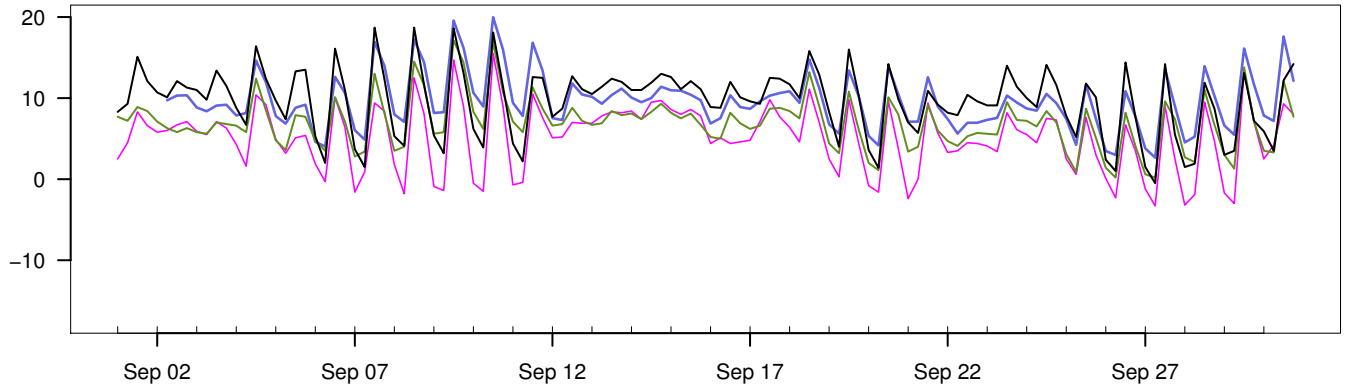
01.09.2015 – 30.11.2015

	Min	Mean	Max	Std	N
— synop: 00,06,12,18	-21.5	1.6	17.2	5.1	364
— AM25: 12+18,+24,+30,+36	-14.8	-0.3	13.3	4.3	359
— Hirlam8: 12+18,+24,+30,+36	-16.8	-0.9	12.2	4.3	360
— ECMWF: 12+18,+24,+30,+36	-17.9	-0.5	14.1	5.3	364

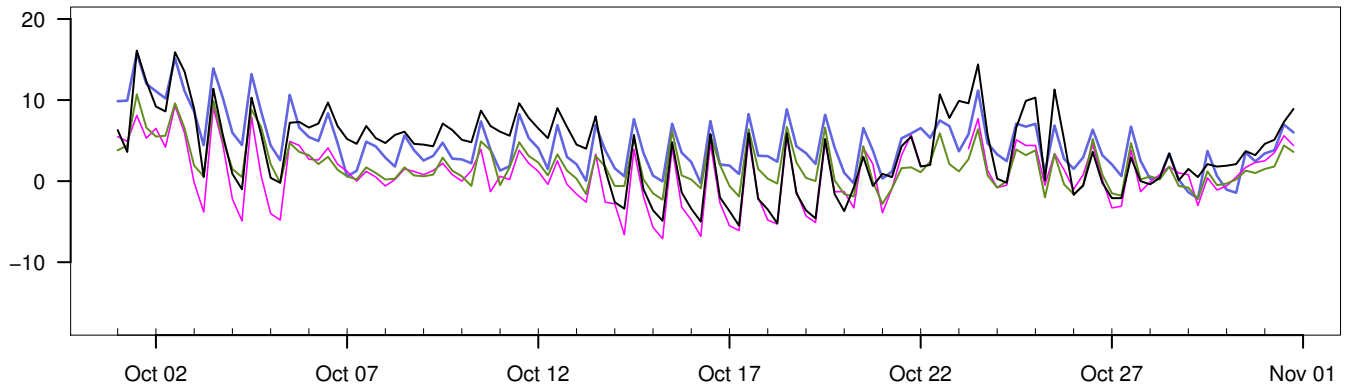
	ME	SDE	RMSE	MAE	Max.abs.err.	N
AM25 – synop	-1.8	1.8	2.6	2.3	9.1	359
Hirlam8 – synop	-2.5	1.7	3	2.8	7.8	360
ECMWF – synop	-2	2	2.8	2.5	7.8	364

NESBYEN

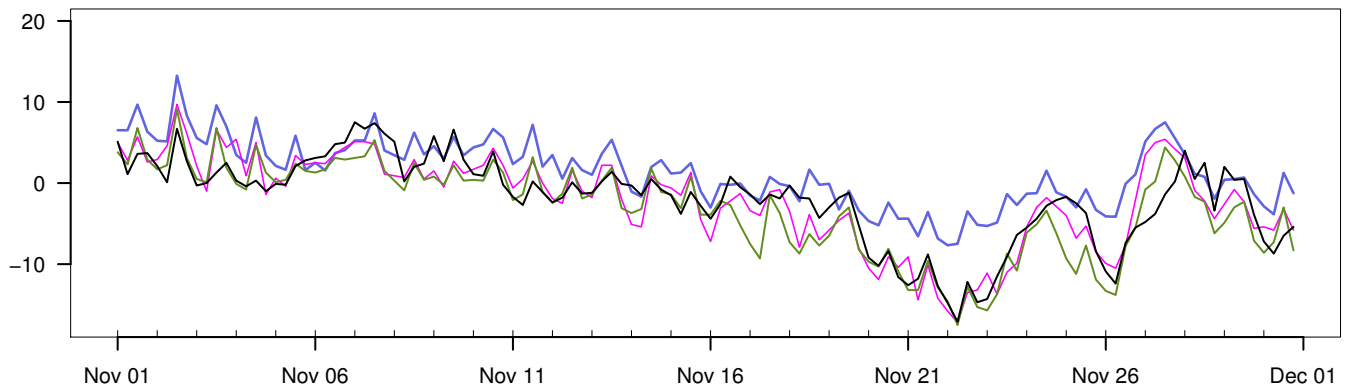
01.09.2015 – 30.09.2015



01.10.2015 – 31.10.2015



01.11.2015 – 30.11.2015



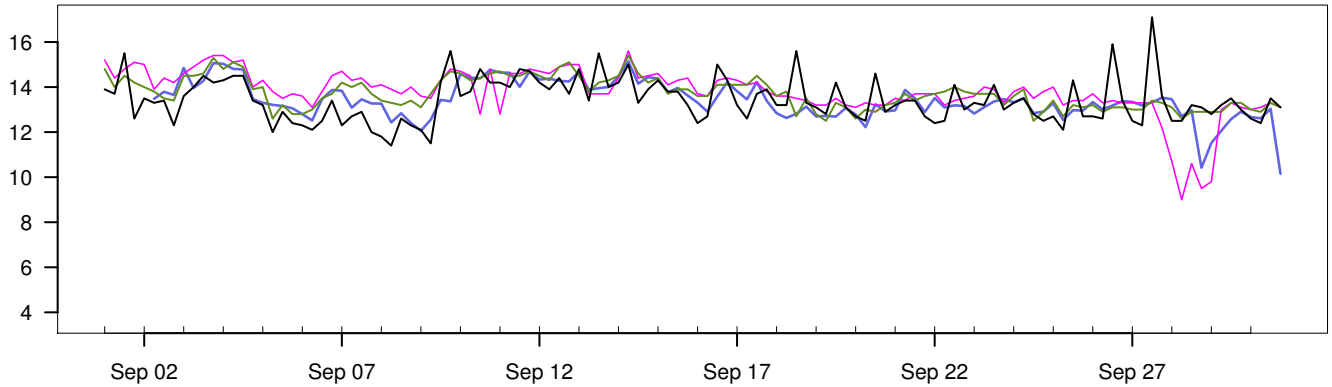
01.09.2015 – 30.11.2015

	Min	Mean	Max	Std	N
— synop: 00,06,12,18	-17.1	3.8	18.7	6.7	364
— AM25: 12+18,+24,+30,+36	-7.7	5.1	20	5	359
— Hirlam8: 12+18,+24,+30,+36	-17.2	1.3	15.5	5.4	360
— ECMWF: 12+18,+24,+30,+36	-17.5	1.9	17.1	5.7	364

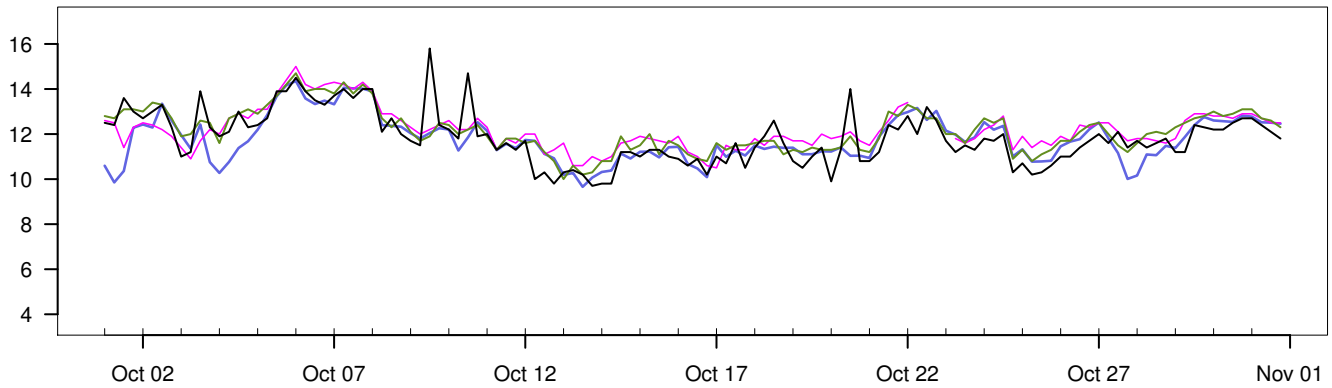
	ME	SDE	RMSE	MAE	Max.abs.err.	N
AM25 – synop	1.4	3.3	3.5	2.9	10.5	359
Hirlam8 – synop	-2.5	3	3.9	3.2	9.4	360
ECMWF – synop	-1.9	2.8	3.4	2.8	8.7	364

EKOFISK

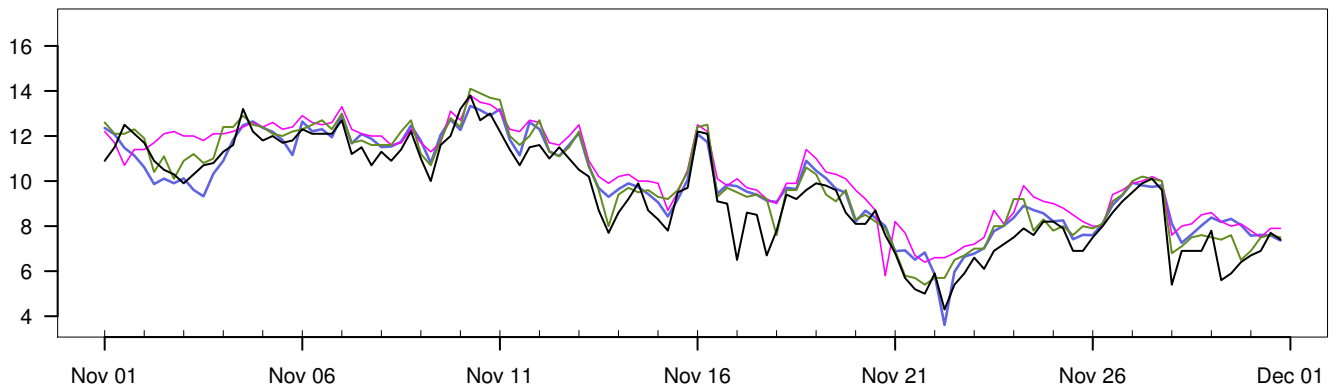
01.09.2015 – 30.09.2015



01.10.2015 – 31.10.2015



01.11.2015 – 30.11.2015



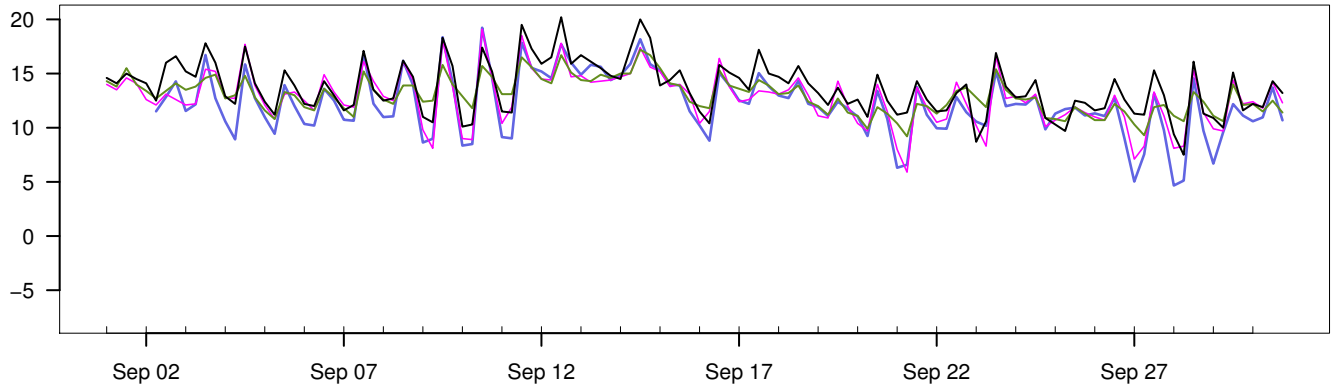
01.09.2015 – 30.11.2015

	Min	Mean	Max	Std	N
— synop: 00,06,12,18	4.3	11.6	17.1	2.3	364
— AM25: 12+18,+24,+30,+36	3.6	11.7	15.1	2	359
— Hirlam8: 12+18,+24,+30,+36	5.8	12.1	15.6	2	360
— ECMWF: 12+18,+24,+30,+36	5.4	11.9	15.4	2.1	364

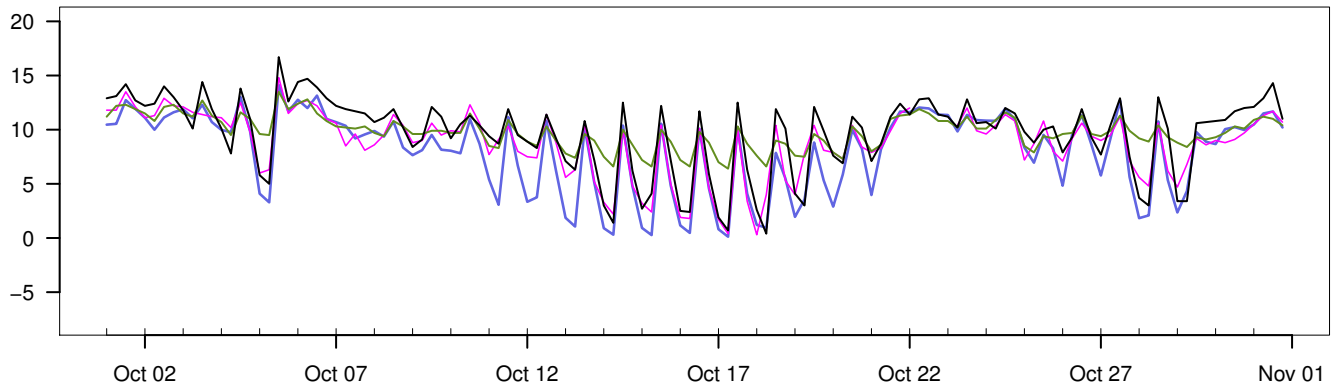
	ME	SDE	RMSE	MAE	Max.abs.err.	N
AM25 – synop	0.1	0.9	0.9	0.6	3.8	359
Hirlam8 – synop	0.5	1	1.1	0.9	3.8	360
ECMWF – synop	0.4	0.7	0.8	0.6	3.9	364

SOLA

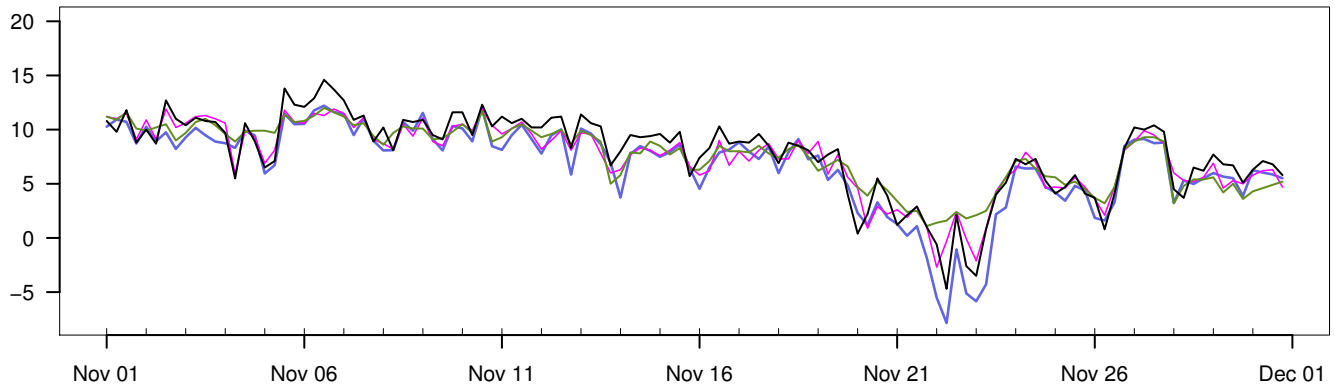
01.09.2015 – 30.09.2015



01.10.2015 – 31.10.2015



01.11.2015 – 30.11.2015



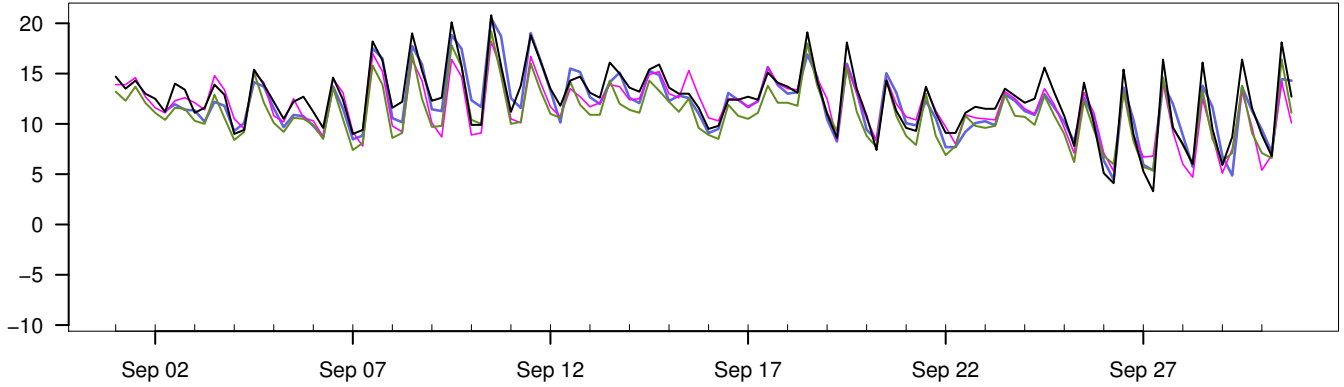
01.09.2015 – 30.11.2015

	Min	Mean	Max	Std	N
— synop: 00,06,12,18	-4.7	10.4	20.2	4	364
— AM25: 12+18,+24,+30,+36	-7.8	8.9	19.2	4.2	359
— Hirlam8: 12+18,+24,+30,+36	-2.7	9.7	19.1	3.7	360
— ECMWF: 12+18,+24,+30,+36	1.1	10.1	17.2	3	364

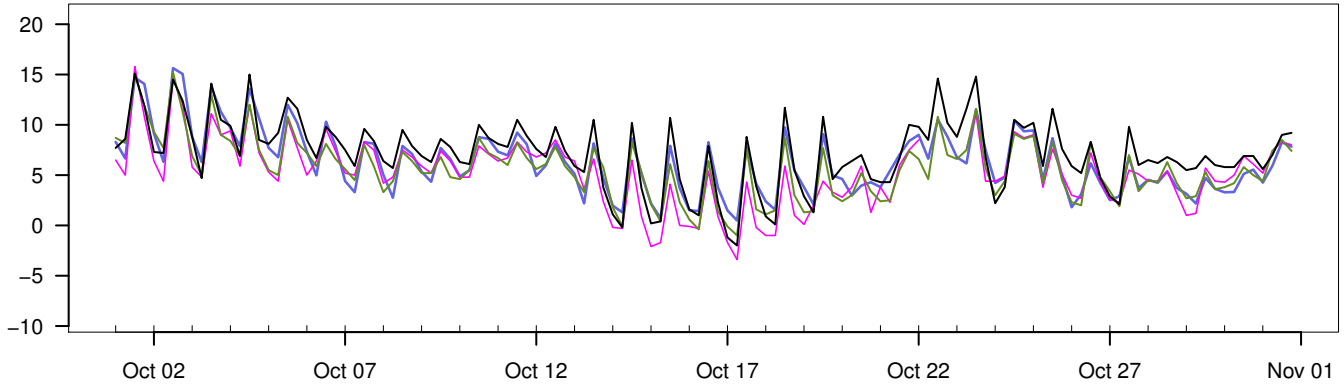
	ME	SDE	RMSE	MAE	Max.abs.err.	N
AM25 – synop	-1.4	1.3	1.9	1.6	6.3	359
Hirlam8 – synop	-0.7	1.3	1.5	1.2	5.5	360
ECMWF – synop	-0.3	1.8	1.8	1.4	6.3	364

OSLO – BLINDERN

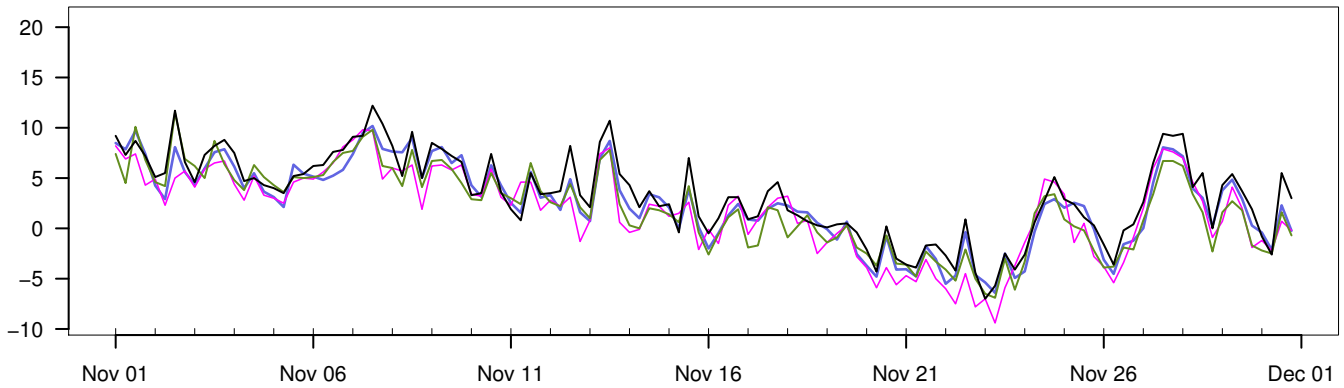
01.09.2015 – 30.09.2015



01.10.2015 – 31.10.2015



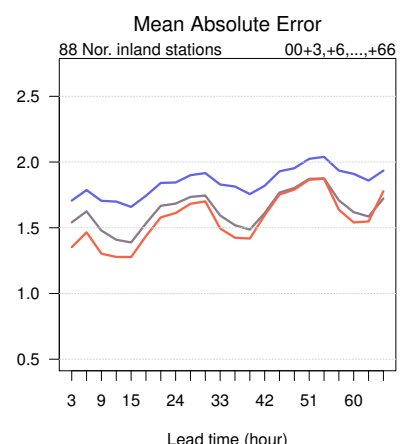
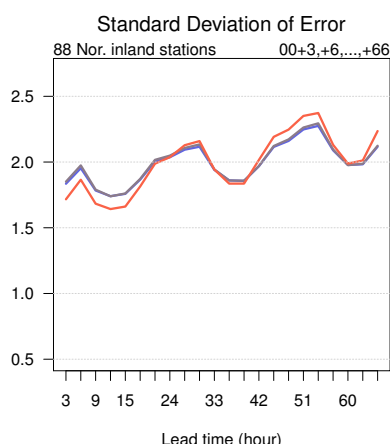
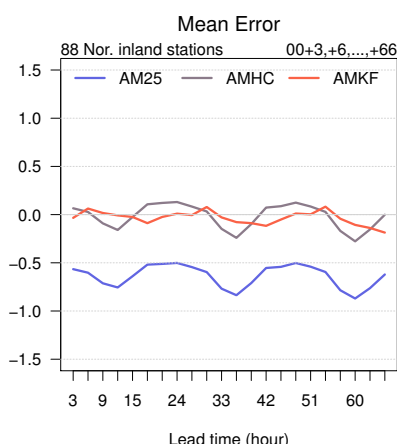
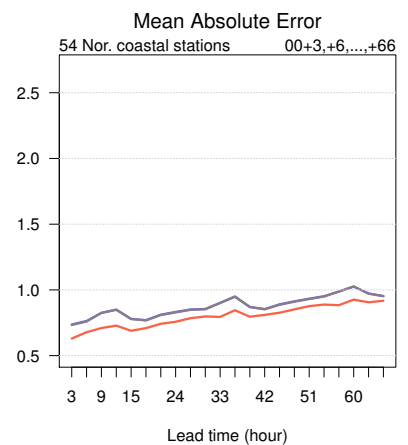
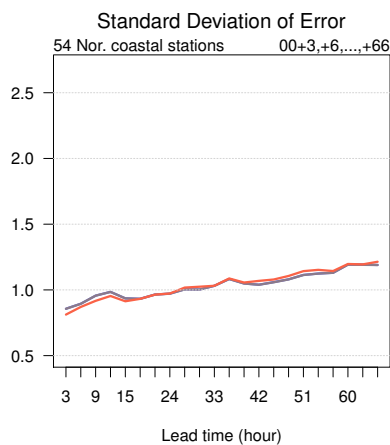
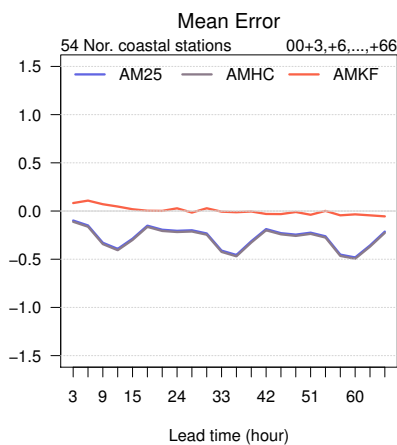
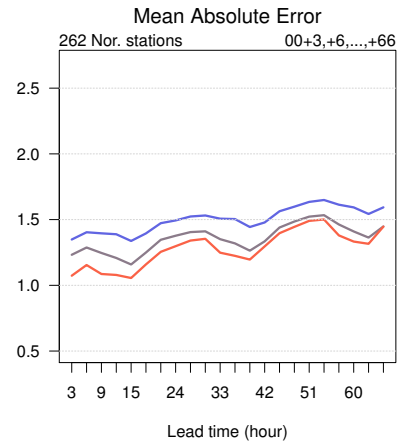
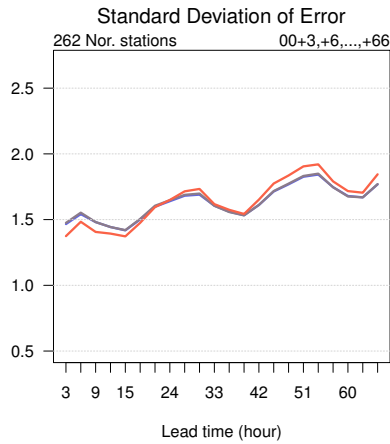
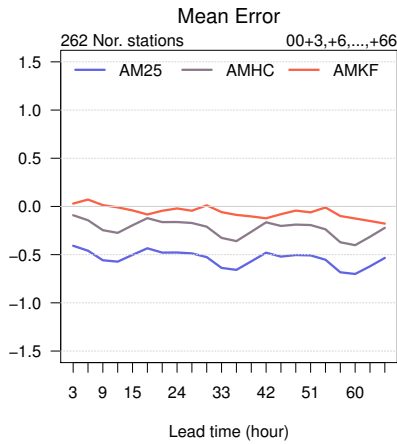
01.11.2015 – 30.11.2015

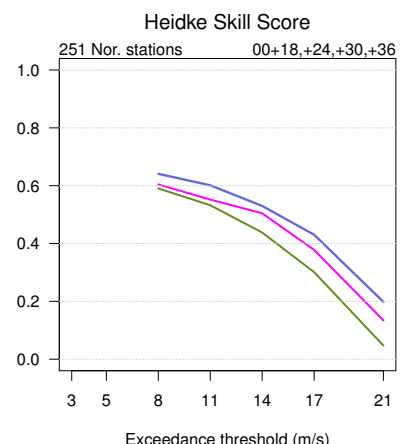
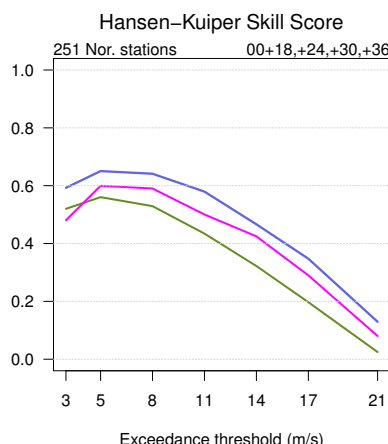
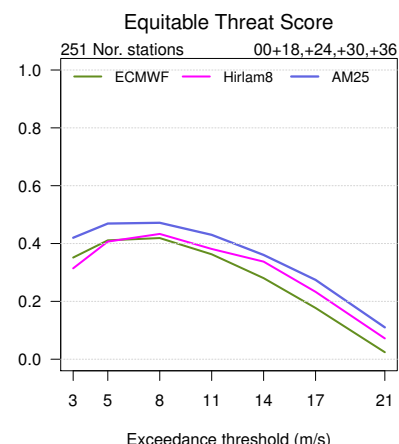
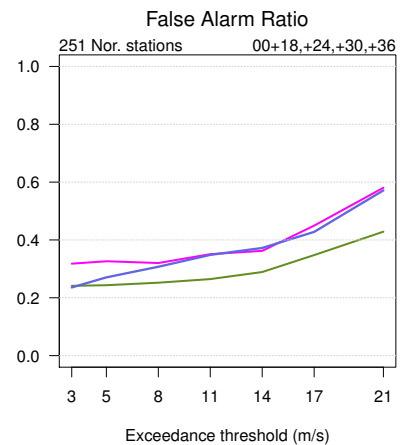
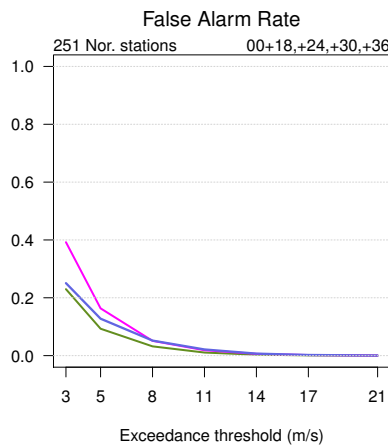
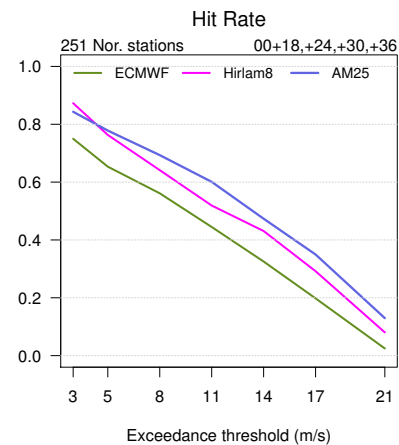
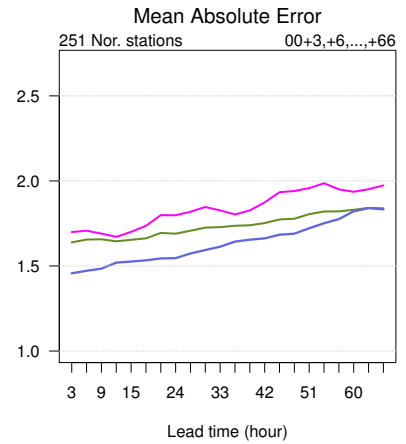
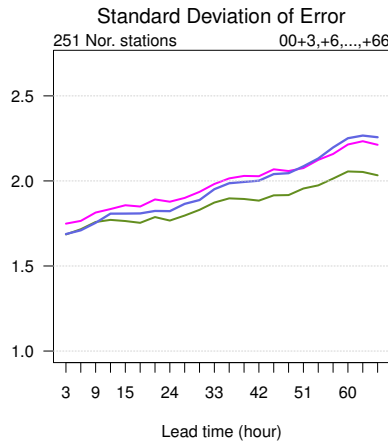
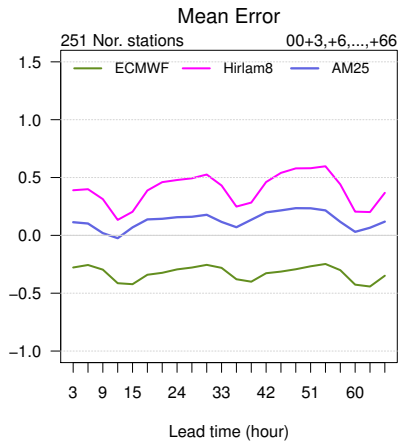


01.09.2015 – 30.11.2015

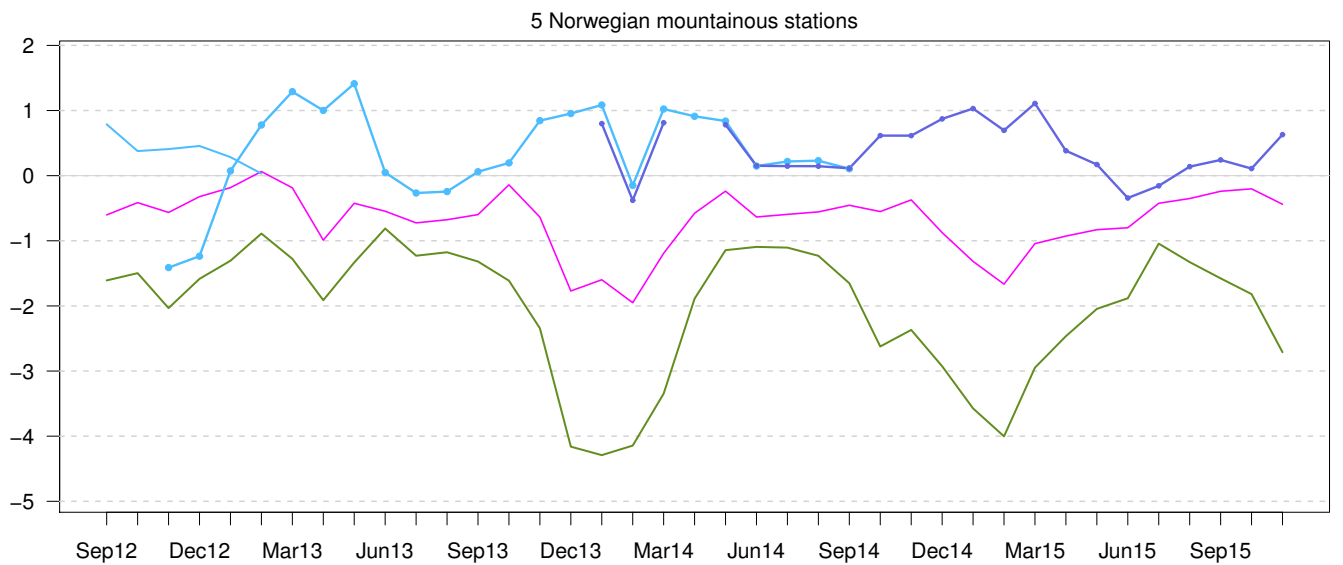
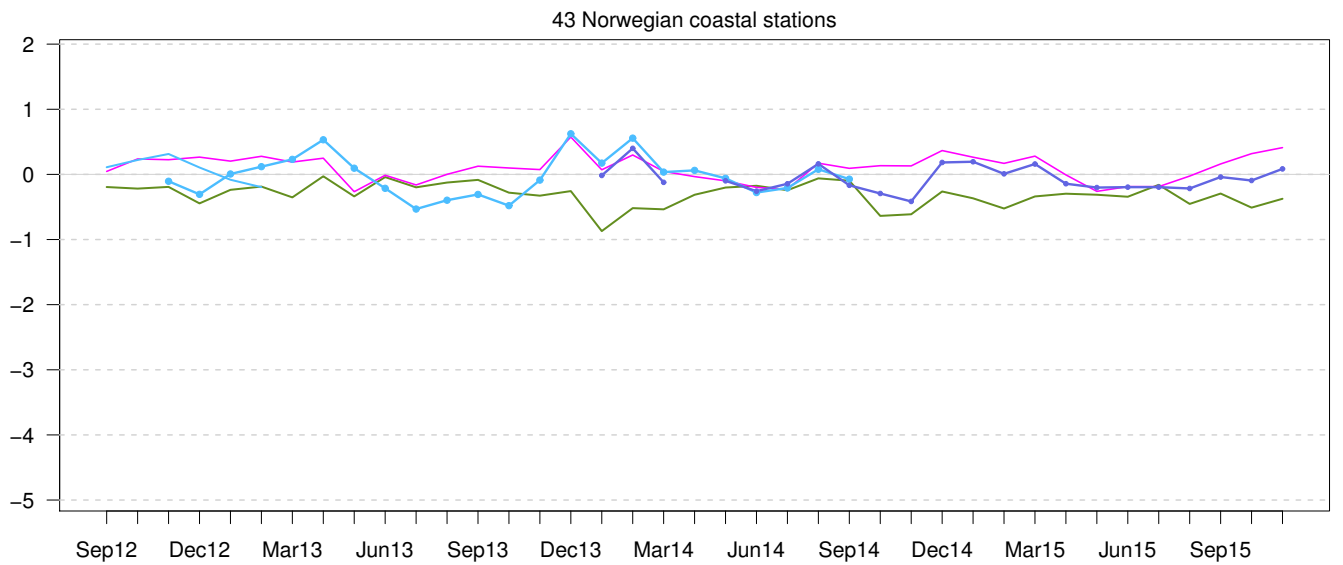
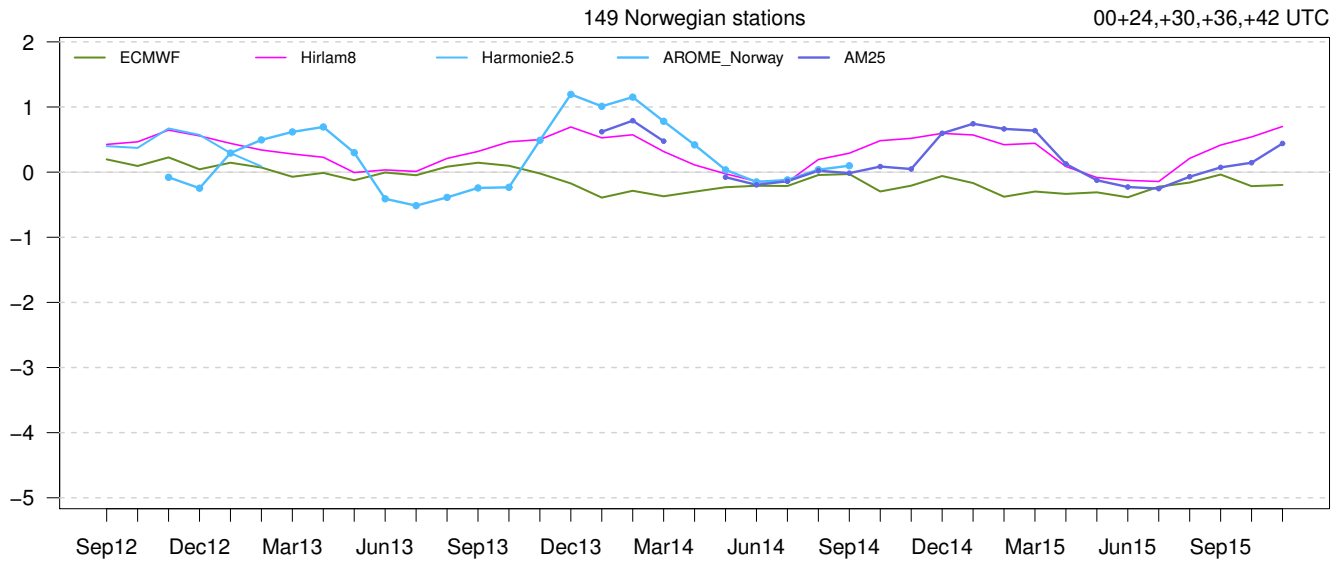
	Min	Mean	Max	Std	N
— synop: 00,06,12,18	-7	7.6	20.8	5.2	364
— AM25: 12+18,+24,+30,+36	-6.4	6.8	20.5	5.1	359
— Hirlam8: 12+18,+24,+30,+36	-9.4	6.2	18.2	5.4	360
— ECMWF: 12+18,+24,+30,+36	-6.9	6.2	19.2	4.9	364

	ME	SDE	RMSE	MAE	Max.abs.err.	N
AM25 – synop	-0.7	1.4	1.5	1.2	5.4	359
Hirlam8 – synop	-1.4	1.6	2.1	1.6	6.7	360
ECMWF – synop	-1.4	1.3	1.9	1.6	4.6	364

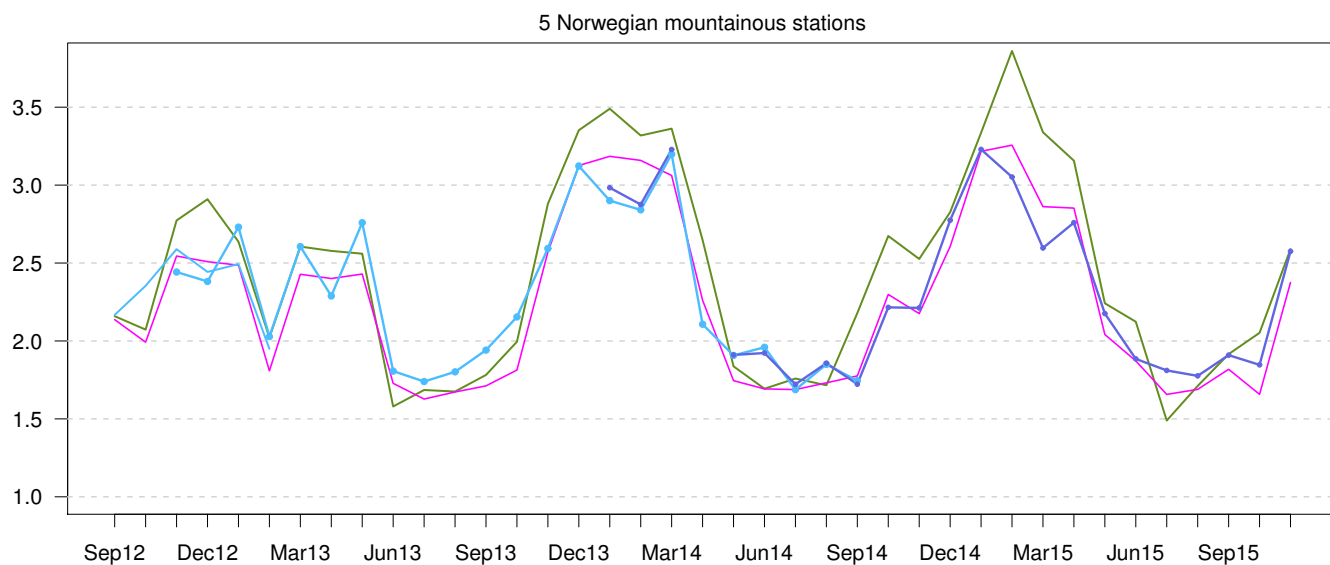
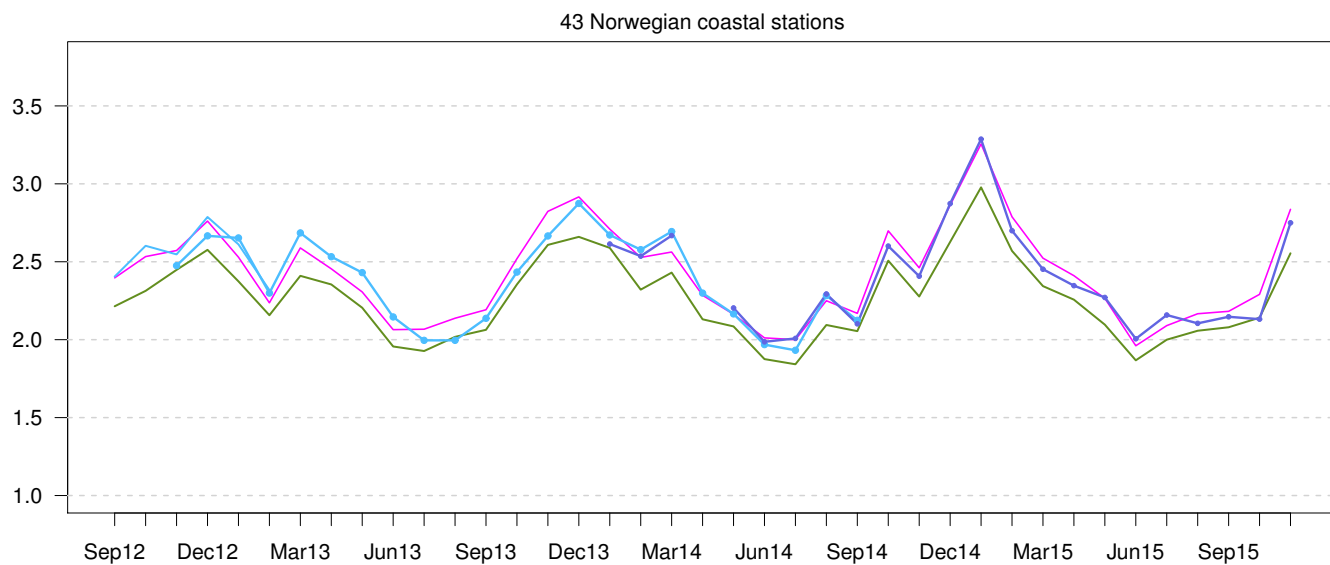
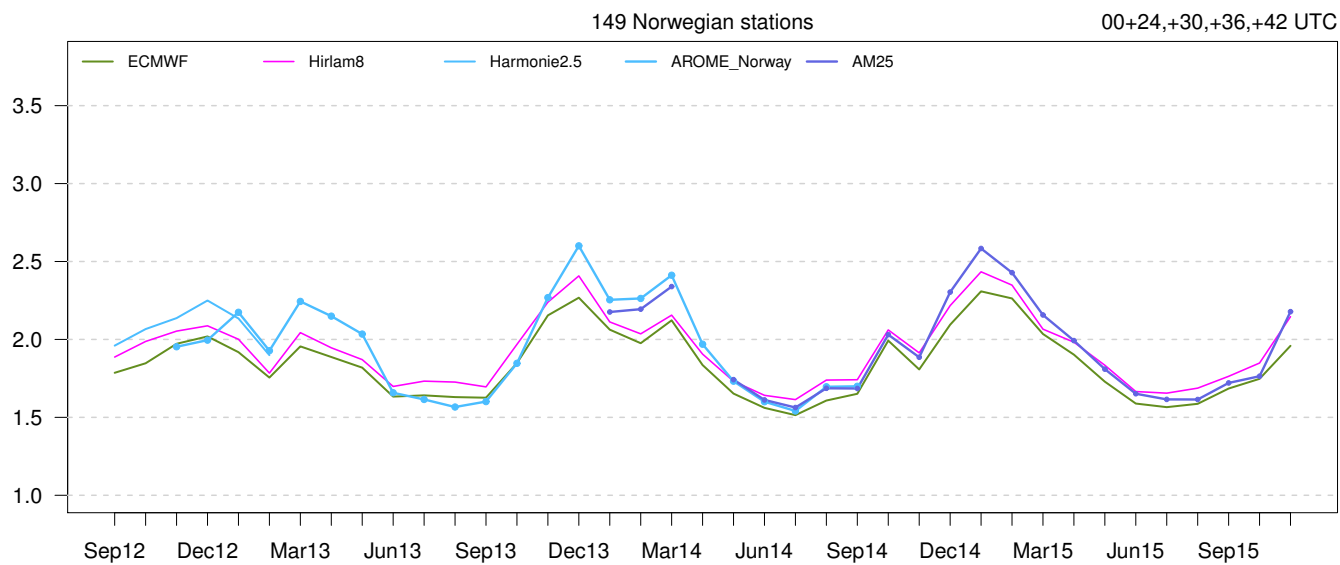




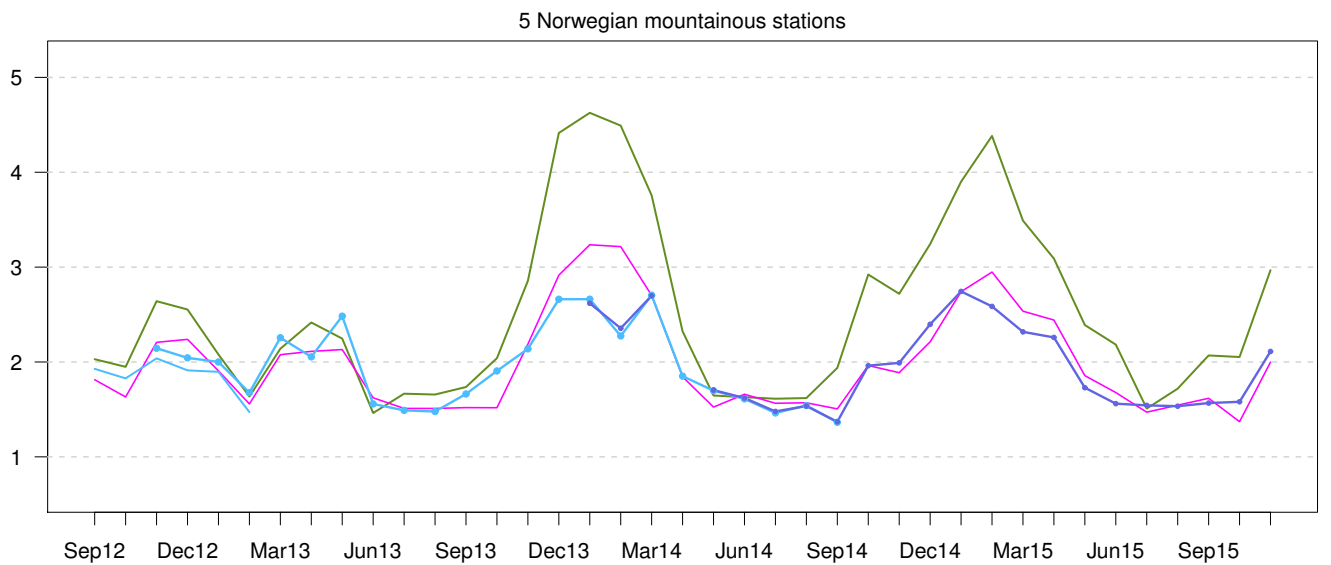
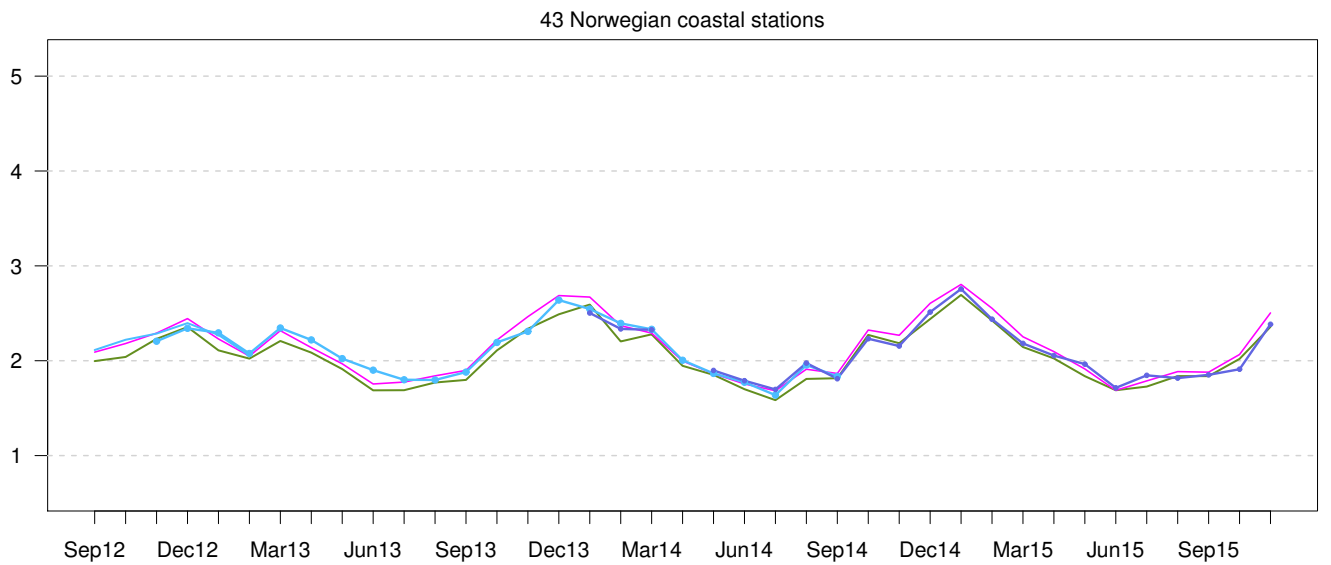
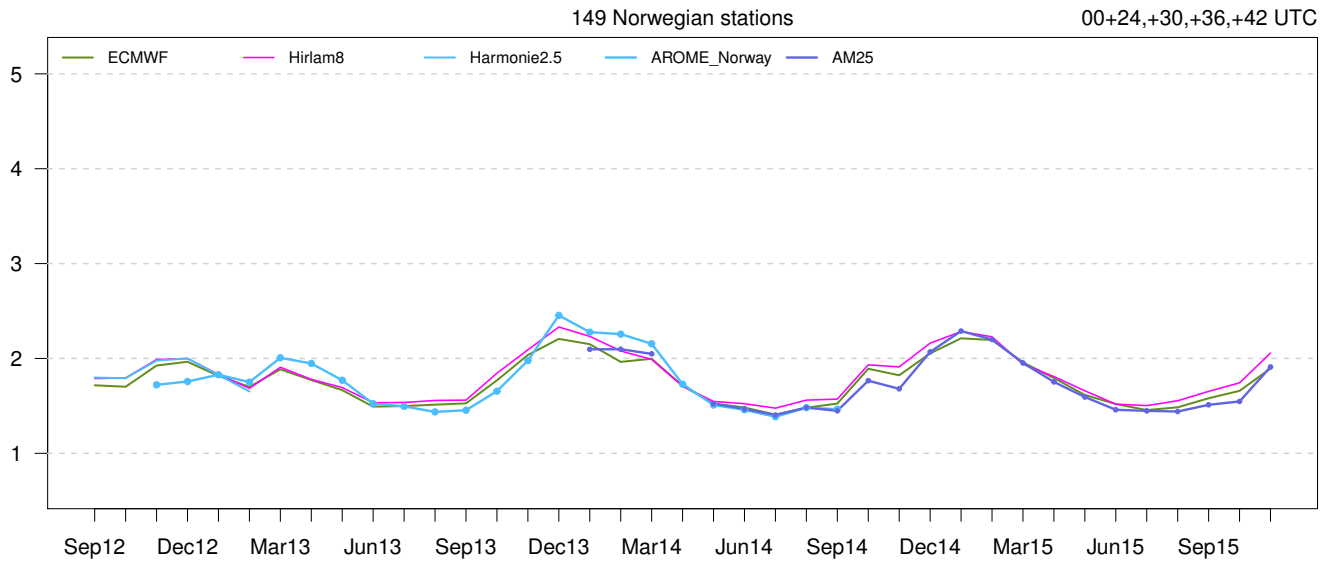
Mean Error



Standard Deviation of Error



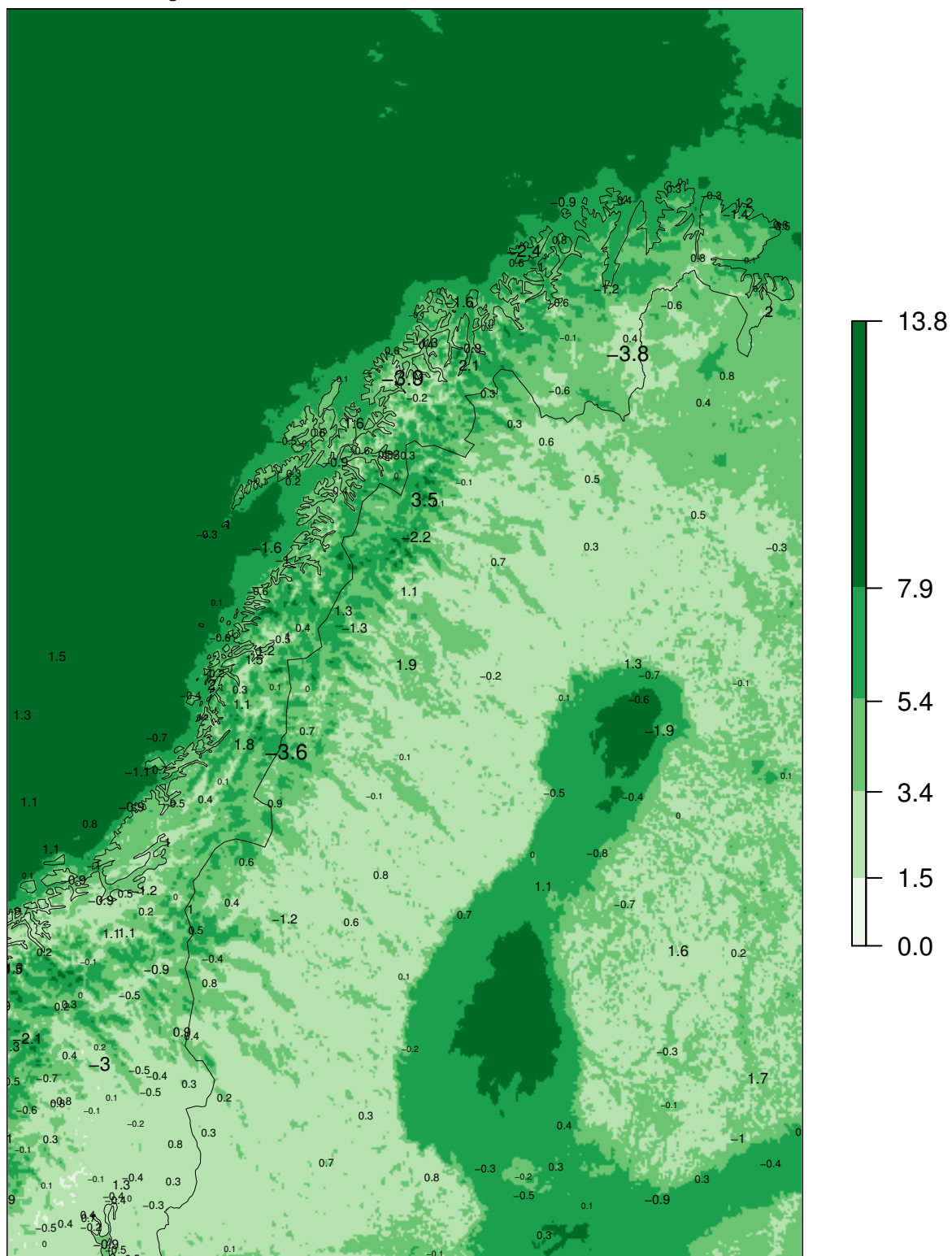
Mean Absolute Error



AM25 00+12

ME at observing sites

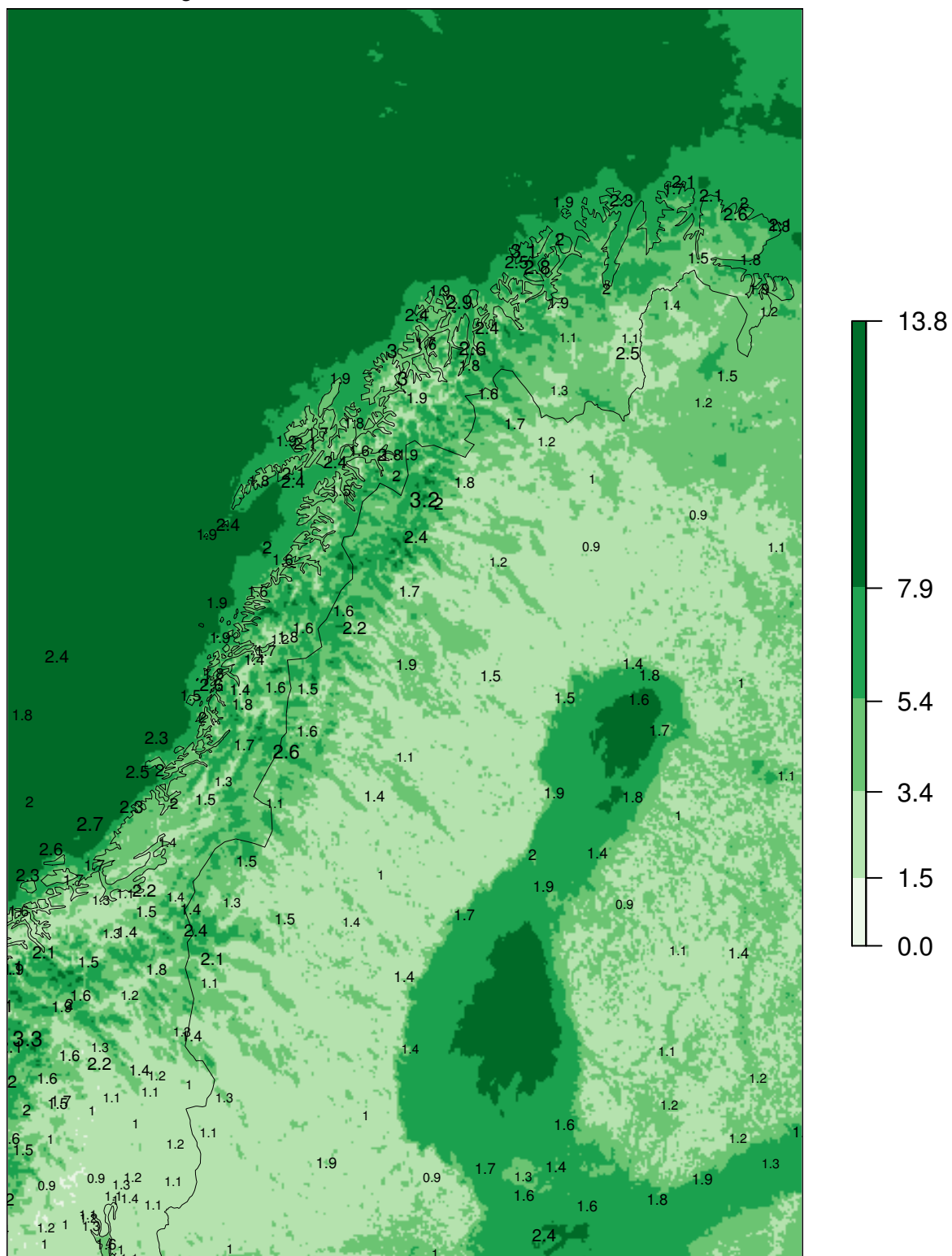
forecast means 01.09.2015 – 30.11.2015



AM25 00+12

SDE at observing sites

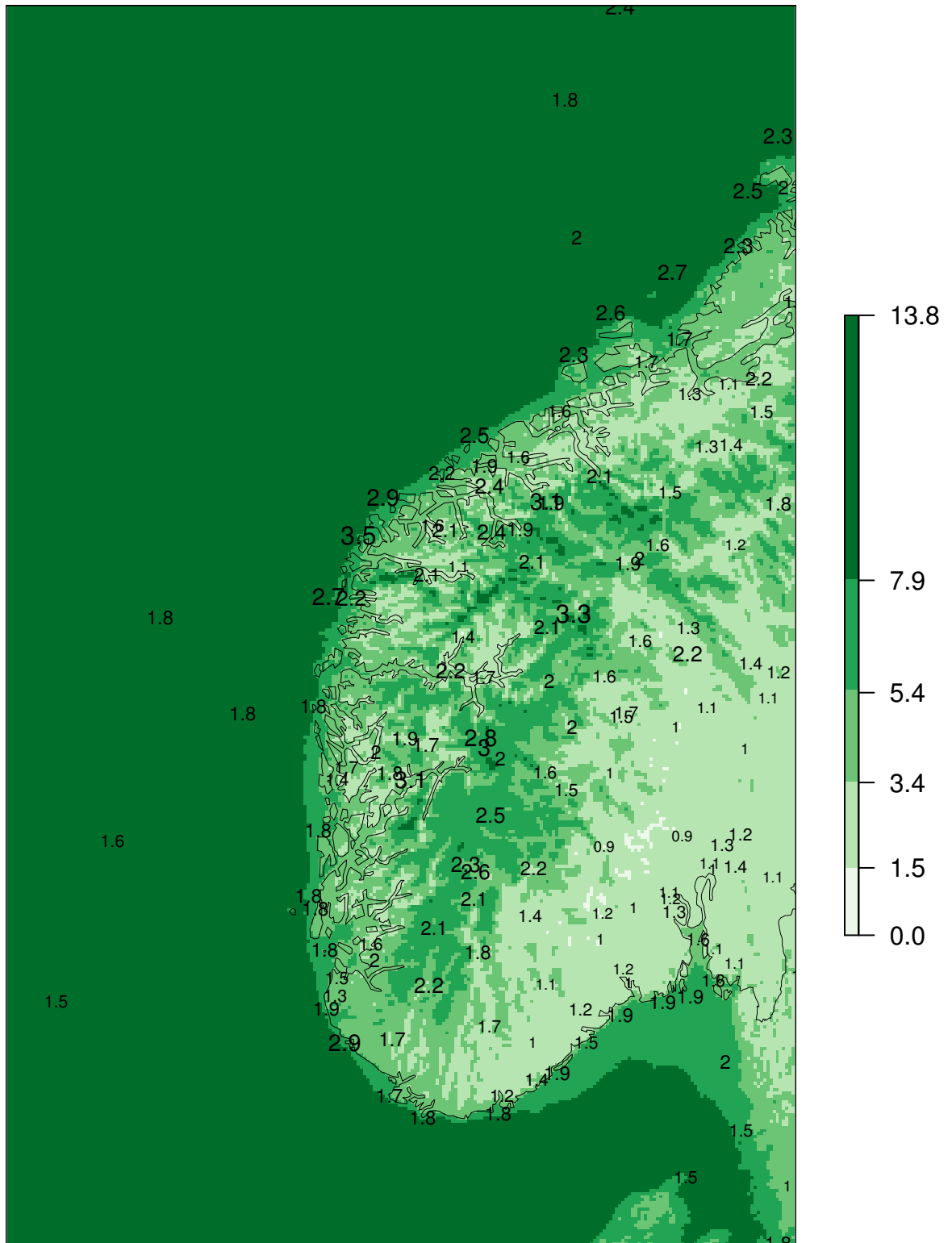
forecast means 01.09.2015 – 30.11.2015



AM25 00+12

SDE at observing sites

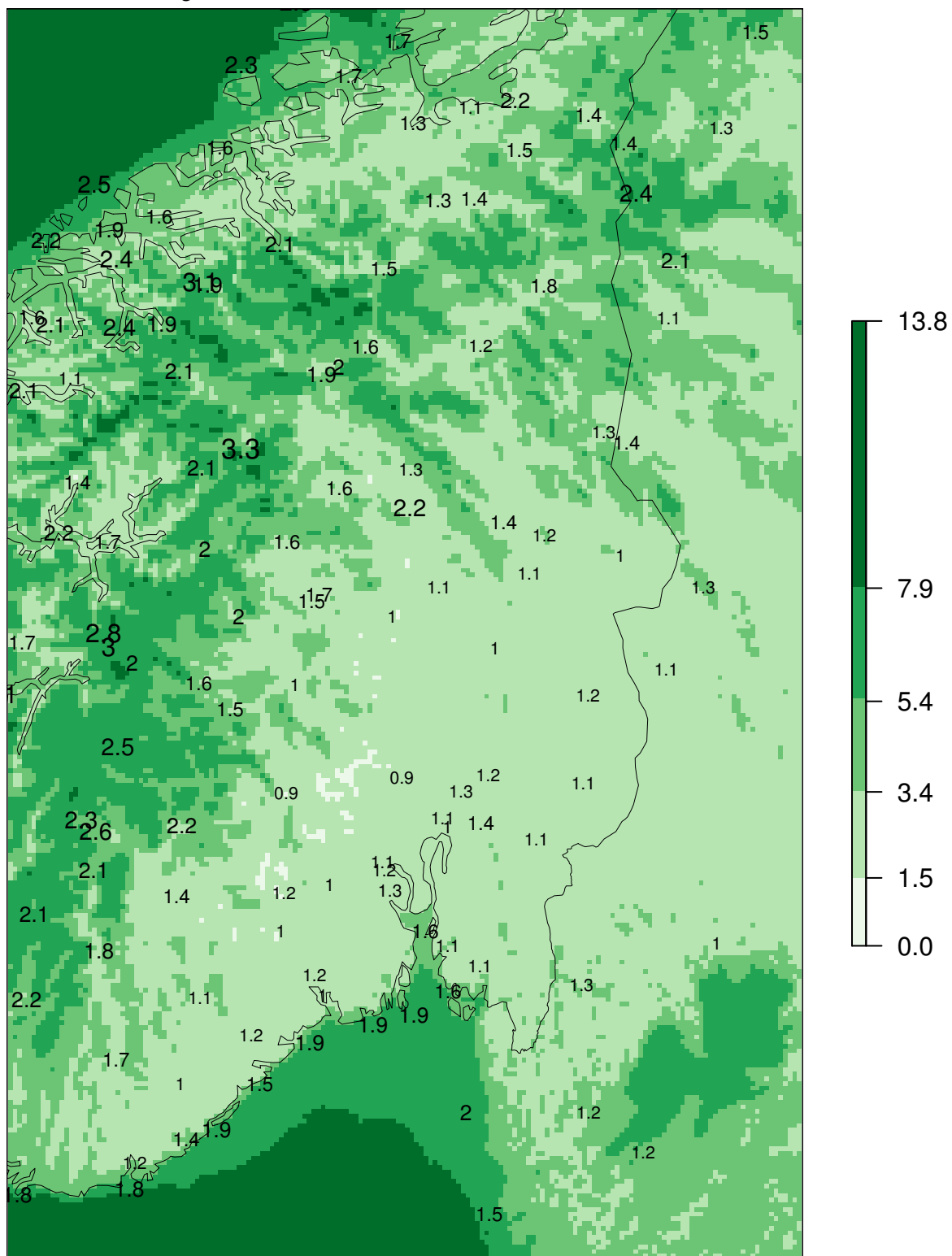
forecast means 01.09.2015 – 30.11.2015



AM25 00+12

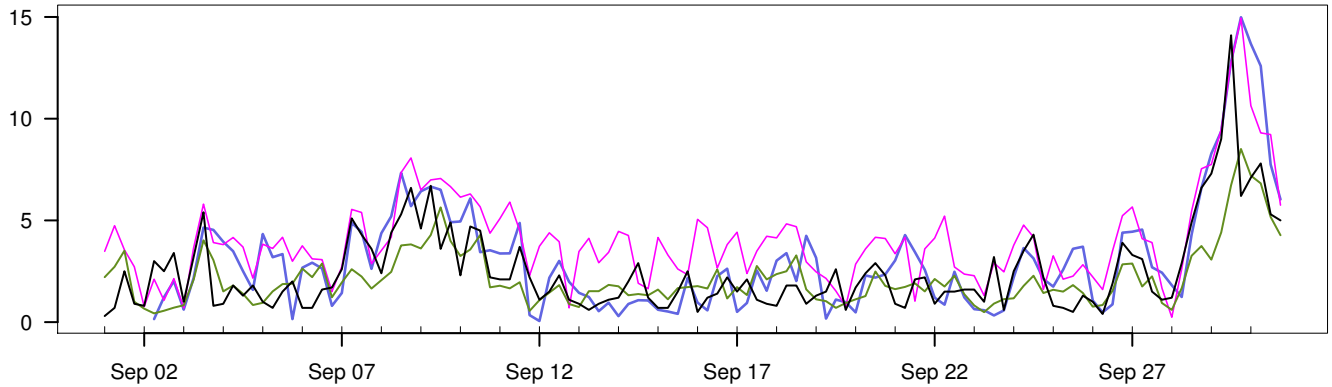
SDE at observing sites

forecast means 01.09.2015 – 30.11.2015

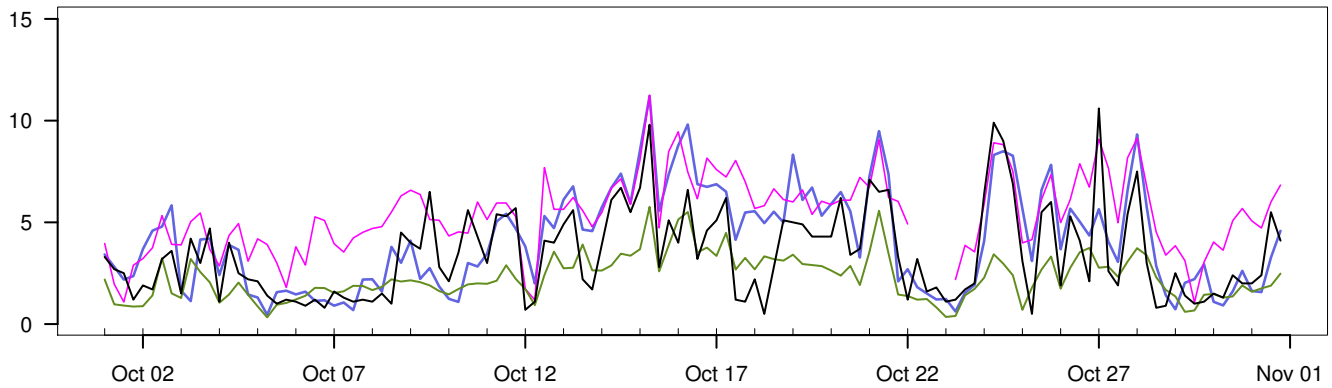


TROMSØ

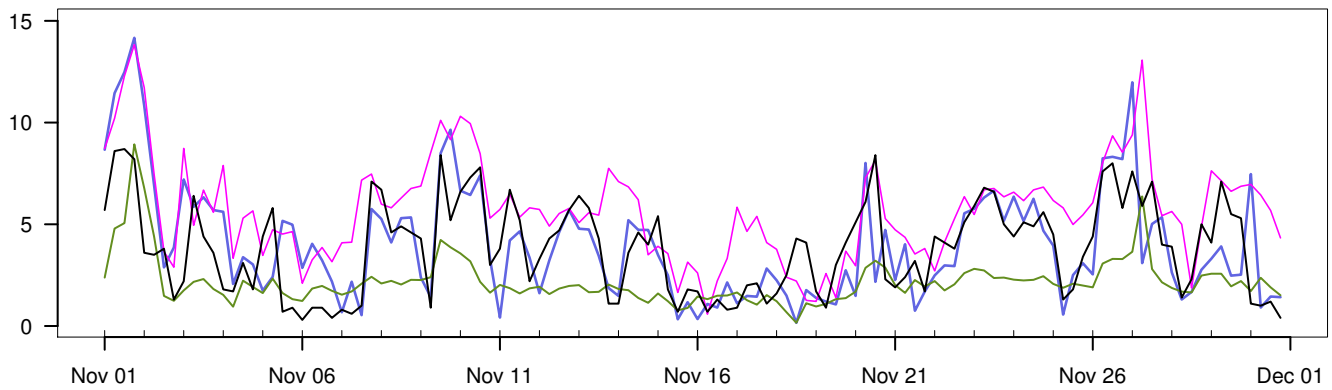
01.09.2015 – 30.09.2015



01.10.2015 – 31.10.2015



01.11.2015 – 30.11.2015



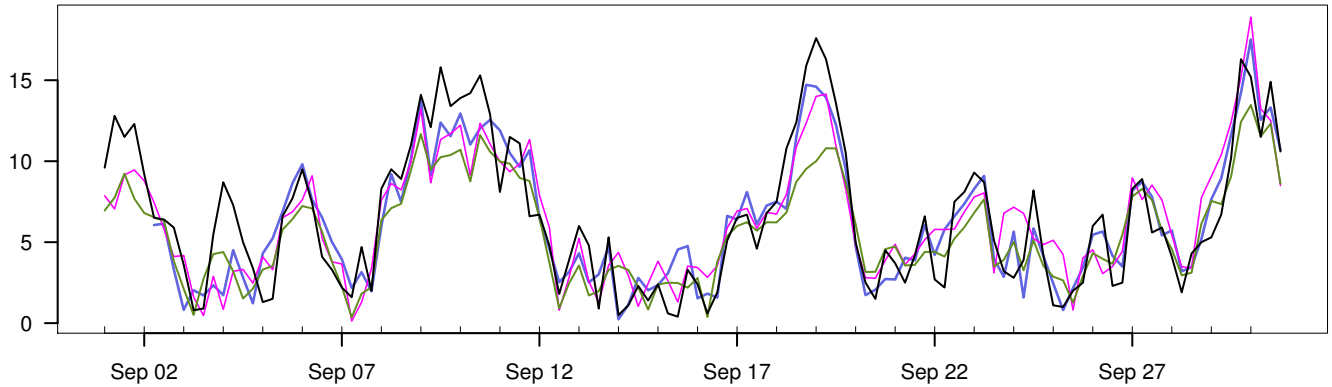
01.09.2015 – 30.11.2015

	Min	Mean	Max	Std	N
— synop: 00,06,12,18	0.3	3.2	14.1	2.3	364
— AM25: 12+18,+24,+30,+36	0.1	3.8	15	2.7	359
— Hirlam8: 12+18,+24,+30,+36	0.2	5.1	14.9	2.3	360
— ECMWF: 12+18,+24,+30,+36	0.2	2.2	8.9	1.2	364

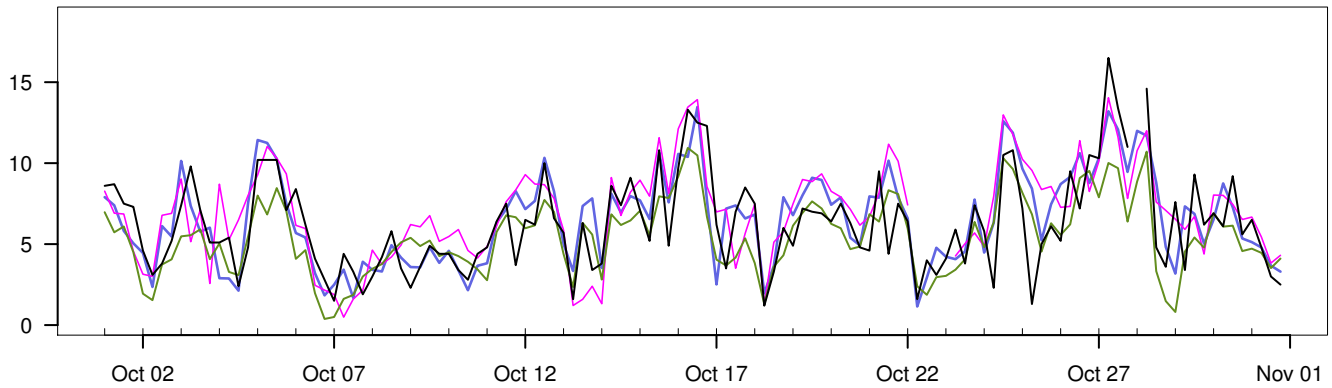
	ME	SDE	RMSE	MAE	Max.abs.err.	N
AM25 – synop	0.5	1.9	1.9	1.4	8.8	359
Hirlam8 – synop	1.8	1.8	2.5	2	8.7	360
ECMWF – synop	-1	1.8	2.1	1.6	7.8	364

SLETNES FYR

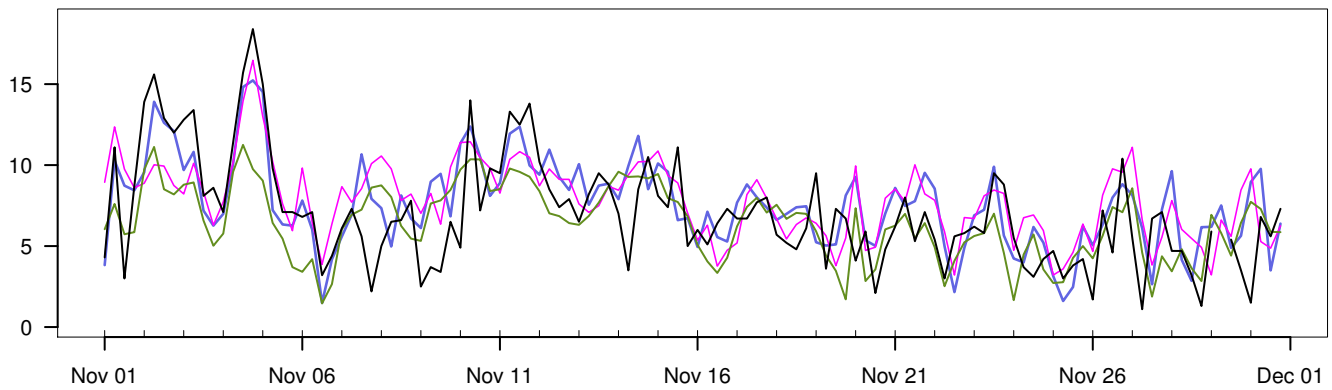
01.09.2015 – 30.09.2015



01.10.2015 – 31.10.2015



01.11.2015 – 30.11.2015



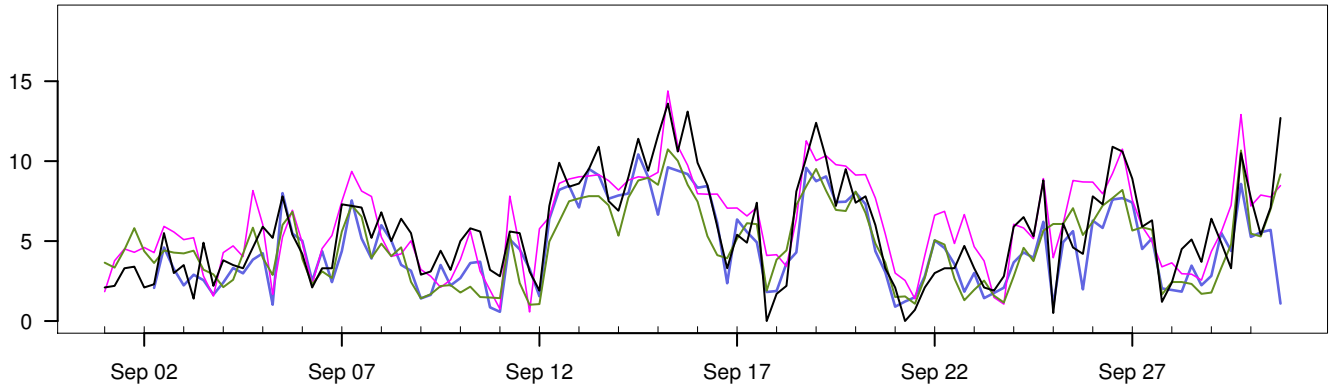
01.09.2015 – 30.11.2015

	Min	Mean	Max	Std	N
— synop: 00,06,12,18	0.4	6.6	18.4	3.6	362
— AM25: 12+18,+24,+30,+36	0.2	6.8	17.5	3.2	359
— Hirlam8: 12+18,+24,+30,+36	0.1	7.1	18.9	3.1	360
— ECMWF: 12+18,+24,+30,+36	0.4	5.8	13.5	2.6	364

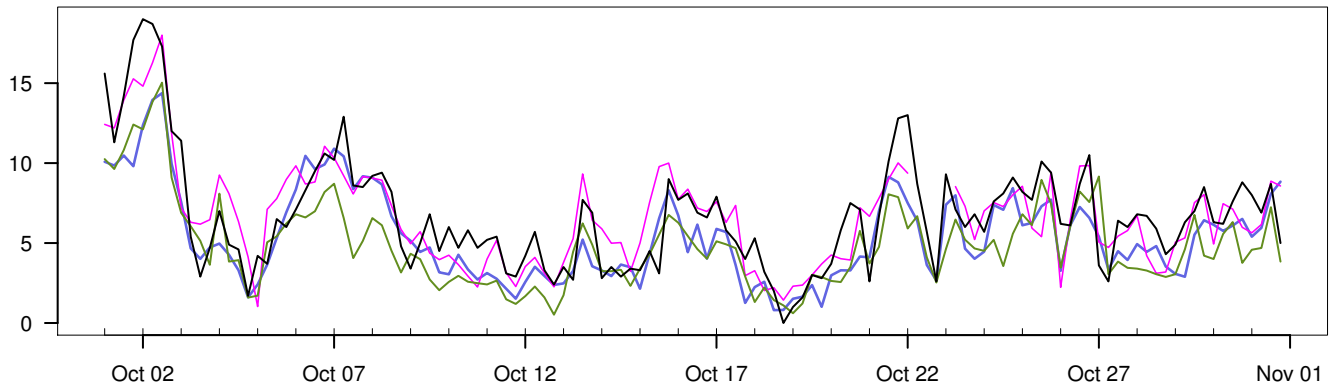
	ME	SDE	RMSE	MAE	Max.abs.err.	N
AM25 – synop	0.2	2.2	2.2	1.6	7.5	357
Hirlam8 – synop	0.4	2.5	2.5	2	8.3	358
ECMWF – synop	-0.8	2.3	2.4	1.9	8.6	362

ØRLAND

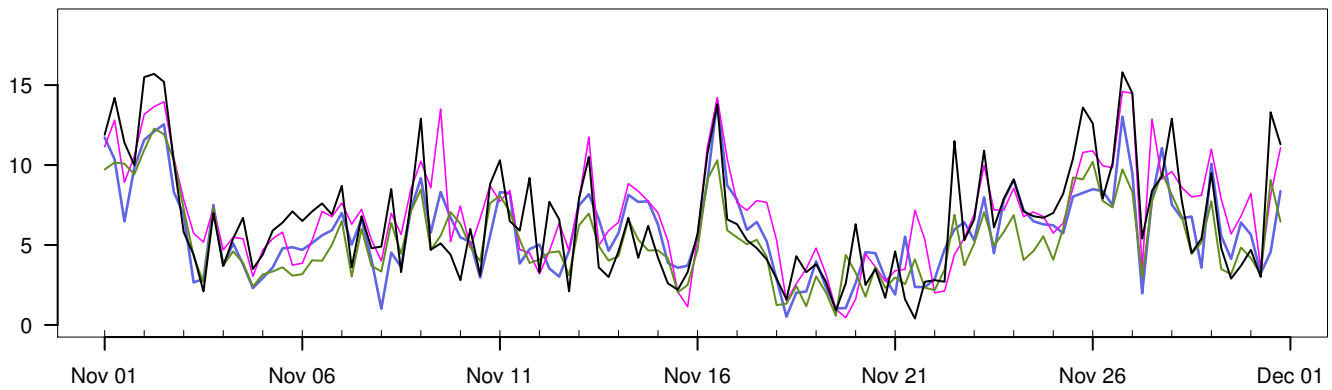
01.09.2015 – 30.09.2015



01.10.2015 – 31.10.2015



01.11.2015 – 30.11.2015



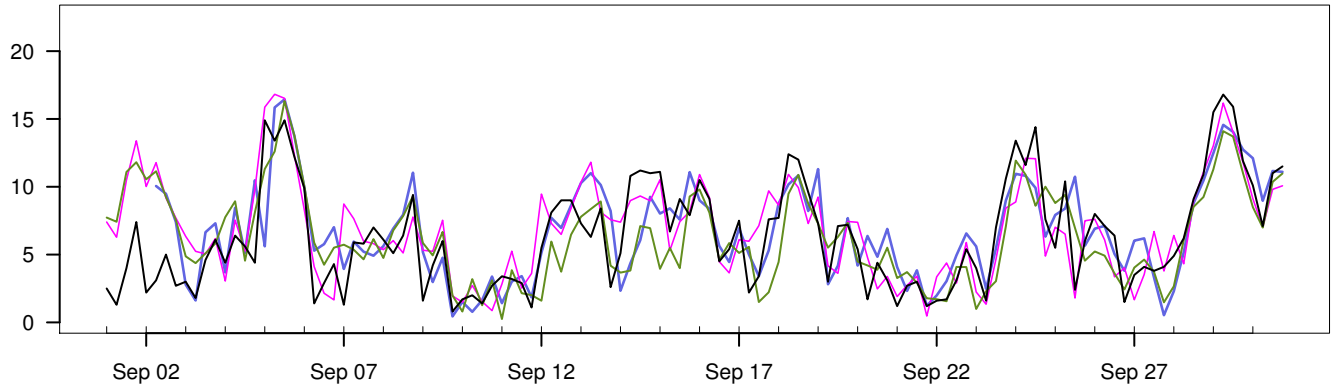
01.09.2015 – 30.11.2015

	Min	Mean	Max	Std	N
— synop: 00,06,12,18	0	6.3	19	3.5	364
— AM25: 12+18,+24,+30,+36	0.5	5.4	14.4	2.7	359
— Hirlam8: 12+18,+24,+30,+36	0.4	6.6	18	3	360
— ECMWF: 12+18,+24,+30,+36	0.5	5	15	2.6	364

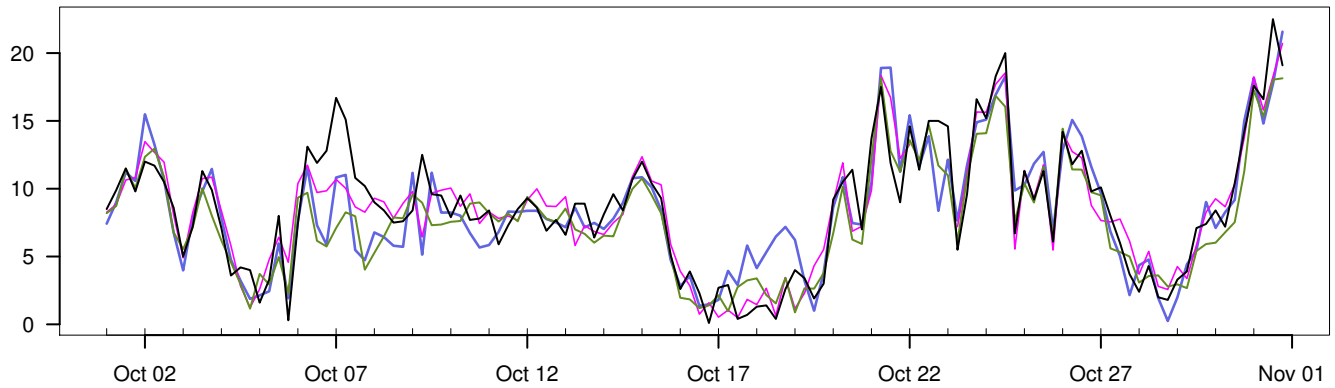
	ME	SDE	RMSE	MAE	Max.abs.err.	N
AM25 – synop	-1	2	2.2	1.7	11.6	359
Hirlam8 – synop	0.2	2.1	2.1	1.6	8.4	360
ECMWF – synop	-1.3	1.9	2.3	1.8	7.1	364

YTTERØYANE FYR

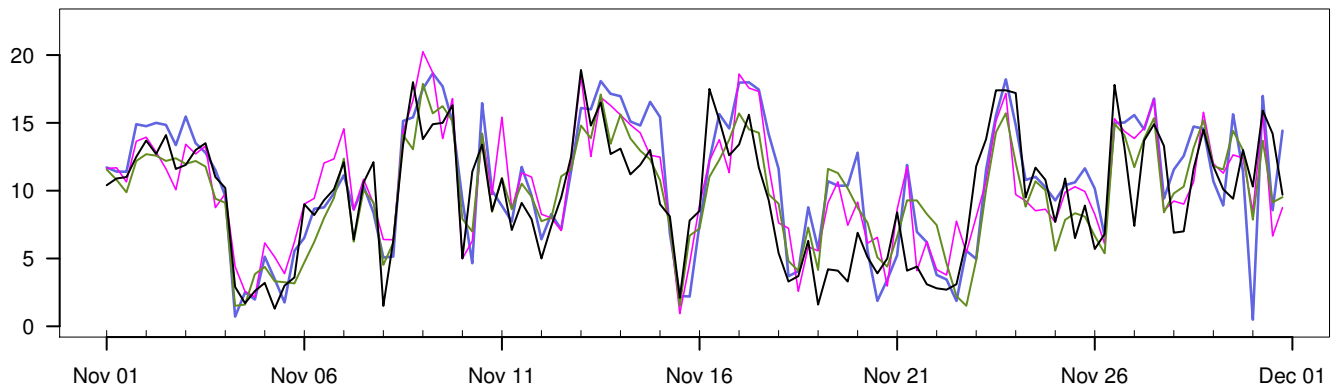
01.09.2015 – 30.09.2015



01.10.2015 – 31.10.2015



01.11.2015 – 30.11.2015



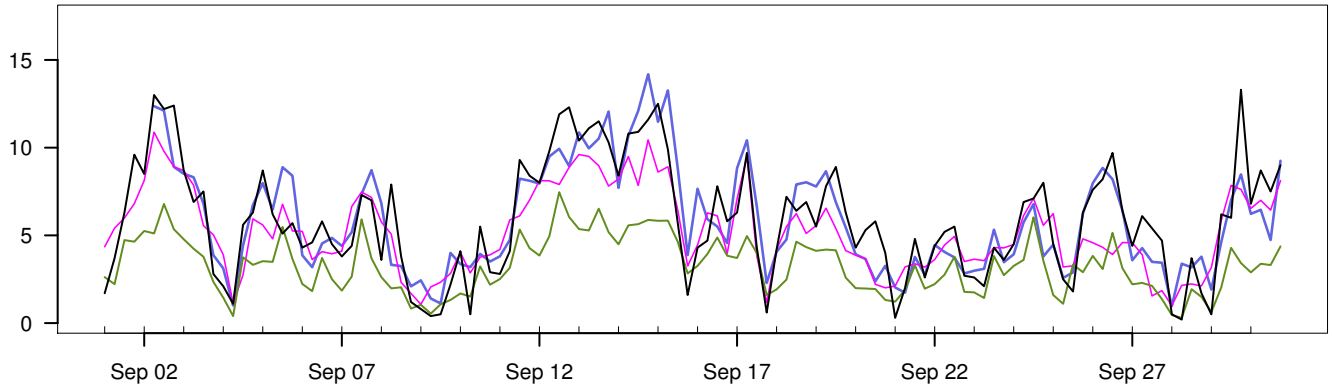
01.09.2015 – 30.11.2015

	Min	Mean	Max	Std	N
— synop: 00,06,12,18	0.1	8.2	22.5	4.5	364
— AM25: 12+18,+24,+30,+36	0.2	8.6	21.6	4.5	359
— Hirlam8: 12+18,+24,+30,+36	0.5	8.6	20.7	4.3	360
— ECMWF: 12+18,+24,+30,+36	0.2	7.9	18.2	4	364

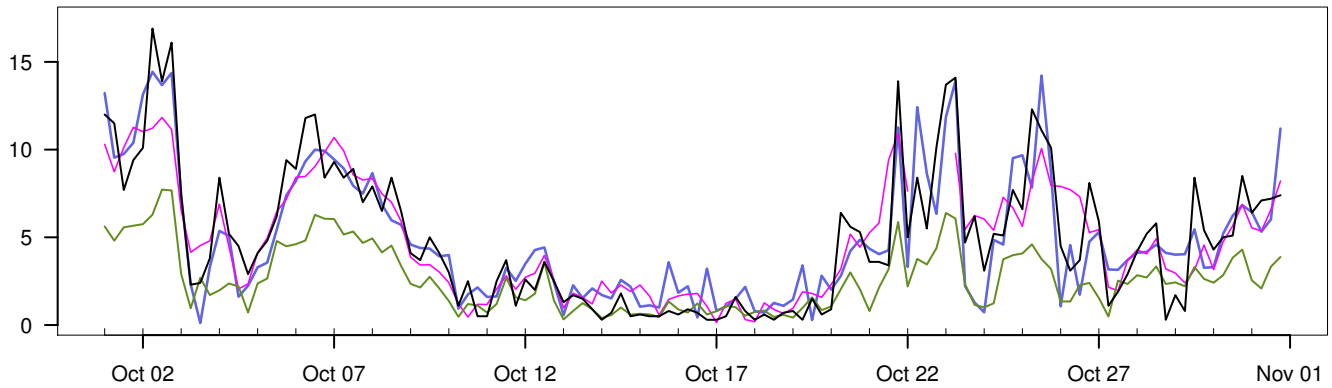
	ME	SDE	RMSE	MAE	Max.abs.err.	N
AM25 – synop	0.3	2.8	2.8	2.1	9.8	359
Hirlam8 – synop	0.4	2.4	2.5	1.8	8.7	360
ECMWF – synop	-0.3	2.6	2.6	1.9	9.6	364

FINSEVATN

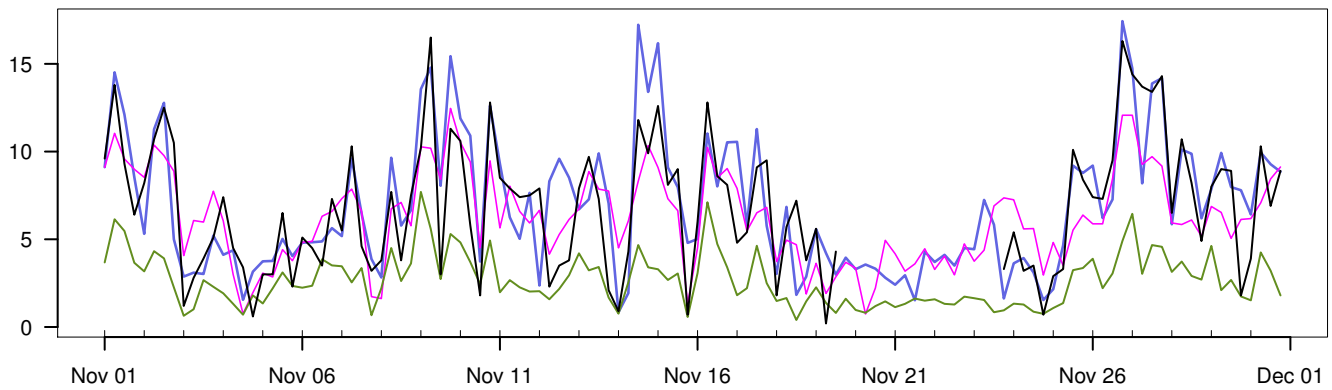
01.09.2015 – 30.09.2015



01.10.2015 – 31.10.2015



01.11.2015 – 30.11.2015



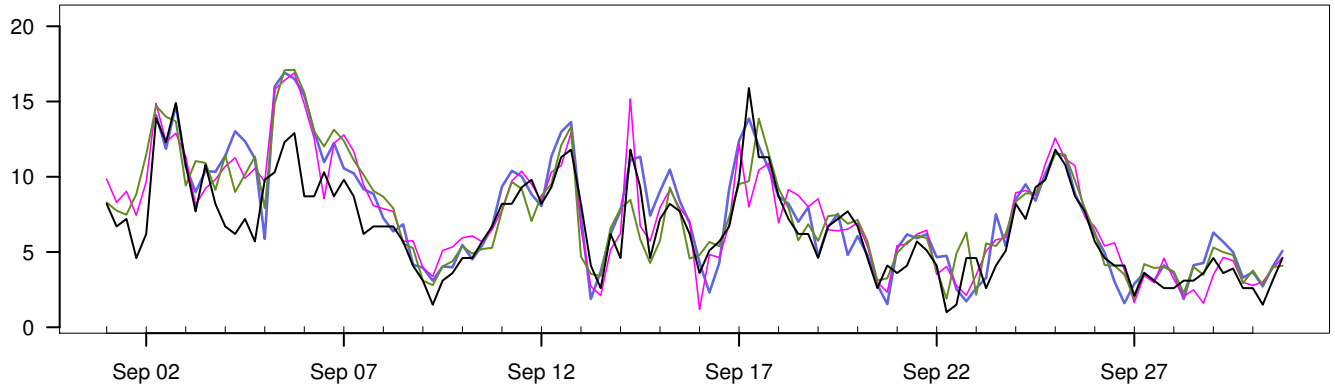
01.09.2015 – 30.11.2015

	Min	Mean	Max	Std	N
— synop: 00,06,12,18	0.2	5.8	16.9	3.7	348
— AM25: 12+18,+24,+30,+36	0.1	5.9	17.4	3.6	359
— Hirlam8: 12+18,+24,+30,+36	0.1	5.4	12.5	2.8	360
— ECMWF: 12+18,+24,+30,+36	0.3	2.9	7.7	1.7	364

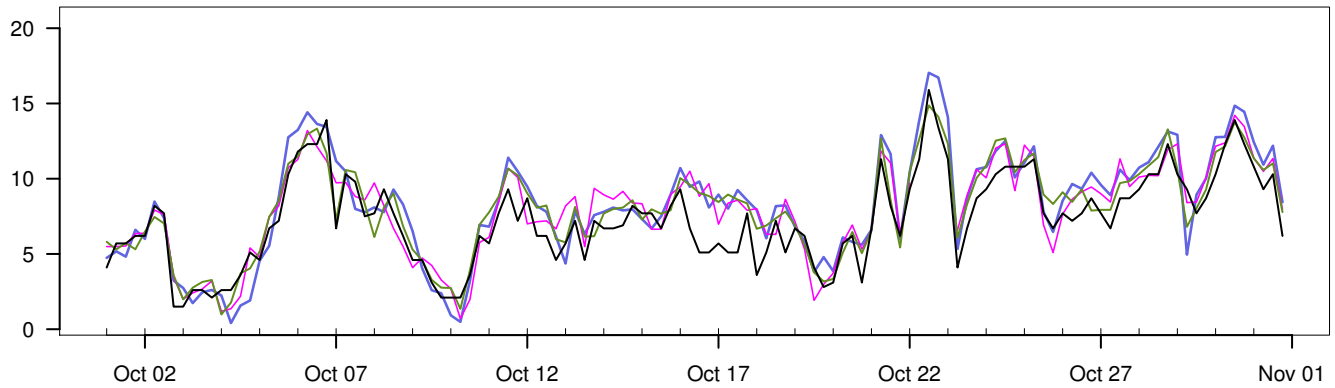
	ME	SDE	RMSE	MAE	Max.abs.err.	N
AM25 – synop	0.2	2	2	1.5	6.1	343
Hirlam8 – synop	-0.3	2	2.1	1.6	6.3	344
ECMWF – synop	-2.9	2.6	3.9	3.1	11.4	348

EKOFISK

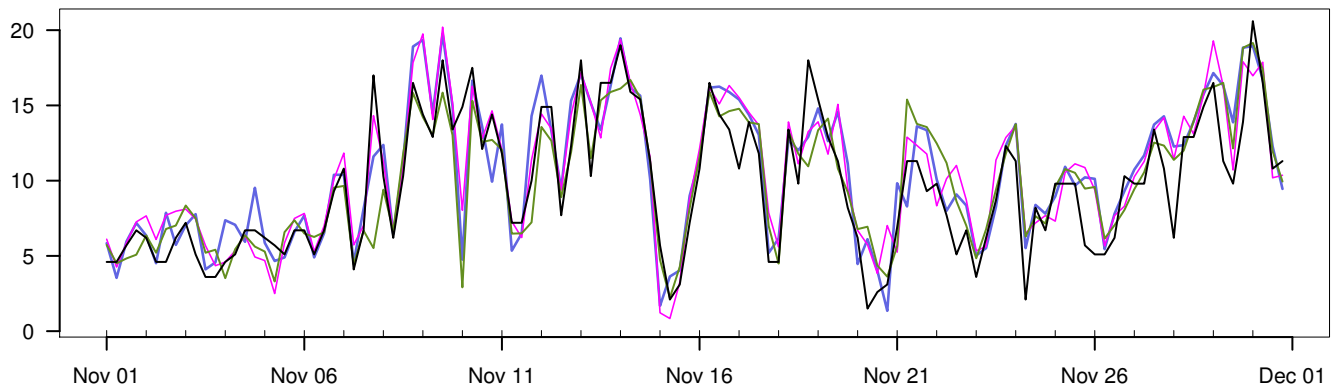
01.09.2015 – 30.09.2015



01.10.2015 – 31.10.2015



01.11.2015 – 30.11.2015



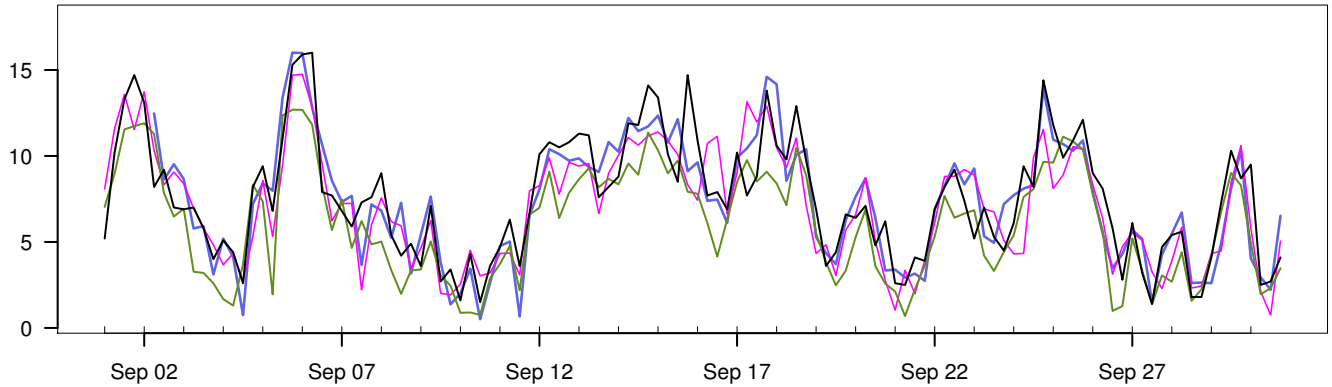
01.09.2015 – 30.11.2015

	Min	Mean	Max	Std	N
— synop: 00,06,12,18	1	7.8	20.6	3.8	364
— AM25: 12+18,+24,+30,+36	0.4	8.8	19.8	4.1	359
— Hirlam8: 12+18,+24,+30,+36	0.7	8.6	20.2	3.9	360
— ECMWF: 12+18,+24,+30,+36	1	8.5	19.1	3.7	364

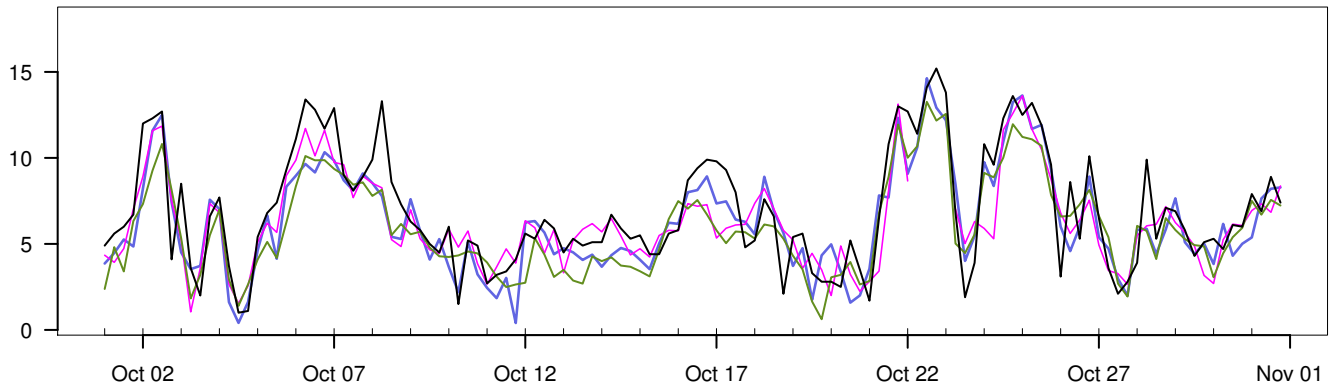
	ME	SDE	RMSE	MAE	Max.abs.err.	N
AM25 – synop	0.9	1.9	2.1	1.6	10.1	359
Hirlam8 – synop	0.8	1.8	2	1.5	7.9	360
ECMWF – synop	0.6	1.9	2	1.4	12	364

FERDER FYR

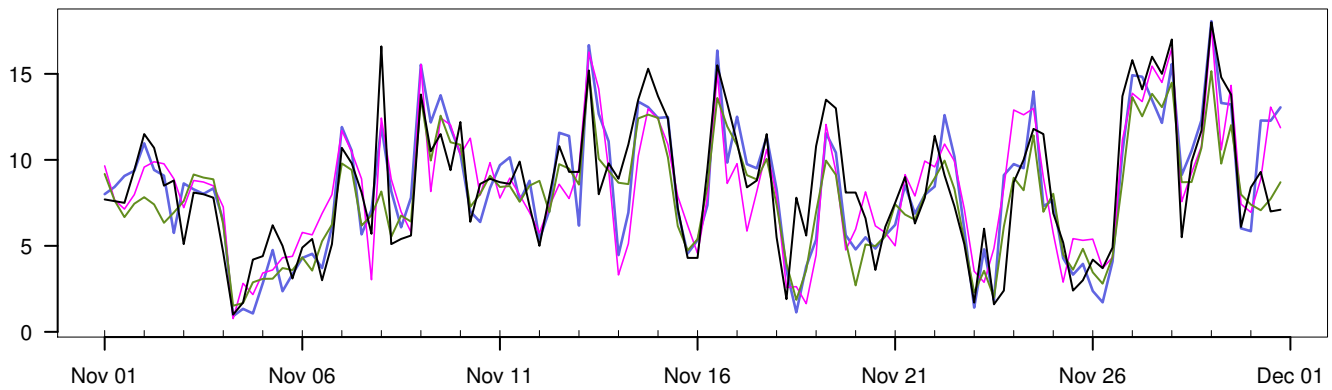
01.09.2015 – 30.09.2015



01.10.2015 – 31.10.2015



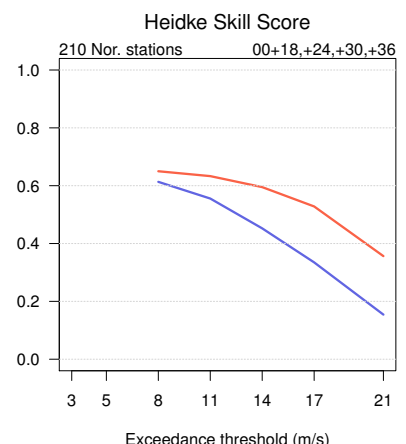
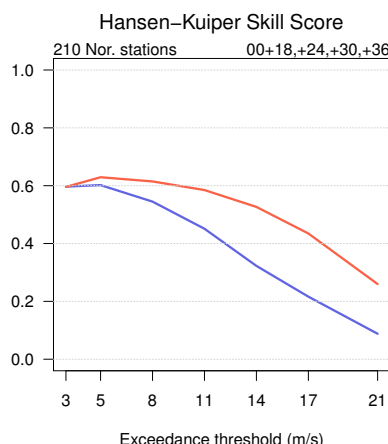
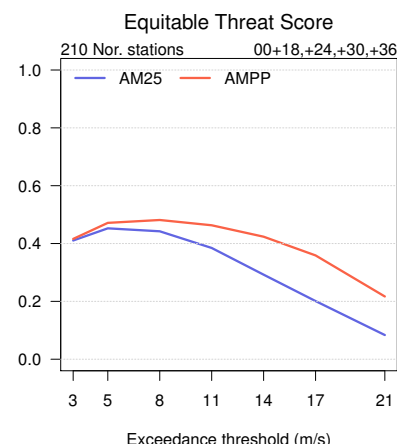
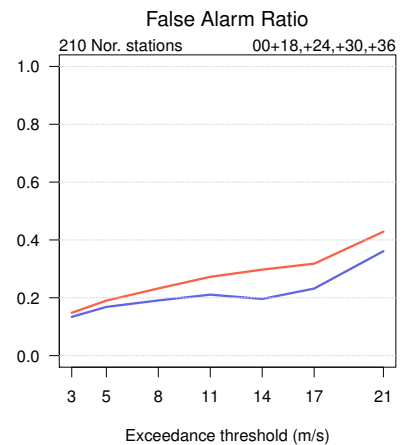
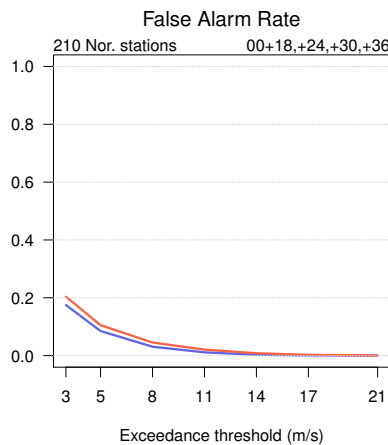
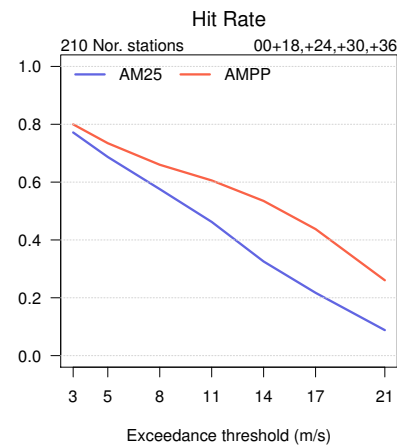
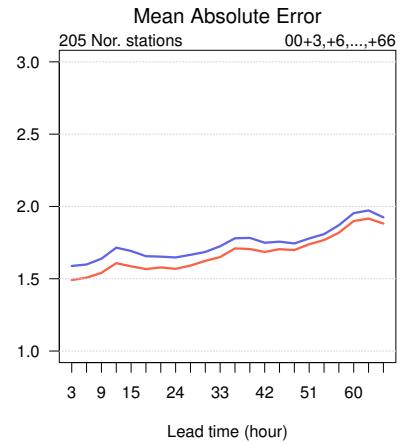
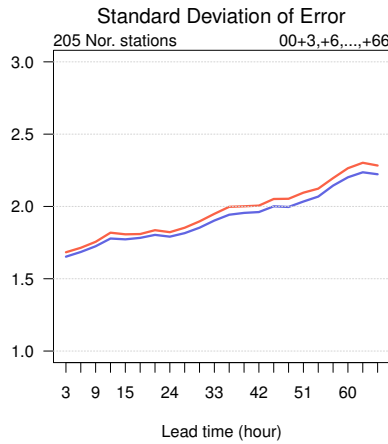
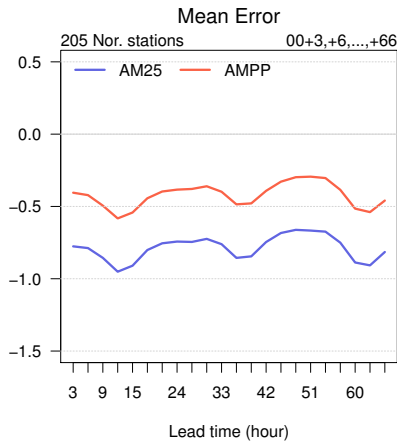
01.11.2015 – 30.11.2015

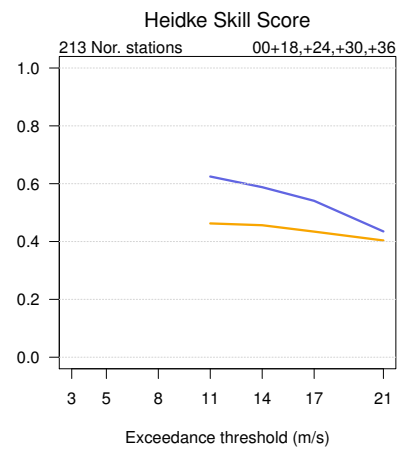
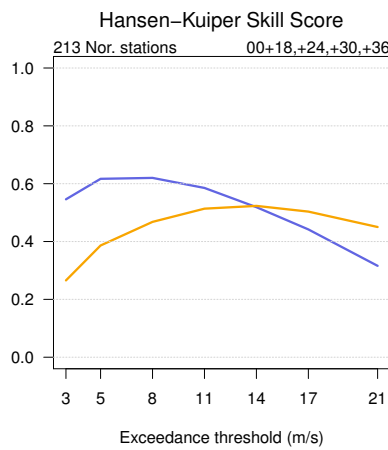
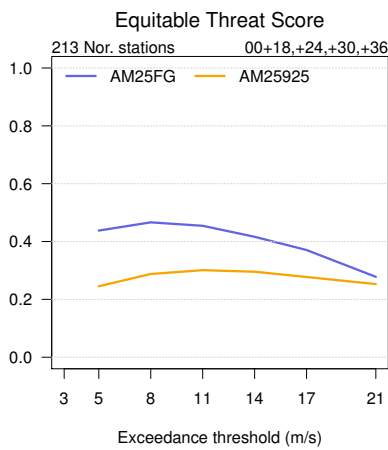
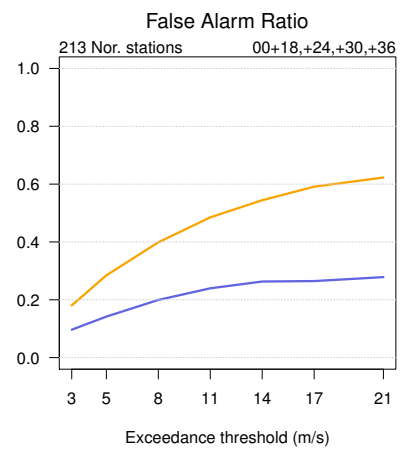
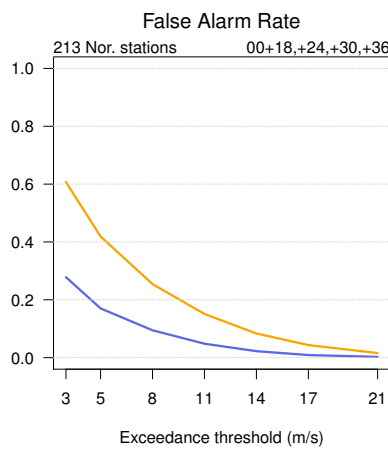
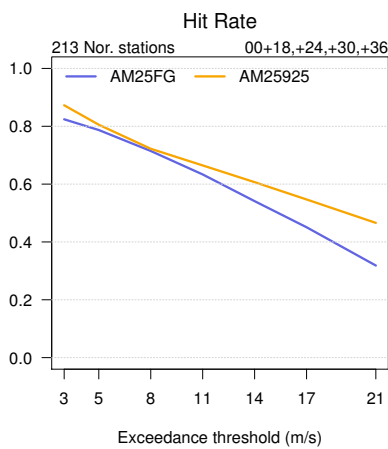
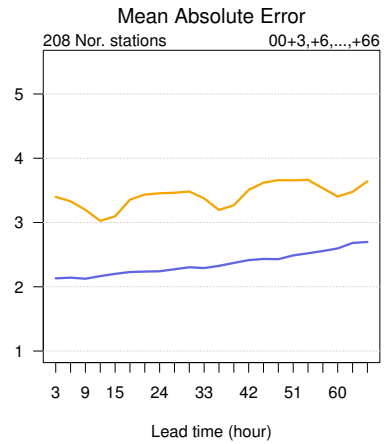
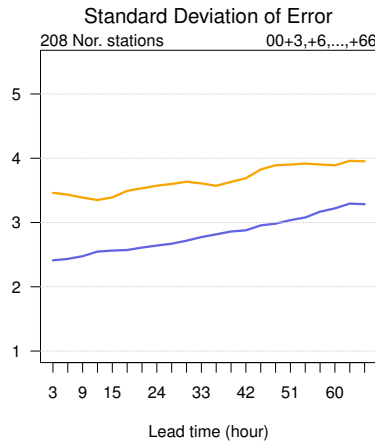
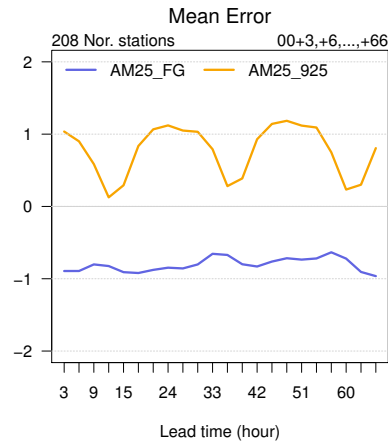


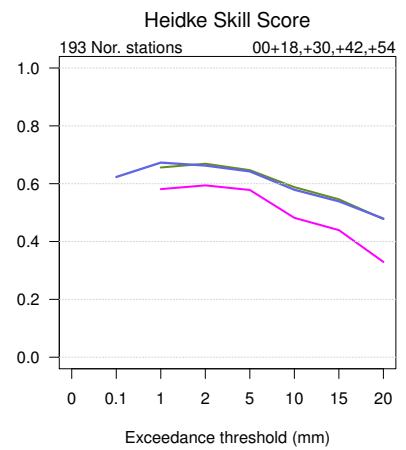
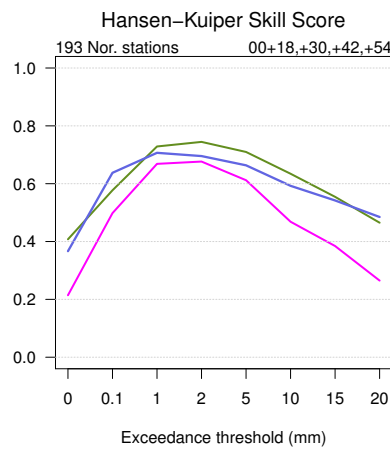
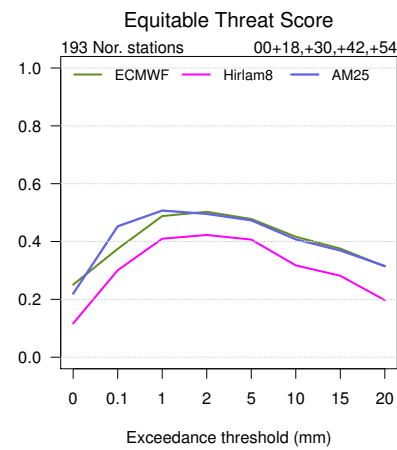
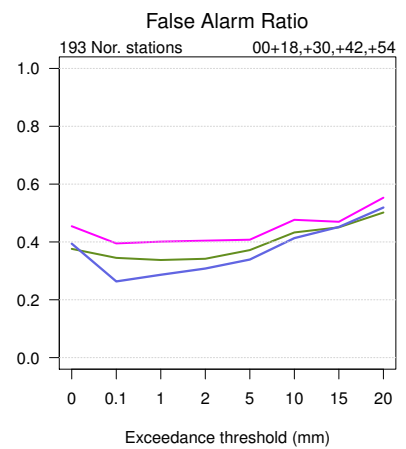
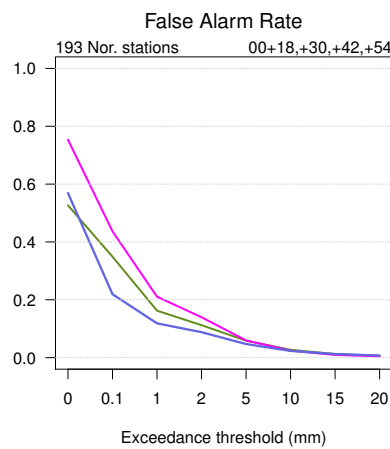
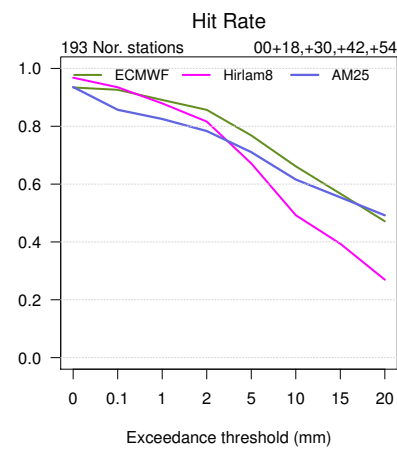
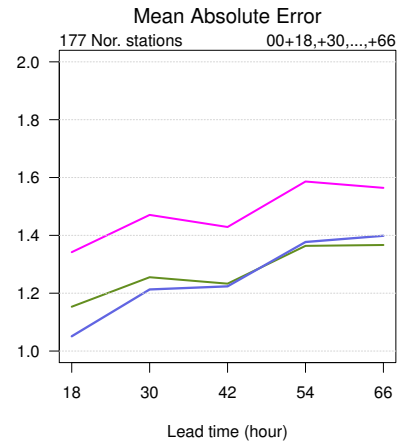
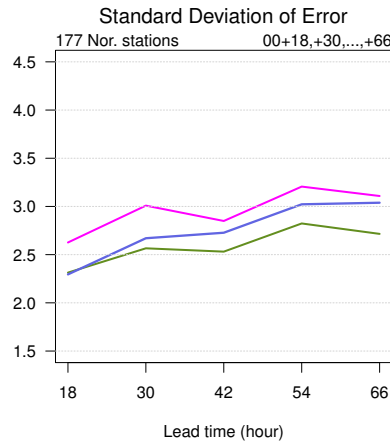
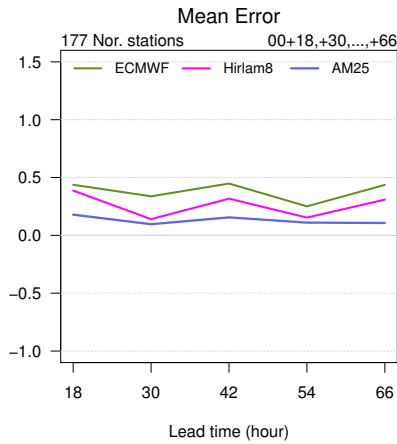
01.09.2015 – 30.11.2015

	Min	Mean	Max	Std	N
— synop: 00,06,12,18	1	7.6	18	3.6	364
— AM25: 12+18,+24,+30,+36	0.4	7.3	18.1	3.5	359
— Hirlam8: 12+18,+24,+30,+36	0.8	7.2	17.8	3.3	360
— ECMWF: 12+18,+24,+30,+36	0.6	6.6	15.2	3.1	364

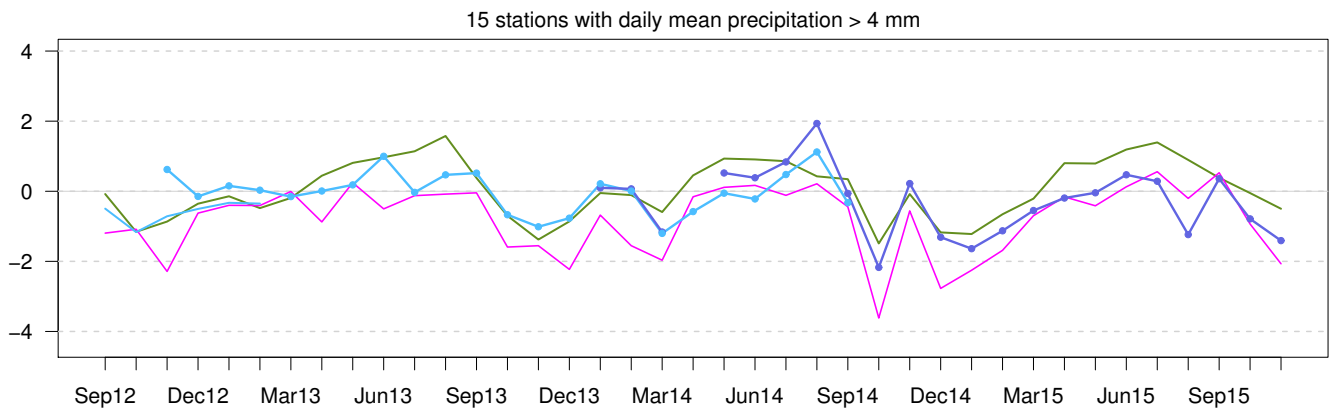
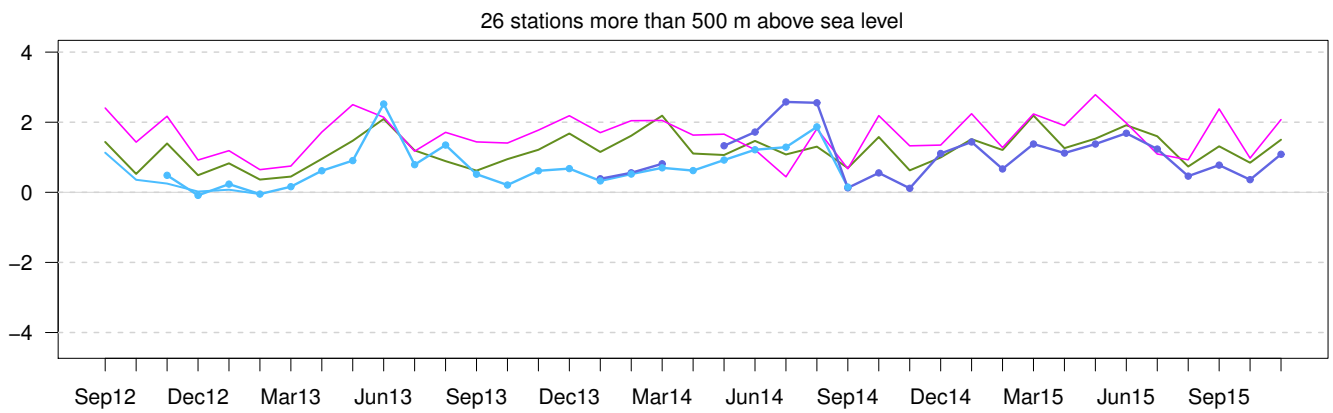
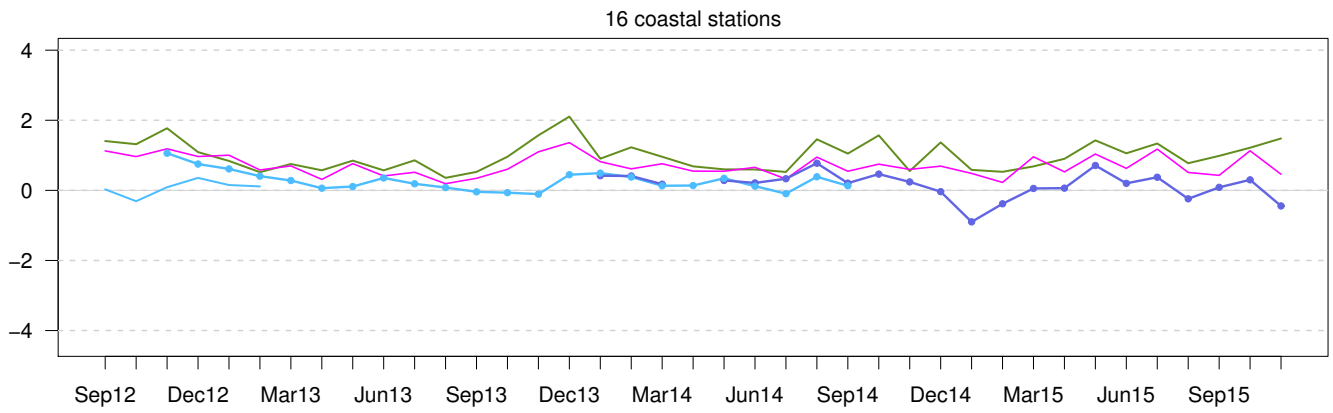
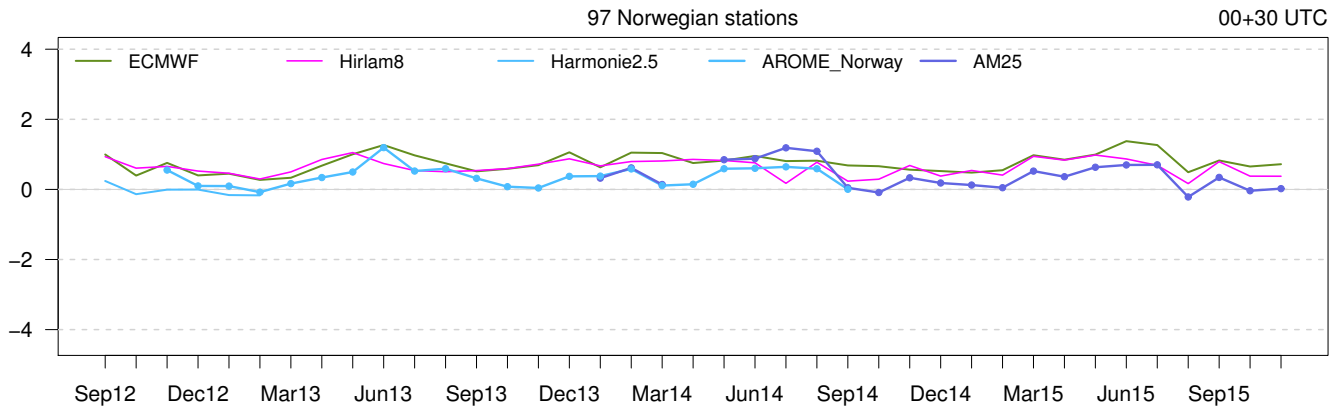
	ME	SDE	RMSE	MAE	Max.abs.err.	N
AM25 – synop	-0.3	1.9	1.9	1.5	6.7	359
Hirlam8 – synop	-0.3	2.1	2.1	1.6	6.4	360
ECMWF – synop	-1.1	1.8	2.1	1.7	8.4	364



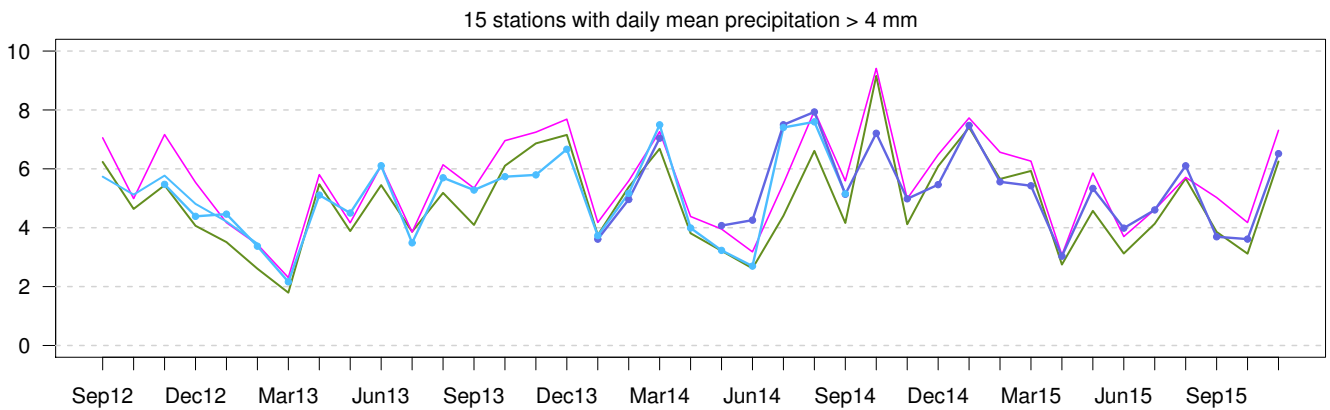
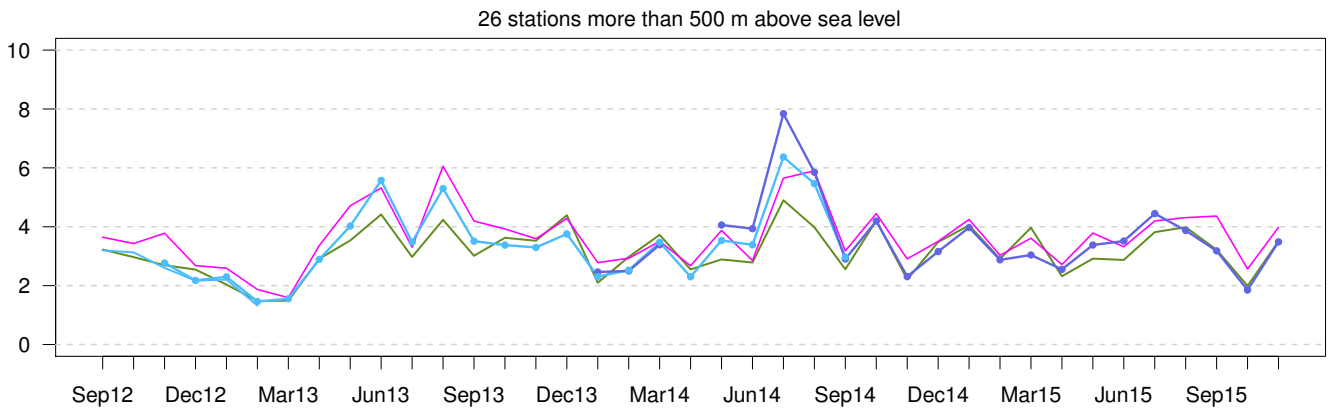
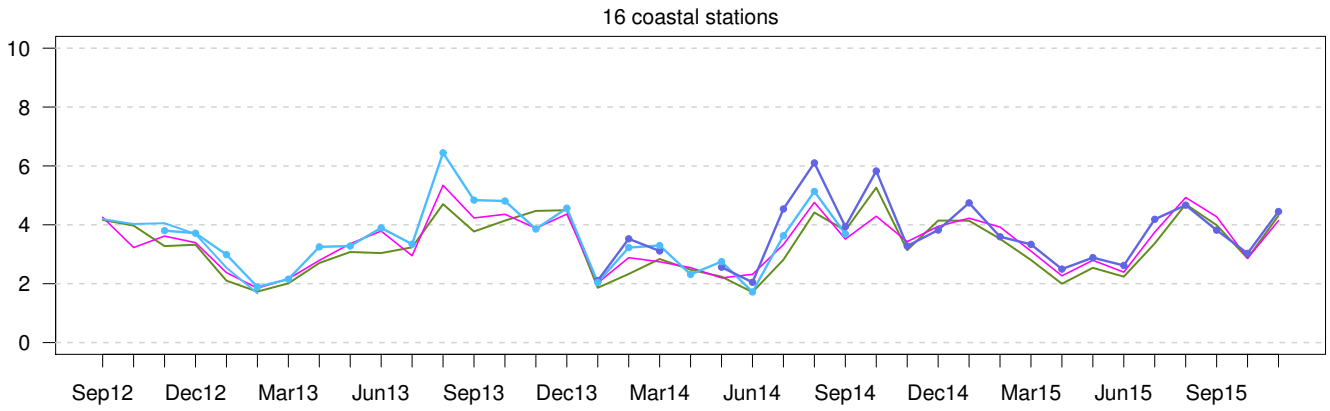
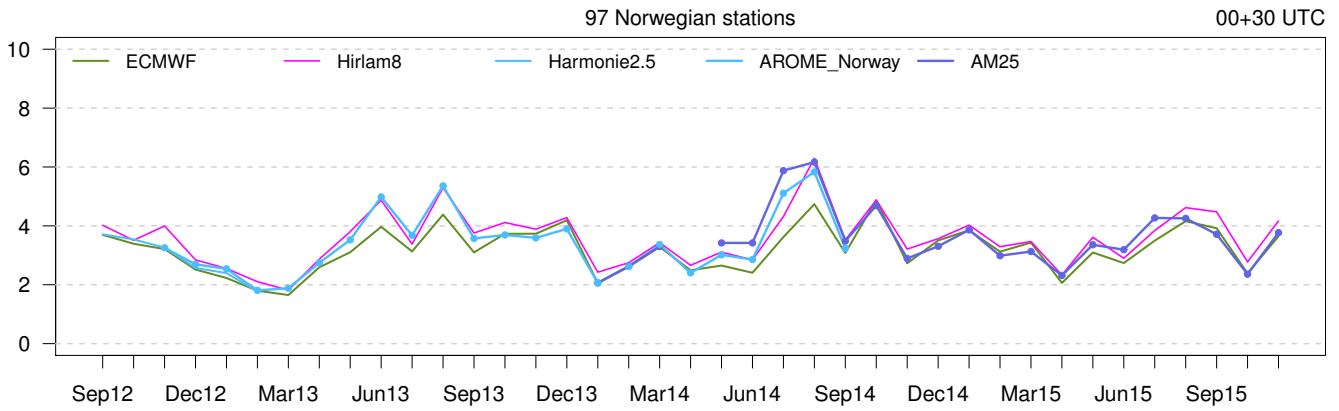




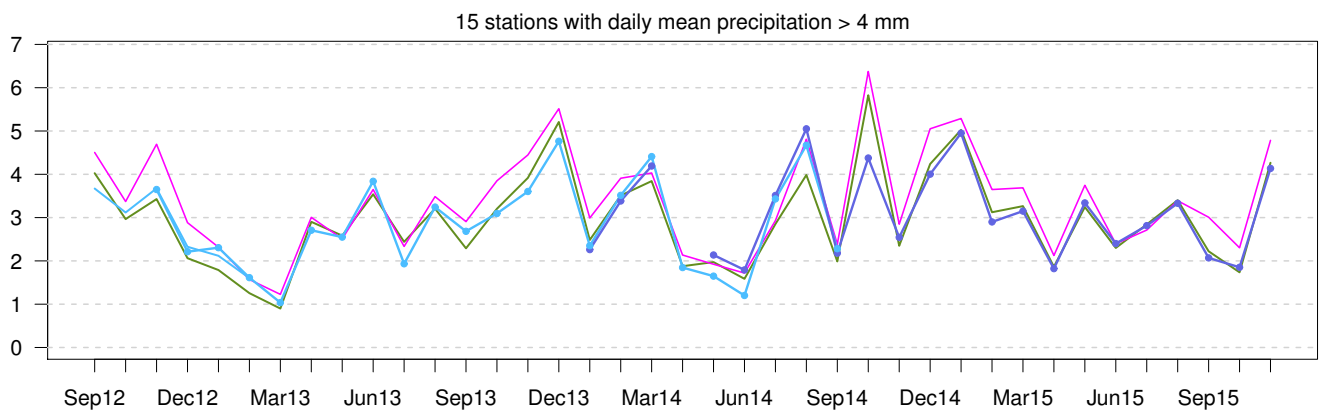
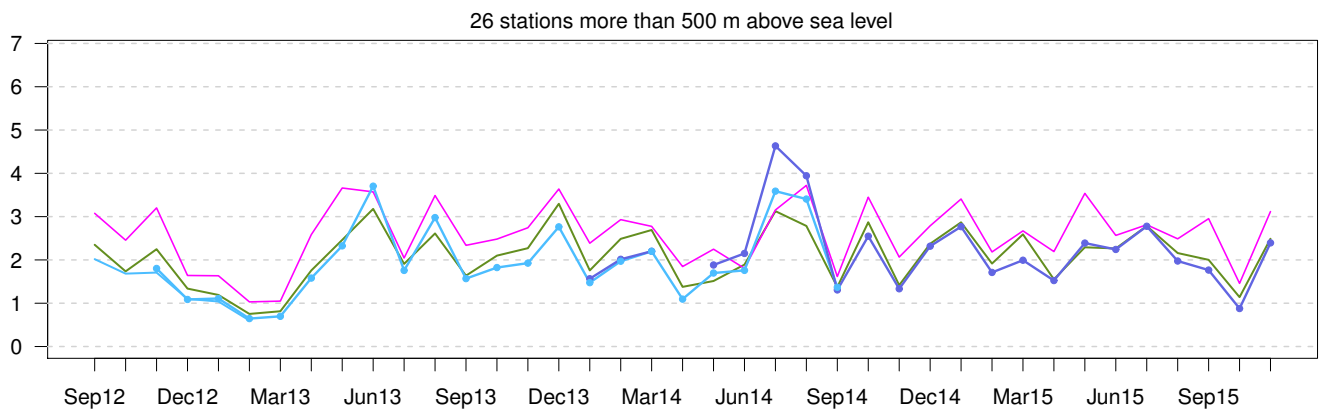
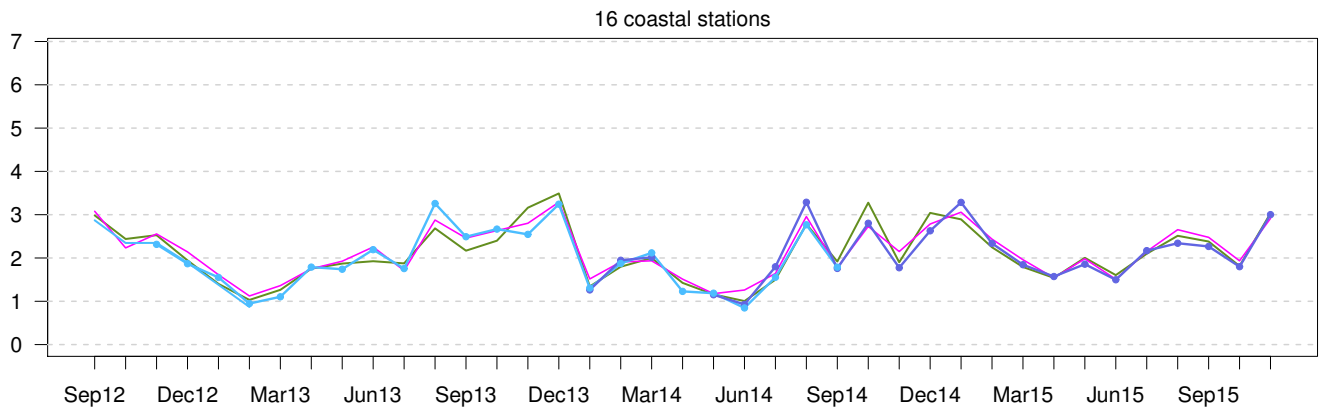
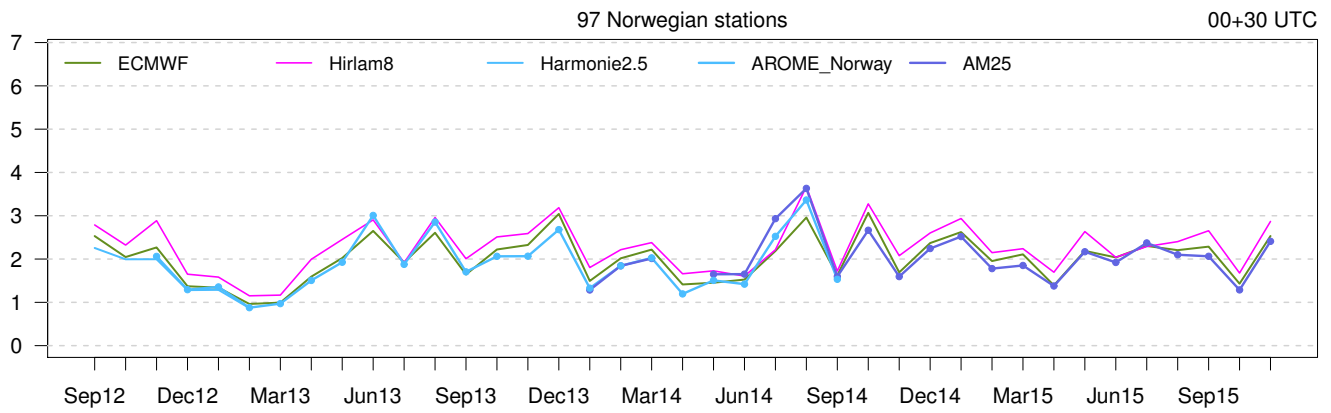
Mean Error



Standard Deviation of Error



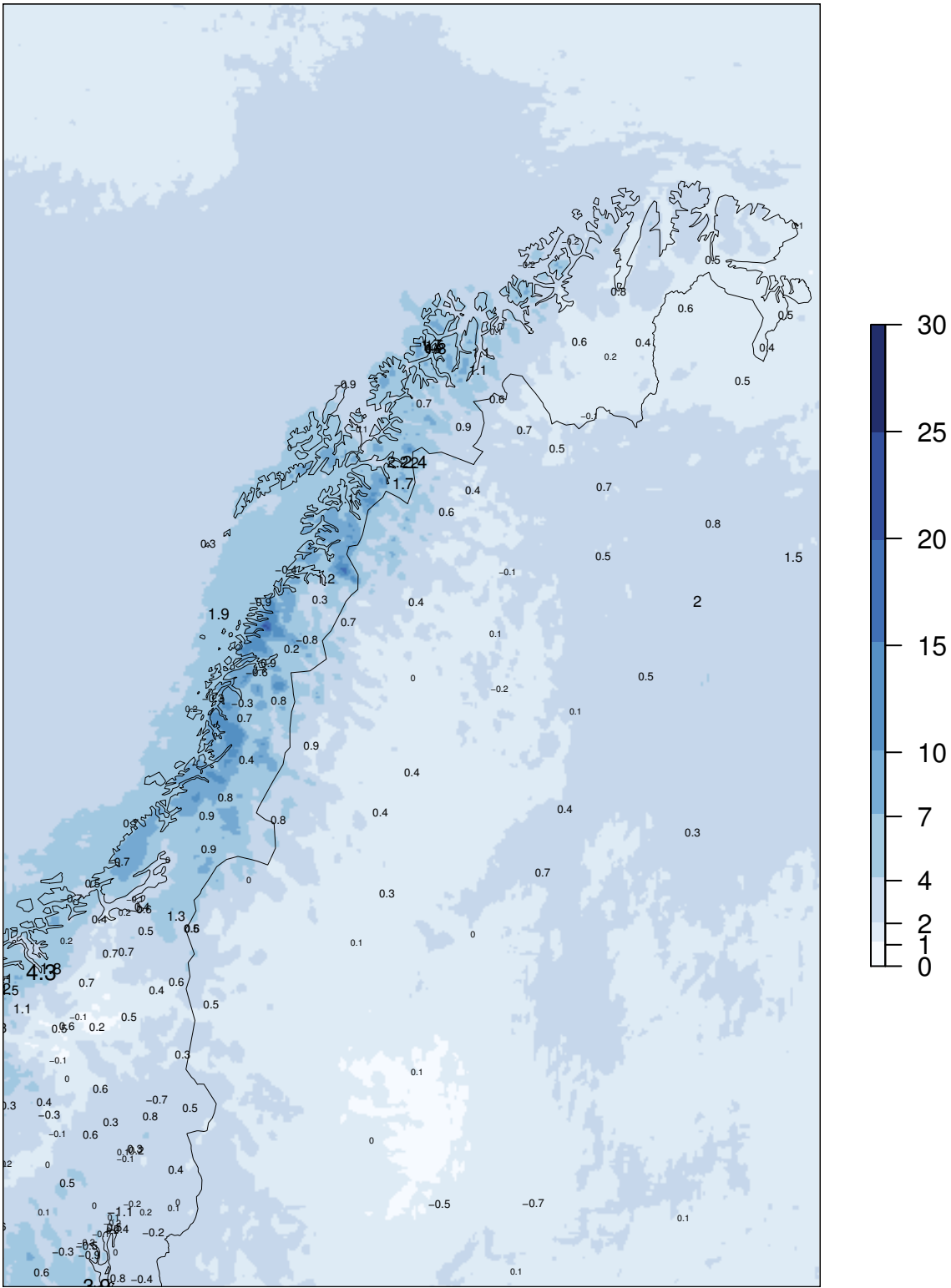
Mean Absolute Error



AM25 00+30

ME at observing sites

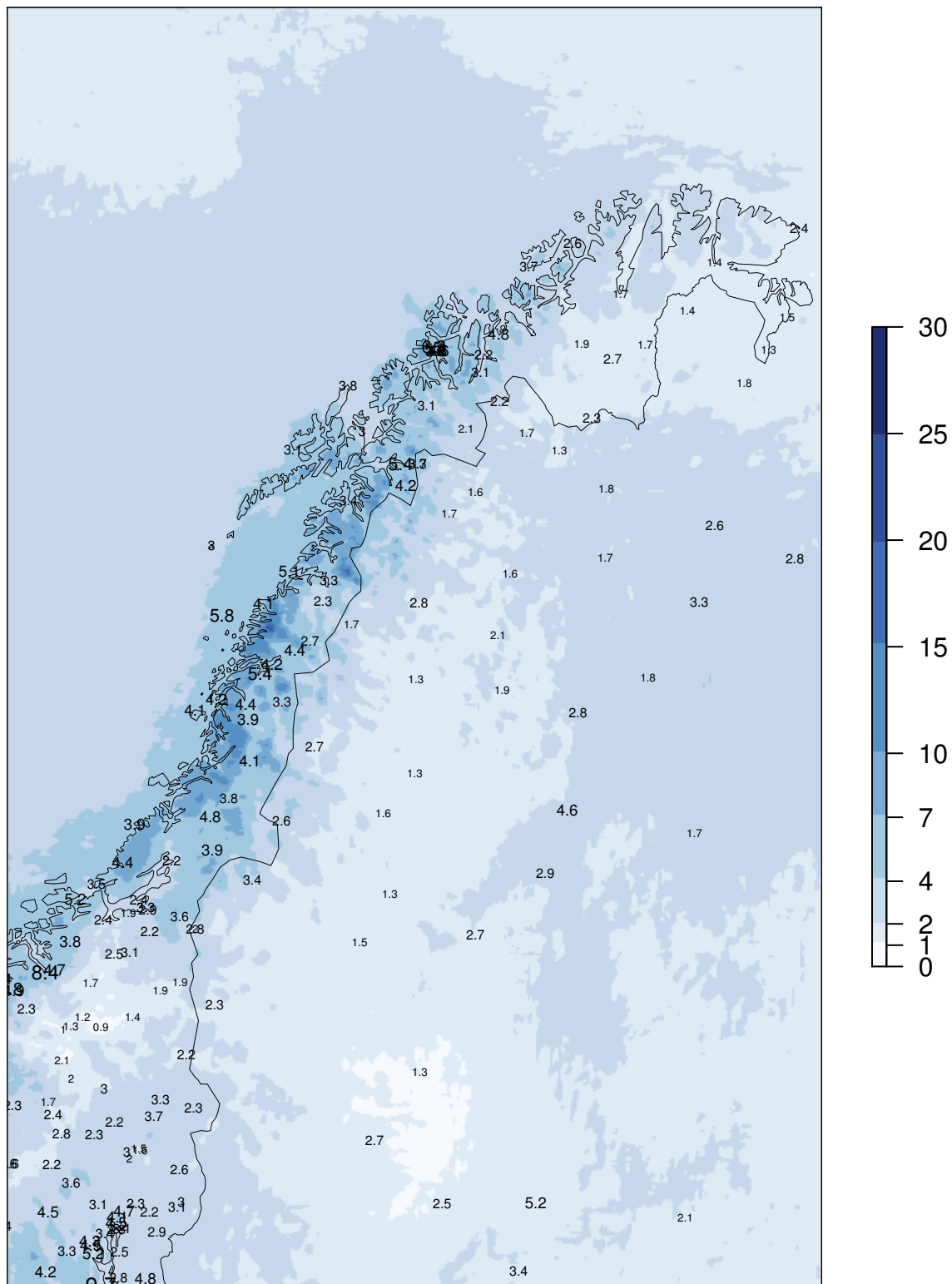
forecast means 01.09.2015 – 30.11.2015



AM25 00+30

SDE at observing sites

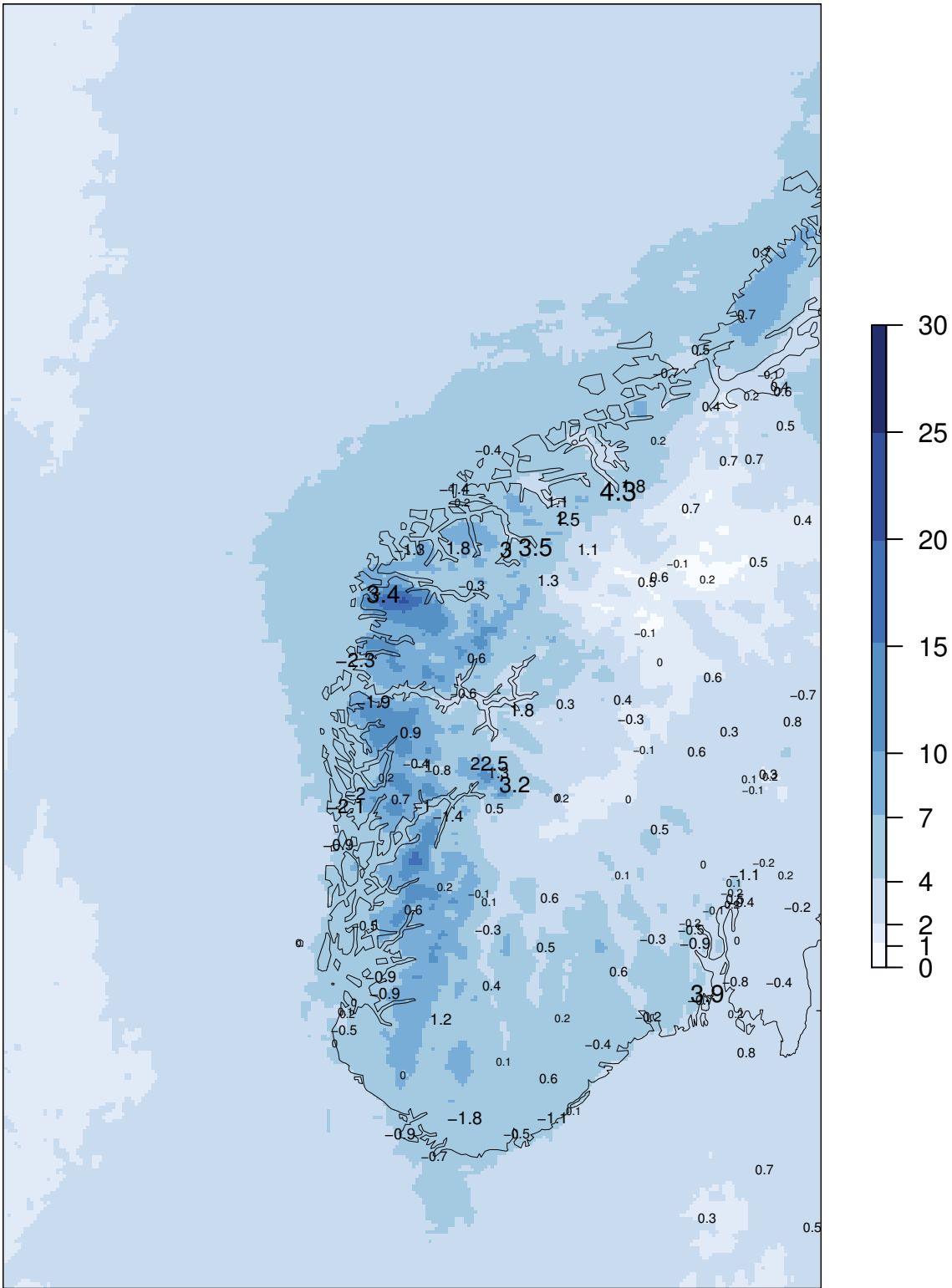
forecast means 01.09.2015 – 30.11.2015



AM25 00+30

ME at observing sites

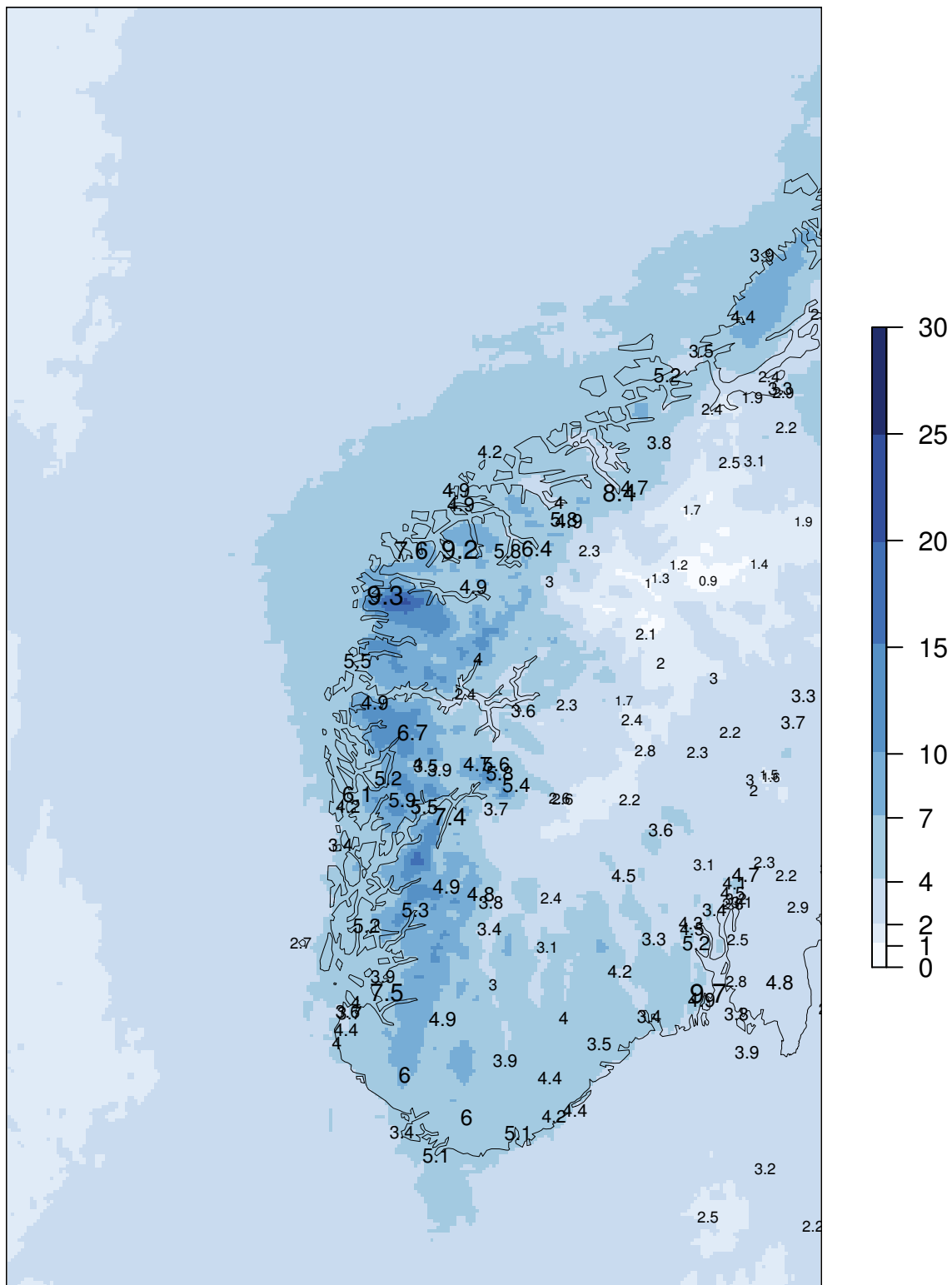
forecast means 01.09.2015 – 30.11.2015



AM25 00+30

SDE at observing sites

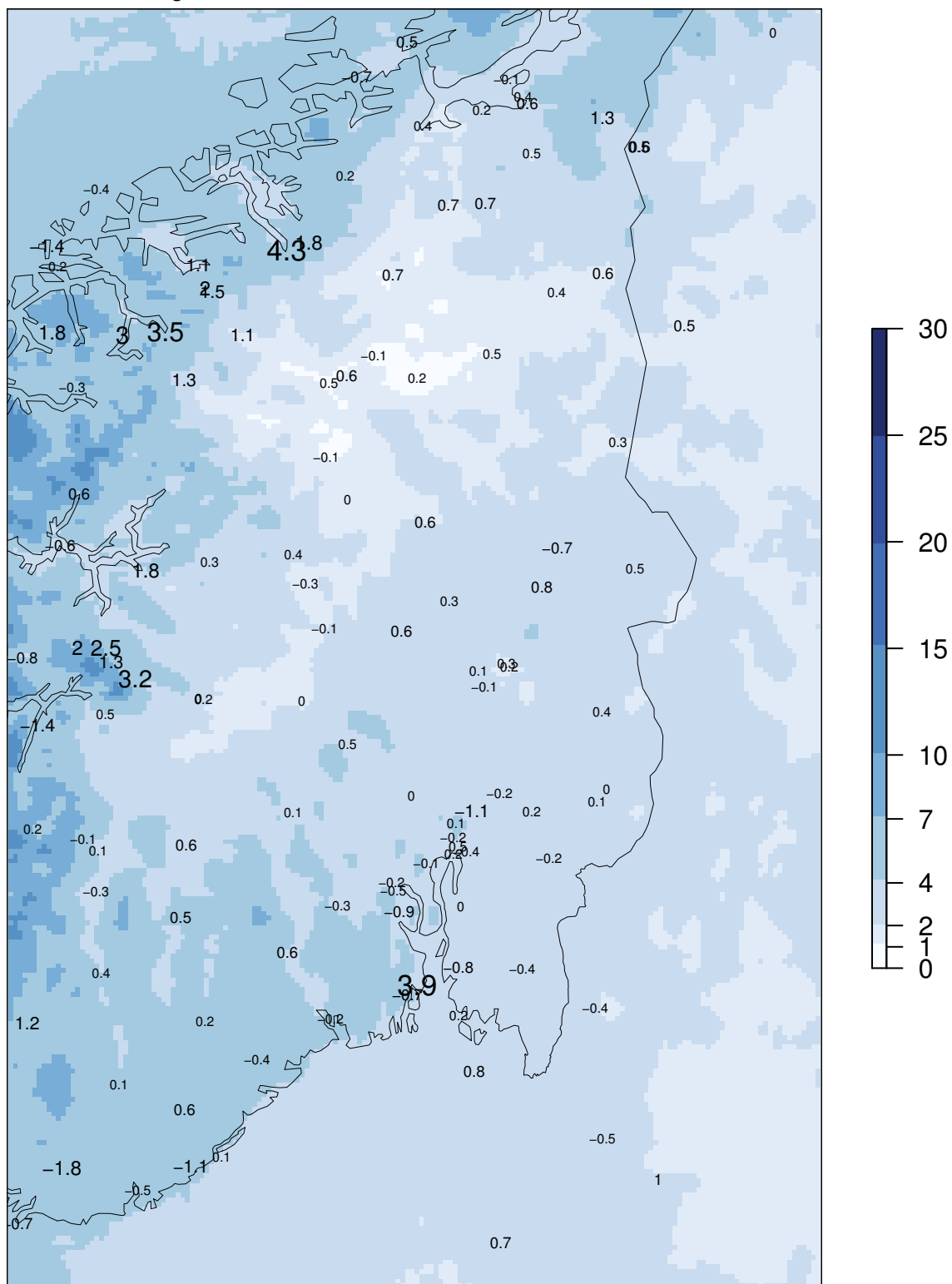
forecast means 01.09.2015 – 30.11.2015



AM25 00+30

ME at observing sites

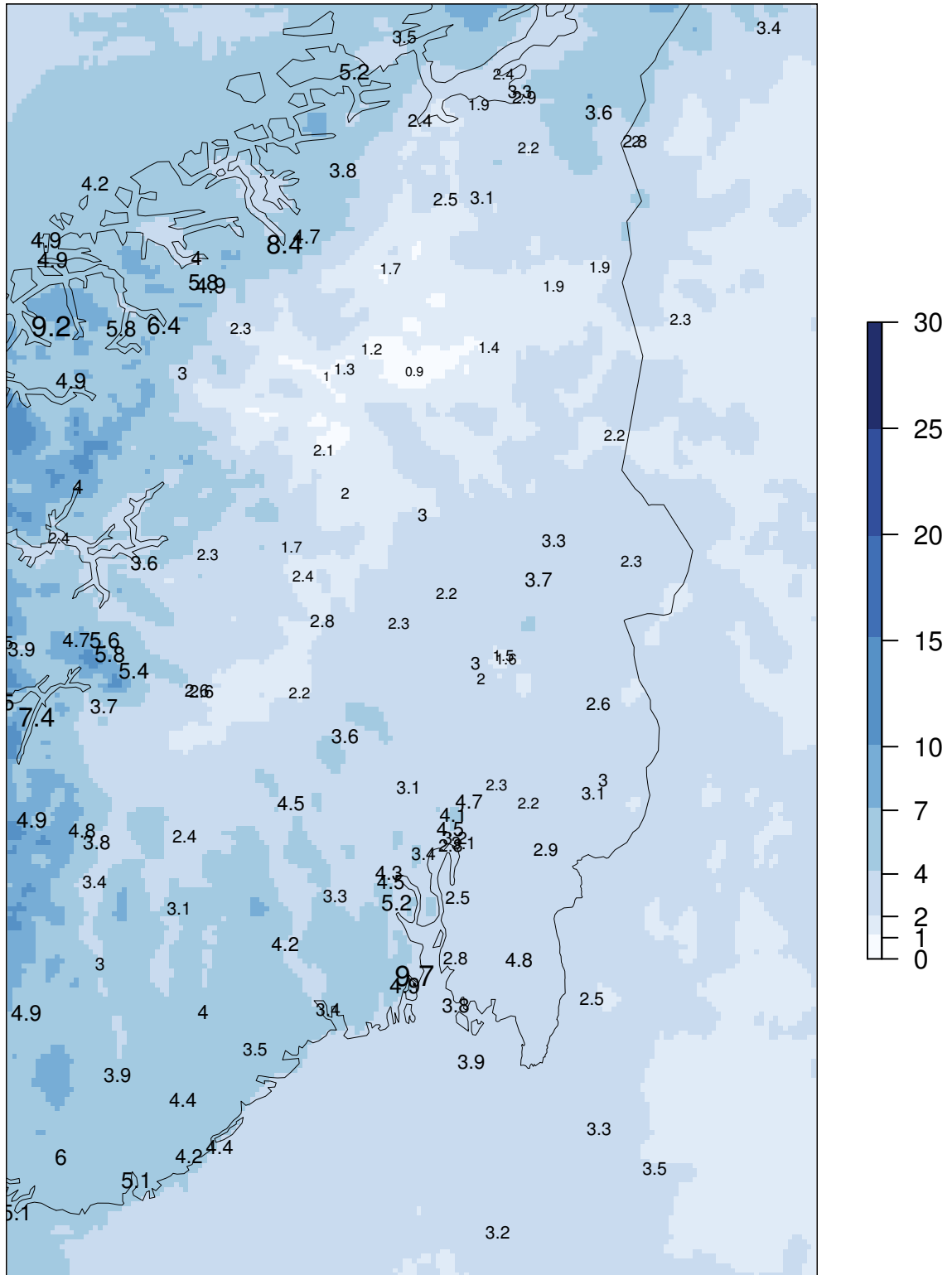
forecast means 01.09.2015 – 30.11.2015



AM25 00+30

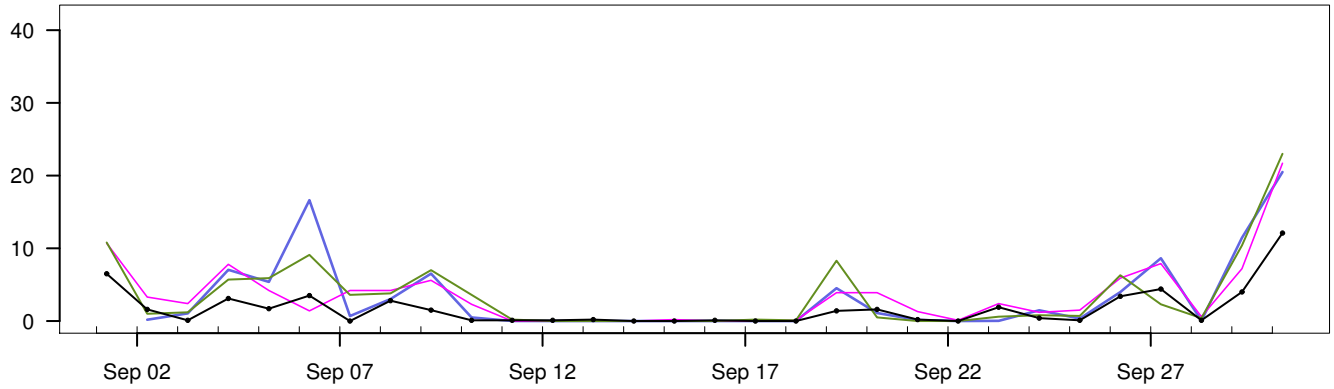
SDE at observing sites

forecast means 01.09.2015 – 30.11.2015

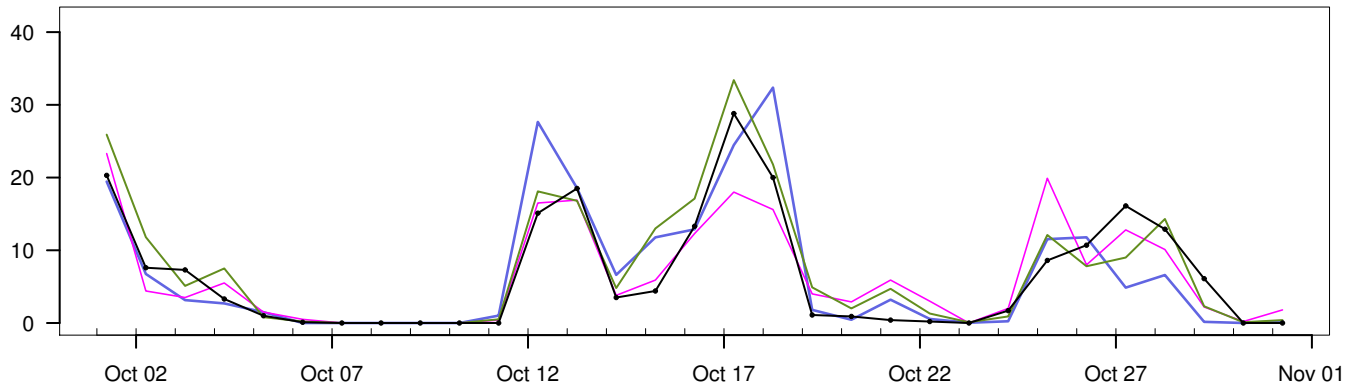


TROMSØ

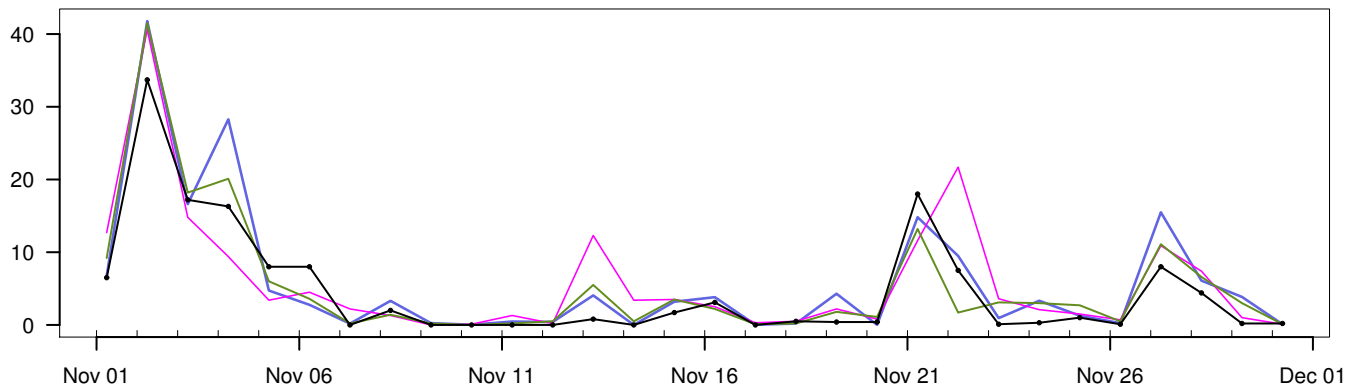
01.09.2015 – 30.09.2015



01.10.2015 – 31.10.2015



01.11.2015 – 30.11.2015



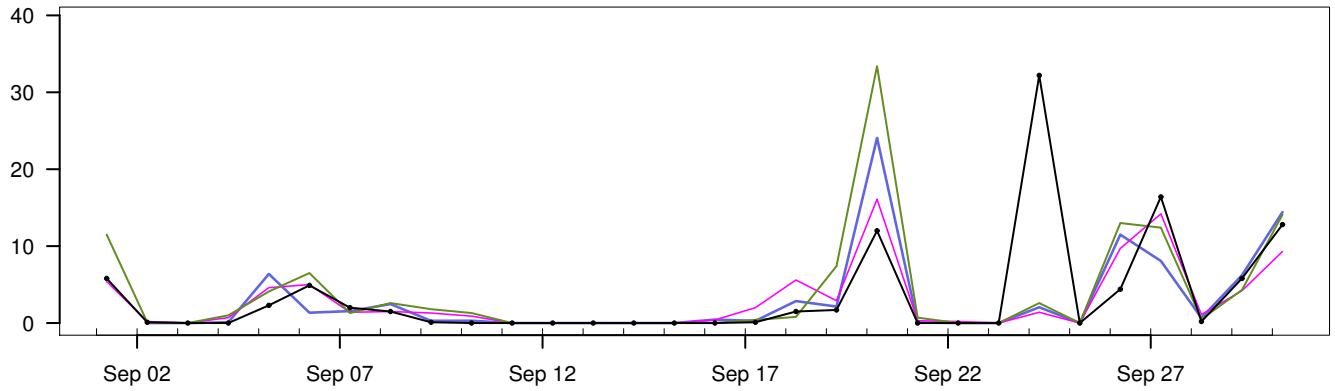
01.09.2015 – 30.11.2015

	Min	Mean	Max	Std	N
— synop: 06	0	4.3	33.7	6.8	91
— AM25: 00+30	0	5.3	41.8	8.2	90
— Hirlam8: 00+30	0	5.3	40.6	6.9	91
— ECMWF: 00+30	0	5.5	41.5	7.8	91

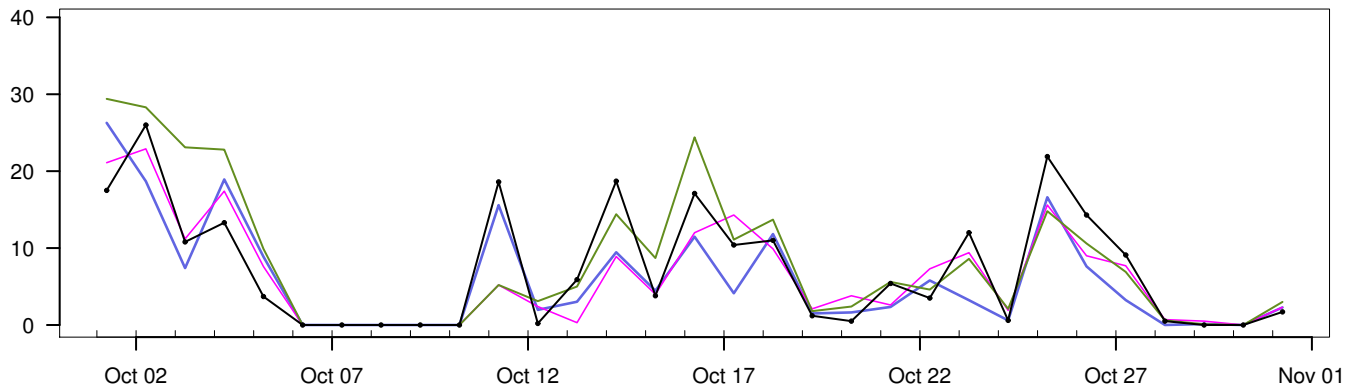
	ME	SDE	RMSE	MAE	Max.abs.err.	N
AM25 – synop	1.1	3.8	4	2.3	13.1	90
Hirlam8 – synop	1	3.6	3.7	2.4	14.2	91
ECMWF – synop	1.2	2.9	3.2	2.2	10.9	91

BODØ

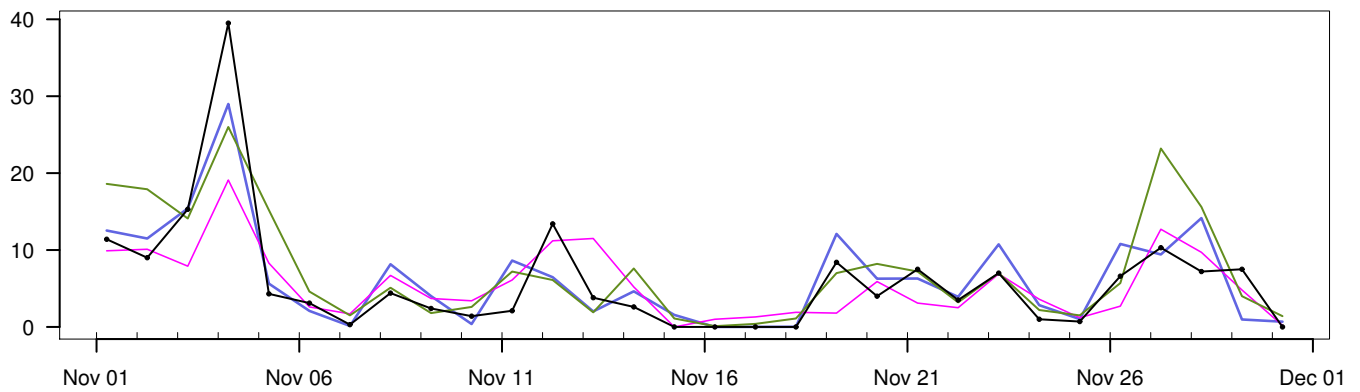
01.09.2015 – 30.09.2015



01.10.2015 – 31.10.2015



01.11.2015 – 30.11.2015



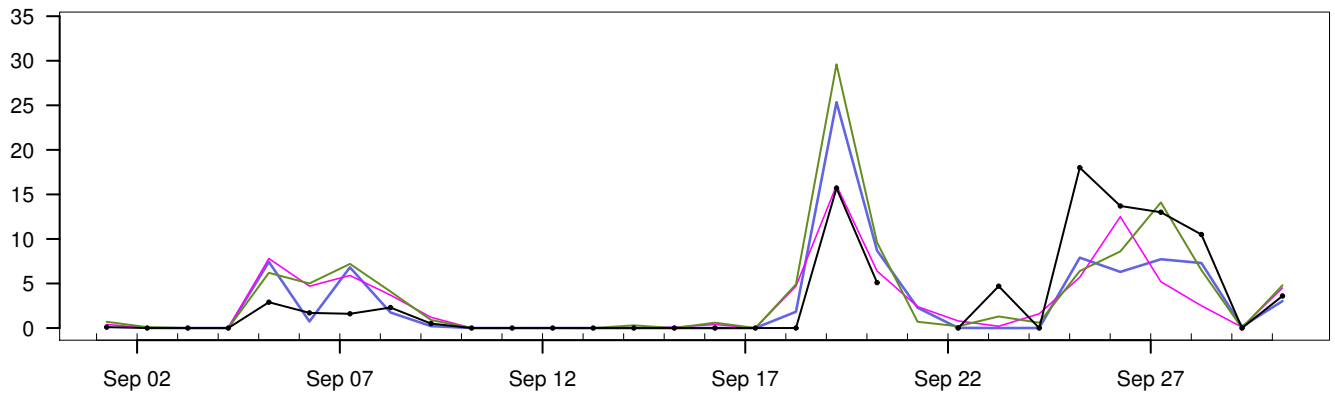
01.09.2015 – 30.11.2015

	Min	Mean	Max	Std	N
— synop: 06	0	5.6	39.5	7.6	91
— AM25: 00+30	0	5.2	29	6.4	90
— Hirlam8: 00+30	0	5	22.9	5.4	91
— ECMWF: 00+30	0	6.6	33.4	7.9	91

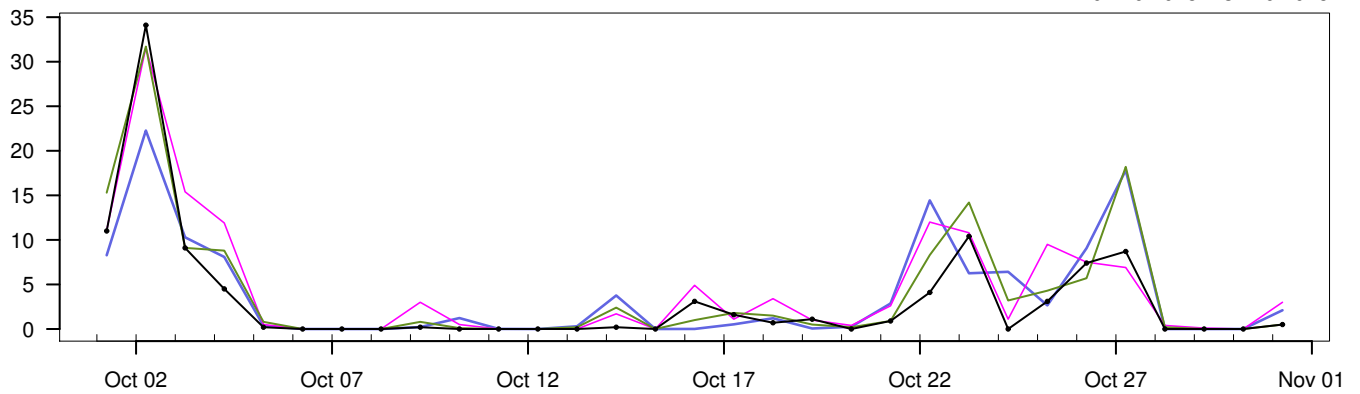
	ME	SDE	RMSE	MAE	Max.abs.err.	N
AM25 – synop	-0.4	4.9	4.9	2.7	30.2	90
Hirlam8 – synop	-0.6	5	5	2.6	30.8	91
ECMWF – synop	1	5.8	5.9	3.2	29.6	91

ØRLAND

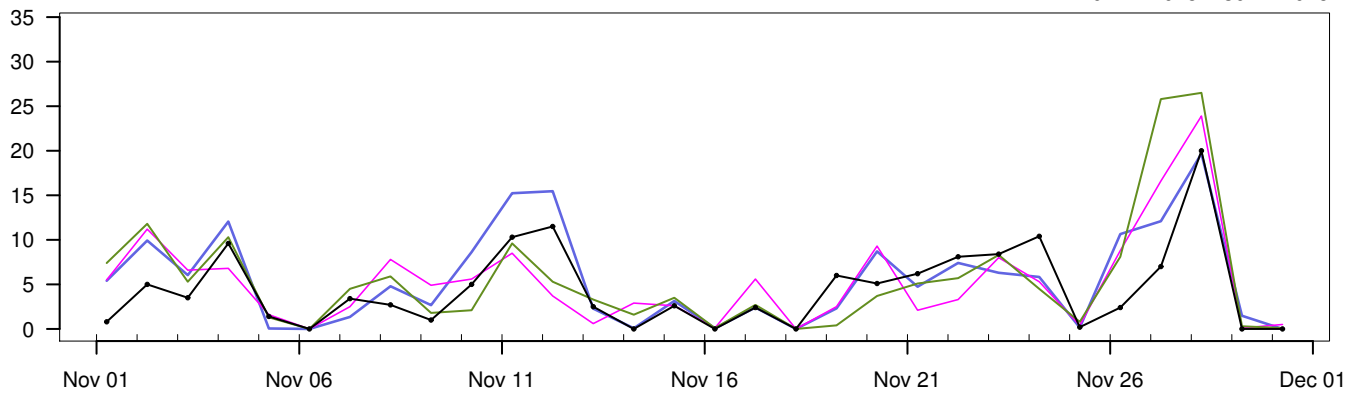
01.09.2015 – 30.09.2015



01.10.2015 – 31.10.2015



01.11.2015 – 30.11.2015



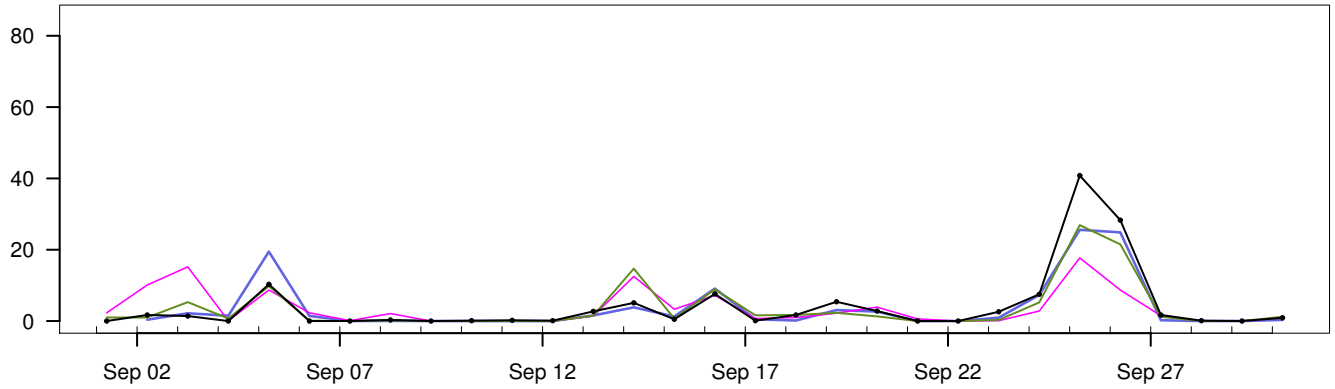
01.09.2015 – 30.11.2015

	Min	Mean	Max	Std	N
— synop: 06	0	3.7	34.1	5.6	90
— AM25: 00+30	0	4.2	25.3	5.6	90
— Hirlam8: 00+30	0	4.2	31.6	5.5	91
— ECMWF: 00+30	0	4.5	31.7	6.6	91

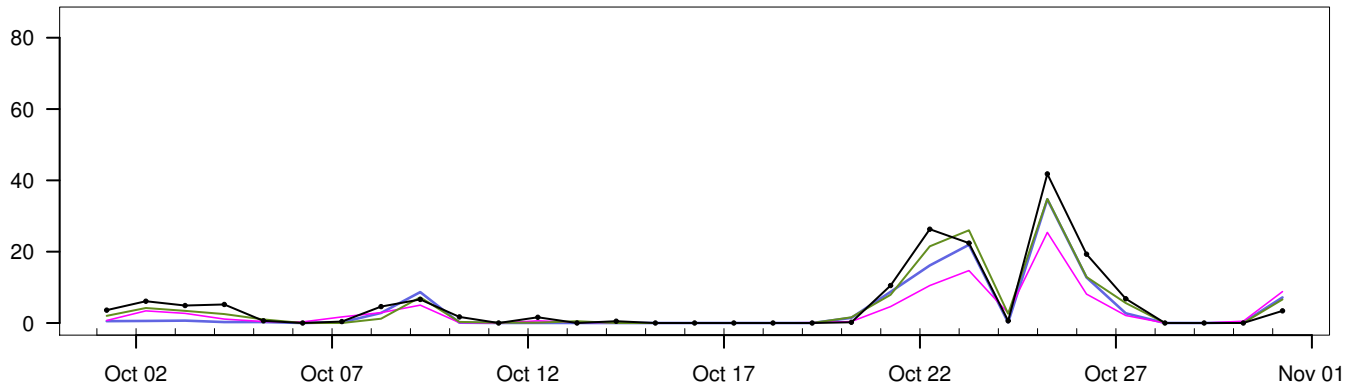
	ME	SDE	RMSE	MAE	Max.abs.err.	N
AM25 – synop	0.5	3.5	3.5	2.1	11.8	89
Hirlam8 – synop	0.6	3.4	3.5	2.2	12.3	90
ECMWF – synop	0.9	3.8	3.9	2.1	18.8	90

BERGEN – FLORIDA

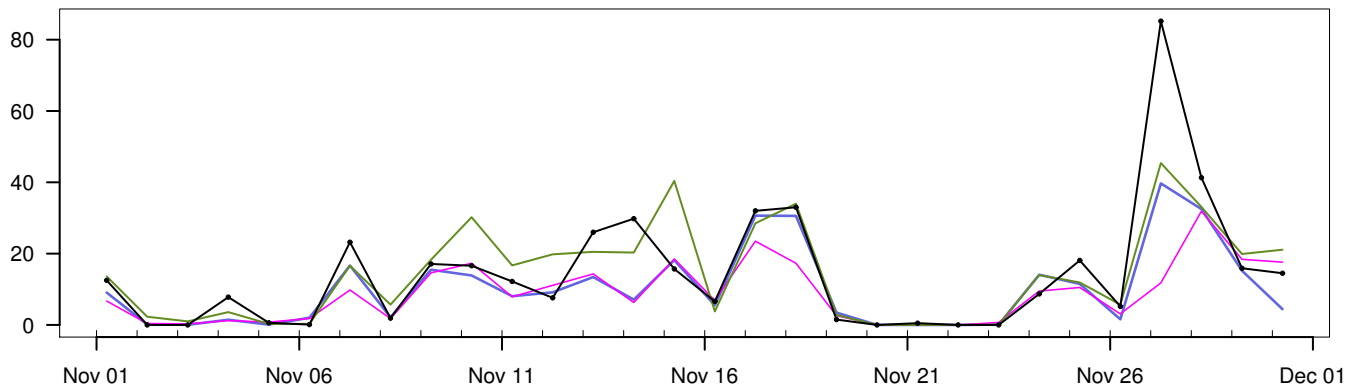
01.09.2015 – 30.09.2015



01.10.2015 – 31.10.2015



01.11.2015 – 30.11.2015



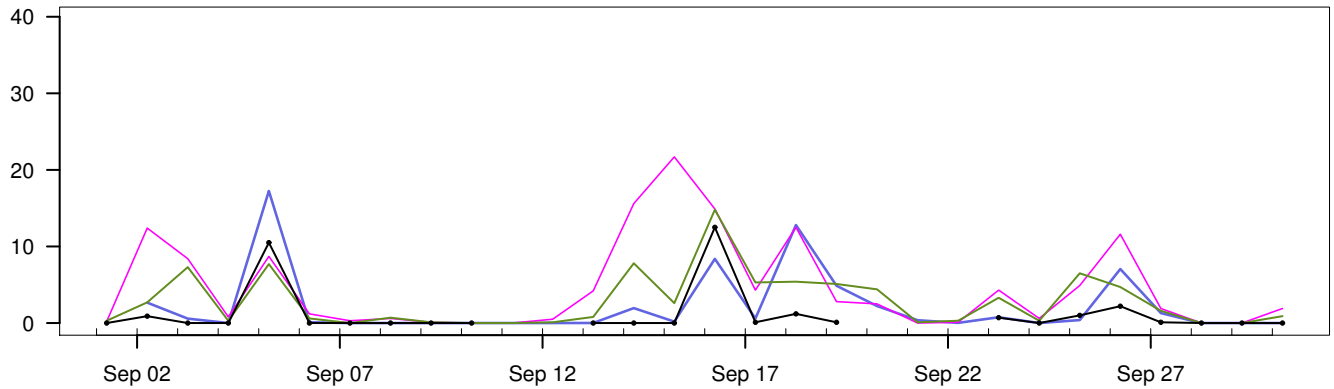
01.09.2015 – 30.11.2015

	Min	Mean	Max	Std	N
— synop: 06	0	7.9	85.2	13.4	91
— AM25: 00+30	0	5.9	39.7	9.3	90
— Hirlam8: 00+30	0	5.2	31.9	6.8	91
— ECMWF: 00+30	0	7.5	45.4	10.9	91

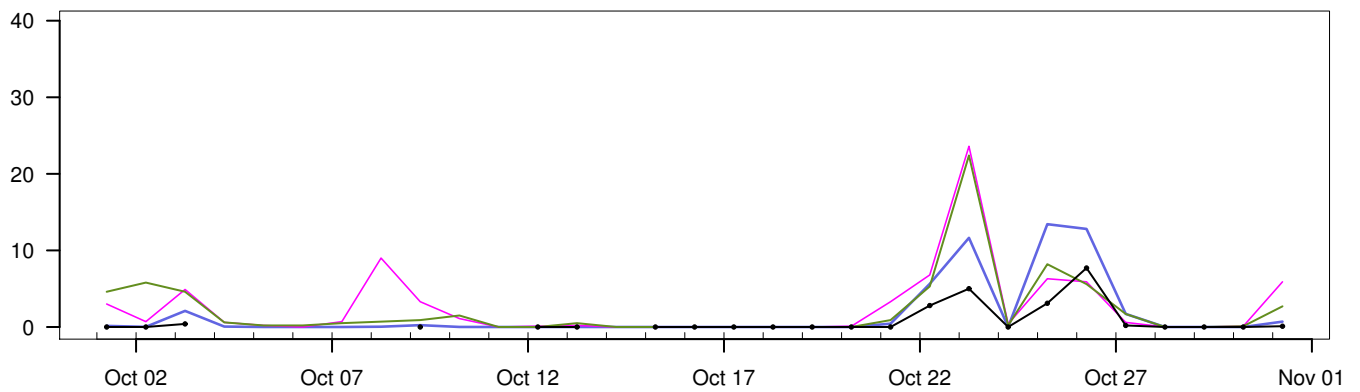
	ME	SDE	RMSE	MAE	Max.abs.err.	N
AM25 – synop	-2.1	6.2	6.6	2.9	45.5	90
Hirlam8 – synop	-2.8	9.6	10	4.3	73.4	91
ECMWF – synop	-0.5	6.2	6.3	3	39.8	91

LÆRDAL

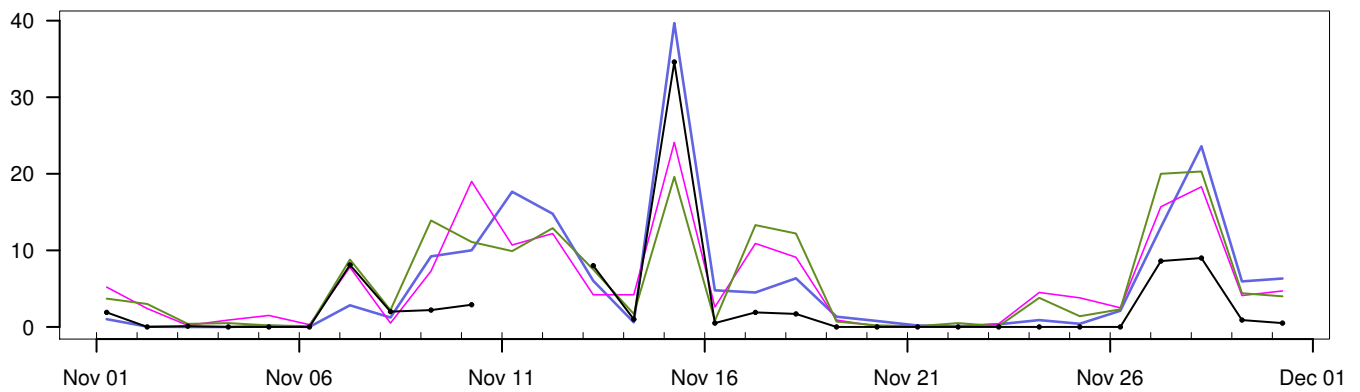
01.09.2015 – 30.09.2015



01.10.2015 – 31.10.2015



01.11.2015 – 30.11.2015



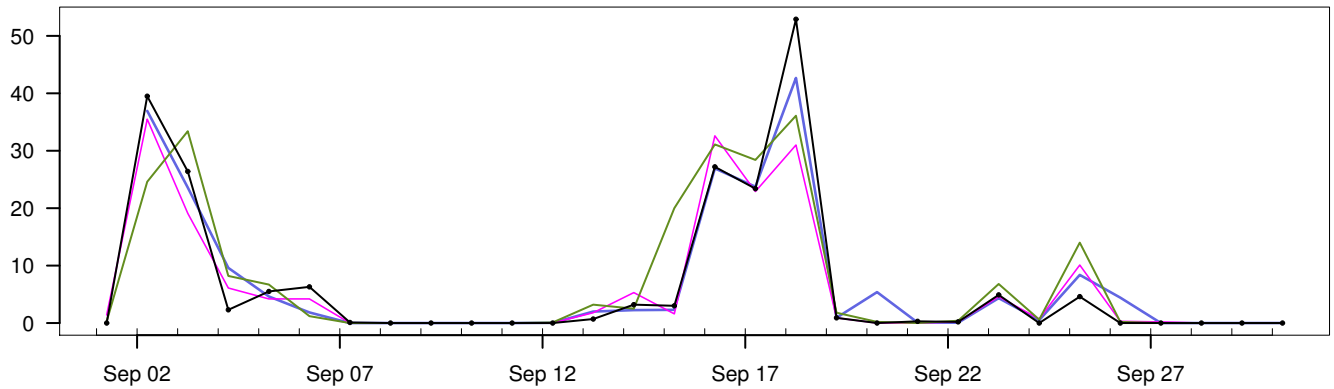
01.09.2015 – 30.11.2015

	Min	Mean	Max	Std	N
— synop: 06	0	1.7	34.6	4.7	76
— AM25: 00+30	0	3.2	39.7	6.2	90
— Hirlam8: 00+30	0	4.3	24.1	5.8	91
— ECMWF: 00+30	0	3.6	22.4	5.2	91

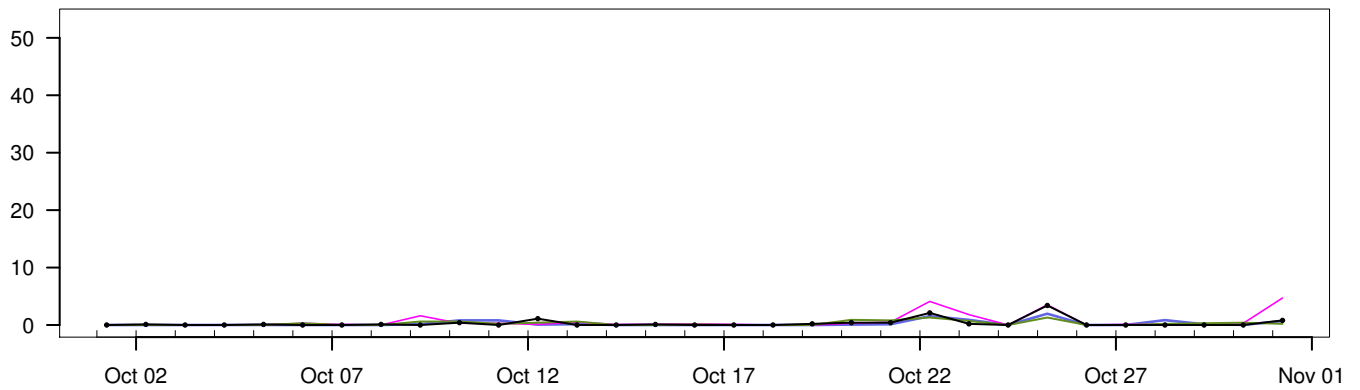
	ME	SDE	RMSE	MAE	Max.abs.err.	N
AM25 – synop	1.6	3.2	3.6	1.9	14.6	75
Hirlam8 – synop	2.9	4.9	5.7	3.4	21.7	76
ECMWF – synop	2.2	4.2	4.7	2.7	17.4	76

GARDERMOEN

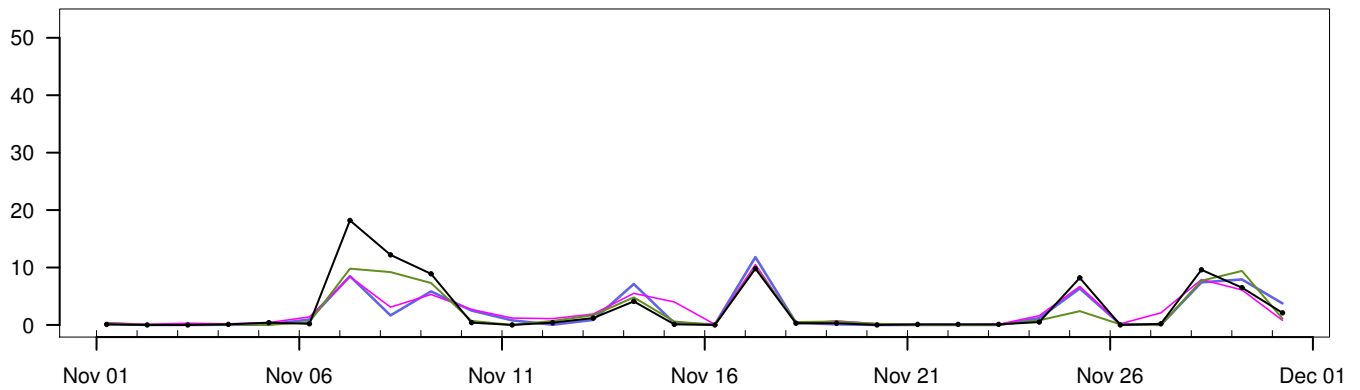
01.09.2015 – 30.09.2015



01.10.2015 – 31.10.2015



01.11.2015 – 30.11.2015



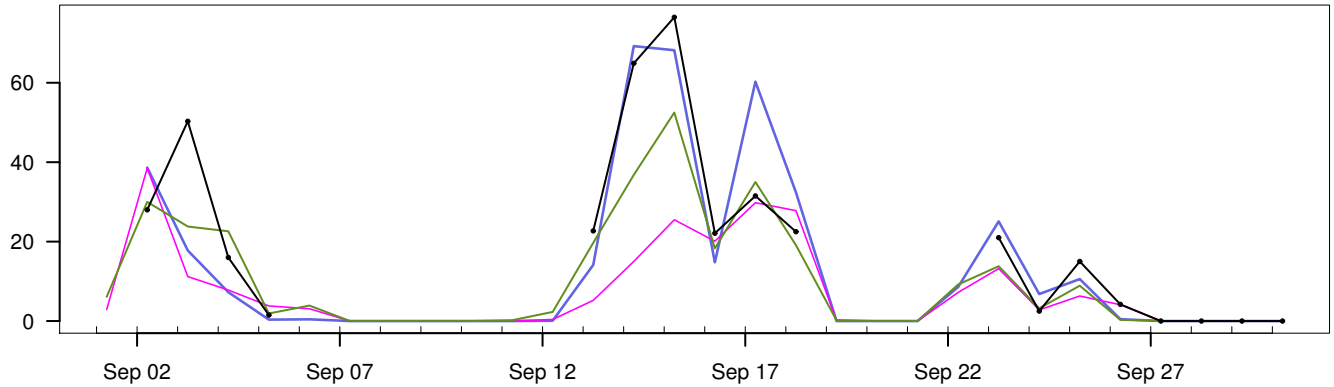
01.09.2015 – 30.11.2015

	Min	Mean	Max	Std	N
— synop: 06	0	3.2	52.9	8.5	91
— AM25: 00+30	0	3.1	42.7	7.5	90
— Hirlam8: 00+30	0	3	35.5	6.7	91
— ECMWF: 00+30	0	3.3	36.1	7.5	91

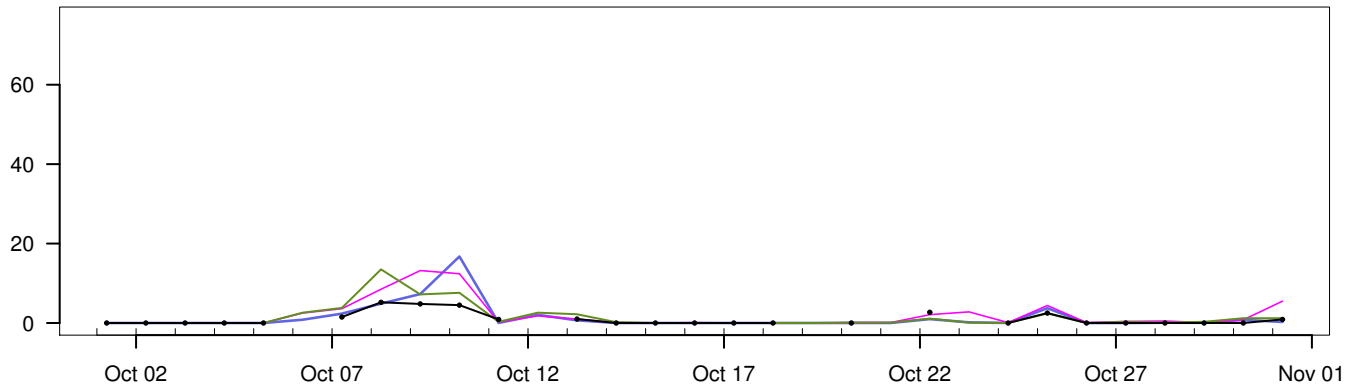
	ME	SDE	RMSE	MAE	Max.abs.err.	N
AM25 – synop	-0.2	2.4	2.4	1.1	10.5	90
Hirlam8 – synop	-0.2	3.1	3.2	1.3	21.9	91
ECMWF – synop	0	3.6	3.6	1.5	17	91

NELAUG

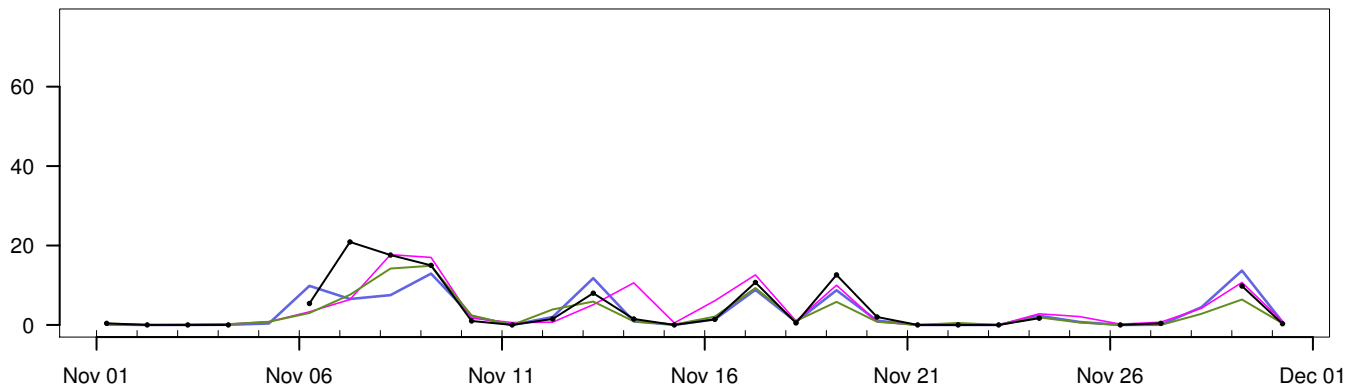
01.09.2015 – 30.09.2015



01.10.2015 – 31.10.2015



01.11.2015 – 30.11.2015



01.09.2015 – 30.11.2015

	Min	Mean	Max	Std	N
— synop: 06	0	7.2	76.5	14.5	71
— AM25: 00+30	0	5.7	69.2	13.2	90
— Hirlam8: 00+30	0	4.4	38.5	7.4	91
— ECMWF: 00+30	0	4.8	52.5	9.3	91

	ME	SDE	RMSE	MAE	Max.abs.err.	N
AM25 – synop	-0.3	6.5	6.6	2.9	32.5	71
Hirlam8 – synop	-2	10.4	10.6	4	51	71
ECMWF – synop	-1.5	6	6.1	2.6	28.1	71