Norwegian
Meteorological
Institute

METinfo

No. 41/2025
ISSN 1894-759X
Meteorology

Verification of Operational Weather Prediction Models June to August 2025

Bjørn Gilje Lillegraven and Lene Østvand

Trollheimen. Photo: Lene Østvand

Contents

More information...

Verification results are also available on internal web pages

- https://metcoop-comm.smhi.se/ and https://metcoop.smhi.se/ - MetCoOp Web Tools - including verification and observation monitoring
- https://harp.smhi.se/ - MetCoOp verification visualized with harp
- http://verif/vmap/ - timeseries and windroses - on Google map

About this report

This verification report indicates the quality of the main operational weather forecasting models used at the Norwegian Meteorological Institute (MET Norway) for the period indicated. Another purpose of the verification report series is to provide a stable source of information suitable for monitoring longer trends in forecasting quality for interested readers. The report complements the verification and monitoring performed on individual models. Each model is monitored and developed according to the scientific method, where changes are only introduced when they can document a better likely prediction skill. Such documentation is available as research papers, consortium news, and presentations at team-, syndicate- and consortium- meetings. The skill of the forecasting service in severe weather situations is also documented with special emphasis on forecast failures, in order to learn from them and improve the system.

The report includes verification results for 3 Numerical Weather Prediction (NWP) models; MetCoOp ensemble prediction system (MEPS) covering Norway, Sweden, Finland, Denmark and the Baltic states, AROME-Arctic covering Svalbard, Novaja Semlja, Frans Josefs land and the Northern part of Scandinavia and the global Integrated Forecasting System (IFS). The models are further described in the Models section. The variables verified are mean sea level pressure, temperature, wind speed and precipitation. The results are grouped by variable. A short summary of the results and cases studies by forecasters are also included.

Verification results are shown for different groups of stations: Norwegian, Svalbard and North Scandinavian. For temperature there are additional groups with Norwegian coastal and Norwegian inland stations, for wind speed Norwegian coastal and Norwegian mountainous stations, and for precipitation coastal stations, stations more than 500 m above sea level, and stations with daily mean precipitation $>$ 4 mm. For MEPSctrl statistics at the observing sites are also visualized on maps with model climatology. The text size of the statistics increases with the value. Time series with observations and available models are included for selected stations. Post processed variables are compared with MEPSctrl.

Models

The following Numerical Weather Prediction (NWP) models are verified in this report. The verification measures are plotted for each model with the colors indicated in the table below.

Integrated Forecasting System (IFS)	Operational forecasts from the European Centre for Medium-Range Weather Forecasts (ECMWF) are produced with the Integrated Forecasting System (IFS), which is a global model with horizontal resolution of about 9 km. Cycle 49r1 since 12 November 2024. MET Norway always uses the latest available operational cycle. IFS is available about 5 hours later than models run at MET Norway.
MetCoOp ensemble prediction system (MEPSctrl)	MEPS has 30 lagged ensemble members, constructed from 5 members updated hourly and run up to 66 hours. Only member 0, the control, is verified in this report. MEPS is based on HARMONIE with AROME physics and non-hydrostatic dynamics, horizontal resolution defined by a 2.5×2.5 km^2 grid. Cycle 43h2.1 since 23 March 2021. MEPS is run in cooperation with Swedish Meteorological and Hydrological Institute (SMHI), Finnish Meteorological Institute (FMI) and Estonian Environment Agency (ESTEA).
AROME-Arctic (AA25)	HARMONIE with AROME physics, horizontal resolution defined by a 2.5×2.5 km^2 grid. Cycle 43h2.1 since 5 May 2021.

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.

A change log for HARMONIE AROME (which MEPSctrl is based on) is available on internal webpages: https://metcoop.smhi.se/dokuwiki/nwp/metcoop/changelog/start

A similar change log for AA25 is found on github:
https://github.com/metno/NWPdocs/wiki/AROME-Arctic-dataset#arome-arctic-changelog

Post processed forecasts

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

The met nordic temperature forecasts, YrPP in the plots, are post-processed forecasts based on the latest MEPS ensemble runs. The MEPS temperature forecasts are first downscaled to 1 km resolution using the model lapse rate in a neighbourhood. The forecasts are then bias corrected using a fine scale 1 km temperature analysis as reference. The temperature analysis is based on multiple data sources using both conventional and citizen observations.

The MEPS 10 m wind speed forecast is post-processed by downscaling to 1 km resolution to better represent local topography, and called YrPP.

YrPP is plotted with the color below.

The HARMONIE system

HARMONIE is the acronym for HIRLAM's meso-scale forecast system (Hirlam Aladin Regional/Meso-scale Operational NWP In Europe). For documentation see
- *The HARMONIE-AROME Model Configuration in the ALADIN-HIRLAM NWP System* by Bengtsson et al. 2017, available at https://doi.org/10.1175/MWR-D-16-0417.1
- *AROME-MetCoOp: A Nordic Convective-Scale Operational Weather Prediction Model* by Müller et al. 2017, available at https://doi.org/10.1175/WAF-D-16-0099.1

More documentation is also available on hirlam.github.io/HarmonieSystemDocumentation/dev/, www.accord-nwp.org and www.cnrm.meteo.fr/gmapdoc/.

This section presents some of the main components and setups that are used at MET.

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 and 65 vertical layers, and from April 2015 1.3 km and 90 vertical layers.

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 uses SURFEX in all their configurations. Surface modelling and assimilation 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. MEPS 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 UTC as there are very few snow depth observations at 00, 03, 09, 12, 15, 18 and 21.

The Sea Surface Temperature (SST) and Sea Ice Concentration (SIC) is not analysed, but taken from the boundaries. IFS 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 ocean models run at SMHI; first HIROMB and since 26 April 2017 NEMO.

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

MEPS 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, IASI 26 November 2015 and ASCAT 17 March 2016. Mode-S EHS, AMSU-A and MHS from METOP-C satellite were introduced June 2020, METOP-C IASI (deactivation of METOP-A IASI), June 2021, radar radial wind observations and German radars, June 2022.

Boundary fields

MEPS gets its boundary values (1-hourly) from the IFS model at approximately 9 km resolution, and has currently 65 vertical levels. None of the HARMONIE configurations at MET Norway 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 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.

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

In the formula for COR the following definitions are used

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

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

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

For wind direction the probability density function (PDF) is used to show the distribution of observed and forecast wind directions. The PDF used here is a kernel density estimate, which is a smoothed version of the histogram.

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)
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 frost.met.no. Only synop stations are used. From June 1 2021, both the model wind speed and the post-processed wind speed are verified against mean wind observations, FF. The model wind gust is verified against the observed wind gust, FG. FF and FG are defined as follows:

- FF: Wind speed (10 meters above ground) - defined as the mean value for the last 10 minutes before the time of the observation.
- FG: Gust wind speed (10 m above ground) - defined as highest gust wind speed (3 second mean) the last 10 minutes before the time of the observation.

Summary of the results

Summarized statistics show that IFS in general forecasts sea level pressure better than MEPSctrl/AA25, but the errors are small for both.

Temperature is on average better forecast by MEPSctrl/AA25 than IFS. IFS underestimates the temperature for all the different groups of stations. MEPSctrl shows a very small underestimation for the stations on the Norwegian mainland. The same can also be said for AA25 for the North Norwegian and Svalbard stations. Still, the errors are small, indicating that the timing of the temperature changes is generally good. The temperature forecast from MEPSctrl is further improved by post processing, particularly for the shortest lead times. The improvement is larger for inland stations than coastal stations, which have less variation in temperature and smaller errors than inland stations for both MEPSctrl and post processed forecasts.

For wind speed and precipitation, a larger number of verification scores is used to assess model quality, including threshold statistics.

Wind speed is challenging to evaluate. MEPSctrl performs better than IFS over land, and particularly in the mountains, where IFS underestimates the speed considerably as seen in the monthly mean error and mean absolute error. AA25 performs slightly better than IFS for the Svalbard stations, mostly due to a general tendency in IFS to underestimate the wind speed. The threshold scores indicate that wind speed is better forecast for lower than for higher wind speeds for all models. The post-processing of wind speed shows a small effect in the mean error and mean absolute error, while the other scores show almost identical results for MEPSctrl and YrPP.

Precipitation also shows varying results, depending on the amount and location. On average IFS has more precipitation than MEPSctrl. Both models have more errors for both very small and very high amounts, than for precipitation in the mid range.

For temperature and wind, the monthly scores for the last three years show that the models generally perform better during summer months than during winter, and the summer of 2025 is no exception. A possible cause is that storm activity is challenging to predict accurately, and that there are often more storms with high wind speeds during fall and winter than during summer. Precipitation does not have clear seasonal patterns. Convective cases that are challenging to predict may occur with different frequency for different months and years. A challenge with verification of precipitation that occurs during winter is the undercatchment of observed snow. This is the case when there is strong wind in combination with snow, which is often the case especially in Northern Norway and in the mountainous areas in Southern Norway. It is suspected that the models are too dry in the coastal and fjord areas, but the undercatchment leads to cases where the observations give an impression that there is better fit in the models with regards to precipitation than what is actually the case. AA25 and MEPSctrl show very similar results, which is expected since both are HARMONIE models with AROME physics and a horizontal resolution defined by a 2.5×2.5 km^2 grid.

Case studies by forecasters

Case 1. Convection

South East Norway often experiences convective clouds that form over warm landmasses during summer. On 19 June both the MEPSctrl and IFS models did not correctly forecast the convection that resulted in towering cumulus clouds and rain showers, as seen in figure 1.

In this case, it seems that both models might be too dry at the surface. Looking at the prognostic sounding from Torp Airport (figure 2), it appears that the forecast 2m dew point temperature, T_{d2m}, (indicated by the dashed lines) at the surface is too low. METAR observations at Torp Airport shows a dew point temperature from 5°C up to 8°C between 12 and 15 UTC, while the model had a T_{d2m} of 0 to 4°C. Although not a big difference, since the lower dew-point temperature alters the lifted condensation level of cloud formation in the area, it resulted in a too low vertical extent of the convective clouds in the model.

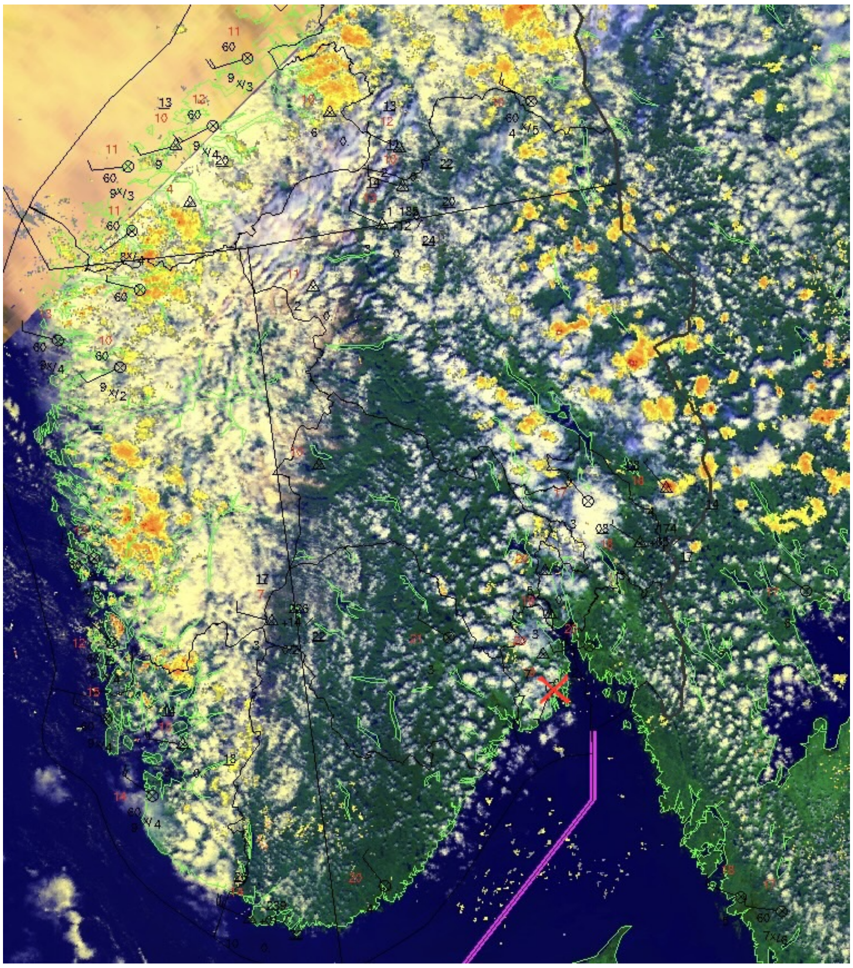


Figure 1: Satellite and radar image (yellow and orange dots) from 12:50 UTC June 19th. The red X marks the location of Torp Airport.

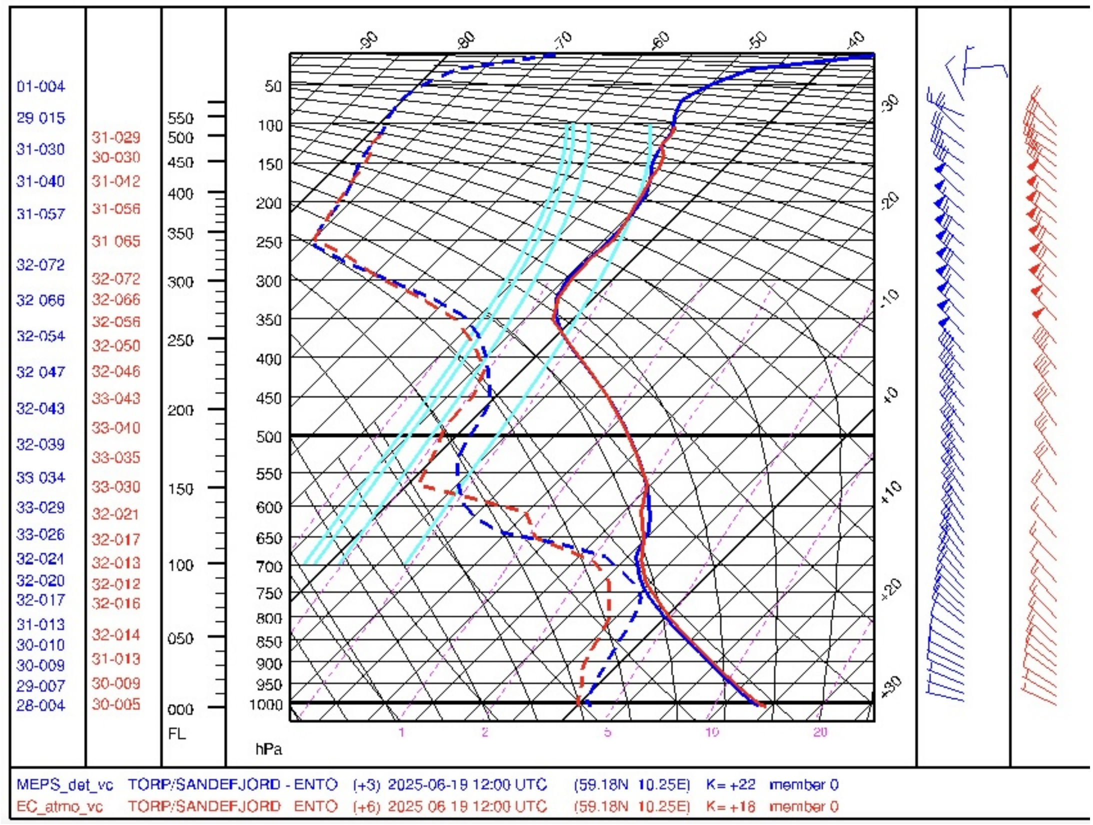


Figure 2: Prognostic sounding at Torp Airport at 13:00 UTC June 19th, MEPSctrl in blue and IFS in red.

Case 2. Precipitation

Ensemble forecasts are currently not included in the summarized statistics in the quarterly verification reports, but are produced e.g. for probability forecasts. This case from late July illustrates a challenge of using ensembles when forecasting precipitation amounts. In some instances there seems to be a tendency towards the MEPSctrl run forecasting higher precipitation amounts than the other ensemble members. Especially in situations where convective and stratiform precipitation is present at the same time, due to embedded cumulonimbus clouds, this phenomenon has been recorded.

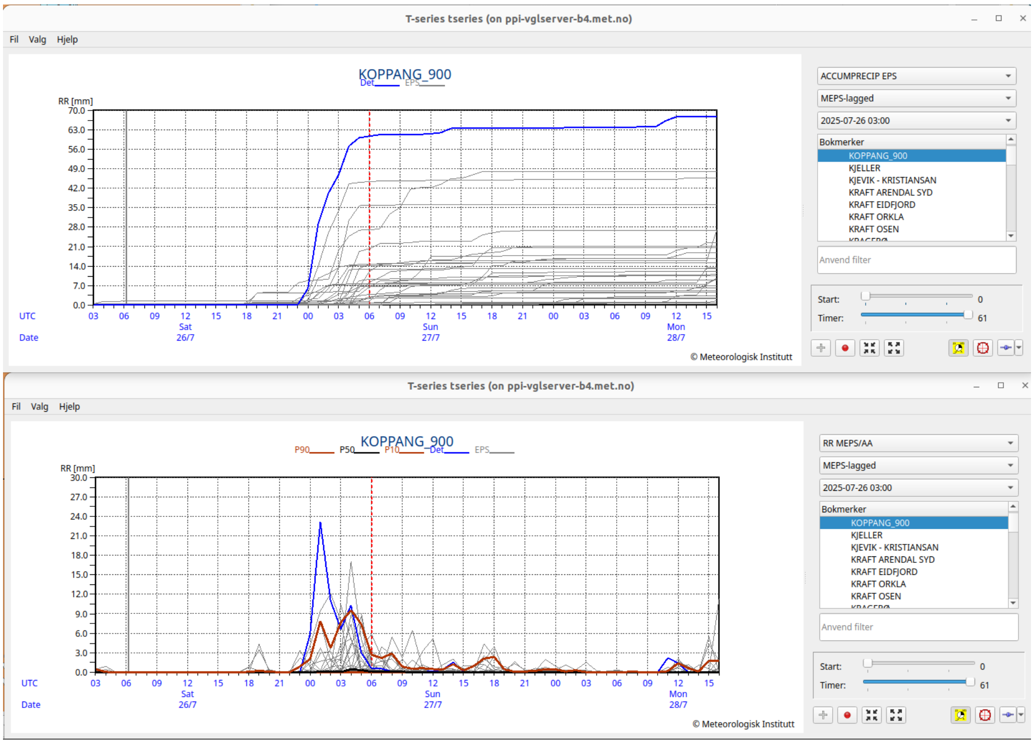


Figure 3: Precipitation amounts at Koppang for MEPSctrl in blue and the MEPS ensemble members in gray. The upper panel shows cumulative values, while the bottom shows hourly values.

In this case, for an area around Koppang, MEPSctrl forecast higher precipitation amounts than the rest of the ensemble members. While the control member predicted more than 60 mm/6h for Koppang for the period between 00 and 06 UTC July 27th, the rest of the members predicted values much lower (figure 3). The observed maximum 6h precipitation on July 27th was 19.6 mm at Gausdal - Follebu and 18.1 mm at Drevsjø, where almost all (17.3 mm) came within one hour (upper right corner of figure 4). These amounts were nowhere near the values forecast by the MEPS control run. A look at the ensembles gives more reasonable results, in the range of 10-20 mm/6h. While it is expected that some ensemble members give higher values than others, it is curious that the control run often is the highest in similar weather situations according to the forecasters.

A similar case was observed also on July 11th near Kongsvinger, although for a longer forecast lead time (nearly 60 hours), showing the control member forecasting way more precipitation than other members (not shown). The reason for the positive bias seen in precipitation for MEPSctrl compared to the rest of the ensemble members in these situations is not known, but should be looked further into.

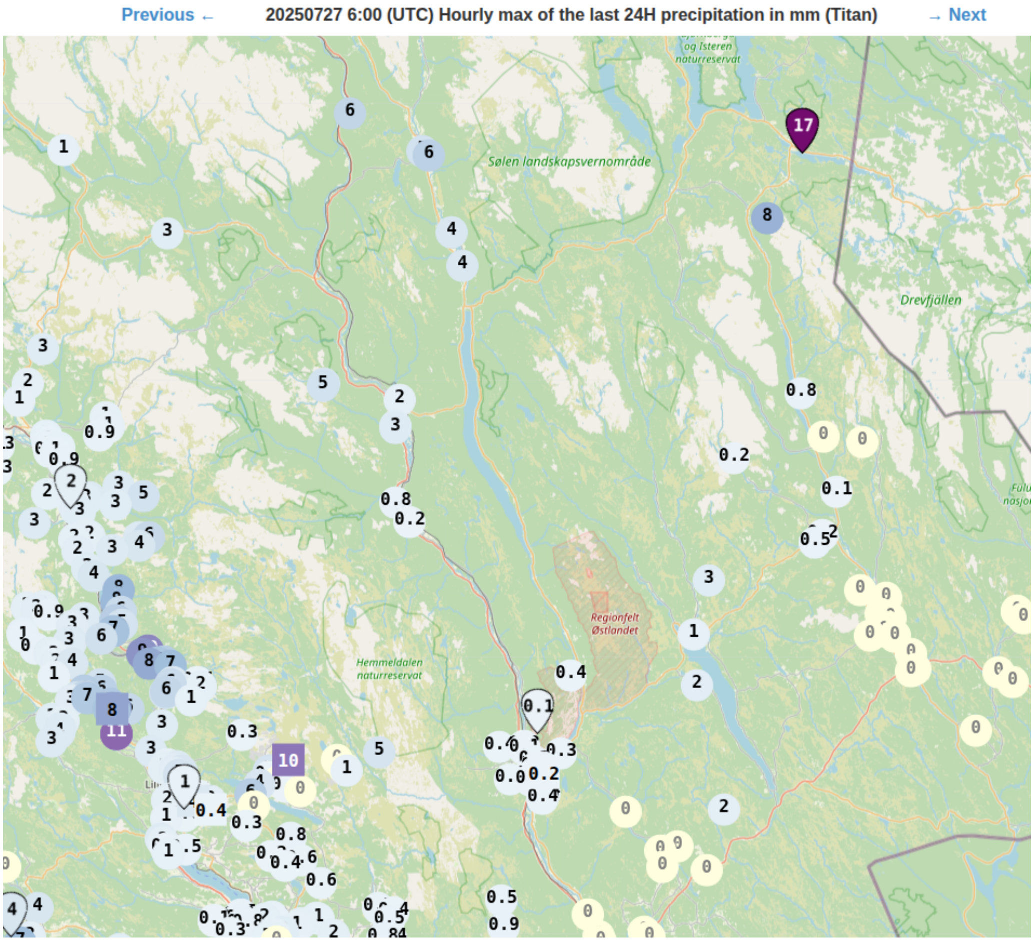


Figure 4: Hourly maximum values of precipitation from 06 UTC July 26th to 06 UTC July 27th for parts of South East Norway. Screenshot from yrverif.met.no/NORVIEW/obs_map_titan/

Case 3. Low clouds over the sea

There have been many recorded cases of problems with the model representation of fog and low clouds over the ocean this summer, in particular in the north. Forecasting fog is often a challenge in the summer, and this year we received more reports than usual. The following case is from August 22nd and shows an example of how the finer-scale models, MEPSctrl and AA25 (in this case mainly AA25 due to the domain borders) often exaggerate the fog/stratus clouds over the sea during summer.

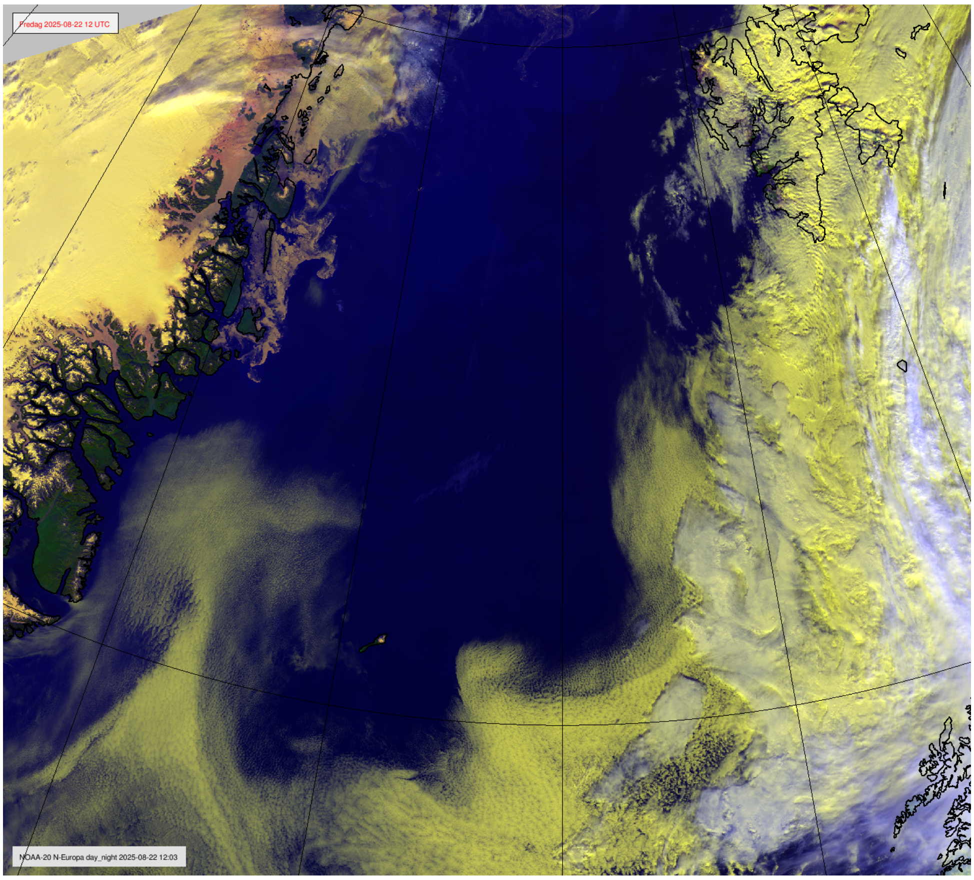


Figure 5: Satellite image over the northern part of the Norwegian Sea at 12:03 UTC August 22nd.

Parts of the Norwegian Sea were covered by a low cloud cover, but in the area north of Jan Mayen there are mostly cloud-free conditions (figure 5). It is interesting to see how the AA25 and IFS models differ in representing the cloud cover at the time (figure 6), where AA25 has a too widespread cloud layer in the sea north of Jan Mayen and west of Spitsbergen, while IFS is quite accurate when comparing it to the satellite image in figure 5. As most of the clouds are low clouds and not fog, it is difficult to use surface observations to verify the cloud cover.

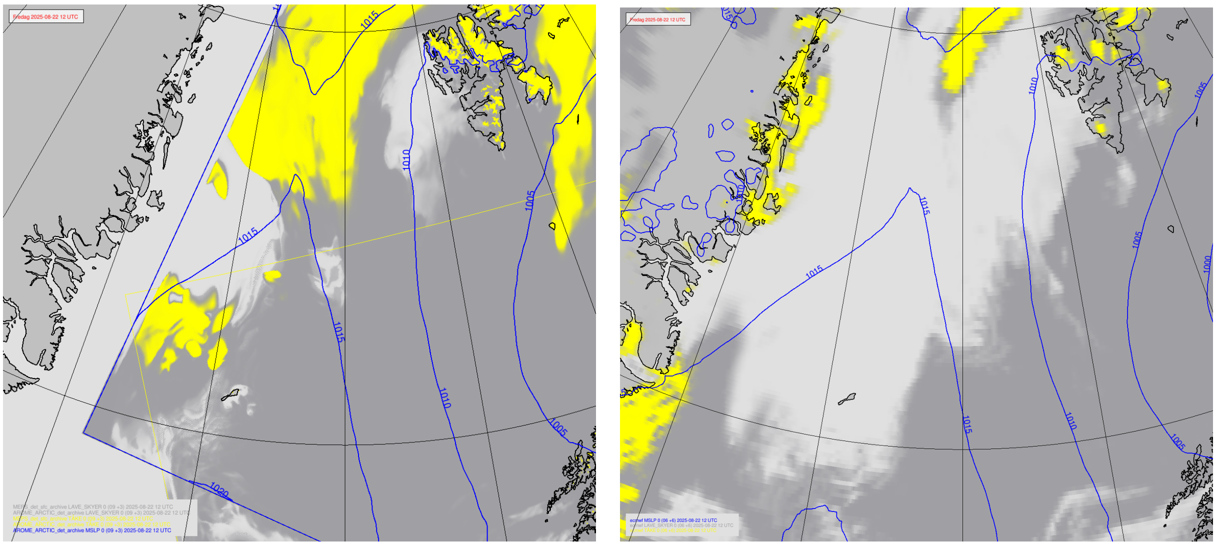


Figure 6: Fog (in yellow) and low clouds (in gray) from MEPSctrl and AA25 (left) and IFS (right) at 12:00 UTC August 22nd.

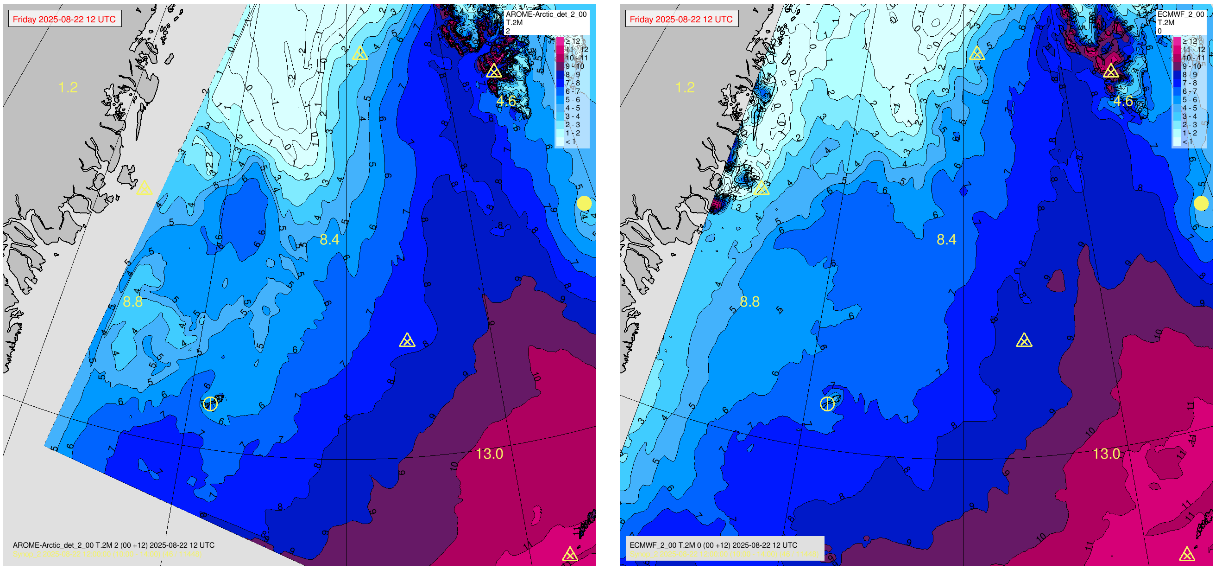
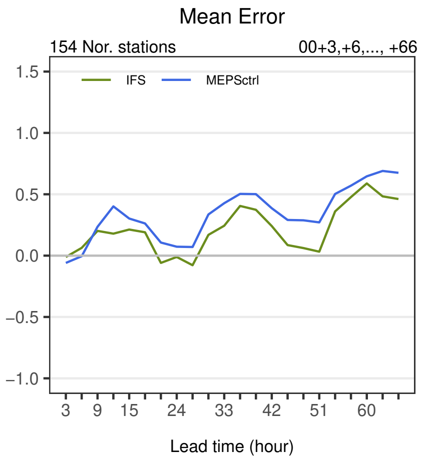
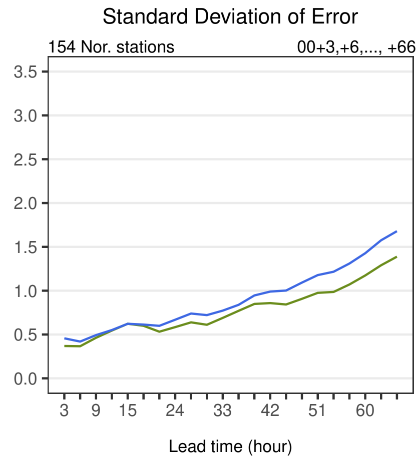


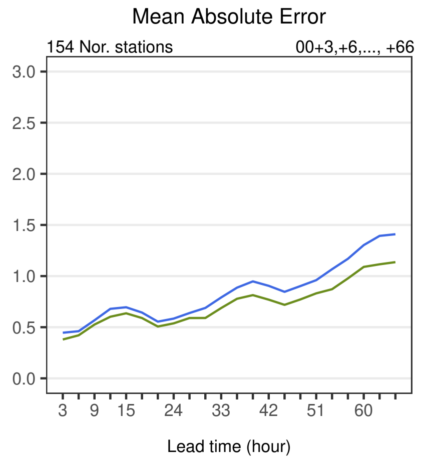
Figure 7: T_{2m} (°C) from AA25 (left) and IFS (right) at 12 UTC August 22nd. The yellow numbers show the available observations at that time.

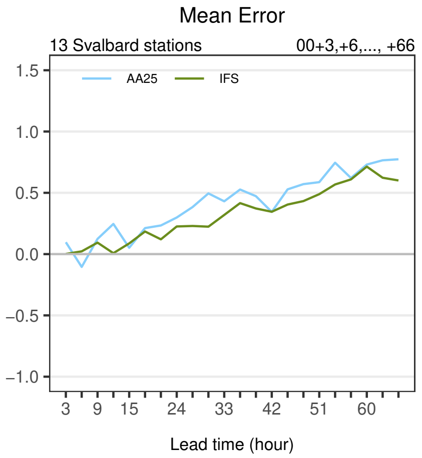
However, the two available observations of 2m temperature, T_{2m}, available in the area show that IFS is closer to the observed temperature than AA25 (figure 7). Based on prognostic soundings (not shown), it appears that in this case the AA25 model predicts a shallow cloud layer below an inversion at 1000-2000 ft for large parts of the ocean north of Jan Mayen because the temperature in the lower layers of the model's atmosphere is too low. For the area north west of Jan Mayen, however, the satellite image shows an area with stratus clouds that is better captured by AA25 than IFS, despite the fact that both models have a too low T_{2m} here. The SST and T_{d2m} from the two models are very similar.

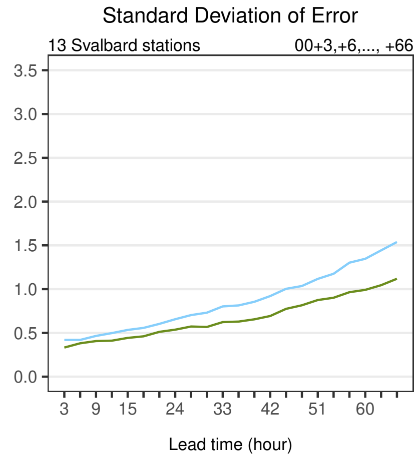
Summarized statistics

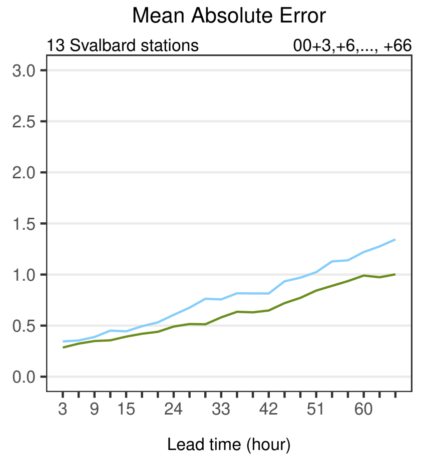

Mean Error
154 Nor. stations
00+3,+6,..., +66
IFS
MEPSctrl
Lead time (hour)

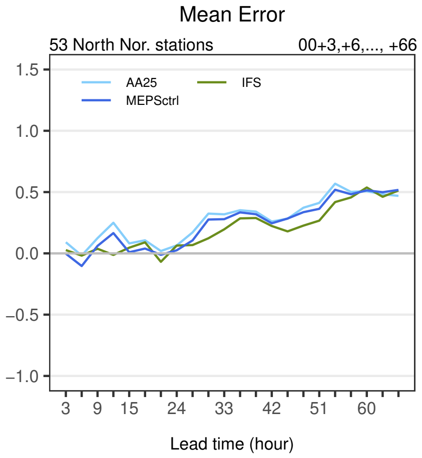

Standard Deviation of Error
154 Nor. stations
00+3,+6,..., +66
Lead time (hour)

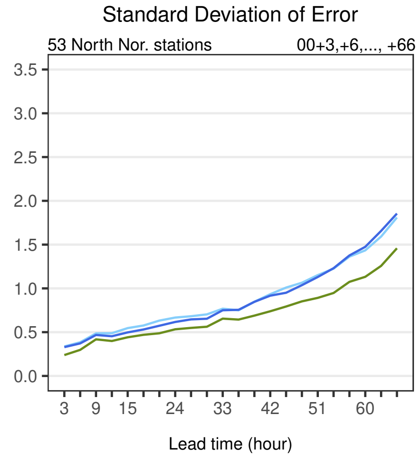

Mean Absolute Error
154 Nor. stations
00+3,+6,..., +66
Lead time (hour)

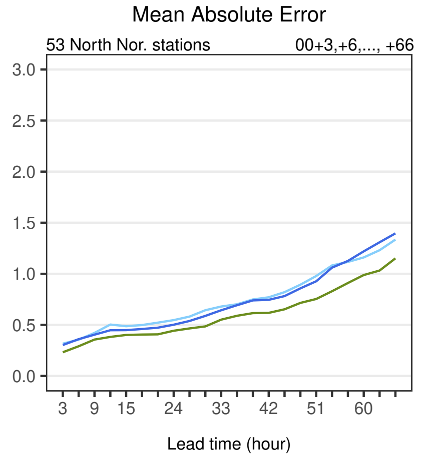

Mean Error
13 Svalbard stations
00+3,+6,..., +66
AA25
IFS
Lead time (hour)

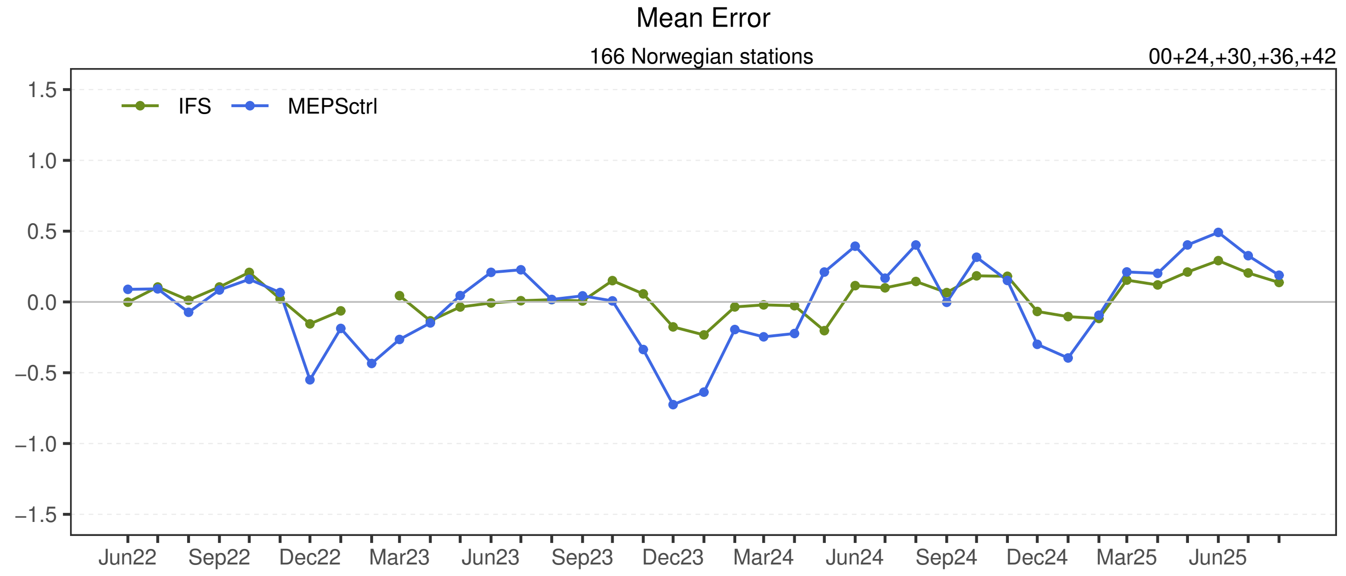

Standard Deviation of Error
13 Svalbard stations
00+3,+6,..., +66
Lead time (hour)

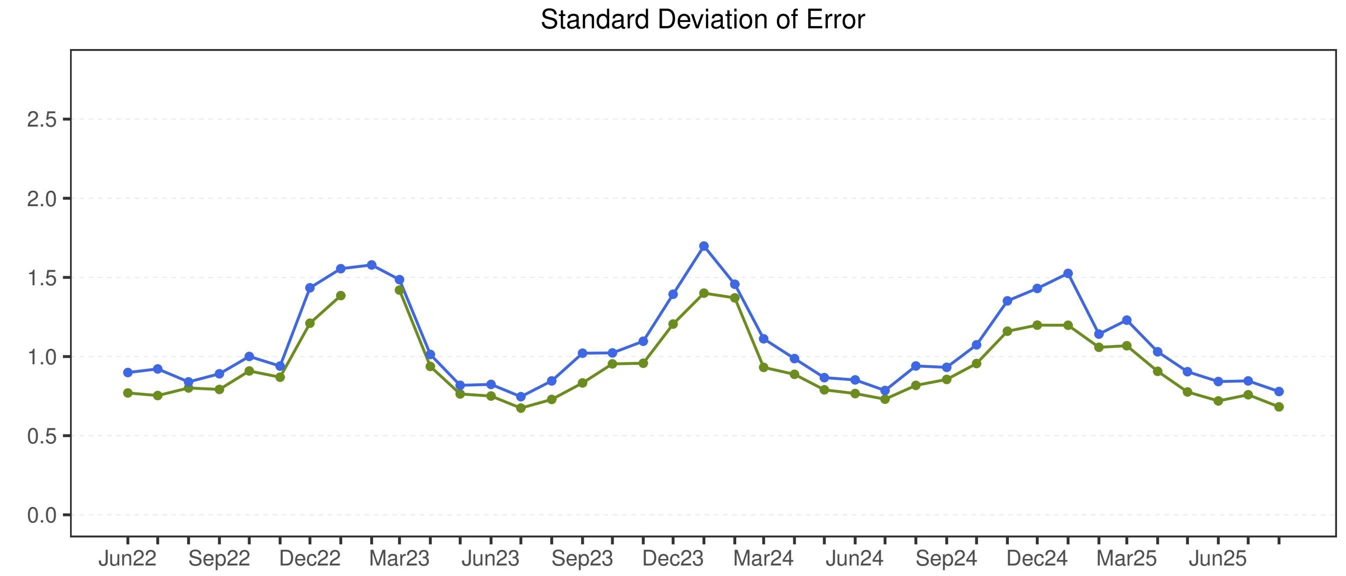

Mean Absolute Error
13 Svalbard stations
00+3,+6,..., +66
Lead time (hour)

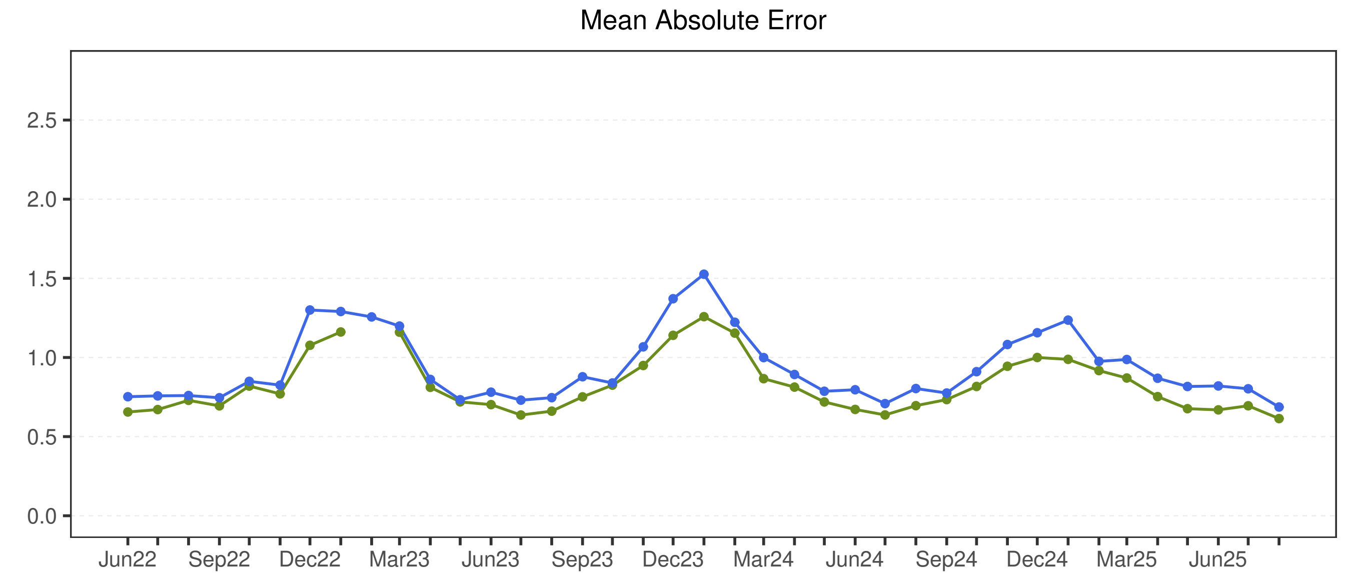

Mean Error
53 North Nor. stations
00+3,+6,..., +66
AA25
IFS
MEPSctrl
Lead time (hour)

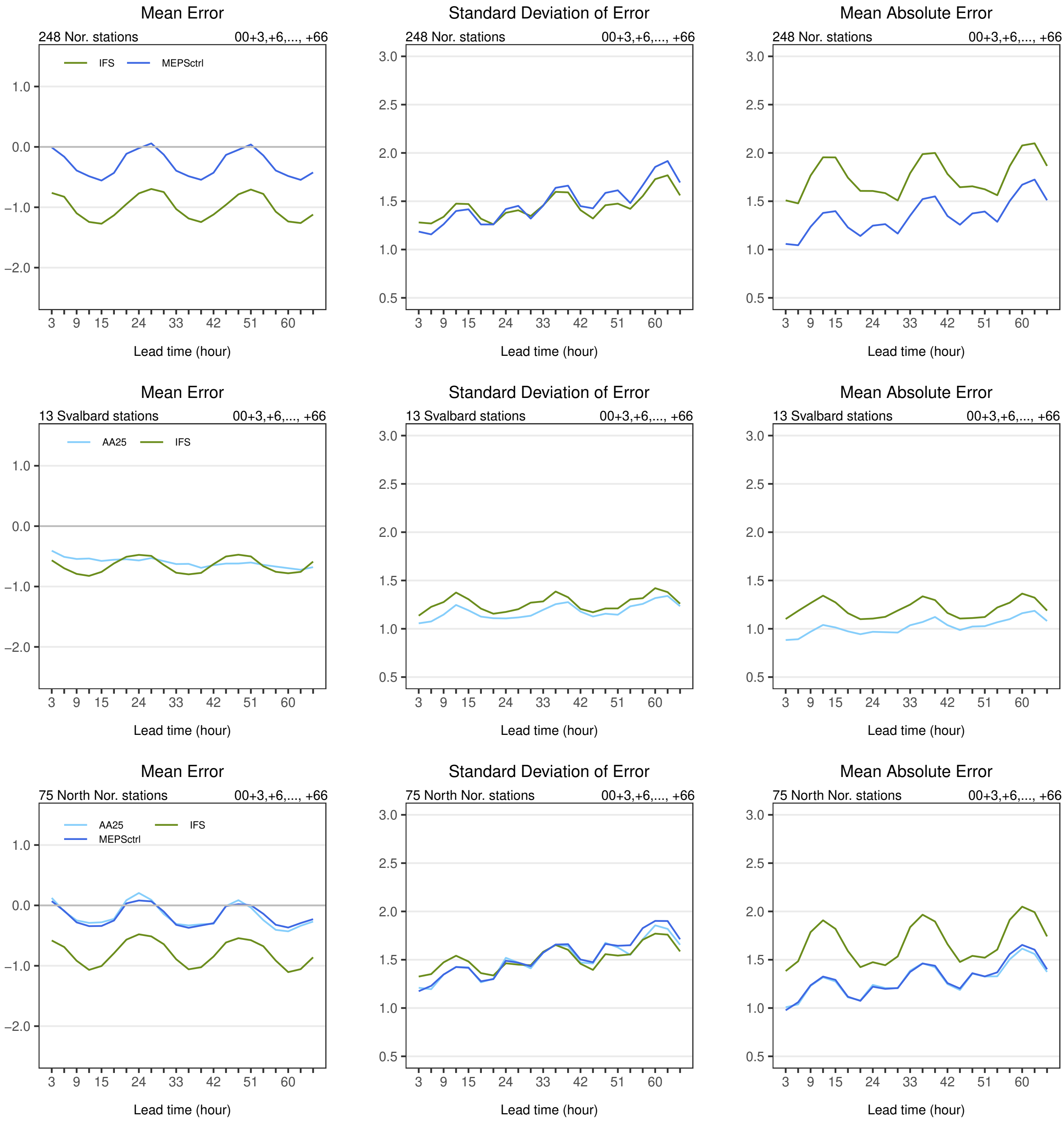

Standard Deviation of Error
53 North Nor. stations
00+3,+6,..., +66
Lead time (hour)

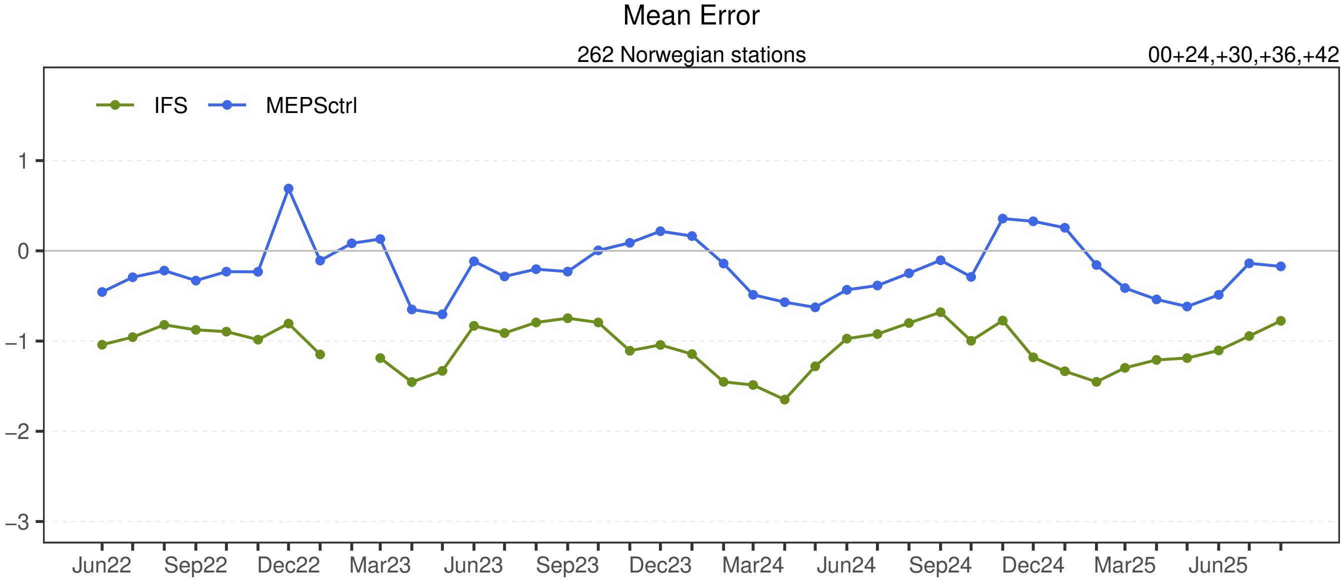

Mean Absolute Error
53 North Nor. stations
00+3,+6,..., +66
Lead time (hour)

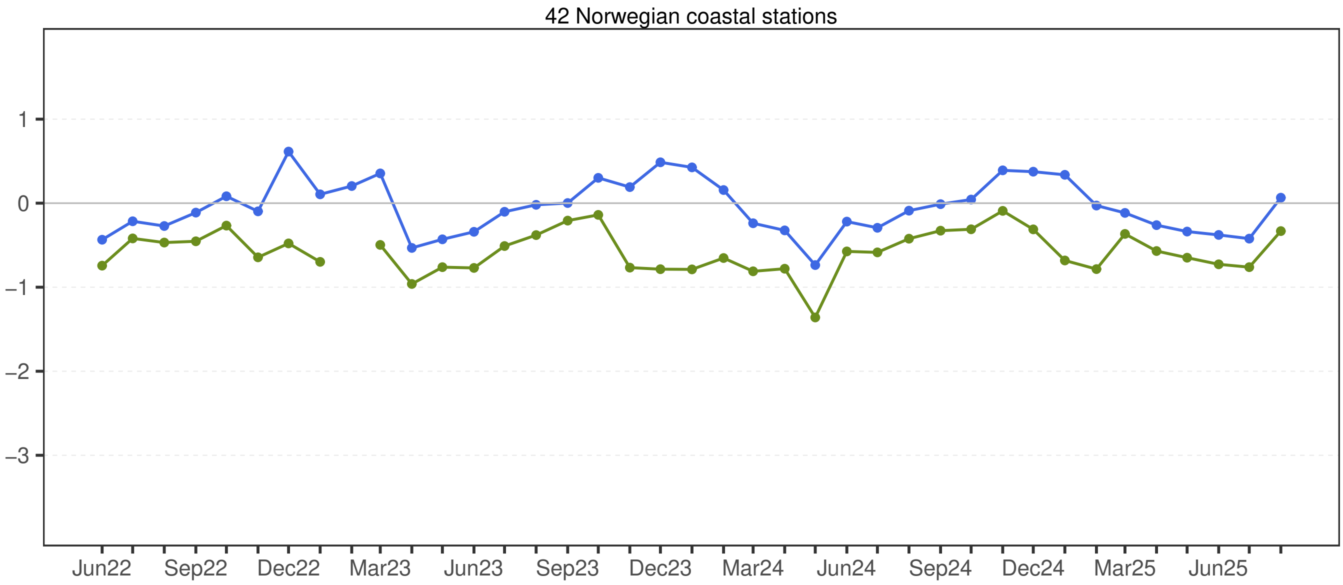

Mean Error
166 Norwegian stations
00+24,+30,+36,+42
IFS
MEPSctrl
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
Jun22
Sep22
Dec22
Mar23
Jun23
Sep23
Dec23
Mar24
Jun24
Sep24
Dec24
Mar25
Jun25

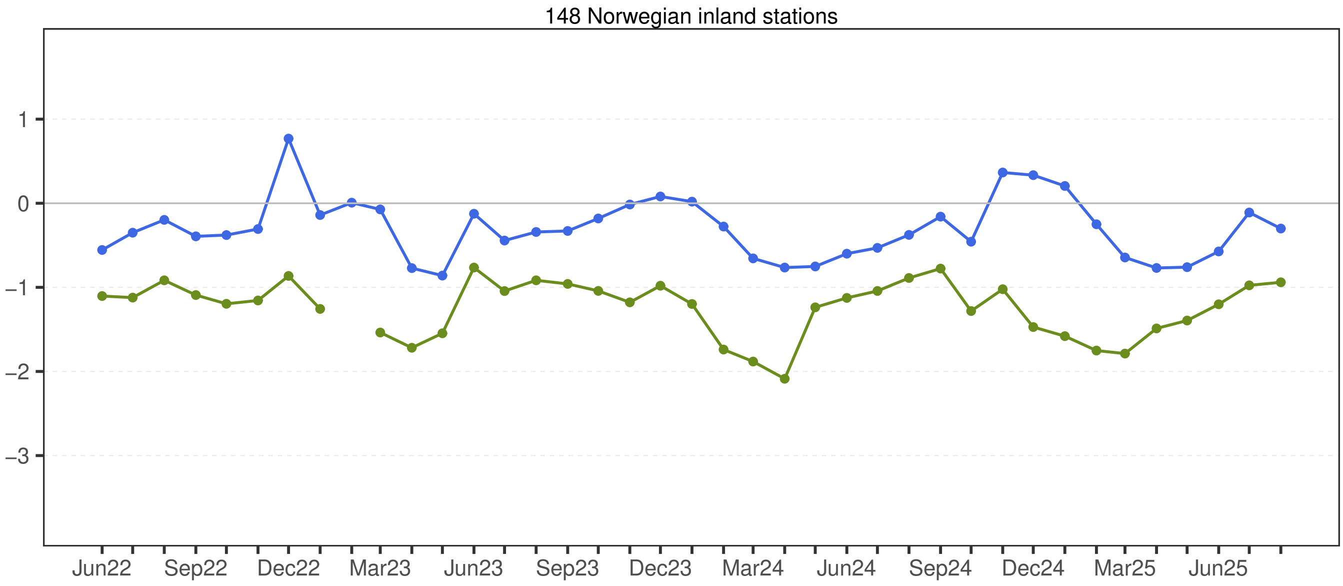

Standard Deviation of Error
2.5
2.0
1.5
1.0
0.5
0.0
Jun22
Sep22
Dec22
Mar23
Jun23
Sep23
Dec23
Mar24
Jun24
Sep24
Dec24
Mar25
Jun25


Mean Absolute Error
2.5
2.0
1.5
1.0
0.5
0.0
Jun22
Sep22
Dec22
Mar23
Jun23
Sep23
Dec23
Mar24
Jun24
Sep24
Dec24
Mar25
Jun25

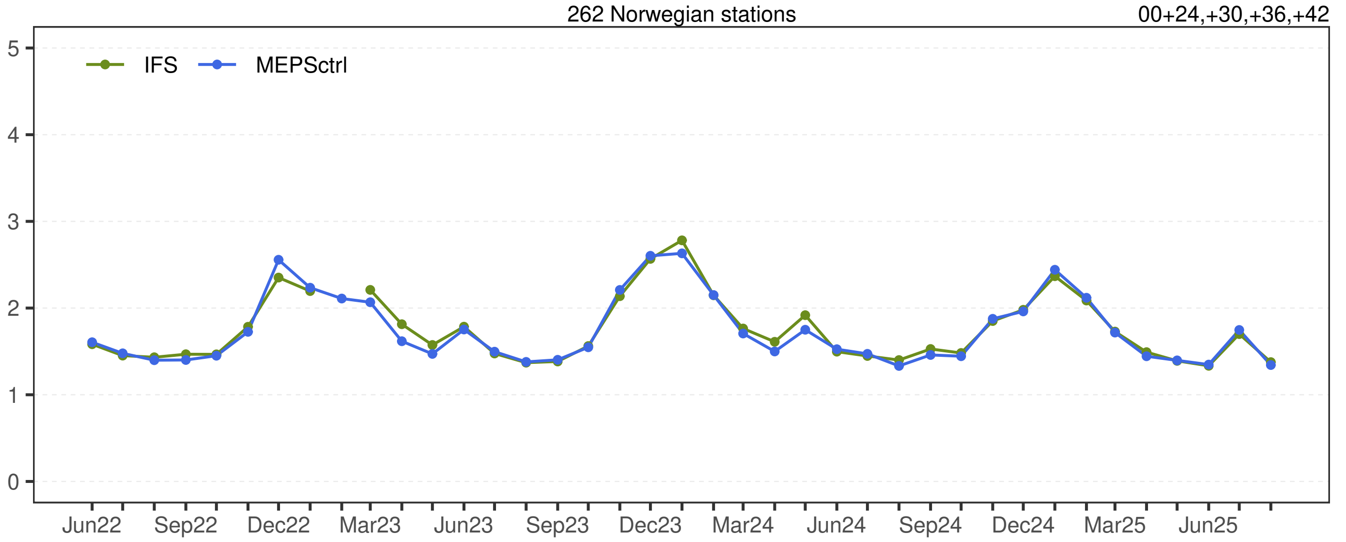

Mean Error
248 Nor. stations
00+3,+6,..., +66
IFS
MEPSctrl
Lead time (hour)
Standard Deviation of Error
248 Nor. stations
00+3,+6,..., +66
Lead time (hour)
Mean Absolute Error
248 Nor. stations
00+3,+6,..., +66
Lead time (hour)
Mean Error
13 Svalbard stations
00+3,+6,..., +66
AA25
IFS
Lead time (hour)
Standard Deviation of Error
13 Svalbard stations
00+3,+6,..., +66
Lead time (hour)
Mean Absolute Error
13 Svalbard stations
00+3,+6,..., +66
Lead time (hour)
Mean Error
75 North Nor. stations
00+3,+6,..., +66
AA25
IFS
MEPSctrl
Lead time (hour)
Standard Deviation of Error
75 North Nor. stations
00+3,+6,..., +66
Lead time (hour)
Mean Absolute Error
75 North Nor. stations
00+3,+6,..., +66
Lead time (hour)

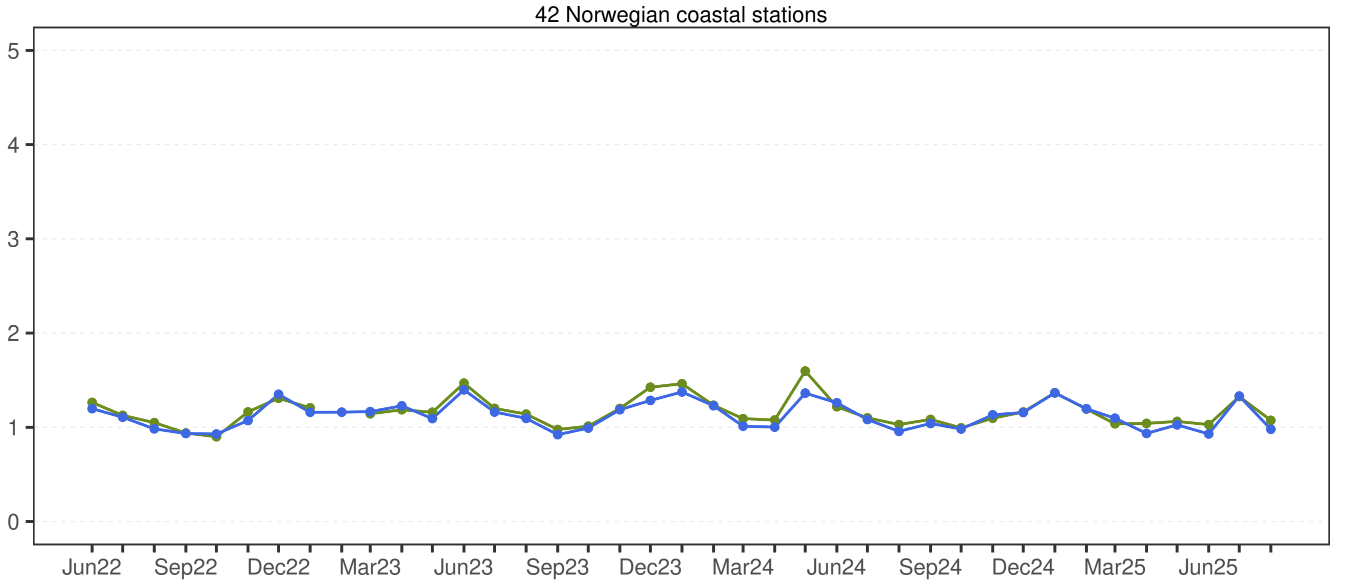

Mean Error
262 Norwegian stations
00+24,+30,+36,+42
IFS
MEPSctrl
1
0
−1
−2
−3
Jun22 Sep22 Dec22 Mar23 Jun23 Sep23 Dec23 Mar24 Jun24 Sep24 Dec24 Mar25 Jun25

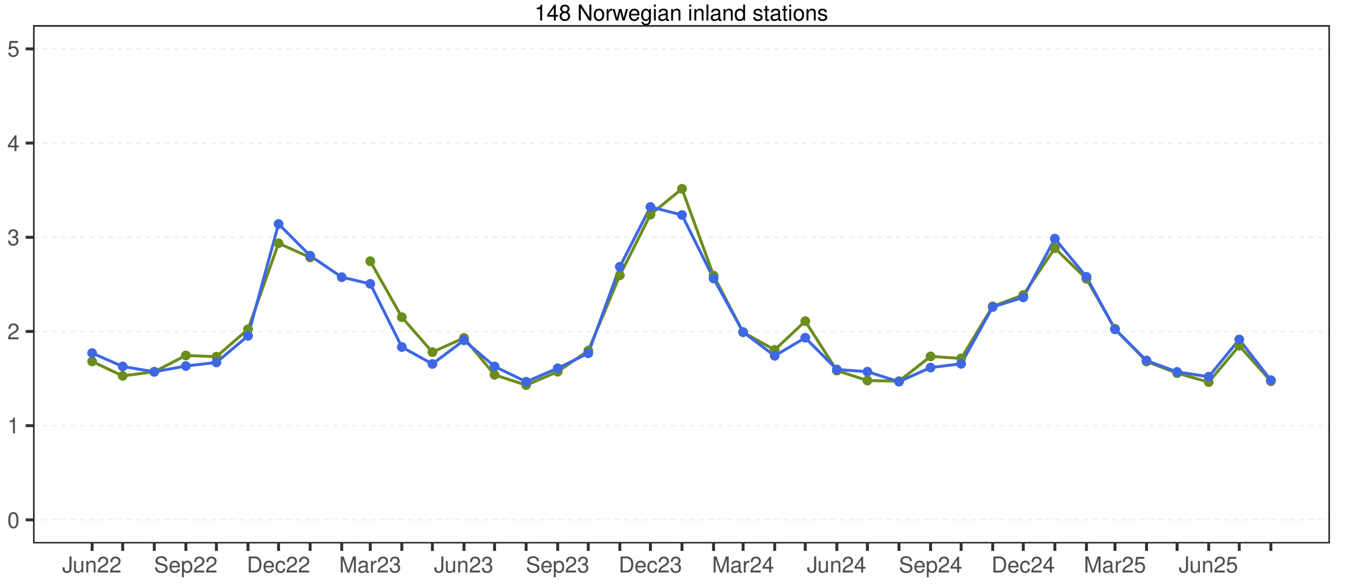

42 Norwegian coastal stations
1
0
−1
−2
−3
Jun22 Sep22 Dec22 Mar23 Jun23 Sep23 Dec23 Mar24 Jun24 Sep24 Dec24 Mar25 Jun25

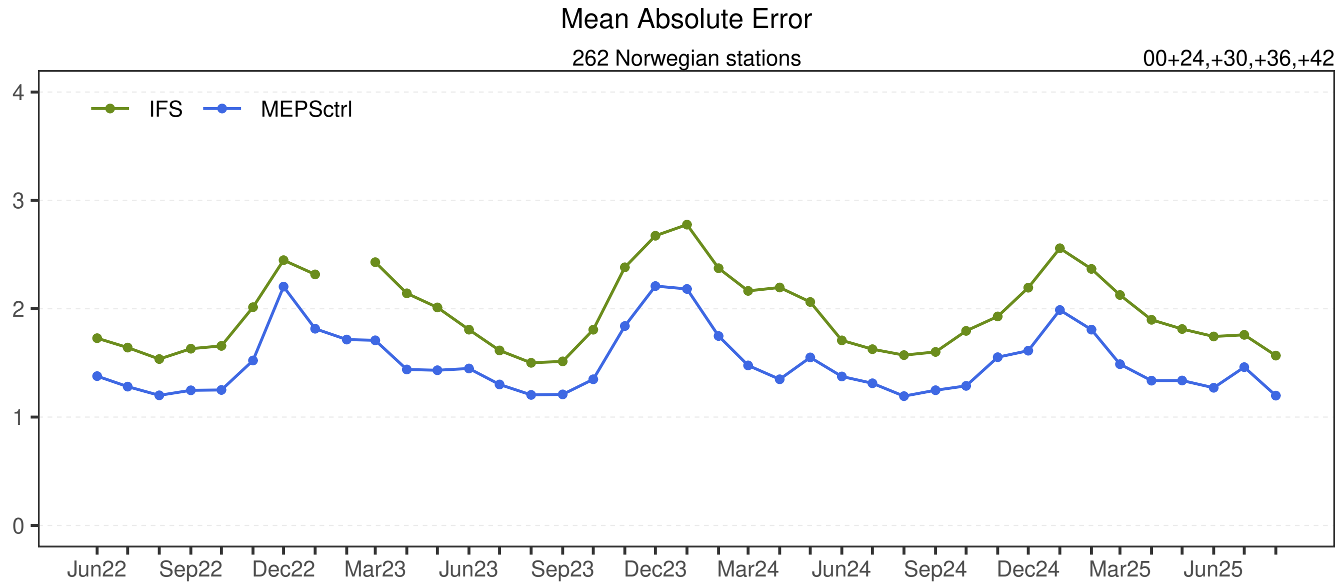

148 Norwegian inland stations
1
0
−1
−2
−3
Jun22 Sep22 Dec22 Mar23 Jun23 Sep23 Dec23 Mar24 Jun24 Sep24 Dec24 Mar25 Jun25

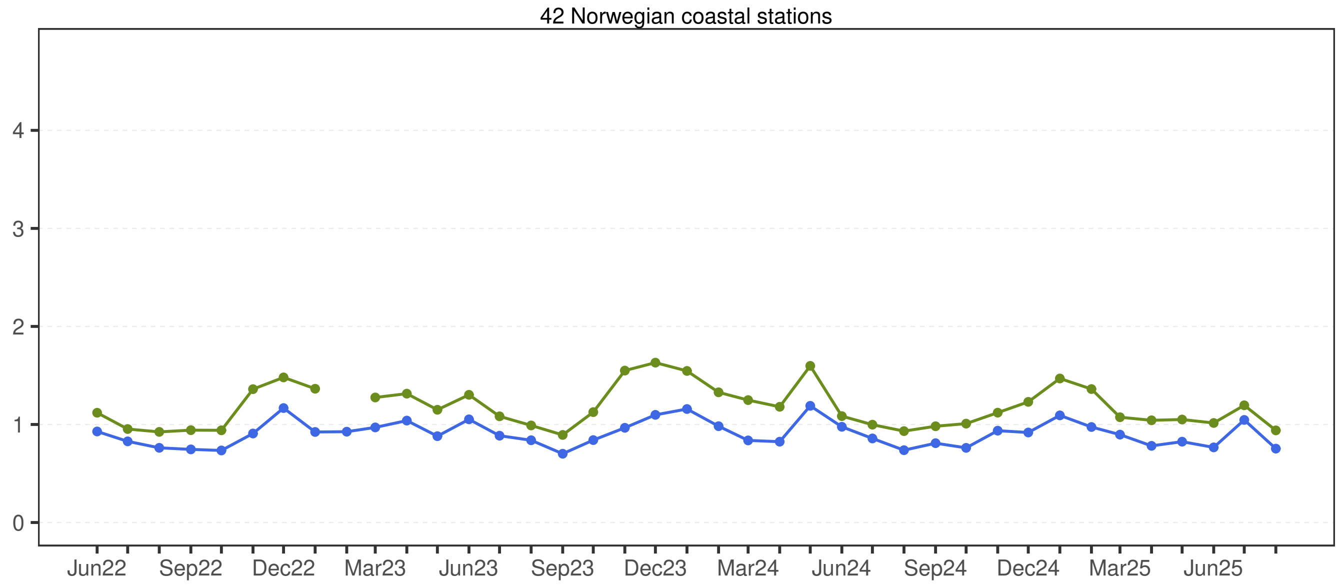
Standard Deviation of Error

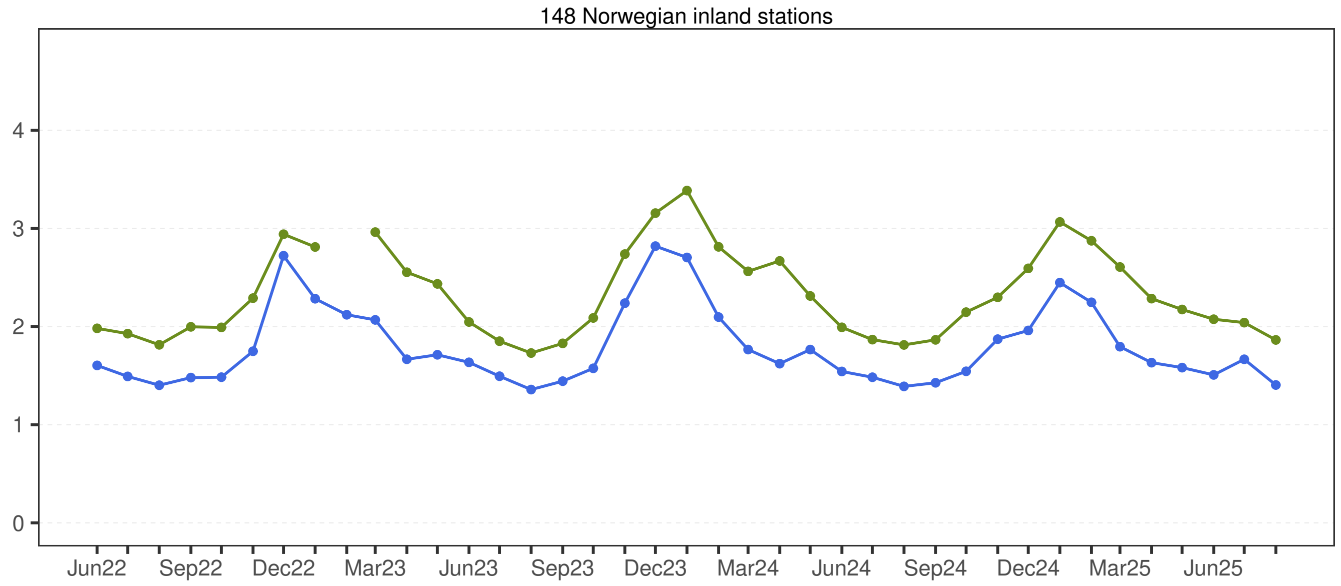






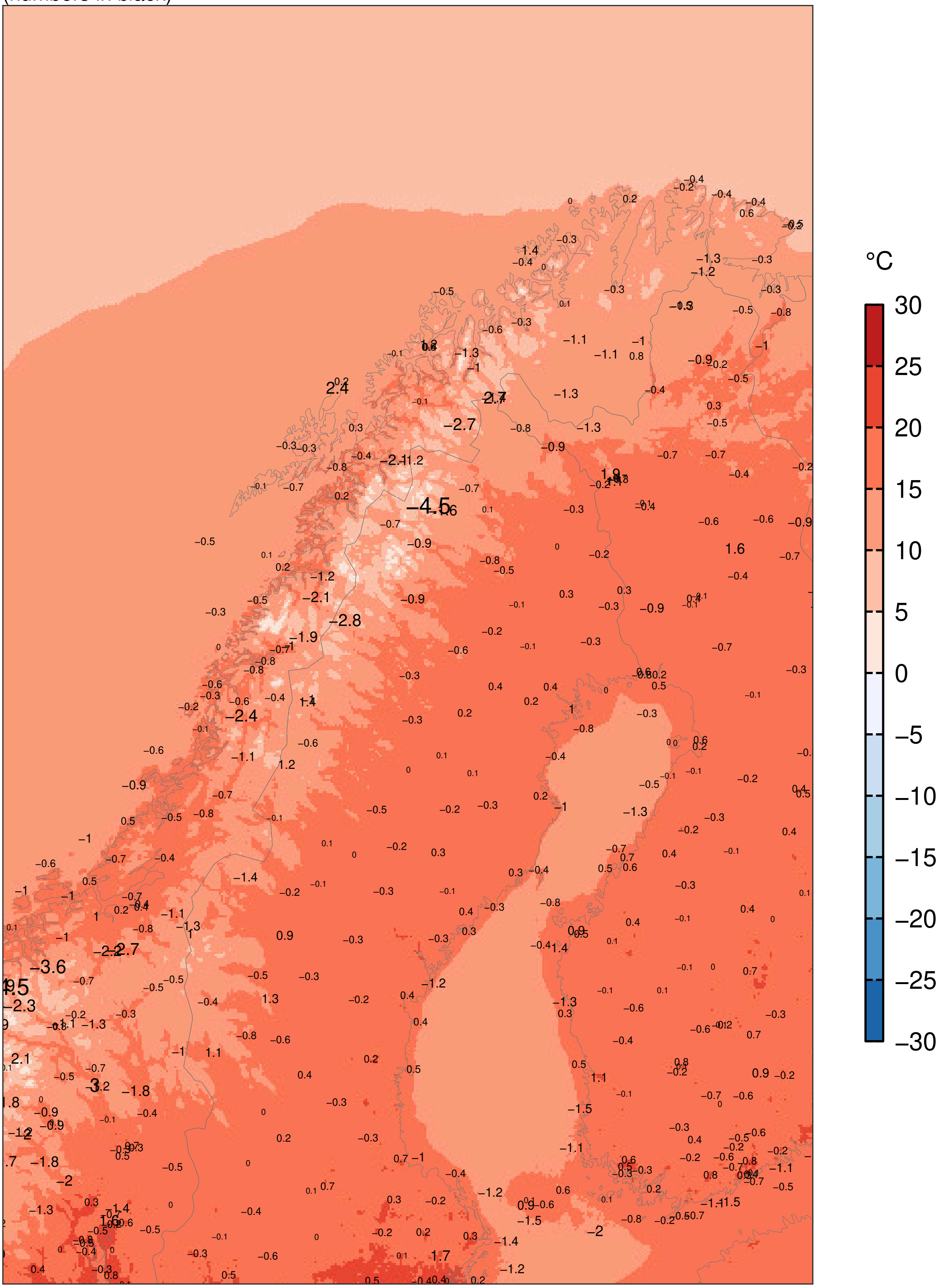

Mean Absolute Error
262 Norwegian stations
00+24,+30,+36,+42
IFS
MEPSctrl
0
1
2
3
4
Jun22
Sep22
Dec22
Mar23
Jun23
Sep23
Dec23
Mar24
Jun24
Sep24
Dec24
Mar25
Jun25


42 Norwegian coastal stations
0
1
2
3
4
Jun22
Sep22
Dec22
Mar23
Jun23
Sep23
Dec23
Mar24
Jun24
Sep24
Dec24
Mar25
Jun25


148 Norwegian inland stations
0
1
2
3
4
Jun22
Sep22
Dec22
Mar23
Jun23
Sep23
Dec23
Mar24
Jun24
Sep24
Dec24
Mar25
Jun25

MEPSctrl 00+12

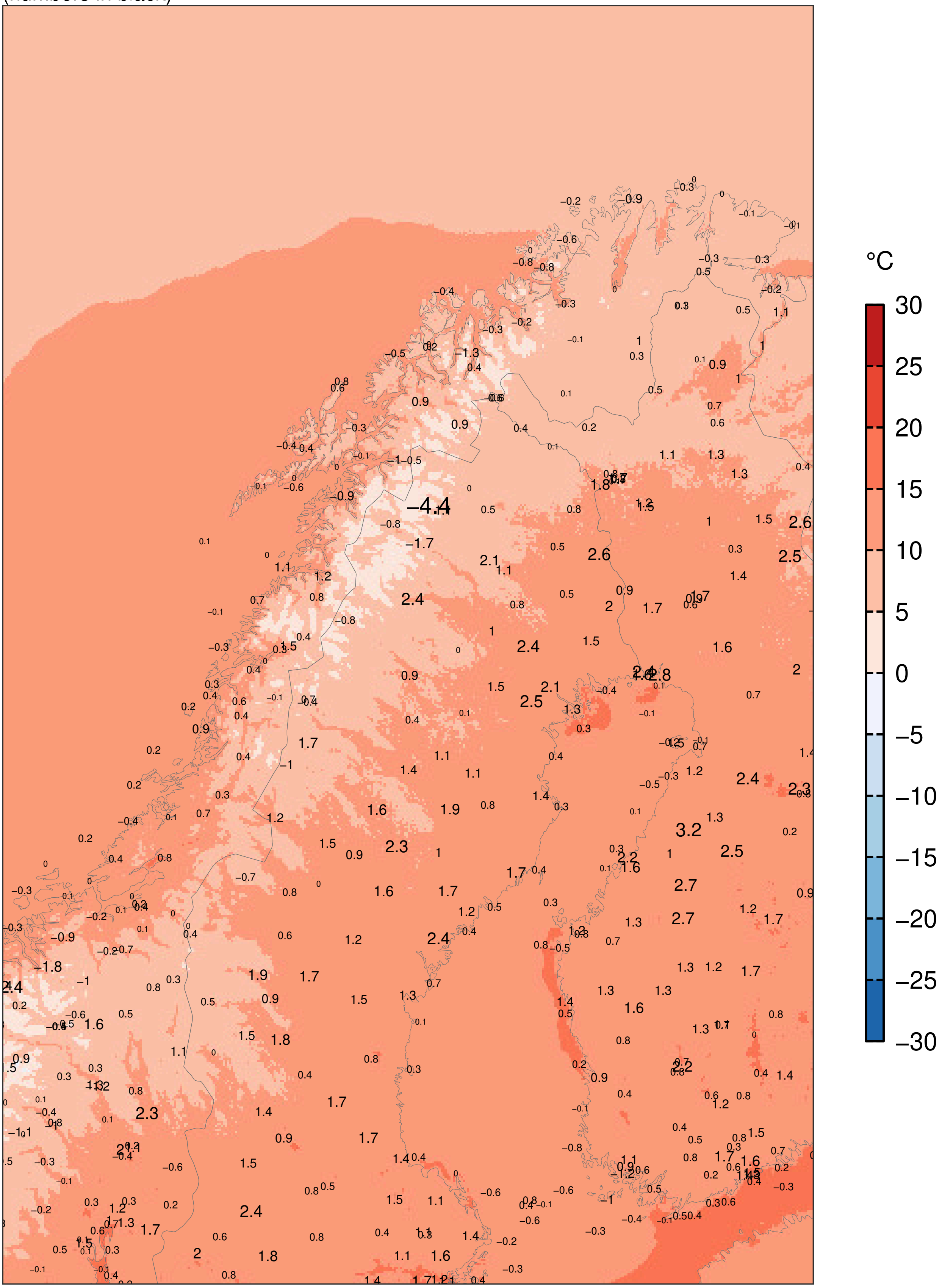
ME at observing sites
(numbers in black)



Model "climatology" 01.06.2025–31.08.2025

MEPSctrl 00+24

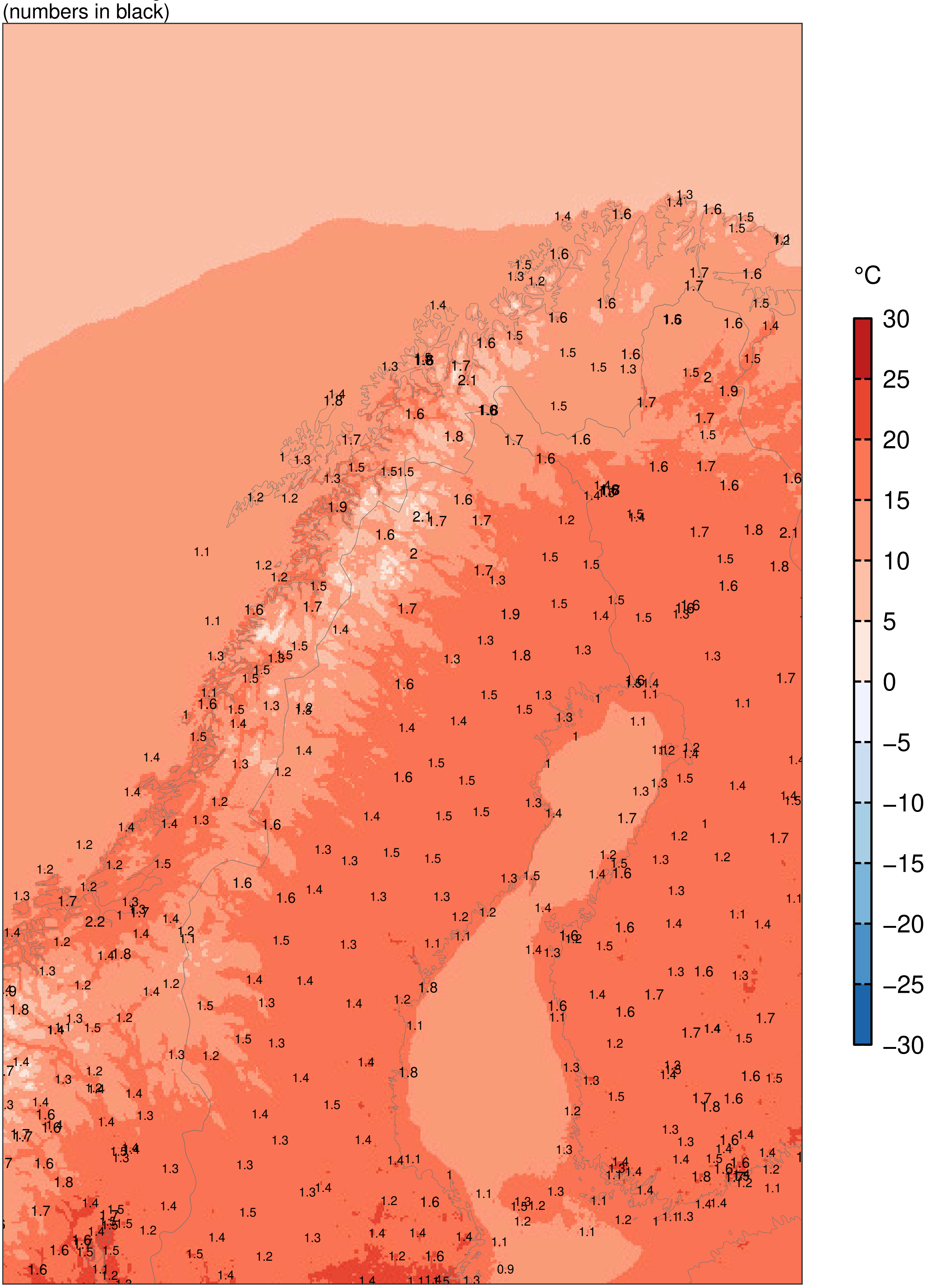
ME at observing sites
(numbers in black)



Model "climatology" 01.06.2025–31.08.2025

MEPSctrl 00+12

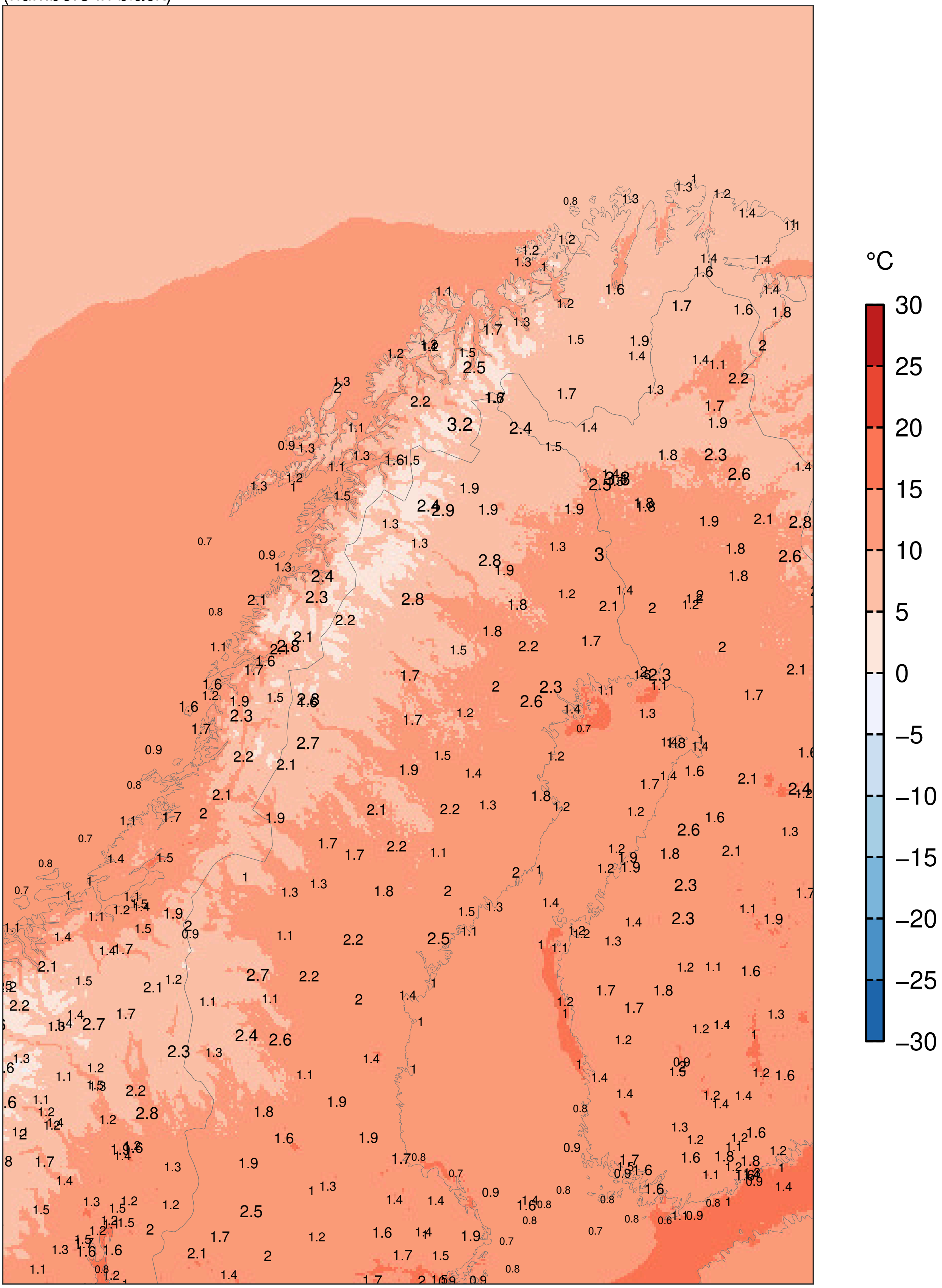
SDE at observing sites
(numbers in black)



Model "climatology" 01.06.2025–31.08.2025

MEPSctrl 00+24

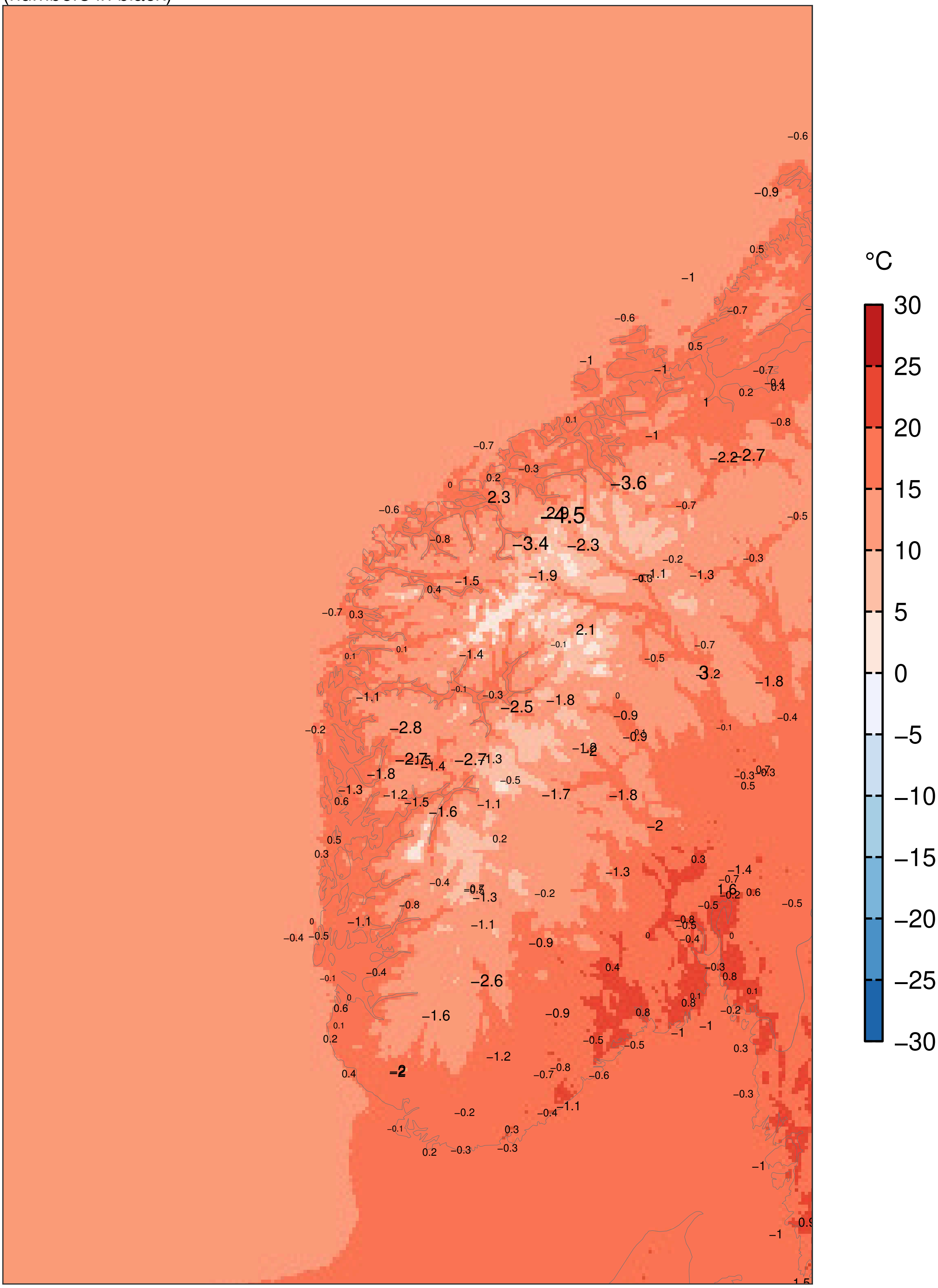
SDE at observing sites
(numbers in black)



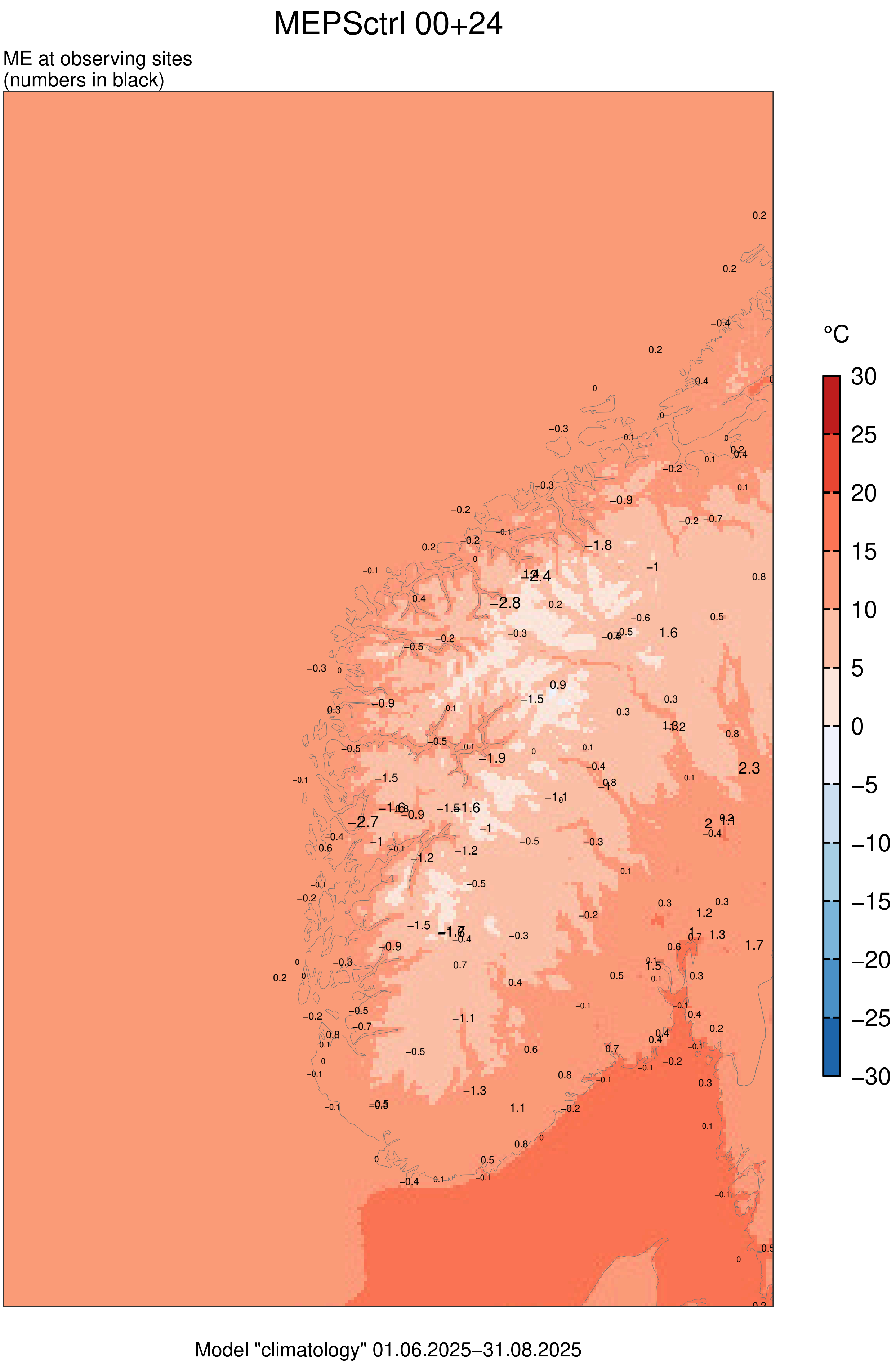
Model "climatology" 01.06.2025–31.08.2025

MEPSctrl 00+12

ME at observing sites
(numbers in black)

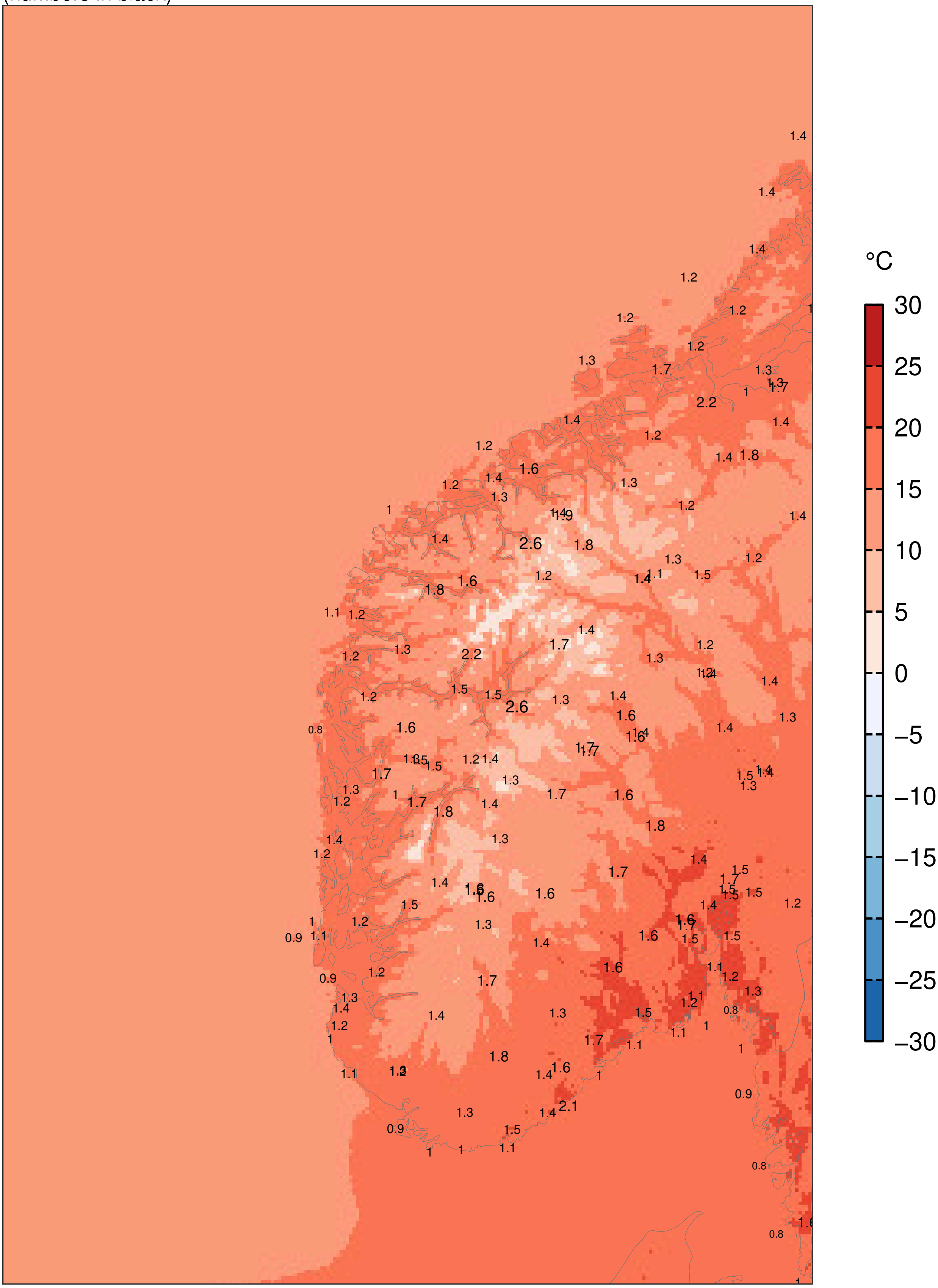


Model "climatology" 01.06.2025–31.08.2025

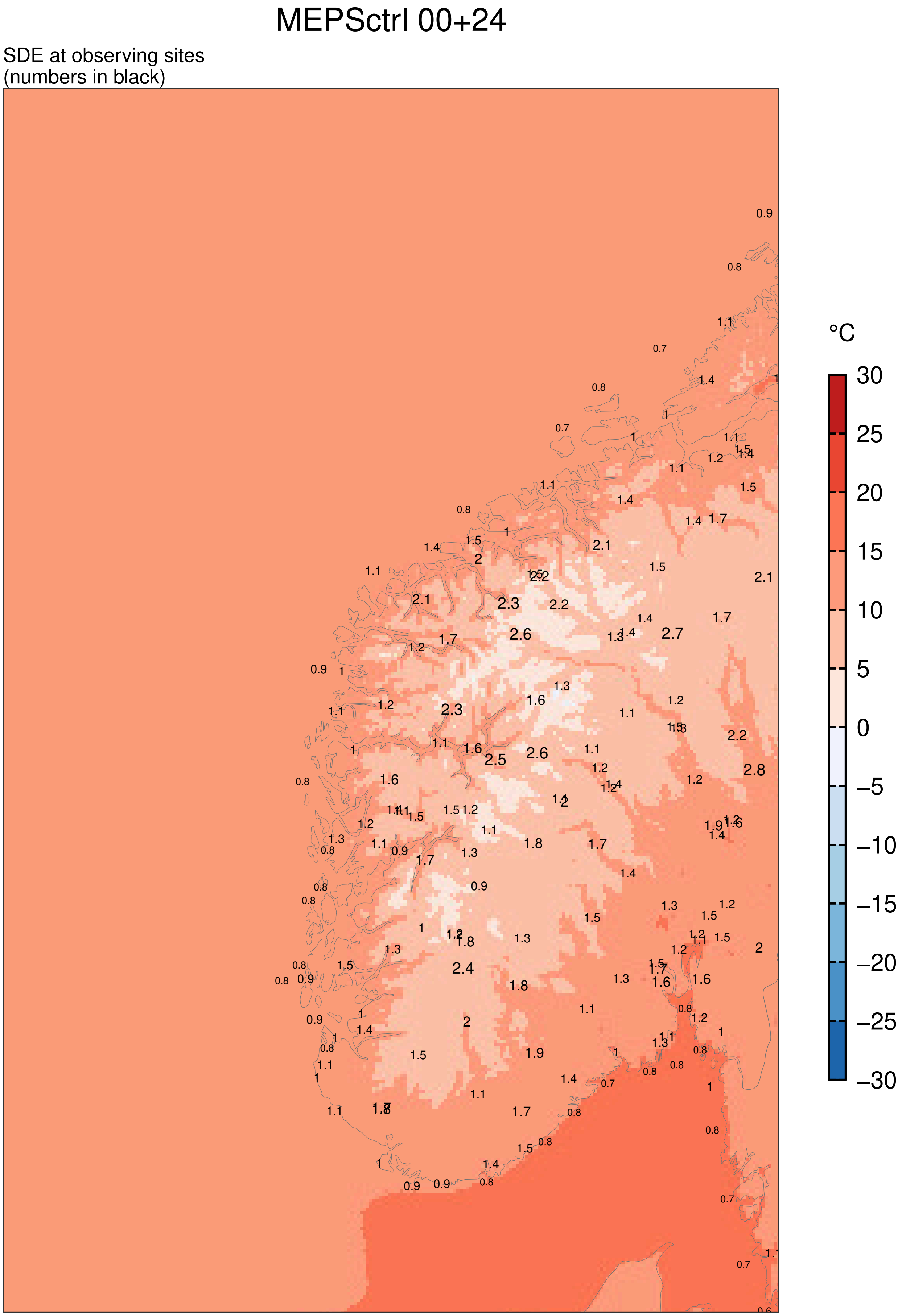

MEPSctrl 00+24
ME at observing sites
(numbers in black)
°C
30
25
20
15
10
5
0
−5
−10
−15
−20
−25
−30
Model "climatology" 01.06.2025–31.08.2025

MEPSctrl 00+12

SDE at observing sites
(numbers in black)



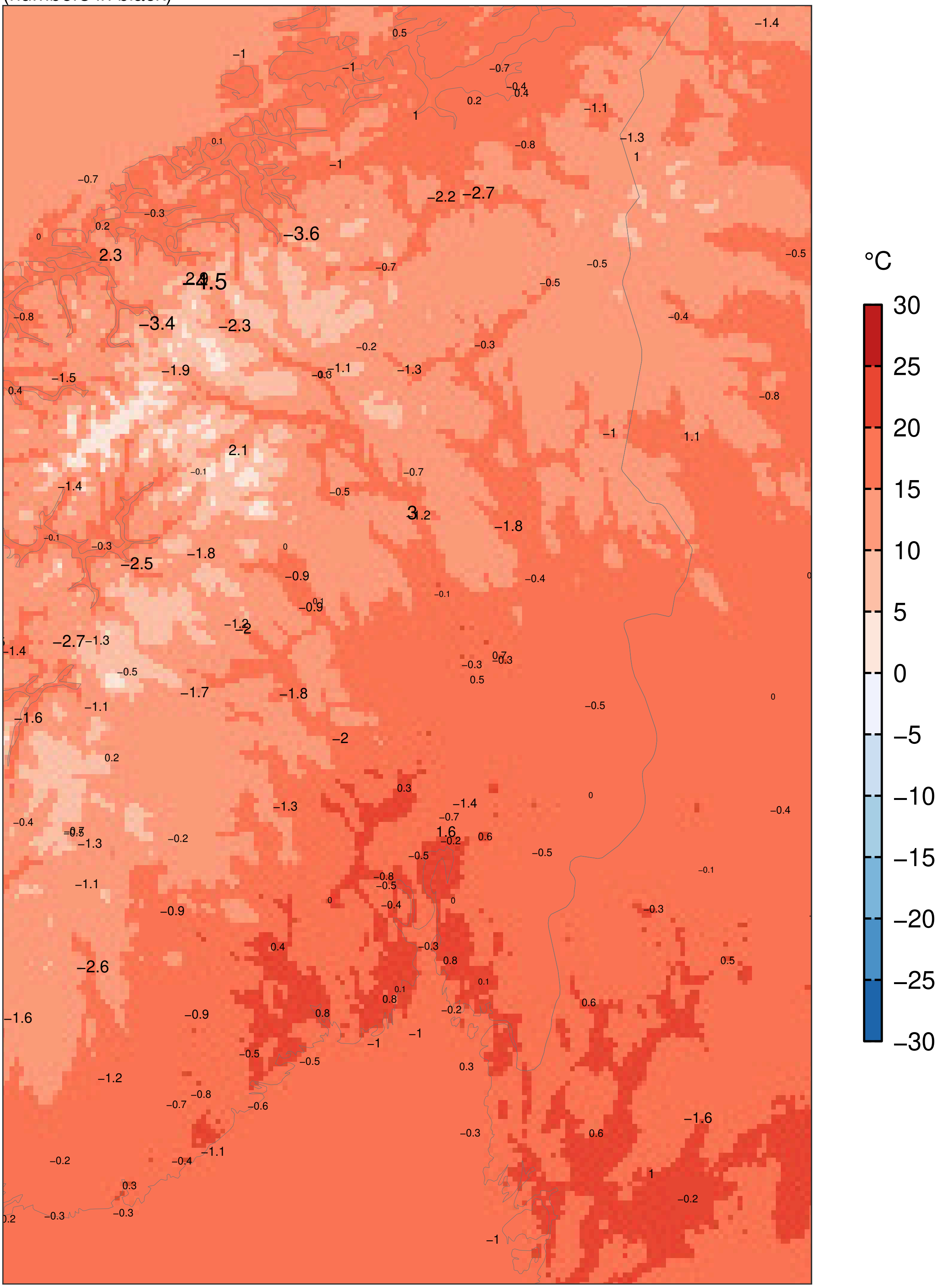
Model "climatology" 01.06.2025–31.08.2025



Model "climatology" 01.06.2025–31.08.2025

MEPSctrl 00+12

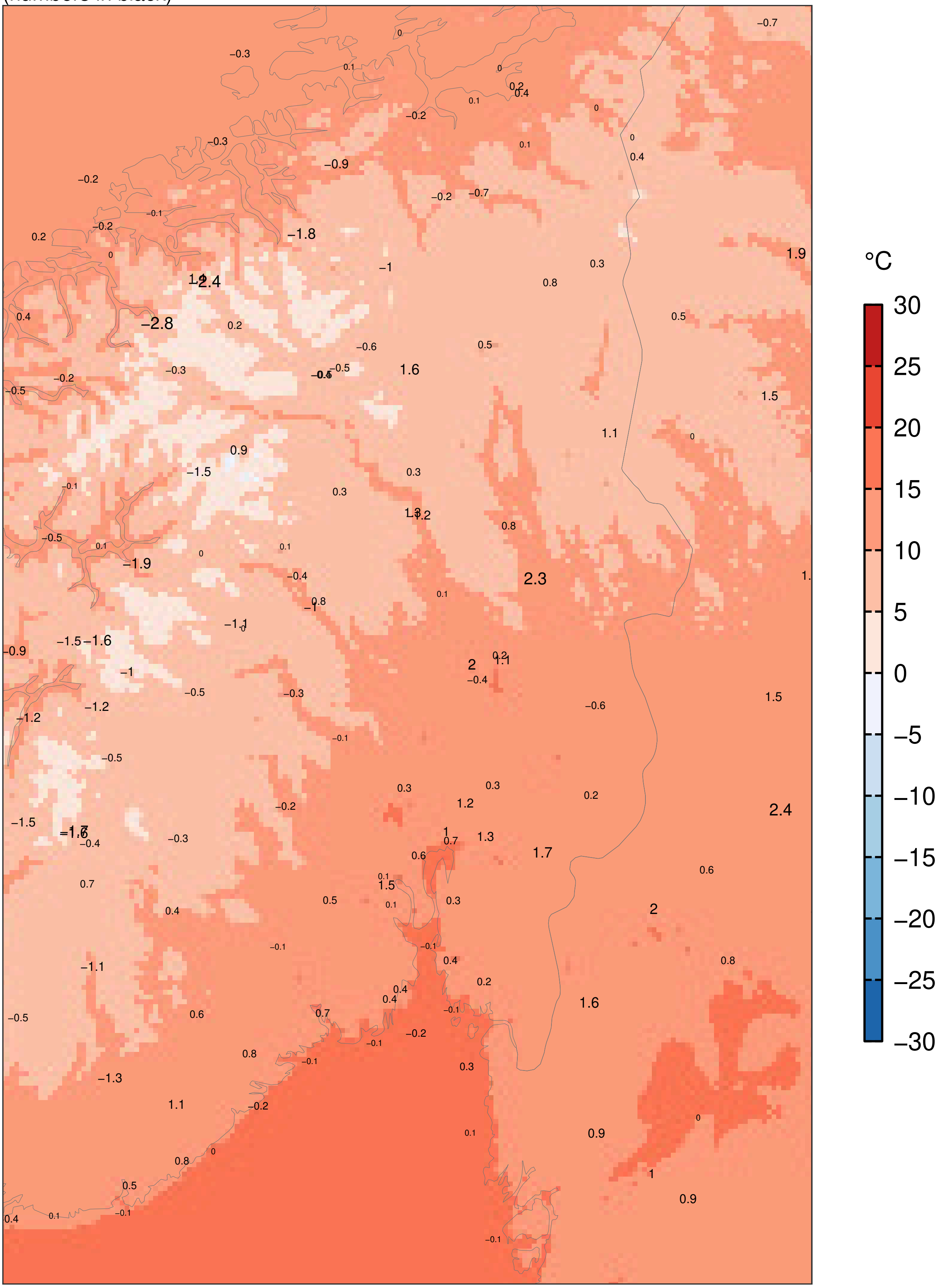
ME at observing sites
(numbers in black)



Model "climatology" 01.06.2025–31.08.2025

MEPSctrl 00+24

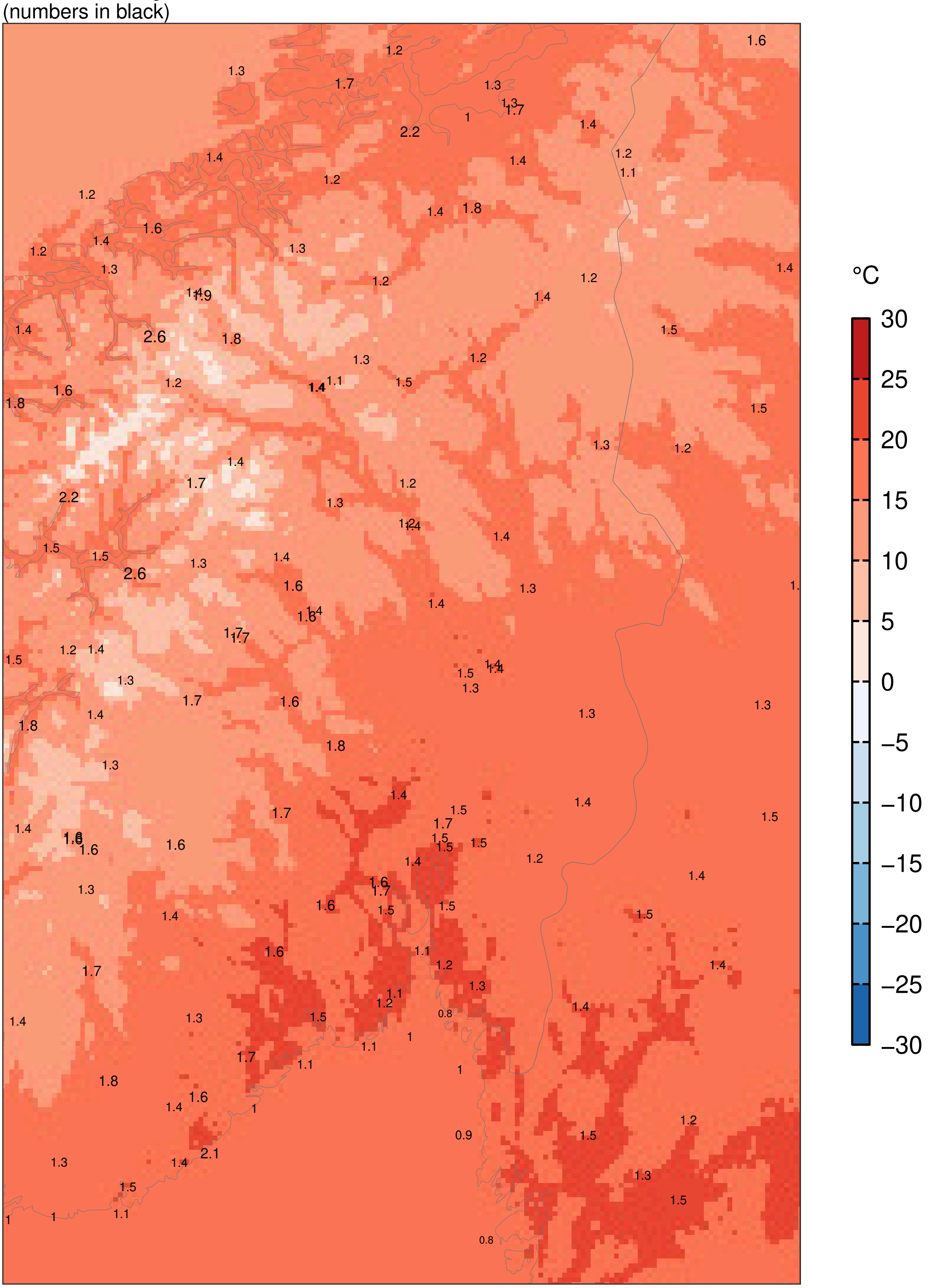
ME at observing sites
(numbers in black)



Model "climatology" 01.06.2025–31.08.2025

MEPSctrl 00+12

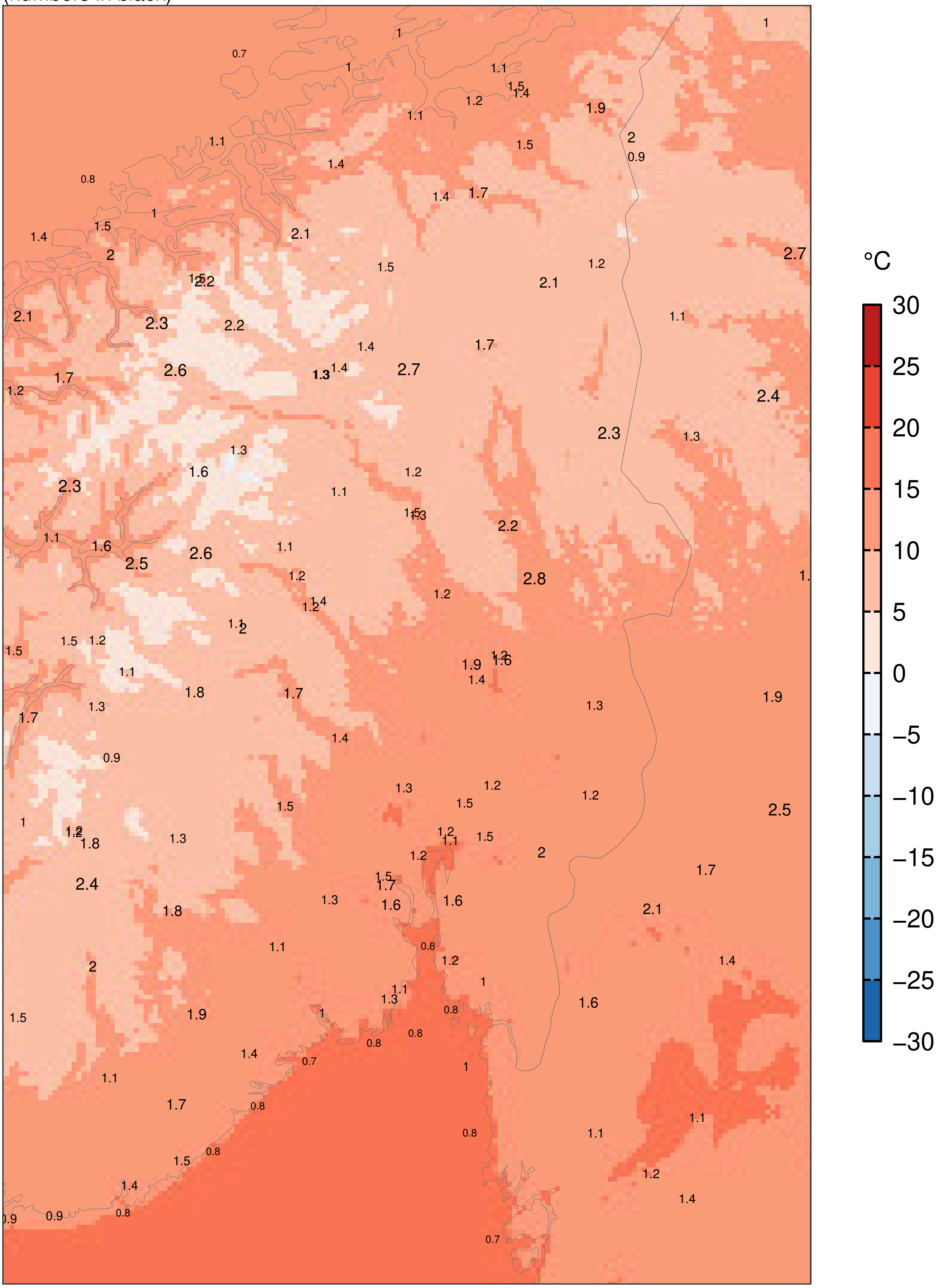
SDE at observing sites
(numbers in black)



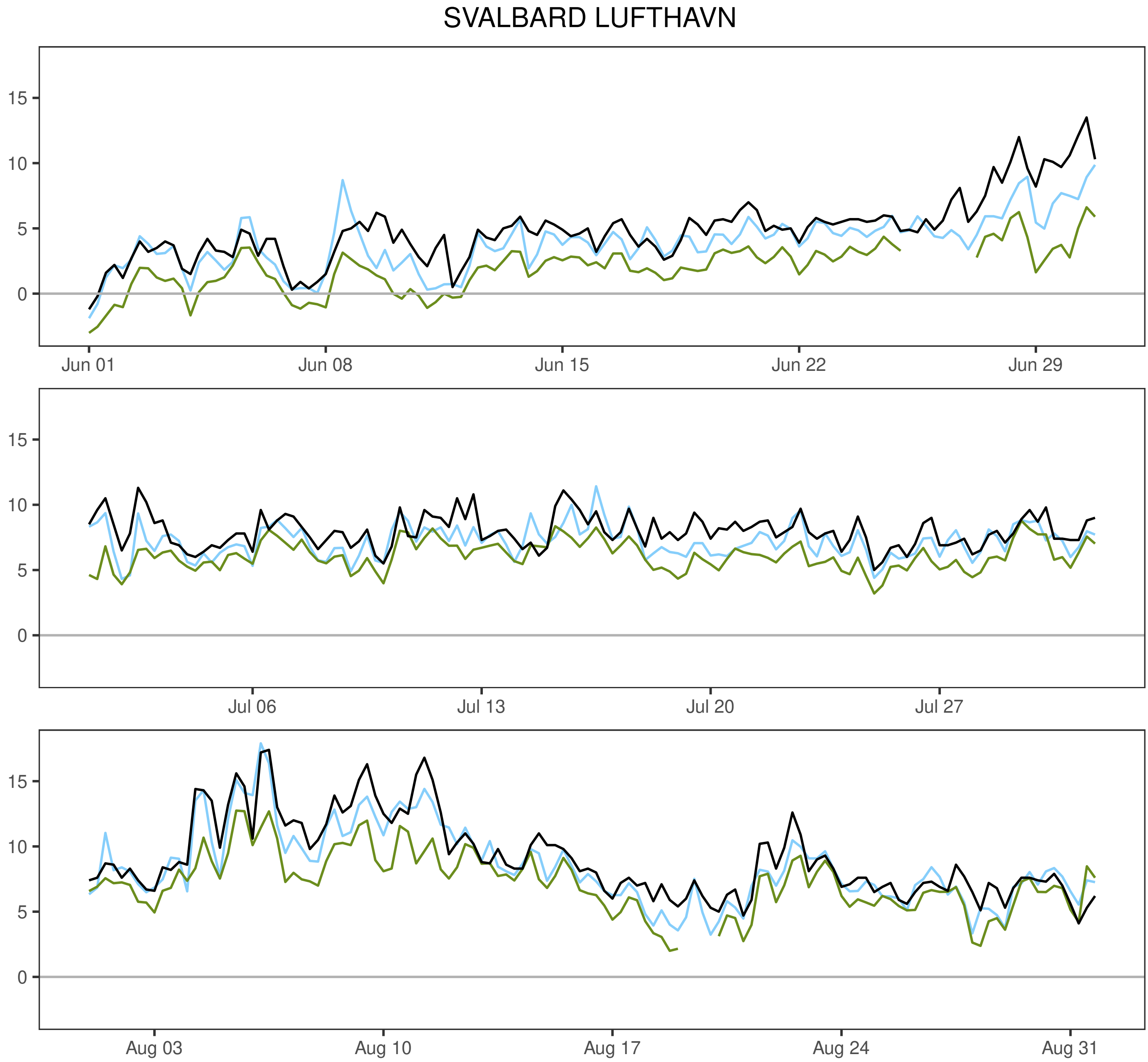
Model "climatology" 01.06.2025–31.08.2025

MEPSctrl 00+24

SDE at observing sites
(numbers in black)

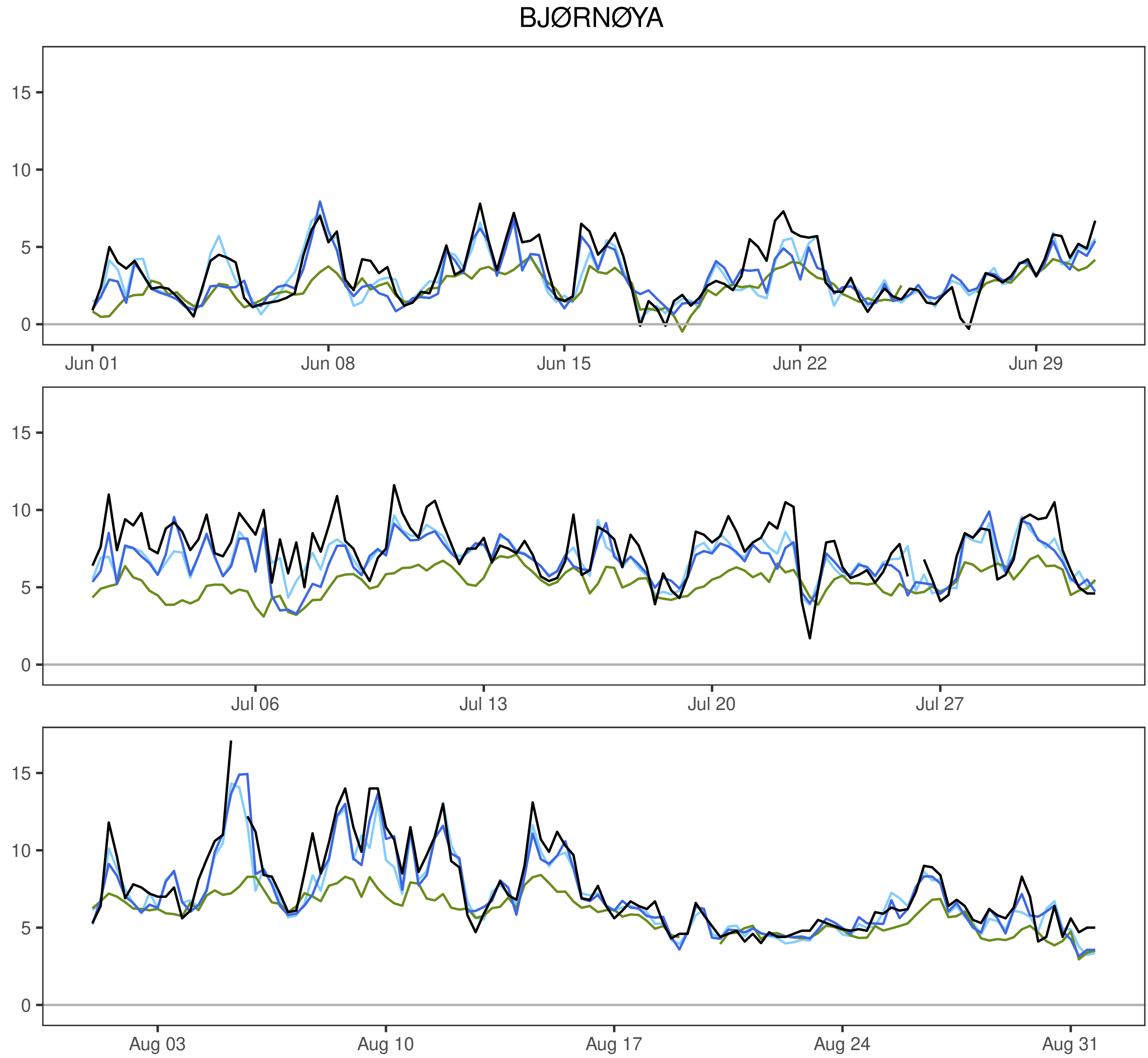


Model "climatology" 01.06.2025–31.08.2025



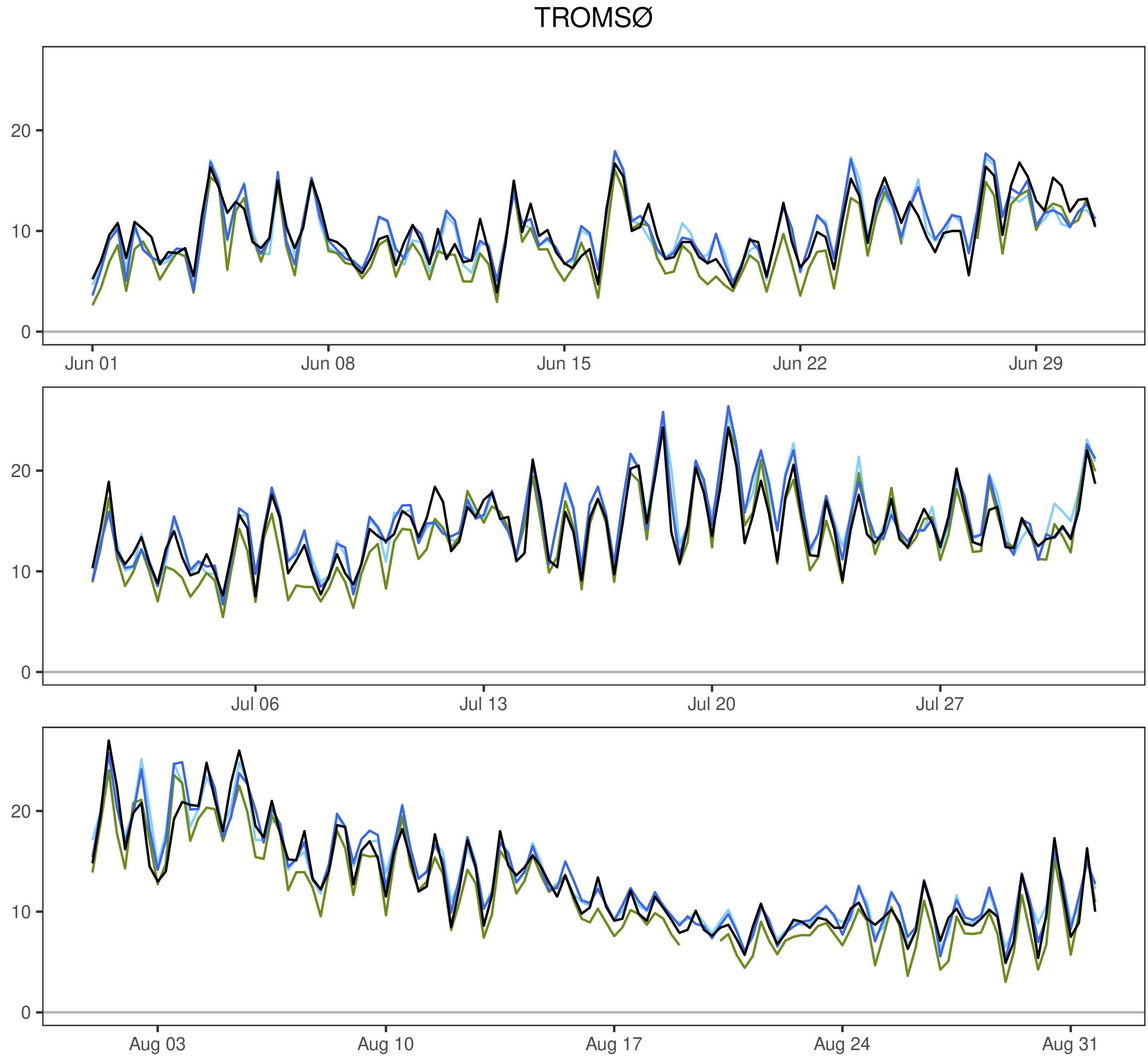
	Min	Mean	Max	Std	N
synop: 00,06,12,18	–1.2	7.3	17.4	3.0	368
AA25: 12+18,+24,+30,+36	–1.9	6.6	17.9	2.9	368
IFS: 12+18,+24,+30,+36	–3.0	5.2	12.7	2.9	356

	ME	SDE	RMSE	MAE	Max.abs.err	N
AA25 – synop	–0.8	1.2	1.4	1.1	5.3	356
IFS – synop	–2.2	1.5	2.7	2.3	7.8	356



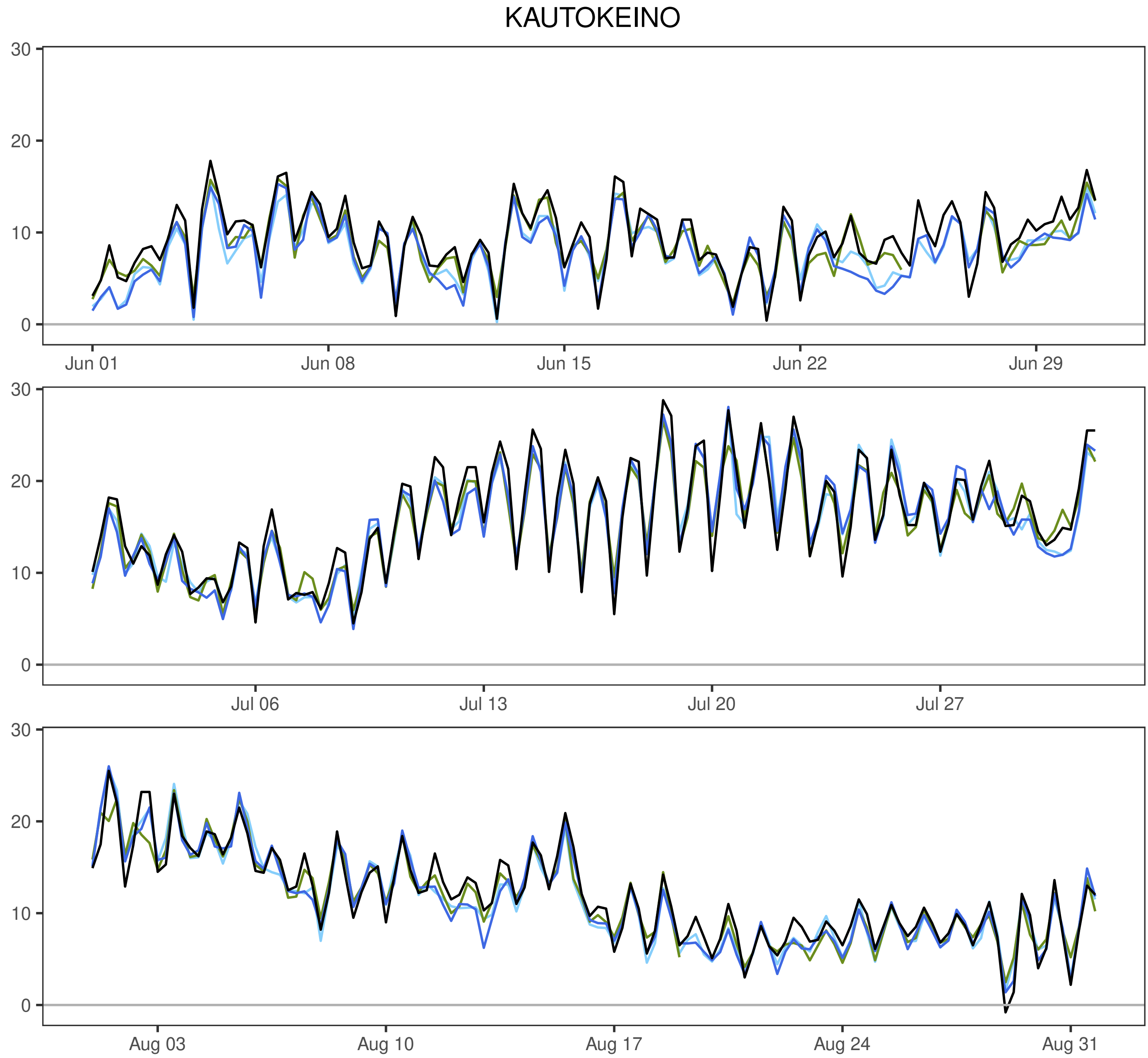
	Min	Mean	Max	Std	N
synop: 00,06,12,18	–0.3	6.1	17.1	2.9	366
MEPSctrl: 12+18,+24,+30,+36	0.7	5.6	14.9	2.6	368
AA25: 12+18,+24,+30,+36	0.3	5.7	14.3	2.6	368
IFS: 12+18,+24,+30,+36	–0.5	4.6	8.4	1.8	356

	ME	SDE	RMSE	MAE	Max.abs.err	N
MEPSctrl – synop	–0.5	1.1	1.2	0.9	4.6	354
AA25 – synop	–0.5	1.0	1.1	0.8	4.0	354
IFS – synop	–1.6	1.7	2.3	1.7	9.9	354



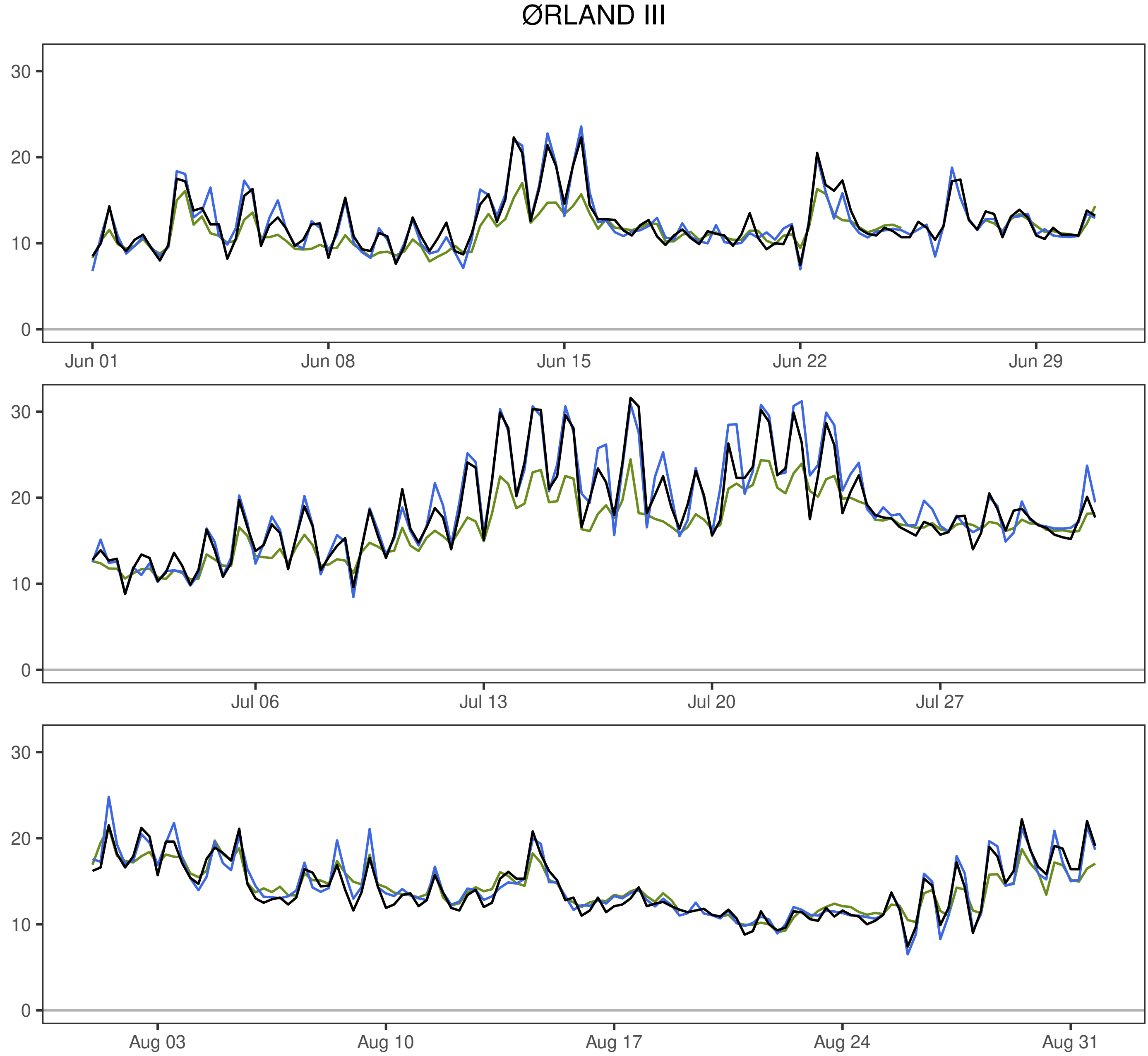
	Min	Mean	Max	Std	N
synop: 00,06,12,18	3.9	12.4	27.0	4.2	368
MEPSctrl: 12+18,+24,+30,+36	3.6	12.8	26.4	4.4	368
AA25: 12+18,+24,+30,+36	4.6	12.7	25.7	4.4	368
IFS: 12+18,+24,+30,+36	2.6	11.4	24.3	4.6	356

	ME	SDE	RMSE	MAE	Max.abs.err	N
MEPSctrl – synop	0.4	1.4	1.4	1.1	5.5	356
AA25 – synop	0.3	1.5	1.5	1.2	6.3	356
IFS – synop	−1.1	1.4	1.7	1.4	5.7	356



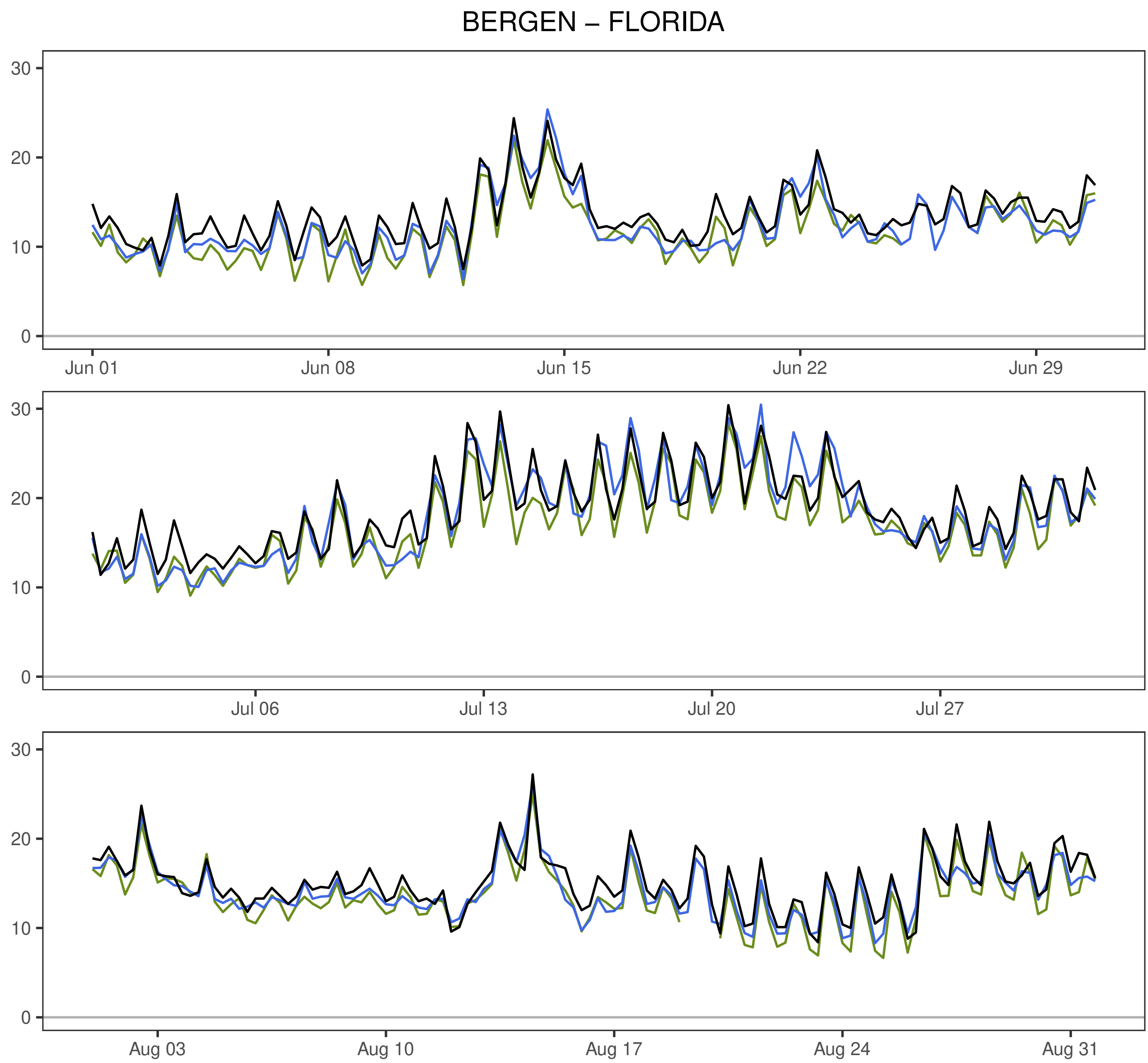
	Min	Mean	Max	Std	N
synop: 00,06,12,18	–0.8	12.4	28.8	5.5	368
MEPSctrl: 12+18,+24,+30,+36	0.8	11.7	28.1	5.6	368
AA25: 12+18,+24,+30,+36	0.2	11.7	27.6	5.5	368
IFS: 12+18,+24,+30,+36	2.3	12.1	26.6	5.2	356

	ME	SDE	RMSE	MAE	Max.abs.err	N
MEPSctrl – synop	–0.8	1.6	1.8	1.4	6.1	356
AA25 – synop	–0.7	1.6	1.7	1.4	5.0	356
IFS – synop	–0.5	1.5	1.5	1.2	5.6	356



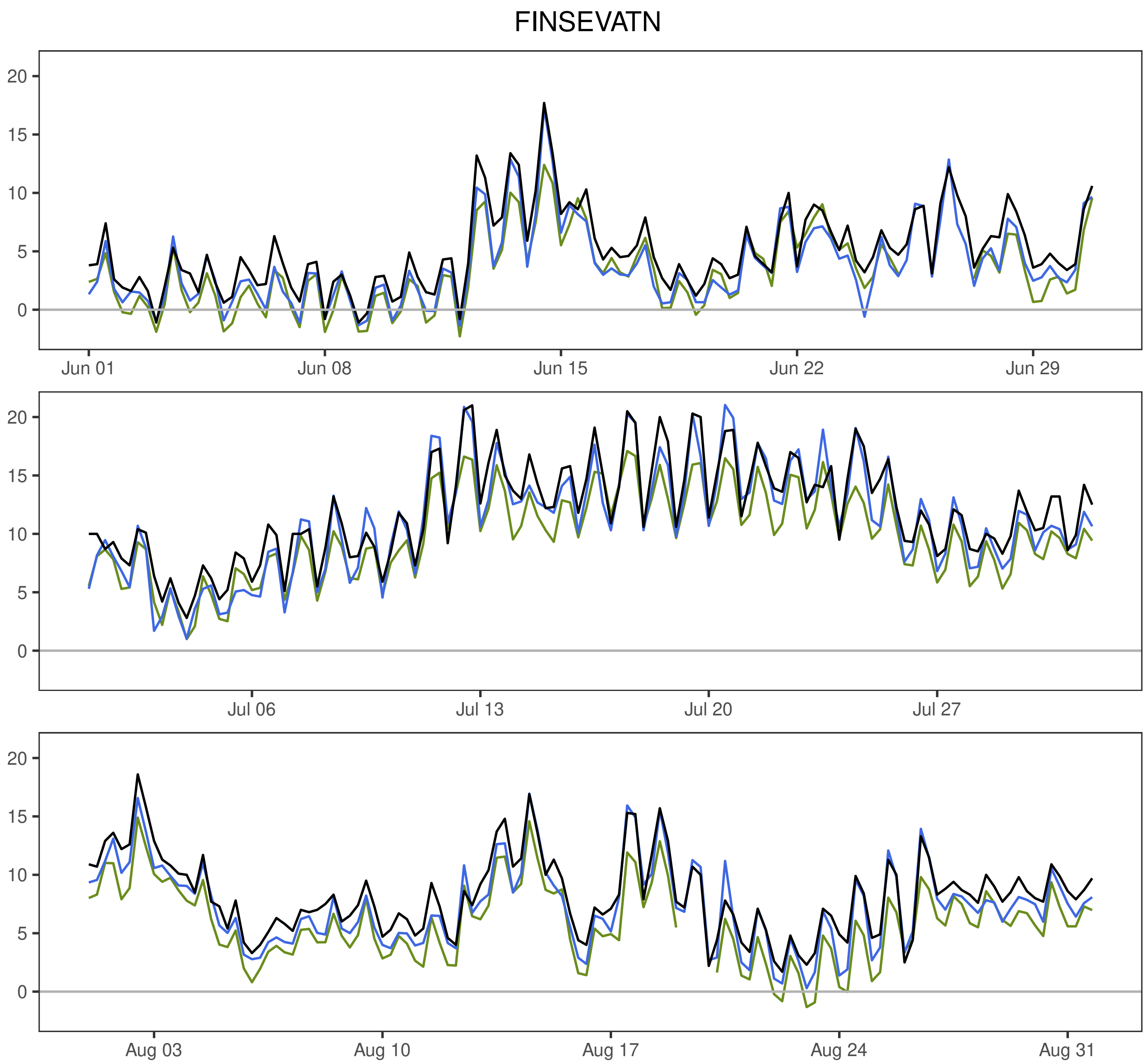
	Min	Mean	Max	Std	N
synop: 00,06,12,18	7.4	15.0	31.6	4.7	368
MEPSctrl: 12+18,+24,+30,+36	6.5	15.2	31.2	5.0	368
IFS: 12+18,+24,+30,+36	7.9	14.2	24.5	3.5	356

	ME	SDE	RMSE	MAE	Max.abs.err	N
MEPSctrl – synop	0.2	1.2	1.2	0.9	6.2	356
IFS – synop	−1.0	2.1	2.3	1.6	12.4	356



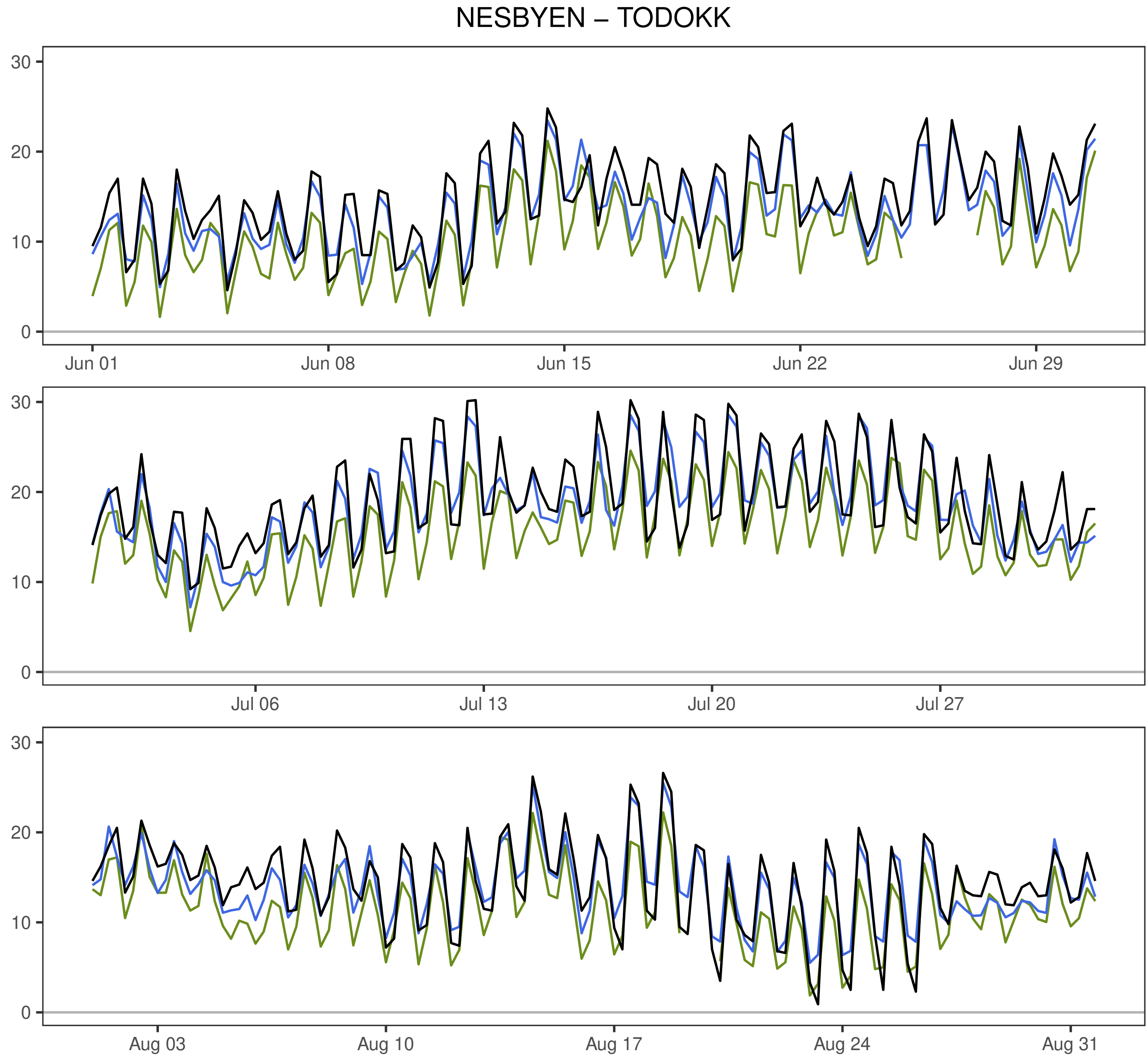
	Min	Mean	Max	Std	N
synop: 00,06,12,18	7.5	15.8	30.4	4.2	368
MEPSctrl: 12+18,+24,+30,+36	6.4	15.0	30.5	4.7	368
IFS: 12+18,+24,+30,+36	5.7	14.3	28.4	4.3	356

	ME	SDE	RMSE	MAE	Max.abs.err	N
MEPSctrl – synop	–0.7	1.5	1.6	1.3	5.5	356
IFS – synop	–1.5	1.1	1.9	1.6	5.5	356



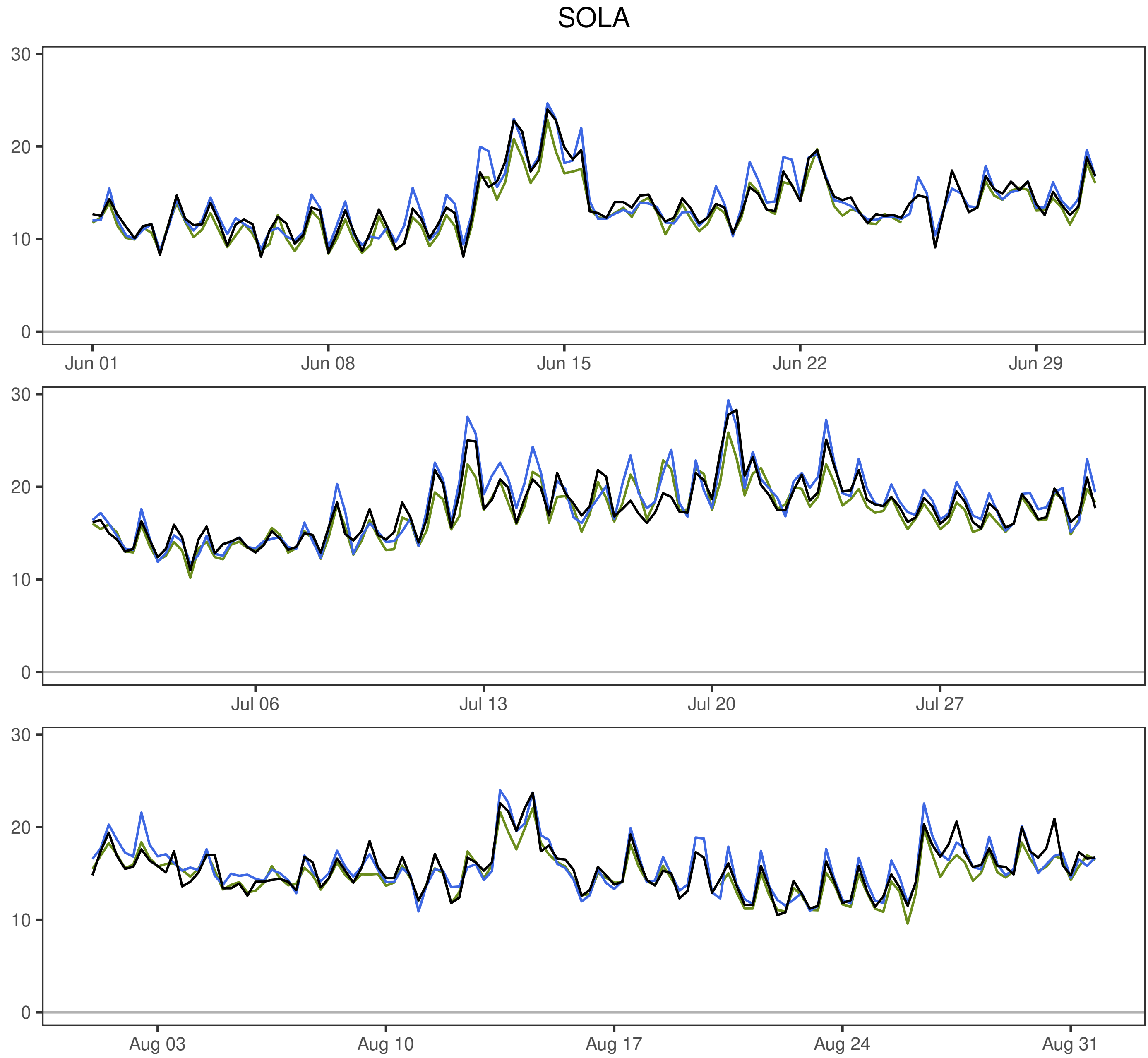
	Min	Mean	Max	Std	N
synop: 00,06,12,18	−1.1	8.4	21.0	4.7	368
MEPSctrl: 12+18,+24,+30,+36	−1.4	7.5	21.0	4.9	368
IFS: 12+18,+24,+30,+36	−2.3	6.4	17.1	4.4	356

	ME	SDE	RMSE	MAE	Max.abs.err	N
MEPSctrl – synop	−1.0	1.1	1.5	1.3	4.9	356
IFS – synop	−2.0	1.1	2.3	2.1	5.3	356



	Min	Mean	Max	Std	N
synop: 00,06,12,18	0.9	16.0	30.2	5.6	368
MEPSctrl: 12+18,+24,+30,+36	4.9	15.3	28.6	5.0	368
IFS: 12+18,+24,+30,+36	1.6	12.6	24.6	5.0	356

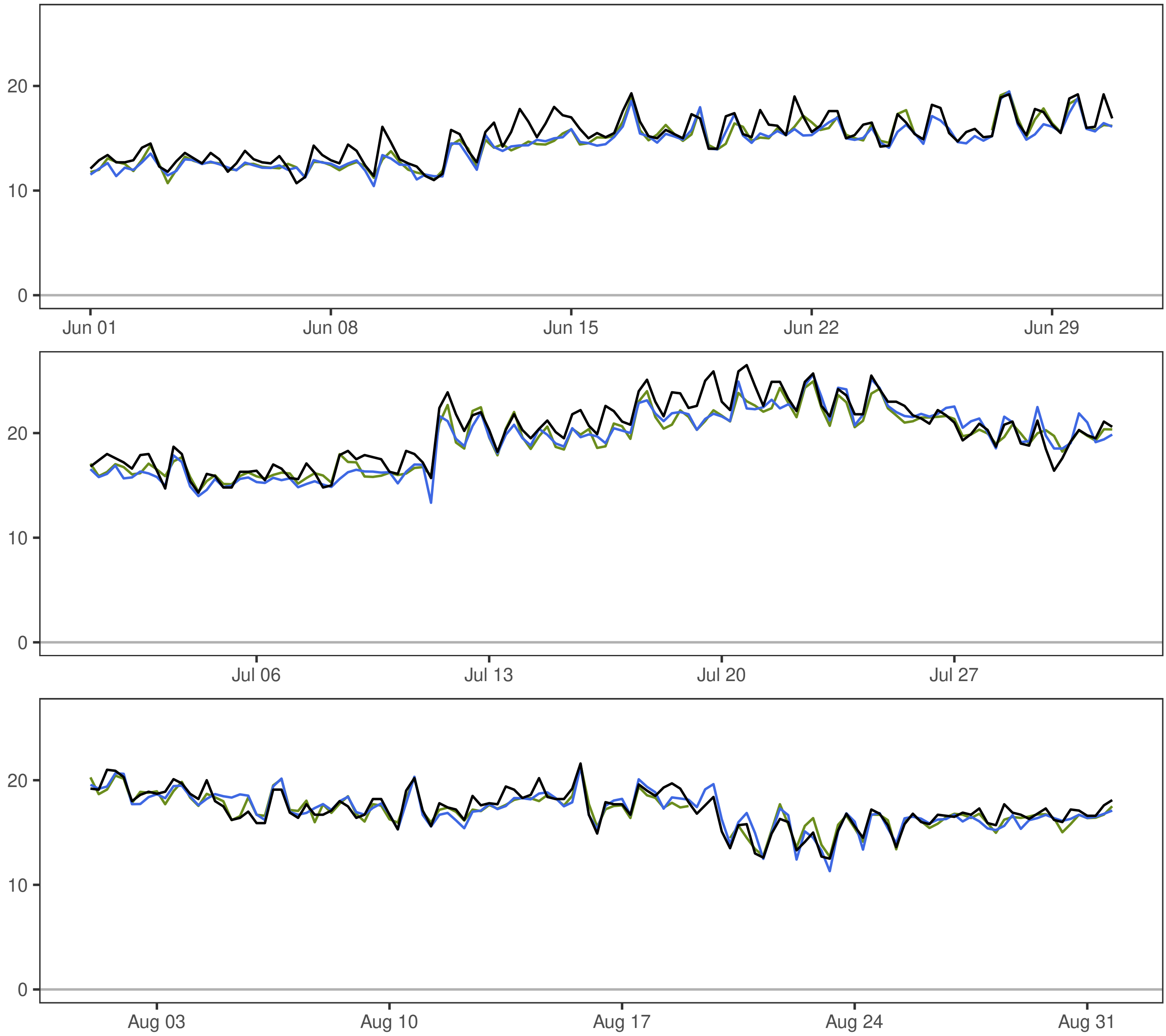
	ME	SDE	RMSE	MAE	Max.abs.err	N
MEPSctrl – synop	–0.7	2.1	2.2	1.8	7.0	356
IFS – synop	–3.4	2.0	4.0	3.6	8.4	356



	Min	Mean	Max	Std	N
synop: 00,06,12,18	8.1	15.6	28.3	3.3	368
MEPSctrl: 12+18,+24,+30,+36	8.7	15.9	29.4	3.6	368
IFS: 12+18,+24,+30,+36	8.2	15.0	25.9	3.1	356

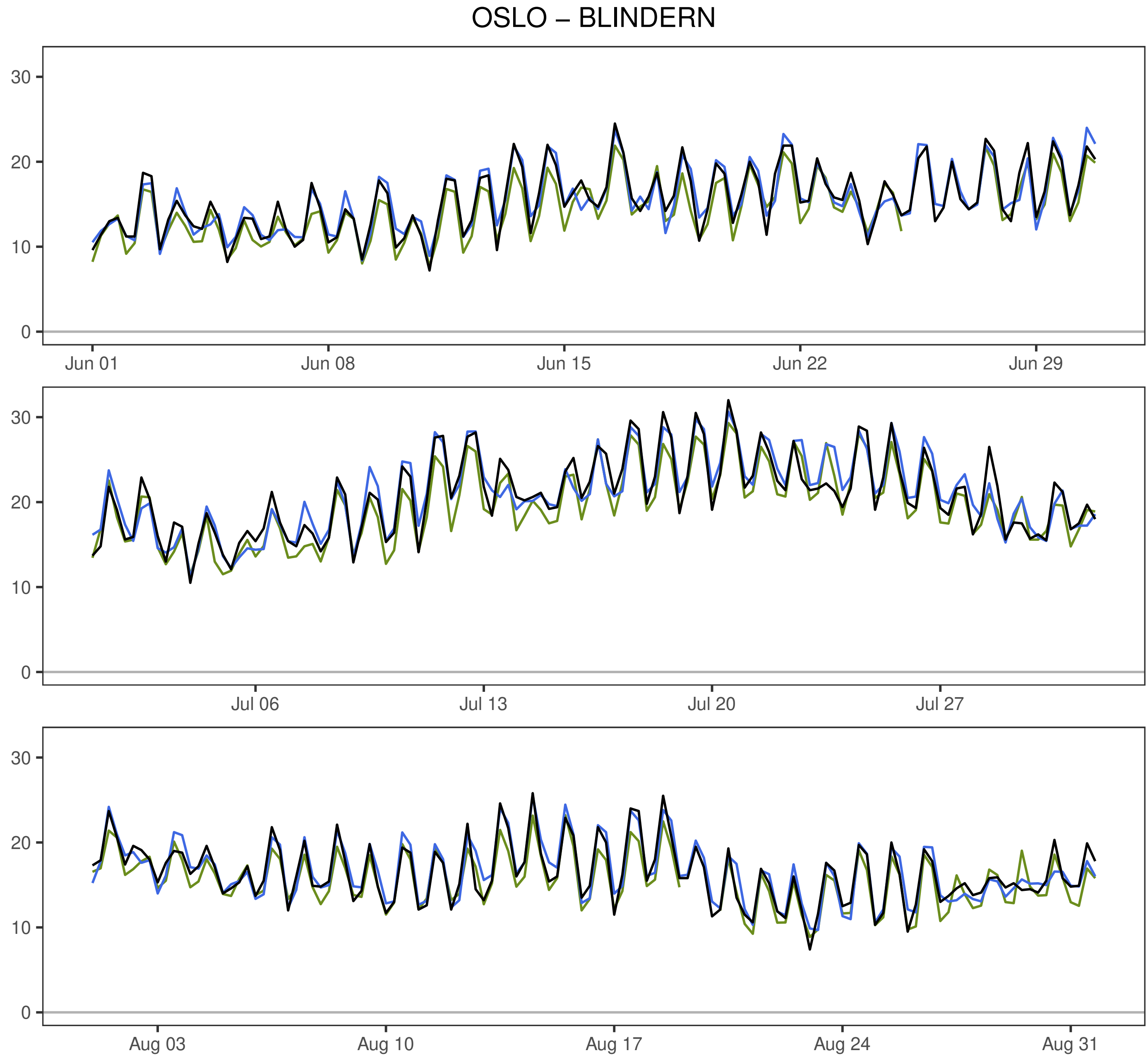
	ME	SDE	RMSE	MAE	Max.abs.err	N
MEPSctrl – synop	0.3	1.2	1.2	0.9	5.1	356
IFS – synop	−0.6	1.0	1.2	0.9	5.2	356

FÆRDER FYR



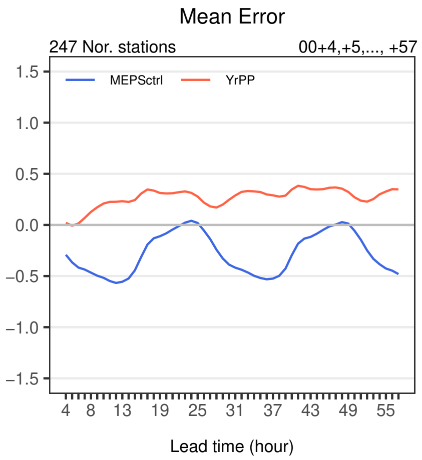
	Min	Mean	Max	Std	N
synop: 00,06,12,18	10.7	17.5	26.5	3.1	368
MEPSctrl: 12+18,+24,+30,+36	10.4	16.9	25.6	3.0	368
IFS: 12+18,+24,+30,+36	10.7	17.0	24.9	2.9	356

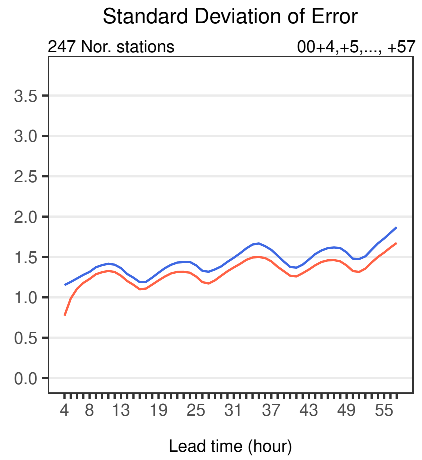
	ME	SDE	RMSE	MAE	Max.abs.err	N
MEPSctrl – synop	–0.5	1.0	1.1	0.8	4.1	356
IFS – synop	–0.5	1.0	1.1	0.8	3.9	356

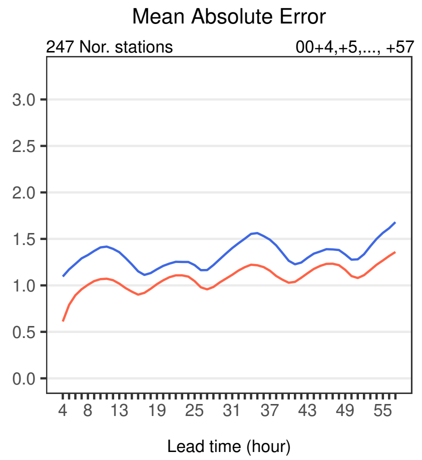


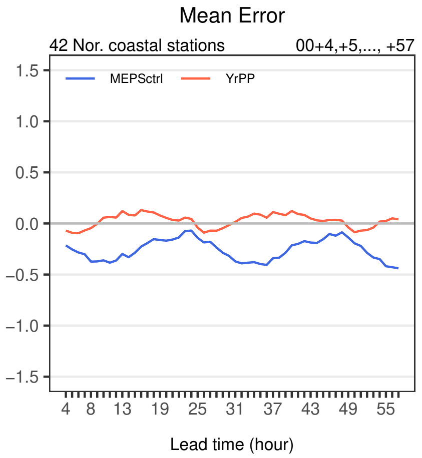
	Min	Mean	Max	Std	N
synop: 00,06,12,18	7.2	17.6	32.0	4.6	368
MEPSctrl: 12+18,+24,+30,+36	8.4	17.7	30.7	4.6	368
IFS: 12+18,+24,+30,+36	7.7	16.6	29.3	4.4	356

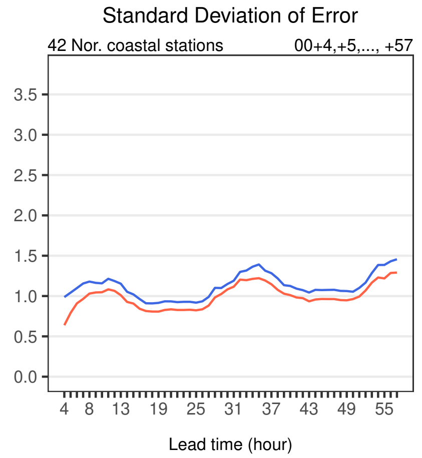
	ME	SDE	RMSE	MAE	Max.abs.err	N
MEPSctrl – synop	0.1	1.5	1.5	1.1	5.2	356
IFS – synop	–1.0	1.3	1.7	1.4	5.6	356

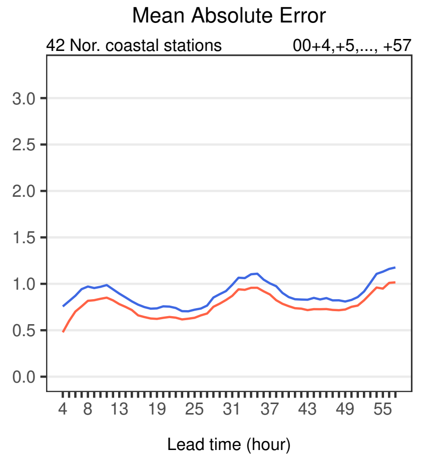

Mean Error
247 Nor. stations
00+4,+5,..., +57
MEPSctrl
YrPP
Lead time (hour)

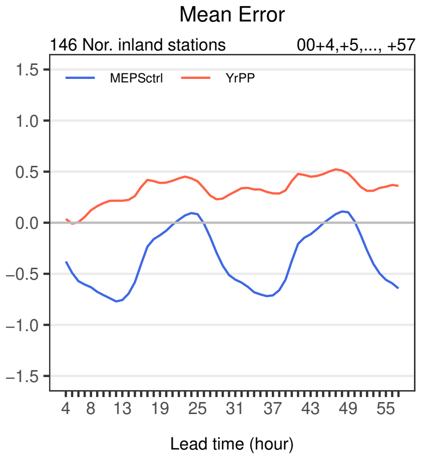

Standard Deviation of Error
247 Nor. stations
00+4,+5,..., +57
Lead time (hour)

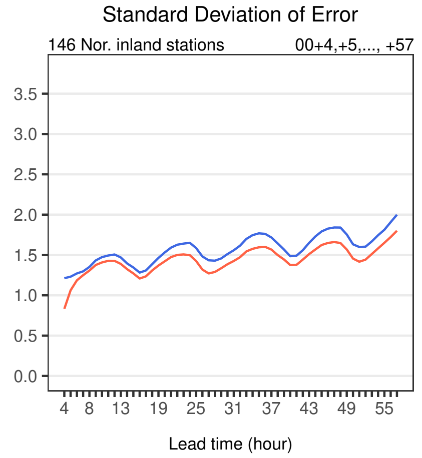

Mean Absolute Error
247 Nor. stations
00+4,+5,..., +57
Lead time (hour)

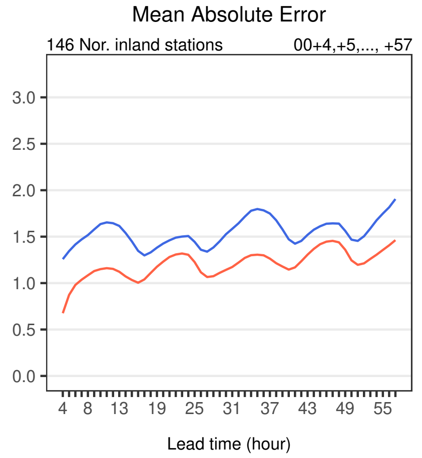

Mean Error
42 Nor. coastal stations
00+4,+5,..., +57
MEPSctrl
YrPP
Lead time (hour)

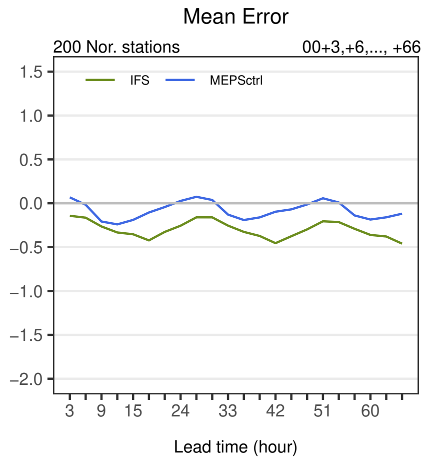

Standard Deviation of Error
42 Nor. coastal stations
00+4,+5,..., +57
Lead time (hour)

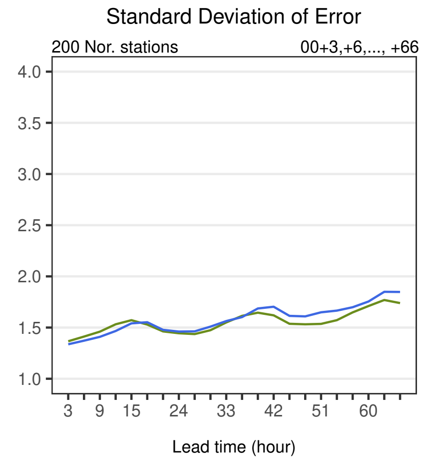

Mean Absolute Error
42 Nor. coastal stations
00+4,+5,..., +57
Lead time (hour)

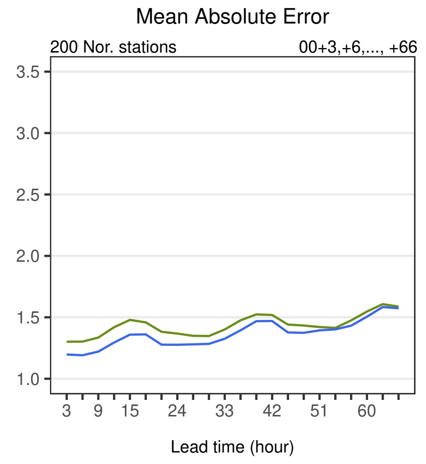

Mean Error
146 Nor. inland stations
00+4,+5,..., +57
MEPSctrl
YrPP
Lead time (hour)

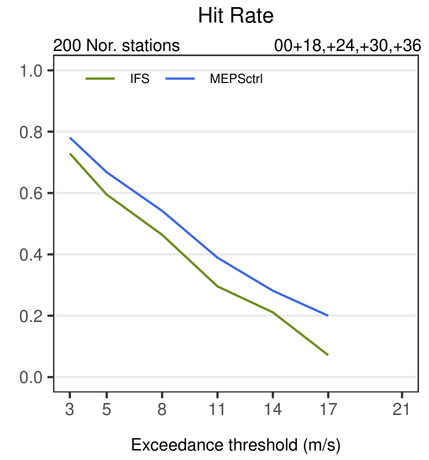

Standard Deviation of Error
146 Nor. inland stations
00+4,+5,..., +57
Lead time (hour)

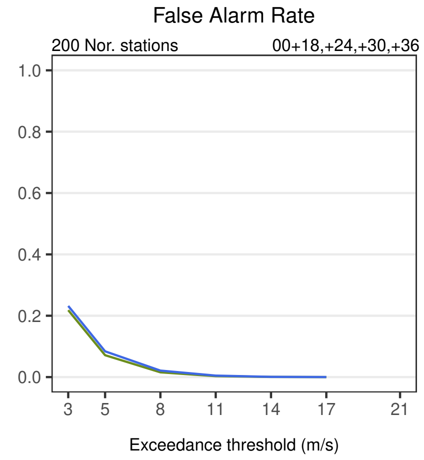

Mean Absolute Error
146 Nor. inland stations
00+4,+5,..., +57
Lead time (hour)

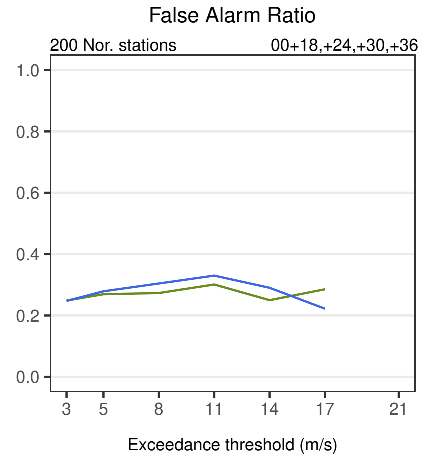

Mean Error
200 Nor. stations
00+3,+6,..., +66
IFS
MEPSctrl
Lead time (hour)

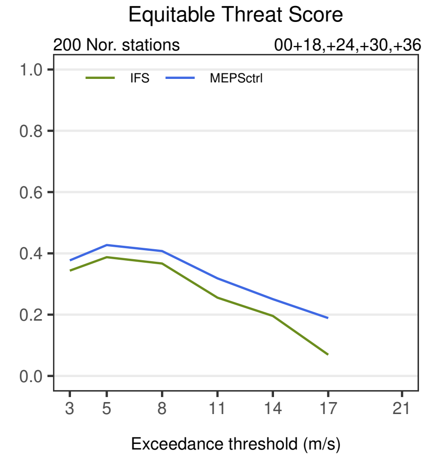

Standard Deviation of Error
200 Nor. stations
00+3,+6,..., +66
Lead time (hour)

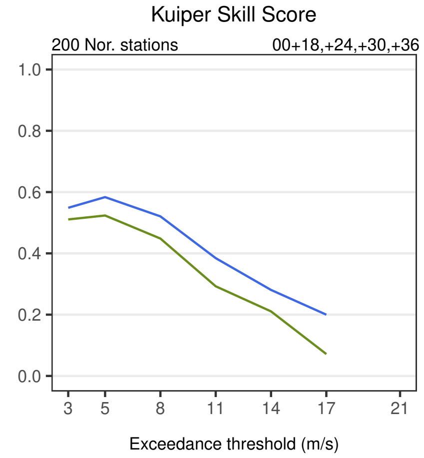

Mean Absolute Error
200 Nor. stations
00+3,+6,..., +66
Lead time (hour)

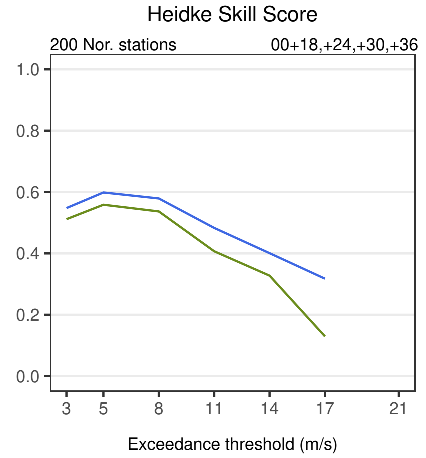

Hit Rate
200 Nor. stations
00+18,+24,+30,+36
IFS
MEPSctrl
Exceedance threshold (m/s)


False Alarm Rate
200 Nor. stations
00+18,+24,+30,+36
Exceedance threshold (m/s)

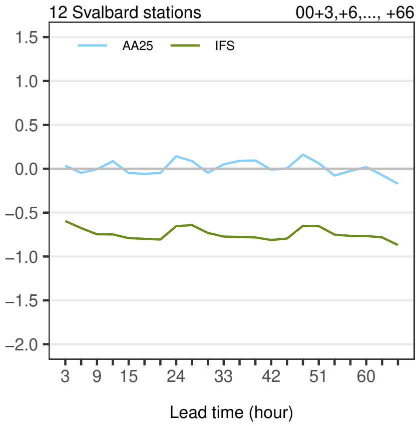

False Alarm Ratio
200 Nor. stations
00+18,+24,+30,+36
Exceedance threshold (m/s)


Equitable Threat Score
200 Nor. stations
00+18,+24,+30,+36
IFS
MEPSctrl
Exceedance threshold (m/s)

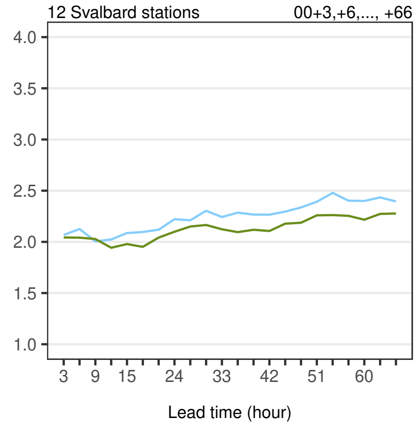

Kuiper Skill Score
200 Nor. stations
00+18,+24,+30,+36
Exceedance threshold (m/s)


Heidke Skill Score
200 Nor. stations
00+18,+24,+30,+36
Exceedance threshold (m/s)

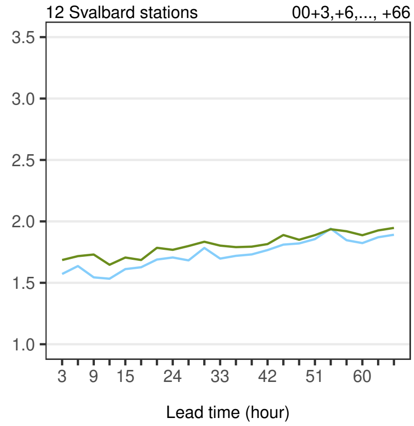
Mean Error



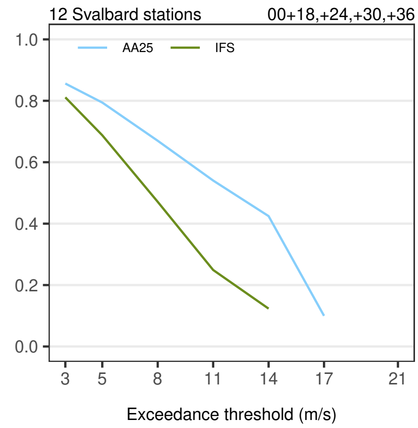
Standard Deviation of Error



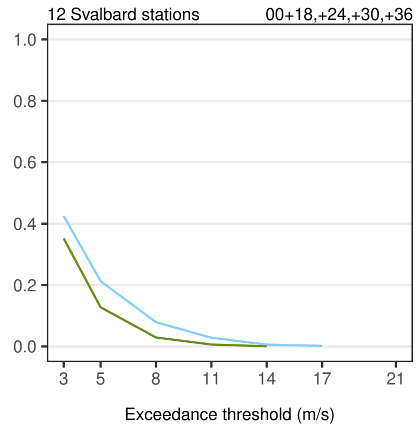
Mean Absolute Error



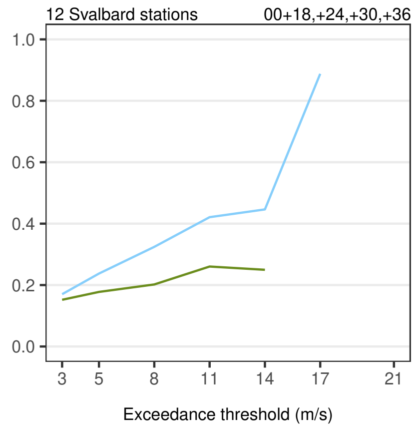
Hit Rate



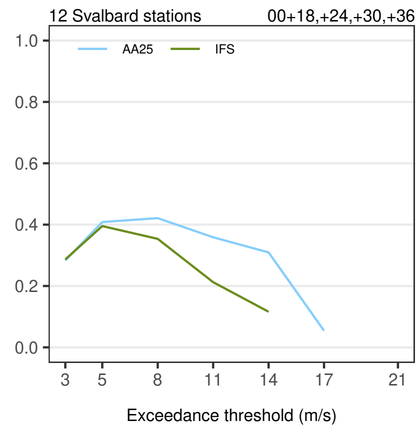
False Alarm Rate



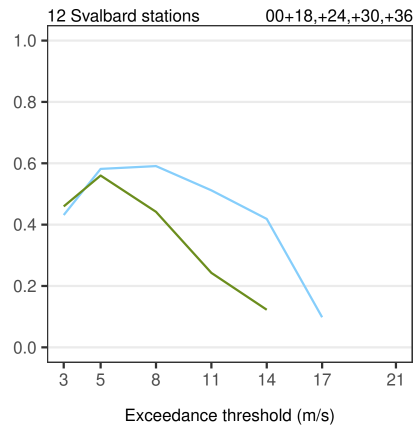
False Alarm Ratio



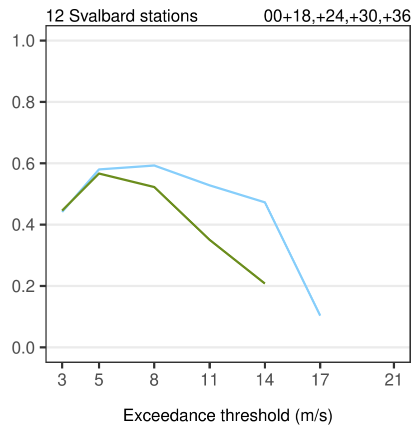
Equitable Threat Score

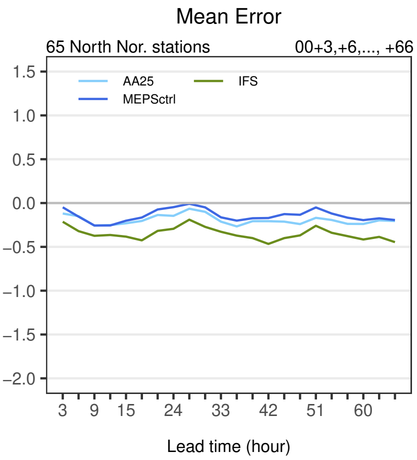


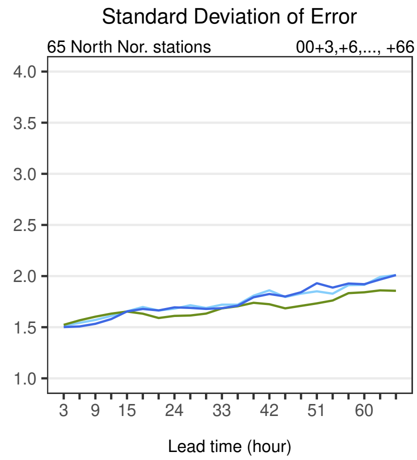
Kuiper Skill Score

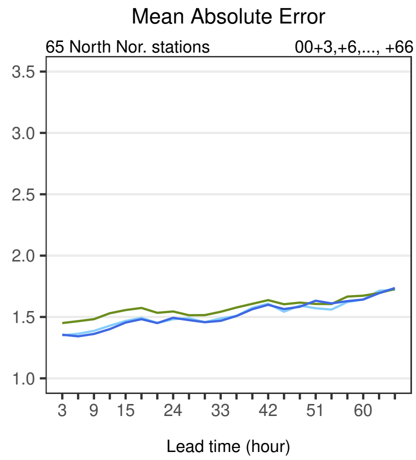


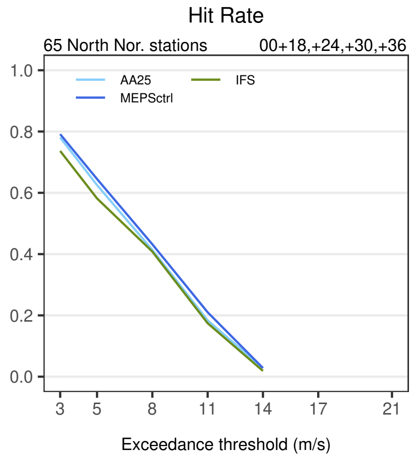
Heidke Skill Score

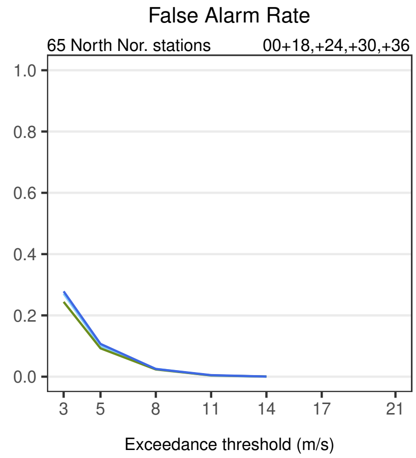


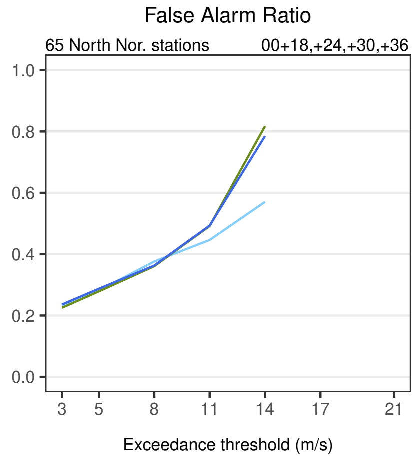

Mean Error
65 North Nor. stations
00+3,+6,..., +66
AA25
MEPSctrl
IFS
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
3 9 15 24 33 42 51 60
Lead time (hour)

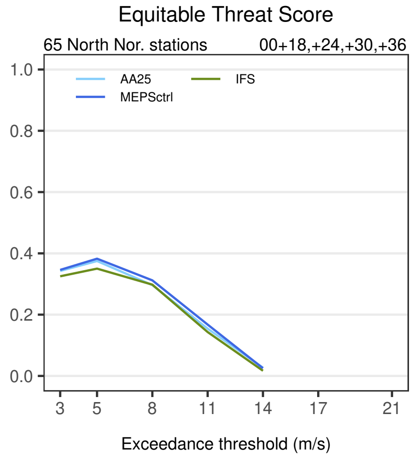

Standard Deviation of Error
65 North Nor. stations
00+3,+6,..., +66
4.0
3.5
3.0
2.5
2.0
1.5
1.0
3 9 15 24 33 42 51 60
Lead time (hour)

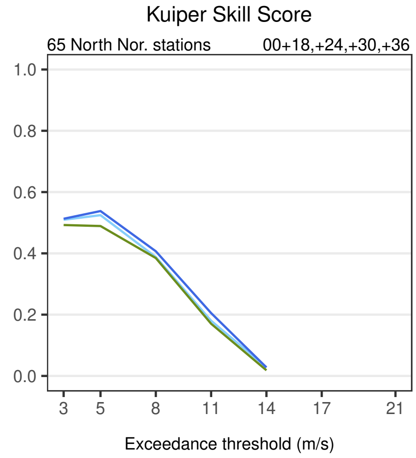

Mean Absolute Error
65 North Nor. stations
00+3,+6,..., +66
3.5
3.0
2.5
2.0
1.5
1.0
3 9 15 24 33 42 51 60
Lead time (hour)

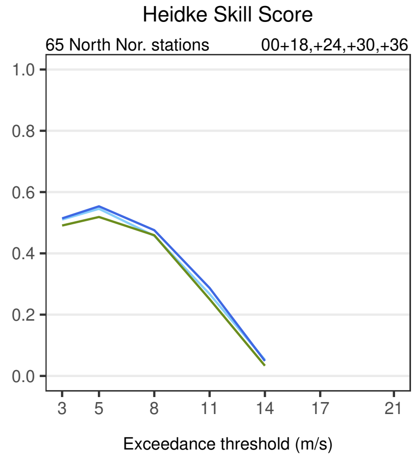

Hit Rate
65 North Nor. stations
00+18,+24,+30,+36
AA25
MEPSctrl
IFS
1.0
0.8
0.6
0.4
0.2
0.0
3 5 8 11 14 17 21
Exceedance threshold (m/s)

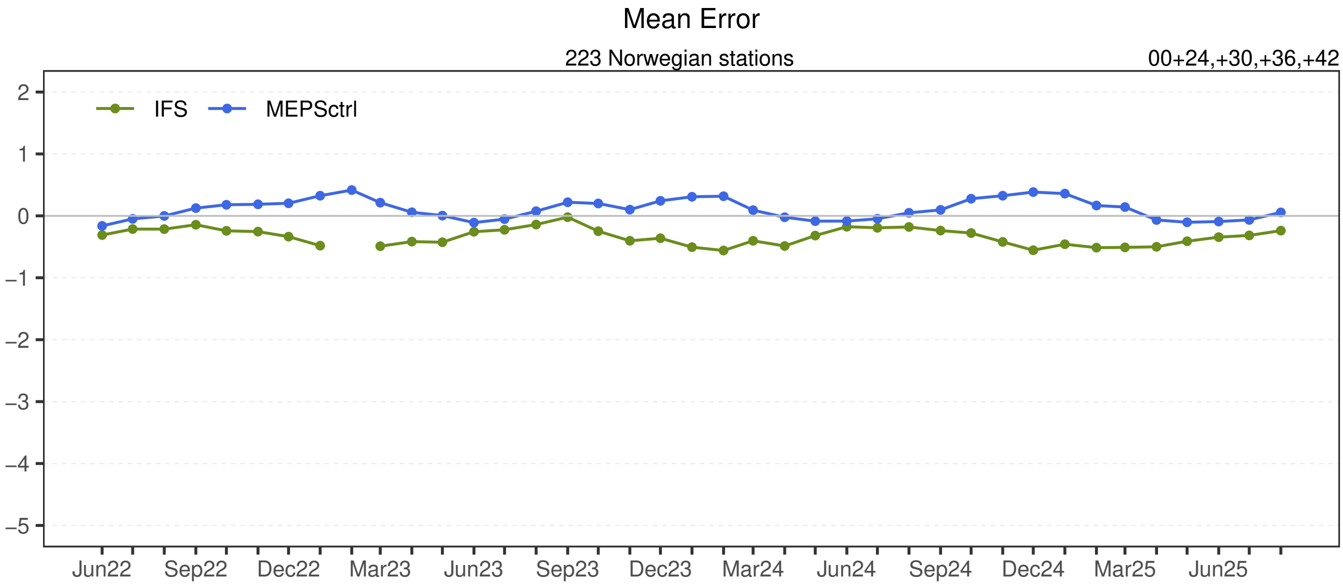

False Alarm Rate
65 North Nor. stations
00+18,+24,+30,+36
1.0
0.8
0.6
0.4
0.2
0.0
3 5 8 11 14 17 21
Exceedance threshold (m/s)

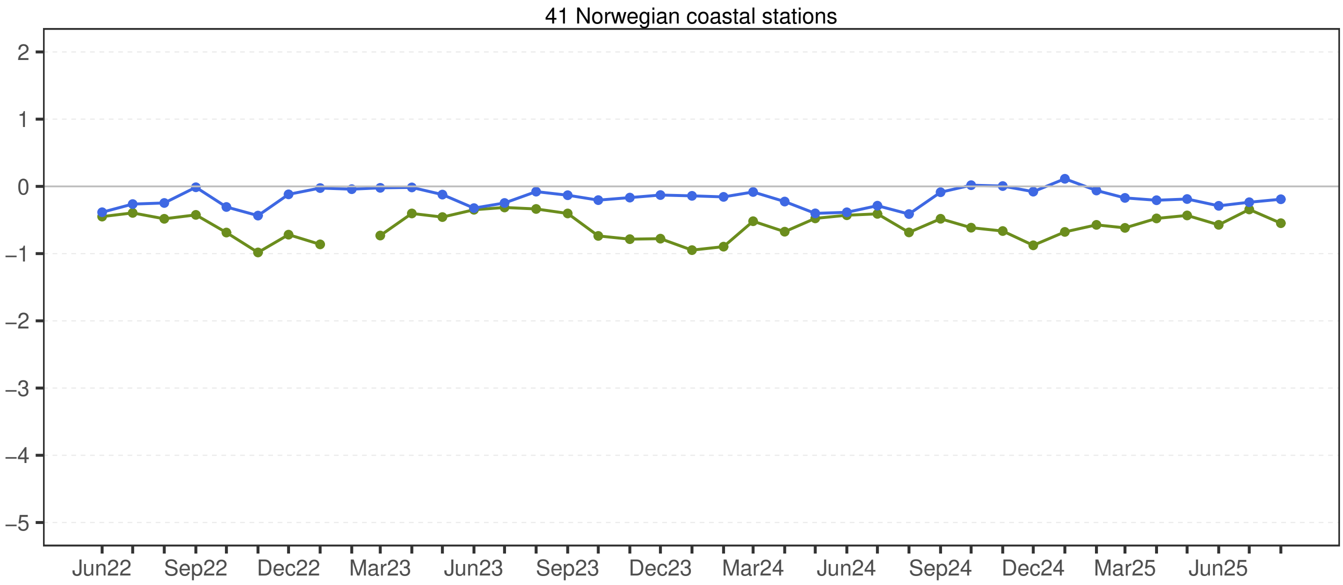

False Alarm Ratio
65 North Nor. stations
00+18,+24,+30,+36
1.0
0.8
0.6
0.4
0.2
0.0
3 5 8 11 14 17 21
Exceedance threshold (m/s)

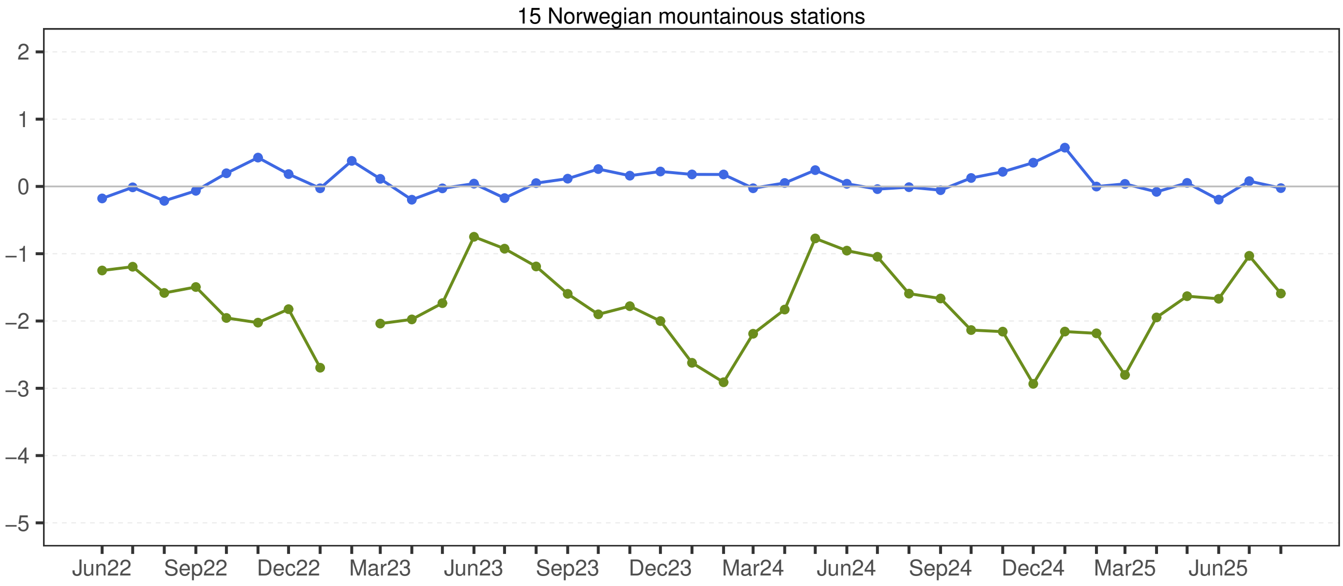

Equitable Threat Score
65 North Nor. stations
00+18,+24,+30,+36
AA25
MEPSctrl
IFS
1.0
0.8
0.6
0.4
0.2
0.0
3 5 8 11 14 17 21
Exceedance threshold (m/s)

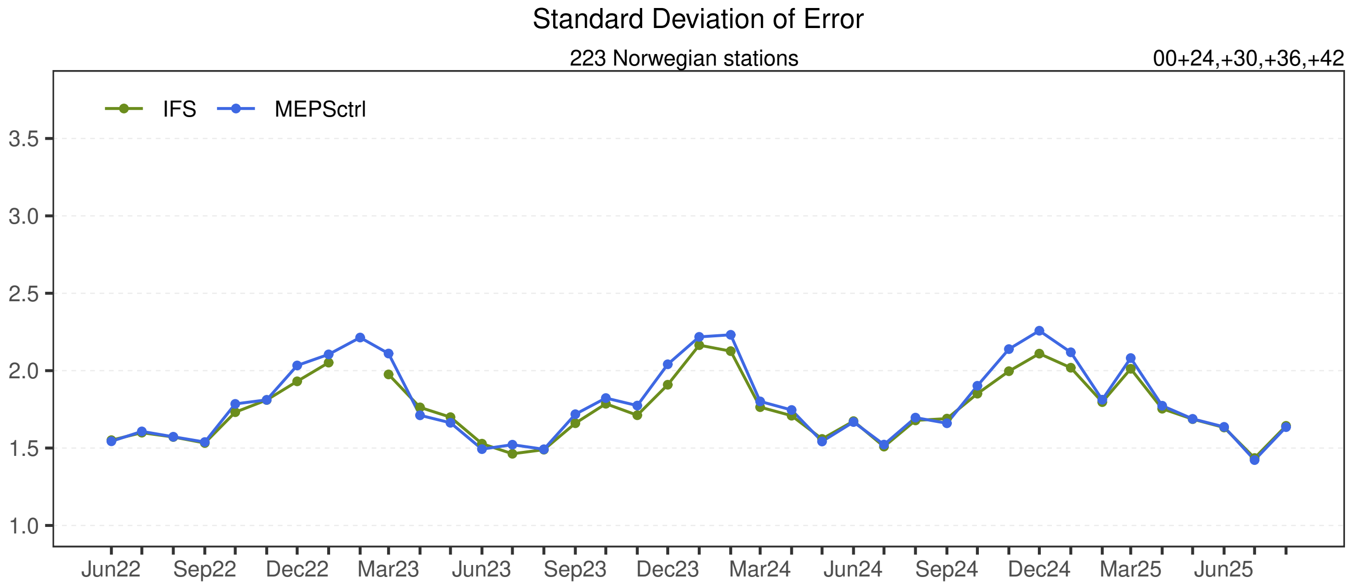

Kuiper Skill Score
65 North Nor. stations
00+18,+24,+30,+36
1.0
0.8
0.6
0.4
0.2
0.0
3 5 8 11 14 17 21
Exceedance threshold (m/s)

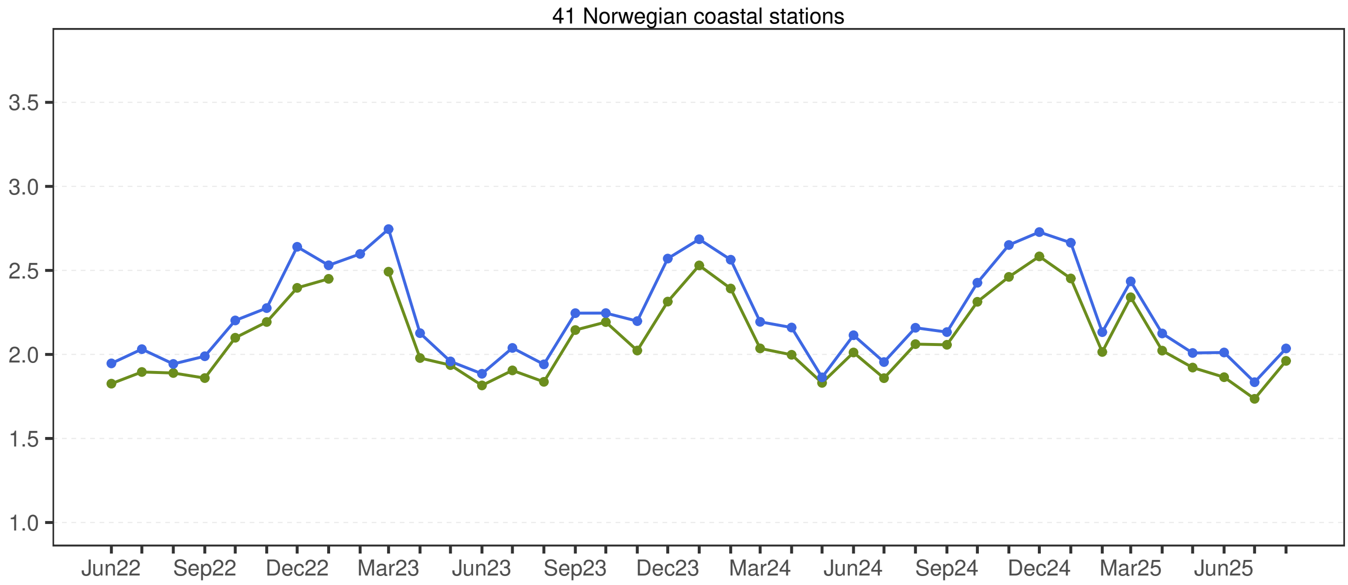

Heidke Skill Score
65 North Nor. stations
00+18,+24,+30,+36
1.0
0.8
0.6
0.4
0.2
0.0
3 5 8 11 14 17 21
Exceedance threshold (m/s)

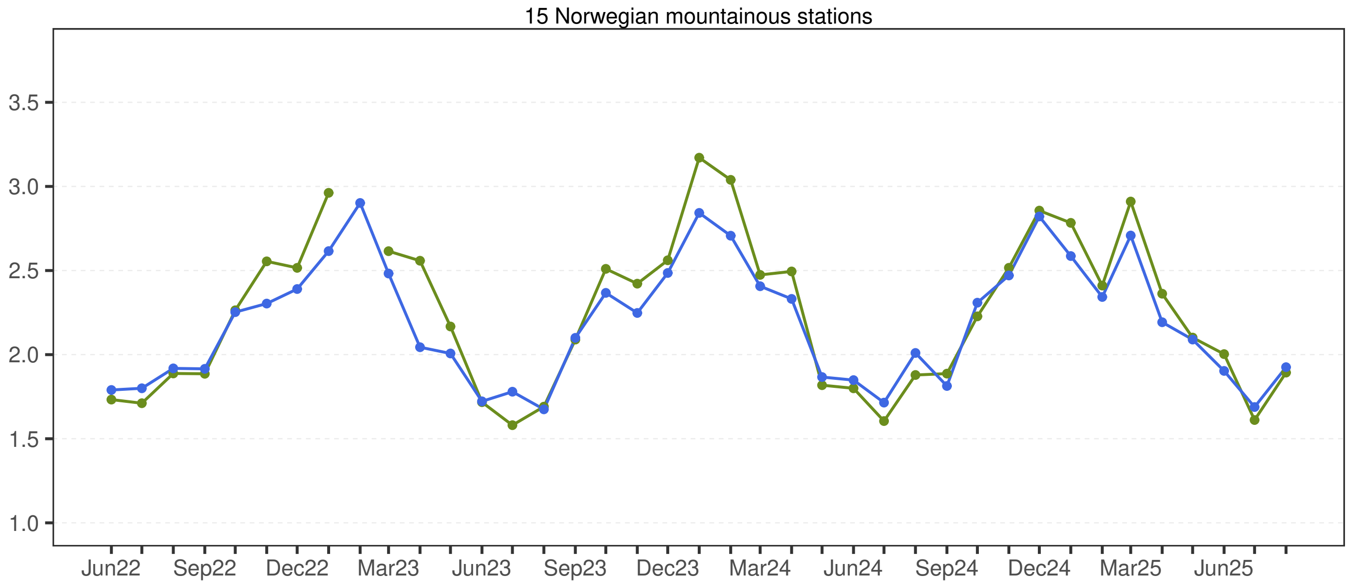

Mean Error
223 Norwegian stations
00+24,+30,+36,+42
IFS
MEPSctrl
2
1
0
−1
−2
−3
−4
−5
Jun22
Sep22
Dec22
Mar23
Jun23
Sep23
Dec23
Mar24
Jun24
Sep24
Dec24
Mar25
Jun25

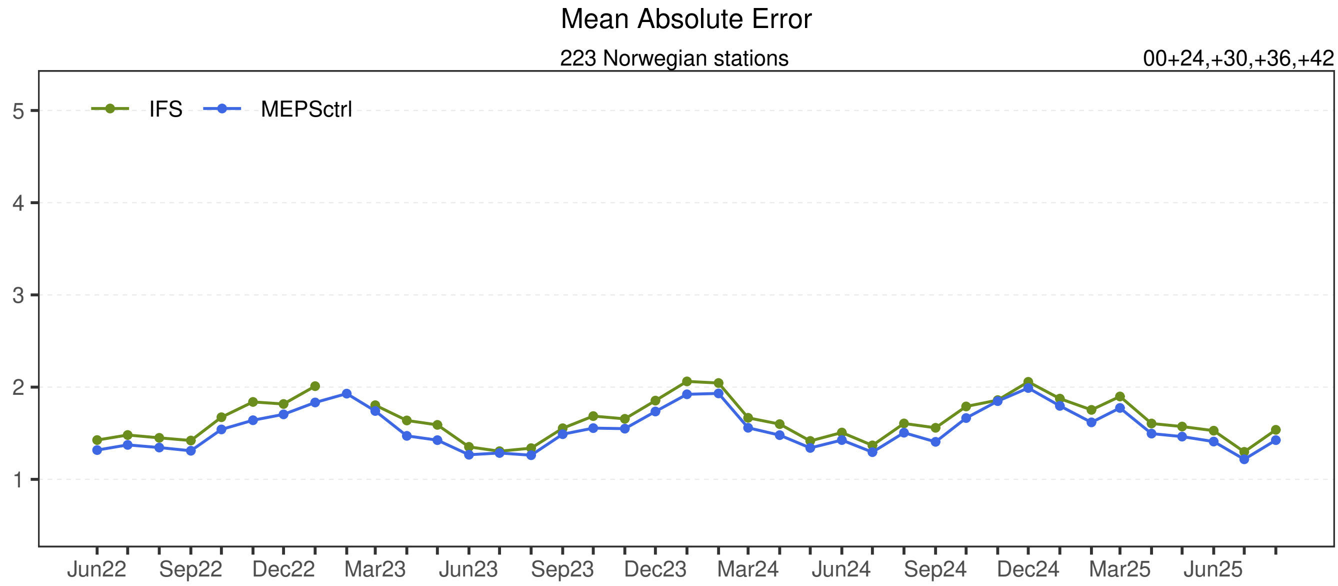

41 Norwegian coastal stations
2
1
0
−1
−2
−3
−4
−5
Jun22
Sep22
Dec22
Mar23
Jun23
Sep23
Dec23
Mar24
Jun24
Sep24
Dec24
Mar25
Jun25

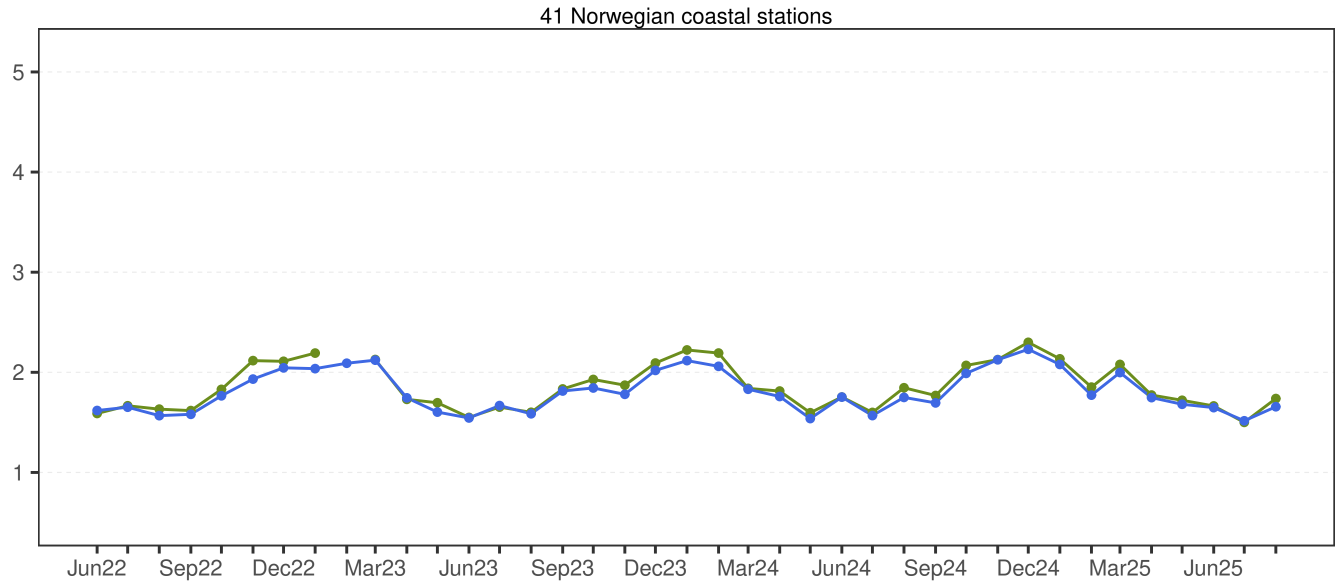

15 Norwegian mountainous stations
2
1
0
−1
−2
−3
−4
−5
Jun22
Sep22
Dec22
Mar23
Jun23
Sep23
Dec23
Mar24
Jun24
Sep24
Dec24
Mar25
Jun25

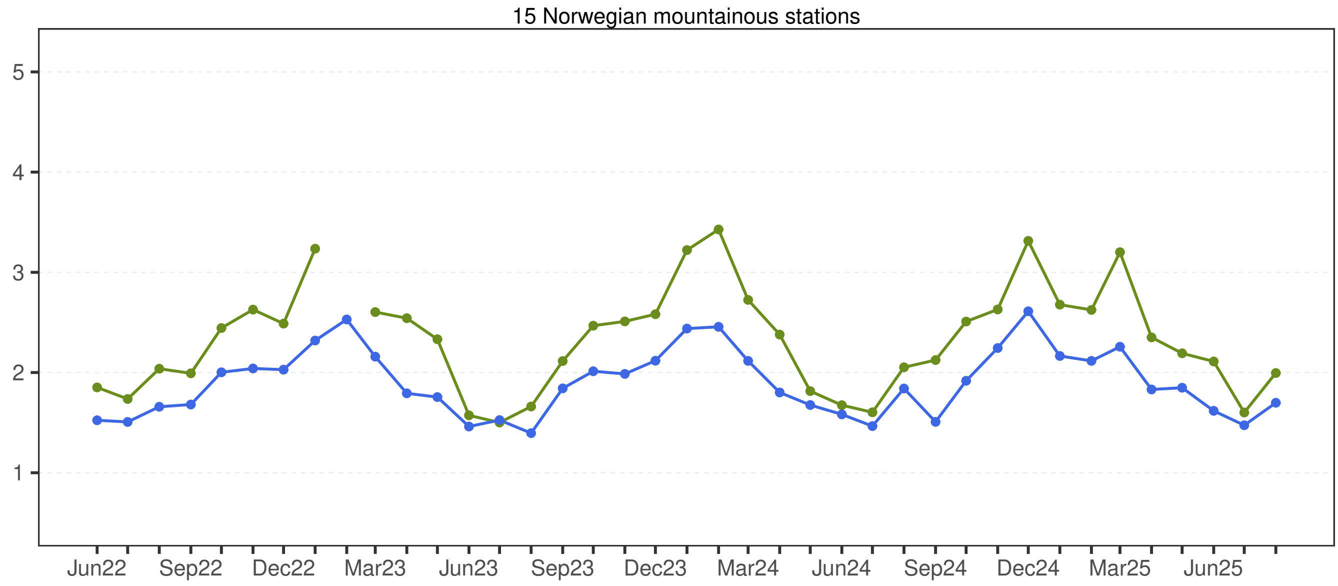

Standard Deviation of Error
223 Norwegian stations
00+24,+30,+36,+42
IFS
MEPSctrl
3.5
3.0
2.5
2.0
1.5
1.0
Jun22
Sep22
Dec22
Mar23
Jun23
Sep23
Dec23
Mar24
Jun24
Sep24
Dec24
Mar25
Jun25


41 Norwegian coastal stations
3.5
3.0
2.5
2.0
1.5
1.0
Jun22
Sep22
Dec22
Mar23
Jun23
Sep23
Dec23
Mar24
Jun24
Sep24
Dec24
Mar25
Jun25


15 Norwegian mountainous stations
3.5
3.0
2.5
2.0
1.5
1.0
Jun22
Sep22
Dec22
Mar23
Jun23
Sep23
Dec23
Mar24
Jun24
Sep24
Dec24
Mar25
Jun25

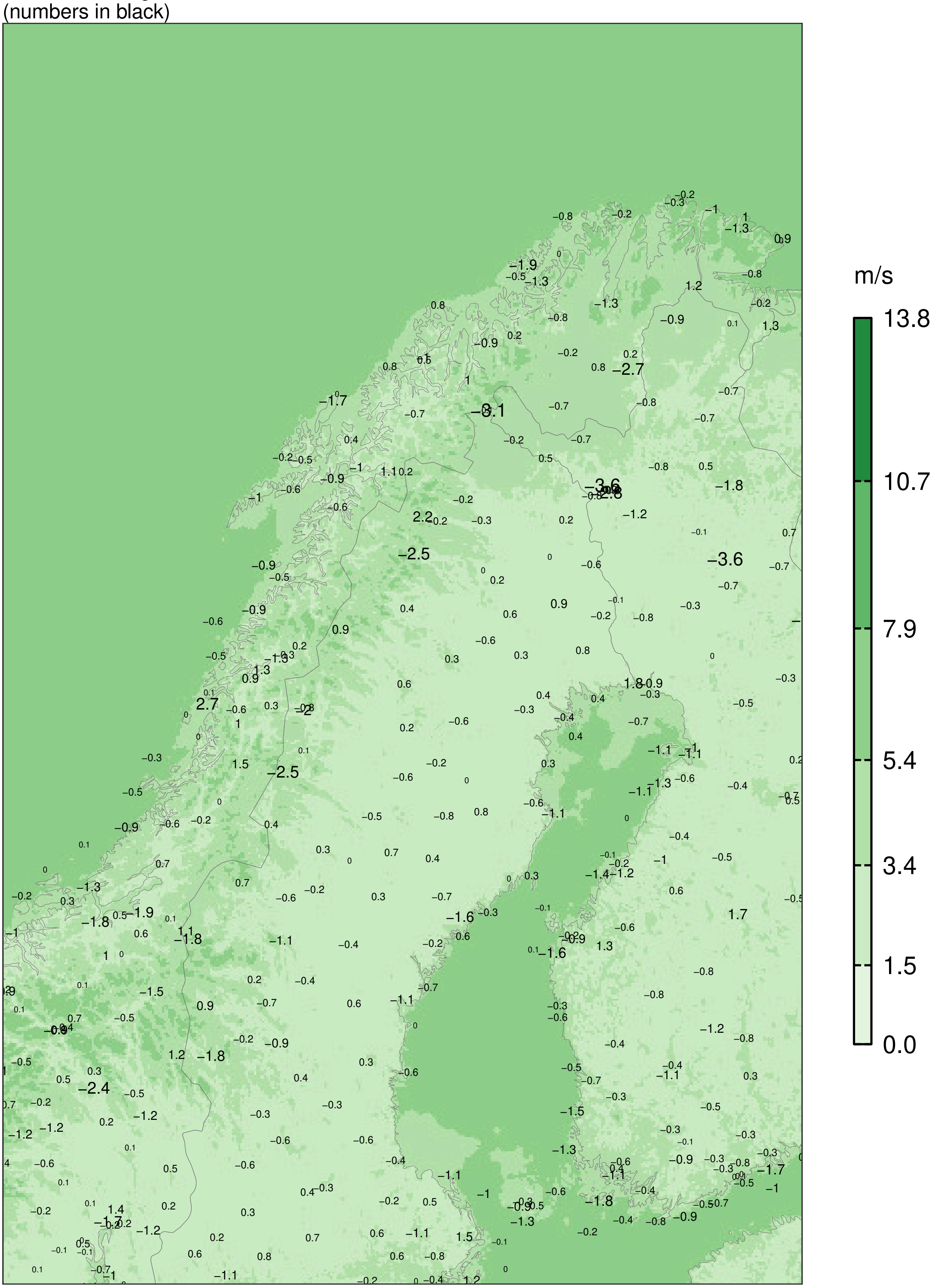

Mean Absolute Error
223 Norwegian stations
00+24,+30,+36,+42
IFS
MEPSctrl
5
4
3
2
1
Jun22 Sep22 Dec22 Mar23 Jun23 Sep23 Dec23 Mar24 Jun24 Sep24 Dec24 Mar25 Jun25


41 Norwegian coastal stations
5
4
3
2
1
Jun22 Sep22 Dec22 Mar23 Jun23 Sep23 Dec23 Mar24 Jun24 Sep24 Dec24 Mar25 Jun25

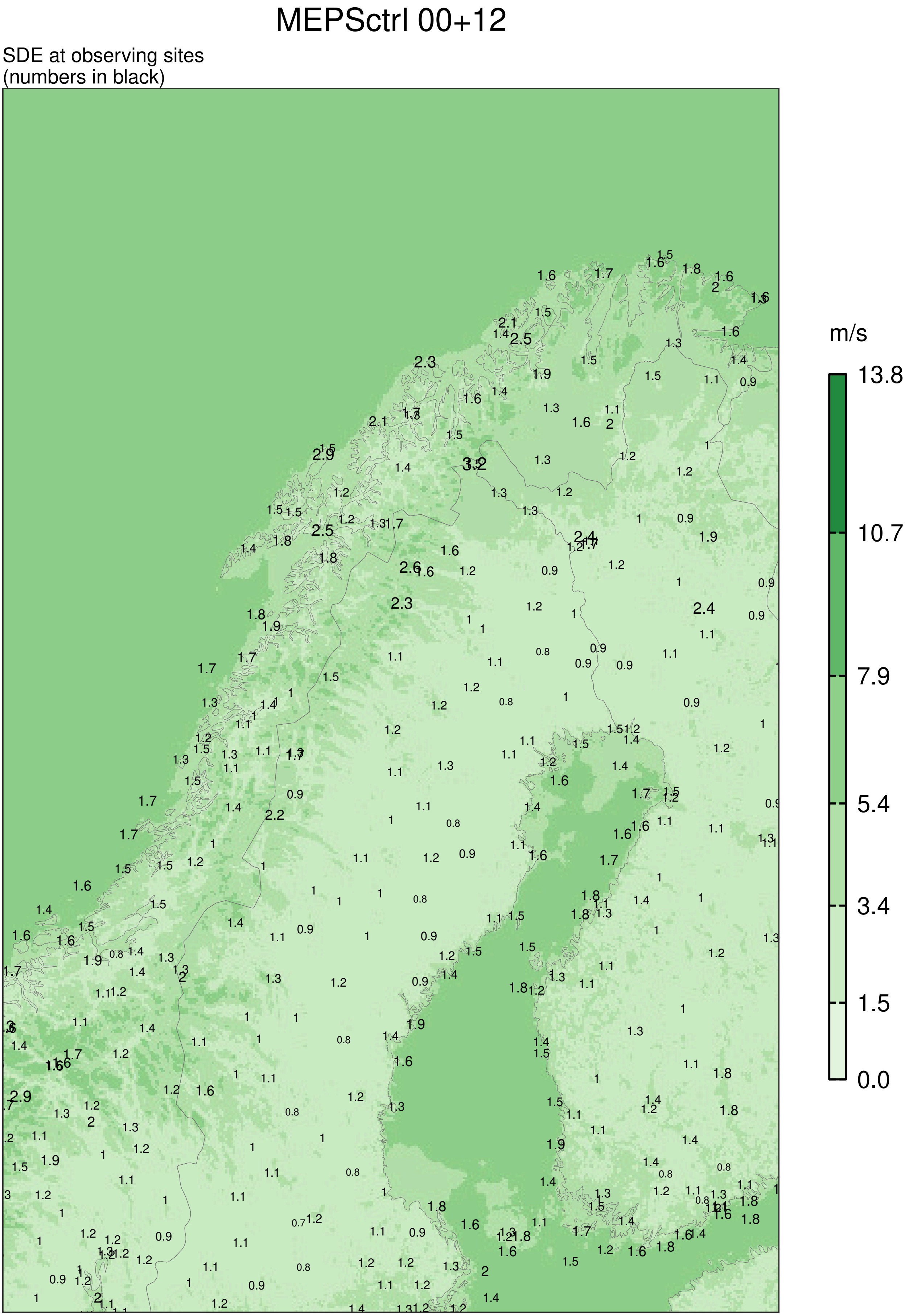

15 Norwegian mountainous stations
5
4
3
2
1
Jun22 Sep22 Dec22 Mar23 Jun23 Sep23 Dec23 Mar24 Jun24 Sep24 Dec24 Mar25 Jun25

MEPSctrl 00+12

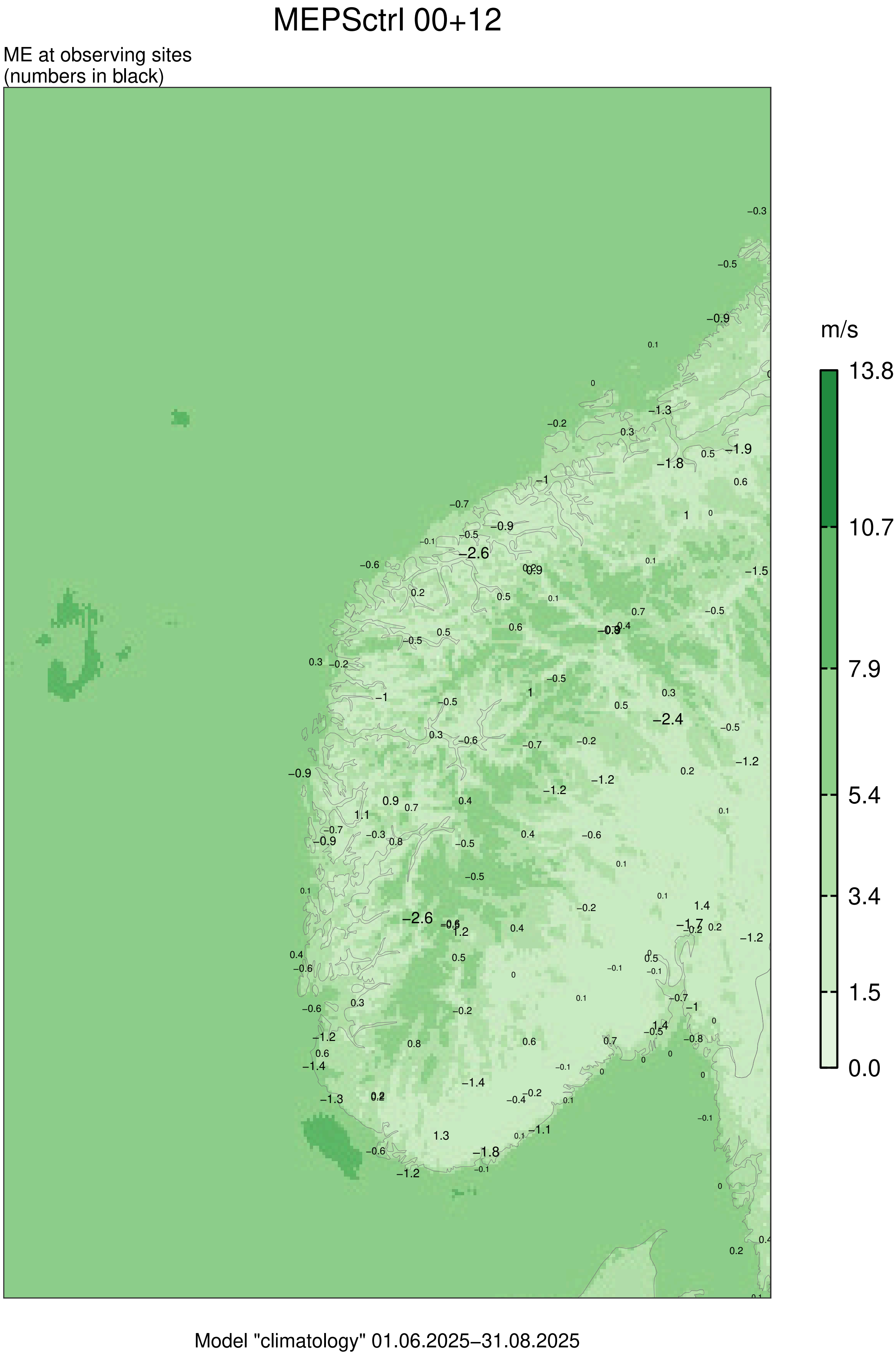
ME at observing sites
(numbers in black)



Model "climatology" 01.06.2025–31.08.2025

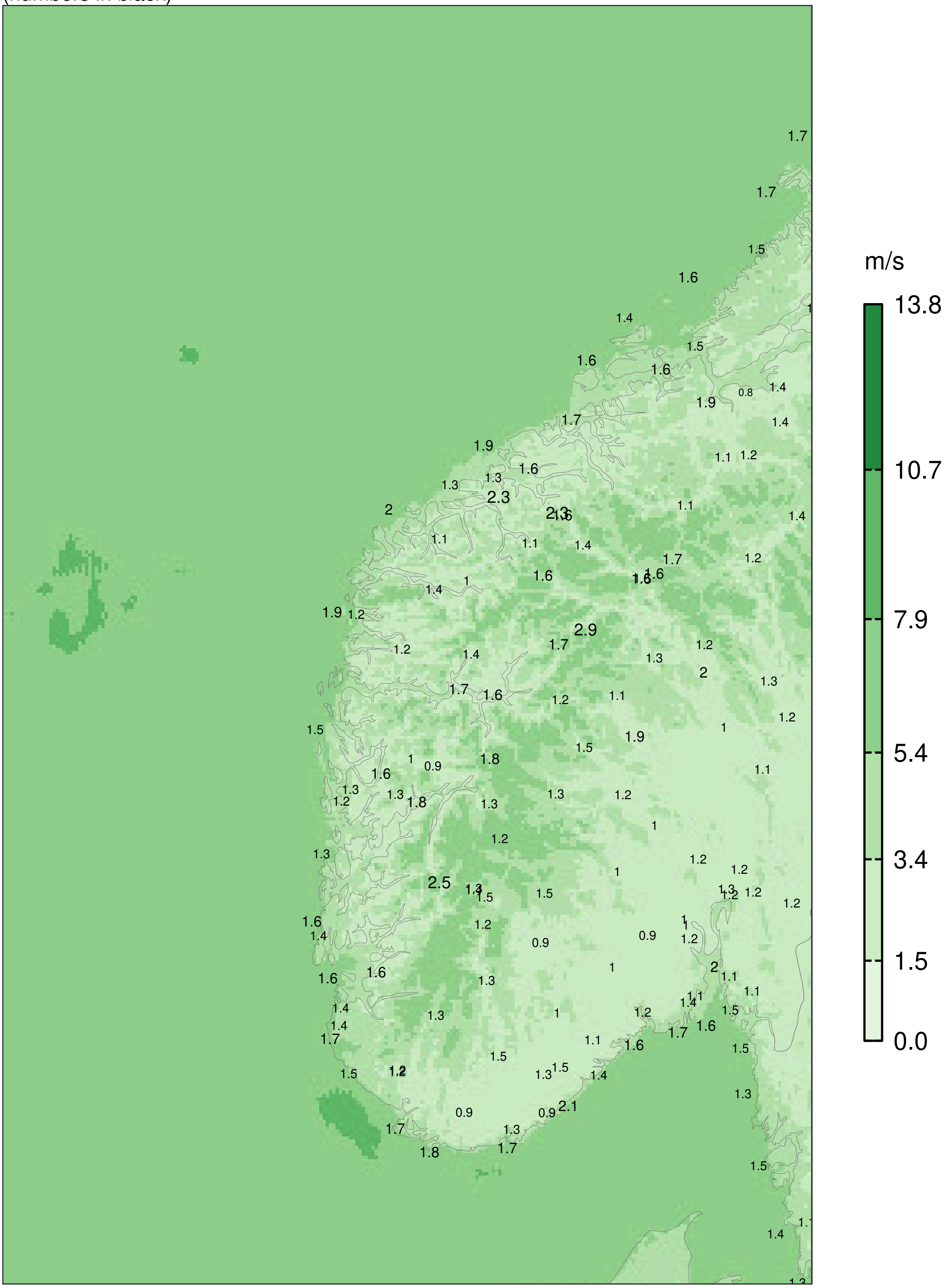


Model "climatology" 01.06.2025–31.08.2025

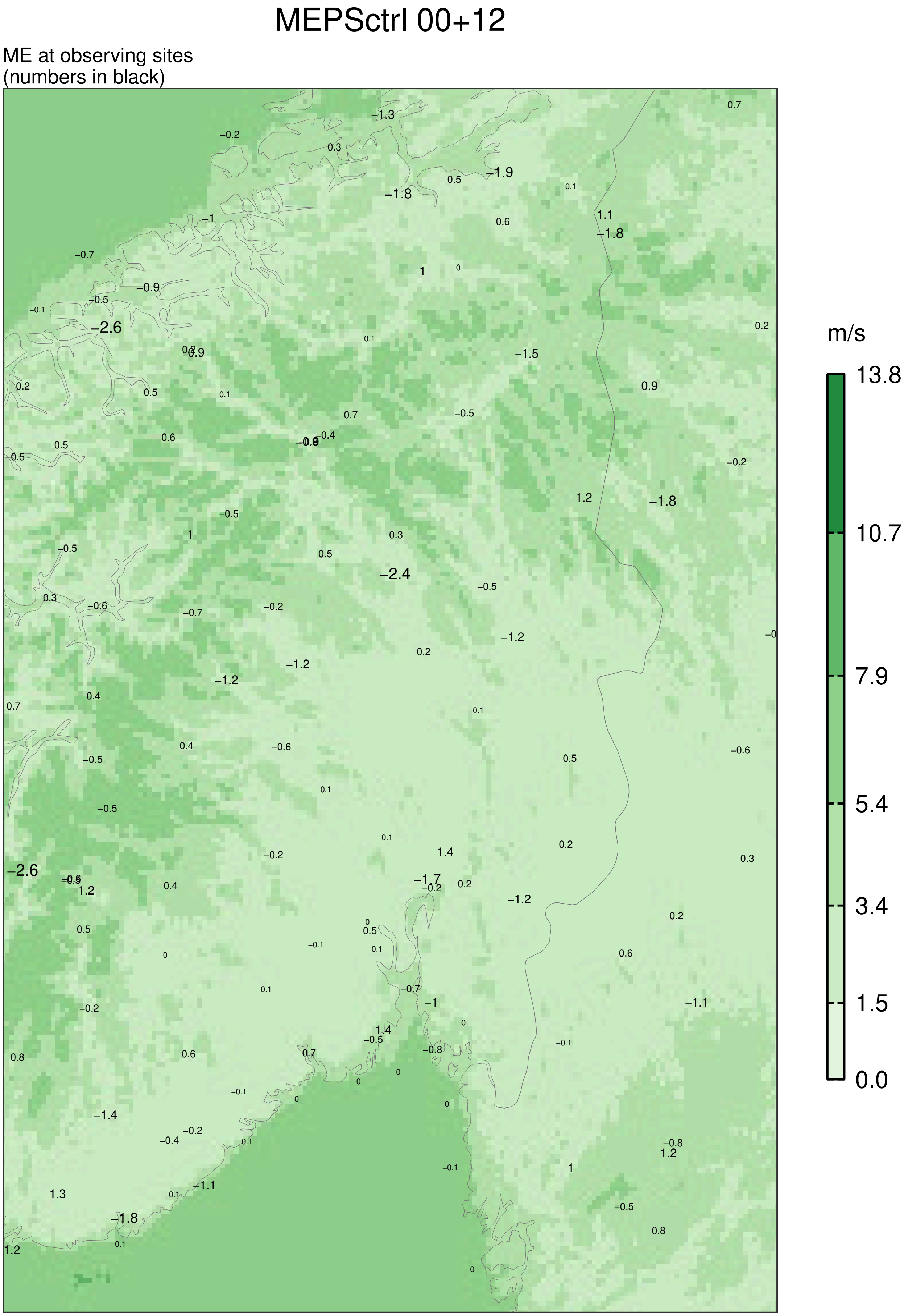

MEPSctrl 00+12
ME at observing sites
(numbers in black)
m/s
13.8
10.7
7.9
5.4
3.4
1.5
0.0
Model "climatology" 01.06.2025–31.08.2025

MEPSctrl 00+12

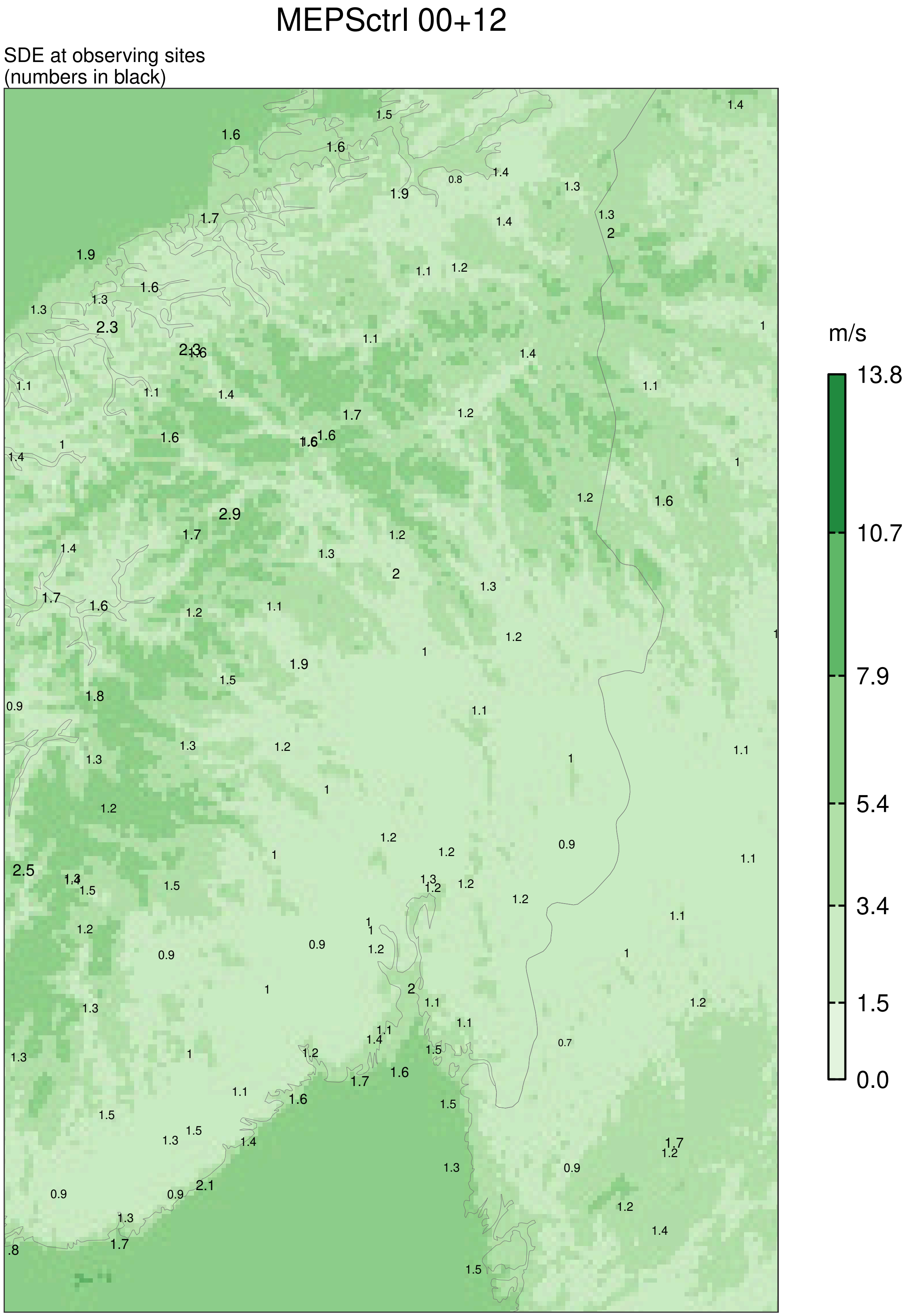
SDE at observing sites
(numbers in black)



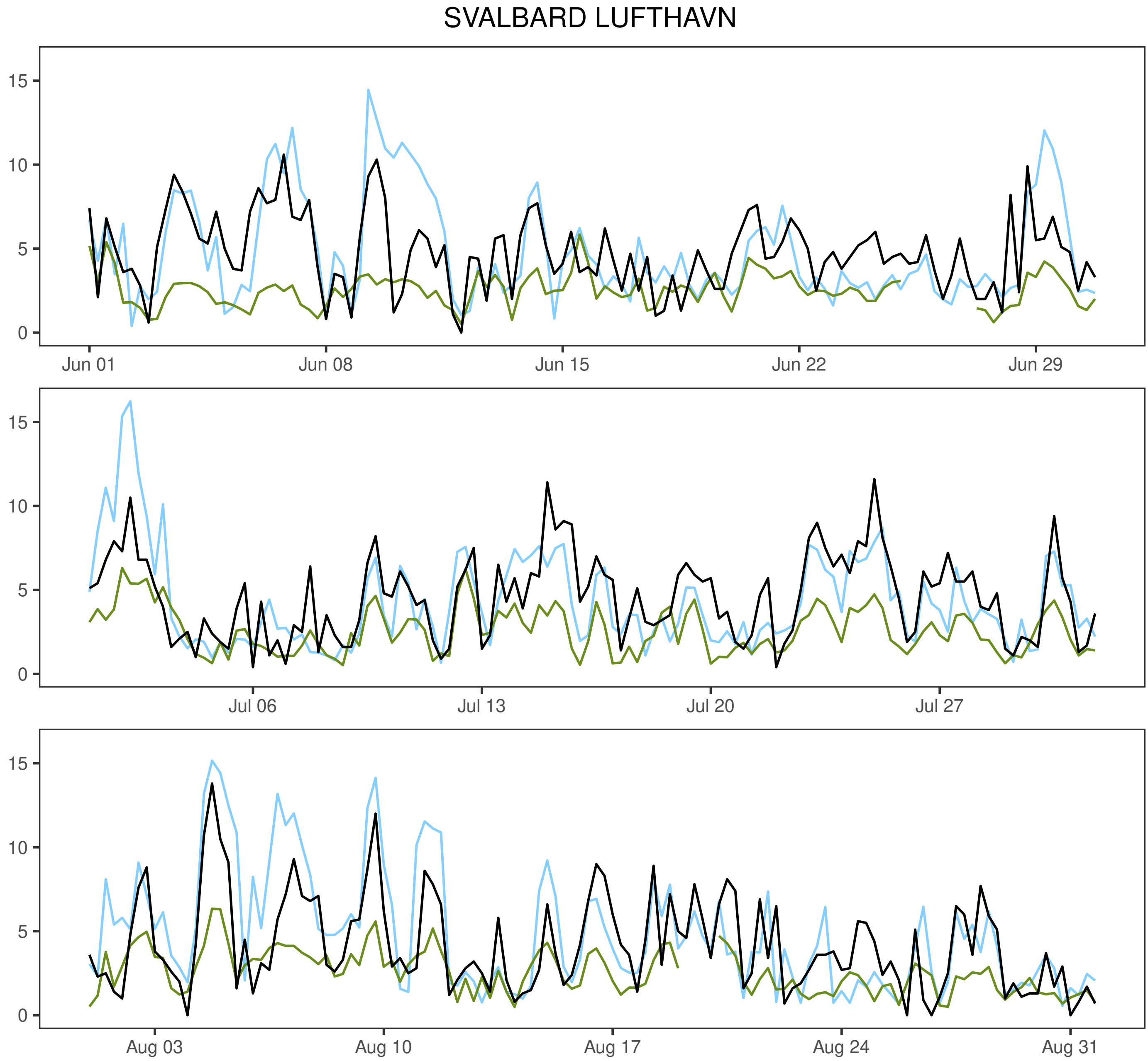
Model "climatology" 01.06.2025–31.08.2025



Model "climatology" 01.06.2025–31.08.2025

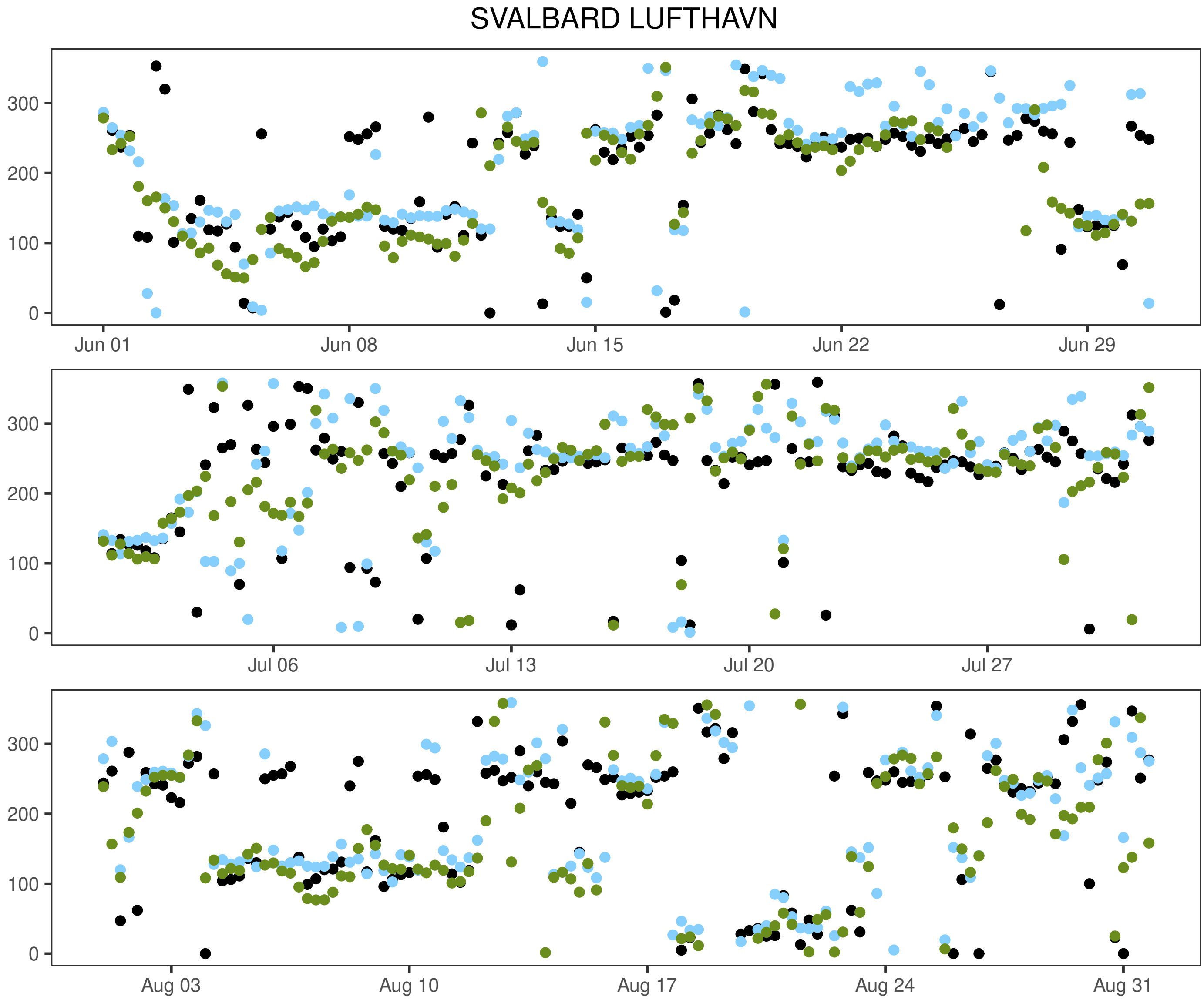


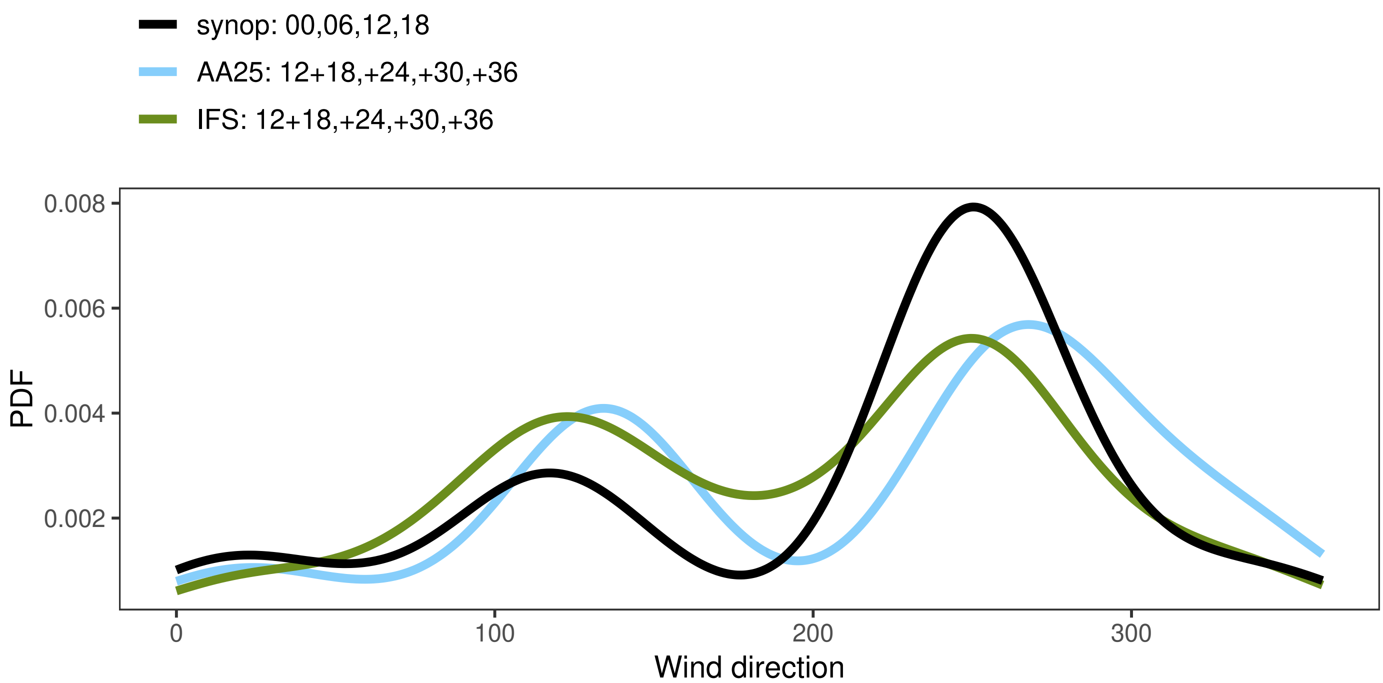
Model "climatology" 01.06.2025–31.08.2025



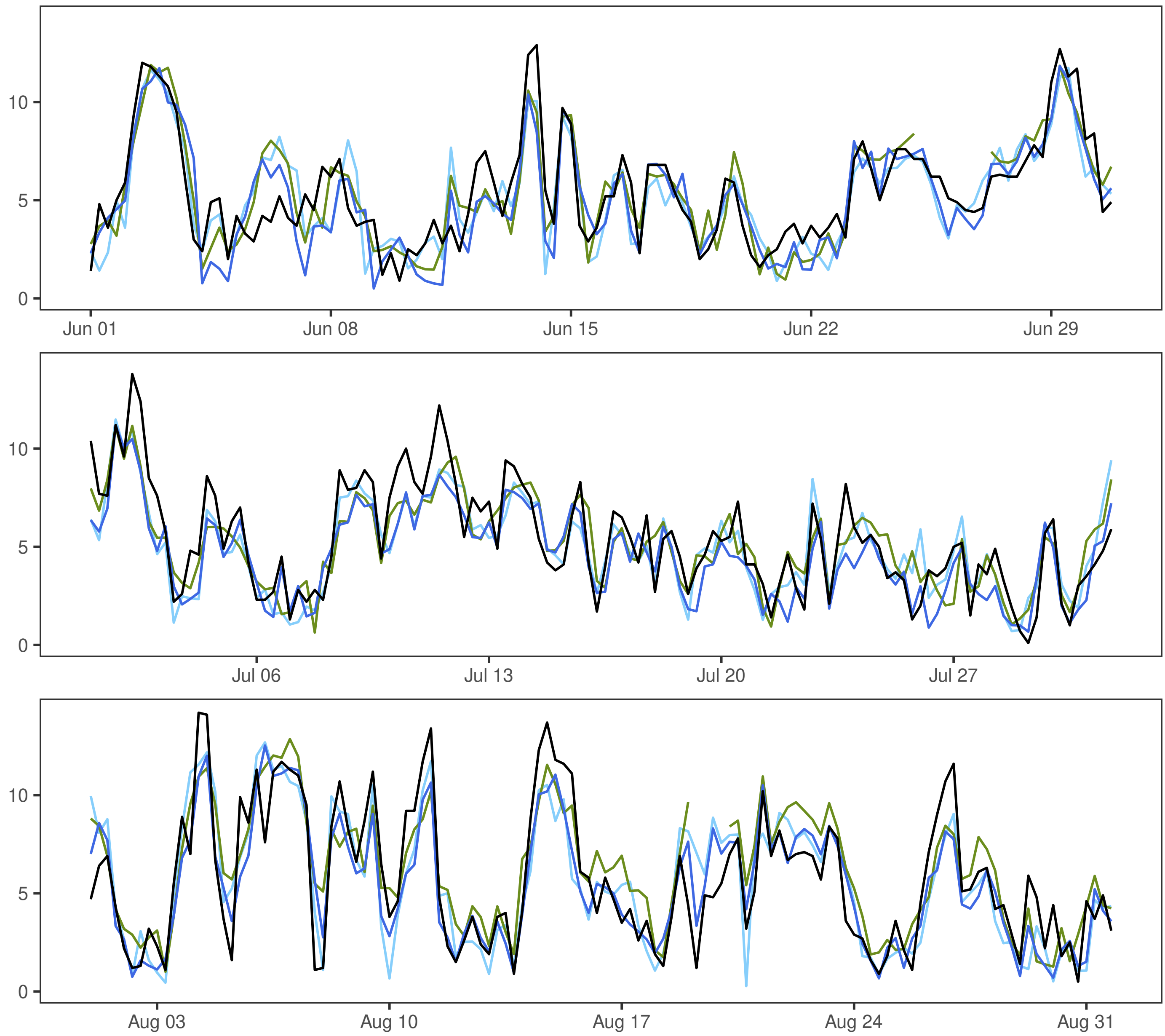
	Min	Mean	Max	Std	N
synop: 00,06,12,18	0.0	4.5	13.8	2.5	368
AA25: 12+18,+24,+30,+36	0.4	4.7	16.2	3.2	368
IFS: 12+18,+24,+30,+36	0.5	2.6	6.3	1.2	356

	ME	SDE	RMSE	MAE	Max.abs.err	N
AA25 – synop	0.2	2.5	2.5	1.9	9.3	356
IFS – synop	−1.9	2.1	2.8	2.3	8.1	356


SVALBARD LUFTHAVN
300
200
100
0
Jun 01
Jun 08
Jun 15
Jun 22
Jun 29
Jul 06
Jul 13
Jul 20
Jul 27
Aug 03
Aug 10
Aug 17
Aug 24
Aug 31

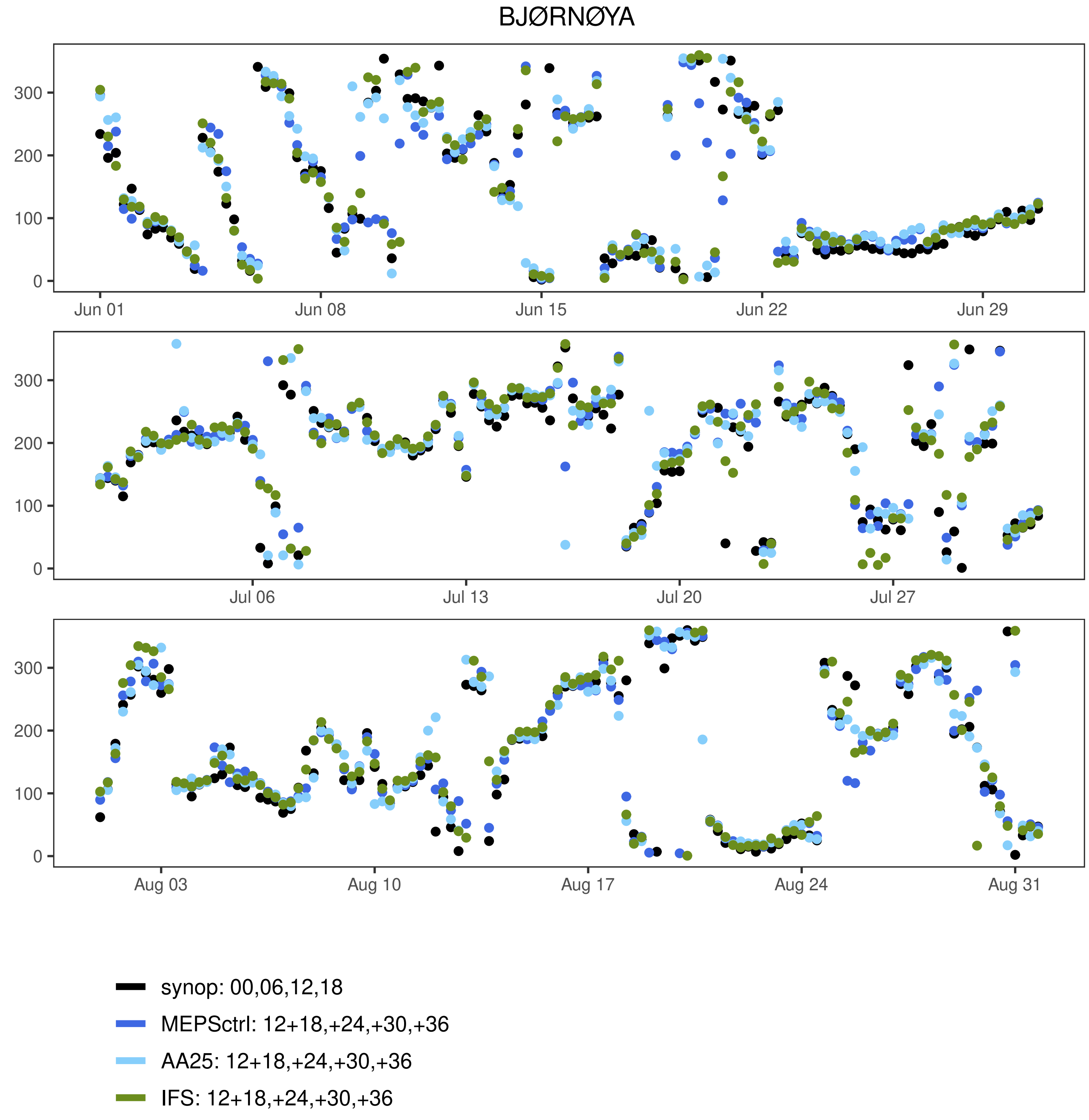

synop: 00,06,12,18
AA25: 12+18,+24,+30,+36
IFS: 12+18,+24,+30,+36
PDF
0.008
0.006
0.004
0.002
0
100
200
300
Wind direction

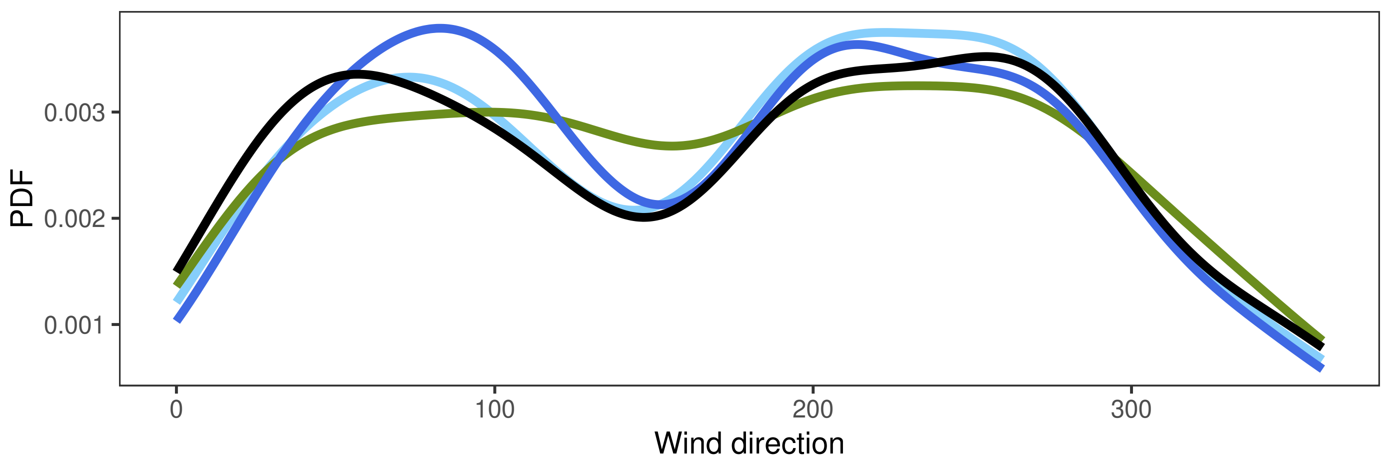
BJØRNØYA

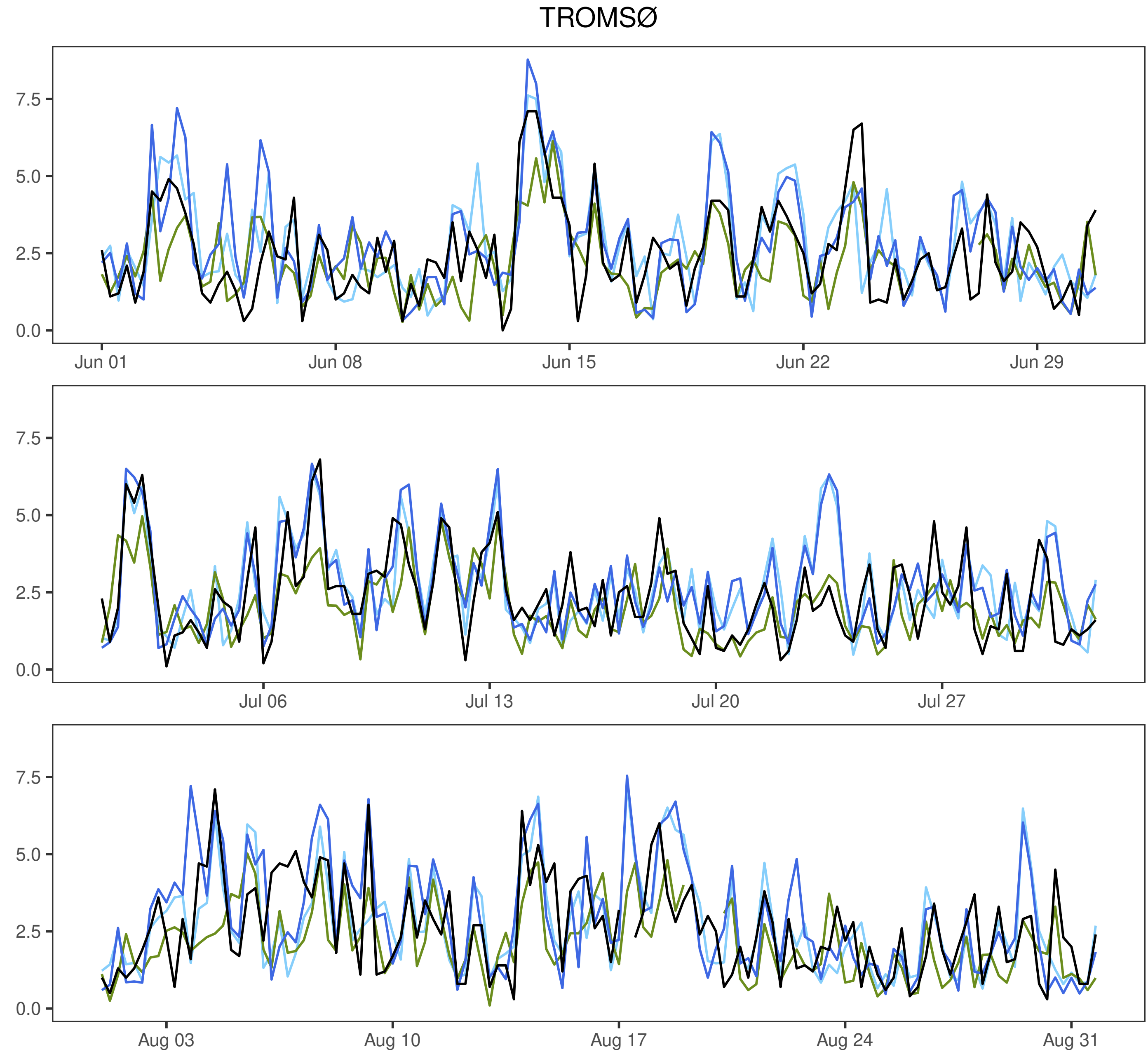


	Min	Mean	Max	Std	N
synop: 00,06,12,18	0.1	5.5	14.2	3.0	368
MEPSctrl: 12+18,+24,+30,+36	0.5	5.0	12.5	2.7	368
AA25: 12+18,+24,+30,+36	0.3	5.2	12.7	2.8	368
IFS: 12+18,+24,+30,+36	0.6	5.6	12.9	2.7	356

	ME	SDE	RMSE	MAE	Max.abs.err	N
MEPSctrl – synop	–0.5	1.5	1.6	1.3	4.9	356
AA25 – synop	–0.3	1.7	1.7	1.3	5.4	356
IFS – synop	0.1	1.7	1.7	1.3	5.3	356

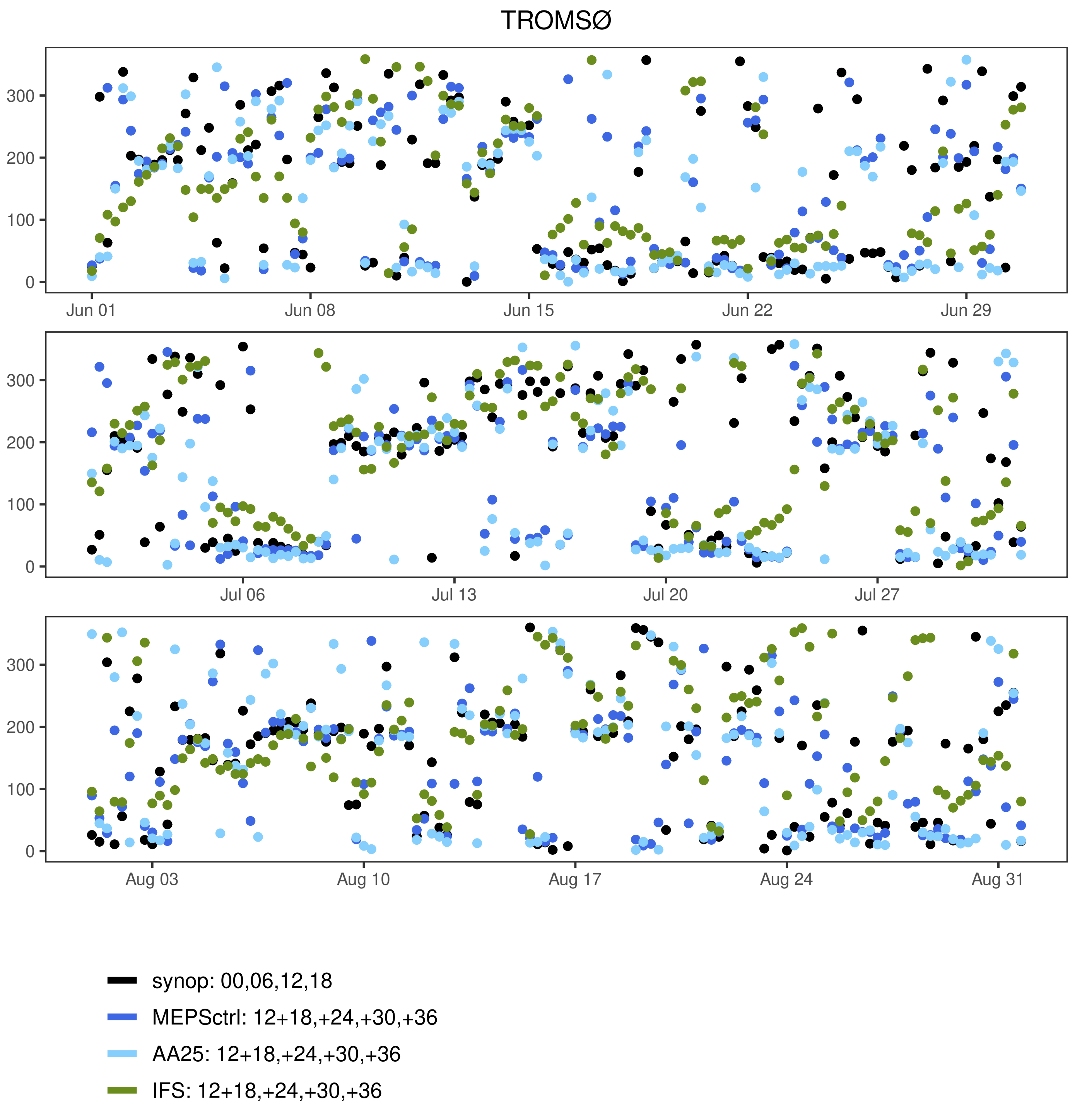

BJØRNØYA
300
200
100
0
Jun 01
Jun 08
Jun 15
Jun 22
Jun 29
Jul 06
Jul 13
Jul 20
Jul 27
Aug 03
Aug 10
Aug 17
Aug 24
Aug 31
synop: 00,06,12,18
MEPSctrl: 12+18,+24,+30,+36
AA25: 12+18,+24,+30,+36
IFS: 12+18,+24,+30,+36

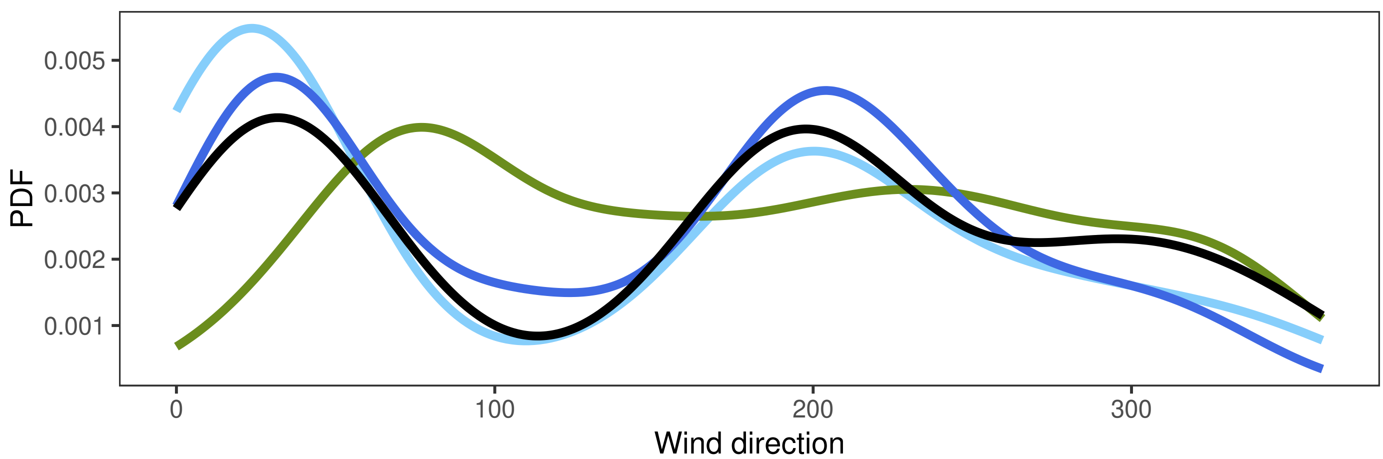

PDF
0.003
0.002
0.001
0
100
200
300
Wind direction

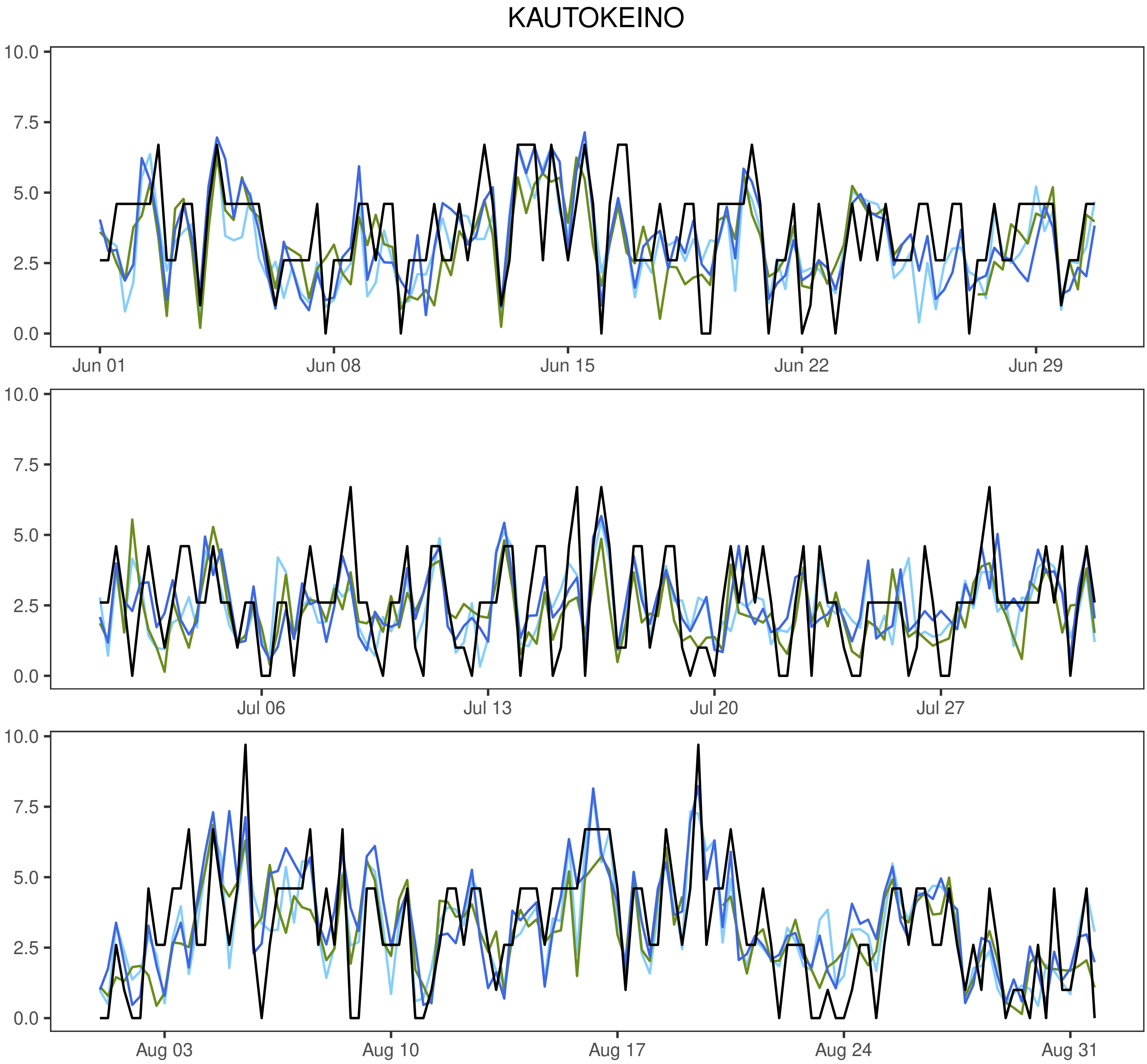


	Min	Mean	Max	Std	N
synop: 00,06,12,18	0.0	2.5	7.1	1.5	367
MEPSctrl: 12+18,+24,+30,+36	0.3	2.8	8.8	1.7	368
AA25: 12+18,+24,+30,+36	0.4	2.7	7.6	1.5	368
IFS: 12+18,+24,+30,+36	0.1	2.1	6.1	1.1	356

	ME	SDE	RMSE	MAE	Max.abs.err	N
MEPSctrl – synop	0.3	1.4	1.4	1.1	5.6	355
AA25 – synop	0.2	1.3	1.4	1.1	5.5	355
IFS – synop	−0.4	1.2	1.3	1.0	4.7	355

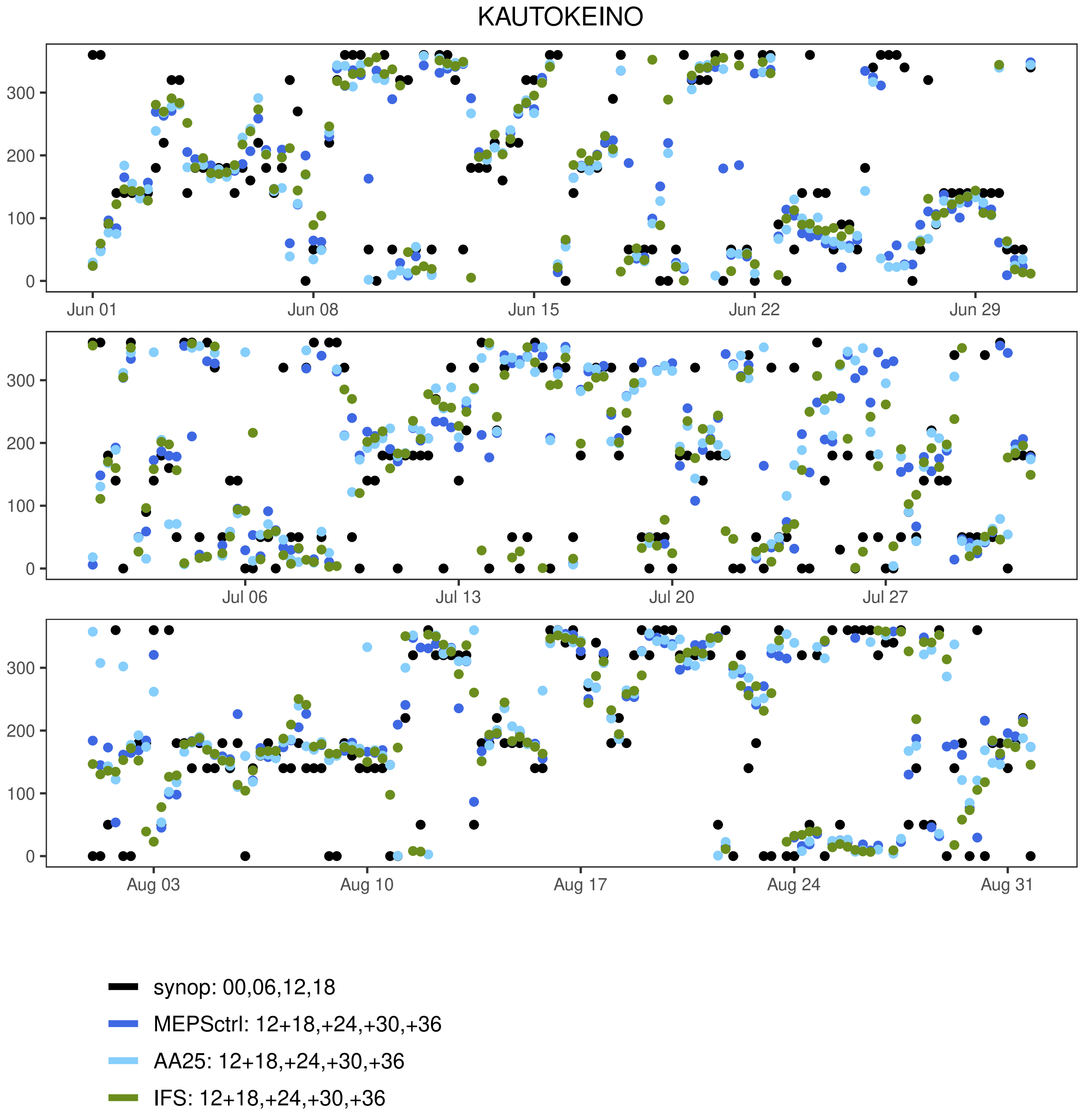

TROMSØ
300
200
100
0
Jun 01
Jun 08
Jun 15
Jun 22
Jun 29
Jul 06
Jul 13
Jul 20
Jul 27
Aug 03
Aug 10
Aug 17
Aug 24
Aug 31
synop: 00,06,12,18
MEPSctrl: 12+18,+24,+30,+36
AA25: 12+18,+24,+30,+36
IFS: 12+18,+24,+30,+36

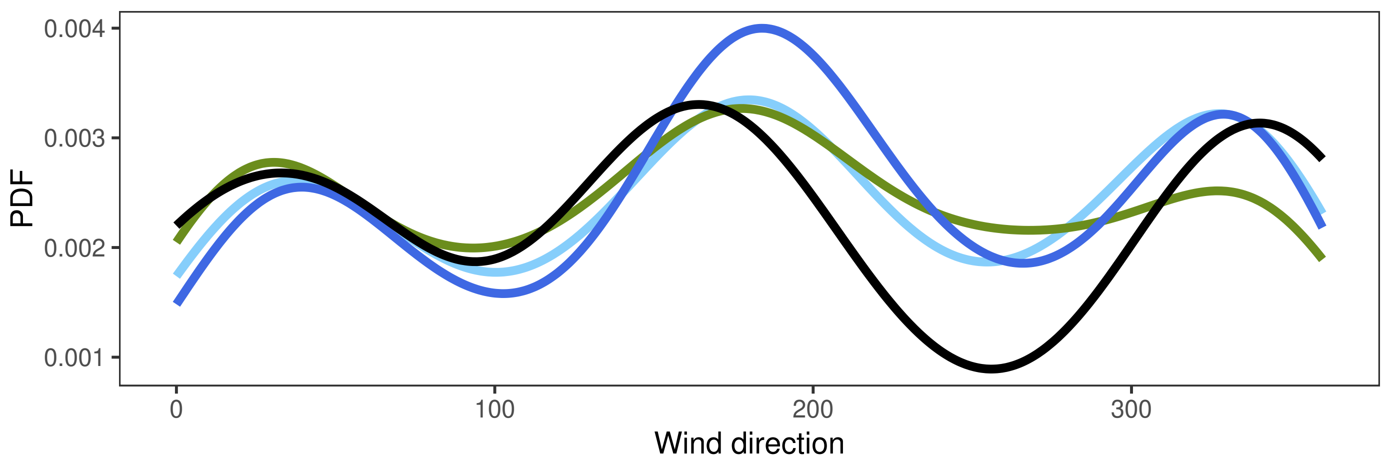

PDF
0.005
0.004
0.003
0.002
0.001
0
100
200
300
Wind direction

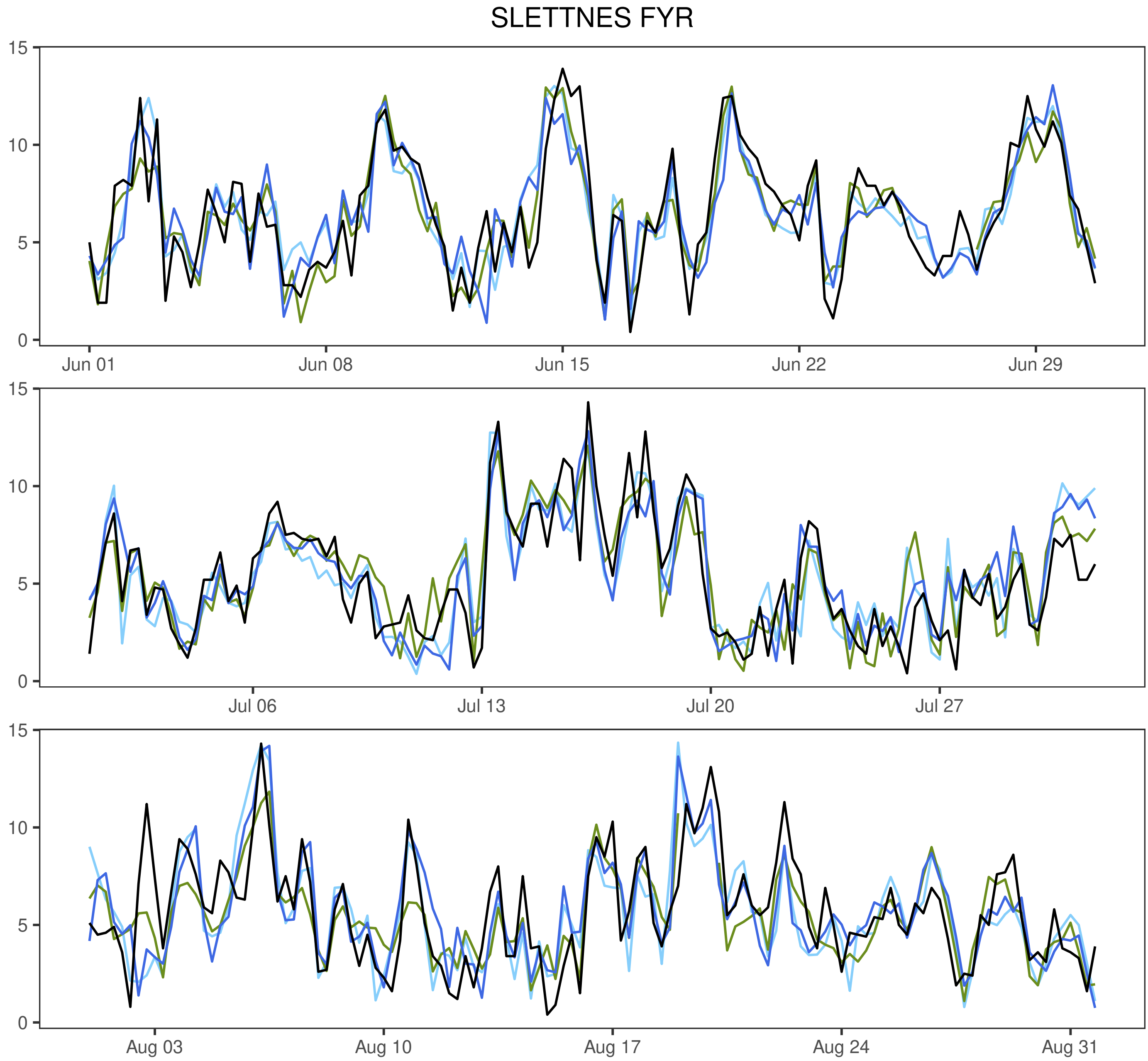


	Min	Mean	Max	Std	N
synop: 00,06,12,18	0.0	3.1	9.7	1.9	368
MEPSctrl: 12+18,+24,+30,+36	0.5	3.1	8.2	1.6	368
AA25: 12+18,+24,+30,+36	0.3	2.9	7.9	1.5	368
IFS: 12+18,+24,+30,+36	0.1	2.8	6.9	1.4	356

	ME	SDE	RMSE	MAE	Max.abs.err	N
MEPSctrl – synop	0.0	1.5	1.5	1.2	4.9	356
AA25 – synop	−0.2	1.5	1.5	1.2	5.1	356
IFS – synop	−0.3	1.5	1.5	1.2	5.5	356

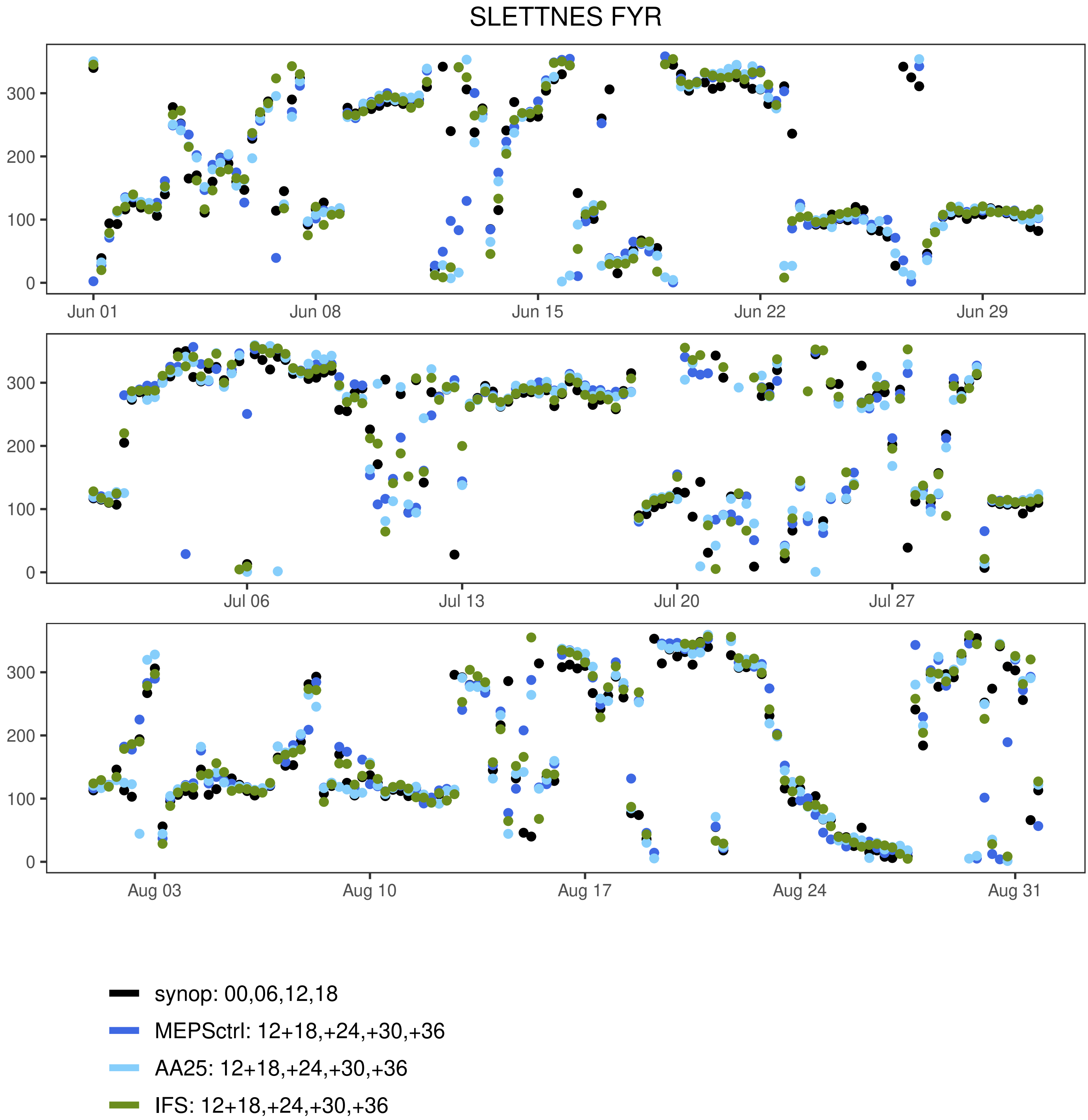

KAUTOKEINO
300
200
100
0
Jun 01
Jun 08
Jun 15
Jun 22
Jun 29
Jul 06
Jul 13
Jul 20
Jul 27
Aug 03
Aug 10
Aug 17
Aug 24
Aug 31
synop: 00,06,12,18
MEPSctrl: 12+18,+24,+30,+36
AA25: 12+18,+24,+30,+36
IFS: 12+18,+24,+30,+36

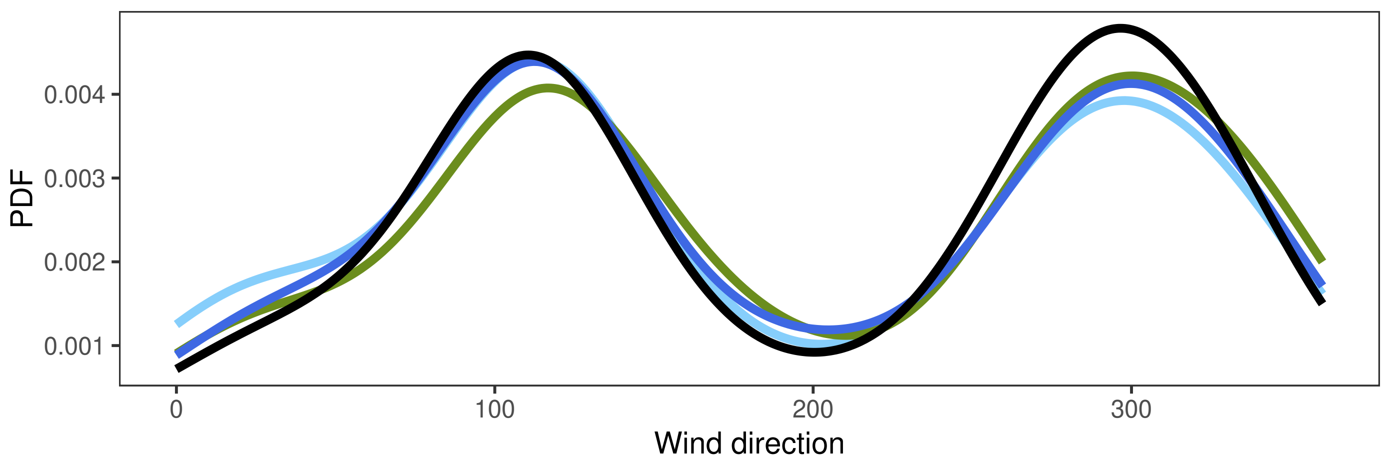

PDF
0.004
0.003
0.002
0.001
0
100
200
300
Wind direction



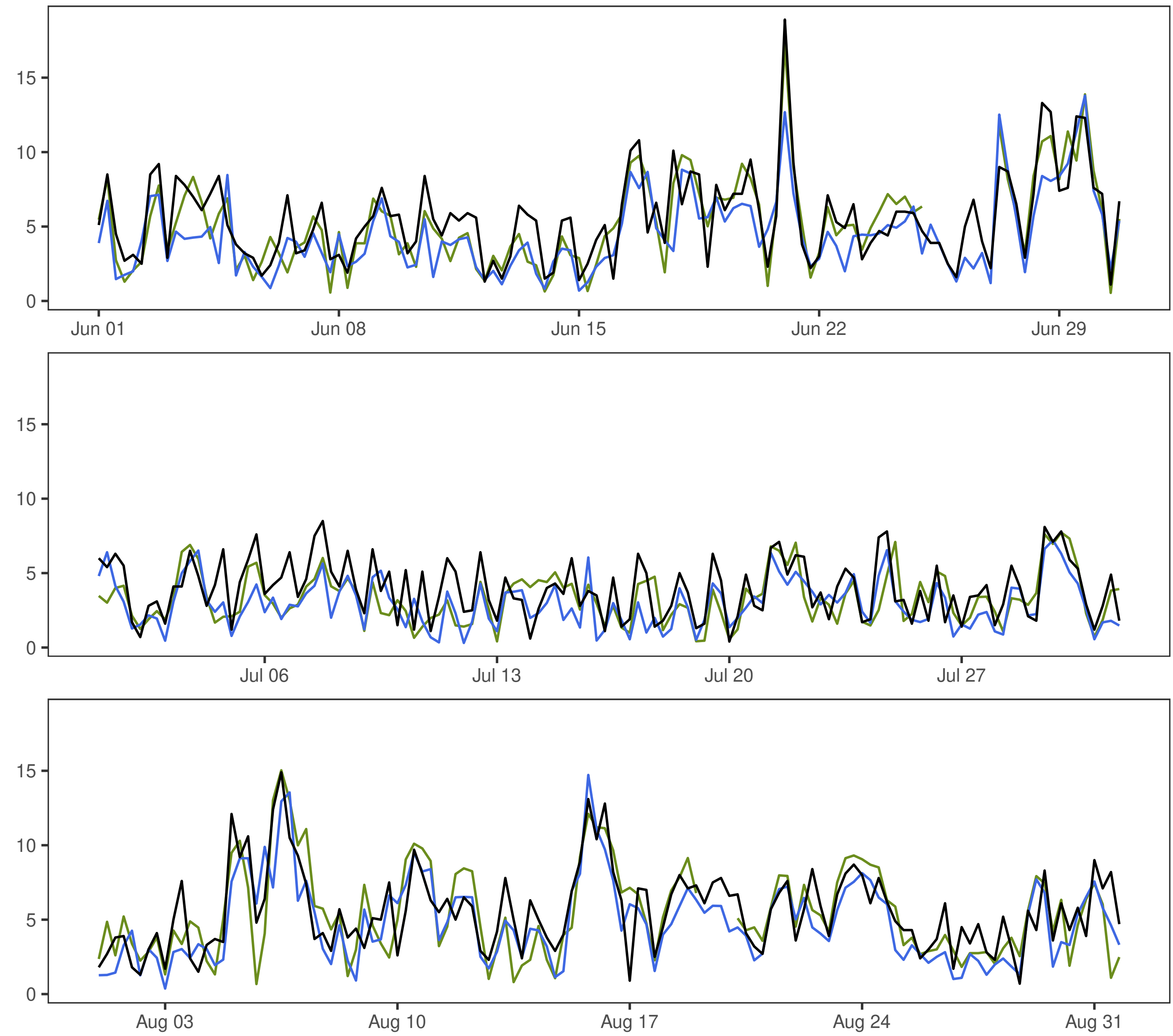
	Min	Mean	Max	Std	N
synop: 00,06,12,18	0.4	5.8	14.3	3.0	368
MEPSctrl: 12+18,+24,+30,+36	0.6	5.9	14.2	2.7	368
AA25: 12+18,+24,+30,+36	0.4	5.8	14.3	2.8	368
IFS: 12+18,+24,+30,+36	0.5	5.7	13.0	2.6	356

	ME	SDE	RMSE	MAE	Max.abs.err	N
MEPSctrl – synop	0.0	1.9	1.9	1.4	7.5	356
AA25 – synop	0.0	1.9	1.9	1.5	8.8	356
IFS – synop	−0.1	1.6	1.6	1.3	5.7	356


SLETTNES FYR
300
200
100
0
Jun 01
Jun 08
Jun 15
Jun 22
Jun 29
Jul 06
Jul 13
Jul 20
Jul 27
Aug 03
Aug 10
Aug 17
Aug 24
Aug 31
synop: 00,06,12,18
MEPSctrl: 12+18,+24,+30,+36
AA25: 12+18,+24,+30,+36
IFS: 12+18,+24,+30,+36

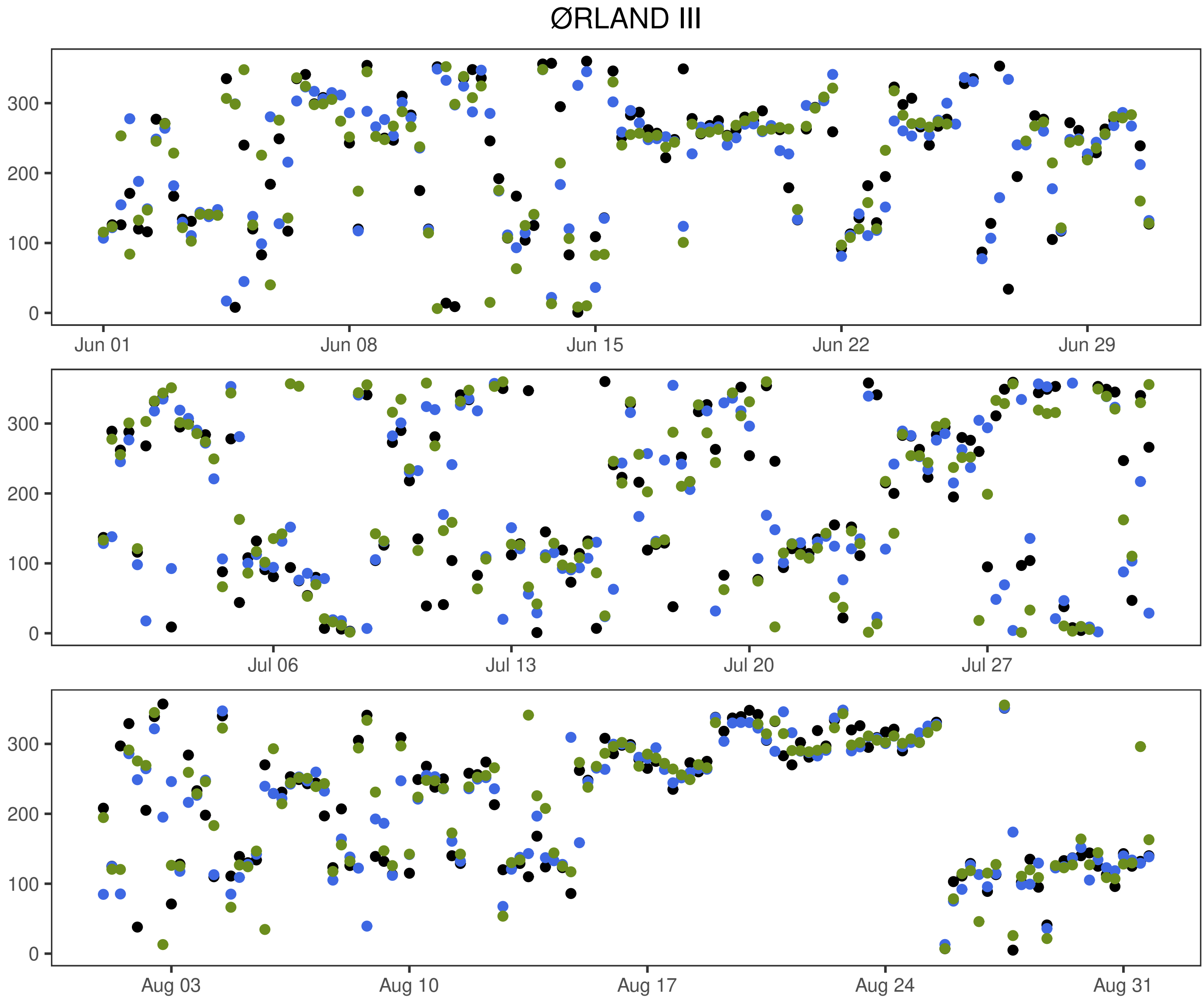

PDF
0.004
0.003
0.002
0.001
0
100
200
300
Wind direction

ØRLAND III

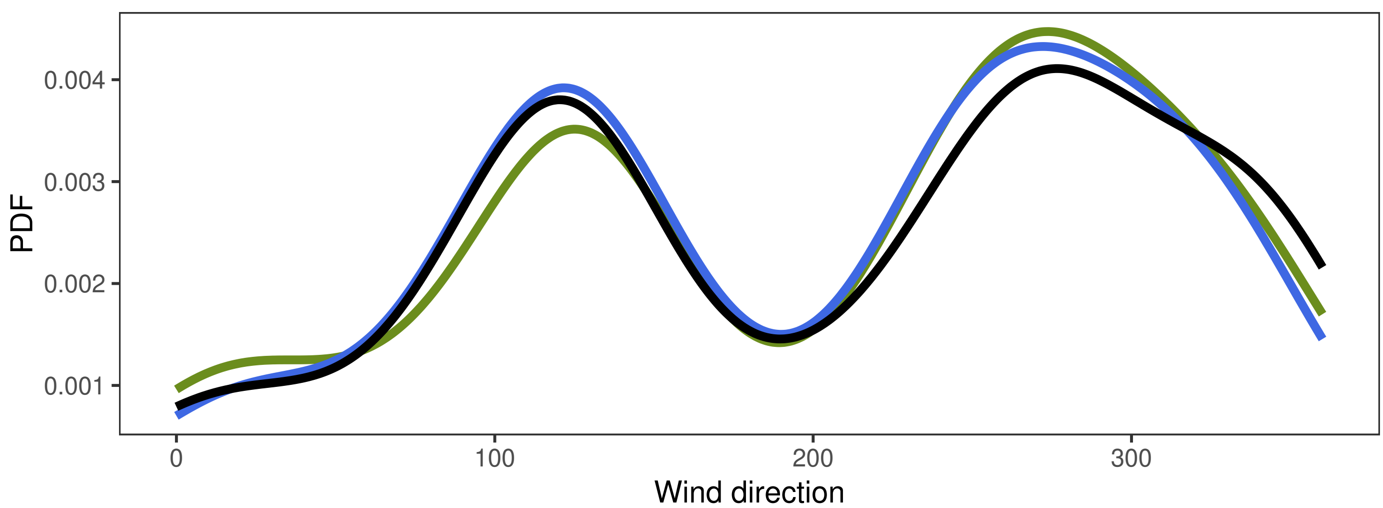


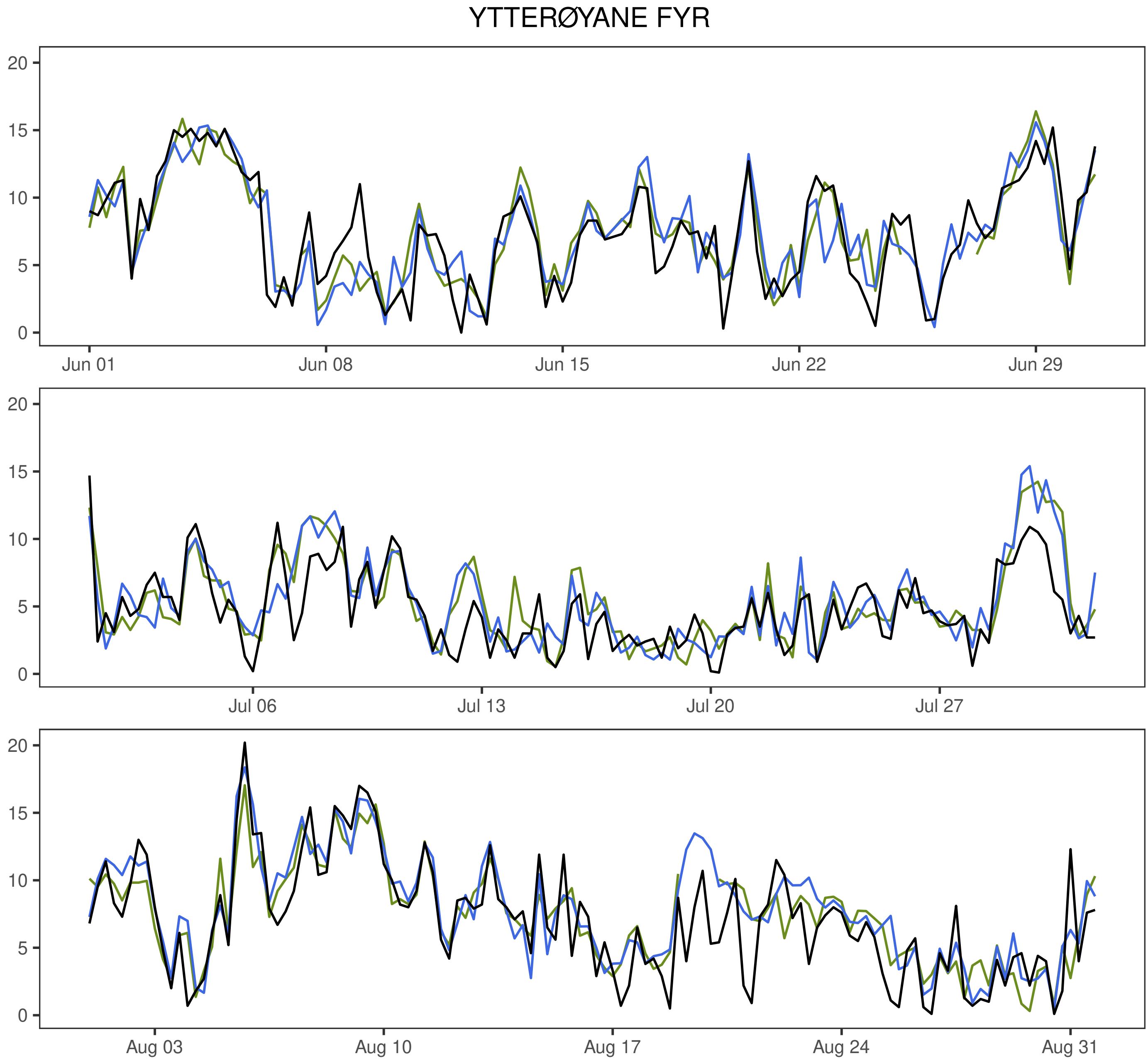
	Min	Mean	Max	Std	N
synop: 00,06,12,18	0.4	5.0	18.9	2.7	368
MEPSctrl: 12+18,+24,+30,+36	0.3	4.1	14.7	2.5	368
IFS: 12+18,+24,+30,+36	0.4	4.7	17.2	2.8	356

	ME	SDE	RMSE	MAE	Max.abs.err	N
MEPSctrl – synop	–0.9	1.7	1.9	1.5	6.7	356
IFS – synop	–0.4	1.8	1.8	1.4	7.1	356



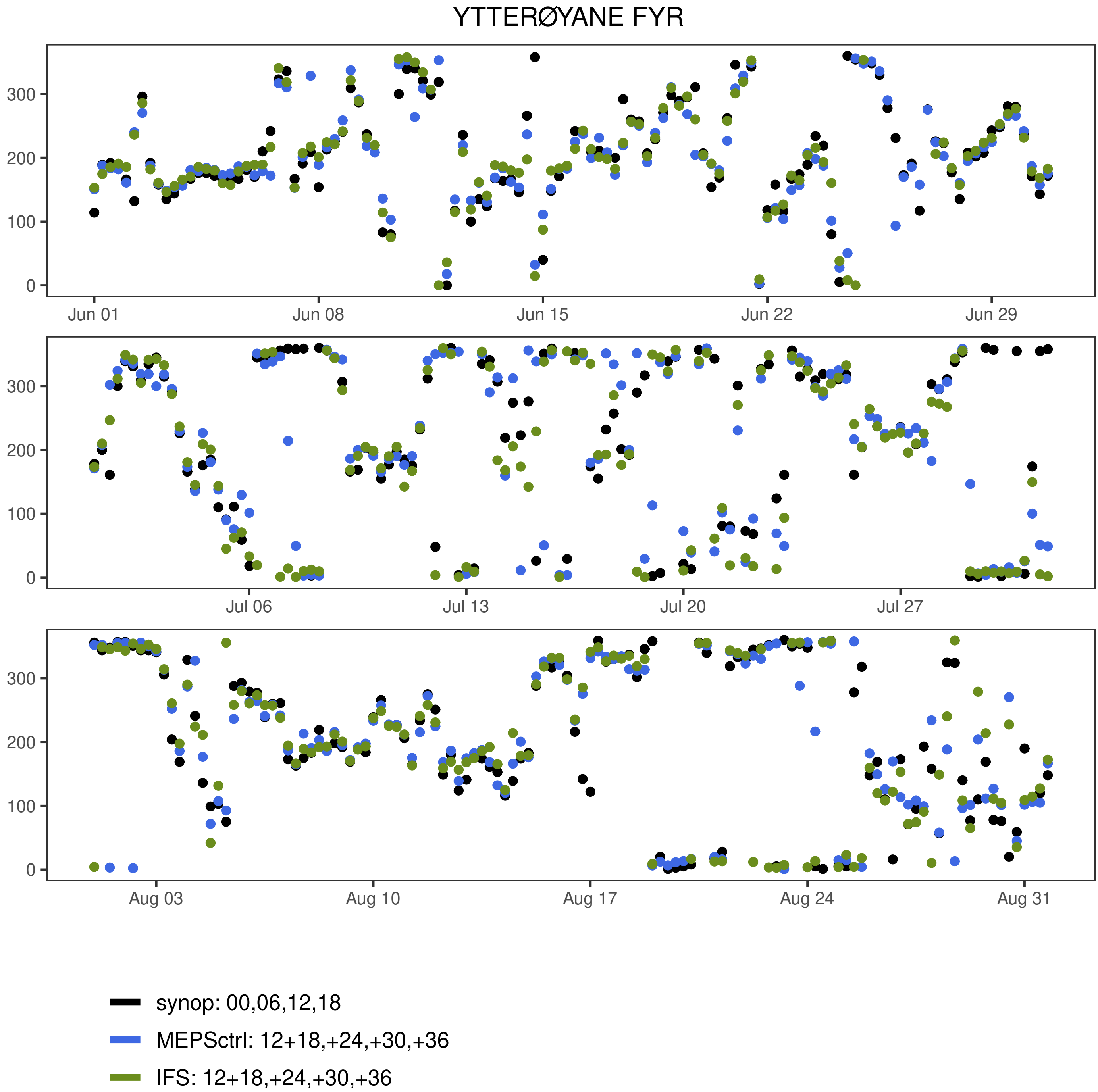
synop: 00,06,12,18
MEPSctrl: 12+18,+24,+30,+36
IFS: 12+18,+24,+30,+36

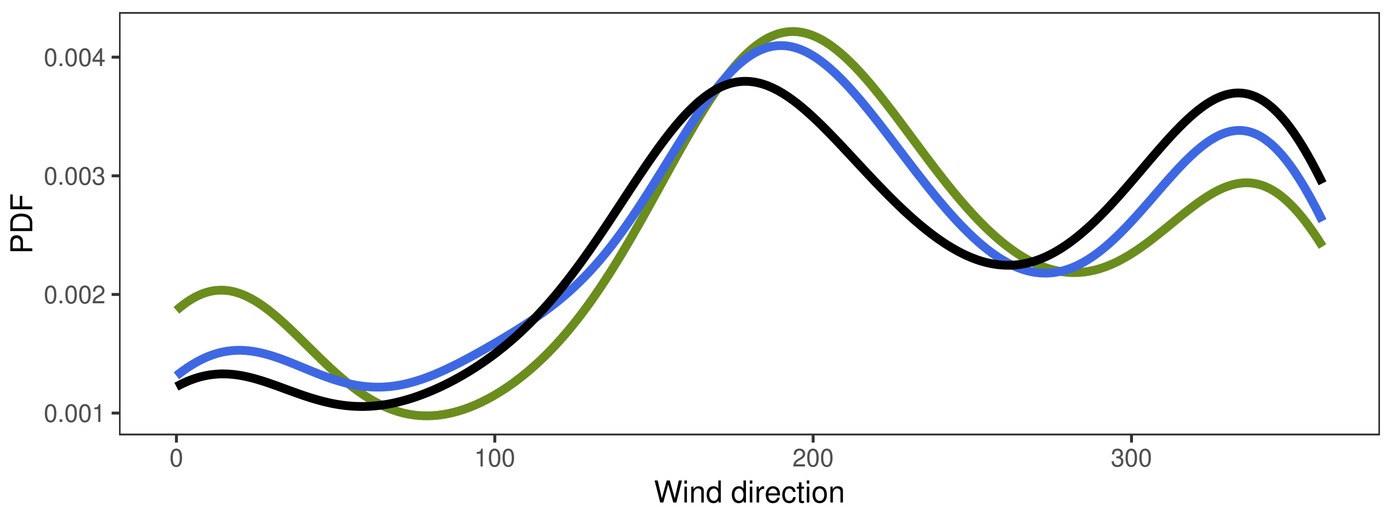


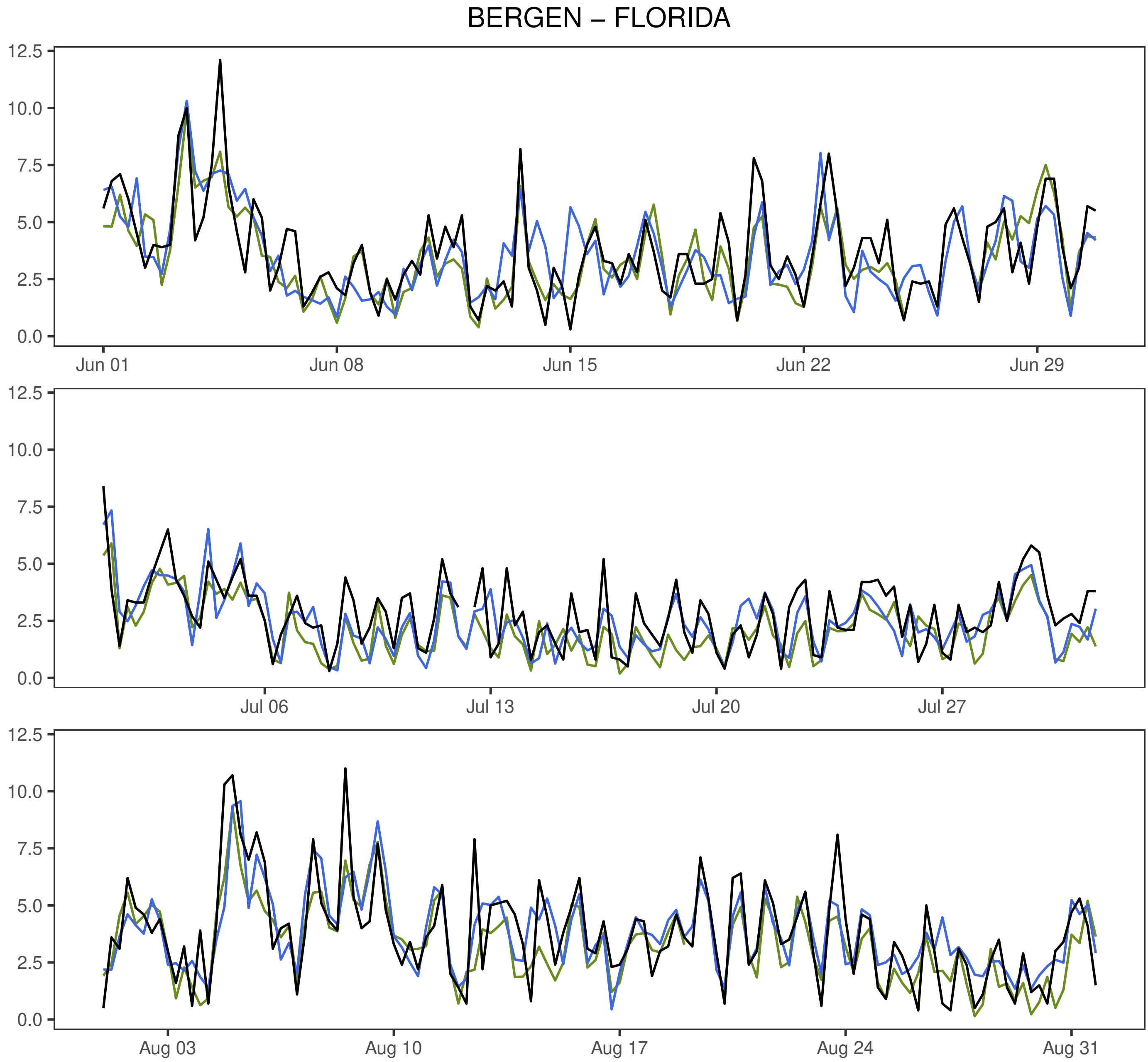


	Min	Mean	Max	Std	N
synop: 00,06,12,18	0.0	6.4	20.2	3.9	368
MEPSctrl: 12+18,+24,+30,+36	0.4	6.9	18.4	3.8	368
IFS: 12+18,+24,+30,+36	0.3	6.8	17.0	3.6	356

	ME	SDE	RMSE	MAE	Max.abs.err	N
MEPSctrl – synop	0.5	2.2	2.2	1.7	7.7	356
IFS – synop	0.4	2.1	2.2	1.6	9.5	356

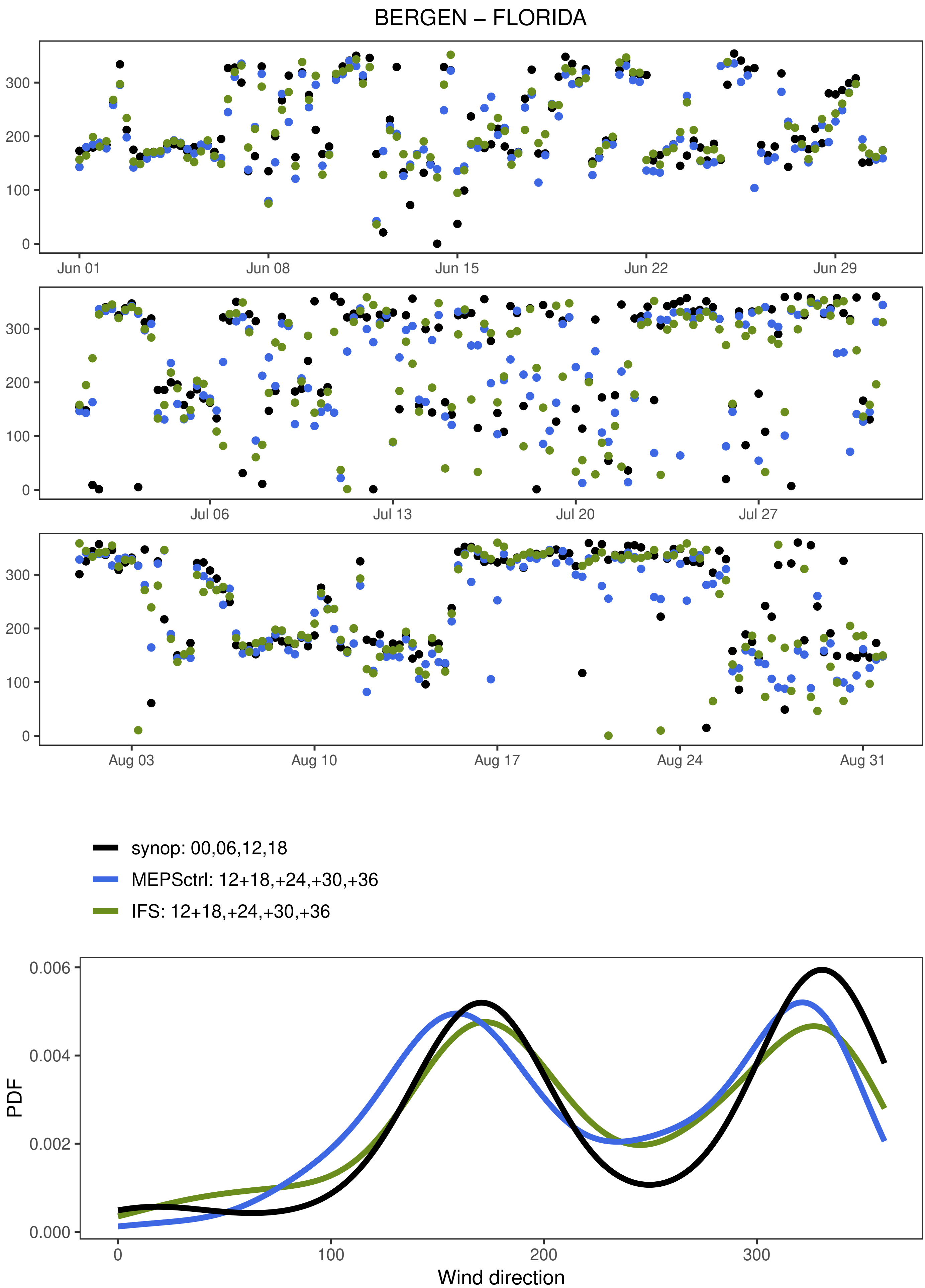

YTTERØYANE FYR
300
200
100
0
Jun 01
Jun 08
Jun 15
Jun 22
Jun 29
Jul 06
Jul 13
Jul 20
Jul 27
Aug 03
Aug 10
Aug 17
Aug 24
Aug 31
synop: 00,06,12,18
MEPSctrl: 12+18,+24,+30,+36
IFS: 12+18,+24,+30,+36

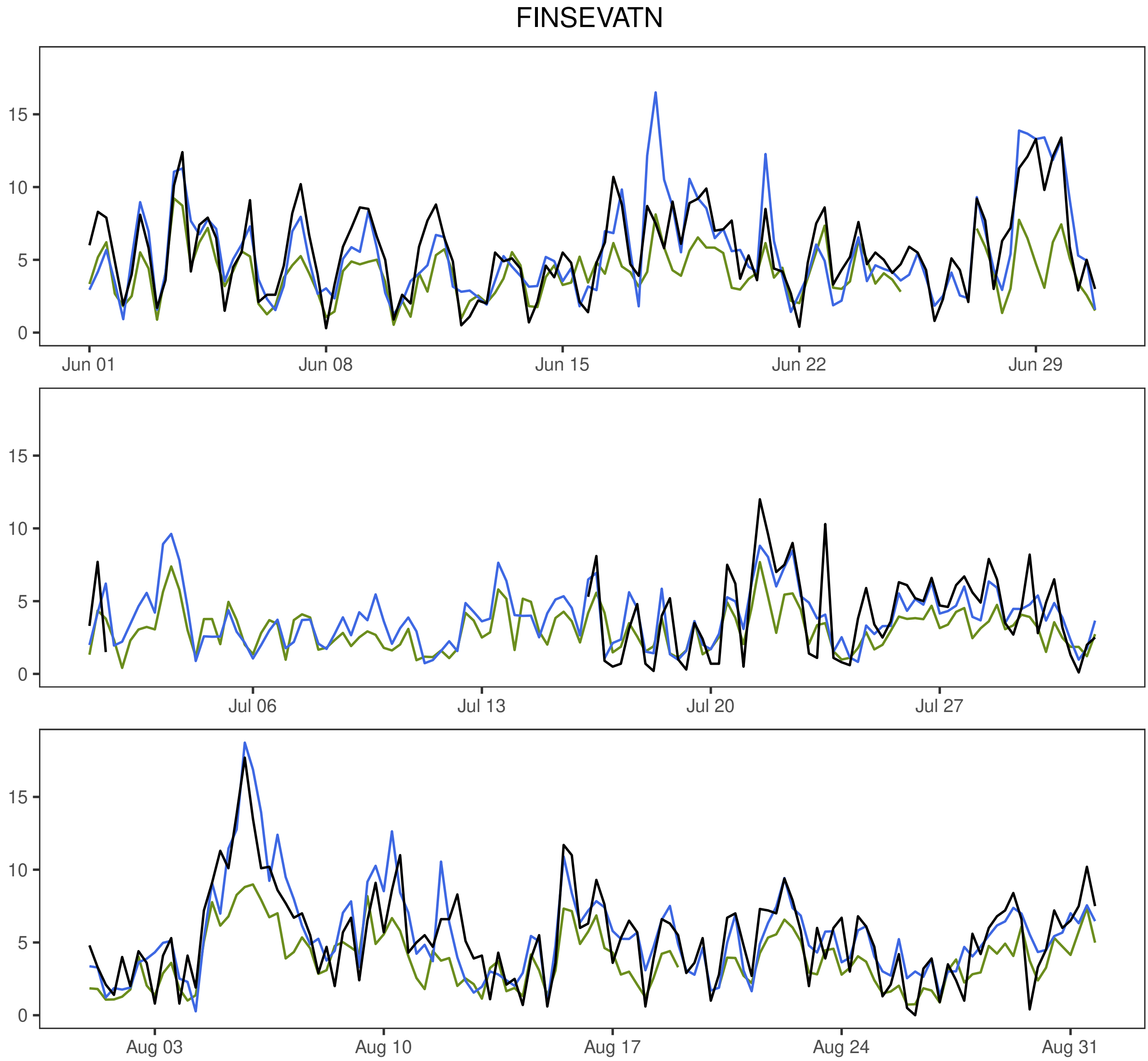

PDF
0.004
0.003
0.002
0.001
0
100
200
300
Wind direction



	Min	Mean	Max	Std	N
synop: 00,06,12,18	0.3	3.5	12.1	2.0	367
MEPSctrl: 12+18,+24,+30,+36	0.3	3.3	10.3	1.7	368
IFS: 12+18,+24,+30,+36	0.1	2.9	9.9	1.7	356

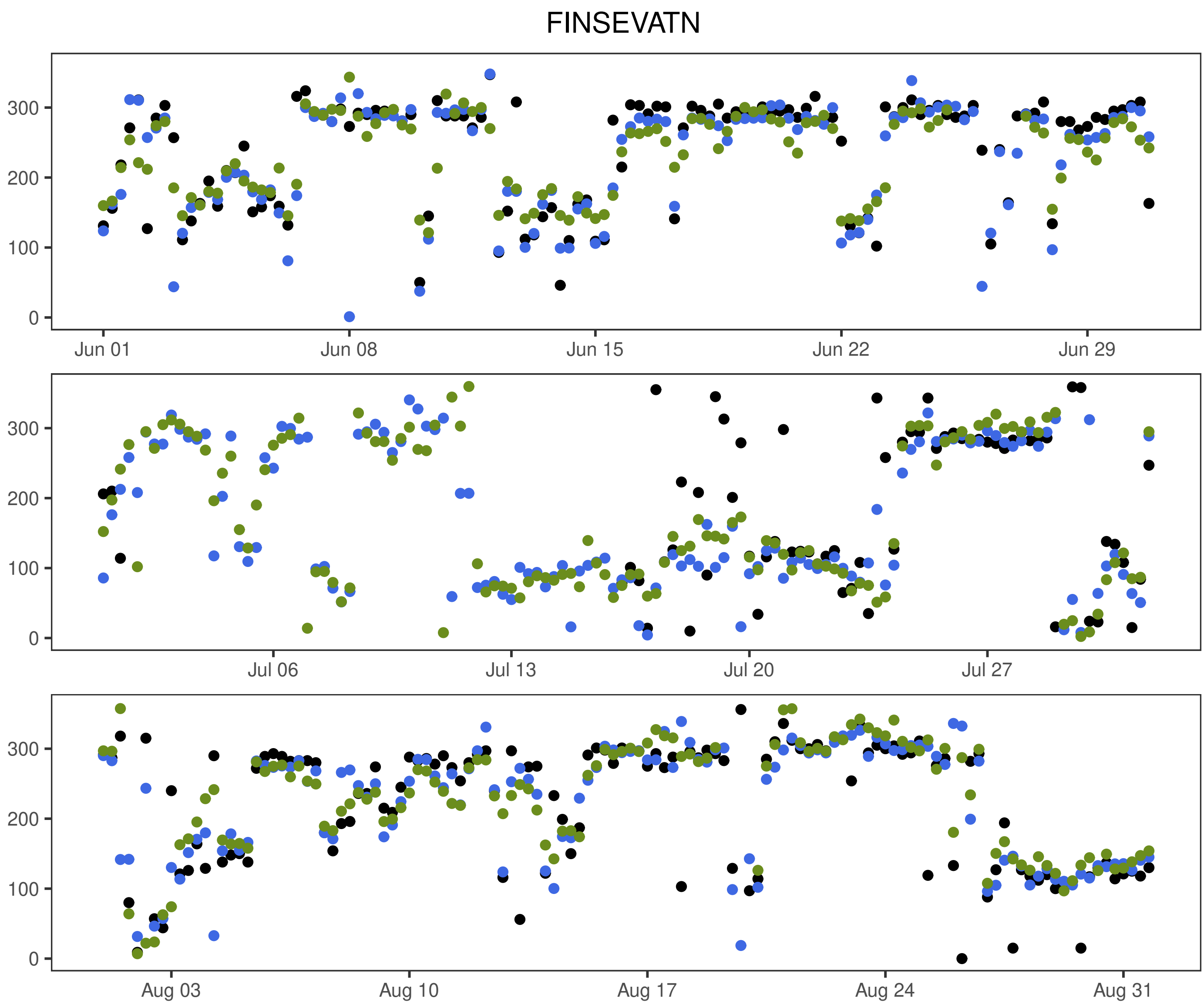
	ME	SDE	RMSE	MAE	Max.abs.err	N
MEPSctrl – synop	–0.1	1.4	1.4	1.0	5.4	355
IFS – synop	–0.5	1.2	1.3	1.0	5.7	355

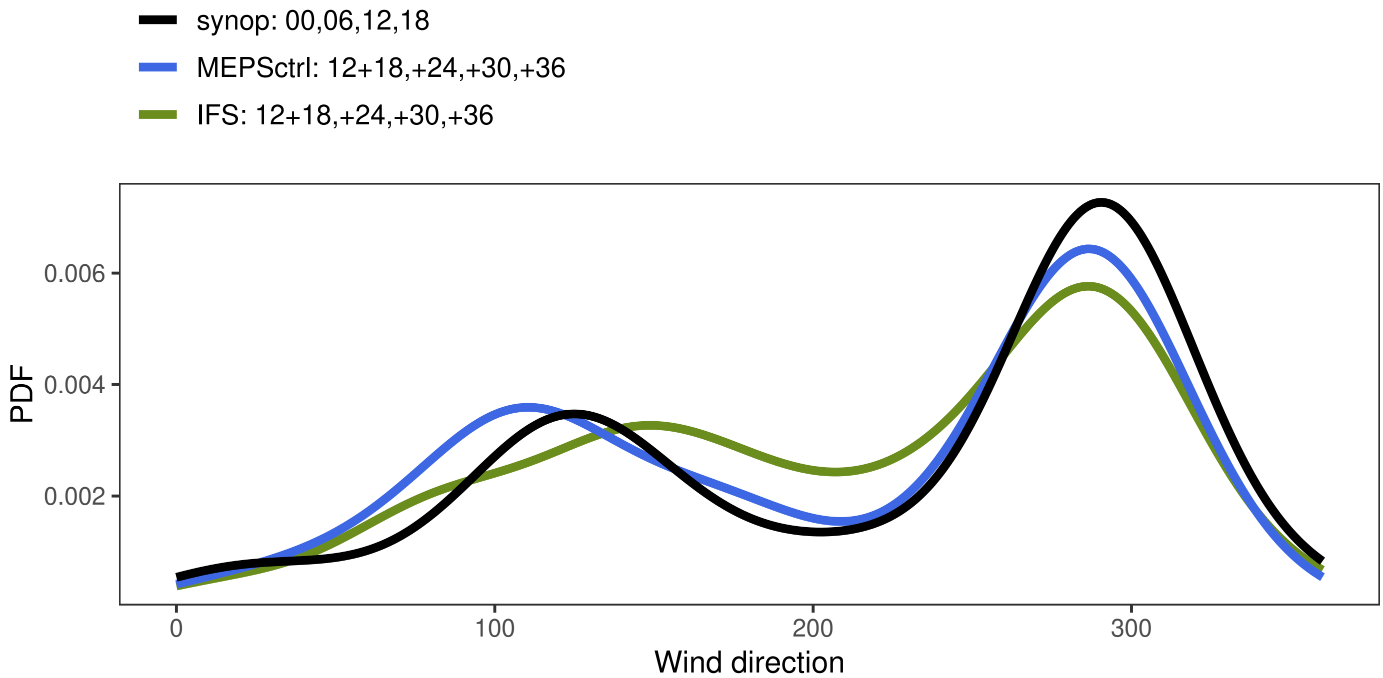

BERGEN – FLORIDA
300
200
100
0
Jun 01
Jun 08
Jun 15
Jun 22
Jun 29
Jul 06
Jul 13
Jul 20
Jul 27
Aug 03
Aug 10
Aug 17
Aug 24
Aug 31
synop: 00,06,12,18
MEPSctrl: 12+18,+24,+30,+36
IFS: 12+18,+24,+30,+36
PDF
0.006
0.004
0.002
0.000
0
100
200
300
Wind direction

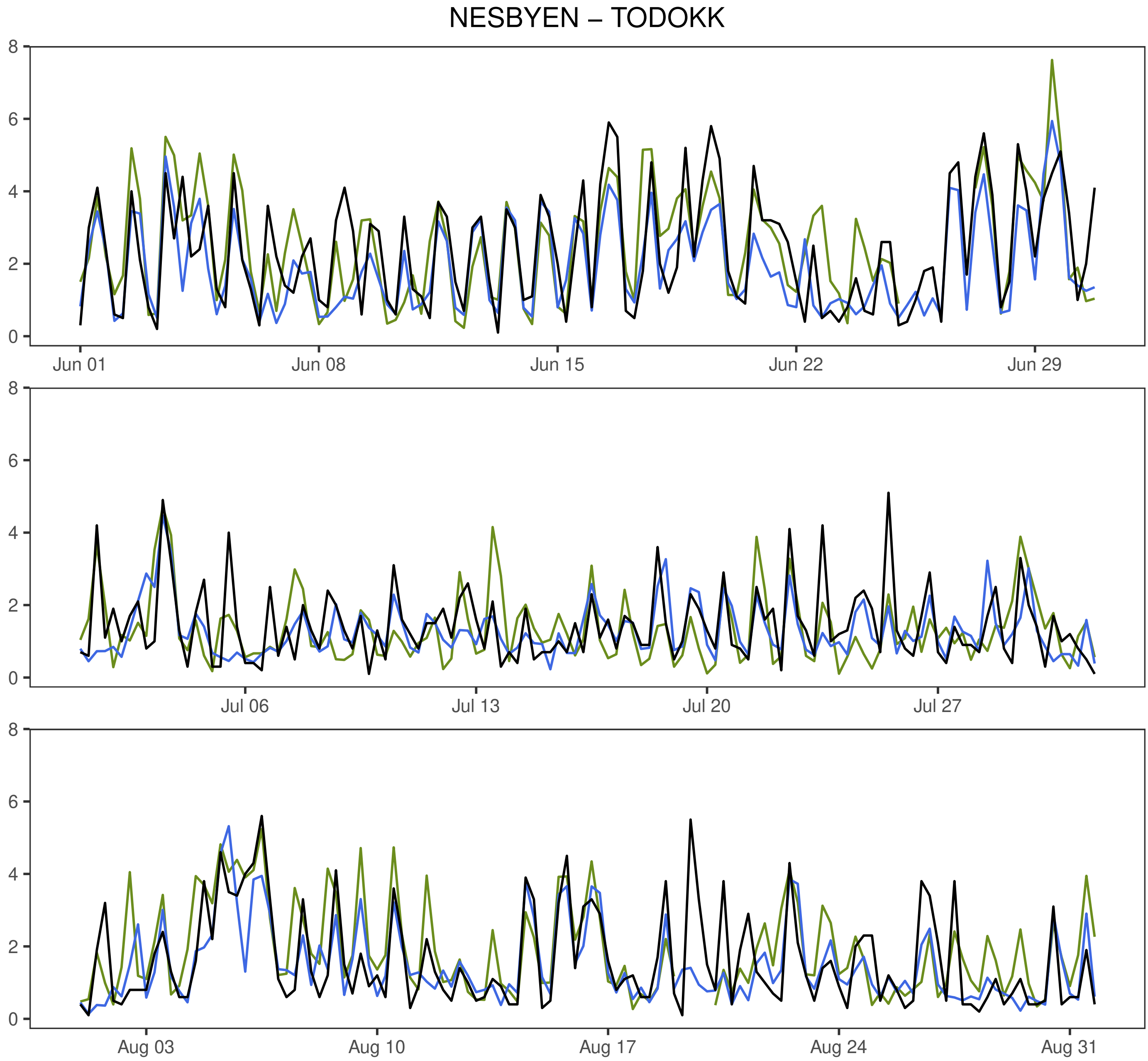


	Min	Mean	Max	Std	N
synop: 00,06,12,18	0.0	5.2	17.7	3.0	310
MEPSctrl: 12+18,+24,+30,+36	0.3	5.0	18.7	2.9	368
IFS: 12+18,+24,+30,+36	0.4	3.7	9.2	1.8	356

	ME	SDE	RMSE	MAE	Max.abs.err	N
MEPSctrl – synop	0.0	1.9	1.9	1.4	9.0	298
IFS – synop	–1.5	1.9	2.4	1.9	8.9	298

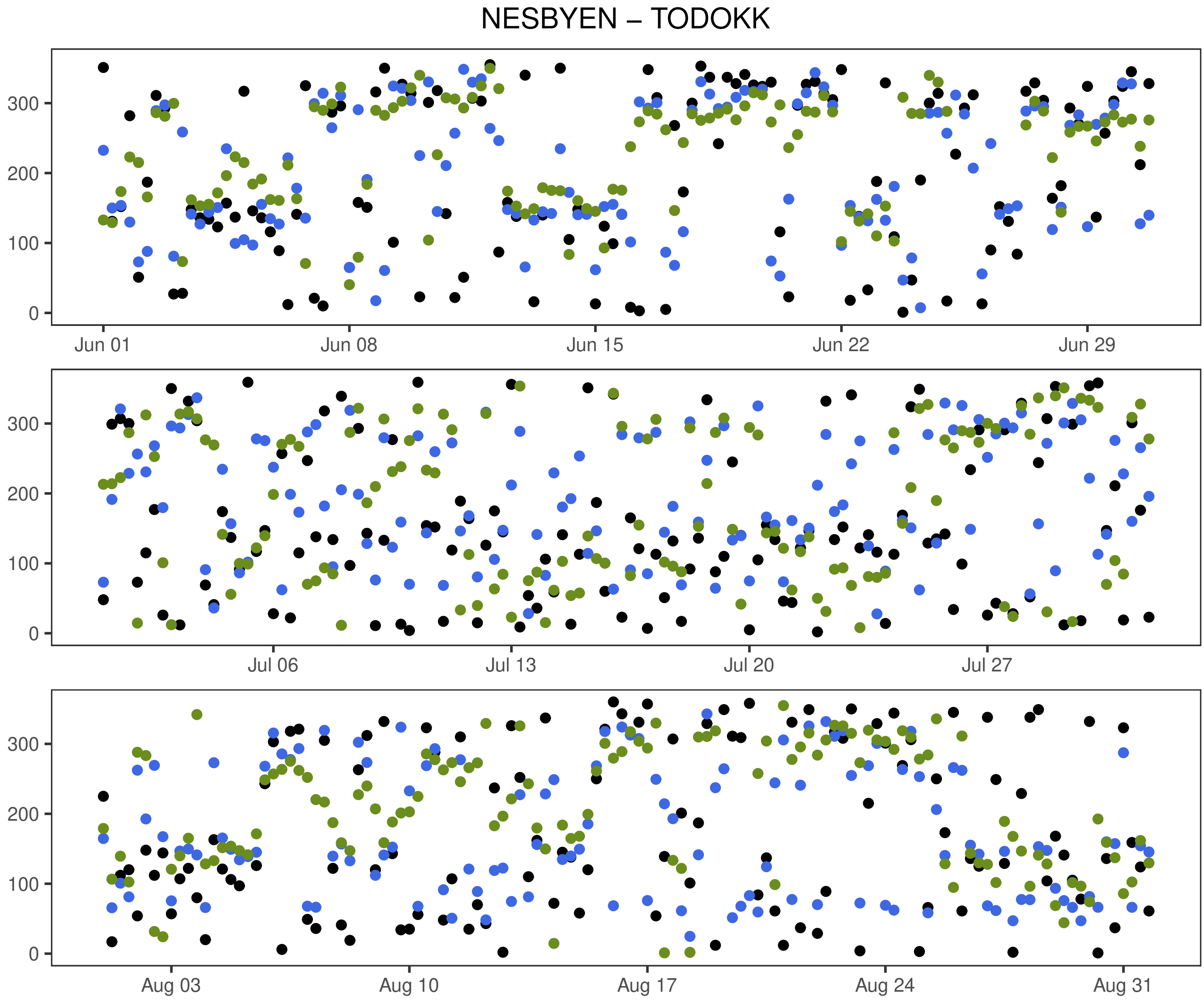

FINSEVATN
300
200
100
0
Jun 01
Jun 08
Jun 15
Jun 22
Jun 29
Jul 06
Jul 13
Jul 20
Jul 27
Aug 03
Aug 10
Aug 17
Aug 24
Aug 31

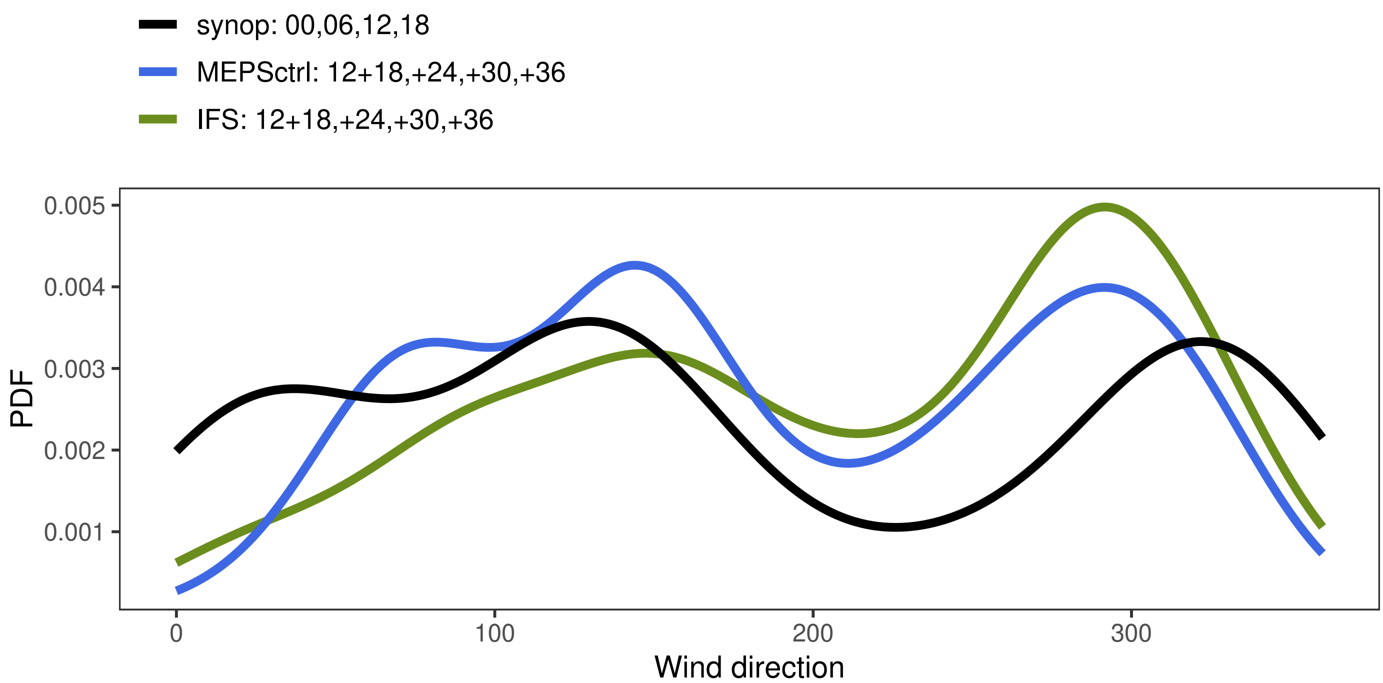

synop: 00,06,12,18
MEPSctrl: 12+18,+24,+30,+36
IFS: 12+18,+24,+30,+36
PDF
0.006
0.004
0.002
0
100
200
300
Wind direction

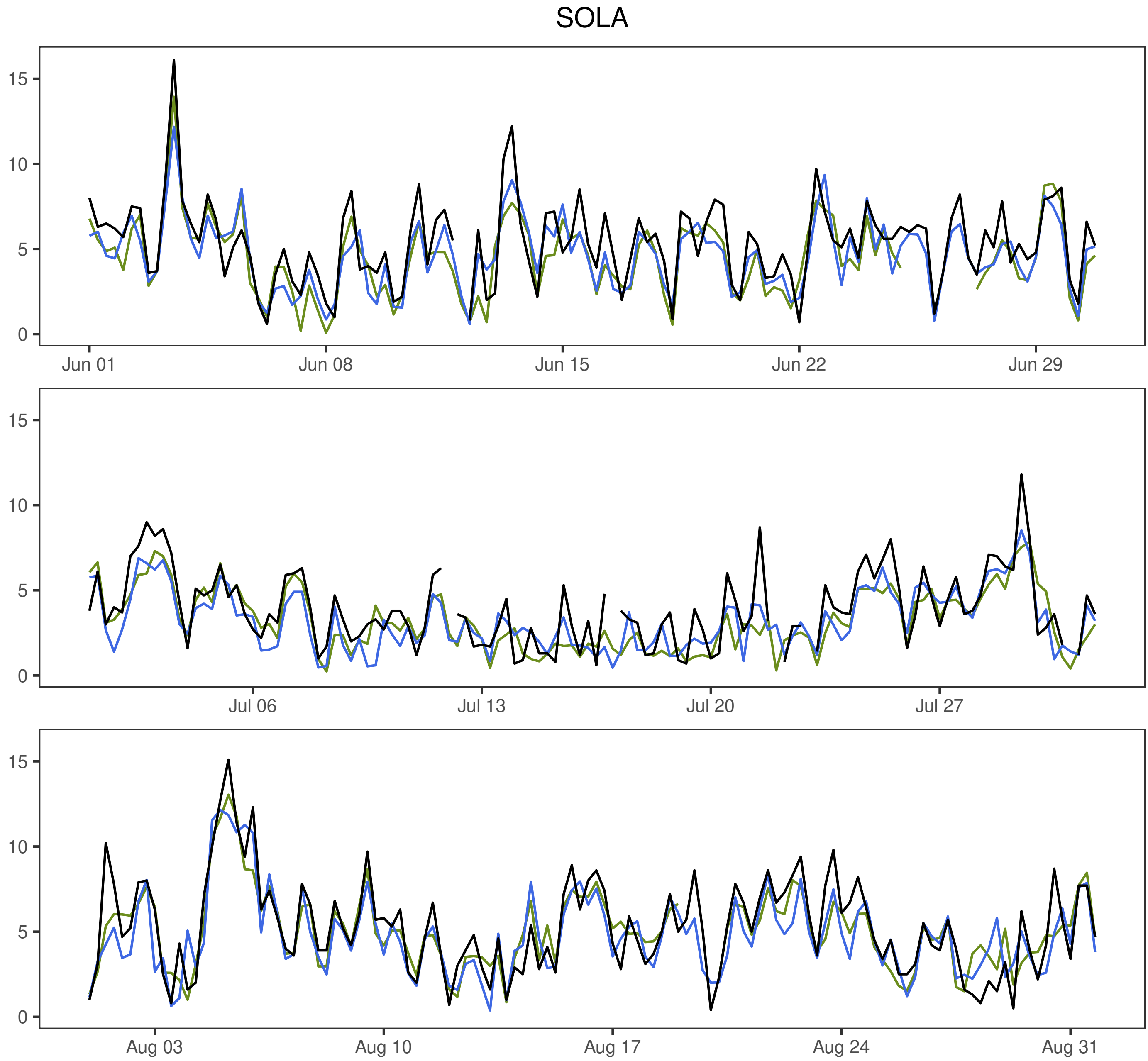


	Min	Mean	Max	Std	N
synop: 00,06,12,18	0.1	1.8	5.9	1.4	368
MEPSctrl: 12+18,+24,+30,+36	0.1	1.6	5.9	1.1	368
IFS: 12+18,+24,+30,+36	0.1	1.9	7.6	1.3	356

	ME	SDE	RMSE	MAE	Max.abs.err	N
MEPSctrl – synop	−0.2	0.9	1.0	0.7	3.5	356
IFS – synop	0.1	1.1	1.1	0.8	3.3	356

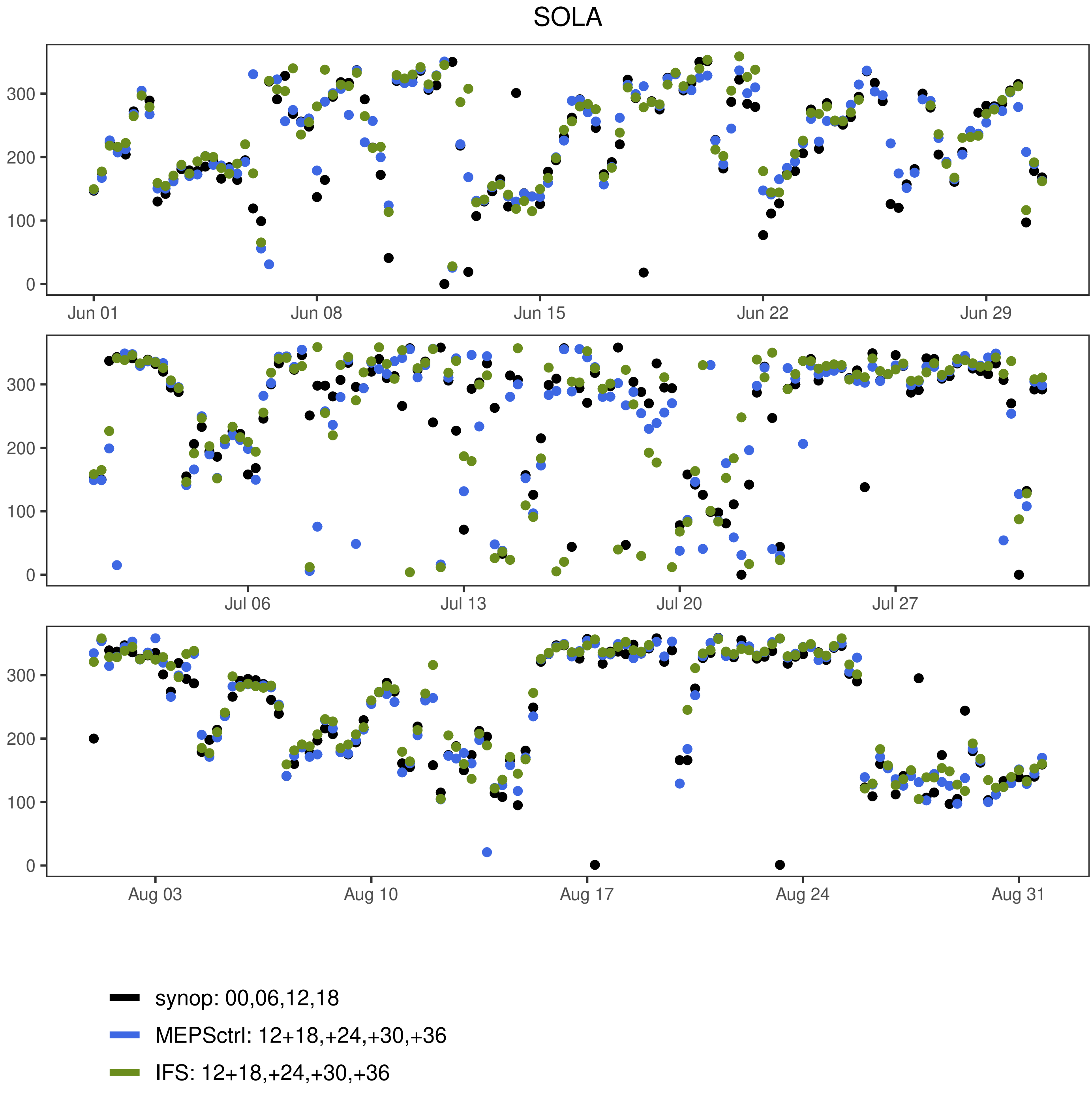

NESBYEN – TODOKK
300
200
100
0
Jun 01
Jun 08
Jun 15
Jun 22
Jun 29
Jul 06
Jul 13
Jul 20
Jul 27
Aug 03
Aug 10
Aug 17
Aug 24
Aug 31

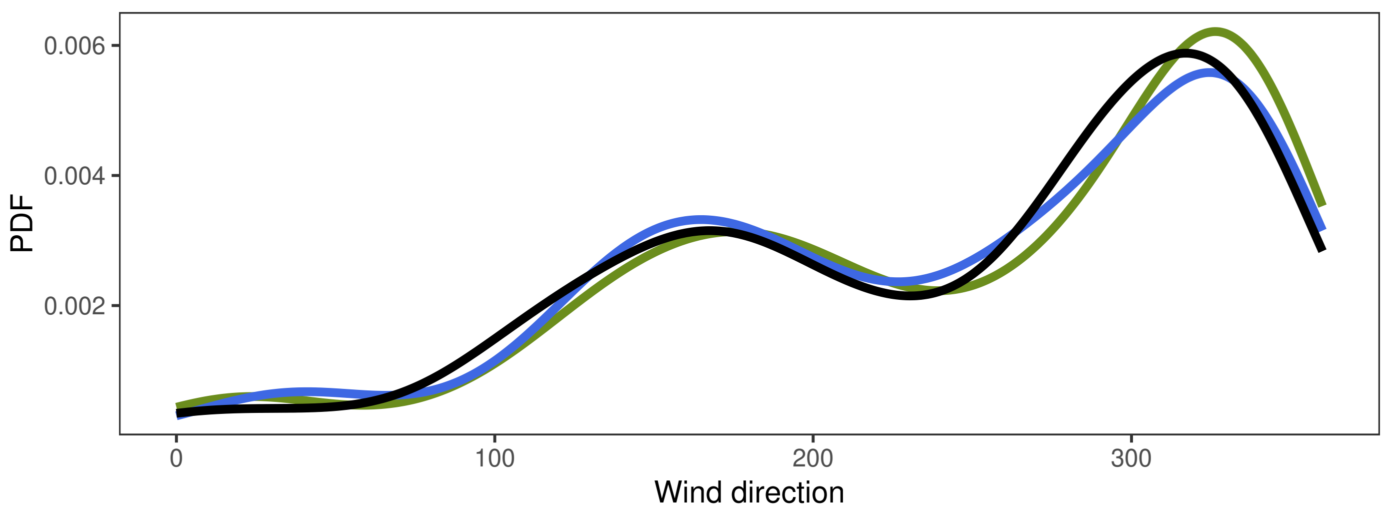

synop: 00,06,12,18
MEPSctrl: 12+18,+24,+30,+36
IFS: 12+18,+24,+30,+36
PDF
0.005
0.004
0.003
0.002
0.001
0
100
200
300
Wind direction

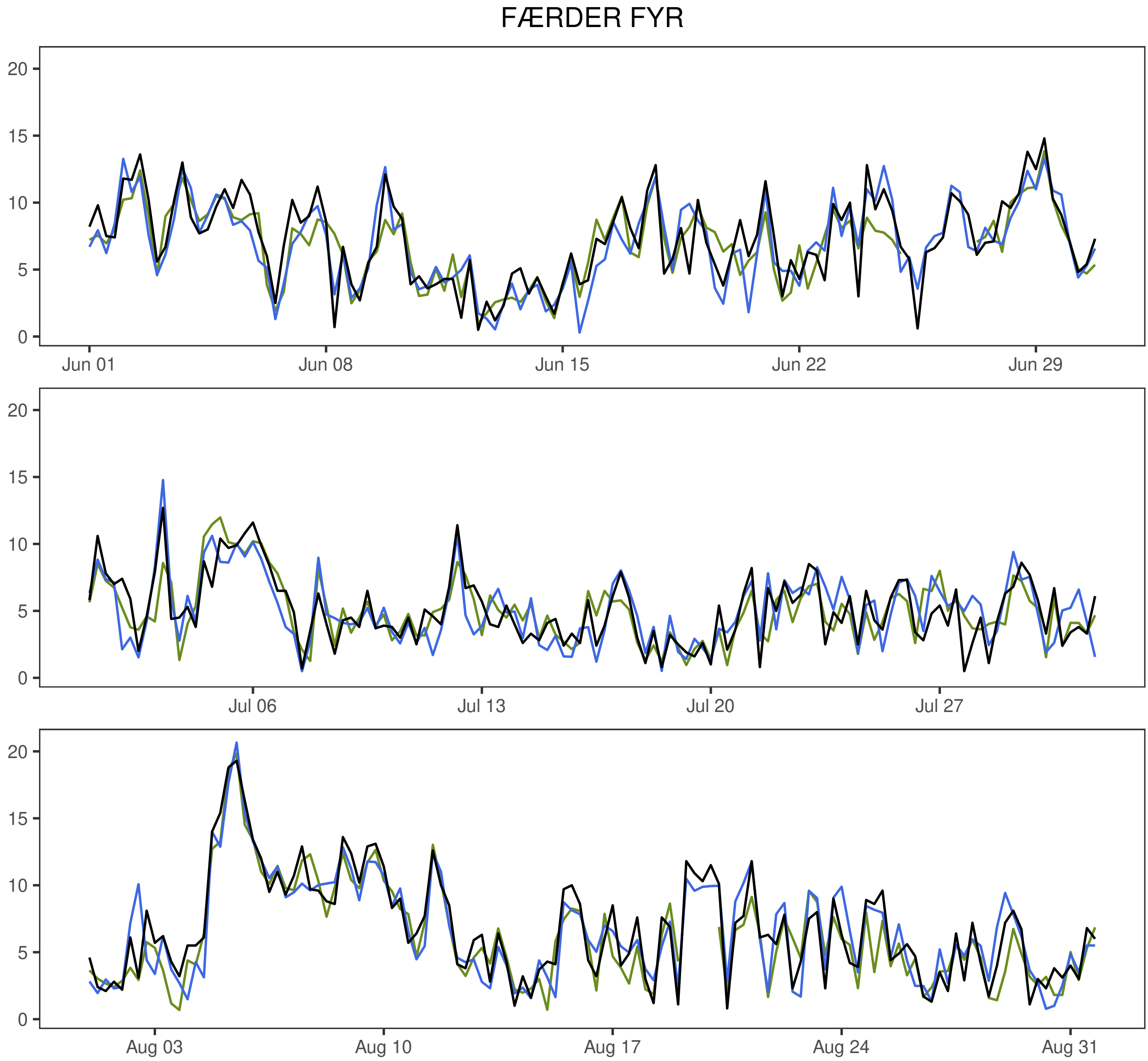


	Min	Mean	Max	Std	N
synop: 00,06,12,18	0.4	4.9	16.1	2.6	362
MEPSctrl: 12+18,+24,+30,+36	0.4	4.2	12.2	2.2	368
IFS: 12+18,+24,+30,+36	0.1	4.2	13.9	2.2	356

	ME	SDE	RMSE	MAE	Max.abs.err	N
MEPSctrl – synop	–0.6	1.4	1.5	1.2	6.0	350
IFS – synop	–0.6	1.4	1.5	1.1	6.3	350

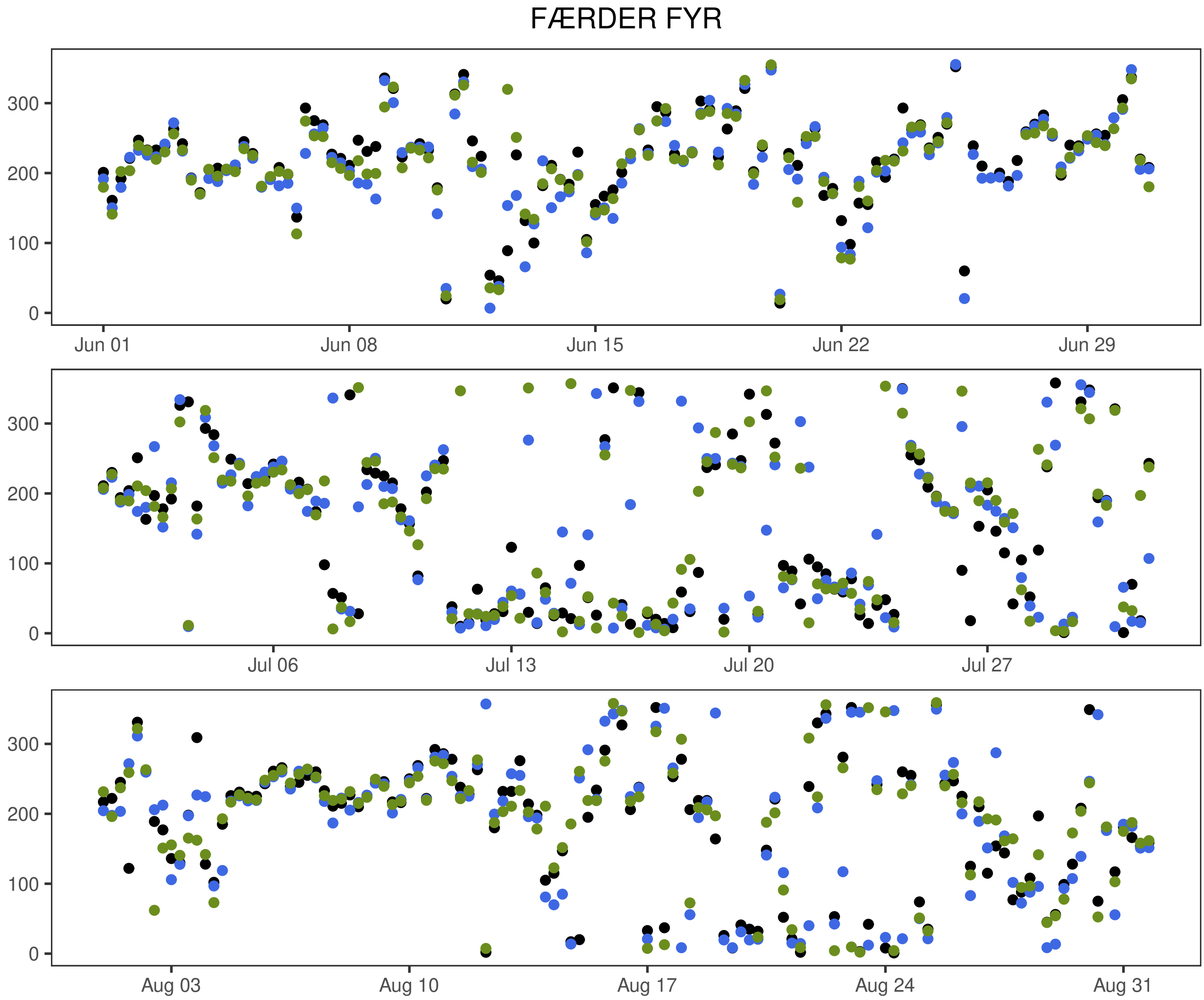

SOLA
300
200
100
0
Jun 01
Jun 08
Jun 15
Jun 22
Jun 29
Jul 06
Jul 13
Jul 20
Jul 27
Aug 03
Aug 10
Aug 17
Aug 24
Aug 31
synop: 00,06,12,18
MEPSctrl: 12+18,+24,+30,+36
IFS: 12+18,+24,+30,+36

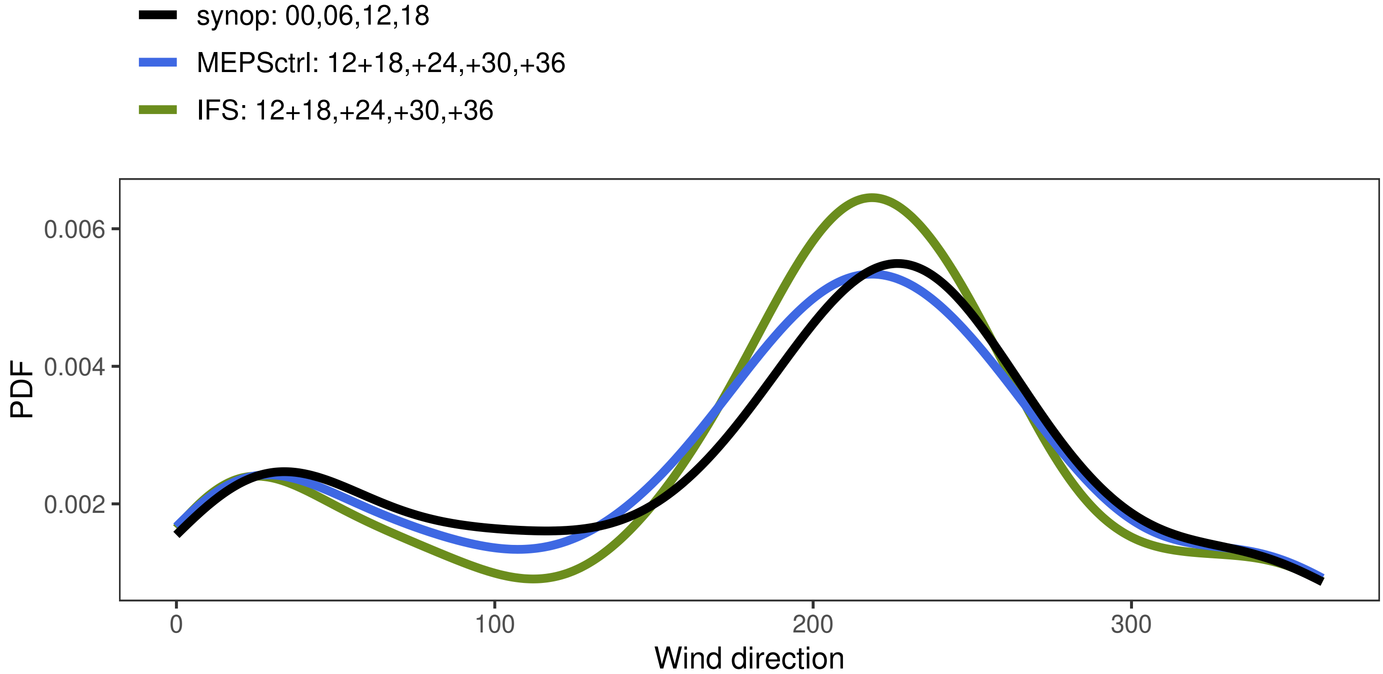

PDF
0.006
0.004
0.002
0
100
200
300
Wind direction

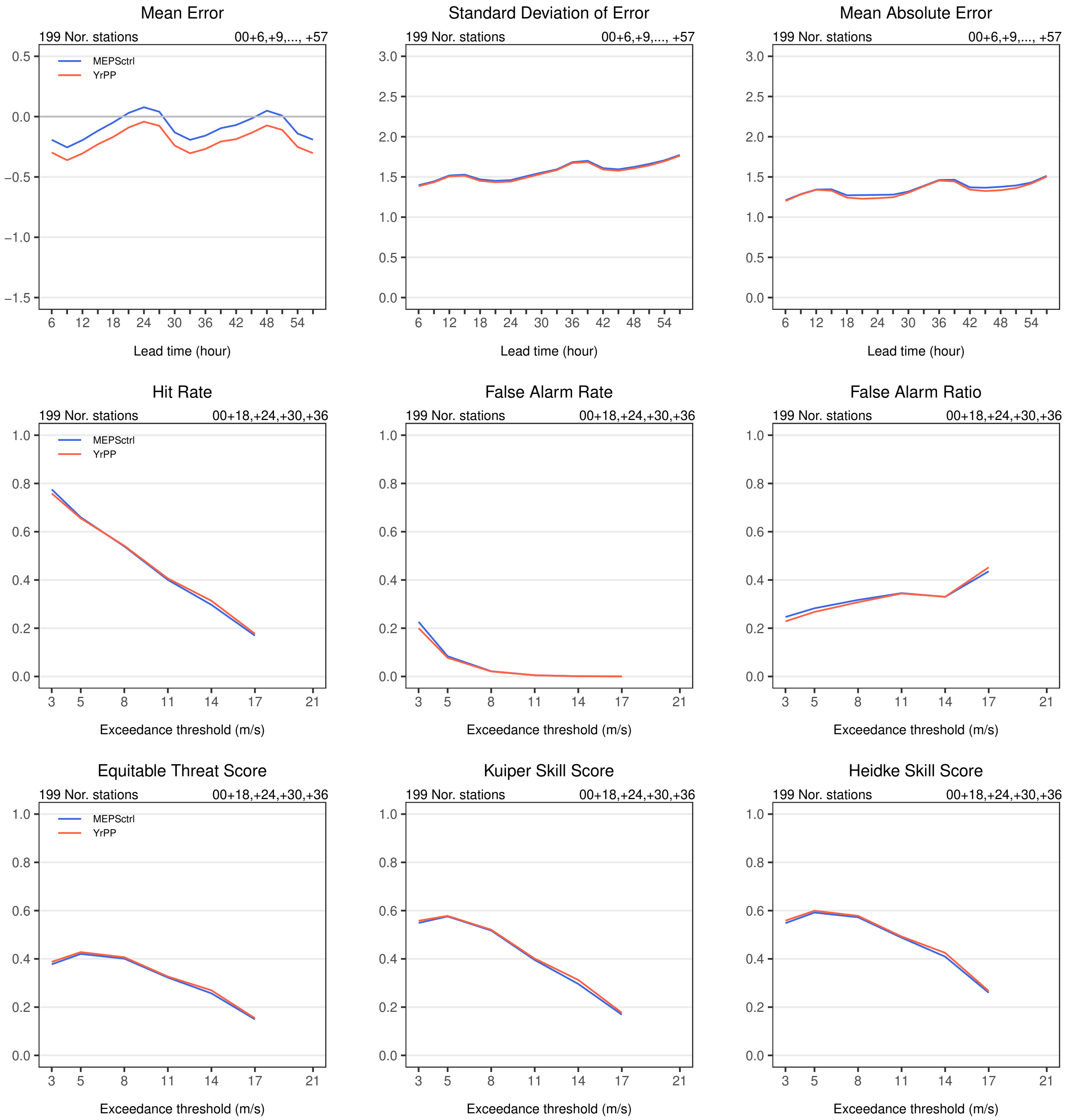


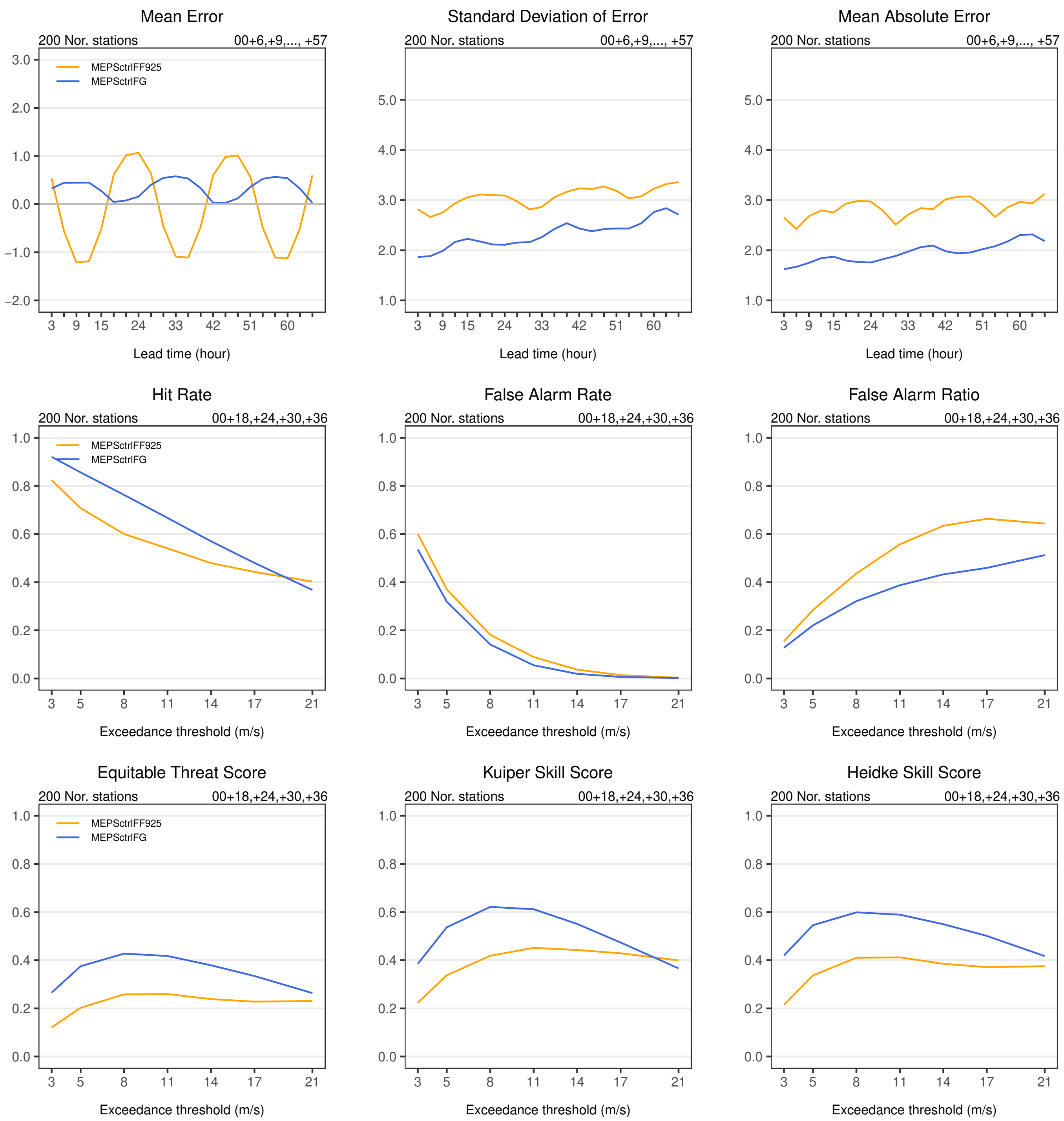
	Min	Mean	Max	Std	N
synop: 00,06,12,18	0.5	6.4	19.3	3.4	368
MEPSctrl: 12+18,+24,+30,+36	0.3	6.2	20.7	3.3	368
IFS: 12+18,+24,+30,+36	0.7	6.0	19.8	3.1	356

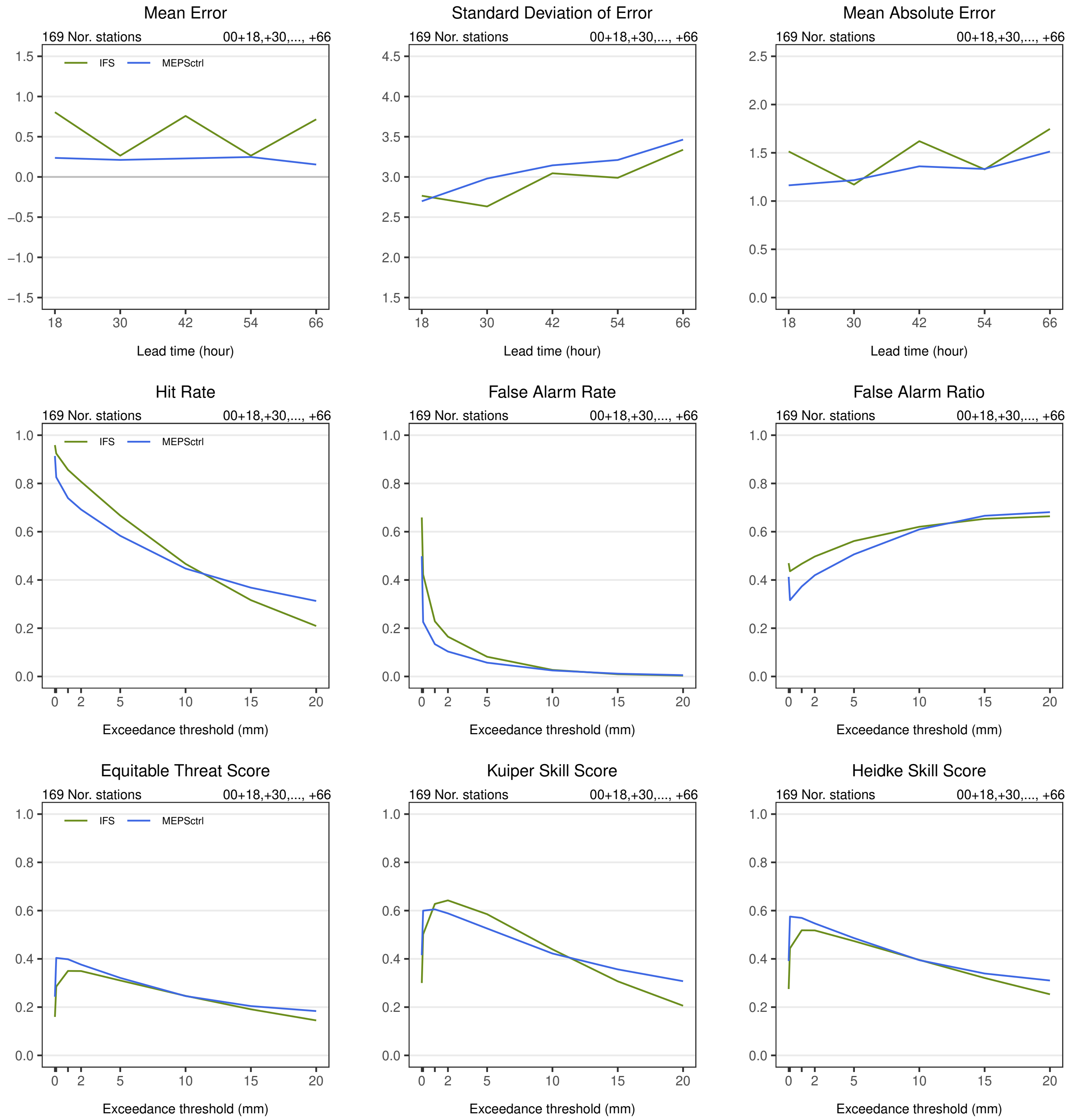
	ME	SDE	RMSE	MAE	Max.abs.err	N
MEPSctrl – synop	–0.2	1.7	1.7	1.3	7.0	356
IFS – synop	–0.3	1.6	1.7	1.3	7.0	356

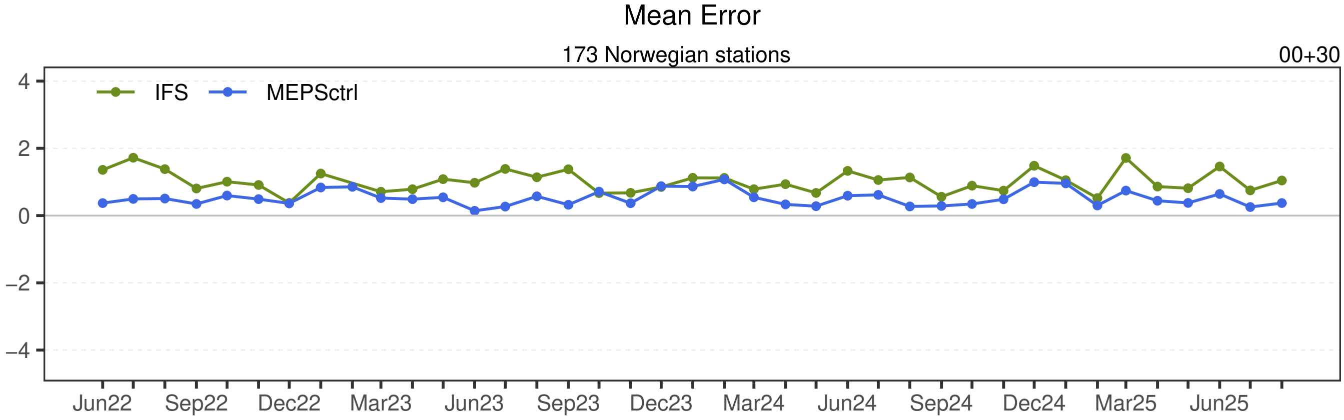

FÆRDER FYR
300
200
100
0
Jun 01
Jun 08
Jun 15
Jun 22
Jun 29
Jul 06
Jul 13
Jul 20
Jul 27
Aug 03
Aug 10
Aug 17
Aug 24
Aug 31

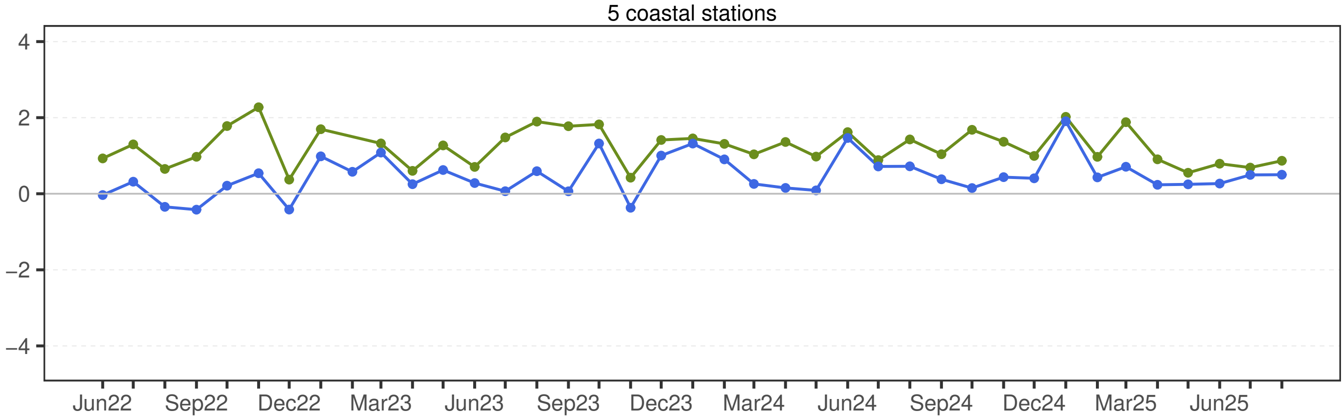

synop: 00,06,12,18
MEPSctrl: 12+18,+24,+30,+36
IFS: 12+18,+24,+30,+36
PDF
0.006
0.004
0.002
0
100
200
300
Wind direction

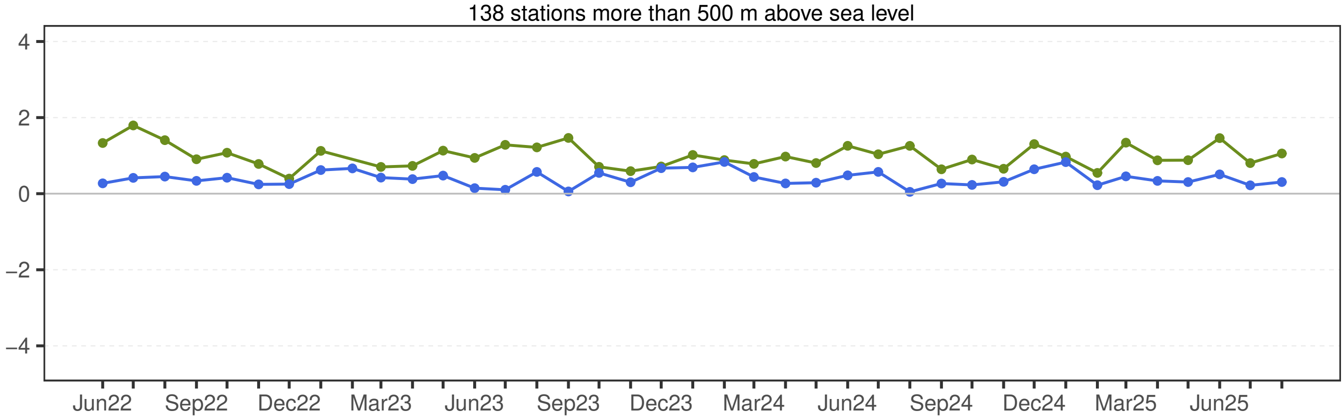

Mean Error
199 Nor. stations
00+6,+9,..., +57
MEPSctrl
YrPP
Lead time (hour)
Standard Deviation of Error
199 Nor. stations
00+6,+9,..., +57
Lead time (hour)
Mean Absolute Error
199 Nor. stations
00+6,+9,..., +57
Lead time (hour)
Hit Rate
199 Nor. stations
00+18,+24,+30,+36
MEPSctrl
YrPP
Exceedance threshold (m/s)
False Alarm Rate
199 Nor. stations
00+18,+24,+30,+36
Exceedance threshold (m/s)
False Alarm Ratio
199 Nor. stations
00+18,+24,+30,+36
Exceedance threshold (m/s)
Equitable Threat Score
199 Nor. stations
00+18,+24,+30,+36
MEPSctrl
YrPP
Exceedance threshold (m/s)
Kuiper Skill Score
199 Nor. stations
00+18,+24,+30,+36
Exceedance threshold (m/s)
Heidke Skill Score
199 Nor. stations
00+18,+24,+30,+36
Exceedance threshold (m/s)

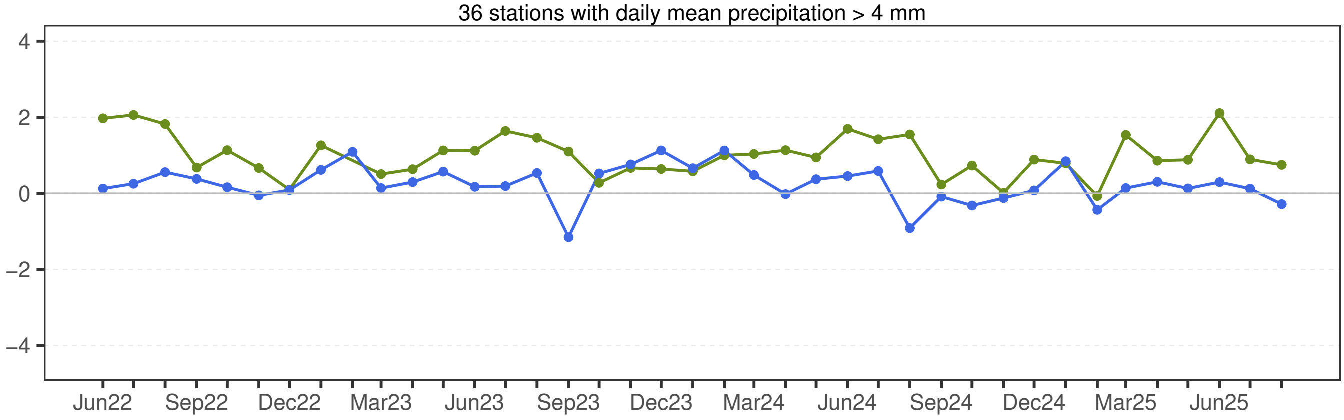

Mean Error
200 Nor. stations
00+6,+9,..., +57
MEPSctrlFF925
MEPSctrlFG
Lead time (hour)
Standard Deviation of Error
200 Nor. stations
00+6,+9,..., +57
Lead time (hour)
Mean Absolute Error
200 Nor. stations
00+6,+9,..., +57
Lead time (hour)
Hit Rate
200 Nor. stations
00+18,+24,+30,+36
MEPSctrlFF925
MEPSctrlFG
Exceedance threshold (m/s)
False Alarm Rate
200 Nor. stations
00+18,+24,+30,+36
Exceedance threshold (m/s)
False Alarm Ratio
200 Nor. stations
00+18,+24,+30,+36
Exceedance threshold (m/s)
Equitable Threat Score
200 Nor. stations
00+18,+24,+30,+36
MEPSctrlFF925
MEPSctrlFG
Exceedance threshold (m/s)
Kuiper Skill Score
200 Nor. stations
00+18,+24,+30,+36
Exceedance threshold (m/s)
Heidke Skill Score
200 Nor. stations
00+18,+24,+30,+36
Exceedance threshold (m/s)

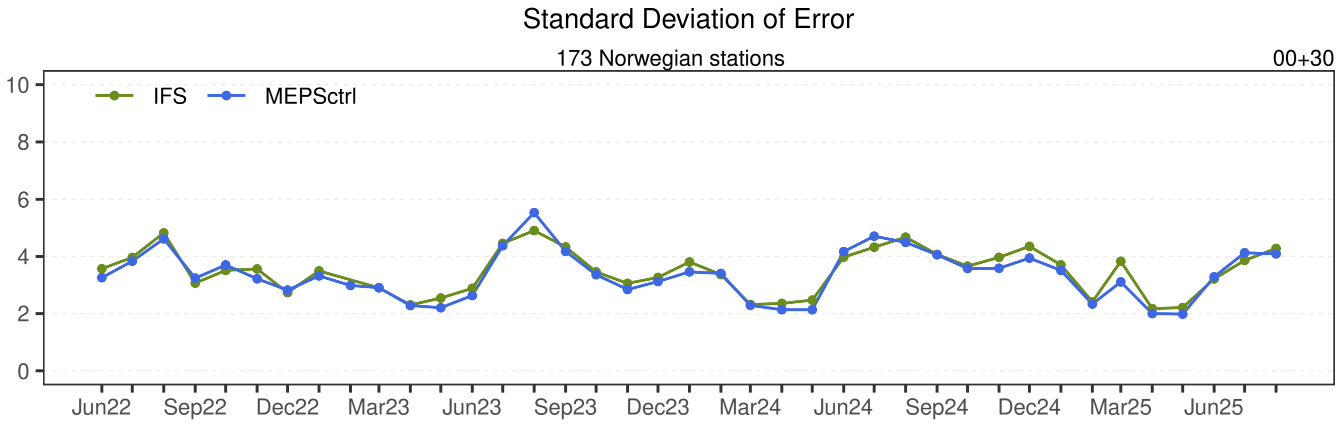

Mean Error
169 Nor. stations
00+18,+30,..., +66
IFS
MEPSctrl
Lead time (hour)
Standard Deviation of Error
169 Nor. stations
00+18,+30,..., +66
Lead time (hour)
Mean Absolute Error
169 Nor. stations
00+18,+30,..., +66
Lead time (hour)
Hit Rate
169 Nor. stations
00+18,+30,..., +66
IFS
MEPSctrl
Exceedance threshold (mm)
False Alarm Rate
169 Nor. stations
00+18,+30,..., +66
Exceedance threshold (mm)
False Alarm Ratio
169 Nor. stations
00+18,+30,..., +66
Exceedance threshold (mm)
Equitable Threat Score
169 Nor. stations
00+18,+30,..., +66
IFS
MEPSctrl
Exceedance threshold (mm)
Kuiper Skill Score
169 Nor. stations
00+18,+30,..., +66
Exceedance threshold (mm)
Heidke Skill Score
169 Nor. stations
00+18,+30,..., +66
Exceedance threshold (mm)

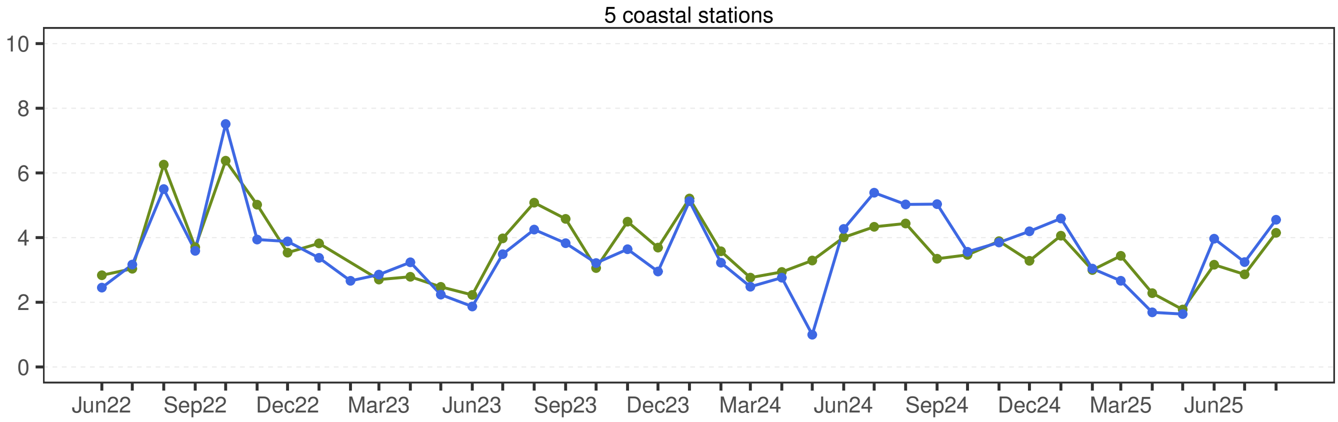

Mean Error
173 Norwegian stations
00+30
IFS
MEPSctrl
4
2
0
−2
−4
Jun22
Sep22
Dec22
Mar23
Jun23
Sep23
Dec23
Mar24
Jun24
Sep24
Dec24
Mar25
Jun25

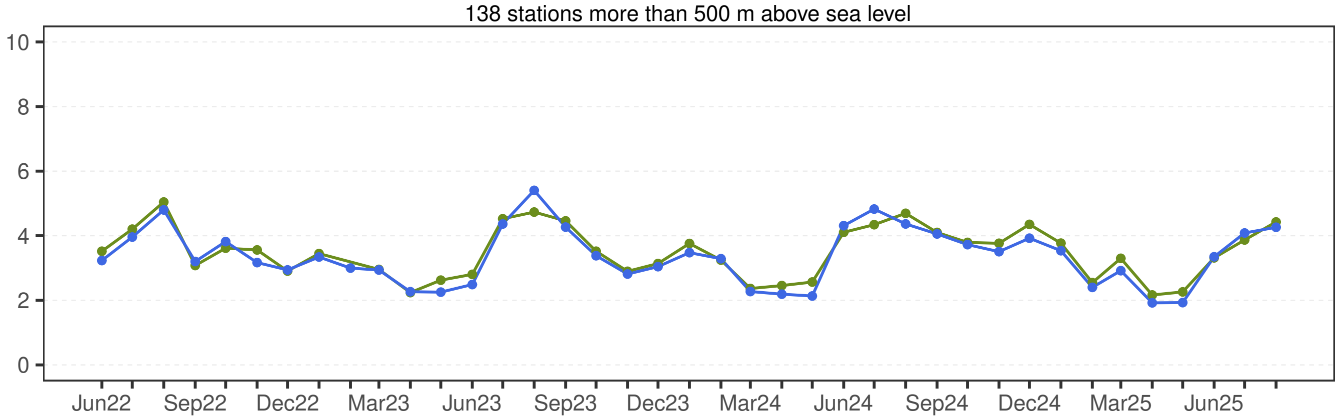

5 coastal stations
4
2
0
−2
−4
Jun22
Sep22
Dec22
Mar23
Jun23
Sep23
Dec23
Mar24
Jun24
Sep24
Dec24
Mar25
Jun25

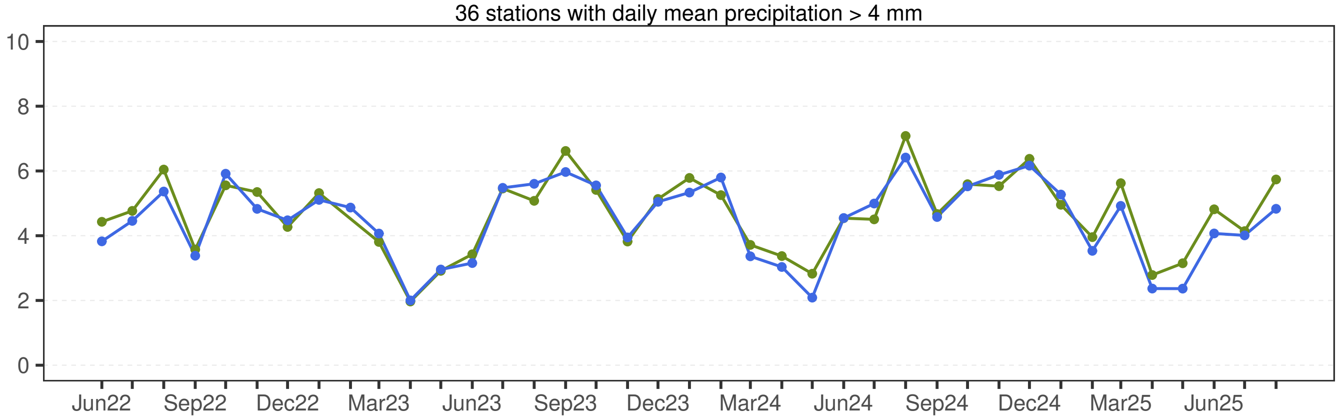

138 stations more than 500 m above sea level
4
2
0
−2
−4
Jun22
Sep22
Dec22
Mar23
Jun23
Sep23
Dec23
Mar24
Jun24
Sep24
Dec24
Mar25
Jun25

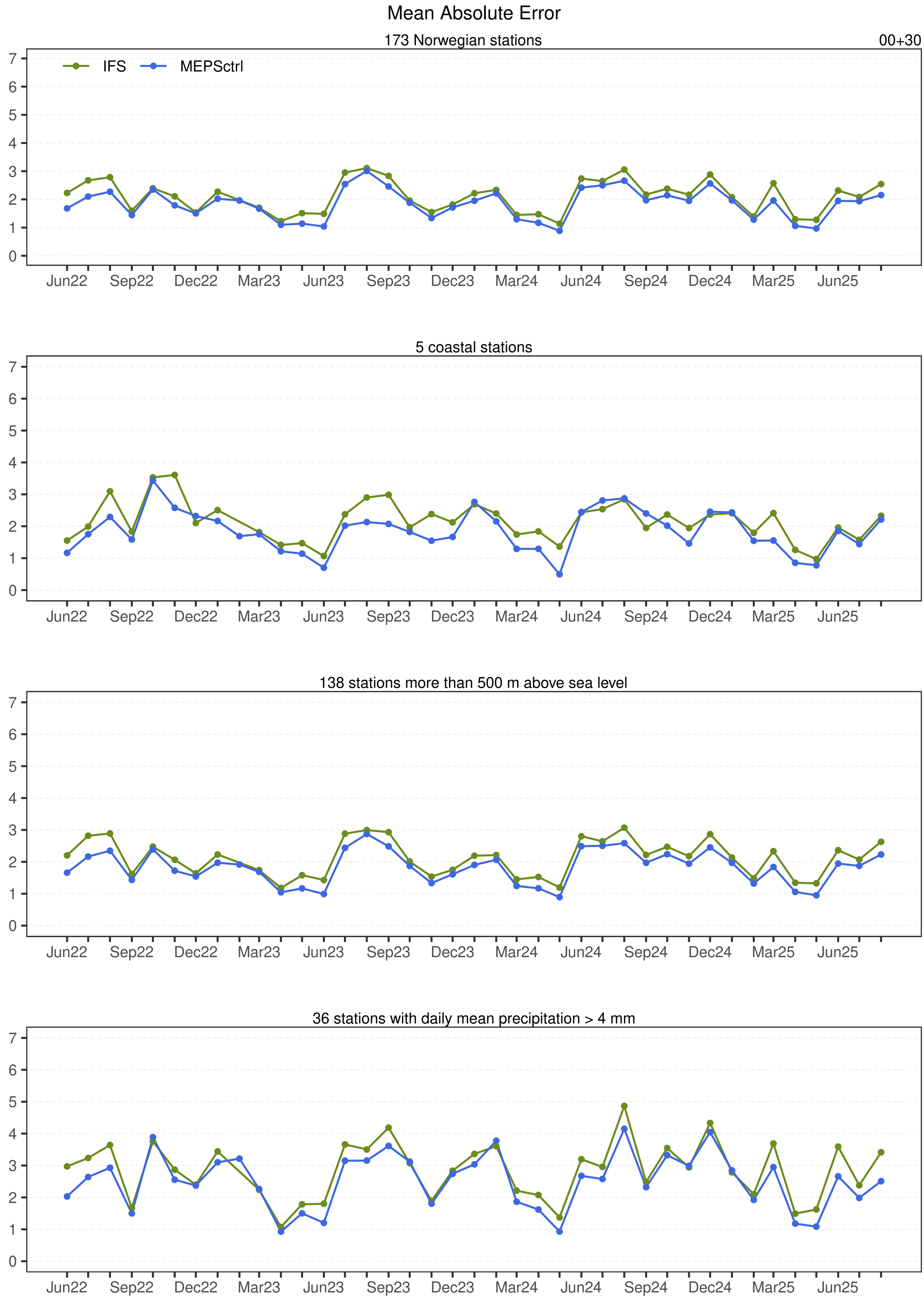

36 stations with daily mean precipitation > 4 mm
4
2
0
−2
−4
Jun22
Sep22
Dec22
Mar23
Jun23
Sep23
Dec23
Mar24
Jun24
Sep24
Dec24
Mar25
Jun25


Standard Deviation of Error
173 Norwegian stations
00+30
IFS
MEPSctrl
0
2
4
6
8
10
Jun22
Sep22
Dec22
Mar23
Jun23
Sep23
Dec23
Mar24
Jun24
Sep24
Dec24
Mar25
Jun25


5 coastal stations
0
2
4
6
8
10
Jun22
Sep22
Dec22
Mar23
Jun23
Sep23
Dec23
Mar24
Jun24
Sep24
Dec24
Mar25
Jun25

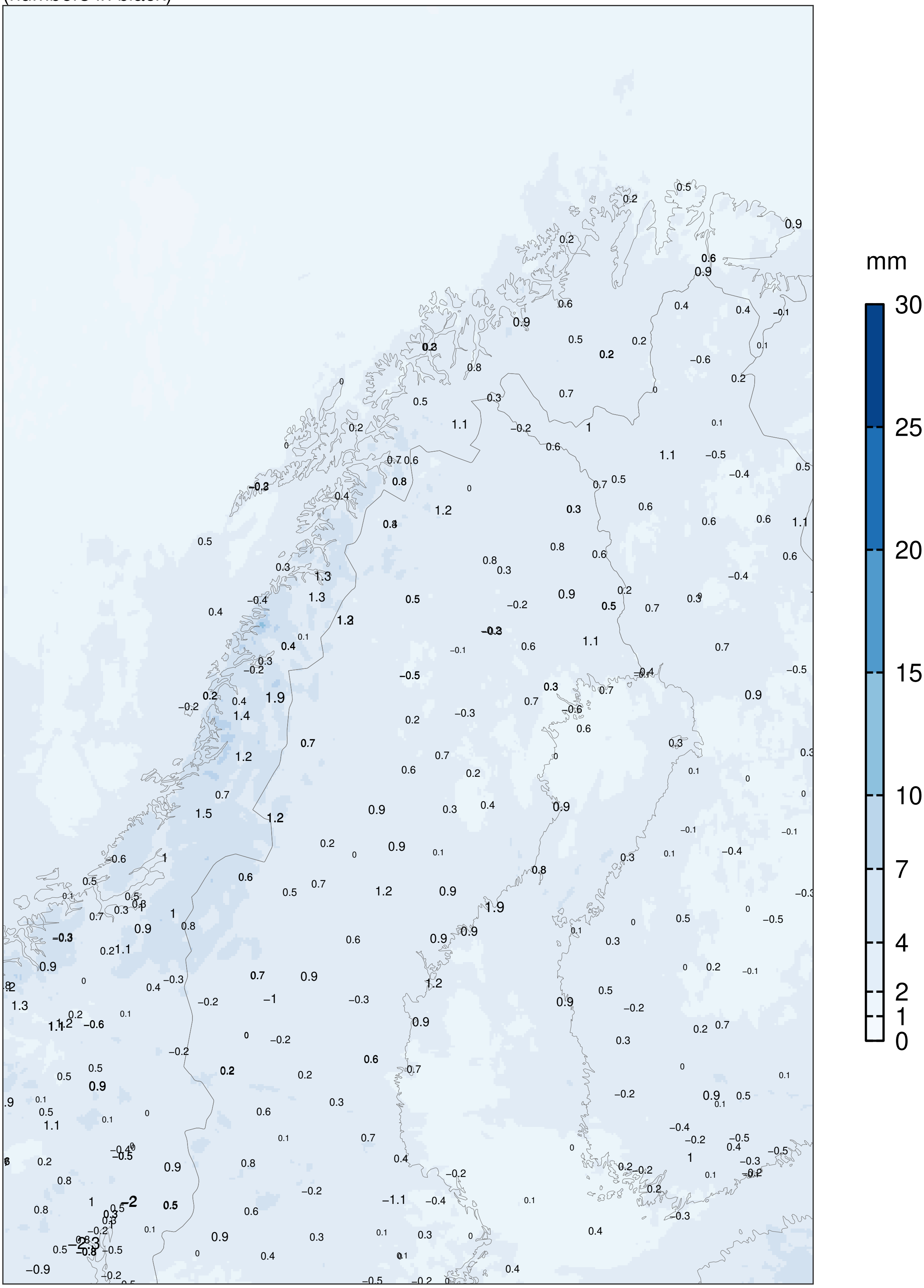

138 stations more than 500 m above sea level
0
2
4
6
8
10
Jun22
Sep22
Dec22
Mar23
Jun23
Sep23
Dec23
Mar24
Jun24
Sep24
Dec24
Mar25
Jun25


36 stations with daily mean precipitation > 4 mm
0
2
4
6
8
10
Jun22
Sep22
Dec22
Mar23
Jun23
Sep23
Dec23
Mar24
Jun24
Sep24
Dec24
Mar25
Jun25


Mean Absolute Error
173 Norwegian stations
00+30
IFS
MEPSctrl
5 coastal stations
138 stations more than 500 m above sea level
36 stations with daily mean precipitation > 4 mm
0 1 2 3 4 5 6 7
Jun22 Sep22 Dec22 Mar23 Jun23 Sep23 Dec23 Mar24 Jun24 Sep24 Dec24 Mar25 Jun25

MEPSctrl 00+30

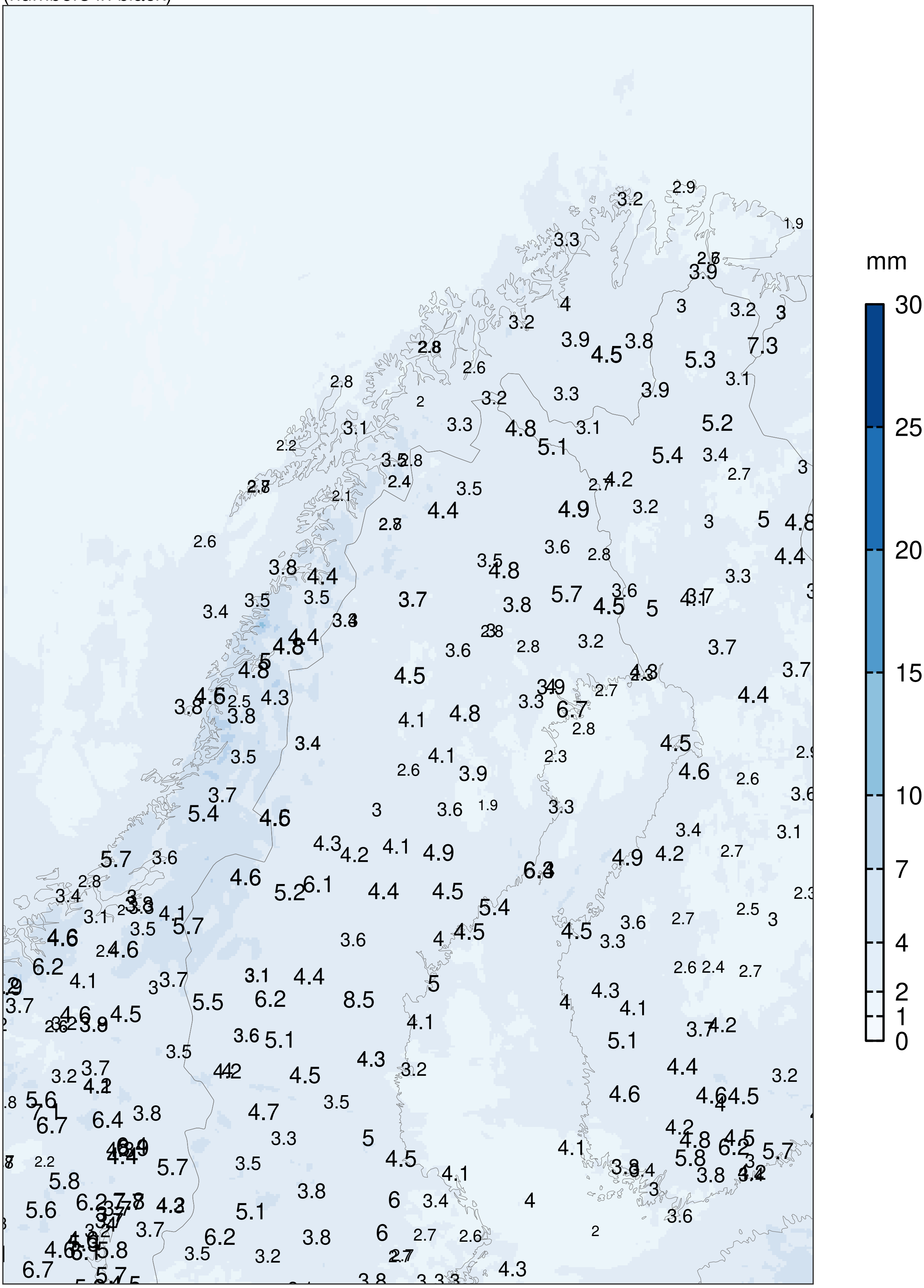
ME at observing sites
(numbers in black)



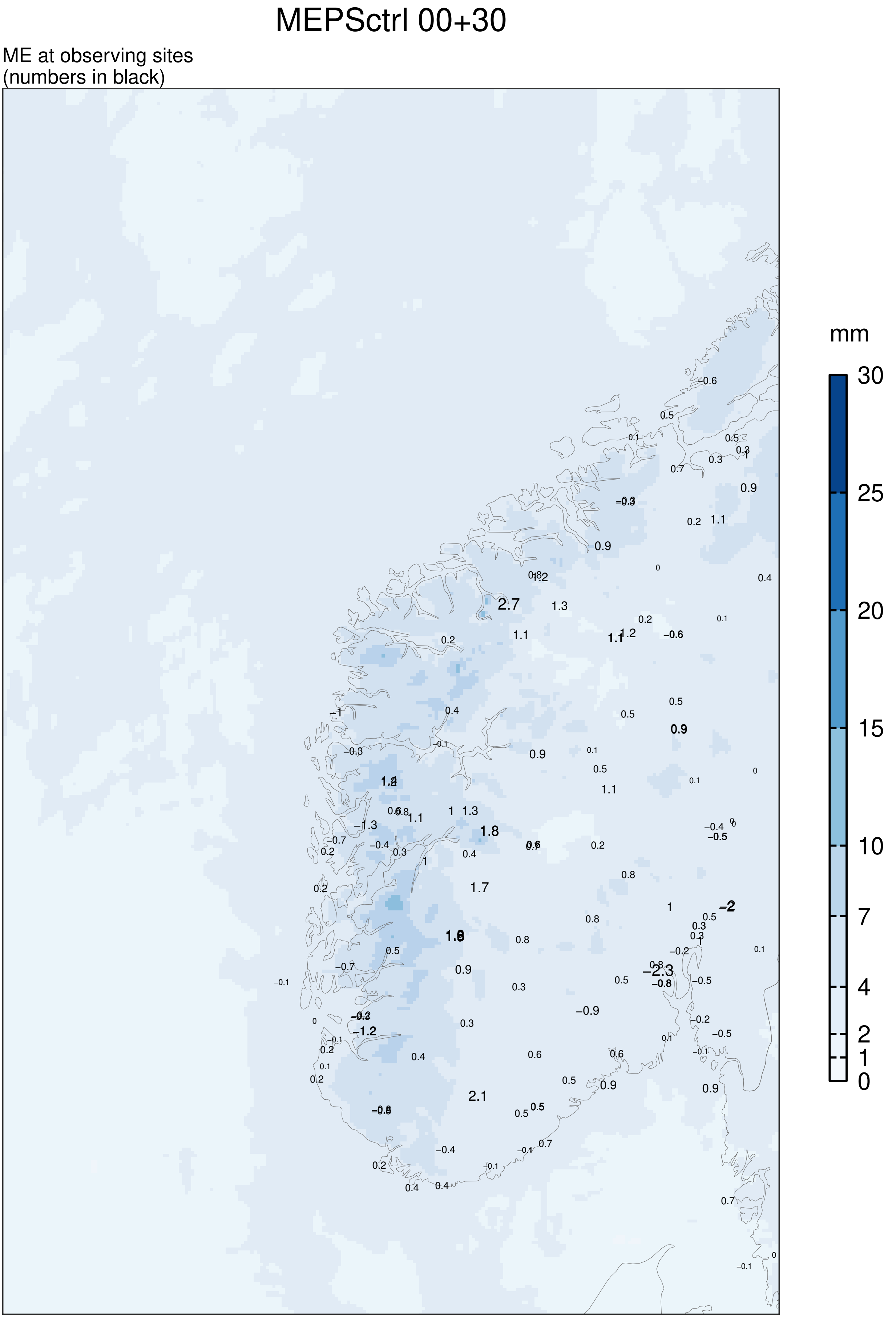
Model "climatology" 01.06.2025–31.08.2025

MEPSctrl 00+30

SDE at observing sites
(numbers in black)



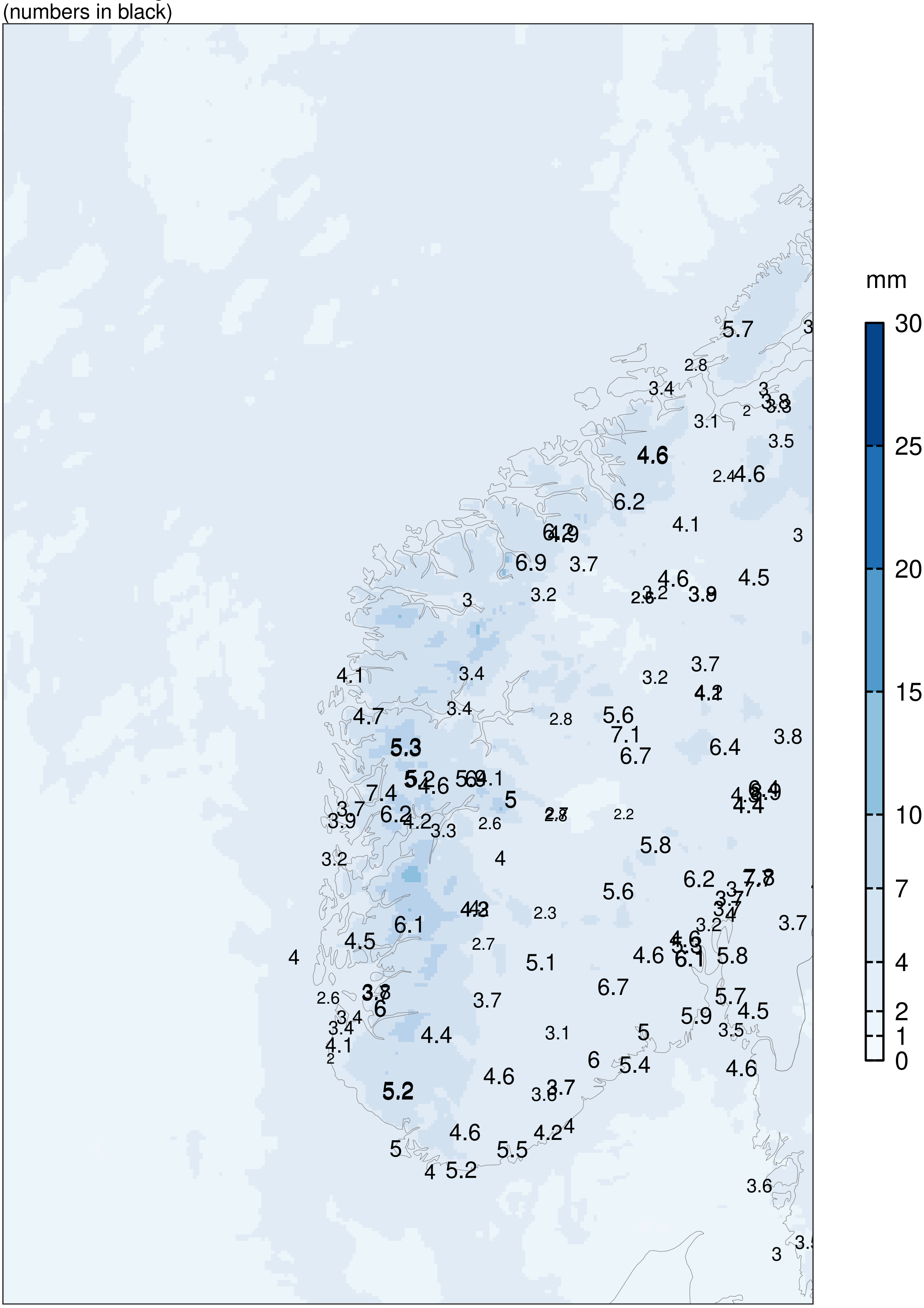
Model "climatology" 01.06.2025–31.08.2025



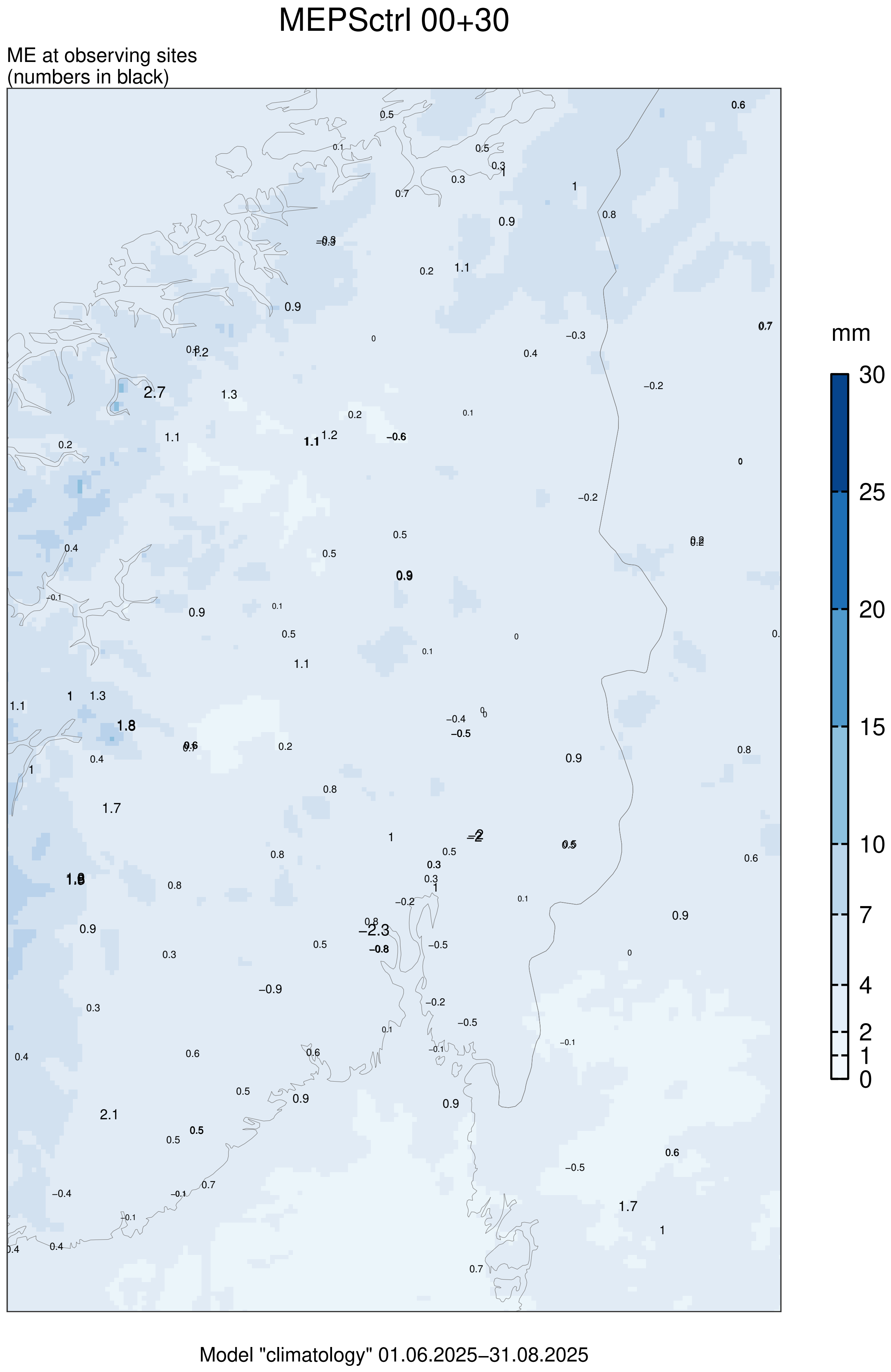
Model "climatology" 01.06.2025–31.08.2025

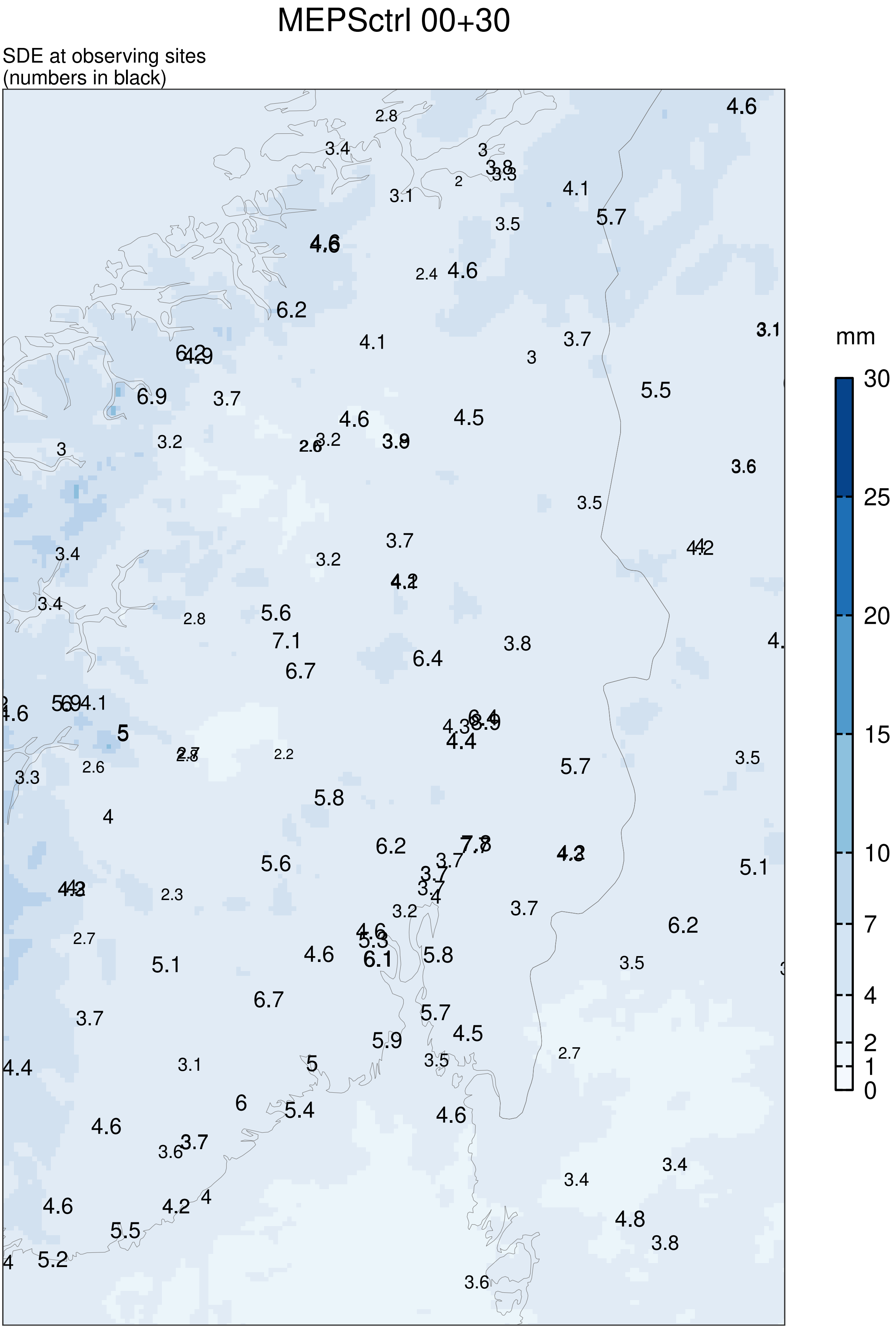
MEPSctrl 00+30

SDE at observing sites
(numbers in black)

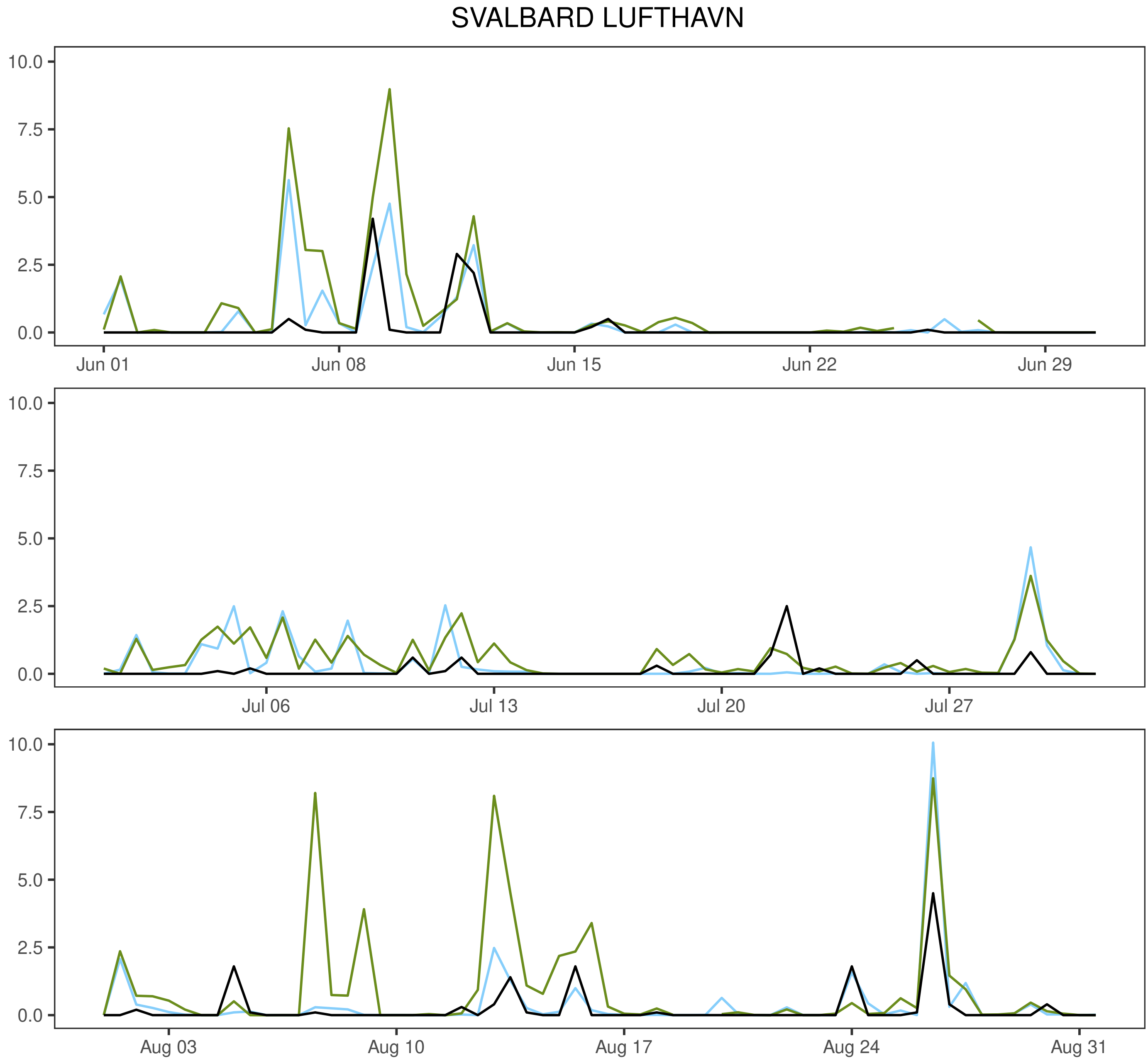


Model "climatology" 01.06.2025–31.08.2025


MEPSctrl 00+30
ME at observing sites
(numbers in black)
mm
30
25
20
15
10
7
4
2
1
0
Model "climatology" 01.06.2025–31.08.2025

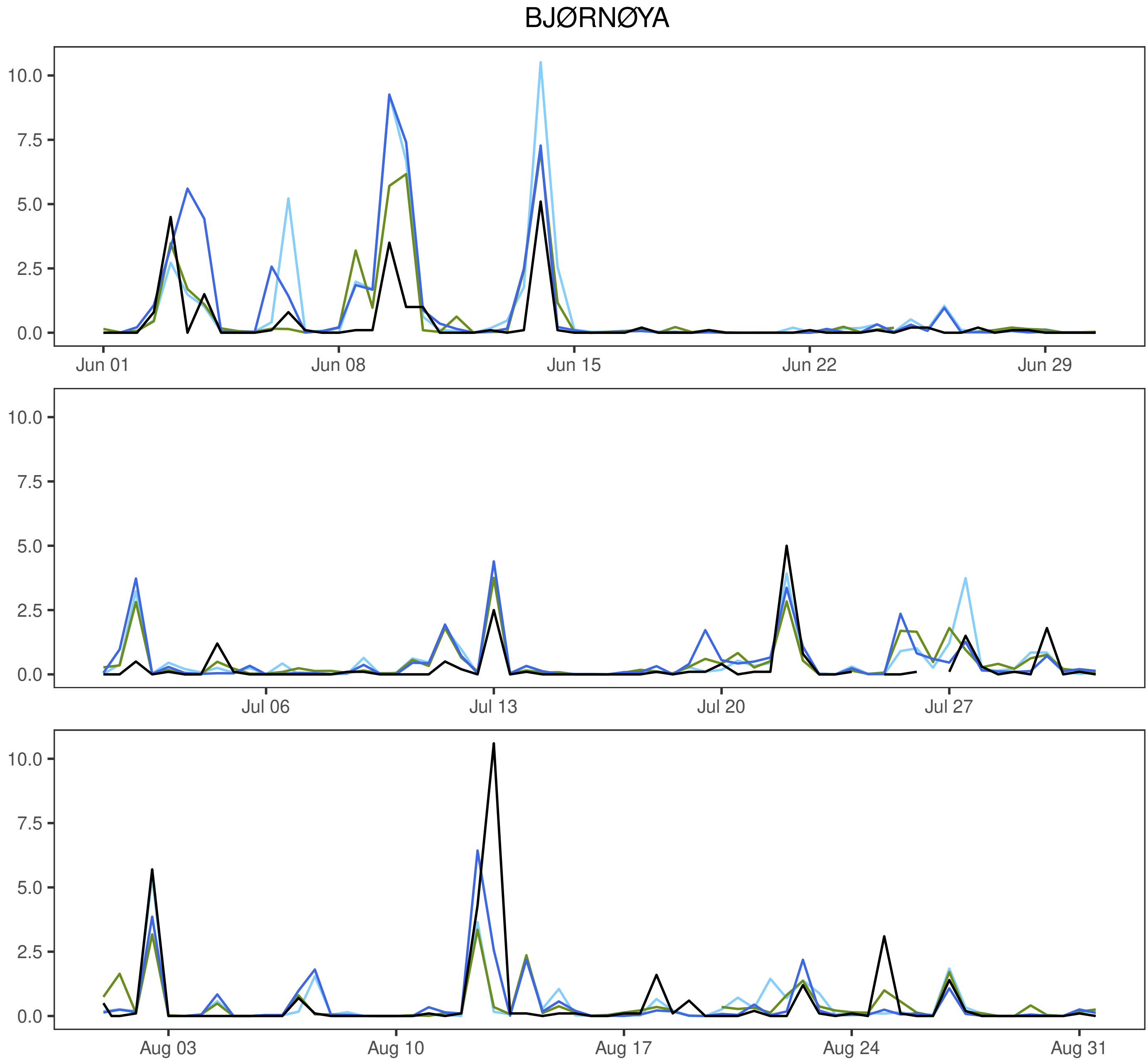


Model "climatology" 01.06.2025–31.08.2025



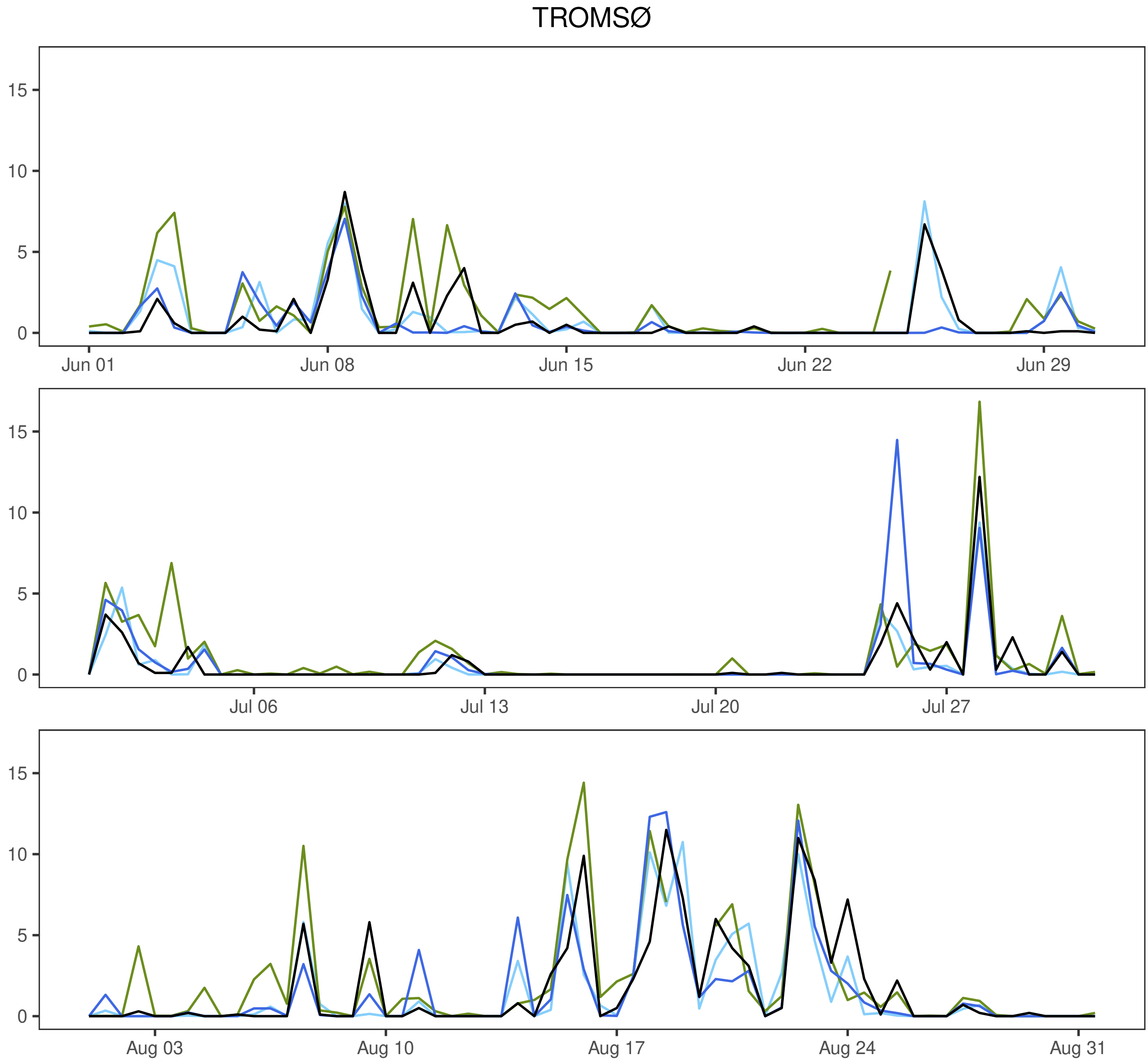
	Min	Mean	Max	Std	N
synop: 06,18	0.0	0.2	4.5	0.6	184
AA25: 12+18,+30	0.0	0.4	10.1	1.1	184
IFS: 12+18,+30	0.0	0.8	9.0	1.6	178

	ME	SDE	RMSE	MAE	Max.abs.err	N
AA25 – synop	0.2	0.9	0.9	0.4	5.6	178
IFS – synop	0.6	1.4	1.5	0.7	8.9	178



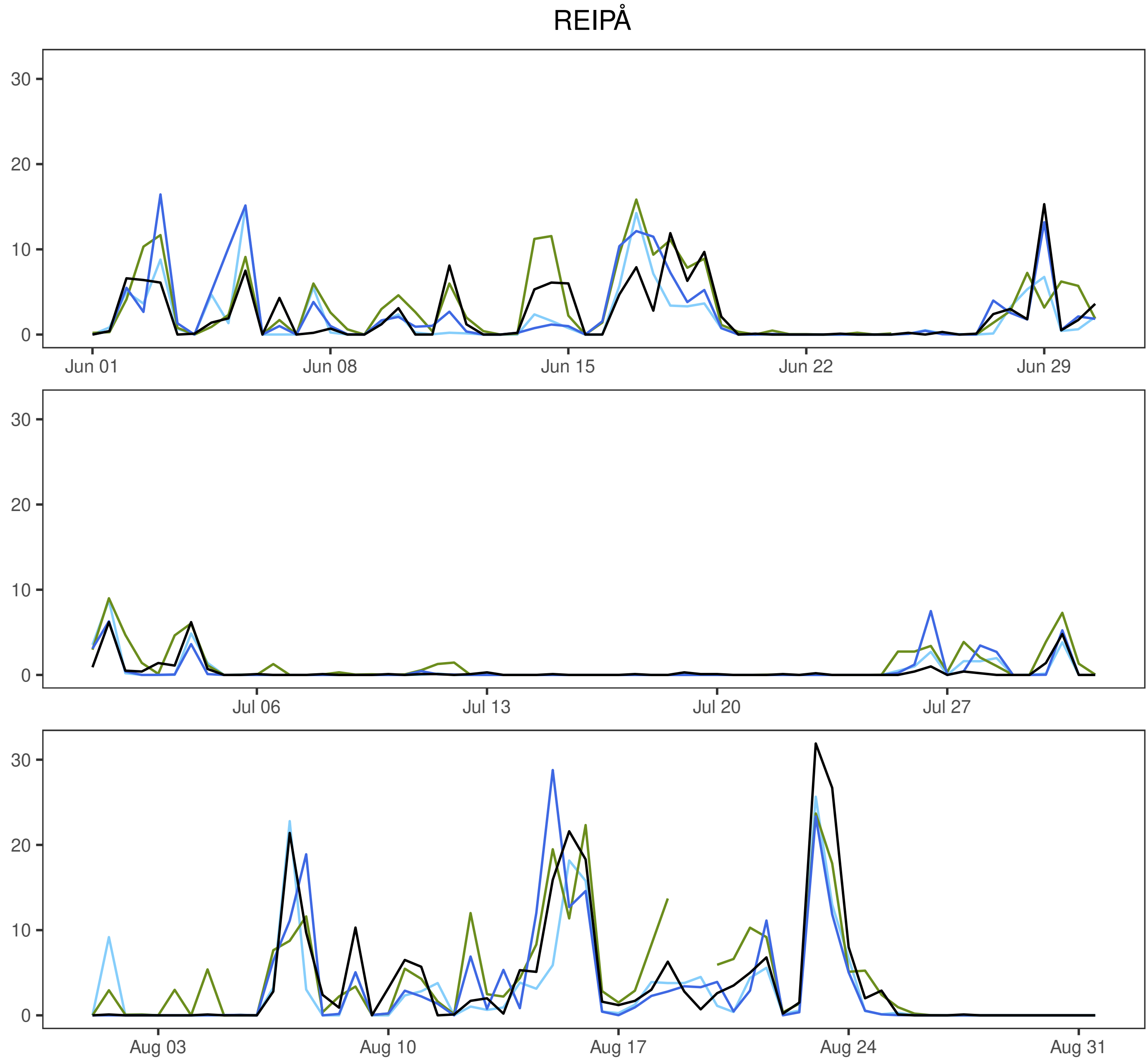
	Min	Mean	Max	Std	N
synop: 06,12,18	0.0	0.4	10.6	1.2	183
MEPSctrl: 12+18,+30	0.0	0.6	9.2	1.4	184
AA25: 12+18,+30	0.0	0.6	10.5	1.4	184
IFS: 12+18,+30	0.0	0.5	7.1	1.1	178

	ME	SDE	RMSE	MAE	Max.abs.err	N
MEPSctrl – synop	0.2	1.2	1.2	0.5	8.0	176
AA25 – synop	0.2	1.3	1.3	0.5	10.4	176
IFS – synop	0.1	1.1	1.1	0.4	10.3	176



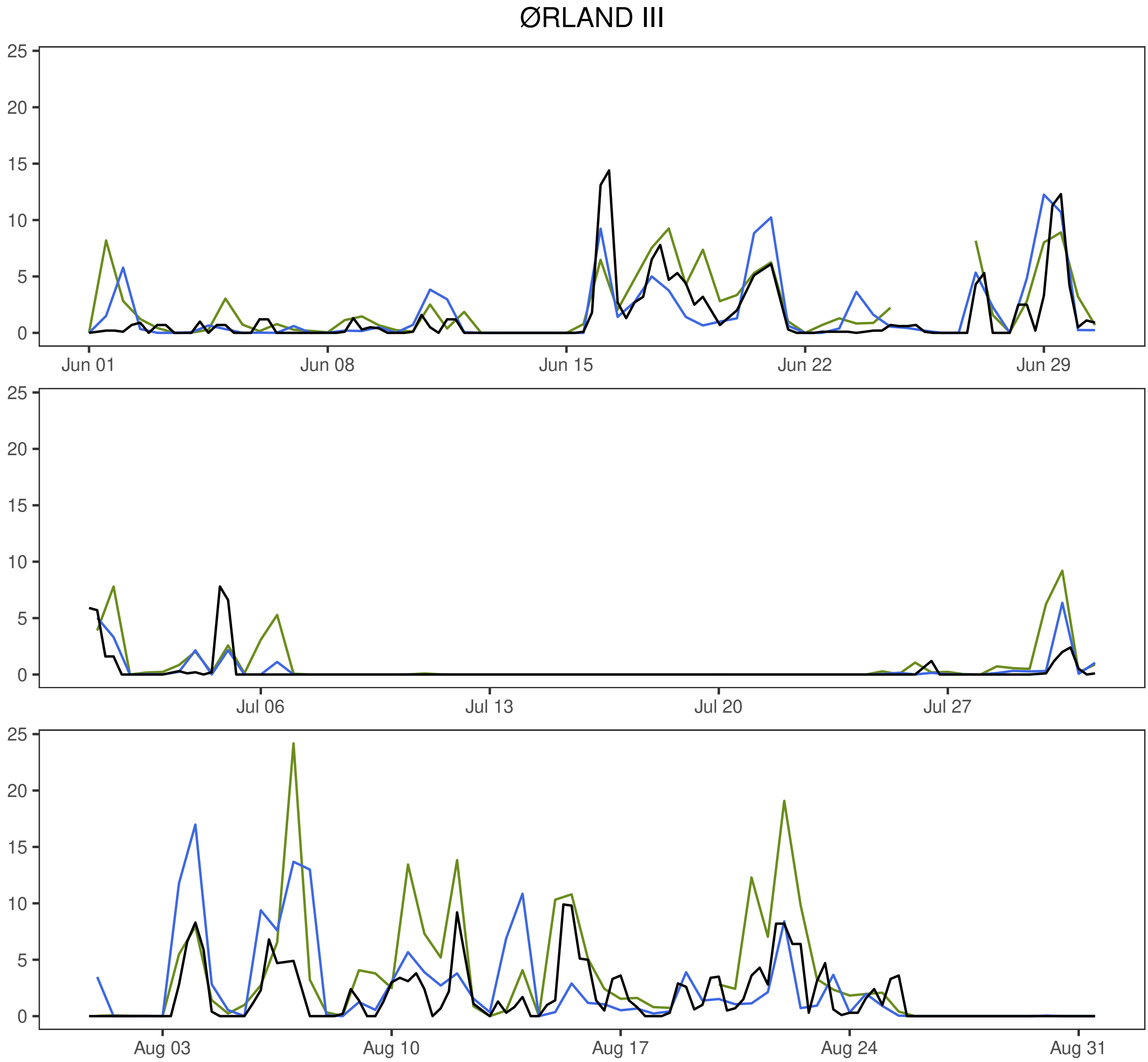
	Min	Mean	Max	Std	N
synop: 06,18	0.0	1.0	12.2	2.3	184
MEPSctrl: 12+18,+30	0.0	1.0	14.5	2.3	184
AA25: 12+18,+30	0.0	1.0	10.7	2.2	184
IFS: 12+18,+30	0.0	1.5	16.8	2.8	178

	ME	SDE	RMSE	MAE	Max.abs.err	N
MEPSctrl – synop	0.0	1.6	1.6	0.7	10.1	178
AA25 – synop	–0.1	1.5	1.5	0.7	7.3	178
IFS – synop	0.6	1.6	1.7	0.9	6.8	178



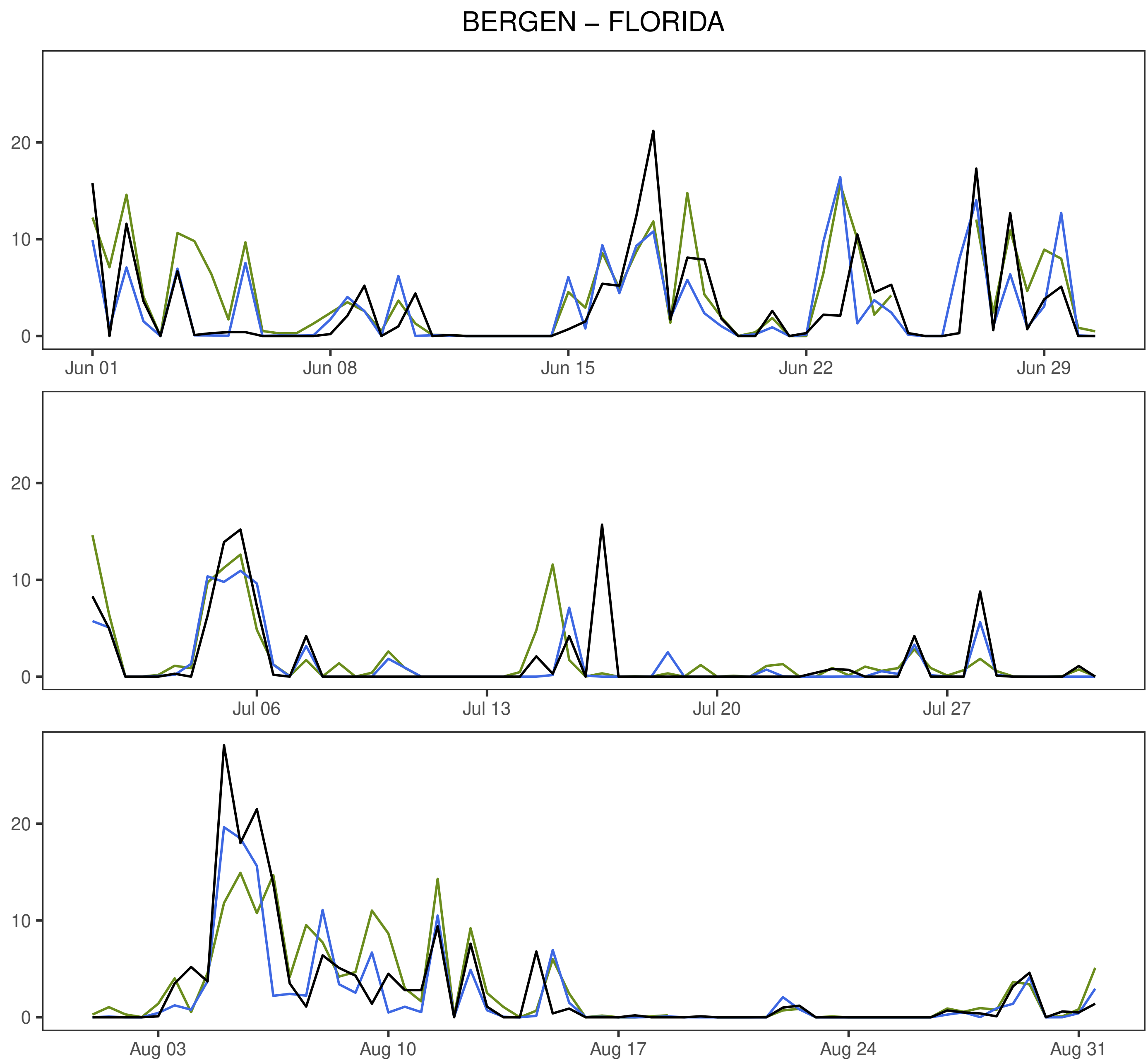
	Min	Mean	Max	Std	N
synop: 06,18	0.0	2.2	31.9	4.7	184
MEPSctrl: 12+18,+30	0.0	2.1	28.8	4.4	184
AA25: 12+18,+30	0.0	1.8	25.7	3.9	184
IFS: 12+18,+30	0.0	2.9	23.7	4.5	178

	ME	SDE	RMSE	MAE	Max.abs.err	N
MEPSctrl – synop	–0.1	3.1	3.1	1.5	14.9	178
AA25 – synop	–0.5	2.5	2.6	1.3	13.7	178
IFS – synop	0.6	2.9	2.9	1.6	12.7	178



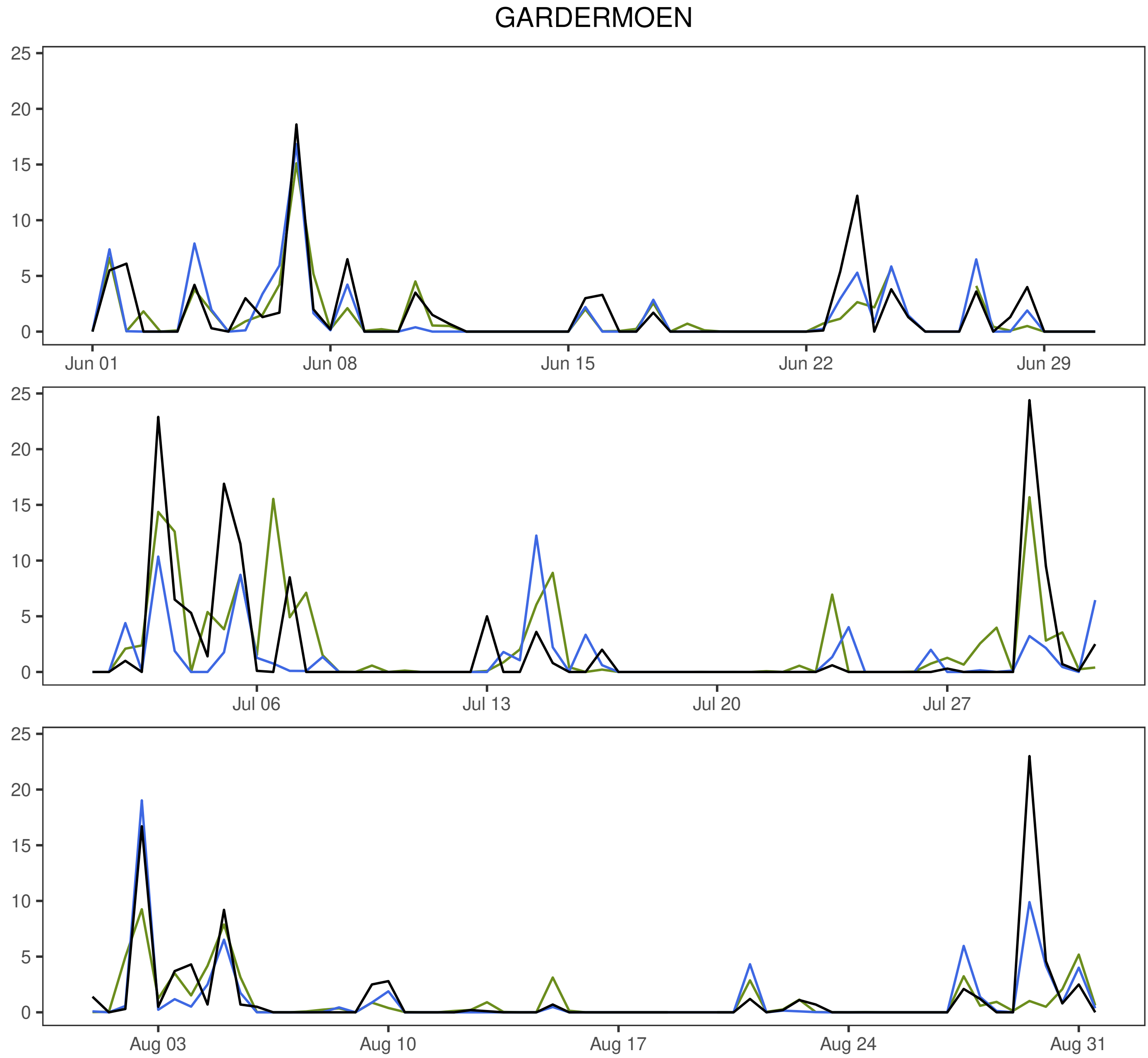
	Min	Mean	Max	Std	N
synop: 00,06,12,18	0.0	1.1	14.4	2.3	348
MEPSctrl: 12+18,+30	0.0	1.5	17.0	3.0	184
IFS: 12+18,+30	0.0	2.1	24.2	3.7	178

	ME	SDE	RMSE	MAE	Max.abs.err	N
MEPSctrl – synop	0.4	2.4	2.5	1.1	13.0	178
IFS – synop	1.0	2.6	2.8	1.3	19.3	178



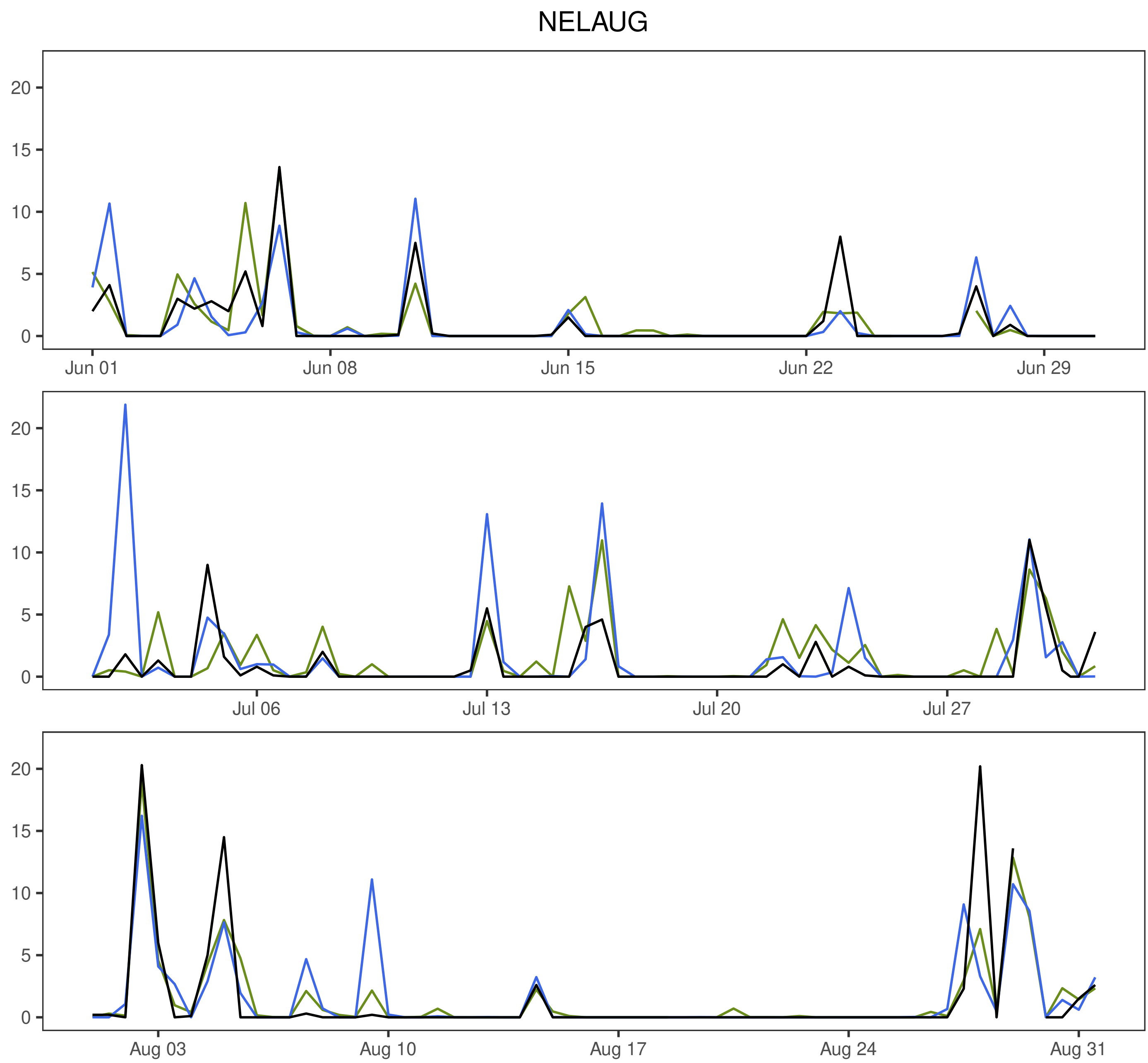
	Min	Mean	Max	Std	N
synop: 06,18	0.0	2.5	28.1	4.7	184
MEPSctrl: 12+18,+30	0.0	2.1	19.6	3.9	184
IFS: 12+18,+30	0.0	2.9	15.7	4.2	178

	ME	SDE	RMSE	MAE	Max.abs.err	N
MEPSctrl – synop	–0.4	3.0	3.0	1.5	15.7	178
IFS – synop	0.4	3.4	3.4	1.8	16.3	178



	Min	Mean	Max	Std	N
synop: 06,18	0.0	1.6	24.4	4.1	184
MEPSctrl: 12+18,+30	0.0	1.2	19.0	2.8	184
IFS: 12+18,+30	0.0	1.5	15.7	3.0	178

	ME	SDE	RMSE	MAE	Max.abs.err	N
MEPSctrl – synop	–0.5	3.0	3.0	1.2	21.2	178
IFS – synop	–0.1	3.2	3.2	1.5	22.0	178



	Min	Mean	Max	Std	N
synop: 00,06,18	0.0	1.1	20.3	3.1	185
MEPSctrl: 12+18,+30	0.0	1.4	21.9	3.3	184
IFS: 12+18,+30	0.0	1.4	19.0	2.8	178

	ME	SDE	RMSE	MAE	Max.abs.err	N
MEPSctrl – synop	0.2	2.8	2.8	1.1	20.1	177
IFS – synop	0.2	1.9	1.9	0.8	13.1	177