Application and verification of ECMWF products 2008

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1. Summary of major highlights

Medium range weather forecasts issued at IMO are mainly based on ECMWF deterministic products. These products are also used in the short range in complement to other models. Local weather forecasts are automatically generated at more than 120 locations in Iceland and 30 foreign locations and some of them made available to the general public and as special services to customers. The EPS products are not received at IMO but regularly consulted on the ECMWF web page. Monthly and seasonal forecasts are also consulted and used to provide guidance to the energy sector. Short and medium range local weather forecasts are verified as in previous years. The verification is performed individually at each station where local forecasts are automatically generated. A daily verification is run and used to appreciate the quality of 2-metre temperature and 10-metre wind-speed forecasts valid from T+12 to T+48 over a 10-day window. A seasonal verification procedure, including precipitation and surface pressure, is run quartely for forecasts valid up to T+168. This procedure is also used for the annual verification over the calendar year. All the results can be consulted internally on a web page.

2. Use and application of products

2.1 Post-processing of model output

2.1.1 Statistical adaptation

Kalman filtering is used to post-process local 2-metre temperature and 10-metre wind-speed forecasts from ECMWF 00 and 12 UTC deterministic runs, up to T+168h (Crochet, 2004).

The probability of precipitation (PoP) in 24h is predicted at 11 locations with a generalized linear model, from D+1 to D+5, using input information from ECMWF 12 UTC deterministic run (Crochet, 2003).

ECMWF 00 and 12 UTC deterministic precipitation forecasts are downscaled using high resolution climatic precipitation maps taking into account the terrain complexity. The resulting maps are derived for precipitation accumulated in 6h, 12h, 24h and 48h up to T+96h.

2.1.2 Physical adaptation

The MM5 NWP model received operationally at IMO with horizontal resolutions of 9 and 3 km is using boundaries from ECMWF.

The climatic precipitation maps used to downscale precipitation forecasts have been derived from a 1-km gridded precipitation dataset made with an orographic precipitation model forced by ERA-40 fields for the period 1958-2001 and ECMWF analysis for the period 2002-2006 (Crochet et. al., 2007; Jóhannesson et. al., 2007). This gridded dataset has been made available to the public domain:

(http://andvari.vedur.is/vedurfar/vedurfarsmyndir/Download/Urkoma/)

2.1.3 Derived fields

2.2 Use of products

During wintertime, ECMWF forecasts are used together with other NWP models to assess the risk of weather conditions that could lead to snow avalanches.

The downscaled precipitation maps are used to assess the rainfall triggered landslide risk by comparison to critical values that depend on the accumulation time and the mean annual precipitation.

3. Verification of products

3.1 Objective verification

3.1.1 Direct ECMWF model output (both deterministic and EPS)

Local 2-metre temperature forecasts exhibit systematic errors at a large number of sites resulting mainly from discrepancies between model and actual orography. Underestimation of 10-metre wind-speed dominates inland, while along the coast, the forecasts tend to exhibit a positive bias. Results also indicate that discrepancies between model and actual orography impact on the the quality of precipitation forecasts. As an example, figure 1 shows that the forecasts overestimate precipitation for Reykjavík (SW Iceland, WMO 4030), located in the lee of a mountain ridge, while 26 km away on the other side of the mountain ridge at Hellisskard (WMO 4862), the forecasts mainly underestimate precipitation (figure 2) and 34 km to the west of Reykjavík, at Keflavík (WMO 4018), a site located in relatively gentle terrain, the forecast is mainly unbiased (figure 3).

3.1.2 ECMWF model output compared to other NWP models

Comparisons of performance of ECMWF model to HIRLAM model are made routinely at all verified locations for 2-metre temperature and 10-metre wind-speed forecasts. These comparisons apply to both DMO and post-processed predictions. The comparisons present time series plots and error statistics, as well as maps showing the model giving the best prediction over a 5-day window according to some criteria. As an example, such a comparison is presented in figure 4 for ECMWF and HIRLAM 00UTC runs for Reykjavík.

3.1.3 Post-processed products

The Kalman filter procedure removes systematic errors. Its prediction intervals are quite reliable at all ranges and most locations, making this information useful to assess the prediction uncertainty, even at sites where there are no systematic errors. As an example, figures 5 and 6 present the statistical scores obtained for the 2-metre temperature and 10-metre wind-speed forecasts for Reykjavík in 2007.

The verification indicates that the PoP prediction is usually reliable at most forecast ranges and sites where it is estimated.

3.1.4 End products delivered to users

3.2 Subjective verification

3.2.1 Subjective scores (including evaluation of confidence indices when available)

3.2.2 Synoptic studies

4. References to relevant publications

Crochet, P., 2003: A statistical model for predicting the probability of precipitation in Iceland. IMO report, 03028. http://www.vedur.is/utgafa/greinargerdir/2003/03028.pdf

Crochet, P., 2004: Adaptive Kalman Filtering of two-metre temperature and ten-metre wind-speed forecasts in Iceland. Meteorol. Appl. 11, 173-187.

Crochet, P., T. Jóhannesson, T. Jónsson, O. Sigurðsson, H. Björnsson, F. Pálsson and **I. Barstad**, 2007: Estimating the spatial distribution of precipitation in Iceland using a linear model of orographic precipitation. *Journal of Hydrometeorol.* **8**, (6), 1285-1306.

Jóhannesson T., G. Aðalgeirsdóttir, H. Björnsson, P. Crochet, E.B. Elíasson, S. Guðmundsson, J.F. Jónsdóttir, H. Ólafsson, F. Pálsson, Ó Rögnvaldsson, O. Sigurðsson, Á. Snorrason, O.G. Blöndal Sveinsson, T. Thorsteinsson, 2007: Effect of climate change on hydrology and hydro-resources in Iceland. Reykjavík, National Energy Authority, Report ISBN 978-9979-68-224-0, OS-2007/011, 91pp. (http://www.os.is/ces)

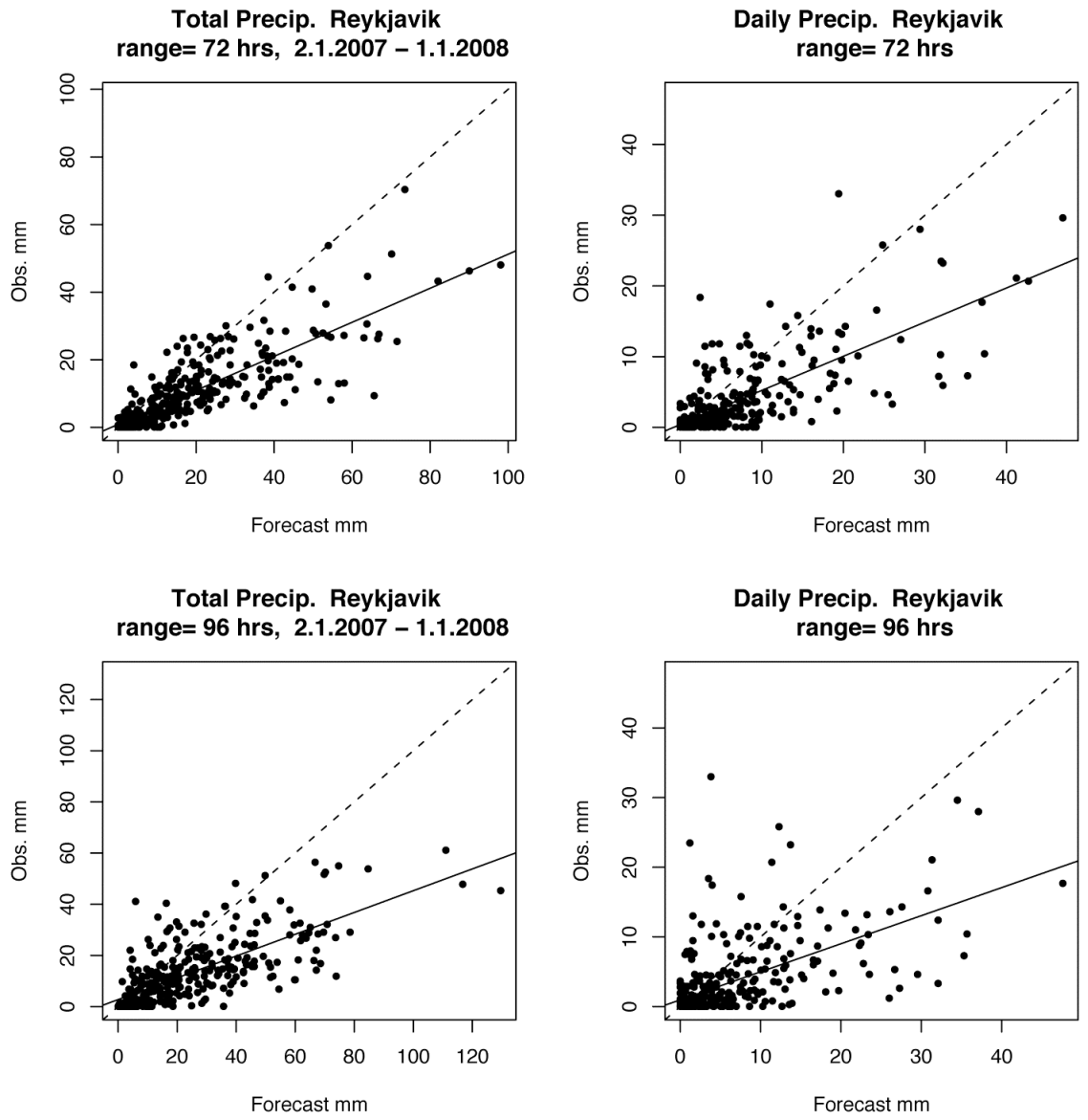

Fig. 1 Verification of ECMWF precipitation forecasts (12UTC run) for Reykjavík (WMO 4030) in 2007. Top left: accumulated precipitation in 72h valid at T+72, top right: 24h accumulated precipitation valid at T+72. Bottom left: accumulated precipitation in 96h valid at T+96, bottom right: 24h accumulated precipitation valid at T+96.

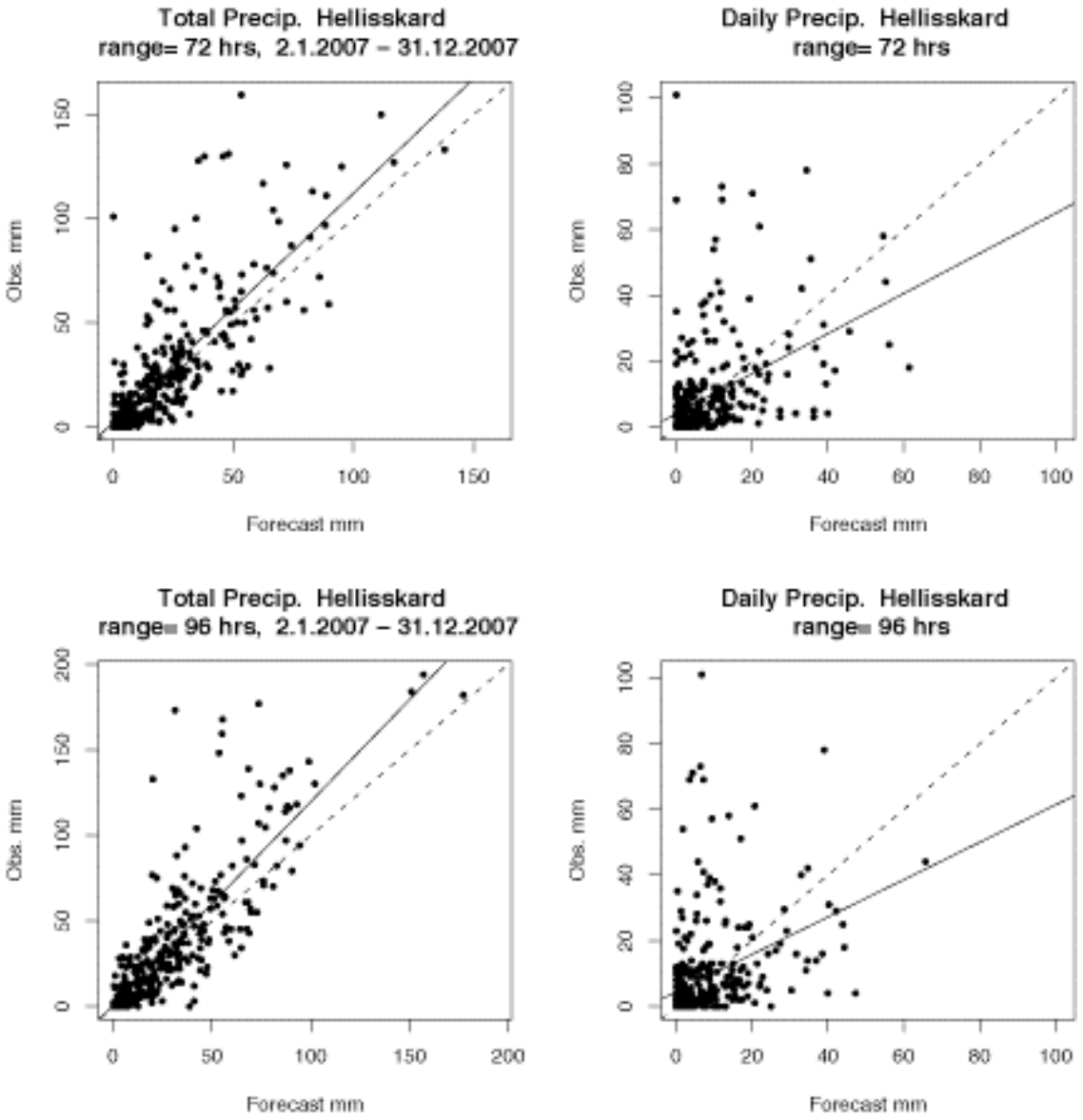

Fig. 2 Same as Fig. 1 for Hellisskard (WMO 4862).

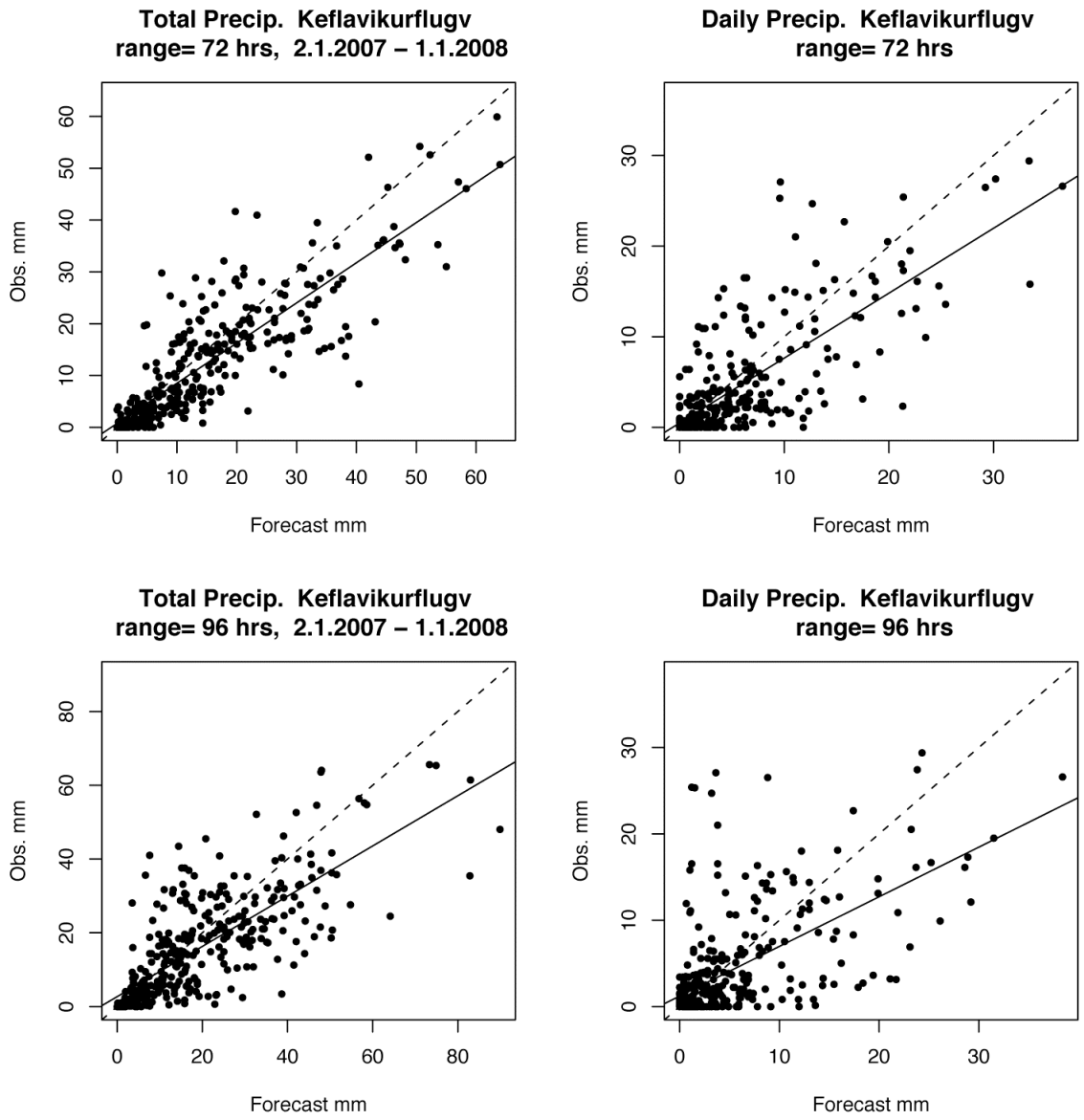

Fig. 3 Same as Fig. 1 for Keflavík (WMO 4018).

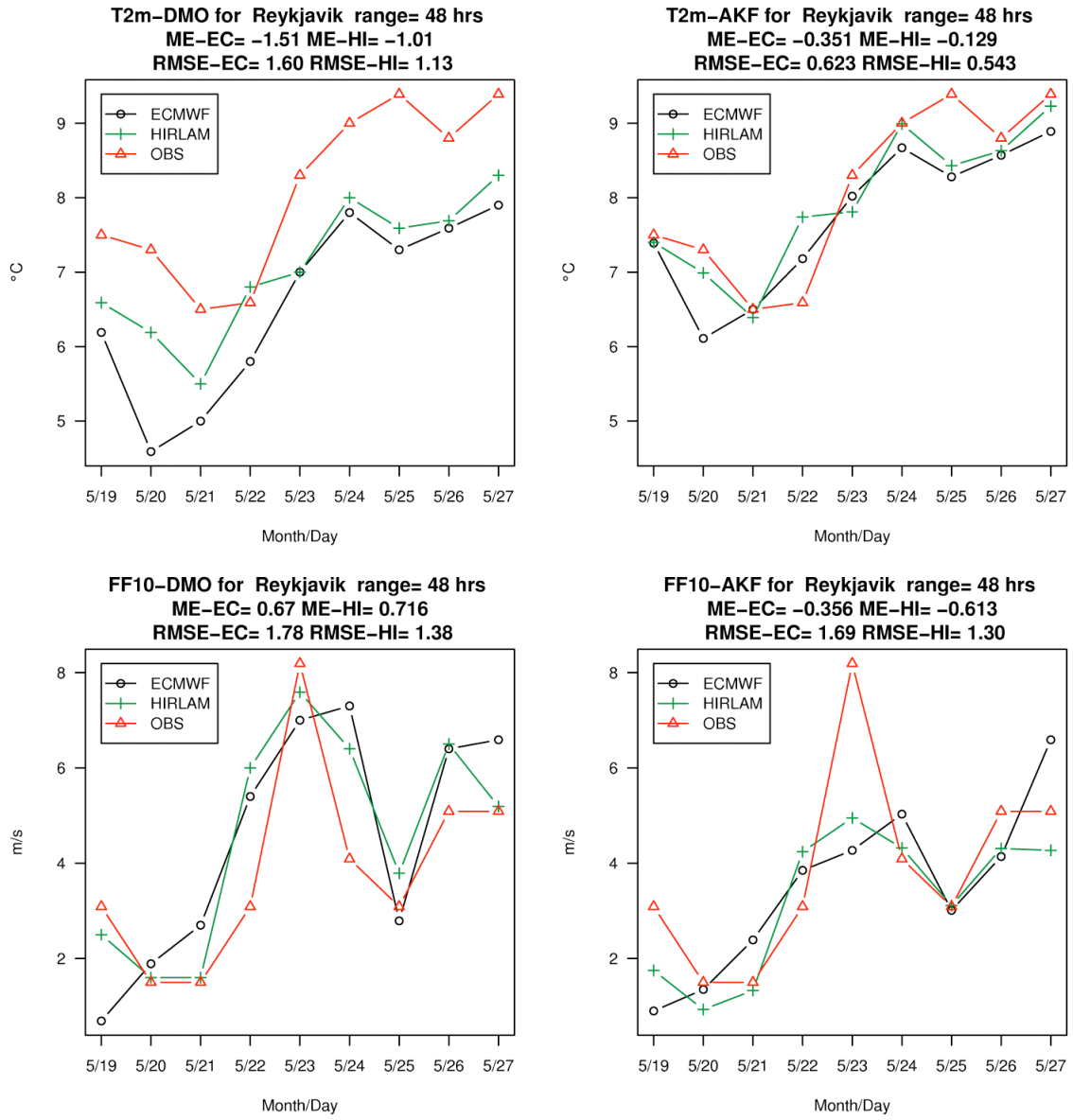

Fig. 4 Comparison of ECMWF and HIRLAM (00UTC run) 2-m temperature and 10-m wind-speed forecasts for Reykjavík (WMO 4030) from 19 May to 27 May 2008. Top left: DMO 2-m temperature at T+48h, top right: Kalman filtered 2-m temperature at T+48h. Bottom left: DMO 10-m wind-speed at T+48h, bottom right: Kalman filtered 10-m wind-speed at T+48h.

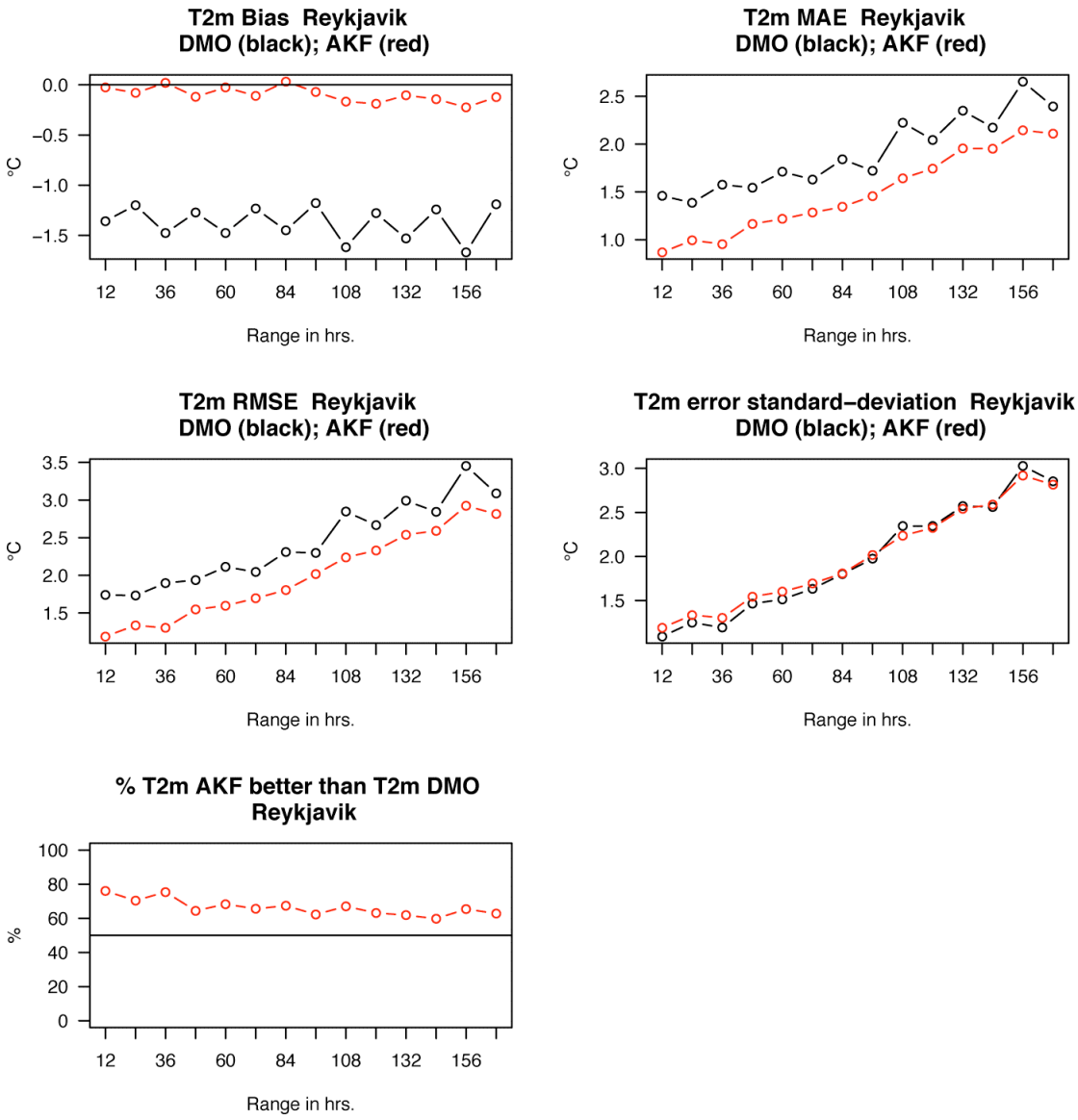

Fig. 5 Verification of ECMWF (12UTC run) DMO and Kalman filtered 2-m temperature forecasts for Reykjavík (WMO 4030) in 2007. Statistical scores versus forecast range.

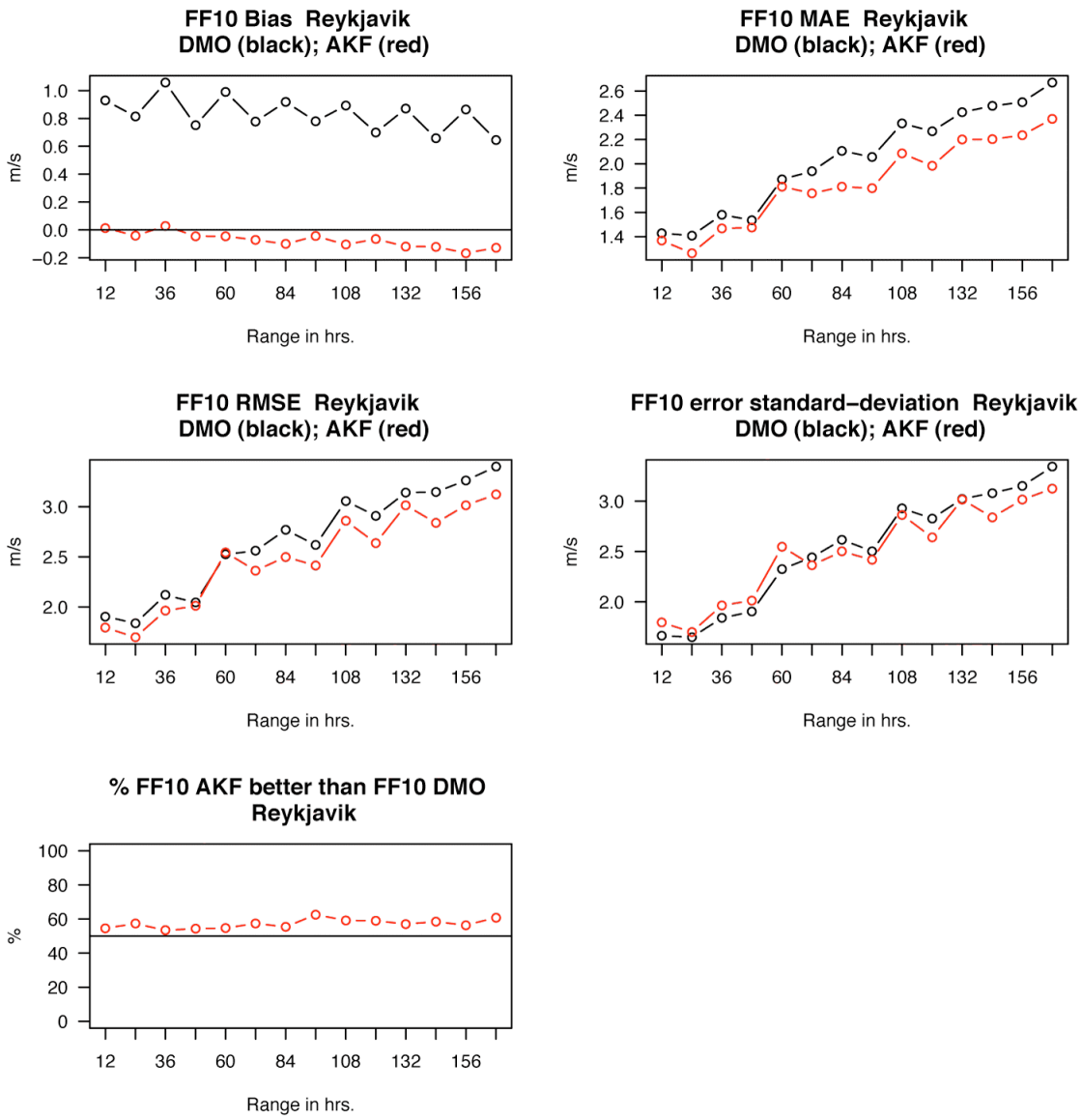

Fig. 6 Verification of ECMWF (12UTC run) DMO and Kalman filtered 10-m wind-speed forecasts for Reykjavík (WMO 4030) in 2007. Statistical scores versus forecast range.