Application and verification of ECMWF products 2011

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1. Summary of major highlights

A wide range of ECMWF products are used in the operational production at forecast at DMI. The deterministic medium-range forecast is still favoured of the duty forecasters, but the ensemble based products are becoming more important, as the forecast is prolonged and the uncertainty has been accepted as important information among the users. In 2011 the information at dmi.dk has been improved, so all information for the coming 15 days is shown as probabilistic forecasts.

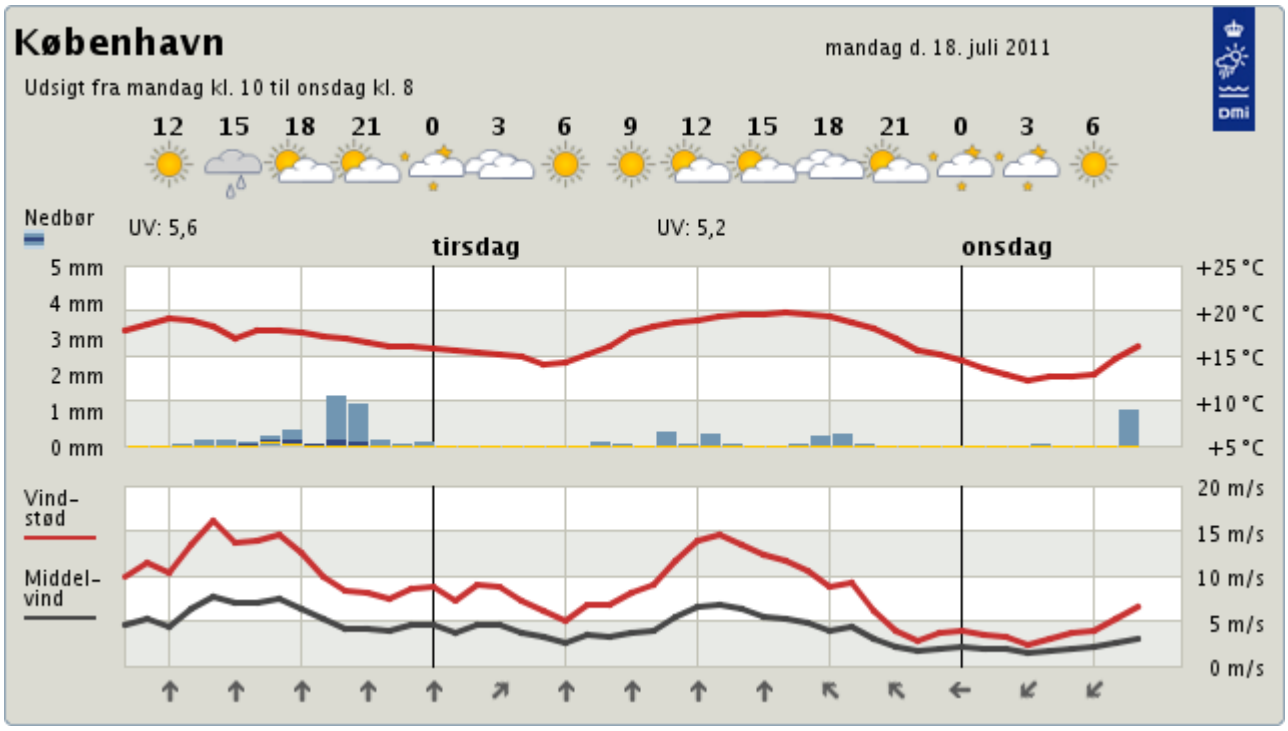


Figure 1 Day 1–2 is based on a newly developed DMI-HIRLAM ensemble prediction system.

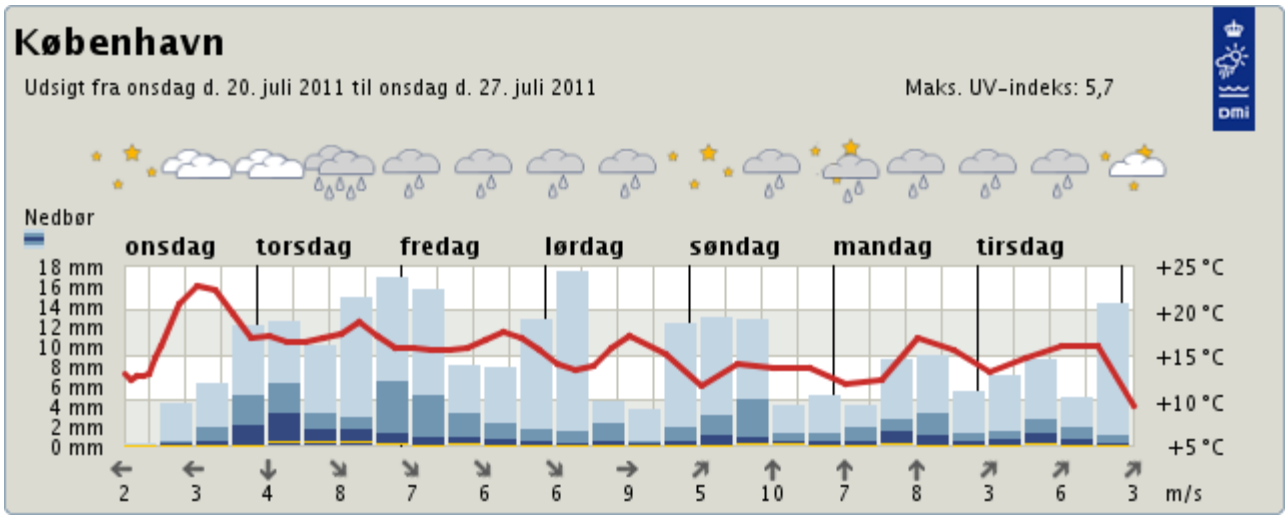


Figure 2 Day 3 to 9. Precipitation is derived from ECMWF EPS while temperature, wind and cloud cover are taken from the deterministic forecast.

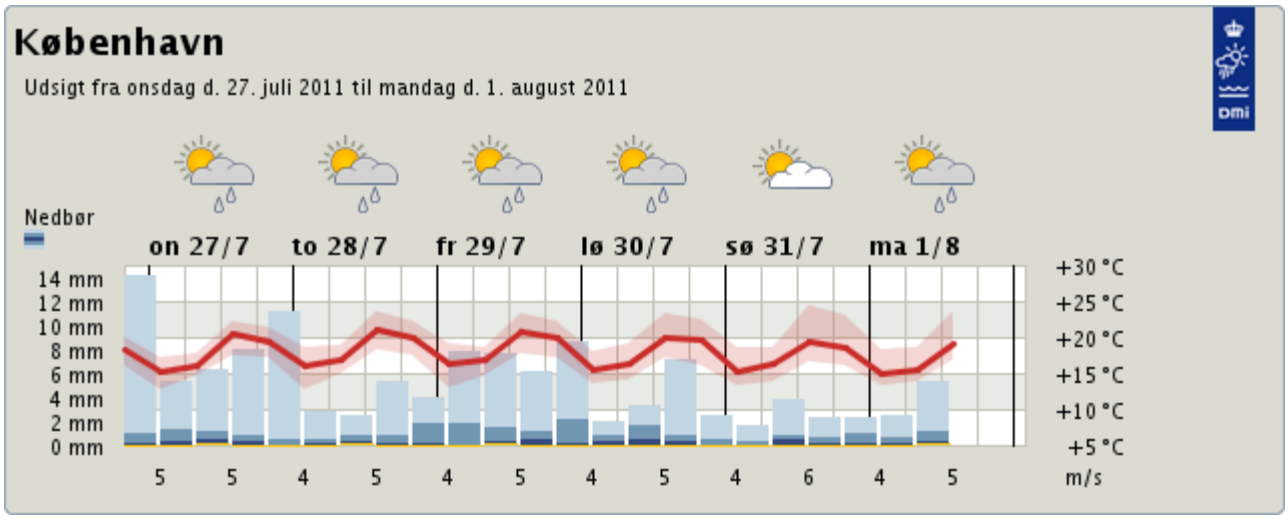


Figure 3 Day 10–15. All graphics are derived from the ECMWF EPS. Wind is ensemble mean and no wind direction can be shown. The cloud cover is derived the mean value of the precipitation.

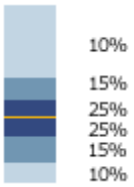


Figure 4 Legend for uncertainty in precipitation, which is shown for 6-hours periods where the orange line is representing the median values and blue shaded areas the quantiles.

DMI is also producing weather information for the Greenland area. As Greenland is outside the HIRLAM ensemble domain, probabilistic data from the ECMWF EPS is shown, and this in a slightly different manner where the most likely outcomes are categorized in three different scenarios.

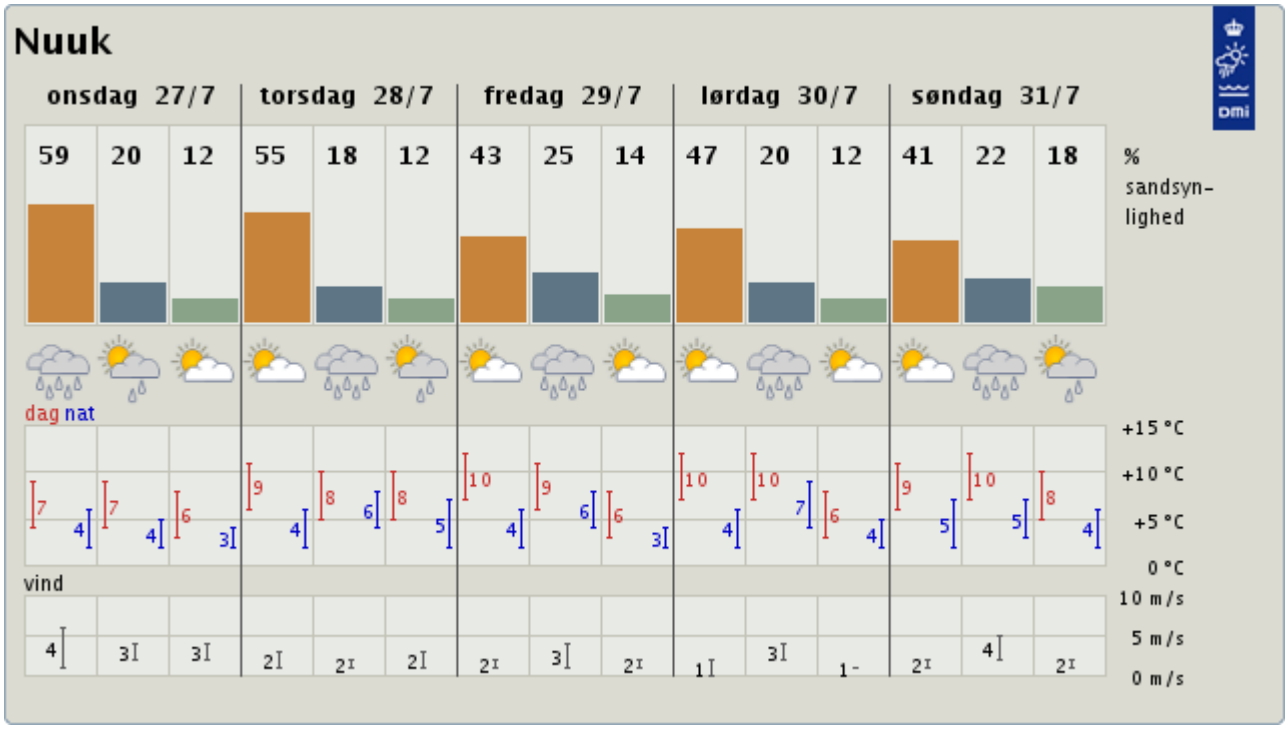


Figure 5 Day 10–14 for Nuuk. For Greenland the three most likely outcomes for wind and temperature is derived and categorized directly from ECMWF EPS.

2. Use and application of products

Most of the DMI operational production on the medium range timescale is based on ECMWF deterministic and EPS data. The forecasters at the public weather service are using ECMWF data for both text forecast and graphics. Also the automatic generated forecasts are based on ECMWF after the first 48 hours.

Every week the ECMWF EPS monthly forecast are used for a text forecast to the public at dmi.dk as well as different commercial products for the energy supply business.

A seasonal forecast for the 2m temperature for the Danish area of interest is displayed at dmi.dk along side a text forecast, both are updated monthly as soon as a new prognosis arrives.

As the anomaly maps at dmi.dk are based on the WMO 30-years normal adapted from 1961-90, the DMI seasonal map differs slightly from the ECMWF presentation (which is based on a 30-years running mean). The seasonal forecast did get a lot of media attention during this winter 2010/11 due to its difference from the monthly forecast.

2.1 Post-processing of model output

2.1.1 Statistical adaptation

Filtering and statistical treatment of model data are not used in any products.

2.1.2 Physical adaptation

The Hirlam model suite consists of different resolutions between 3 and 15 kilometres in three domains. A new development is that all models are now using ECMWF as boundary conditions and the nested HIRLAM model suite has been phased out.

An important element of the Danish disaster preparedness setup is a dispersion model (DERMA) which is based on ECMWF input. This model is able to make a trajectory calculation of pollutants as volcanic ash and radioactive emissions.

2.1.3 Derived fields

DMI is not using any derived fields from EC NWP data, except for the seasonal temperature anomaly chart for North-western Europe mentioned in chapter 2. The Danish City weather product, which is shown in chapter 1, is using EPS data without any filtering.

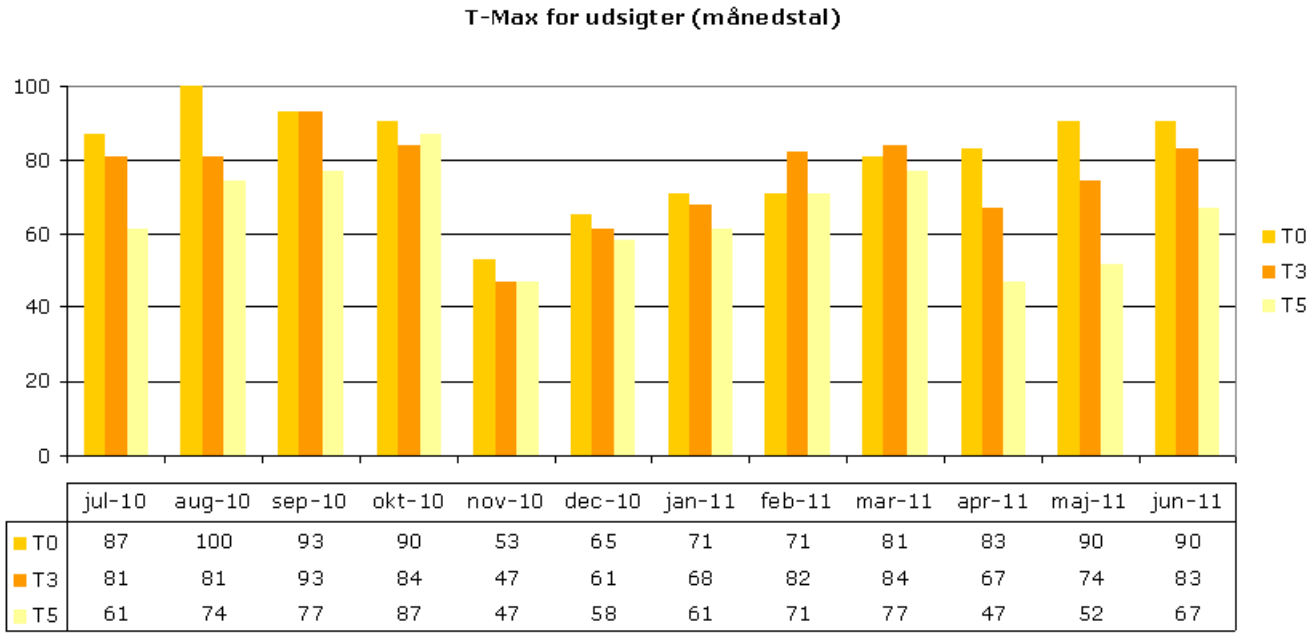
2.2 Use of products

The ECMWF medium range products including the EPS are extensively used as a primary source of information in the public weather service. Also our commercial service is highly dependent of both the deterministic forecast worldwide as well as the quality of the ECMWF WAM model. The forecasters of the DMI Maritime Service are using the EC-models worldwide in order to produce forecasts and provide commercial ships with routeing advices. The onboard systems of the costumers of Maritime Service are supported with ECMWF GRIB data as part of the service provision.

In potential severe weather situations the preferred models are the high resolution DMI-HIRLAM models, the DMI-WAM model and our 3-D seamodel DKSS 2010. As the in-house models are our primary tools in severe weather situation we have not really any experience with the EFI-index, but the deterministic model is quite usable.

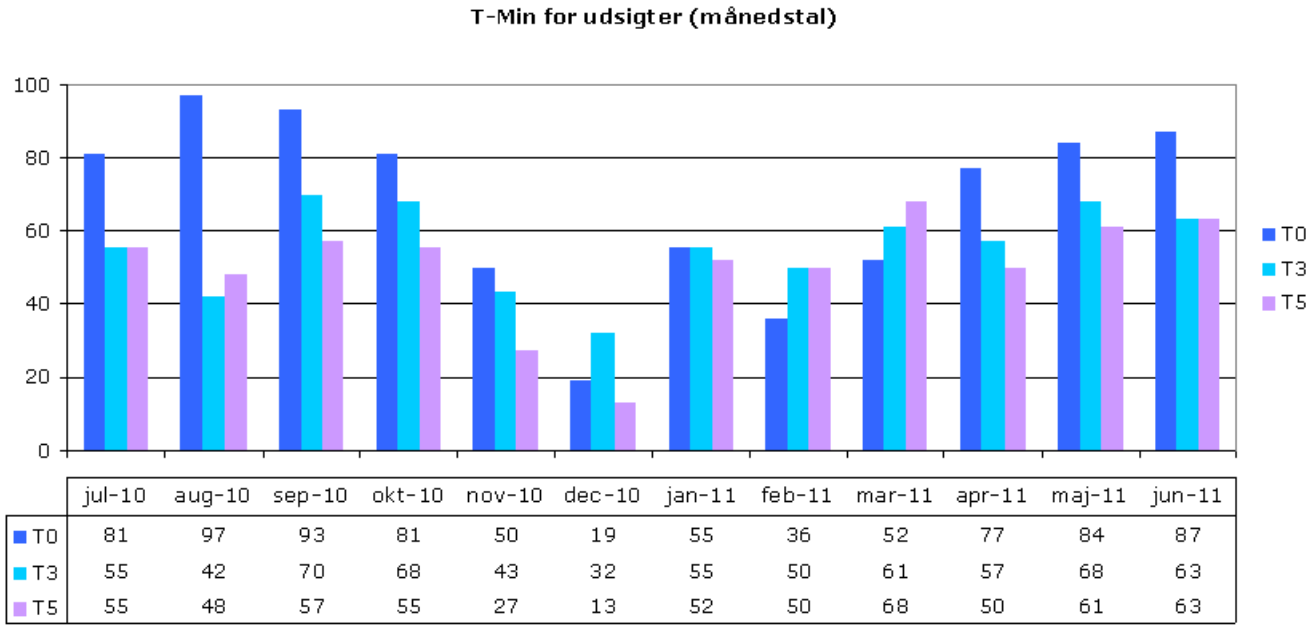
3. Verification of products

The direct ECMWF model output is verified against observations for day 0, 3 and 5 which is corresponding to forecast lengths of +12hrs, +84hrs and +132hrs. We are making a monthly verification of max- and minimum temperatures. The observed maximum and minimum temperatures over Denmark are estimated as the 80% quantile of all synop observations. This technique filters errors and outliers and provides some representative extreme values. The shown figures for the extreme temperatures are Hit Rate for ± 2 degrees. The score is valid for the entire Danish area, and is not taking the Faroe Islands and Greenland into account.



	jul-10	aug-10	sep-10	okt-10	nov-10	dec-10	jan-11	feb-11	mar-11	apr-11	maj-11	jun-11
T0	87	100	93	90	53	65	71	71	81	83	90	90
T3	81	81	93	84	47	61	68	82	84	67	74	83
T5	61	74	77	87	47	58	61	71	77	47	52	67

Figure 6 Monthly HR ± 2 for T max. of ECMWF raw output verified against the Danish synop network. T0, T3 and T5 corresponds to +12hrs, +84hrs and +132hrs. The scores show a significant drop in November 2010.



	jul-10	aug-10	sep-10	okt-10	nov-10	dec-10	jan-11	feb-11	mar-11	apr-11	maj-11	jun-11
T0	81	97	93	81	50	19	55	36	52	77	84	87
T3	55	42	70	68	43	32	55	50	61	57	68	63
T5	55	48	57	55	27	13	52	50	68	50	61	63

Figure 7 Monthly HR ± 2 for T min. of ECMWF raw output verified against the Danish synop network. T0, T3 and T5 corresponds to +12hrs, +84hrs and +132hrs. The scores show a significant drop in November and December 2010.

3.1 Objective verification

3.1.1 Direct ECMWF model output (both deterministic and EPS)

No verification.

3.1.2 ECMWF model output compared to other NWP models

Verification for April 2011 for exposed stations (EWGLAM) for DMI-HIRLAM T15, T1T and ECMWF (ECH) models. T15 is the DMI-HIRLAM version covering the greatest area. T1T is a test version of T15 with same resolution and domain. The improvements are mainly in the assimilation. The included forecasts from the models are with initial time 00UTC, 06UTC, 12UTC and 18UTC. The curves show standard deviation and bias. ECMWF performs well for all parameters and do not seem to suffer over the coarse resolution compared to the high resolution models. This may however partially be explained by the EWGLAM selection of stations.

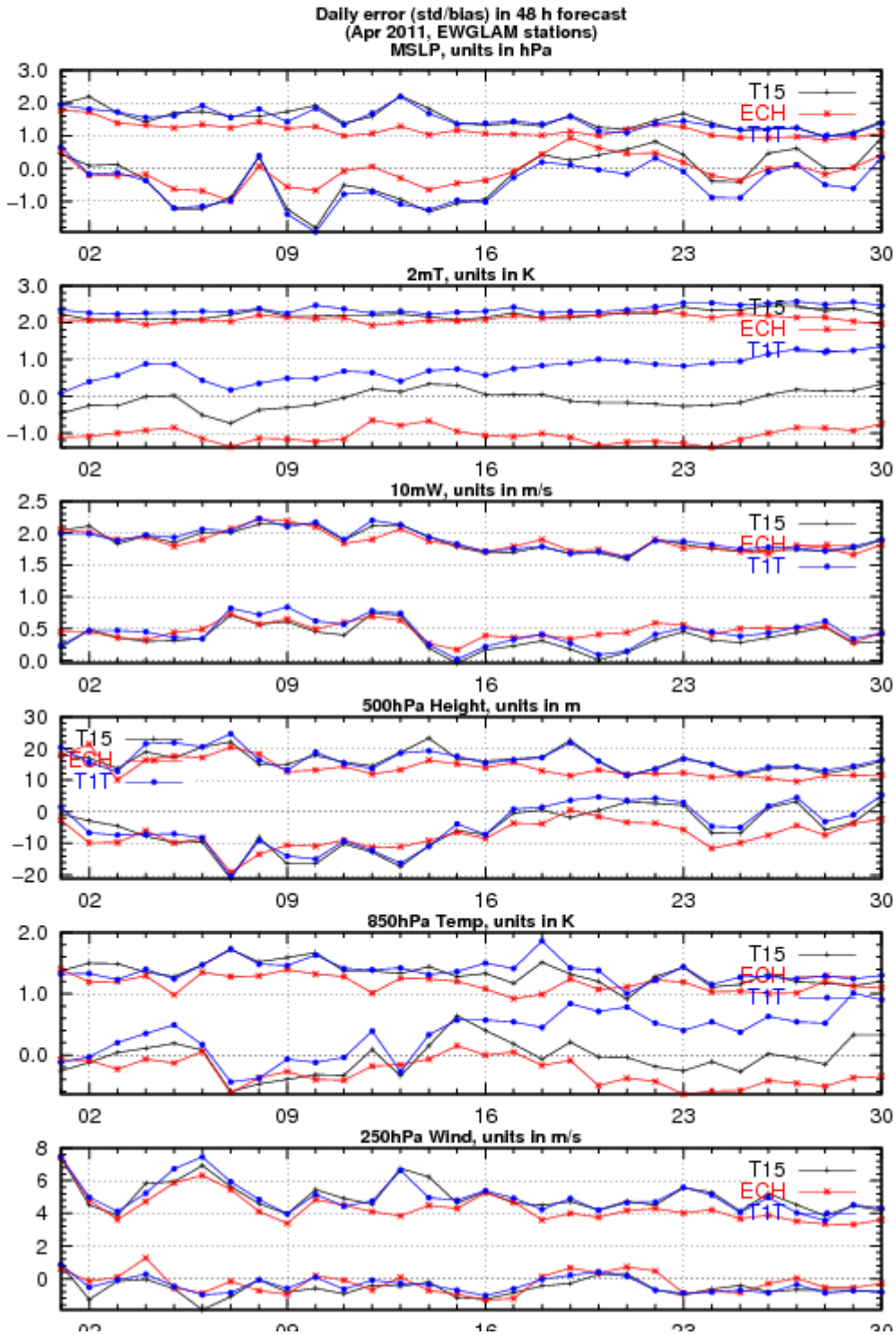


Figure 8 Verification against EWGLAM stations. T15 is an operational DMI-HIRLAM and T1T is a test version. The upper three plots shows surface parameters and the last three displays geopotential height, temperature and wind speed as upper atmospheric parameters

3.1.3 Post-processed products

No verification.

3.1.4 End products delivered to users

No verification.

3.2 Subjective verification

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

The forecasters are still very pleased with the performance of the ECMWF cloud cover. Also they have noticed great improvements in description of snow cover, which has provided better minimum temperatures this winter (2010/11).

3.2.2 Synoptic studies

The new web based visualisation tool “wrep.ecmwf.int” (Web Re-Engineering Project) has been extensively used. This is both because this new presentation tool is well suited to work with the for the duty forecaster, but also due to limitations in bandwidth on the existing DMI/EC data transmissionline, which coarse a delay of new data in DMI's inhouse presentation tools.

Also the EPS test visualisation tool “nwmstest.ecmwf.int/products/forecasts/cdb/” is used to some extend.

4. References to relevant publications

Only DMI internal verification has been used, so no references to publications.