# Application and verification of ECMWF products 2010

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1.   Summary of major highlights

The ECMWF deterministic forecasts are used extensively by the duty forecasters and also to produce a wide range of automatic forecasts. The ocean model is primarily used by the Danish Maritime Service, one of the largest ship routing services in Europe.

The information on the DMI website http://www.dmi.dk has been improved in geography as well as in time. Information in graphical format is now given for cities in Greenland. The information contains forecasts for the next 48 hours taken from HIRLAM and forecasts for day 3 through 9 based on ECMWF deterministic forecast.
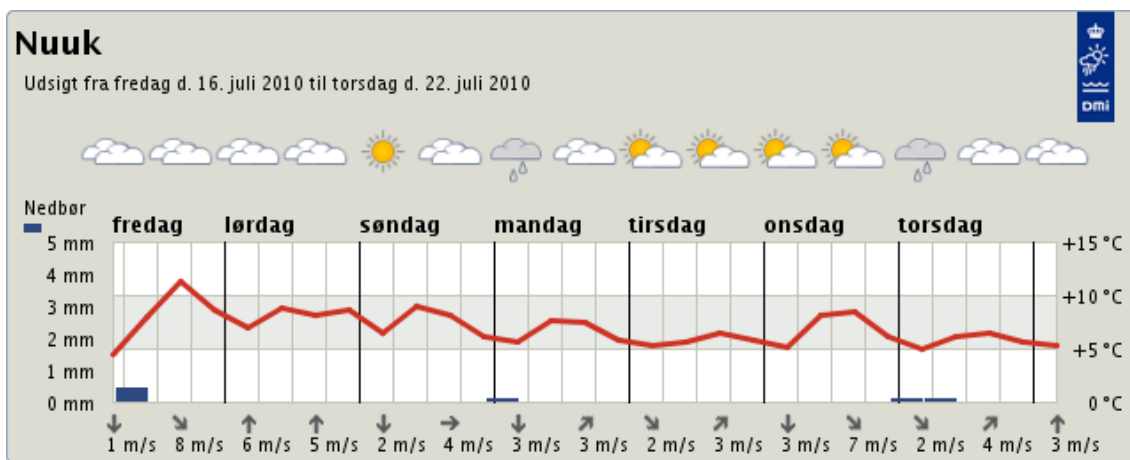
**3-9 day forecast for Nuuk taken from www.dmi.dk**

Last but not least probabilistic forecasts for day 10 to 14 based on ECMWF EPS system. Forecasts are given with probabilities for the 3 most likely scenarios based on the combined forecasted temperatures, wind, cloud amount and precipitation from a group of ensemble members with similar forecast values.
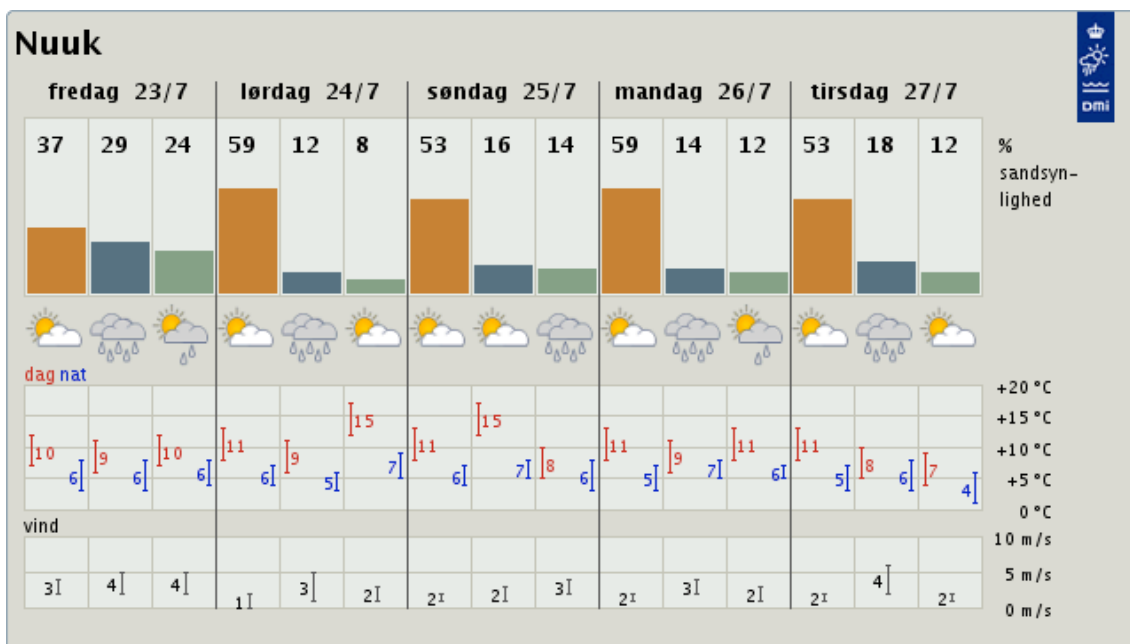
EPS forecast for Nuuk

2.   Use and application of products

Ensemble and monthly forecasts are used for briefings to energy companies
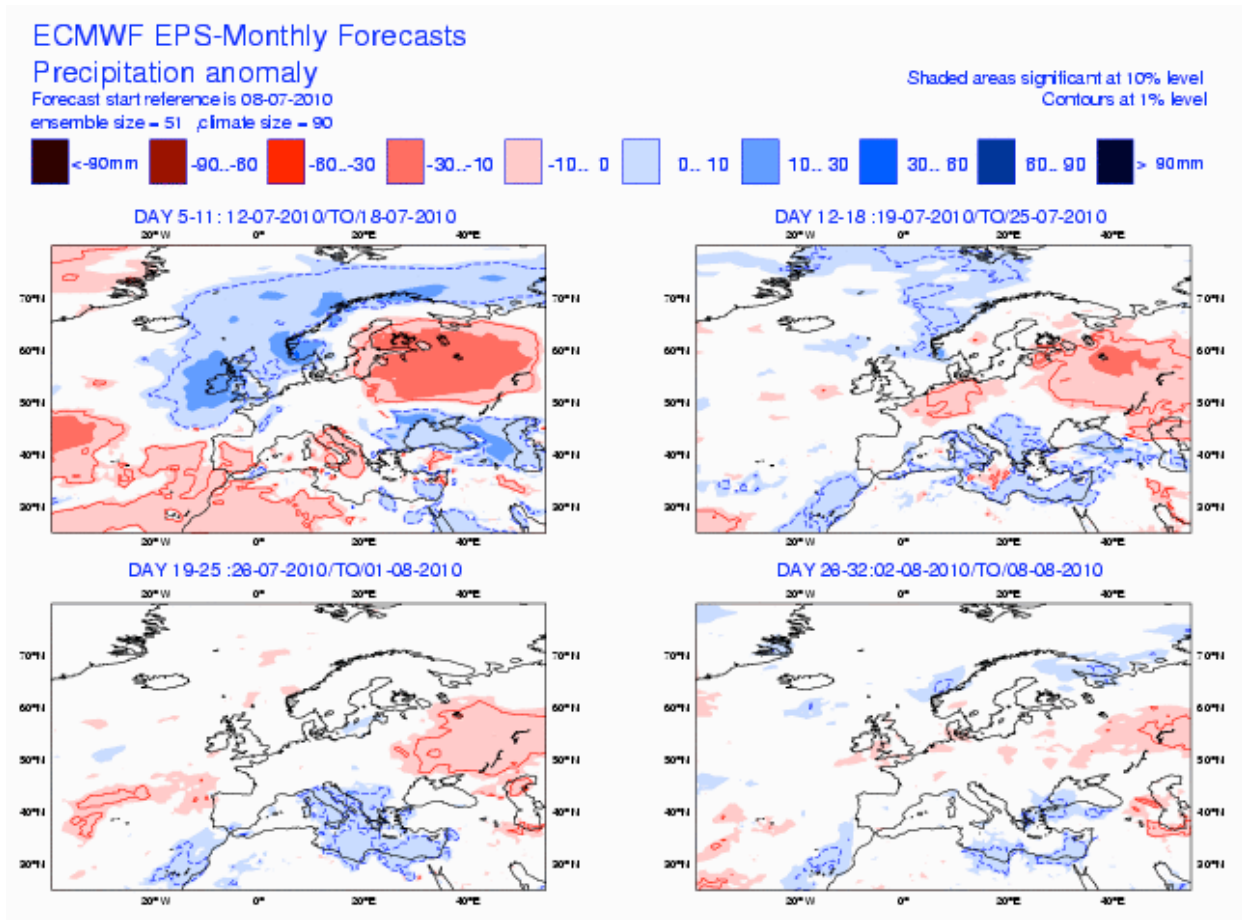
Example of ECMWF product used for the energy briefings

The EPS output is used for as a five days extension for our automatically generated deterministic forecasts on day 10-14. We are also providing a 30-days probability forecast for the 2m temperature for commercial supply companies. Last the EPS products are used as general guidelines for the confidence of the regular day 1-7 forecast.

2.1   Post-processing of model output

2.1.1   Statistical adaptation

Filtering and statistical after treatment are not used in any products

2.1.2   Physical adaptation

Including limited-area models, hydrological models, dispersion models etc. using ECMWF model data as input

The Hirlam model suite consists of 3 different resolutions. ECMWF is used as boundary conditions for the 15 km, which are providing boundary conditions for the nested high resolution models.

As an important element of the Danish disaster preparedness setup the weatherservice are able to make a trajectory calculation of pollutants based on ECMWF data.

2.1.3   Derived fields

None

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 weatherservice. 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.

In potential severe weather situations the preferred models are the high resolution DMI-HIRLAM models, the DMI-WAM model and our 3-D seamodel BSH-cmod. 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

## 3.1   Objective verification

3.1.1 Direct ECMWF model output (both deterministic and EPS)

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 temperature over Denmark is estimated as the 80% quantile of all synop observations of maximum temperature. This technique filters errors and outliers and provides some representative extreme values.


HR2 12 month running mean March 2010
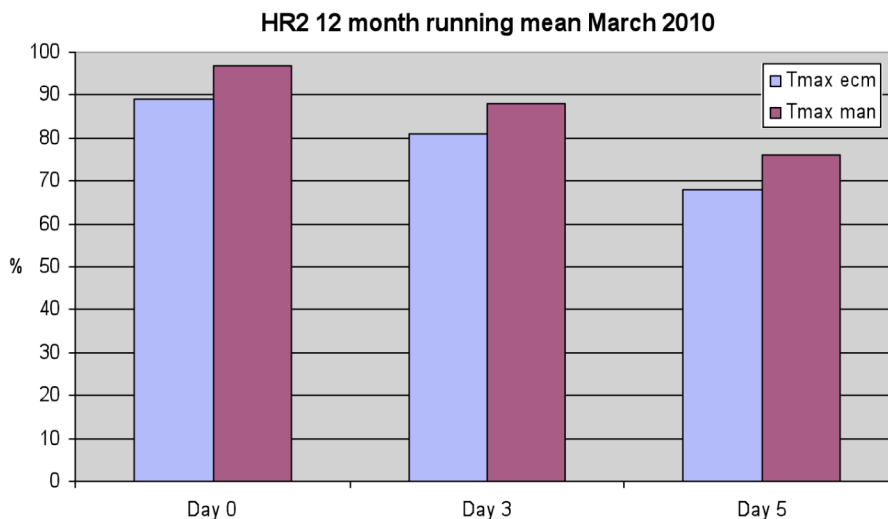
Tmax 12 month running mean Hit Rate calculated for +/- 2 degrees for ecmwf direct output (blue) and manual forecast (red)

Comparison between the direct model output and the manual forecast shows that the latter is an improvement and that the Tmax is better forecasted than the Tmin for both.

HR2 12 month running mean March 2010
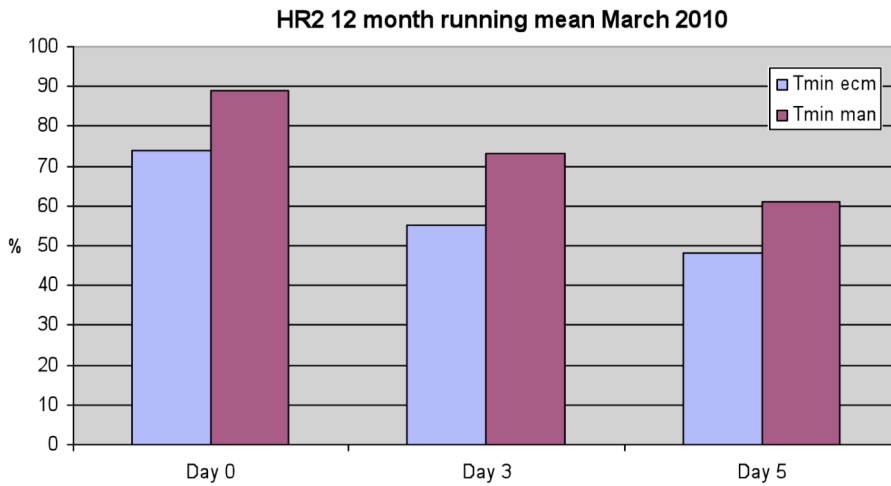
Tmin 12 month running mean Hit Rate calculated for +/- 2 degrees for ecmwf direct output (blue) and manual forecast (red)

3.1.2   ECMWF model output compared to other NWP models
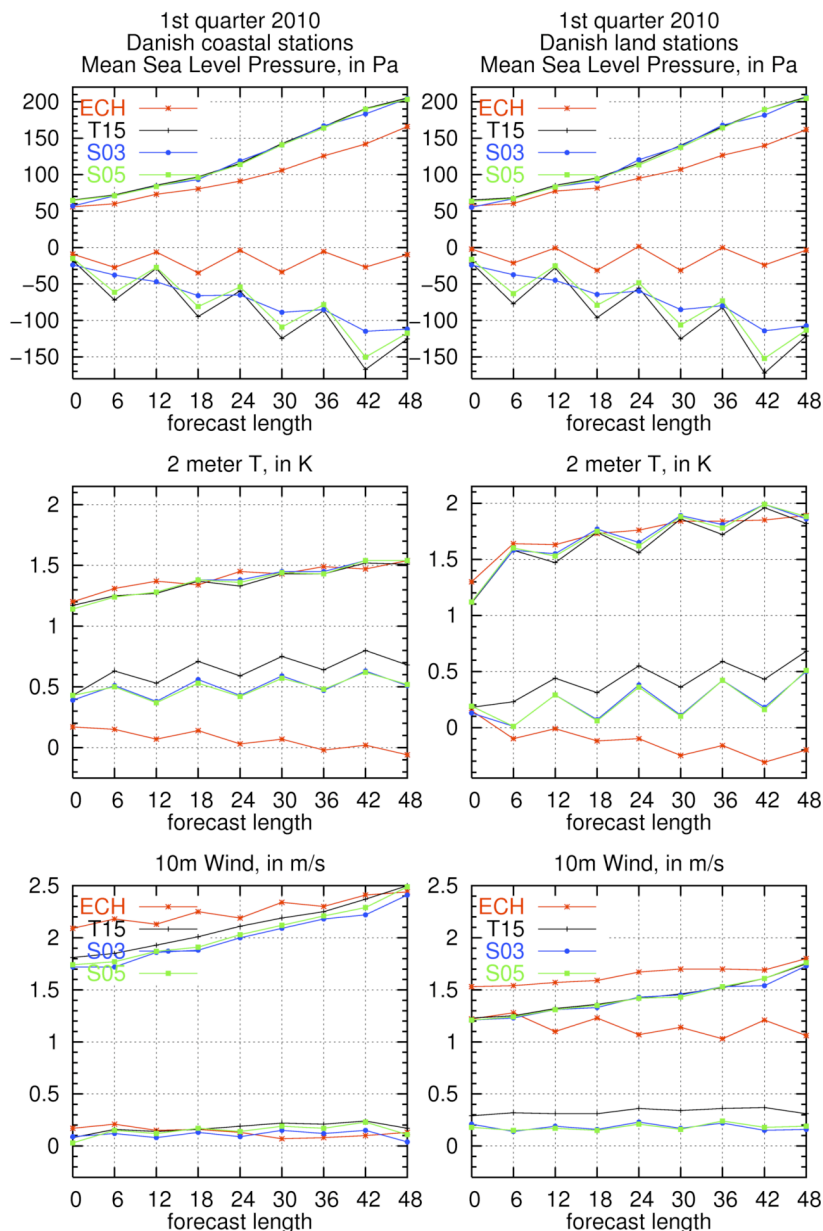
Standard deviation (upper curves) and bias (lower curves) for EC, DMI-HIRLAM T15, S03 and S05 for various parameters divided into Danish costal and in land stations

Verification for 1st quarter 2010 for coastal (left) and in land stations (right) for DMI-HIRLAM T15, S03 and S05 and ECMWF (ECH) models. The included prognosis for the models are with initial time 00UTC, 06UTC, 12UTC and 18UTC. The upper curves show the standard deviation and the lower curves shows the bias. The ECMWF outperforms the other models in the surface pressure but scores (not surprisingly) slightly below the high-resolution models for the 10m wind.

3.1.3 Post-processed products

Filtering and statistical after treatment are not used in any products

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