Application and verification of ECMWF products 2014 at the Finnish Meteorological Institute

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1. Summary of major highlights

FMI's production system relies heavily on deterministic ECMWF model and EPS products. ECMWF EPS products are now available for general public at FMI's webpage. Also Finnish Broadcasting Company has shown EPS products at their weather forecasts.

There is a negative bias in 2m temperature forecast during spring. During cold spells ECMWF model was unable to forecast surface inversion.

2. Use and application of products

FMI's medium and long range weather forecasts are based on ECMWF deterministic and EPS products. In the short range also limited area models HIRLAM/HARMONIE are used, but ECMWF also provides boundary conditions to these high resolution models run at FMI. Monthly and seasonal forecasts are used by energy customers and general public is also very interested about this information.

2.1 Post-processing of model output

Manual editing done by forecasters (by choosing different model or adjusting ECMWF) plays a crucial role in our production system. In near future FMI is focusing more on developing post-processing systems. This will be done in collaboration with researchers, product developers and on duty forecasters. At the moment Kalman filtering is done to ECMWF 2m temperature. Post-processing is done to improve wind gust forecasts. FMI also uses ECMWF to calculate weather parameters that model doesn't provide for example precipitation form, probability of thunder and probability of precipitation.

2.2 Use of products

Majority of FMI's weather forecasts are based on ECMWF products. ECMWF provides input for various applications like limited area models, dispersion and trajectory models, hydrological models (run by Finnish Environmental Institute), road condition models and wave models.

3. Verification of products

Verification information of local weather parameters is used widely at FMI. Verification is used to monitor the quality of our forecasts and also to improve our forecasts. FMI's verification interface makes it possible for on duty forecaster to easily access verification information.

3.1 Objective verification

3.1.1 Direct ECMWF model output (both deterministic and EPS)

Surface parameter verification results are from FMI's verification system.

3.1.2 ECMWF model output compared to other NWP models

ECMWF 2m temperature has a negative bias in spring time, especially evening hours are too cold (fig 1.). This is a problem in our general weather forecasts but also for our end users. For example Finnish Environmental Institute uses ECMWF products in their hydrological models to calculate flood risks. During spring time, when snow is melting, too cold evening temperatures cause underestimation in flood probabilities.

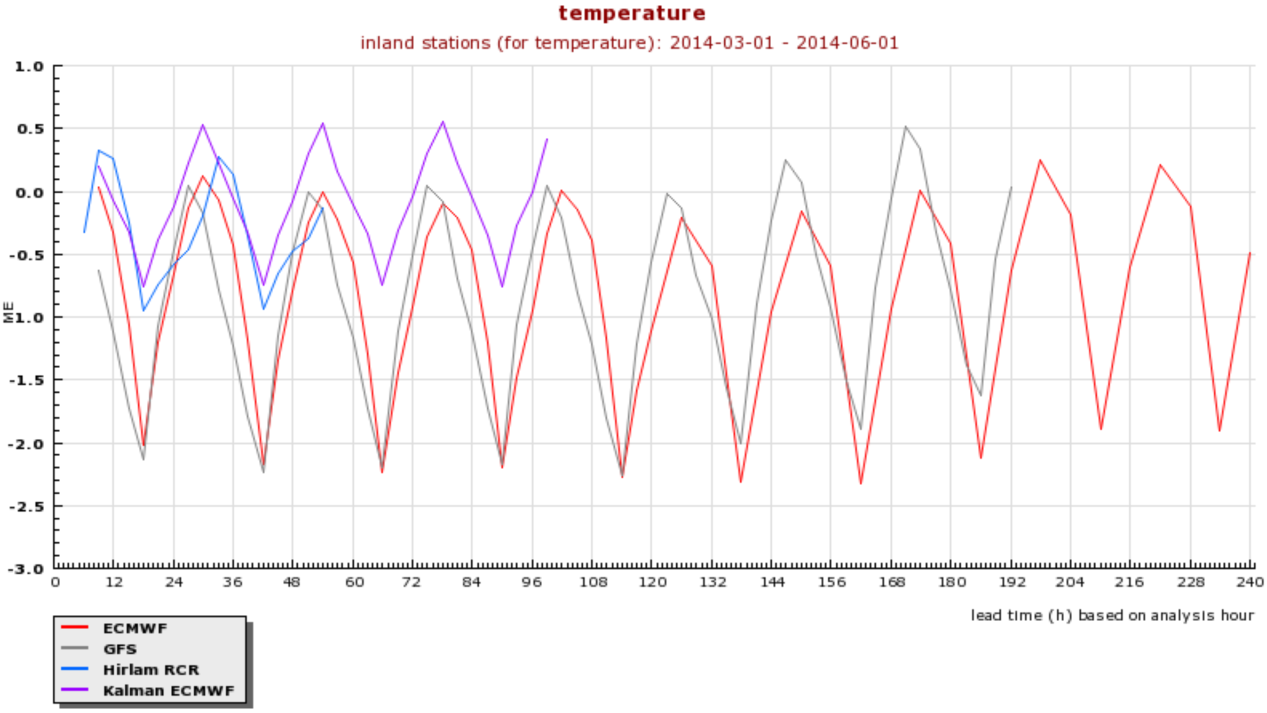

Fig. 1: *Mean error (ME) of 2m temperature forecast of different models for a group of 30 inland observation stations in Finland in spring (MAM) 2014 based on analysis hour 00 UTC. Figure shows negative bias in ECMWF forecast especially during evening hours. Kalman filtering (Violet curve) improves ECMWF forecast.*

3.2 Subjective verification

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

During cold spells in winter 2014 ECMWF was unable to forecast surface inversion. Therefore 2m temperature forecasts during cold spells were too warm (fig. 2 and 3). This problem was already reported to ECMWF previously this year.

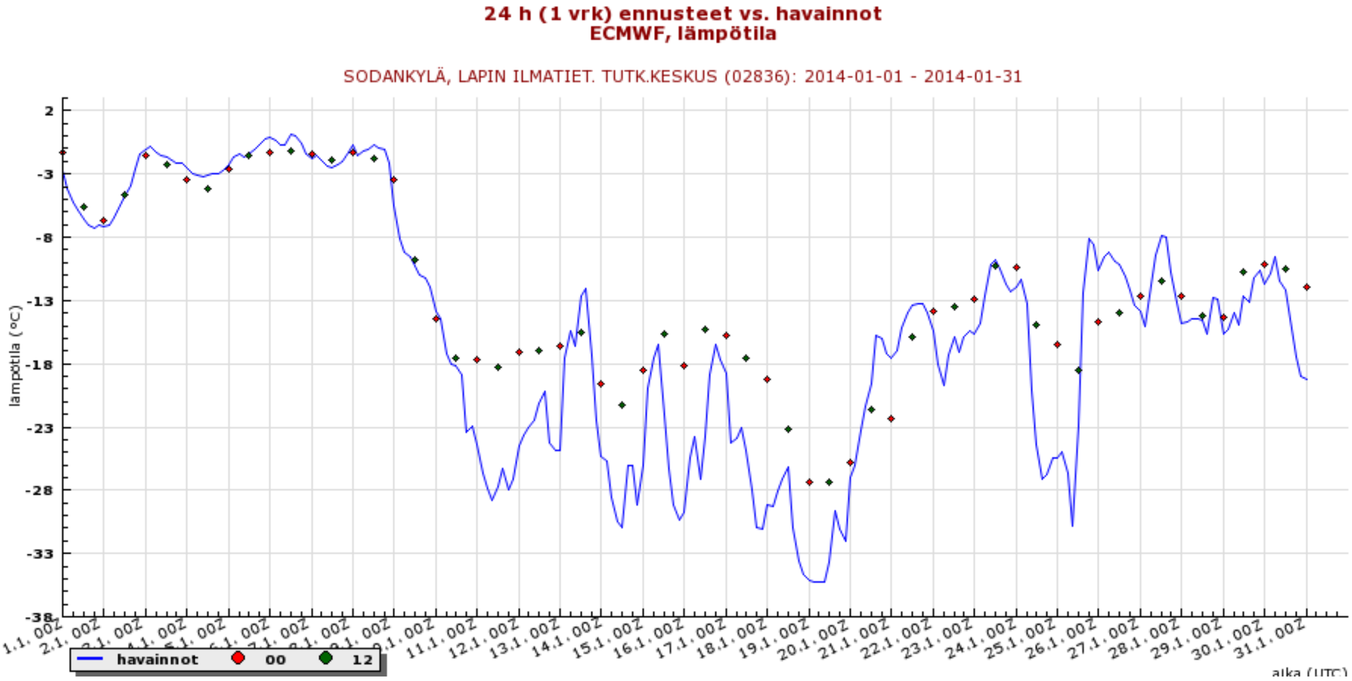

Fig. 2: 2m temperature observations (blue curve) and 24h forecasts of 00 UTC and 12 UTC model runs in Sodankylä in January 2014. ECMWF temperature forecasts are too warm during cold spell 11th to 21st of January.

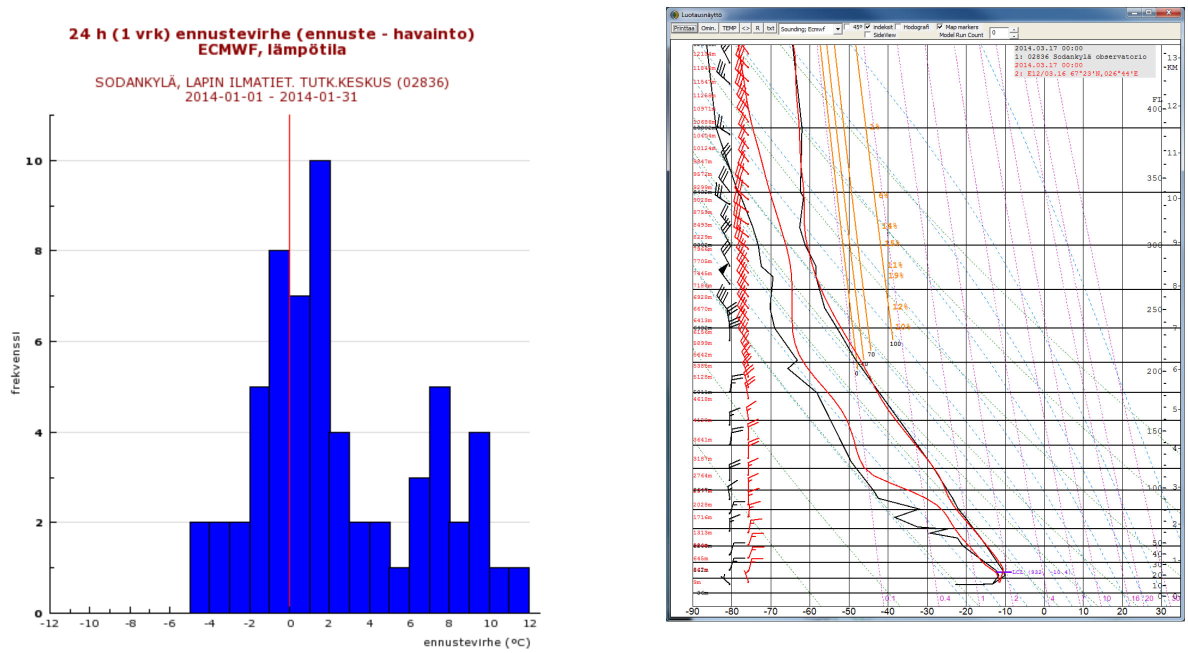

***Fig. 3: Left**: Histogram of ECMWF 2m temperature forecast error (forecast – observation) from 00 UTC and 12 UTC model runs in Sodankylä during January 2014 shows overforecasting up to 12 degrees. **Right:** Sodankylä sounding on 17th of March 2014. Red curve is the ECMWF sounding from model run 20140316 12 UTC and black curve is the observed sounding. ECMWF is missing the observed surface inversion.*

During a period of warm weather in July lake surface temperatures at ECMWF were too cold, even compared to climatological lake surface temperatures. This caused too cold 2m temperature forecasts near lake areas (Fig. 4 and 5).

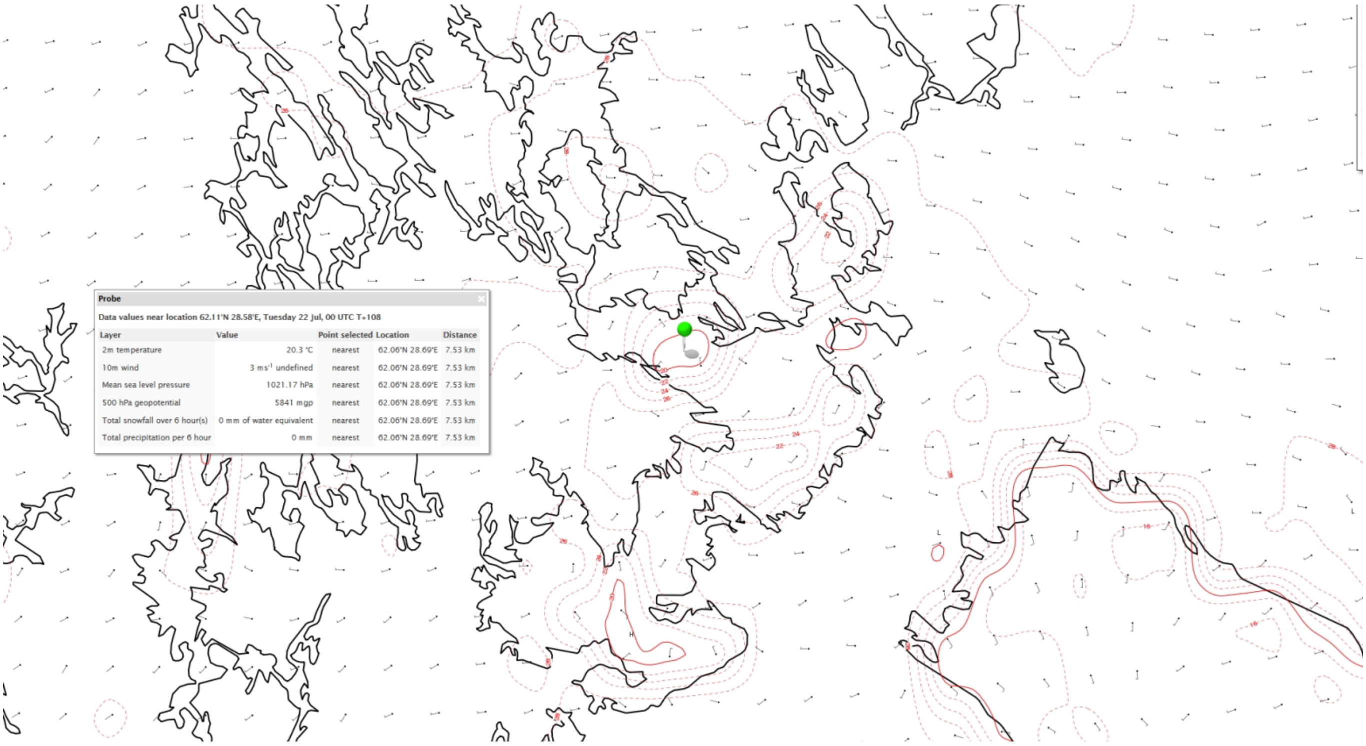

***Fig. 4:** ECMWF 2m temperature forecast in lakeside in southeast Finland on July the 22nd. 2m temperatures over lakes are about 20 degrees of celcius and over Lake Ladoga in Russia (in right) only 16 degrees of celcius. Observed daily maximum temperatures over land were 25 to 28 degrees of celcius.*

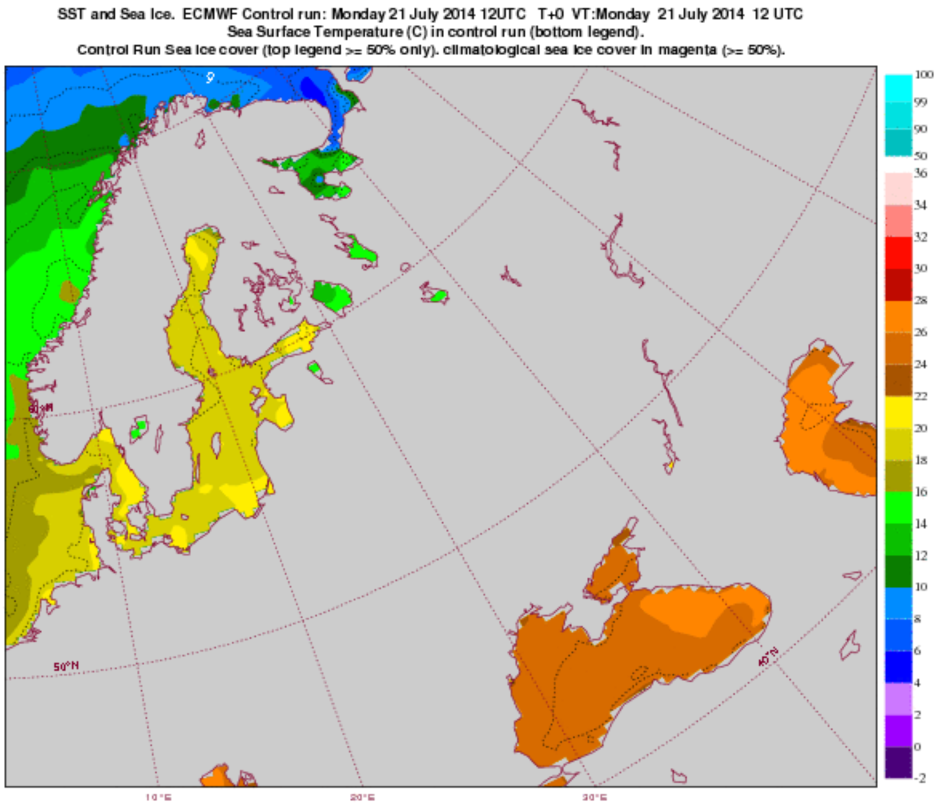

***Fig. 5:** ECMWF SST on 21st of July shows surface temperature of 12-16 degrees at Lake Ladoga and a small similar signal at Lake Saimaa (southeast Finland).*

This year in Finland we have experienced large anomalities in weather, especially temperature has had great variability throughout the year. End of June was in many observation stations coldest we have measured. We have noticed that ECMWF monthly forecasts are quite often unable to catch these important and large chances in weather (Fig. 6)

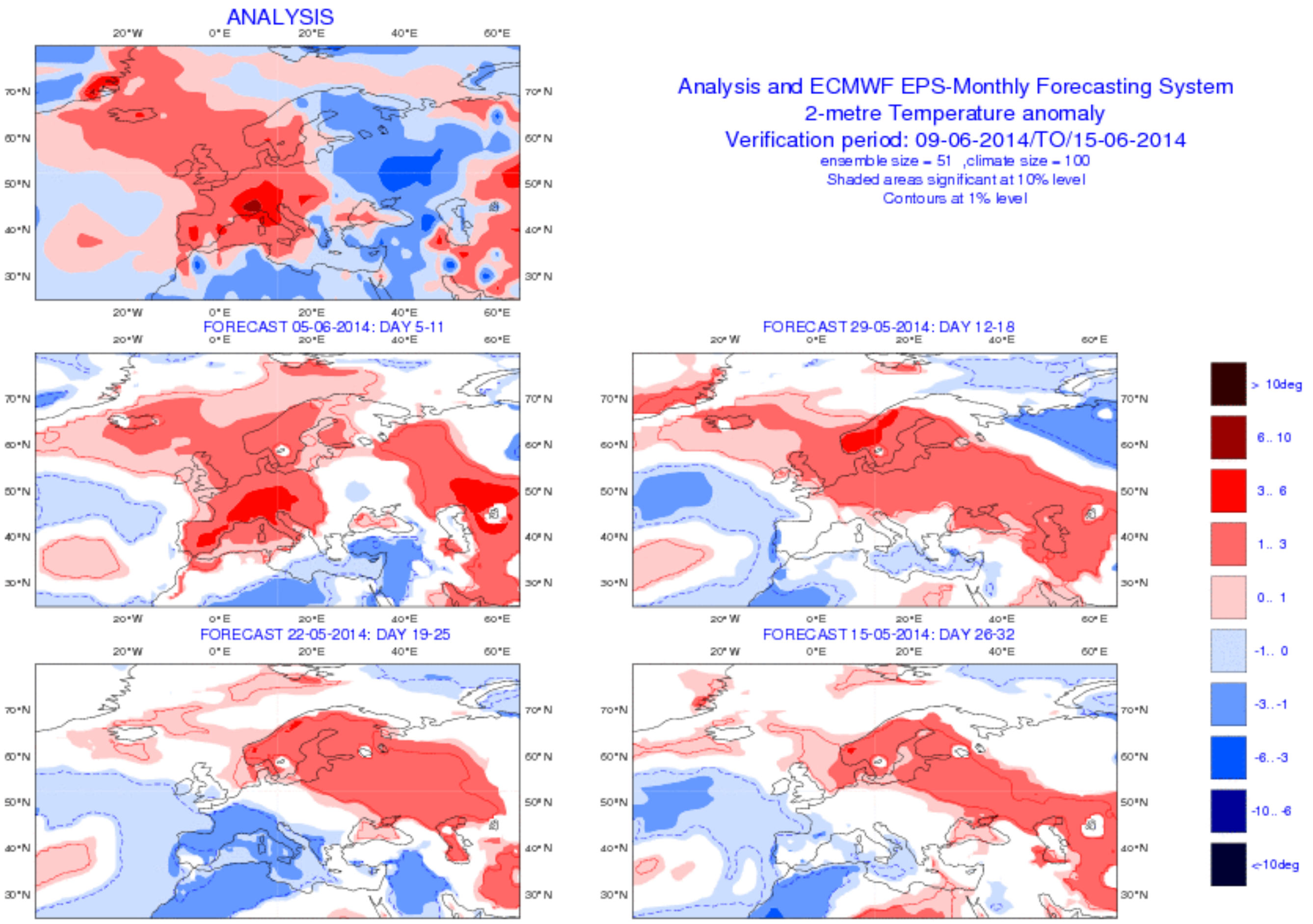

Fig. 6: *ECMWF Analysis and EPS-Monthly forecast for 2m temperature in mid June 2014. Forecasts show warm signal even though June was colder than average.*

3.1.3 Post-processed products

Kalman filtering improves ECMWF 2m temperature forecast especially during spring time (Fig. 1.).