Application and Verification of ECMWF Products 2021

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1. Summary of major highlights

- **Usage of EPSgrams and probabilistic forecasts (precipitation, temperature) in ecCharts to evaluate forecast uncertainty, especially in case of expected severe weather.**
- **Enhanced user-friendliness of ecCharts.**
- **Overestimation of wind gusts by HRES and ENS during the windstorm on 9/10 February 2020.**

2. Use and application of products

Include, as appropriate, medium-range high-resolution (HRES) and ensemble (ENS) forecasts, monthly forecasts, seasonal forecasts.

2.1 Direct Use of ECMWF Products

- **HRES and ENS models are used regularly by our forecasters for general forecasts (short term and especially medium term) and for forecasts of severe weather.**
- **EPSgrams are used frequently to get an overview about the weather evolution in one specific place/area and to evaluate the uncertainty of the forecast.**
- **Monthly or seasonal forecasts are consulted rarely, mainly if specific client requests are received by MeteoLux.**
- **OpenCharts is a nice addition, which is used to share forecast maps with journalists, clients, and stakeholders in case of special demands. Increased user-friendliness of ecCharts is very much appreciated by our forecasters. The application is used by our forecasters as additional tool for their daily business.**

2.2 Other uses of ECMWF output

n/a

2.2.1 Post-processing

n/a

2.2.2 Derived fields

n/a

2.2.3 Modelling

n/a

3. Verification of ECMWF products

HRES, ENS, monthly and seasonal forecasts are all within scope. ECMWF does extensive verification of its products in the free atmosphere. However, verification of surface parameters is in general limited to using synoptic observations. More detailed verification of these weather parameters by National Services is always valuable to us. We are most interested in results for the last 1 or 2 years.

At this time (2021) ECMWF would particularly welcome:

- Conditional verification results (e.g. 10m wind bias stratified by topographical aspects/cloud cover)
- Comparisons between ECMWF ENS and external LAM-EPS systems (for probabilistic forecasts)

3.1 Objective verification

MeteoLux does not perform any verification activities for ECMWF model output.

3.1.1 Direct ECMWF model output (both HRES and ENS), and other NWP models

n/a

3.1.2 Post-processed products and end products delivered to users

n/a

3.1.3 Monthly and Seasonal forecasts

n/a

3.2 Subjective verification

3.2.1 Subjective scores

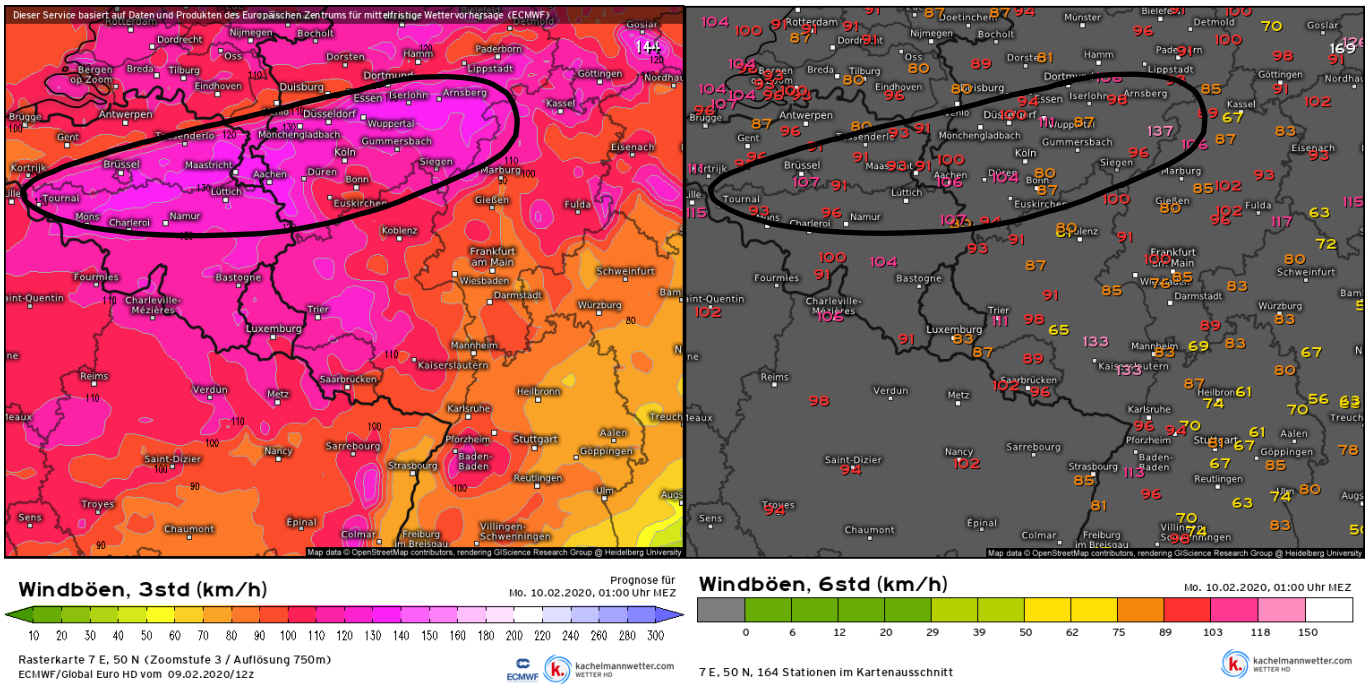
n/a

3.2.2 Case studies

- **Windstorm on 9/10 February 2020**

IFS overestimated the maximum gusts during the passage of an active cold front over large areas of western Europe, and thus also over Luxembourg, where the model predicted widespread gusts > 110 km/h. Only 2 out of more than 20 weather stations in Luxembourg registered maximum gusts between 100 and 110 km/h during the passage of the convective cold front, so the extreme winds were a very local phenomenon. In most areas, the maximum gusts ranged between 80 and 100 km/h. The EPS also provided a moderate-to-high probability for the occurrence of widespread hurricane-force gusts during the passage of the front.

Suggestion: Provision of two different wind gust parameters, one with and one without convective contribution. Hence, the forecaster can better distinguish between the widespread gusts caused by the strong pressure gradient and the local maxima expected in case of downward momentum transport by deep moist convection.



(Left) 3-hourly maximum wind gust forecast by the 12 UTC run of ECMWF's IFS model for 10 February 2020 at 00 UTC. (Right) 6-hourly maximum wind gusts observed by synoptic weather stations on 10 February 2020 at 00 UTC.

4. Requests for additional output

Parameters:

- **SFC-1 km & SFC-3 km storm-relative helicity (calculated after Bunkers et al., 2000)**
- **SFC-1 km, SFC-3 km & SFC-6 km bulk shear**
- **Hourly maximum wind gust speed (with and without convective contribution)**
- **Mixed-layer and most-unstable CAPE/CIN (expected with the IFS cycle update in autumn 2021)**

ecCharts:

- **We suggest integrating hourly forecast data up to T+72h and to increase the temporal resolution of the vertical profiles from 6 h to at least 3 h.**

5. References to relevant publications

Bunkers MJ, Klimowski BA, Zeitler JW *et al.* 2000. Predicting supercell motion using a New Hodograph technique. Weather Forecast. 15*:* 61–79. DOI: https://doi.org/10.1175/1520-0434(2000)015%3C0061:PSMUAN%3E2.0.CO;2

Mathias L, Ludwig P, Pinto J. G. 2021. The damaging tornado in Luxembourg on 9 August 2019: towards better operational forecasts. Weather. DOI: https://doi.org/10.1002/wea.3979