

Application and Verification of ECMWF Products 2019

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1. Summary of major highlights

ECMWF forecast products became the backbone in operational work during last several years. Starting from ten days high deterministic forecast grib data products like input in LAM (WRF-NMM), amount of products in use is growing constantly including EPS, EFI, seasonal forecast etc. Available ECMWF software like MetView, bufrdc_*** and GRIB_API are installed and every day in use for coding synop report in BUFR code and every month for coding climat report in BUFR code.

ECMWF products are an essential tool for operational weather forecasting, issuing alerts to the State Emergency Directorate and for making operational decisions and giving advice to the competent state authorities and citizens on how to plan their activities and adjust them to the weather forecast.

2. Use and application of products

ECMWF products are used for short-range forecast for providing meteorological background for hail suppression activities. Medium-range forecast is mainly based on ECMWF products from deterministic model as well as EPS products available on ECMWF web site. IHMS of Montenegro has continued to use ECMWF's monthly forecasts as well as seasonal forecasts of prediction System. Some of ECMWF forecast products, like CAPE and EFI are widely used in every day work. Wind gusts, 2m minimum and maximum daily temperature forecast as well as daily amount of precipitation are used as a background in the severe weather warnings. Our operational forecasts, information and alerts are based on ECMWF products.

2.1 Direct Use of ECMWF Products

ECMWF products are of primary importance for forecasting..ecCharts tool is very useful. we have an operational dashboard with various prognostic products for daily work. Parameters describing convection are specially grouped in order to predict convection quality and possible disasters such as supercellular disasters.

The vertical profiles tool (CAPE, CIN, wind shear, jet stream) is also very useful for convection forecasting.

Forecasting meteograms for your chosen location are very useful and are used every day.

2.2 Other uses of ECMWF output

2.2.1 *Post-processing*

From grib data who come through the dissemination exchange, we draw some meteo variable (z(500mb,850mb ... , t(500mb,850mb....) , precipitation, ..) for subjective control of the model , and to compare (still not objective compared, we work on some tools (some python scripts) to work operational, to be objective) with products with WRF NMM models

2.2.2 *Derived fields*

2.2.3 *Modelling*

WRF-NMM (the latest version, today is v4.1.1), a non-hydrostatic limited-area model, has been running operationally since 2008. Model uses ECMWF grib1 data from HRES deterministic global model for 144 hours ahead, with 2 downscaling we have products with very high horizontal resolution, about 1km.

Last two years , we test on small area WRF NMM model with input data from ECMWF with very high horizontal resolution, about 0.5 km (0.005 degree) central part of Montenegro, and forecast for wind is very good, special in deep rivers canyons. Products from LAM (WRF-NMM-E) with input data from ECMWF operational use like input in several

hydro models (Wflow, PANTHA-RAI . Also we use products from HRES ECMWF global model for some historical runs and case study.

3. Verification of ECMWF products

3.1 Objective verification

Objective verification of the products still not part of our activities.

3.2 Subjective verification

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

We do not make subjective verification operationally, but in certain significant situations, we make certain comparisons and establish differences. Mostly in some extreme situations, we make a comparison of the forecast and measured values of parameters (tmax, tmin, precipitation, snow, ...).

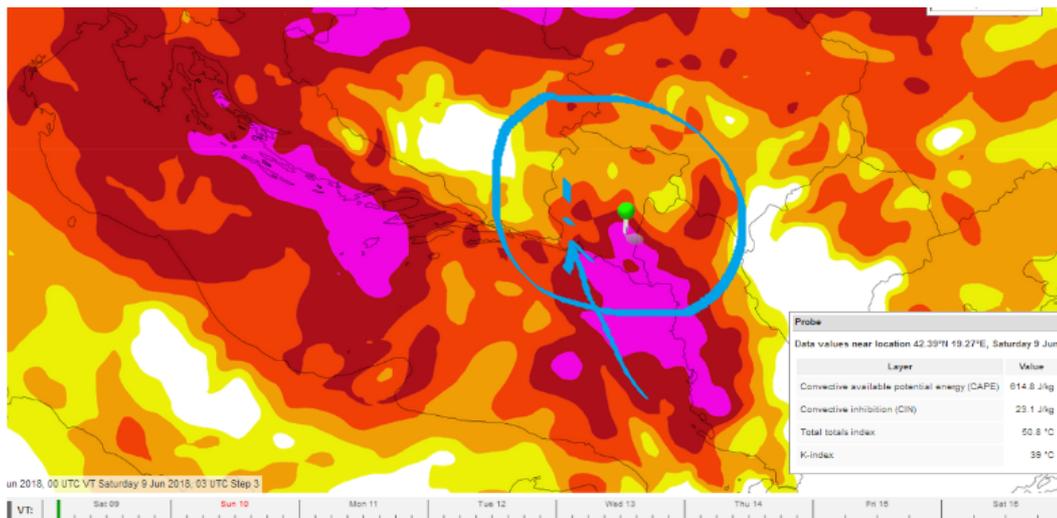
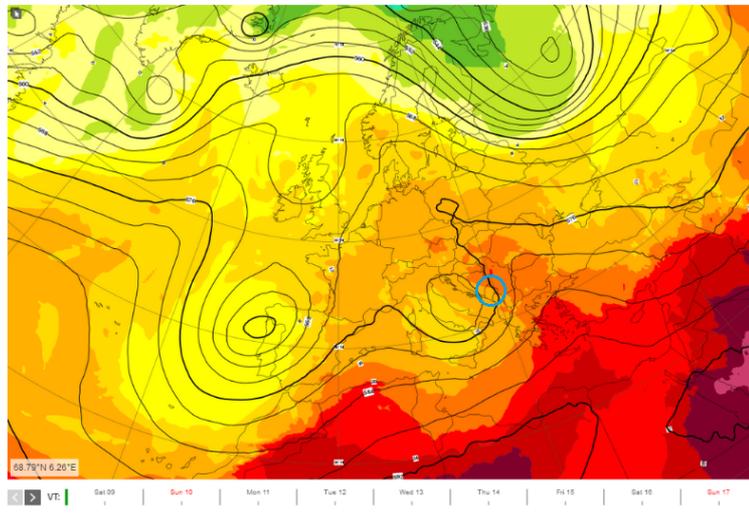
3.2.2 Case studies

Case study1, Jun 9th, 2018.

Very unstable, forming storm clouds during the night in the early morning Cb and tornadoes. The tornado engulfs the main tourism airport on the Adriatic coast, which has done extensive material damage.

In response to this situation, IHMS issued a warning of a storm hazard based on the ECMWF prognostic parameters.

850 hPa temperature / 500 hPa geopotential
Saturday 9 Jun, 00 UTC T+0 Valid: Saturday 9 Jun, 00 UTC

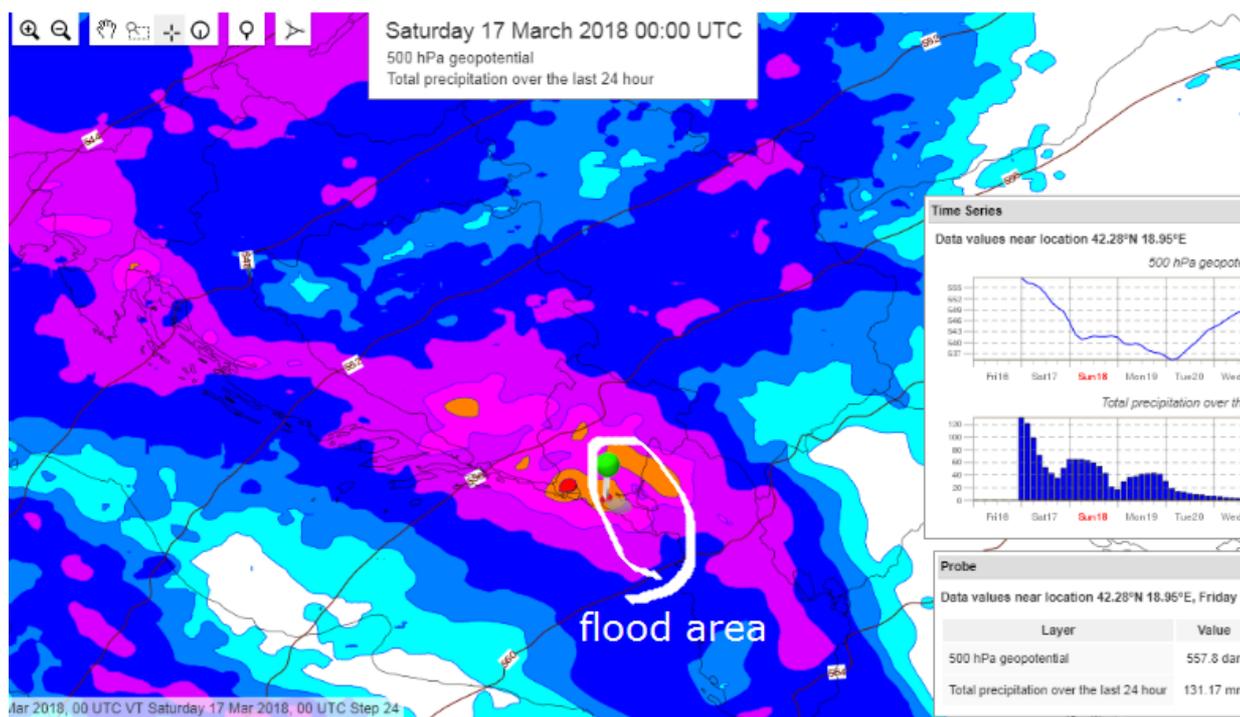




Case Study 2, March 2018. Flood in area Montenegro Albania, Lake Skadar, Drim River and Bojana.

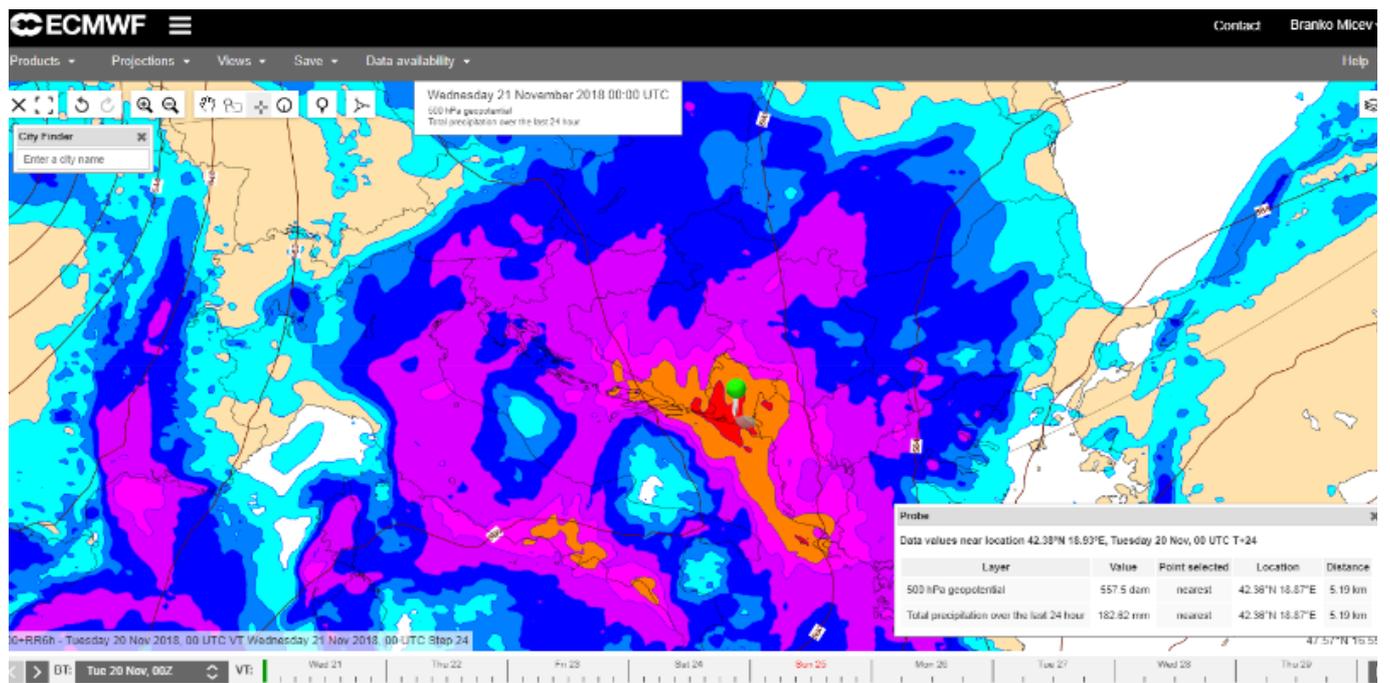
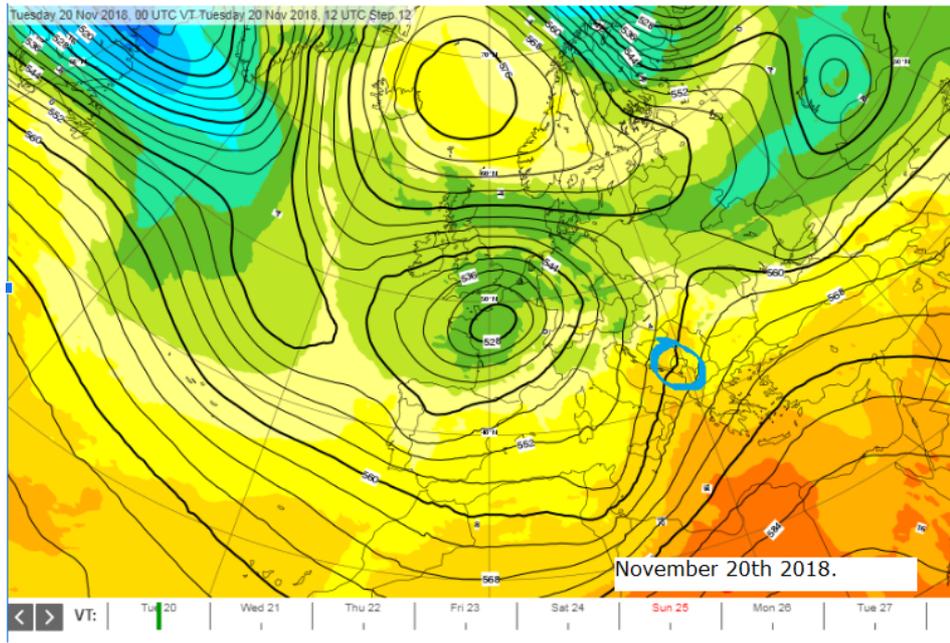
A large amount of rain during March is free of lake levels and heavy flooding. IHMS issued a warning about heavy rainfall and the risk of flooding based on ECMWF forecast products.

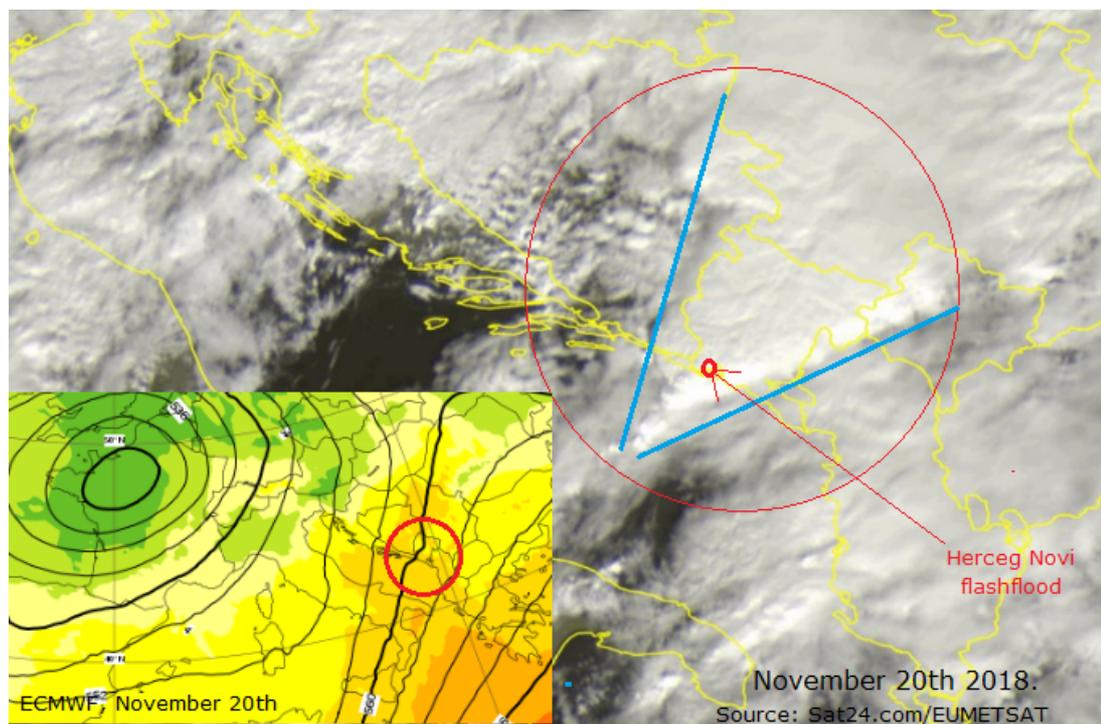
ECMWF products were very high quality and accurate.



Case Study 3, November 21th, 2018.

Extremely heavy rainfall. Herceg Novi, flash flood, amount of rain 248 mm in a very short time.

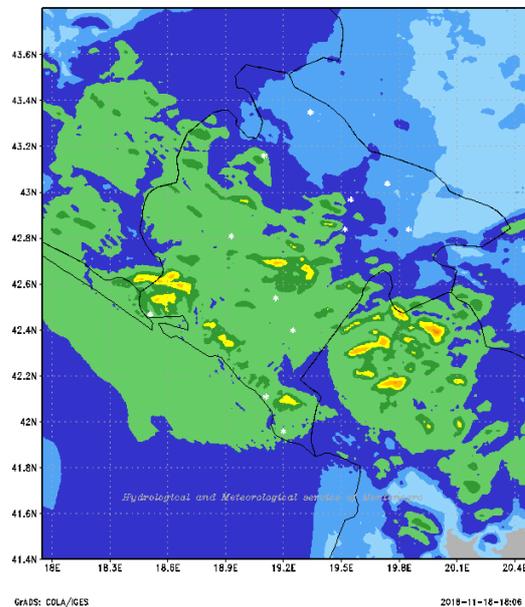
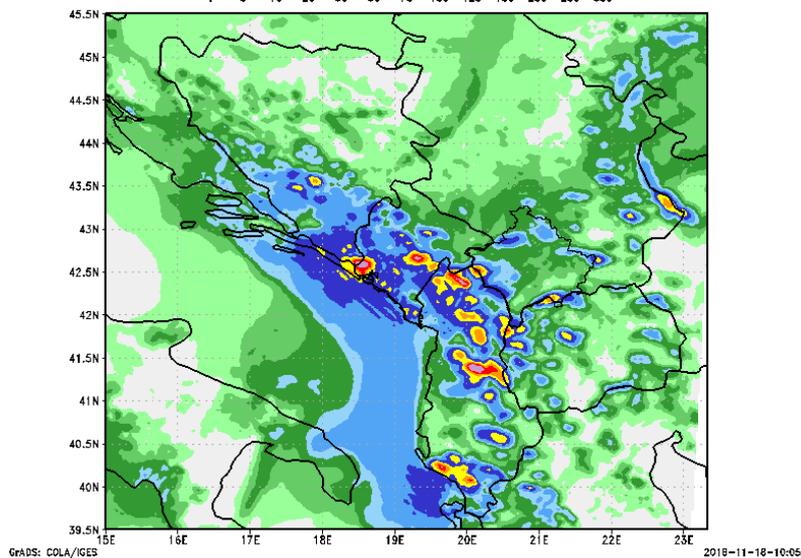




Forecast from LAM model with input boundary condition from ECMWF, first downscaling, to 0.03 degree and second to 0.01 degree horizontal resolution.

wrf-nmmE_v3.9.1-e3km-x.degree) initialisation: 2018.11.18. 00:00 UTC
24-h Acc.Prec. valid(+78h): 2018.NOV.21 06:00 UTC

WRF-NMM_v3.7.1_E1 initialisation: 2018.11.18. 00:00 utc
Acc.Precipitation / 24 h valid(+78h): 2018.NOV.21 06:00 utc



4. Requests for additional output

We wish we could see a vertical cross-section. To be able to choose a line from point A to point B to see the vertical cross section, temperature, humidity, potential temperature, geopotential (example 500hPa, 300hPa.), Vorticity, wind ...

5. Feedback on ECMWF “forecast user” initiatives

-The time step now is 3h, can the step be one hour for time from T+0h to T+96h,

-Whether it is possible for the probe (in Chart dashboard) to receive or to view the data in the table every hour or every three hours. Such as a meteogram, plus a table for the parameters we choose to display in our Chart dashboard we created.

6. References to relevant publications**(7. Structure of these Reports)**