ECMWF MS/CS "Green Book" Report 2024

This report relates to Use and Verification of ECMWF products in Member and Co-operating States, since January 2022. Please add your text below under the appropriate headings. Mandatory questions are marked with a ''. Also,* ***please do include figures/tables wherever you feel they are appropriate****, with figure/table numbers (e.g. "Figure 1") and explanatory captions underneath. You should aim for the finished report to be 8 pages or less. Once completed it would be help us if you could delete all the ECMWF instructions (in grey italics) such as this paragraph.*

Section 1: Background

* 1.1 Country

Which Country is your submission for?
Bulgaria

* 1.2 Author(s)

Please provide your name(s)
Boryana Tsenova, Eram Artinyan, Anastasiya Stoycheva

* 1.3 Organisation

Please provide your organisation National Institute of Meteorology and Hydrology
National Institute of Meteorology and Hydrology (NIMH)

* Section 2: Summary of major highlights

Please detail here major highlights since January 2022. You may wish to complete this section at the end, after completing all others.

Section 3: Forecast Products

3.1. Direct use of ECMWF forecast products

In each of the following 4 categories please outline what direct use you make of standard ECMWF model products (on ecCharts / OpenCharts / own workstation), for operational duties, (noting that new AI model output should be dealt with separately, in Section 3.4).

*** a) Medium Range (e.g. for high impact weather forecasting)**
1. On ecCharts, mainly but from ECMWF web-page - some separate products.
2. We have a small part of the model data on our (NIMH-made) workstation (data for temperatures, wind – ws and wd, precipitation for 12/24 h).
3. We visualise some data from the model on the very old Synergie system.

*** b) Extended Range (monthly)**
On ecCharts, mainly but from ECMWF web-page, as well.

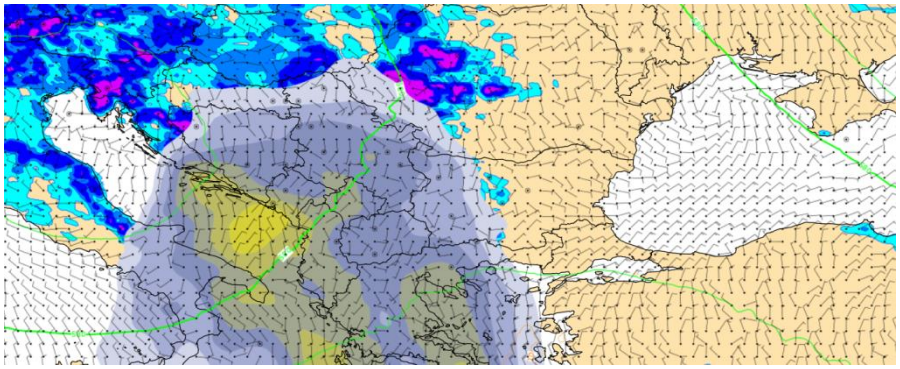
*** c) Long Range (seasonal)**

Information only from ECMWF web-page

*** d) CAMS and Fire-related output (ecCharts mainly)**

CAMS – some information for Saharan dust – on ecCharts.

Example: Combination of dust (CAMS), precipitation and 10 m wind, 26.06.2024 15 UTC, step 87



We use information from CAMS to create a dedicated air pollution product page for Bulgaria. The page is located at https://airquality.meteo.bg/ . Project: CAMS2-72BG.

3.2. Cycle 48r1

ECMWF cycle 48r1 went live at the end of June 2023. Changes included a much higher resolution medium range ensemble, and much more frequent monthly forecasts. In sub-sections a and b below lease detail any positive or negative impacts of this cycle for your organisation.

*** a) Positive impacts of model cycle 48r1**

The better resolution allows improving the forecast in the complex orography that Bulgaria has, but specific quantitative assessments have not been made.
The availability of more frequent monthly forecast products has a two-fold effect - an up-to-date forecast every day, but the differences in the different runs lead to difficulties in summarizing and preparing a reliable monthly forecast. However, the benefit is greater. The lack of some products on the ECMWF web page limits us, but we are working on visualizing them on our workstation by using the available model data.

*** b) Negative impacts of model cycle 48r1**

-

c) Systematic changes in forecast output since model cycle 48r1 was implemented

Please describe any changes you have experienced (if not already covered in your response to questions 3.2a and 3.2b).

3.3: Derived Fields

Do you modify ECMWF model output to create 'derived fields' (e.g. post-processed output, regimes, probabilities)? If so, please describe what you modify and how.

In order to integrate ECMWF model output in different hydrological forecasting models we interpolate data to fit the hydrological model grid. An example is the need to interpolate data of HRES medium range model with 0.1ºx0.1º grid to obtain data in 4x4 km grid.

3.4: Artificial Intelligence (AI) / Machine Learning (ML) techniques

Do you currently use Artificial Intelligence (AI) and/or Machine Learning (ML) techniques in your service, in conjunction with standard ECMWF model output? - Please describe any such techniques and/or any future plans you have in this area.

For now, we use Artificial Intelligence and Machine Learning techniques to build statistical models based on real observational data to predict reduced visibility/fog, and plan to incorporate model information in the future.

3.5: Dynamical Adaptation

Does your NMHS use ECMWF data for modelling purposes - e.g. by providing initial/boundary conditions for limited area model runs, or for hydrological models, or for dispersion models, etc? – if so please describe these activities.

NIMH uses LBCs from IFS four times daily with a forecast range of 72h for a backup operational run of the regional NWP model AROME.
HRES deterministic model products are used in hydrological forecasting models in NIMH (Artinyan et al, 2016) in order to provide input data with 1h step up-to 90h and with 3h step up-to 144 h ahead. Initial conditions are computed mostly using in-situ measurement data but in some cases data for atmospheric and solar radiation and wind speed from HRES model was used for model initialisation because of the lack of enough measured data.

3.6: Data-driven (AI) models

In the last year or so ECMWF has made available, on ecCharts and OpenCharts, selected fields from AI models (e.g. Pangu Weather, AIFS).

* a) ECMWF's real-time AI model initiative

Please describe your views on this initiative, or enter "unaware" if you knew nothing about this.

Hydrology – unaware
Meteorology – We try to follow the proposals for different situations of the AI model of ECMWF, but without having an objective analysis for the region of Bulgaria. Brief information about this is available in one specific case - attached maps and a brief description:

* b) Use of AI forecasts for operational purposes

Please describe ways in which you currently use AI forecasts for operational purposes, or "none" if appropriate
Hydrology – none
Meteorology - We don't use it in operational mode yet, but we're trying to.

Section 4: Verification

ECMWF does extensive verification of its products in the free atmosphere. However, our verification of surface parameters is more limited and can be constrained to only using synoptic observations. More detailed verification of these surface weather parameters by National Services is always valuable to us.

We are most interested in results for the last 1 or 2 years. Also, any verification evidence you have of performance changes since the introduction of cycle 48r1 would be very valuable.

4.1 Raw model output from ECMWF, and other operational models/ensembles

In sub-sections a and b below please describe your verification activities and show and discuss related scores, in the two lead-time categories. This should include, where possible, comparisons between ECMWF and your own models/ensembles, and other models/ensembles.
Ideally focus on surface weather parameters in your own territory. Inclusion of conditional verification results is also strongly encouraged - e.g. stratification by a weather type - as these can provide very useful insights into model weaker points.

a) Short Range and Medium Range

b) Extended Range (Monthly) and Long Range (Seasonal)

4.2 Post-processed products and/or tailored products delivered to users

Please describe verification of such products, and show and discuss related scores.

4.3 Subjective verification

Please describe and illustrate any activities and results the field of subjective verification of forecasts.

4.4 Case Studies

Please describe and illustrate any case study verification you have undertaken. Examples of both good and bad model performance are welcome. Severe weather events (and non-events) are of particular interest to us. Add further sub-sections c, d etc manually if you have more case studies to highlight.

a) Case Study 1

Please describe the forecast(s) and what happened. Also indicate clearly whether you view this as an example of good or bad or mixed forecast performance, or highlight some other reason for including this case.

b) Case Study 2

Please describe the forecast(s) and what happened. Also indicate clearly whether you view this as an example of good or bad or mixed forecast performance, or highlight some other reason for including this case.

Section 5: Output Requests

Please describe, and illustrate if necessary, any particular requests you may have for new or modified ECMWF products. Add more sub-sections manually (c, d etc.) if you need them.

a) Product request 1: *add a title / short-form summary here in bold*

Describe the request here

b) Product request 2: *add a title / short-form summary here in bold*

Describe the request here

Section 6: References

Please list here any recent internal or external publications that relate to the questions in this survey, including the respective link(s). For any publication that cannot be readily downloaded via a link please email a copy of that publication to becky.hemingway@ecmwf.int and to tim.hewson@ecmwf.int.

Artinyan, Eram & Vincendon, Beatrice & Kroumova, Kamelia & Nedkov, Nikolai & Tsarev, Petko & Balabanova, Snezhanka & Koshinchanov, Georgy. (2016). Flood forecasting and alert system for Arda River basin. Journal of Hydrology. 541. 457-470. 10.1016/j.jhydrol.2016.02.059.

(Private copy) https://plovdiv.meteo.bg/1-s2.0-S0022169416301044-main-4.pdf

Section 7: Additional comments and Feedback

Please provide here any additional comments on topics that have not been covered in any of the sections above.