Contribution ID: 2bfb72ae-6daa-45a8-8c5f-2e6683d9c2e2
Date: 30/04/2024 14:46:33

Green Book 2024 - aka Use and verification of ECMWF products in the Member and Co-operating States

Fields marked with * are mandatory.

Introduction

Welcome to ECMWF new "Green Book" online submission system (aka "Use and verification of ECMWF products in the Member and Co-operating States")

This time we have two options for completion:

- Filling out the online questionnaire below (new for this year based on feedback from the Meteorological Representatives meeting in November 2023)
- Producing a single report offline (as done in previous years), and emailing the report as detailed in Section 1.

Both methods ask the same questions, however the questionnaire method requires no formatting and aims to make analysis of all responses easier. The questionnaire option also allows you to part-complete, and save your entries to come back to later (using the "Save as Draft" button in the top right corner of this page). Note that the EUSurvey page will timeout after 60 minutes of no activity, responses are usually saved however to be sure please "Save as Draft" to avoid losing responses.

The deadline for all submissions is 23:59UTC on Wednesday 15th May 2024

A summary of responses will be presented at UEF2024 with a summary report available in the ECMWF Publications library in due course.

Section 1: Background - please fully complete

* **1.1 Which Country is your submission for?**

NO - Norway

* **1.2 Please provide your name(s)**

Terje Alsvik Walløe

* **1.3 Please provide your organisation**

Norwegian Meteorological Institute

* **1.4 Please select your preferred submission method:**

- ○ Producing a single report offline
- ◉ Online questionnaire

Online questionnaire

Please answer the following questions, and illustrate your answers, where appropriate, by also uploading clearly annotated images with image/figure numbers (max 1MB per file). More questions or options may appear, depending on answers to particular questions. Mandatory questions are marked with a '*'. Free text boxes have no word limit, answers don't need to fit the box size given, the boxes expand.

Responses to the questionnaire can be saved and returned to at a later date before submitting. To do this click the 'Save as Draft' button on the left, this will provide you with a link which you can return to to continue /complete your submission.

Section 2: Summary of major highlights

* **Please detail major highlights since January 2022**

You may wish to complete this section at the end, after completing all others**.**

21 day temperature and precipitation probability forecasts are now presented for every location on our website yr.no based on daily updated extended forecasts from ECMWF. This was implemented January 2024.

Section 3: Forecast products

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

* **a) Medium Range (e.g. for high impact weather forecasting)**

ECMWF products - disseminated, and from the ECMWF website - are used every day in operational short range and medium range forecasting, in addition to forecasts from our limited area model. The products are crucial for the forecasts issued to the general public and media, users on land, offshore and aviation. Disseminated parameters are available to the operational forecasters in in-house visualization tools. HRES parameters are presented as horizontal maps, vertical profiles and cross sections, and as time series /meteograms. ENS single member parameters, probabilities and EFI/SOT are presented as horizontal fields. The ensemble spread in t2m, z500 and precipitation is also visualized as time series/meteograms. The EFI products are used to prepare us for any anomalous weather events the coming week.

*** b) Extended Range (monthly)**

Monthly and seasonal forecasts are used as background information by the operational forecasters, and the extended range forecast is presented to collaborating partners during weekly briefs. Extended range anomaly maps of 2m temperature and precipitation are downloaded and distributed, with a few additional words from the forecasters, to users within the energy supply industry and flood forecasting authorities. As from January 2024 we also present daily updated 21 day probability forecasts for temperature and precipitation on our website yr.no.

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

There are plans for presenting some kind of seasonal forecasts for the general public in the coming year, based on ECMWF/Copernicus data, but for the time being we are only using them for internal briefs. The forecast skill at our latitude is not very significant unfortunately.

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

No known use of these products yet.

3.2. 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.

*** a) Please describe any positive impacts of model cycle 48r1 for your service**

The higher resolution in the ensemble gives an improvement for our point data at yr.no and for different customers that use ensemble data, for example precipitation forecasts for the hydro power energy sector. Daily monthly forecasts are a big improvement, since we no longer need to wait for 3 or 4 days for next update. We are now able to see changes in the forecast more rapidly.

If you have any annotated graph/diagram/plot that would help clarify your answer to the previous question, please upload here.
File types: most accepted, File Size: max 1MB per file.

* **b) Please describe any negative impacts of model cycle 48r1 for your service**

We haven't seen any negative impacts yet.

If you have any annotated graph/diagram/plot that would help clarify your answer to the previous question, please upload here.
File types: most accepted, File Size: max 1MB per file.

* **c) Have you noticed any systematic changes in forecast output since model cycle 48r1 was implemented?**

- ○ Yes
- ◉ No

* **3.3: Do you modify ECMWF model output to create 'derived fields' (e.g. post-processed output, regimes, probabilities).**

- ◉ Yes
- ○ No

Please describe what you modify and how

The forecasts on yr.no is a good example of how data from ECMWF are modified and presented to the public.

If you have any annotated graph/diagram/plot that would help support your answer to the previous question, please upload here.
File types: most accepted, File Size: max 1MB per file.

9c6d0e57-5f43-486e-96f5-f17a682cca25/Screenshot_from_2024-04-30_13-44-29.png

* **3.4: Do you currently use Artificial Intelligence (AI) and/or Machine Learning (ML) techniques in your service, in conjunction with standard ECMWF model output?**

- ◉ Yes
- ○ No

Please describe any such techniques and/or any future plans you have in this area

We use ML techniques for post-processing of ECMWF for our public forecasts on Yr. The ECMWF reforecasts are essential for training.

If you have any annotated graph/diagram/plot that would help support your answer to the previous question, please upload here.
File types: most accepted, File Size: max 1MB per file.

* **3.5: 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...**

- (●) Yes
- ( ) No

Please describe these activities

EC HRES provides lateral boundary values for the AROME-MetCoOp Ensemble Prediction System (MEPS) and the limited area atmospheric model AROME-Arctic (both have 2.5 km horizontal resolution, based on Harmonie, covering Scandinavia and Svalbard) with runs every 3 hours. Scaled Lagged Average Forecast (SLAF) is used for initial and lateral boundary perturbations to the MEPS.
MET Norway's regional Storm Surge forecast model (ROMS) has 51 members, and since winter 2019 each is driven by surface pressure and wind stress from EC-ENS. The change from deterministic to ensemble approach has proven to give more consistent warnings for high sea surface levels along the Norwegian coast. In CMEMS, MET Norway runs the TOPAZ ocean and sea ice model, which utilises EC-HRES wind and air temperature forecasts, to produce daily updated 10-day ocean forecasts for the Arctic Ocean. ECMWF HRES and/or ENS are also used in forcing of other Wave- and Ocean models, Drift models for the ocean, and as input to dispersion models for volcanic ash and nuclear emissions to the atmosphere.

If you have any annotated graph/diagram/plot that would help support your answer to the previous question, please upload here.
File types: most accepted, File Size: max 1MB per file.

* **3.6: In the last year or so ECMWF has made available, on ecCharts and OpenCharts, selected fields from AI models (e.g. Pangu Weather, AIFS). Were you aware of this?**

- (●) Yes
- ( ) No

* **a) What are your views on this initiative?**

Yes, we are aware of this and use them regularly.

* **b) Do you currently use AI forecasts for operational purposes?**

- ( ) Yes
- (●) No

What would you need in order to use AI models in your forecast activities?

Not yet.

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 evidence you have of performance changes since the introduction of cycle 48r1 would be very valuable.

* **4.1 Do you routinely verify raw model output from ECMWF model(s) and/or other operational models /ensembles?**

- (●) Yes
- ( ) No

Please describe your verification activities and show and discuss related scores in the the two lead-time categories shown below, including, where possible, comparisons with 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

Verification of Operational
Weather Prediction Models
September to November 2023

(METInfo 21/2024, by Lene Østvand, Mariken Homleid, Gunnar Noer and Bjørn Gilje Lillegraven @met.no)

Summarized statistics show that ECMWF in general forecast sea level pressure better than MEPSctrl/AA25, but the errors are small for both.
Temperature is on average better forecast by MEPSctrl/AA25 than ECMWF. ECMWF underestimate the temperature for the different groups of stations. For MEPSctrl and AA25, the mean error is very close to zero for the Norwegian stations and Svalbard stations respectively, while for the North Scandinavian stations they show a small overestimation. Still, the errors are small, indicating that the timing of the temperature changes is generally good. The temperature forecast is further improved by post processing, particularly for the shortest lead times. The improvement is larger for inland stations than coastal stations, which have less variation in temperature and smaller errors than inland stations for both MEPSctrl and post processed forecasts.
For wind speed and precipitation, a larger number of verification scores is used to assess model quality, including threshold statistics.
Wind speed is challenging to evaluate. MEPSctrl clearly performs better than ECMWF over land, and particularly in the mountains, where ECMWF underestimates the speed considerably as seen in the monthly mean error and mean absolute error. The maps show that underestimation also applies to coastal stations in strong wind events. The threshold scores indicate that wind speed is better forecast for lower than for higher wind speeds for all models. The near surface wind speeds are affected by the upgrade to cycle 43 both by modifications in the turbulence scheme and by the physiography upgrade. ECOCLIMAP Second Generation has new tree heights and a more ”binary” separation between patch 1 (low vegetation) and 2 (trees). The largest effect of the change is seen at coastal stations with increased diurnal cycle in wind speed and less underestimation during day. The mean absolute error indicates somewhat smaller errors in the wind speed after post processing, while the threshold scores show almost identical results for MEPSctrl and YrPP.
Precipitation also shows varying results, depending on the amount and location. ECMWF has on average more precipitation than MEPSctrl which this autumn had mean errors slightly above 0 for the Norwegian stations. Both have more errors for both very small amounts and very high amounts, than precipitation in the mid range.
The models generally perform better during summer months than during winter. A possible cause is that storm activity is challenging to predict accurately, and there are often more storms during fall and winter than during summer. Precipitation is an exception from this trend, as summer often comes with convective cases that are challenging to predict. AA25 and MEPSctrl show very similar results, which is expected since both are HARMONIE with AROME physics, horizontal resolution defined by a 2.5×2.5 km2 grid.

If you have any annotated graph/diagram/plot that would help support your answer to the previous question, please upload here.
File types: most accepted, File Size: max 1MB per file.

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

If you have any annotated graph/diagram/plot that would help support your answer to the previous question, please upload here.
File types: most accepted, File Size: max 1MB per file.

* **4.2 Do you routinely verify post-processed products and/or tailored products delivered to users?**

- (●) Yes
- ( ) No

Please describe these activities and show and discuss related scores

We use post-processed ECMWF data for our official medium and extended range forecasts for Norway so we do extensive verification of these.

If you have any annotated graph/diagram/plot that would help support your answer to the previous question, please upload here.
File types: most accepted, File Size: max 1MB per file.

* **4.3 Do you perform any subjective verification of forecasts?**

- ( ) Yes
- (●) No

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.

a) Case Study 1 - Please describe the forecast(s) and what happened

A case from 17 November 2023 illustrates the problem with too high temperatures in the winter night-time inversion minima. In the areas that in reality were cloud free, the model had a positive bias of up to 10 degrees in the inversion cold spots. Folldal is an inland station situated in a depression in the terrain, and is prone to have very low temperature minima on clear nights such as were the case during the period from 17 to 20 November. As seen in the timeseries plot in figure 5, even the post processed temperature YrPP forecasts were not able to capture the very low temperatures during this period.

If you have any annotated graph/diagram/plot that would help support your answer to the previous question, please upload here.
File types: most accepted, File Size: max 1MB per file.

3af9a9a4-3fd2-47ad-9c14-b7a36cb54756/Screenshot_from_2024-04-30_14-21-09.png

Case Study 1 is an example of:

- ○ Good model performance
- ◉ Bad model performance
- ○ Mixed (good and bad) model performance
- ○ Other (please describe above)

Add another Case Study?

- ○ Yes
- ◉ No

Section 5: Output Requests

5. Please describe, and illustrate if necessary, any particular requests you may have for new or modified ECMWF products.

a) Product request 1 - title / summary

New map area

Product request 1 - description of request

We would like a predefined map that covers the Nordic countries including the Spitsbergen area. The Northwest Europe map do not cover Spitsbergen.

If you have any annotated graph/diagram/plot that would help support your answer to the previous question, please upload here.
File types: most accepted, File Size: max 1MB per file.

Add another Product Request?

- ○ Yes
- ◉ No

Section 6: References

6. Are there any recent internal or external publications that relate to the questions in this survey? Please list them including the respective link/s. For any publications that cannot be readily

downloaded via a link please attach a copy below (or email Becky Hemingway (becky.hemingway@ecmwf.int) and Tim Hewson (timothy.hewson@ecmwf.int) if too large to upload here).

If you have any annotated graph/diagram/plot that would help support your answer to the previous question, please upload here.
File types: most accepted, File Size: max 1MB per file.

Section 7: Additional comments and Feedback

7.1. Please use the box below if you have additional comments on topics that have not been covered in any of the questions above

If you have any annotated graph/diagram/plot that would help support your answer to the previous question, please upload here.
File types: most accepted, File Size: max 1MB per file.

7.2. This is the first time we have used a survey style structure for Green Book submissions. You thoughts and feedback on this process are very welcome

The survey style structure is definitely an improvement that makes the task easier.

Thank you for taking the time to complete your Green Book report. Your feedback and comments are very valuable to us!

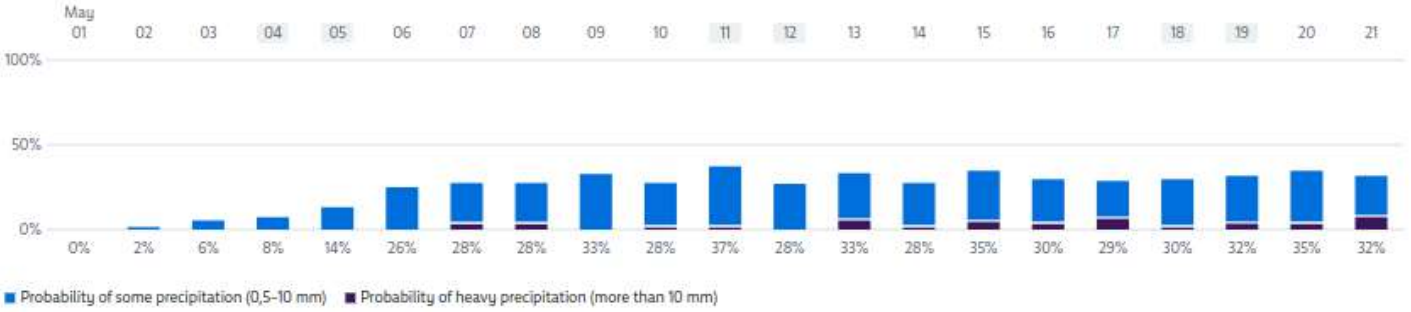
Contact

Contact Form

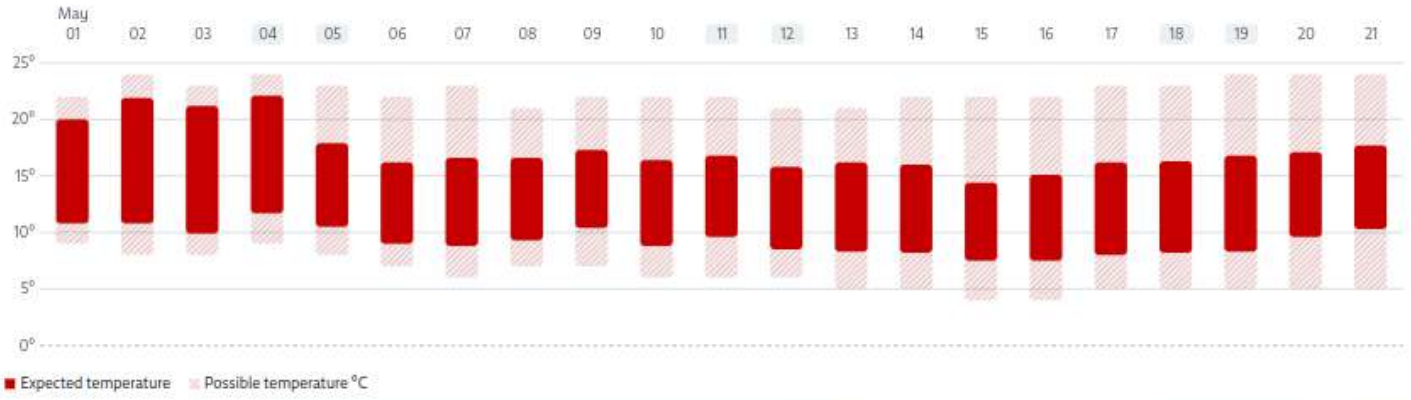
Summary

Period	Precipitation mm	Temperature high/low	Probability of frost
1 May–7 May	0 (0–8)	22° / 9°	0 %
8 May–14 May	8 (0–22)	17° / 8°	0 %
15 May–21 May	11 (0–27)	18° / 8°	0 %

Probability of precipitation



Temperature



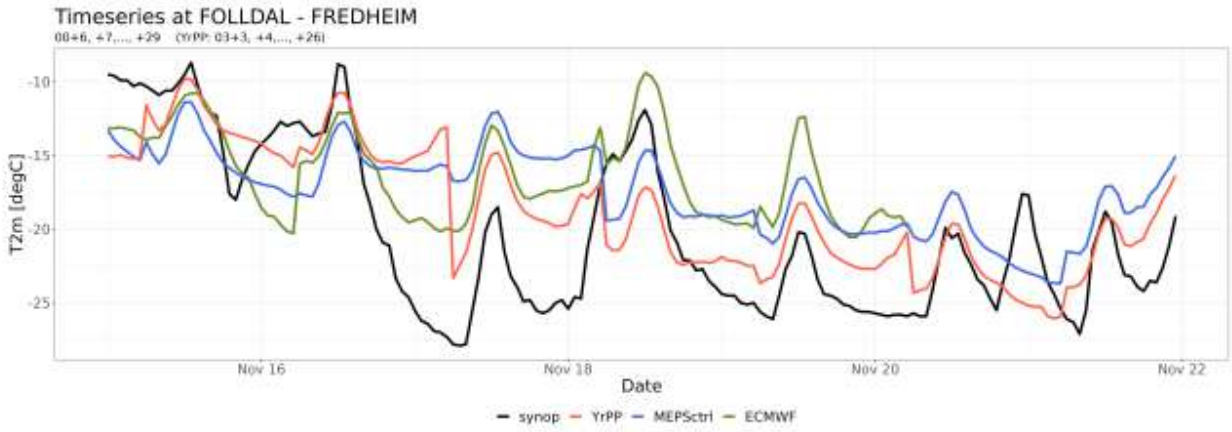


Figure 5: The timeseries plot from Folldal showing post processed temperature (YrPP) in red, MEPSctrl in blue and ECMWF in green against observations (black).