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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?**

IL - Israel

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

Eyal Amitai

* **1.3 Please provide your organisation**

Israel Meteorological Service

* **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 appear to have a 5000 character limit (if your answers are longer than this please email them to Becky and they will manually added), 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**.**

Most IMS activities utilizing ECMWF products remain the same as in previous years.
However, we did obtain improved accuracy with cycle 48r1 products (e.g., 2m Temp).
Improvement also was detected in the regional COSMO-EPS upon using ECMWF-EPS new resolution for boundary conditions.
Validation of 2022/23 seasonal rainfall forecast yields a positive value of RPSS=0.48 while validation for the 2023/24 seasonal rainfall forecast yields a low positive value of RPSS=0.19

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)**

Our main objective for using ECMWF products is to provide guidance for the medium forecast range. The various medium-range high-resolution (HRES) and ensemble (ENS) fields are made available to the forecaster. EPSgrams are a main tool used routinely by the forecasters in the daily work. EFI and/or probability of crossing thresholds are often used when significant weather event is expected. All of them are very useful.
The forecasting aspects that relate to ECMWF model outputs that are of particular concern to us are:

- Extreme events forecasts - which allow early warnings
- Temp., humidity & wind forecasts - used as the main input to our public website
- Boundary conditions - used for local area model (COSMO det&ens, ICON)
- Rain forecasts - used to derive the hydrological models
- Aviation forecasting - visibility, low ceiling, turbulence, icing, lightning
- Flash floods - especially convective events over small catchments.

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

N/A

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

Seasonal rain forecasts - especially forecasts for DJF

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

a. CAMS UV Index product is used operationaly and presented on IMS website.
b. CAMS dust products are used to generate tailored maps and vertical cross section for operational use.
c. CAMS aerosols (aermr01-11) 3D fields are used as an input to COSMO LAM run as an input to radiation scheme.
d. We use the EFFIS Fire-related products: FWI and Danger Risk Index

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**

It can be seen from the attached image that the averaged 2m Temp RMSE is reduced in the last 6-months, which are associated with a higher resolution, compare to the previous periods associated with a lower resolution.

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.

ef3bf4ac-cafc-4c11-a7fb-59cd73d4a880/TT_rmse.png

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

N/A

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

a. CAMS UV Index product is used operationaly and presented on IMS website.
b. CAMS dust products are used to generate tailored maps and vertical cross section for operational use.
c. CAMS aerosols (aermr01-11) 3D fields are used as an input to COSMO LAM run as an input to radiation scheme.
d. EFFIS fire related products

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.

* **3.4: 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

* **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

a. ECMWF HRES model output is ingested to INCA (Integrated Nowcasting through Comprehensive Analysis) high-resolution (1-km) nowcasting system together with data from 81 meteorological stations. INCA (from ZAMG) together with automatic station data yield a corrected analysis and nowcasting up to 6 hours.
b. The COSMO, ICON-LAM regional models are running operationally with a 2.5-km resolution, driven by IFS HRES model as hourly boundary conditions.
c. Starting November 2020, the Israel Meteorological Service is operationally running a 20-members COSMO regional ensemble (C3-ENS) in a convection-permitting resolution of 2.5-km, driven by the ECMWF ensemble (EC-ENS). The ensemble is running on the ECMWF HPC as a time-critical application (TC2).

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?**

Our first impression was suprisingly good of the model ability to forecast same basic features as the physical IFS model.

* **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?

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

Using 20 ECMWF EPS randomly selected members to serve as boundary conditions for a convection-permitting regional ensemble (COSMO-EPS)
A statistical analysis was performed to determine the ensemble percentile that best forecasts extreme events.
Near-surface fields verification
Tables 1-4 present the verification of the regional COSMO-EPS with ECMWF-EPS boundary conditions forecasts and the IFS deterministic (or control) runs, against 81 automatic weather stations throughout Israel. The verification sample included 6-78 hours of lead time. The verification was performed for the period between November to April (6 months) of 2022-2024 to allow a comparison of the period with the high-resolution ECMWF-EPS (~ 9 km) that started on 27.6.2023 and the previous periods with ~18 km resolution. It can be seen from all 4 tables that for the last 6 months after the ECMWF-EPS resolution was improved, the COSMO-EPS achieved a better hit score compared to 2022 and 2023 after normalizing to the IFS deterministic (or control) that had the same resolution during the 3 years. However, every model cycle since 2022 included improvements which may also explain the improvement.

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.

72f7de14-edad-400c-837b-eabd17d46493/Screenshot_2024-05-09_at_11.29.42.png

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

Seasonal forecasts-
Analysis of DJF 2023/24 and JJA 2023 seasons
The SEAS5 (Sys5) DJF 2023/24 averaged precipitation forecast over Israel (five grid points in Northern Israel) assigned 39% chance for the “above normal” tercile, 33% for the “around normal” tercile, and 28% for the “below normal” tercile, and was located in the 51th percentile of 1981-2010 distribution.
DJF 2023/24 average precipitation for the Mediterranean climate region in Israel (above 200 mm/yr) was 441.8 mm. This value is above the 1981/82-2010/11 average by 33.0%, above the median by 49.1%, and resides in the 85.5 percentile of the precipitation distribution. Hence, DJF 2023/24 resides in the “above normal” tercile, yielding a positive Rank Probability Skill Score (RPSS = 0.19), (Table 4).
The Temperature forecasts are skillful. However, the main source of predictability is the warming since 1981 due to climate change.

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.

98e10103-2e73-42e1-9699-6630255e3e5f/Screenshot_2024-05-07_at_16.40.45.png

* **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

- Low stratus cloud base and mixing level heights along the Israeli coastal plain during summertime (May, June, July, August) are typically predicted lower than actually are observed.
- Insufficient penetration of convective precipitation inland.
- Low skill of seasonal rain forecasts.
- Underestimate of rain amounts over most of Israel in the rough grid models (SEAS5, ERA5).

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.

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

EC Charts: Positive Vorticity Advection (PVA)

Product request 1 - description of request

...@ several levels, especially at high levels (e.g., 500mb, 300mb, 200mb).

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

b) Product request 2 - title / summary

EC Charts: Liquid Water Content (LWC)

Product request 2 - description of request

...@ several levels, especially at low levels (e.g., 1000mb, 950mb).

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 a third Product Request?

- (●) Yes
- ( ) No

c) Product request 3 - title / summary

EC Charts: Satellite Airmass Simulation

Product request 3 - description of request

Similar to the existing Vis, IR, WV products.

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 a forth 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).

Davide Miozzo, Sabrina Meninno, Giorgio Meschi, Fabio Violante, Rocco Masi, Martina Lagasio, Massimo Milelli, Lorenzo Massucchielli, Yoav Levi, Pavel Khain, Alon Shtivelman, Nir Stav, Sari Lappi, Umberto Modigliani, Supporting the humanitarian effort in Ukraine, ECMWF Newsletter (175) 2023

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

Both structures are fine with us. The old structure does not have"red asterisk" which is nice. Also, easy to prepare a report using previous Word doc report than previous pdf report. Nice to have an option to choose. Keep both.

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

Contact

Contact Form

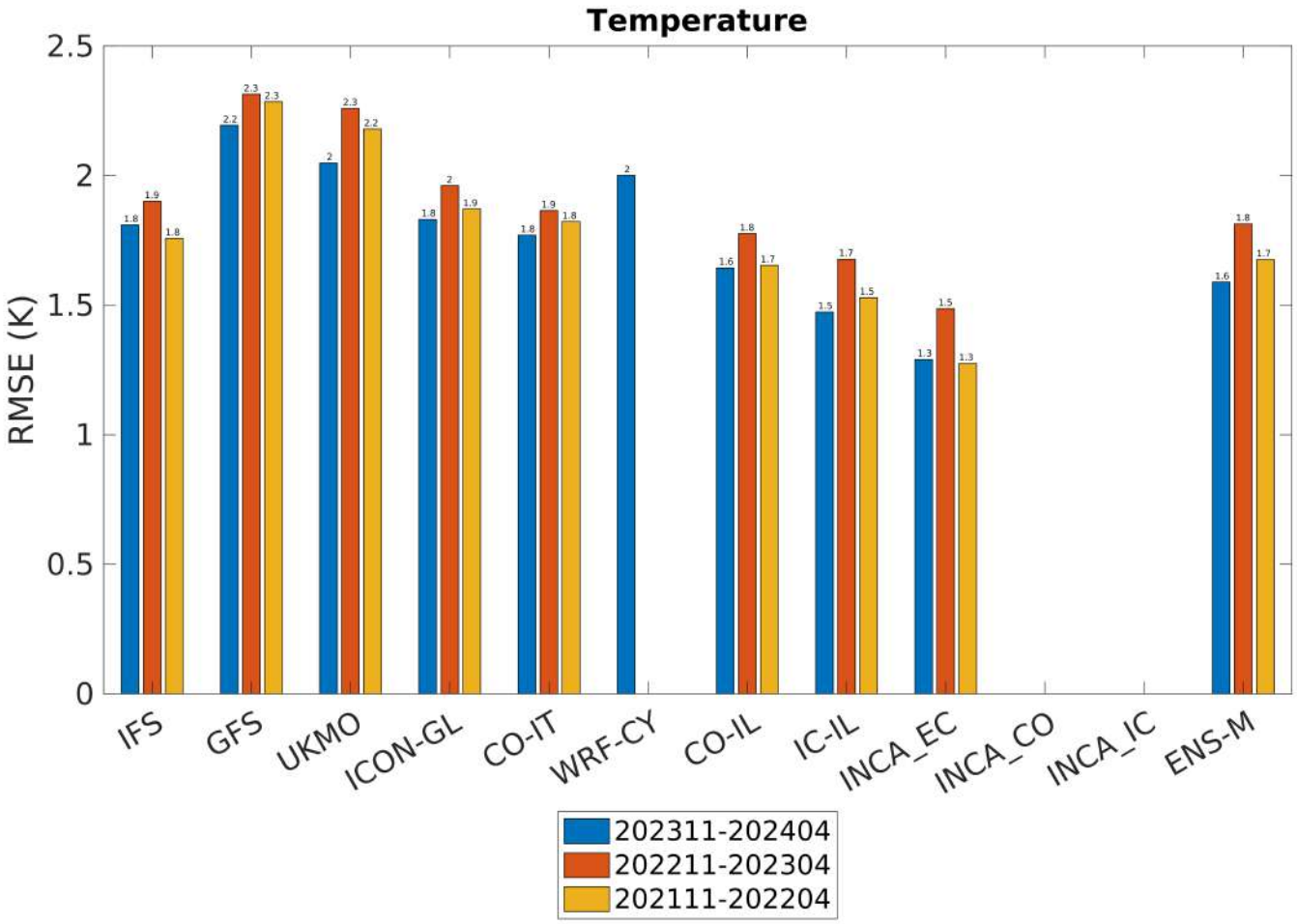
Temperature
RMSE (K)
2.5
2
1.5
1
0.5
0
1.8
1.9
1.8
2.2
2.3
2.3
2
2.3
2.2
1.8
2
1.9
1.8
1.9
1.8
2
1.6
1.8
1.7
1.5
1.7
1.5
1.3
1.5
1.3
1.6
1.8
1.7
IFS
GFS
UKMO
ICON-GL
CO-IT
WRF-CY
CO-IL
IC-IL
INCA_EC
INCA_CO
INCA_IC
ENS-M
202311-202404
202211-202304
202111-202204

Table 1. The percent of 2m max. temperatures forecasted by COSMO-EPS mean driven from IFS-EPS (2024 at ~9 km and 2022-2023 at ~18 km) and IFS deterministic (~9 km) forecast that where within ±1°C (hits) of the observed at 81 stations in Israel. The forecast leat time is 6 to 78 hours. The Enhancement ratio is defined by the ratio between the COSMO-EPS hits to the IFS deterministic hits.

Hits Tobs=Tfore±2K	2024 (~9 km)	2023 (~18 km)	2022 (~18 km)
COSMO T2m (%) EPS	75.8	71.9	74.0
IFS T2m (%) Det.	70	68.3	71.3
Enhancement ratio	1.08	1.05	1.04

Table 2. As Table 1 for RH where a hit score is defined if the forecast RH is within ±13% of the observed at 80 stations in Israel.

Hits Tobs=Tfore±13%	2024 (~9 km)	2023 (~18 km)	2022 (~18 km)
COSMO RH (%) EPS	82.1	79.1	80.8
IFS RH (%) Det.	80.3	78.7	80
Enhancement ratio	1.02	1.01	1.01

Table 3. As Table 1 for Wind Speed (WS) max where a hit score is defined if the forecast RH is within ±4 knots of the observed at 80 stations in Israel.

Hits Tobs=Tfore±4knots	2024 (~9 km)	2023 (~18 km)	2022 (~18 km)
COSMO WS (%) EPS	82.8	80	80
IFS WS (%) Det.	81.4	81.3	79
Enhancement ratio	1.02	0.98	1.01

Table 4. As Table 1 for precipitation Fractions Skill Score (FSS) based on a precipitation analysis (radar+rain gauges) in Israel as the observed value. The average FSS was calculated for a 20 km radius and thresholds of 0.01, 0.1, 0.5, 1, 2, 5, 10, and 20 mm per 6h. The COSMO-EPS precipitation was taken from the 75th percentile.

FSS	2024 (~9 km)	2023 (~18 km)	2022 (~18 km)
COSMO Precip. FSS EPS	55	37	46
IFS Precip. FSS Det.	49	35	43
Enhancement ratio	1.12	1.06	1.07

Table 4: Verification summary of the seasonal forecast for Israel

	temperature			precipitation		
	Observed	ECMWF forecast	RPSS	Observed	ECMWF forecast	RPSS
DJF 2023/24 (SEAS5)	above normal	90% above normal 10% ~normal 0% below normal	0.98	above normal	39% above normal 33% ~normal 28% below normal	0.19
JJA 2023 (SEAS5)	above normal	71% above normal 20% ~normal 9% below normal	0.83	Dry season		