ECMWF MS/CS “Green Book” Report 2024

Section 1: Background

* 1.1 Country

Portugal

* 1.2 Author(s)

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* 1.3 Organisation

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* Section 2: Summary of major highlights

IFS cycle 48r1 was implemented on 27 June 2023, being the first new scientific model upgrade to run in ECMWF’s new Data Centre in Bologna. In this report an overview of ECMWF products and post-processed output at IPMA is provided. The verification results of HRES for cycles 47r3 and 48r1 are presented for Mainland Portugal.

Section 3: Forecast Products

3.1. Direct use of ECMWF forecast products

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

For operational duties, the opencharts of EFI, ENS vertical profiles and meteograms are most useful tools. In particular, the “new” ENS visibility meteograms are widely used in foggy conditions.

Given our large forecasting domain that includes central North Altantic, the tropical cyclone parameters (especially, tropical cyclone activity, plumes, and strike probability) are useful during hurricane season, namely in Azores. Furthermore, these parameters also provide guidance to IPMA’s global weather forecast team within the Severe Weather group of ARISTOTLE project (http://pilot.aristotle.ingv.it/).

* b) Extended Range (monthly)

As part of the cooperation between IPMA and the National Civil Protection, daily weather briefings are held at IPMA in which an extended range forecast of the next two weeks is given by the forecasters. In this context, some of the most widely known ECMWF products are used, e.g., weekly mean anomalies (500 hPa height, mean sea level pressure, precipitation, 2 m temperature), probability distributions of some parameters and weather regime probabilities.

These products can be useful for high impact weather (such as in the case of persistent warm and dry conditions during the warm season that lead to an increased risk of wildfires) together with other specific severe weather parameters. Additionaly, weekly reports are prepared with an overview of the extended forecast up to four weeks for mainland and island territories.

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

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

3.2. Cycle 48r1

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

The main positive impacts includes: i) the increased horizontal resolution of the medium range ensemble is paramount because it matches the one from HRES, thereby making all the forecasts physically consistent; ii) in the extended range, the increased number of ensemble members and the daily updates improve the guidance provided by the model, as it allows a better assessment of the forecast uncertainty.

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

Nothing relevant to report.

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

3.3: Derived Fields

The automatic forecasting system applies statistical post-processing to DMO from both ECMWF and AROME forecasts of 2 m temperature, 2m relative humidity and 10 m wind (speed and gust). The final post-processed forecast is then computed by combining the statistically adjusted near-surface variables. In this system IPMA is computing an estimate of the snow-depth due to precipitation and the likelihood of icy road and snowstorm conditions in several locations in the mountainous regions.

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

3.5: Dynamical Adaptation

3.6: Data-driven (AI) models

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

This is a very welcome initiative as it allows a fast comparison between AI models and IFS, so that forecasters can start assess the outputs.

*** b) Use of AI forecasts for operational purposes**

None.

Section 4: Verification

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

a) Short Range and Medium Range

While ECMWF presented the overall validation scores, this report shows the results for HRES, up to 6/10 days, for cycles 47r3 and 48r1, in the period 25 March to 27 June 2023, using around 150 surface weather stations in Mainland Portugal.

The results in figures 1 and 2 (RMSE and bias) apply to the 2 m air temperature and relative humidity. Figure 3 is similar, but valid for the 10 m wind speed whenever it is equal or above 4 m/s. Figures 4 and 5 show the same scores for the daily minimum and maximum 2 m temperature.

The scores for the 2 m temperature show a light improvement in RMSE up to 2.5 days. Beyond this lead time the upgrade is neutral, but one notices a reduced bias during the nighttime. The scores for the daily minimum (tmin) and maximum 2 m temperature (tmax) show a consistent light improvement up to 10 days, with a nearly constant decrease of the bias in the case of the tmax values.

The scores for the 2 m relative humidity show that the model cycle was neutral or led to a slight degradation of the RMSE in lead times up to 72h. When considering 10 m wind speeds above or equal to 4 m/s the RMSE has increased slightly, particularly in the nighttime. The scores for the 10 m wind gusts (not shown) highlight both a lower RMSE and a smaller positive bias, at least up to 144 h. Finally, the Heidke Skill Score of the 3 and 24 h accumulated precipitation shows that the model upgrade was roughly neutral.

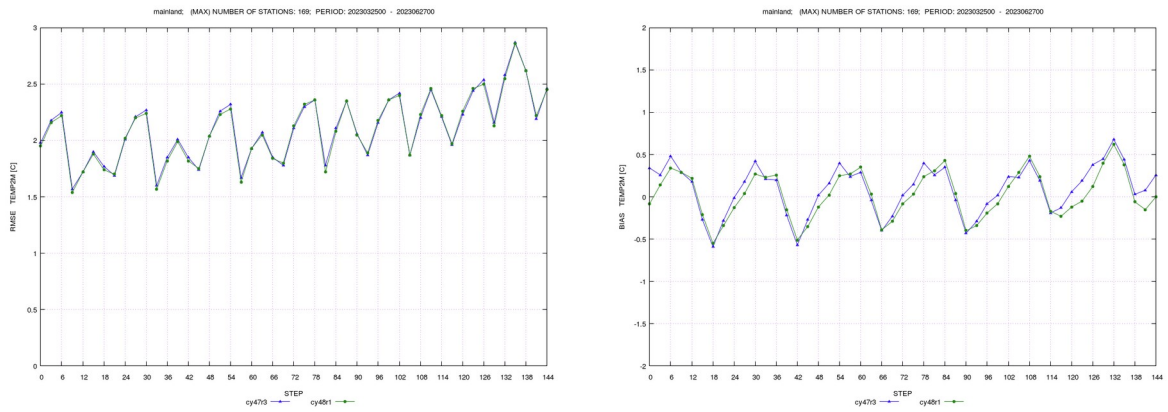

Figure 1 – RMSE (left) and bias (right) of the 2 m temperature, for cycles 47r3 and 48r1, in the period 25 March to 27 June 2023.

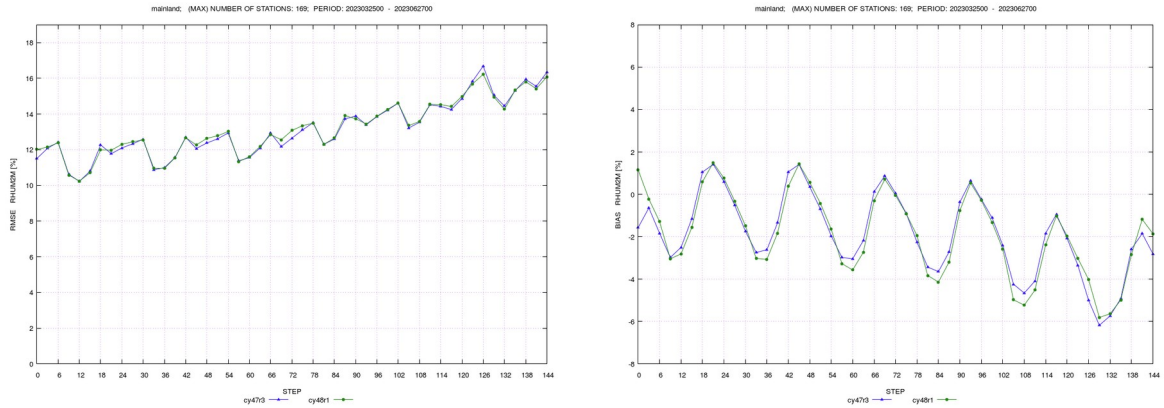

Figure 2 – RMSE (left) and bias (right) of the 2 m relative humidity, for cycles 47r3 and 48r1, in the period 25 March to 27 June 2023.

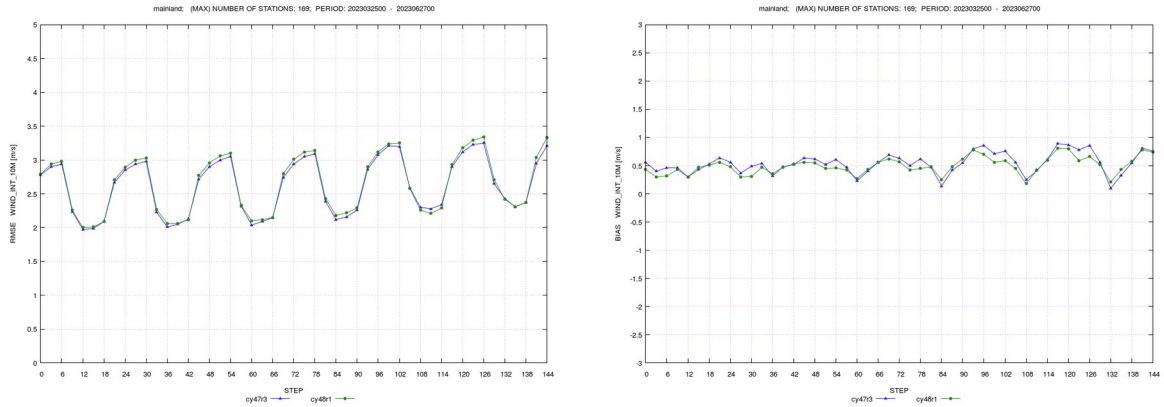

Figure 3 – RMSE (left) and bias (right) of the 10 m wind speed, for cycles 47r3 and 48r1, in the period 25 March to 27 June 2023.

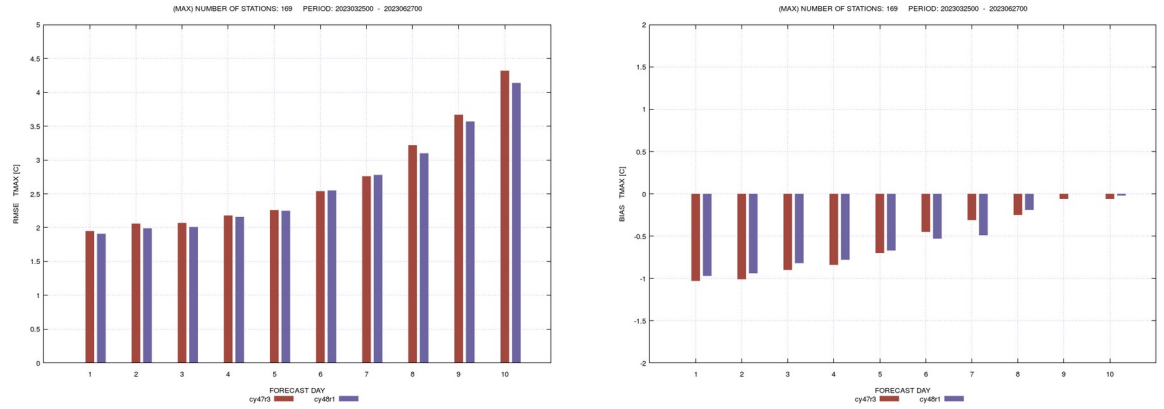

Figure 4 – RMSE (left) and bias (right) of the daily maximum 2 m temperature, for cycles 47r3 and 48r1, in the period 25 March to 27 June 2023.

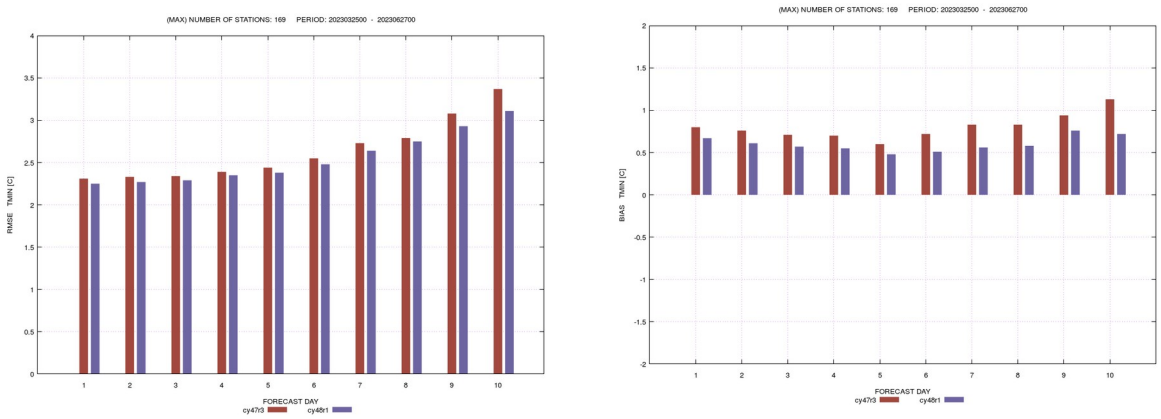

Figure 5 – RMSE (left) and bias (right) of the daily minimum 2 m temperature, for cycles 47r3 and 48r1, in the period 25 March to 27 June 2023.

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

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

4.3 Subjective verification

4.4 Case Studies

a) Case Study 1

b) Case Study 2

Section 5: Output Requests

a) Product request 1: *tephigrams in Metview*

Metview is used to plot forecast (HRES and AROME) and observed (radiosonde) tephigrams. It would be most useful if one could have the values of the geopotential height shown on the right vertical axis of the plot.

b) Product request 2:

Section 6: References

Section 7: Additional comments and Feedback