

## Article review

"Quantifying forecast uncertainty of Mediterranean cyclone-related surface weather extremes in ECMWF ensemble forecasts.  
Part 1: Method and case studies"

**Summary:** In their article, [Katharina Hartmuth et al.] present a novel method to assess the forecast skill of the ECMWF ensemble in predicting extreme weather events associated with Mediterranean cyclones. The first part of their study explains the methodology and illustrates it with three case studies of impactful Mediterranean cyclones. The forecast skill is evaluated based on the ability to predict the occurrence of extreme precipitation and extreme surface winds (both defined by exceedance of the local 99th percentile). The paper is overall clear and well-structured. Particular attention has been given to the description of figures, which makes them especially pleasant to read. In the following, you will find some suggestions, mostly minor, that may help improve the paper.

# 1 Major revisions

**0.5°, 6 h:** As discussed in your conclusion, using 0.5° may be limiting, especially if you look at small objects (such as medicanes). Also, 6 h is coarse for the Mediterranean, where storms evolve quickly. If the work is not too big, I strongly encourage you to take full advantage of the available resolutions. Another way (if increasing resolutions is not possible) could be to use products like "accumulation of precipitation within the 6 h" or "maximum wind gust within the 6 h" if they are available.

**Radius of 400 km:** While this radius is adapted for medicanes, it is not for strong winds associated with extratropical cyclones, even in the Mediterranean. I suggest using a circle of 1000 km around the cyclone centre, or (maybe better) using isolines of pressure that you utilised already to capture cyclones. Also, if you want to avoid attributing high wind to weak lows, you could use a threshold on the minimum central pressure.

**Percentile calculated each season:** I do not think that this is relevant when looking at impacts. Indeed, high wind or precipitation do not impact differently following the season but following their strength. I encourage you to recalculate the results based on a fixed threshold for the whole year. Also, generally the 98th percentile has been used for wind gusts [Klawns and Ulbrich (2003)], as it was shown to fit well the observed losses. Finally, you could use the so-called Storm Severity Index to draw conclusions on the prediction of the impacts.

**"Probablity":** The word probability is sometimes unclear throughout the manuscript. You could reword it in the text when it is relevant, like "proportion of members". The terms "conditional" and "unconditional" probabilities are also adding complexity that may be avoided. This point is a detail, but I think the manuscript could gain clarity with slight modifications.

**Different operational cycles of IFS:** You plan to use different cycles of the IFS (successive improvements of the model) for your statistical analysis. I suggest either using reforecasts instead, or clearly justifying how the use of different cycles will—or will not—affect your results.

## 2 Minor suggestions

**Title:** The title could be more concise and clearer, maybe something like: Forecast uncertainty of high-impact weather associated with Mediterranean cyclones. Part 1: Method and case studies. Also, the term "forecast uncertainty" may be replaced by "predictability" in your case.

**General comment:** Using the passive voice may provide better objectivity.

**General comment:** A figure illustrating the value of the local 99th percentile of precipitation and wind gusts would be very enjoyable.

### Introduction

L. 4: "ECMWF" not defined at this point.

L. 5: "We apply .. to attribute Mediterranean cyclones to events of extreme.." Is it not the opposite? (We apply .. to attribute extreme events to Mediterranean cyclones).

L. 25: The whole sentence could be split into two parts for clarity ('Jansà .. cyclones', 'surface' .. '2024').

L. 36-37: How can you say that the forecast skill of the position is higher than for the intensity since it is based on two different parameters?

L. 59-64: Could be reworded to shorten the sentences and prevent the repetition of "such".

L. 66-80: This part should be made more concise and clearer. For example, the methodology presented in the "Discussion and Conclusions" is easier to follow. The word "whether" line 70 could be replaced, as uncertainty does depend (to a lesser or greater extent) on the following parameters.

L. 75-77: "For instance, .. 1000 individual forecasts." is unnecessary.

L. 75: ERA5 not defined at this point.

L. 79: "This first part .. (1) and parts of (2) and (3)." May be reworded.

L. 82: ERA5 not defined at this point.

### Data and method

L. 89-90: Passive voice may be more appropriate here.

L. 98: Replace "Reduced sea level pressure (SLP)" by "Mean Sea Level Pressure (SLP)"

L. 107: Replace "active" by "operational"

**L. 112:** "data is downloaded every 6 h": Not very clear. This whole sentence could be included at the beginning of the section. "ECMWF ensemble consists of 50 members initialised twice per day. For each base time, a forecast output is available every 6 h up to a maximum lead time of 15 d."

**L. 137:** Can we be sure it is the same cyclone? Does it happen frequently? If yes, maybe a criterion based on the SLP value may be helpful.

$\theta$ : Usually,  $\theta_e$  or  $\theta'_w$  are better adapted to look at fronts.

**L. 158:** "probability of such object". Not very clear, is it a probability of occurrence? If yes, please clarify in the text.

**Fig. 3, 5, 7:** "number of overlapping objects" refers to extreme events detected in X members. Maybe the legend could be reworded to enhance clarity. The stars are too small.

### Case study overview

**Table 1:** "Maximum intensification" may be in [hPa / 12 h] for the three cases to enhance clarity and to fix the given unit.

**Fig. 4, 6, 8:** I suggest slight modifications to these nice looking figures. White coastlines a bit thicker, grey contours a bit thicker, black star larger, TH [K] to  $\theta$  [K]. The areas are also difficult to see with the colours (blue on blue and orange on orange).

**L. 206:** I do not think it "passed across the Pyrenees", at least for the storm centre. It seems that it remains on their North side.

**L. 206:** by 10 hPa / how much time?

**L. 208:** "as a medicane by EUMETSAT": I would be careful with this sentence, since the actual definition given by [Miglietta et al., 2025] is more precise. A consensus did not exist at the time EUMETSAT did that categorisation for a storm evolving in the middle of winter. In particular, "the warm core" was not formally detected. Also, if you choose to keep the sentence, the reference given should be corrected in L. 482 (northern Atlantic? + double https)

### ECMWF forecast performance

**L. 246:** I would replace the word "performance" by "skill" in the whole manuscript since we compare to ERA5.

**Fig. 9:** The figure was difficult to read, but the description was really useful. However, I suggest two simplifications: replace the word "probability" by "percentage of members", or plot directly the number of members. Replace "time relative to cyclogenesis in ERA5" by something like "Initialization time [h]". The parts after "0" seem not very useful for the analysis and may be removed.

**L. 301:** "They contain many small panels". Replace by "Each panel represents.."

**L. 307:** "averaged extreme object probability of ENS within the ERA5 object", may be simplified.

**Fig. 10, 12, 13:** The figures could be simplified by plotting  $t_{fc}$  at only two times (cyclogenesis and mature stage). It would also have the advantage of avoiding a supplementary notation ( $t_{cyc}$ ) while providing useful information. Also, if you modify Fig. 9. as stated earlier, maybe replace ( $t_{fc}$ ) by "Initialization" or " $t_{ini}$ " for consistency.

**Fig. 11:** If you do modify Fig. 10, 12, 13, consider modifying Fig. 11 by plotting only cyclogenesis and the mature stage. If you want to keep the area size, make it larger. It would be easier to understand, and you can still provide additional information in your part 2 if it is meaningful. And last, maybe the figure is misplaced; I would expect this information after reviewing the 3 case studies.

### Conclusion

**L. 366:** "three three"

**L. 371:** This sentence could be discussed a bit more. Indeed, we expect the strongest winds to be located in the southern parts of extratropical cyclones, but in medicanes they tend to occur all around the centre.

**L. 400:** Could be discussed for medicanes that are small objects with high precipitation.

**L. 435:** It would be also interesting to see how prediction varies depending on cyclone type (baroclinic vs. strongly diabatically impacted).