## Response to referee #1 About Intercomparison of four tropical cyclone detection algorithms on ERA5

## Stella BOURDIN on behalf of the authors

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We thank the reviewer for investing time in reviewing our manuscript, and for their constructive comment. It helped us improve the manuscript and lay our argumentation in a more clear way.

Comment 1

Abstract is missing the research problem of the article. Please include the goal of your research work in the abstract.

We added it at the end of the first part of the abstract :

The assessment of Tropical Cyclones (TC) statistics requires the direct, objective and automatic detection and tracking of TCs in reanalyses and model simulations. Research groups have independently developed numerous algorithms during recent decades in order to answer that need. Today, there is a large number of algorithms, often referred to as trackers, that aim to detect the positions of tropical cyclones in gridded datasets. The questions we ask here are the following: does the choice of tracker impacts the climatology obtained? And, if it does, how should we deal with this issue?

(Comment 2)

Paragraph 15 is not clear. Needs to explain the conclusion here more clearly. Does the author mean that we need to select one or a combination of few trackers with better performance and average the result.?

We suggest rephrasing the end of the abstract to :

We conclude by advising against using as many trackers as possible and averaging the results. We favor a more efficient approach involving the selection of one or a few trackers with well-known properties.

Comment 3

Also, in the paragraph 75 the word "we used" has been used frequently, please reduce the usage of that. Also, in the entire draft we find the word "we used" is repeated. Instead use "we employed", "we utilized".

We reformulated the paragraph this way :

The paper is organized as follows. After a description of the classification and datasets we used, we detail the algorithms of the four trackers we used as well as our track matching method. We then use the four trackers to track TCs in ERA5 and to match the detected tracks with IBTrACS tracks, and we present a detailed analysis of the population of missing and false alarm tracks so obtained. This knowledge is **taken into account** to develop two methods common to all trackers that aim at filtering extra-tropical false alarms from the results. The filtered datasets are then used to analyze the sensitivity of traditional metrics to the choice of the trackers. Finally, we **gather** the insight gained from this analysis to consider the complementarity of different trackers and provide some guidelines for applying TC trackers to model results. The conclusion gives a summary of the trackers' common points and differences.

We also replaced several occurrences in the remainder of the manuscript.

(Comment 4

At paragraph 40, you have mentioned that physics-based trackers embed a wind threshold. Please be precise here which wind threshold do you mean? I guess it should be 10m winds.

This modification has been applied:

By contrast, the physics-based trackers usually embed a wind threshold on the 10m wind, a parameter known to be very sensitive to resolution.

(Comment 5)

At the paragraph 45, mention that OWZ **tracker** was found to produce better results across a wide range of resolutions instead of just OWZ.

It has been corrected.

Comment 6

At line 70, Dulac et al., ? year is not mentioned here.

We wanted to refer here to a paper we thought would be published by the time of the acceptation of this one. However, due to delays, the paper is not yet submitted. We removed that reference and the associated sentence.

Comment 7

In the paragraph 130, the following sentence is not clear: Nevertheless, it has recently been assessed as having similar performances for a range of metrics (Zarzycki et al., 2021; Roberts et al., 2020a).

We added precision on the reanalyses at stake this way :

Nevertheless, **ERA5** has recently been assessed as having similar performances **as JRA-55** or **NCEP-CFSR** for a range of metrics (Zarzycki et al., 2021; Roberts et al., 2020a).

Comment 8

Coming to the methods section on TC trackers: It would be good to provide a table describing different tracker input variables, main idea of the design of the tracking scheme, spatial and temporal resolution requirements of the tracker variables, etc.

The different tracker input variable are detailed in Table B1. We are wary of synthetizing the idea of the design of a tracking scheme in a table, because we are unsure whether we can get the full grasp of its developer's mindset in one case. However, we can add a column with references to the relevant papers where the reader could find such information with more details. As for the temporal resolution requirement, there is no such explicit requirement for any of the trackers we used. Although we used 6-hourly data as was done in our reference versions of the trackers, some of them have been used and adapted for different temporal resolution, the other could also be adapted with little effort: given that the data is instantaneous wind speeds, there is no time-averaging that would require to modify the wind and/or vorticity thresholds; only adjusting the length on which the criteria are satisfied is necessary. As a matter of proof, following a question from the other referee, we tested tracking TCs with 1–hourly data and found very limited changes. For the spatial resolution, it is a trickier subject, and, as we already discussed in the introduction (end of the second paragraph), we know some tracker perform better than others at different resolutions. Unfortunately, a precise quantification of these ranges has yet to be performed. We added the following paragraph in the discussion section to highlight this problem :

Another consideration regards the resolution-(in)dependence of the tracking method, or its performance at a given target resolution. Here, the target resolution was that of ERA5, which is about 30 km. The trackers we used either claim to be resolution-independent, or were calibrated on reanalyses with similar resolution, so that the target resolution here is supposedly optimal. It is not guaranteed that any of these trackers will behave similarly at resolution much lower or much higher that those of ERA5. In particular, trackers embedding a wind threshold might be particularly sensitive to resolution (walsh et al. 2013). There are also situations for which one would want to assess a set of simulations with a wide range of horizontal resolutions, and for which a resolution-independent method would be prefered. Even though there are arguments in the literature that dynamics-based trackers (e.g. TRACK, OWZ) might be less dependent on resolution than physics-based methodologies (Tory et al. 2013a, 2013b, Raavi et al. 2020), there is no quantitative assessment of this property. In general, we are lacking a quantification of the range of resolution for which trackers are valid, with or without retuning.

## (Comment 9)

In the description of the post treatment methods, where you have used two different methods and only focus mainly on the STJ method in the entire manuscript. So, I suggest maybe you can keep the detailed description explaining the VTU method in the supplementary section.

We prefer to keep both methods detailed in the body of the text, because we argue that this section is a contribution in itself and not just a method for the rest of the results. The two methods and complementary and have advantages and drawbacks that we want to illustrate, even though in our application they lead to the same results.

(Comment 10)

In the Discussion section, you have introduced Venn diagrams concept. I suggest you to give some details about how to build the Venn diagrams in the methods section.

Upon reading again the manuscript, we do realize that the way we had written it was interrupting the flow of the argumentation. Because they are not used for any scientific analysis per se, but rather for visualisation and in order to build a quick intuition on the different trackers properties, we don't think the description belongs to the methods. Instead, we moved them to the caption of the corresponding figure and we now specify the precise Python package we used to produce those Venn diagrams.