

OS-2020-100.R2 final review responses

We would like to thank both reviewers for their thoughtful and detailed review of the paper. You may be aware that the project this work is based on concluded in March 2020. Getting this paper completed has taken a monumental effort from all co-authors who have made this happen without any specific project hours since the project ended. We did feel, at the end of the project, that this work should be published, despite knowing that it would be challenging to achieve. It hasn't been easy but I am proud that we have managed to achieve that.

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General comments

I like the addition of the "traditional" statistics but it would have been nice to incorporate them a bit better with the rest of the manuscript, that is, bringing them up when the MODE/MDT results are described and discussed.

The final discussion section has been prefaced by adding a sentence which hopefully provides the missing link between the results in Table 1 and the related discussion.

Specific comments

I 17: Add that the verification methods helped to reveal the following model results.

The text has been adjusted. To respect the 250-word count limit for abstracts the text has had to be adjusted slightly elsewhere.

I 117: Maybe mention straight away that this model grid is coarser than the data grid and that the data is interpolated onto the model grid

Done.

I 219: "For the example blue object 1" -> "In the example in Figure 2(b), blue object 1"

Done.

Fig. 2: Should be "centroid distance" and not "centroid difference".

This is definitely the centroid difference. Each of the objects have a centroid location, and the arrow denotes the difference in these two locations.

I 304: I would suggest to introduce the thresholds one sentence before they are used, i.e.: "three thresholds of 2.5, 4 and 6.3 mg m⁻³ were selected to be equally spaced in logarithmic space"

Done.

I 345: "but for higher thresholds (e.g. 6.3 mg m⁻³)": Since only one is used here: "but for the higher 6.3 mg m⁻³ threshold"

Done.

I 352: "Statistics for matched pairs": I would remove the word "matched" here to not confuse the

reader, as no matching in the MODE/MTD sense was performed. Or if it was, this needs to be elaborated on.

Upon reflection, leaving the word “pairs” behind may still be confusing. It may be expedient to take out the entire phrase “matched pairs”, as it has a specific meaning within the context of this paper.

I 404: "(as seen in Figure 4 Figure 5)": Should just be Figure 4, I assume, or an "and" is missing.

The “and” has been added! Figure referencing didn’t work as it should!

I 409: "the quantile mapping functionality within MODE": Is there a reference you could add for a paper that describes this technique in more detail?

Not in the MODE context. In the weather verification community, it is well known method for removing the bias. It tends to exist implicitly in papers, i.e. I can’t recall it being flagged up as needing greater explanation. That is why moving concepts to other communities can be so useful. Things that are taken for granted in one, may not be in another. I could add Mittermaier et al. (2013) which references a different spatial methodology, but I am not sure that it would not confuse, and in truth, it does not really explain the methodology in any detail. This paper is likely to be the most descriptive one out there!

Mittermaier, M.P., N. Roberts and S.A. Thompson, 2013: A long-term assessment of precipitation forecast skill using the Fractions Skill Score. *Meteorol. Apps*, **20**, 176-186.

Fig. 6: This is a really nice plot showing the results of MODE. I notice a few new objects in the western part of the domain, compared to the previous version of the manuscript, which I assume were dropped accidentally from the old version of the figure.

Not dropped accidentally but the previous version was a more zoomed in version.

I 436: "suggest" -> "indicate"

Done.

I 530: Here and in the following line, the 25th percentile becomes the 0.25 quantile.

Sorry, but we can’t find this.

Fig. 11: Again, nice figure! Minor complaint: It is difficult to distinguish some of the colors, like the shades of purple, is there something that could be done to better match the temporal with the spatial location?

We’ve changed the colour palette so there is no recurrence of the purple... sadly the early times do appear quite purple for some reason. They should look bluer, but didn’t. A slight tweak in the base colour appears to improve this. The colour palette change will hopefully make it clearer and should make the cross-referencing less confusing. The graphics are not intended to provide perfect cross-referencing but are there to show the progression of the season from south to north, for example.

Specific comments

L94-96 the sentence started with “A full traditional” could be slightly rephrased given the following sentence or removed.

The sentence has been removed.

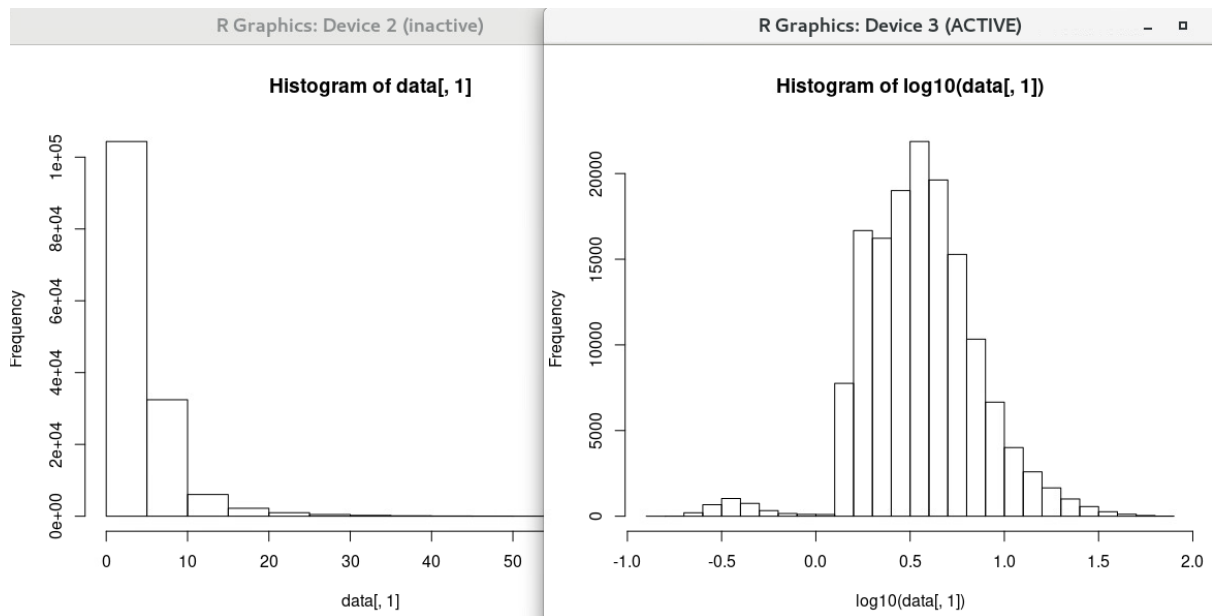
L108-110: Currently sounds abrupt. It would be nice to emphasize once again the aim of the study. A sentence has been added to try to provide a smoother transition to the layout of the paper.

L298-299: please provide a reference on using log10 threshold, or please rephrase

The Campbell (1995) reference documents the fact that Chl-a follows a lognormal distribution. The reference for the use of log10 thresholds was missing and has been added.

It is always statistically advisable to consider the underlying statistical distribution when doing anything categorical, like using thresholds.

Consider below the observed Chl-a values for 2018 season, plotted untransformed (left) and transformed (right). The transformed version will better reflect the upper tail of the distribution. Using thresholds that mimic a transformation will have much the same effect as transforming the data.



```
> qobs # untransformed quantiles
      0%      10%      20%      30%      40%      50%      60%
4.899689e-05 0.06169716 0.1233453 0.1849935 0.2466417 0.3082898 0.5042315
      70%      80%      90%     100%
0.7001732 0.8961149 1.092057 1.287998
> lqobs # transformed quantiles
      0%      10%      20%      30%      40%      50%      60%
-4.309831 -3.550073 -2.790315 -2.030557 -1.270799 -0.5110408 -0.3868496
      70%      80%      90%     100%
-0.2626584 -0.1384672 -0.01427595 0.1099153
```

Instead of using a fixed width sequence of thresholds for the untransformed values, which are heavily skewed, one can mimic the transformation by defining a set of thresholds which are equally spaced in logarithmic space, but are not equally spaced in reality, such that:

```
> 10^seq(0,1,0.2) # sequence of equally spaced thresholds in log space transformed  
back to real space  
1.000000 1.584893 2.511886 3.981072 6.309573 10.000000
```

Which is rounded to 2.5, 4 and 6.3 for this study.

L304: “were not log-transformed” instead of “were not transformed”

Done.

L306: could it be explained clearer?

See the response for I298-299. The text has been amended slightly which will hopefully make this clearer.

L321: Should it be “pushing the concentration threshold too low” instead of “pushing the concentration threshold too high”? otherwise sounds contradictory.

Spurious spikes in observed concentrations could be picked up when pushing the threshold too high, which are probably not real. When the threshold is too low, there are just too many objects to make sense of.

L322: is something missing in the expression in the brackets?

No. The e.g. has been replaced with a “for example” to help.

L329-330: is there also a 4 km resolution L4 product?

A global product is available at 4 km resolution, but the regional product designed for use in the Atlantic is only available at 1 km resolution.

L635: the following references on bloom phenology analysis in modelling could be provided: Ardyna et al. (2017), Hague & Vichi (2018), Pefanis (2021), Rohr et al. (2017), Song et al. (2010).

Thank you for highlighting these papers. We have added references to Pefanis (2021) and Hague and Vichi (2018), see the revised text below. We have omitted the other three, as they are process studies focussing on chlorophyll maxima or rates, rather than verification studies using the type of phenological indices discussed here.

“Phenological indices have been used in observation and model-based process studies (e.g. Racault et al., 2012; Pefanis, 2021), but rarely for model verification, and then usually in 1D (Anugerahanti et al., 2018) or at low temporal resolution (Hague and Vichi, 2018).”

Typos/misprints

L73: citation format: remove the bracket before Shutler;

Done

L84: please correct citation formatting: currently there are double brackets;

Done

L209: mind the font used for “merged” and “one”;

As stated previously the italics is deliberate, used for emphasis.

L211: mind the font used for “matched”;

As above, the italics is deliberate.

L404: “in Figure 4Figure 5” – please correct;

Done.

L529: mind the font used for “and”;

As previously, the use of italics is deliberate.

L566: should it be “in July” instead of “into July”?

“into” is correct