

Earth Syst. Dynam. Discuss., referee comment RC2
<https://doi.org/10.5194/esd-2022-40-RC2>, 2022
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Comment on esd-2022-40

Anonymous Referee #2

Referee comment on "Past and future response of the North Atlantic warming hole to anthropogenic forcing" by Saïd Qasmi, Earth Syst. Dynam. Discuss.,
<https://doi.org/10.5194/esd-2022-40-RC2>, 2022

Overall quality/General comments

The paper assess the SST response in the subpolar gyre region (the region is also known as warming hole) to different forcing and reduces the uncertainties in these responses using a kriging method. While I am not an expert in the statistics (maybe this should be looked at by another reviewer?), the method seems both appropriate and valid to me. It is not that easy to understand though, and I believe the paper would benefit from some clarifications (see specific comments). The method is furthermore used to reduce the uncertainty range of the future WH SST evolution and it is tested whether the results appear valid and indeed add an extra value to what was known before.

The paper does not look at the actual processes causing the different responses, but neither does it claim to do so, therefore, I think that is all right. It does however mean, that the informative value of the paper is not overly large, yet as the WH is a much discussed phenomena I still believe that the findings are valuable to the scientific community. Therefore, I would recommend publication once the comments listed below have been fully addressed.

Specific comments

General: Regarding the method I am not sure why the author is assessing the responses to different forcing when assessing regional SST but not when looking at global GSAT? I see that he is mainly interested in the WH but then why consider GSAT at all (okay, I see the latter is explained in the text)? Plus I wonder whether it can be a problem that air temperature and sea surface temperatures are put into one vector (as they have slightly different variability)?

L 15 ff Drijfhout et al., 2012 did not compare the 1901-2021 period to the 1870-1900 period, please cite a different source

LI 16-19 While the modifications in meridional heat transport are linked to the AMOC, the melting of ice has (so far) not been shown to have affected the AMOC, please rephrase

L 40 Kriging for Climate Change = KCC method? Please introduce abbreviation that is used later

L 55 ff How many ensemble members are in the DAMIP ensemble and what models have been used? Please provide more information and state why you think that there are enough models/members in there to provide an adequate estimate of the response to the individual forcing (as I thought the DAMIP ensemble is rather small...)

LI 69 I am not sure what you mean when you say The sample of the forced responses... do you mean a sample or do you mean the mean/average? Please elaborate

LI 76 ff Can you explain why you expect that some parts of x are not observed in y ? I would assume the full forced time series should be a part of y and if you can not observe it in y then because it is "cancelled out" by epsilon. But it seems I don't fully understand the method.

L 79 Why is this remarkable? Please elaborate or leave this sentence out.

LI 101 ff Is it correct that you assume that the CMIP6 mean response = the forced response (aka you cannot calculate the mean of the forced responses as you identify the forced response as the mean)? If yes, then how do you determine the covariance of the forced response? If not, please explain how you mean this.

LI 112-113 Why do you not use such a more complex hierarchical model? Do you believe that it is not necessary in this case?

L 121 Could you give 2-3 of those studies as a reference?

Fig. 1 Is there any reason why you only go until 2014 here, whereas later you consider the period until 2020? It would be nice if these were the same.

Fig. 2 It would be good to mention in the caption that this refers to SST in the WH (not GSAT)

Ll 140 ff I am a little confused how the uncertainties in the responses to the ANT forcing can be so much smaller than those to the GHG and OA forcing even though the former consists of the latter (Fig.2)

L 174 I would remove slightly since whether >1 degree can be called slightly is debatable

L 191 Sorry, but what is the confusion matrix and why can you used it here?

Ll 1922 But shouldn't this be the case in 90% of the cases, since you are considering the 5-95% interval?

Technical corrections

Title forcing instead of forcings

L 143 Fig. 1d (not de)

L 166 verb missing in sentence