

Earth Syst. Dynam. Discuss., referee comment RC1
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Comment on esd-2022-40

Anonymous Referee #1

Referee comment on "Past and future response of the North Atlantic warming hole to anthropogenic forcing" by Saïd Qasmi, Earth Syst. Dynam. Discuss.,
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I find this a very interesting and valuable statistical study comparing observed northern Atlantic sea surface temperature (SST) changes and model-simulated changes.

I am not a statistics expert and recommend that the statistical methodology should be reviewed by a suitable colleague, but I think I understand the basic approach. A key point of this is that no particular physical mechanism is studied (such as ocean circulation change), but rather simply the statistical relation of SST fields from various model runs (with different forcings) to the observed SST field. In this way we can find how various forcings relate to SST changes (though not by what mechanism) in the models, and whether that resembles what is observed in the northern Atlantic. I think it would be useful to make this a bit more clear right at the outset, because it confused me a bit while reading the introductory part of the paper, until I got to the Methods.

Important findings of this study in my view are:

- that aerosol forcing leads to the opposite SST response compared to observed. This should lay to rest the previous discussions of whether the Atlantic warming hole is caused by aerosol forcing.
- that the historical runs of CMIP6 with all forcings do not get the observed warming hole.
- that increasing greenhouse gases are the main reason for the observed warming hole.

If the author agrees with my assessment, I suggest bringing these conclusions out in

somewhat clearer language in the paper, including the abstract.

I recommend using fewer acronyms (like WH for warming hole) because it makes the paper hard to read.