

Interactive comment on “‘Climate Response Functions’ for the Arctic Ocean: a proposed coordinated modeling experiment” by John Marshall et al.

John Marshall et al.

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We thank the reviewer for their helpful comments.

English spelling and metric units

I have lived in the US for too long and will revert back to English spelling :-). We will also connect to metric units in revision.

Captions to Fig.1

Thanks for pointing this out - we will improve the caption in revision.

Linearity

C1

This was picked up also in the Manucharyan review. Needless to say, not all our CRFs are linear and the degree of linearity depends on the magnitude of the forcing and the particular CRF being plotted. FWC in the BG, for example, appears to be linear in our model for moderate forcing amplitudes, but is not when the wind anomalies are too large. Much more will be written on this issue in revision.

Some metrics are indeed more linear (and symmetric wrt sign of the forcing) - this will be commented on in revision although we do not yet understand all the issues here.

Key Switches

We will motivate our choice of key switches in more detail in revision. The wind patterns correspond, roughly, to the leading modes of atmospheric variability driving the Arctic - the AO (AOO) and the Icelandic/Greenland low. Heat transport through Fram strait and freshwater anomalies are also key drivers of Arctic climate variability and change.

Discussion of metrics and lack of near-surface observations

We are in discussion with Andrey Proshutinsky and these points will be addressed in revision.

Designation of anomalies of Fram Strait transport

We chose the box in Fig.2b to roughly encompass the major temperature signal in the section. We can revisit our detailed choice. We do not completely understand the comment on the seasonal cycle. Suffice to say our (salinity-compensated) T anomaly does not have a seasonal cycle and is meant to represent a secular trend in the properties of Atlantic water entering the Arctic.

Application of CRFs

The CRFs are applied individually, but they could be added sequentially and/or simultaneously. Depending on the linearity, we could de-convolve the separate effects. This will be clarified in revision. As you surmised, the number of ensemble members is

C2

being referred to, not the number of ensembles. In our coarse resolution experiments with the MITgcm, we found that small numbers of ensemble members is required because most of the variability is forced, rather than internal to the model. This may not be true of other models, particularly when such models are run at higher resolution and thus presumably exhibit greater internal variability.

Figure 8.

Yes, it would indeed be best to separate them. We confuse not only the reader but ourselves!

Model resolution and parameterization

Model differences will surely impact our CRFs, but this is precisely a key reason we are interested in comparing them and studying them. For example we are already finding (not reported in the paper) that CRFs, although having broadly similar characteristics, differ in detail across models, both in amplitude and timescale of response. Our goal is to understand why and how, and what they might look like in the real system.

Conclusion

We agree that the conclusion could be much better done - and is an important job in revision.

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