Summary & General comments: This is an interesting take on the multitude of studies concerning the atmospheric response to Arctic sea-ice loss where a general linear model is used to determine the response to sea-ice loss and PDO separately, and the interaction between them. The fact that PDO and sea-ice loss interact non-linearly is certainly of great interest. To me it was a novel technique that I believe should be introduced to the community, but consequently, I do think it could use a bit more clarification and fleshing out of both the methods and the discussion, and for that reason I have selected minor revisions, but also included a heading below with "major" just to separate out some of the more substantial changes I'd like to see from the smaller ones.

Minor comments:

Throughout:

Inconsistent use of sea-ice loss vs. sea ice loss: my preference is the former.

Adding ‘the’ in front of sea-ice loss is not usually necessary.

Abstract

Perhaps it’s worth mentioning that these are PAMIP-style experiments in the abstract?
L33: I find "Weak deepening" is sort of awkward wording, perhaps something like “small increase in strength of the Aleutian Low”, or “modest deepening…”.

L34: In the stratospheric the polar vortex -> the stratospheric polar vortex/in the stratosphere...

L35: Besides: hard to know what is meant here. Is it saying that on the other hand the PDO does X or in addition, it does X?

L38: I was confused which phase of the PDO you were referring to, upon reading the paper I understood. It could be worth mentioning that it is for both phases of the PDO here as a result of the method used.

**Introduction**


L87: Perhaps include a reference to Smith et al 2020 on the NAO signal to noise paradox.

L92 I believe the Cvijanovic study uses a slab ocean, so it might not be the best example to include here as Deser et al 2015 showed that the nature of the slab ocean response was quite different. Hay et al 2022 also discusses the deepening Aleutian Low response and PDO-like response of SST’s.

L108: What is meant by December Wave 1? Wave 1 pattern in december or something else?

L119: 'oppositely' as in they will cancel each other out? Where does the cancellation occur?

L125: extension -> extent
Many of the responses to sea-ice loss? There have been some efforts to make multi-model comparisons (Screen et al 2018, Hay et al 2022, though I appreciate that IPSL hasn’t been used before so I understand what is meant. Though it occurs to me that since these are PAMIP experiments it would be possible to extend this analysis to other models that have done the coupled runs as well.

Methodology

L145: CM6 -> CM6A

L154: resolution increases

L175: which procedures are meant here?

L200: This last sentence probably belongs in the previous paragraph

L231 & elsewhere: FU->FUT

L241-: I’m a bit unclear on this due to the wording here, (esp. together with the equatorial SST anomaly), does this just mean that this is a known bias of climate models that they extend too far westward?

L261-262: This might be easier to read if written as two equations (assuming I’m understanding it correctly, the dummy variables effectively makes this two separate equations?)

L275: residue -> residual

L281: FDR is becoming more common within climate science but I think this bit will be a bit opaque to most readers and needs clarifying

Results
L310: Since I took issue with using 'weak deepening' in the abstract, here I want to note that you don't use it in the text, so perhaps it's not even necessary to state in that way in the abstract.

L406: What do you mean by somehow? Somewhat?

Summary & Discussion

See comment above in Intro section about other studies I think should be referenced here, and my thought son some of the discrepancies.

L446: How so?

L478: Increase in what?

L503: missing -LR

L506: Besides again, not clear what it meant.

Last paragraph: some ocean analysis is also done in Hay et al 2022.

Figures:

Fig 1: Fut-PI, and PD-PI surely? As there's a [-] in SIC? Or does that mean unitless?

Fig 8. Perhaps changing the vertical extent/scaling in the bottom panels would be helpful for making this easier to read

Fig 9. I'm a bit confused by what is meant by the triangles being associated with terciles, it looks as though they're just located at -1, 0, 1?
Major

L71: “is likely” might be a bit of an overstatement/oversimplification of the large body of research debating the topic and considering how small of an effect is found (e.g. Smith et al 2022), as well this just being one driver of mid-latitude climate change, where change driven by lower latitudes may be more important and induce changes of the opposite sign (e.g. tug of war between high/low latitudes)

L257: Can this be shown? For readers not familiar with the method this might be helpful. This is an example of where I think readers would appreciate a bit more of an explanation of the method, though I understand there’s a limited amount of space. I think it’s a very interesting and, to me, novel way to analyse these types of experiments. I’m not sure what sort of assumptions go in to this, for example.

L297: So this suggests agrees with the results of Screen & Francis 2016, but shouldn’t that effect have been quite hard to detect with present day sea-ice loss? I think discussing your results here in the context of theirs might be useful.

I like that there is a discussion of the short length of the experiments, as this is an atypical way of running coupled experiments and is sure to reduce oceanic effects, particularly slow time-scale ones. Perhaps it’s not surprising that the results are not too different between ATM and CPL, but it feels like something is missing between what is stated in the abstract about comparing ATM and CPL experiments as this is just a single paragraph and doesn’t really delve in to the effects of the stratospheric weakening.

References:


