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The Cryosphere Discussions

Interactive comment on "Mechanisms causing reduced Arctic sea ice loss in a coupled climate model" *by* A. E. West et al.

Anonymous Referee #1

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The focus on what causes variability on top of a long term trend is interesting in this paper. It appears that nonlinearities in two negative feedbacks combine to give rise to a temporary slowdown in the loss of Arctic sea ice. These feedbacks are associated with the tendency for northern North Atlantic temperatures to warm less as the AMOC weakens and for sea ice volume export to weaken as the ice thins. I found the analysis careful and thorough.

It would be good if there were dozens of ensemble members, instead of eight. But that cannot be helped. I hope that this paper serves as motivation for those with access to very large ensembles to analyze their runs for such behaviors.

I appreciate the attempt to put the results of this model in context of the real world. The authors say they cannot predict there will be a slow down in the real world's sea ice

loss. I agree, one cannot know for sure because the nonlinearities in the feedbacks could easily be off a bit in the model. It is interesting to see that such a slow down is possible in a sophisticated GCM.

The authors should probably review the Ogi and Wallace papers about how summer ice export has been a major factor in observed Arctic sea ice change in the past deacade.

The Introduction is succinct at explaining the motivation and the content of the paper.

I only have some minor suggestions

p 2654 line 17 Are you sure the month of October hasn't declined at a fast rate? A reference would be good here, unless you verified it yourselves.

Given that the interesting transition occurs soon after the change from historical to SRESA1B forcing, it would be useful to have a brief reminder of what forcings are included in the SRESA1B and whether the CO2 varies smoothly from 1990 to 2010 or so.

p 2657 line 20 The verb tense changes suddenly to past. I thought at first the authors were referring to another paper. Try to use the same tense throughout.

p 2658 line 18-19 Should state that it is reasonable accuracy compared to observations?

p 2659 line 12-13 The parenthetic statement implies that the surface temperature cannot change for a zero-layer model. I suggest rewriting this statement or leave it out.

p2659 The sentences about various residuals are confusing, and Appendix B didn't help clear it up. Attention is needed to make this clearer. Figure 4 is very nice. I suggest adding the variables used in Appendix B to it and then write out the equations for the residuals (including the atmospheric het transport) explicitly in Appendix B

p2672-3 It think botmelt is not a good variable name for the conductive heat flux through the ice. Instead, I think it would be better to call it conductive flux and then explain that

it usually gives rise to basal ice growth in winter but can cause a small amount of basal melt when the surface temperature is above the ocean temperature. It took me a few minutes to convince myself it belonged in the AI term and not the OI term. I think It should be in the AI term because the top surface temperature controls it. It would be nice to state this.

Fig 5. I suggest giving the sign convention of the terms in the caption. I guess the heat stored in the ice is negative? So it is inversely proportionate to volume. I guess the arrows in Fig 5 are supposed to tell me the sign convention, but some words about it would help too. Also it is unclear to me how the changing area of the ice affects the breakdown. I'm guessing it does not play a role since the units are not per area. So the ice energy flux is into whatever ice volume is present. Helping the reader get these details will make the paper more accessible.

Fig 6 I was unsure why the computation in (b) did not equal (a). Is it because the variables in the integral are daily or monthly averages as opposed to an instantaneous product or is it because of the small layer with a heat capacity at the surface.

Interactive comment on The Cryosphere Discuss., 6, 2653, 2012.