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Interactive comment on "Impacts of marine instability across the East Antarctic Ice Sheet on Southern Ocean dynamics" *by* S. J. Phipps et al.

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Response to Short Comment 1: 'Southern Subpolar Gyre changes' by Anders Levermann

Dear authors, this is a very interesting paper. Perhaps you are interested in this paper, even though it uses a very coarse ocean model, but it discusses the interaction of meltwater and Southern Ocean circulation Best wishes, Anders

T. Hattermann and A. Levermann Response of Southern Ocean circulation to global warming may enhance basal ice shelf melting around Antarctica Climate Dynamics 35 (2010), 741-756.

We thank Anders Levermann for his kind comments.

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Discussion paper

Hattermann and Levermann (2010) use an intermediate complexity model to study the response of the Southern Ocean (SO) to increasing atmospheric CO_2. A simple parameterisation is used to represent the heat and freshwater fluxes due to basal melting of the Antarctic ice shelves. The authors find that a strengthening of the Antarctic Circumpolar Current (ACC) leads to warming of the SO and hence enhanced basal melting. They also identify three feedback loops whereby basal melting influences the circulation of the SO. The dominant feedback loop involves local cooling; this loop is negative. A secondary feedback loop involves acceleration of the subpolar gyres; this loop is positive. A minor additional feedback loop involves weakening of the ACC; this loop is negative.

This study is extremely pertinent, and we thank Anders for bringing it to our attention. We will incorporate discussion of it into the manuscript and, where appropriate, we will also test for the presence of each of the three feedback loops within our experiments.

We have also completed an additional experiment in which we increase the atmospheric CO_2 concentration to four times the pre-industrial concentration (1120 ppm) at 1% per year. We will incorporate this experiment into the manuscript. This will allow us to compare and contrast the response to increased freshwater input with the response to increasing atmospheric CO_2. It will also allow us to compare our experiments with those conducted by Hattermann and Levermann (2010).

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