

***Interactive comment on* “Sensitivity of the current Antarctic surface mass balance to sea surface conditions using MAR” by Christoph Kittel et al.**

Anonymous Referee #2

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This paper is an interesting analysis of the sensitivity of the Antarctic surface mass balance in a regional climate model to perturbed sea surface conditions (sea surface temperature and sea ice extent). The paper is well written and the results are relevant. There are some mechanisms given in the paper to explain some of the sensitivities, but there are no quantitative analyses done to support these hypotheses. I therefore recommend such analyses to be added to the manuscript (see major point 3 and 3) before it can be accepted. 1. You perturb both the SST and the SIC, but not necessarily in a consistent way. In my opinion, more material should be given to illustrate a consistent perturbation, for example by comparing how the SST bias in the GCM compares to the SIC bias? Another way would be to assume – for example – that meridional SST gradient remains unchanged as the SST increases, which imposes the retreat of the

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Discussion paper



sea-ice edge. 2. I do not really following the reasoning throughout the paper why there is more precipitation inland when SST is lower or SIC is higher. You argue that this is because the dryer air has to rise up higher to reach saturation. Although, this is of course true, it does not imply that precipitation can be brought higher up – it just means the saturation point is at a higher elevation. For saturated air, the amount of moisture transported in the interior is only dependent on temperature and circulation. So additional analyses are needed to shed light on this issue. The best way would be to do a moisture budget over the interior and see whether small circulation changes might be responsible for this. Although you do spectral nudging, circulation close to the surface might deviate which can be relevant for moisture advection. Although this comment is valid for the entire results/discussion section, p11, line 14/15 is particularly misleading. 3. On p 11 linr 19 you state that ‘Katabatic winds prevent significant impacts of SSC on the Antarctic SMB’. Although this might be true, I do not see proof for this in the manuscript. Even if there would be no katabatics, the fact that air has to rise over the topographic barrier and additional moisture is constrained to the boundary layer, might be enough to prevent significant effect. The paper would need to be strengthened with some quantitative postprocessing of the model output to shed light on this explanation. Minor comments: 1. Abstract: last sentence: a number for a sensitivity in % is meaningless when the magnitude of the perturbation is not specified. Please clarify in the abstract 2. P1, line 22: I am not sure if I follow the definition of the Sea Ice Extent given there. Can you give a reference for this definition or clarify? 3. P 2, l11: reference is van Lipzig et al., (2002) not van Lipzig and van Meijgaard (see below). 4. P9: l12: Air does not have ‘a capacity’ to hold water vapour. The water vapour is one of the components of air. Please reformulate. Van Lipzig, N.P.M., E. van Meijgaard and J. Oerlemans, 2002. Temperature sensitivity of the Antarctic surface mass balance in a regional atmospheric climate model. *J. Clim.*, 15(19), 2758-2774. doi:10.1175/1520-0442(2002)015<2758:TSOTAS>2.0.CO;2.

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