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# A new convective model for the Maud Rise Polynya

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The Maud Rise Polynya, a large hole in the Antarctic sea-ice, was first observed in the 1970s and reappeared again in 2017. The general paradigm is that the polynya formed due to deep convection caused by static instability of the water column. There is, however, no consensus on the processes responsible for the initialisation of deep convection. Both atmospheric and oceanic processes have been suggested by observational and model studies. Deep convection is viewed as an irregular event caused by densification of the surface layer. Heat accumulation in the subsurface layer is also considered to be vital for the formation of the polynya. This study investigates the initiation of deep convection using a simple 1D convective model introduced by Martinson et al. (1981) which is further extended with a dynamical subsurface layer. This extended version of the model allows us to study the contribution of both surface- and subsurface forcing on the initiation of deep convection. Two model set-ups with different subsurface characteristics have been used: (1) with a constant subsurface layer; (2) with periodic subsurface accumulation of heat and/or salt. Model set-up 1 results in either one or no polynya events. This does not agree with observations, since multiple polynya events have been observed. Model set-up 2 results in in periodically returning polynyas with the same period as the subsurface accumulation. Therefore, model set-up 2 is able to again multiple events as observed. Adding noise to the simulations does not change the conclusions for both model set-ups. The results suggest that subsurface forcing is a dominant process in Maud Rise Polynya formation. Our results indicate that densification of the surface layer plays a much smaller role than previously assumed by various literature. Based on these results and previous studies, we suggest that subsurface processes govern both the initial formation and reccurrence of the Maud Rise Polynya.

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