Geophysical Research Abstracts
Vol. 13, EGU2011-8342, 2011
EGU General Assembly 2011

The effect of sea-level rise on the stress regime of the Brunt and Riiser-Larsen ice shelves

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Ice rises and rumples act as pinning points along the ice front of ice shelves. The smaller these grounded areas are, the more likely they are getting afloat in case of sea level rise. The Brunt Ice Shelf is an unbounded ice shelf situated along Caird Coast (East Antarctica) that is confined by a small ice rise, the McDonald Ice Rumples. Along the ice front and in the interior of the adjacent Riiser-Larsen Ice Shelf a number of small ice rises and a mixed ice-rise/ice-rumple feature exists.

In this study we assume that these grounded zones are highly affected by future sea-level rise. In order to investigate the response of the ice shelves to decreased and vanishing pinning we apply various geometric settings in which a prescribed sea level rise is used to reduce the grounded area of the Brunt and Riiser-Larsen ice shelves to the full-Stokes finite difference model $\mathrm{TIM}-\mathrm{FD}^3$. $\mathrm{TIM}-\mathrm{FD}^3$ is a numerical thermo-coupled ice flow model, that solves the full-Stokes equations, the heat transfer equation and ice thickness evolution equation in three-dimensions on a 1km horizontal grid scale. We compare the simulated stress fields, principal deformation rates and axes to the present day situation. Furthermore, we analyse the temporal evolution of the stress field and estimate the response time of the ice shelf system to the ungrounding of the pinning points.