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Sensitivity of a spatially-varying Elastic Lithosphere-Relaxed Asthenosphere (ELRA) isostatic model of the Antarctic ice sheet

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On glacial-interglacial time scales, isostatic effects of ice sheet volume changes may have a large impact on timing and magnitude of retreating and advancing ice through grounding-line migration. A common isostatic model used in ice-flow modelling is the Elastic Lithosphere-Relaxed Asthenosphere (ELRA) model. It considers an elastic lithosphere, defined by a given effective lithosphere thickness and a relaxation equation for asthenospheric response with a characteristic time scale as a function of asthenosphere viscosity. However, effective lithosphere thickness in Antarctica ranges from tens (West-Antarctica) to hundreds of meters (East Antarctica), leading to a flexural rigidity that varies spatially across several orders of magnitude. Furthermore, recent studies also point out to a large spatial variability in asthenosphere viscosity. Here, we explore in a sensitivity analysis both spatially uniform and spatially varying values of flexural rigidity and asthenosphere viscosity applied to a model of the Antarctic ice sheet, forced by background temperature and sea-level changes over the last 40,000 years, thus covering the last glacial-interglacial transition. Results demonstrate a higher sensitivity for the West Antarctic ice sheet, where asthenosphere viscosity essentially influences timing and magnitude of grounding-line retreat during the glacial-interglacial transition.