

Supplementary Information: Gravity-derived Antarctic bathymetry using the Tomofast-x open-source code: a case study of Vincennes Bay

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Supplementary Information

Supplementary information comprises an overview of the ROMS model setup and model simulations (Sect. 1) and supplementary Figures (Sect. 2)

1 ROMS Ocean Model Setup

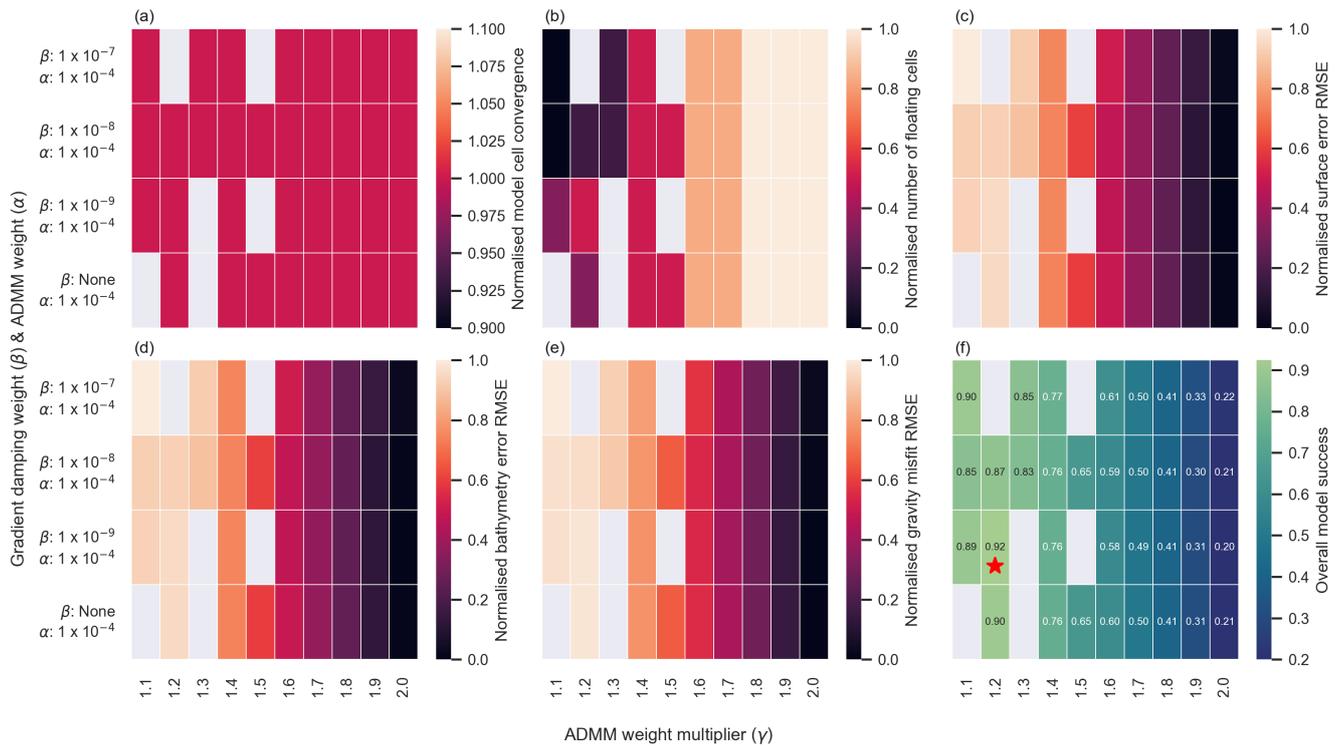
- 5 Ocean simulations were conducted with the Regional Ocean Modelling System (ROMS; Shepetchkin and McWilliams, 2005), with modifications for ice shelf mechanical pressure and thermodynamics, following Galton-Fenzi et al. (2012) and Dinniman et al. (2003). The model was built on a polar stereographic grid with a spatial resolution of ~2 km and 25 vertical layers (producing minimum vertical resolutions of ~10–20 m on the deep continental shelf and less than ~2 m within the ice shelf cavity). This kernel has been previously employed for simulations of this region (e.g.
- 10 Gwyther et al., 2014; McCormack et al., 2021). Lateral forcing (i.e. temperature, salinity, and velocity) is sourced from ACCESS-OM2-1 (Kiss et al., 2020). Surface forcing is also sourced from ACCESS-OM2-1, and is comprised of

wind, and heat and salt fluxes which together represent sea ice formation. We employ the sea ice flux parameterisation as used previously (e.g. Richter et al., 2022), rather than a dynamic sea ice model. Two simulations were conducted, where the only difference is the bathymetry surface product (i.e. IBCSOv2 and our modelled bathymetry). For
15 further technical details on the model setup, we refer the reader to previous implementations of this model kernel (e.g. Gwyther et al., 2014).

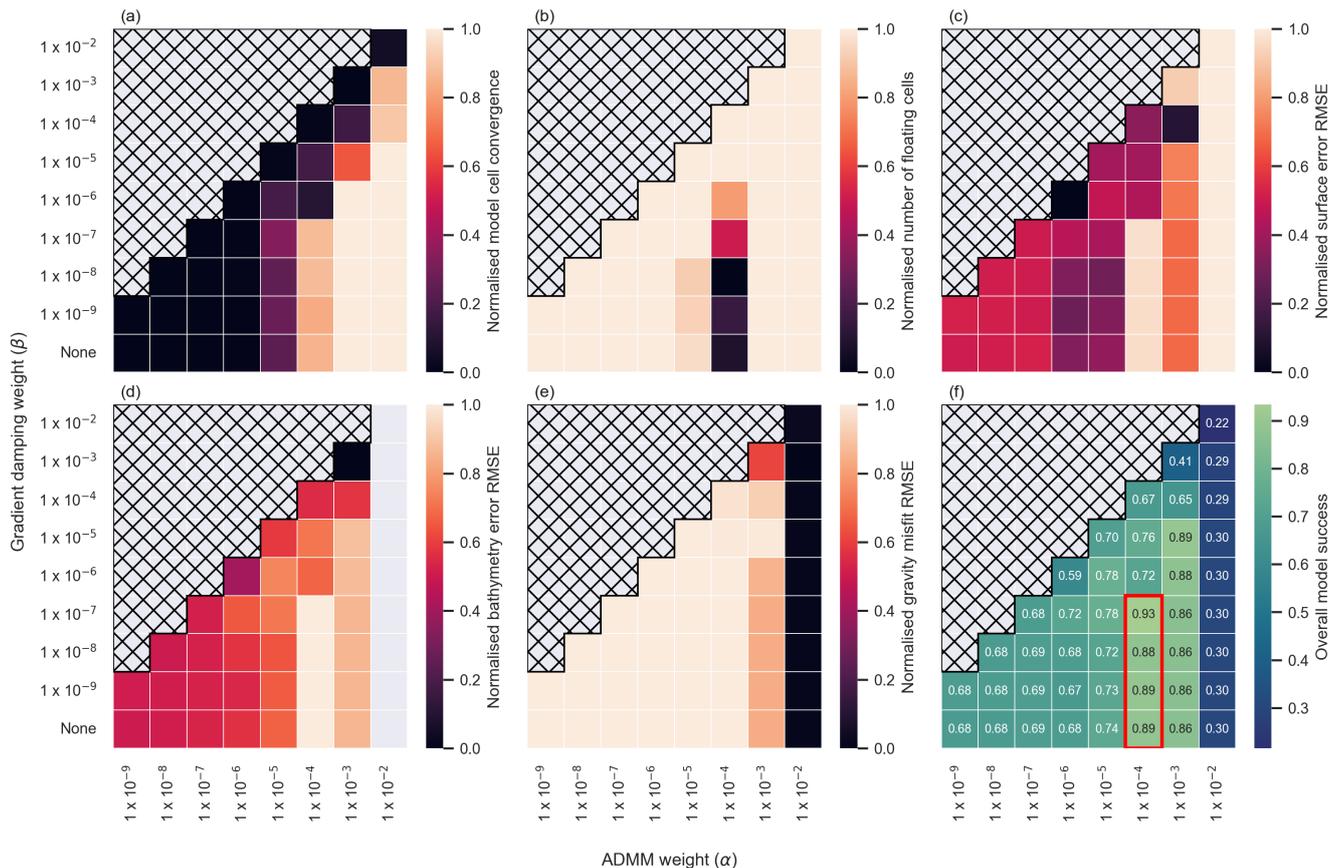
In order to ensure numerical compliance and stability several procedures had to be conducted. The bathymetry was smoothed in order to remove any overly steep gradients and a minimum water column (of ~20 m) was enforced. The resulting change in bathymetry was minimal and key features (e.g. the Vanderford Valley and ice shelf cavity
20 shape) were preserved. Ten years of forcing were simulated and we analyse only the final year. Annual-mean fields are presented in Fig. 13 and Fig. S4.

2 Supplementary Figures

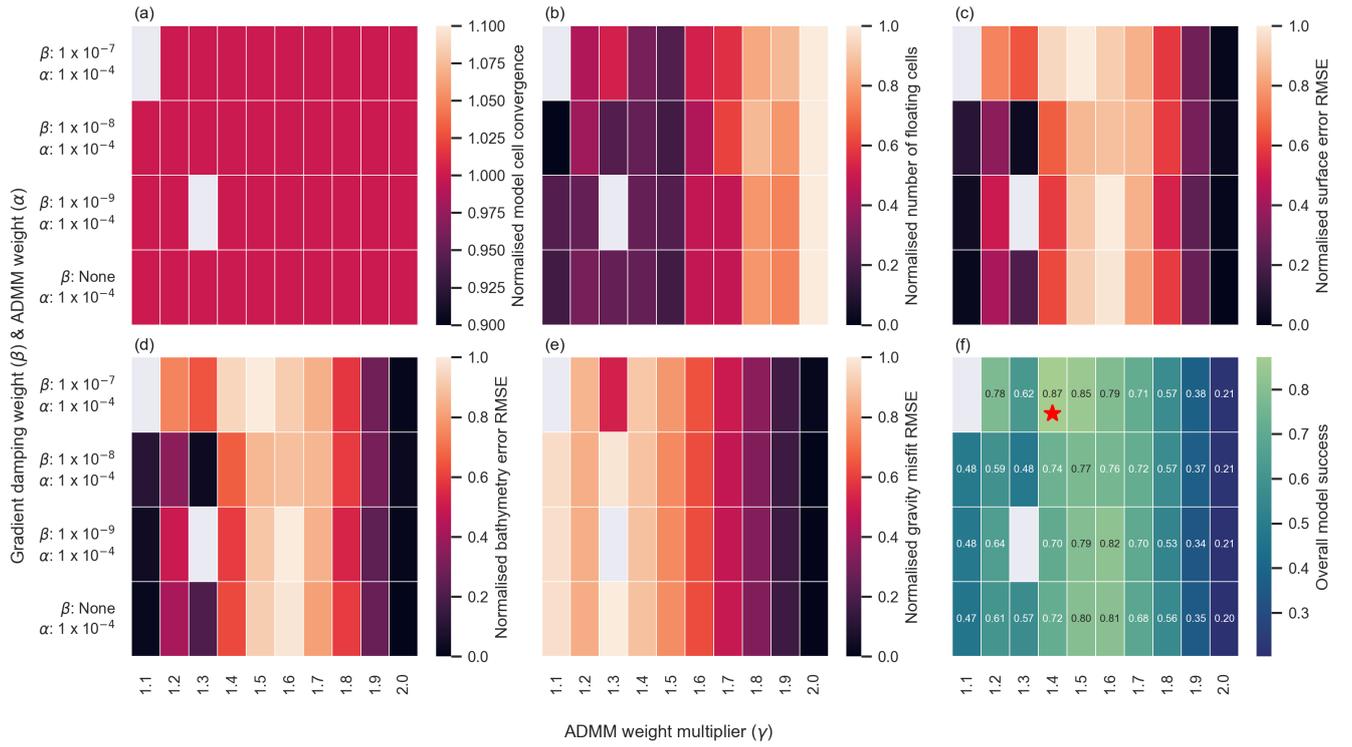
Figure S1 shows normalised results of individual model success criteria for the Synthetic model second stage ensemble modelling. Figure S2 shows normalised results of individual model success criteria for the Vincennes Bay model
25 initial stage ensemble modelling. Figure S3 shows normalised results of individual model success criteria for the Vincennes Bay model secondary stage ensemble modelling. Figure S4 shows two-dimensional cross-sections of ocean temperatures along Northing -905 km, through the Vanderford Glacier ice shelf cavity.



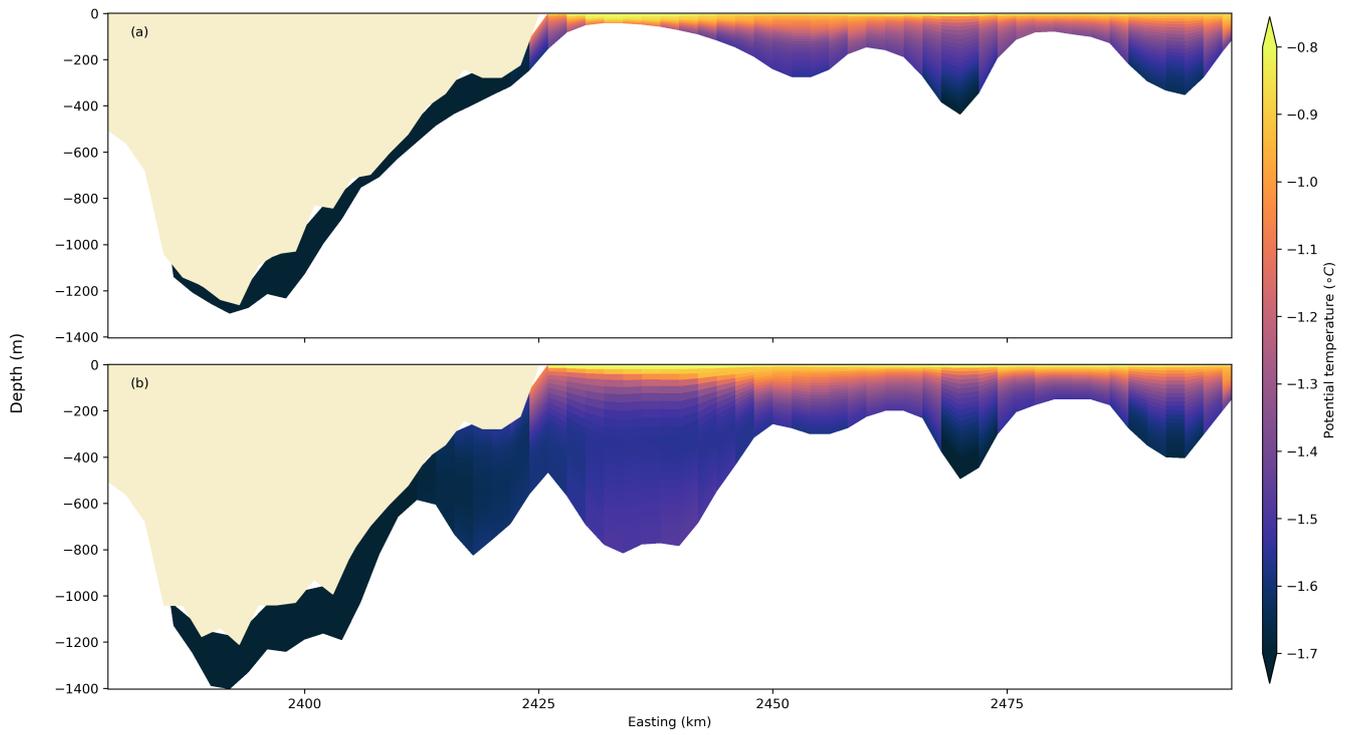
S 1: Secondary Synthetic model ensemble modelling results. Red star in (f) denotes final selected model. All values in (a) are 1.0 as models that did not reach 100 % cell convergence are removed. The colour bars used in (a) – (f) show models with good success in light colours and models with poor success in dark colours.



S 2: Initial Vincennes Bay model ensemble modelling results. Red polygon in (f) denotes preferred models. The colour bars used in (a) – (f) show models with good success in light colours and models with poor success in dark colours.



S 3: Secondary Vincennes Bay model ensemble modelling results. Red star in (f) denotes final selected model. All values in (a) are 1.0 as models that did not reach 100 % cell convergence are removed. The colour bars used in (a) – (f) show models with good success in light colours and models with poor success in dark colours.



S 4: Potential temperature along Northing -905 km. Green area represents the ice shelf and coloured regions represent ocean water.

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