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The dynamical response of the Warszawa Icefield to recent and predicted climate change

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A 3D higher-order ice flow model is applied to the basal topography of the Warszawa icefield at 100 m resolution. The model is coupled to climate through a temperature-index melt model (incorporating a direct radiation algorithm) and a snow-drifting re-distribution model which yields the surface mass-balance boundary condition. A suite of spin-up experiments are run to validate the model against observables and to investigate the primary influences on the present icefield geometry. These are followed by a set of experiments driven by climate records/proxies to replicate post-Little Ice Age fluctuations and the subsequent best and worst-case trajectory of the icefield to the end of this century. These experiments reveal the icefield to be sensitive to climate, rapidly responding to perturbations in mass balance, basal dynamics and ice calving. Prevailing wind-direction and aspect also exerts control on the present icefield geometry through their primary effect on mass accumulation and ablation. Historical simulation reveals that the icefield was relatively stable until the mid 1950s, after which it has steadily retreated. Given continuation of the current rapid warming trend observed across the region, the Warszawa icefield will dwindle to $<5\%$ of its present volume by the end of this century. More conservative estimates of climate forcing, offset by enhanced precipitation, result in significantly less depreciation in ice volume.