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Dynamic Hydrological Discharge Modelling for Coupled Climate Model Simulations of the Last Glacial Cycle

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The continually evolving large ice sheets present in the Northern Hemisphere during the last glacial cycle caused significant changes to river pathways both through directly blocking rivers and through glacial isostatic adjustment. These river pathway changes are believed to of had a significant impact on the evolution of ocean circulation through changing the pattern of fresh water discharge into the oceans. A fully coupled ESM simulation of the last glacial cycle thus requires a hydrological discharge model that uses a set of river pathways that evolve with the earth's changing orography while being able to reproduce the known present-day river network given the present-day orography. Here we present a method for dynamically modelling hydrological discharge that meets such requirements by applying relative manual corrections to an evolving fine scale orography (accounting for the changing ice sheets and isostatic rebound) each time the river directions are recalculated. The corrected orography thus produced is then used to create a set of fine scale river pathways and these are then upscaled to a course scale. An existing present-day hydrological discharge model within the JSBACH3 land surface model is run using the course scale river pathways generated. This method will be used in fully coupled paleoclimate runs made using MPI-ESM1 as part of the PalMod project. Tests show this procedure reproduces the known present-day river network to a sufficient degree of accuracy.