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Dynamic Lake 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 drainage pathways both through directly blocking rivers and through glacial isostatic adjustment. These changing drainage pathways drove the formation, evolution and (sometimes catastrophic) drainage of large glacial lakes such as Lake Agassiz. Studies have shown this changing hydrology had a significant impact on the ocean circulation through changing the pattern of freshwater discharge into the oceans. A coupled Earth system model simulation of the last glacial cycle thus requires a lake model that uses a set of river pathways and lakes that evolve with Earth's changing orography. Here, we present a method for dynamically modelling lakes (building on previous work on dynamically modelling rivers) by applying predefined corrections to an evolving fine-scale orography (accounting for the changing ice sheets and isostatic rebound) each time the river directions and lakes basins are recalculated. The lakes are delineated from this corrected fine scale orography and water level within each lake is modelled within the JSBACH land surface model. Lake inflow and outflow are linked to the existing river flow model within JSBACH while evaporation from the lake surface is linked to the ECHAM atmospheric general circulation model.