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Subglacial drainage of the Eurasian Ice Sheet Complex during the last glacial period

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The presence and behaviour of water at the interface between an ice sheet and its substrate exerts a fundamental control over many aspects of ice dynamics. The long-term evolution of subglacial hydrology is therefore a key issue when considering how ice sheets respond to environmental change. We investigate the long-term development of the subglacial drainage system beneath the Eurasian Ice Sheet Complex (EISC) - the third largest ice mass globally during the Last Glacial Maximum. At its peak the EISC comprised three semi-independent ice sheets centered over the Barents Sea, Fennoscandia, and the British Isles, which merged together to form continuous ice cover over more than 60° of longitude and 30° of latitude. Using empirically constrained modelled ice sheet surfaces and high-resolution isostatically corrected topographies, we calculate hydraulic pressure potential surfaces across a full glacial cycle (37-10 ka BP). Snapshots of hydraulic activity are produced at a temporal resolution of 100 years, with hydraulic potential minima used as a proxy for potential subglacial lake locations, and channelized flow routing. Up to 4000 potential lakes are predicted during ice maximum conditions, some reaching extents over 100 km2. More than 70% have a surface area <10 km2, comparable with lake-size distributions observed beneath the Antarctic Ice Sheet. We identify distinct lake characteristics associated with the individual ice sheets through the glacial cycle, reflecting the first-order influence of divergent topographic relief within each sub-domain. Furthermore, drainage switching and water piracy in response to subtle changes in ice surface configurations are observed, with potential implications for the stability of major palaeo-ice streams in the Baltic and Barents seas. The persistency of hydraulic potential minima during the last glacial period is used to identify possible sites of preserved palaeo-subglacial lakes, defining useful target areas for further field-based investigations.