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Three-dimensional morphometry of eskers derived from Lidar data

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Meltwater drainage systems are important for understanding ice sheet dynamics. In particular, the configuration and flux of meltwater in subglacial drainage systems has been demonstrated to play an important role in ice flow velocity at diurnal, seasonal and even longer time scales. Contemporary observations of ice sheet beds are notoriously difficult to make, but it is possible to turn to the geomorphological record of former ice sheets to further our understanding of subglacial drainage. Eskers in particular are useful landforms for reconstructing channelised drainage beneath ice sheets, since they record deposition within (predominantly) subglacial meltwater channels. Until recently no systematic morphometric measurements had been made of eskers; such data are useful for quantifying the extent of esker systems and can also provide insights into how the meltwater channels in which they formed operated. This paper builds on recent morphometric analyses to present the first systematic three-dimensional measurements of eskers. We present a semi-automated method for determining esker width; height; cross-sectional area; slope; and volume from Lidar Digital Elevation Models from Finland. The data presented in this paper provide new insights into the scale of sedimentation within subglacial meltwater channels, providing important constraints on theoretical predictions of subglacial meltwater drainage.