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Continuous mega-channels measured across the Foundation Ice Stream grounding zone, West Antarctica

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There is a scant information regarding the subglacial geomorphology of the across the Foundation ice stream, West Antarctica. Definition of the grounding line region is ambiguous, depending on whether surface slopes of tidal flexure are used. MODIS satellite imagery reveal surface lineations from the ice sheet onto the ice shelf, which are thought to be associated with ice flow processes and, hence, aligned parallel to ice flow. Some of the channels on the ice shelf cut across others, however. While such channels are thought to be formed by organised flow of basal water from the upstream ice sheet, measurement of discrete channels upstream of the grounding that would demonstrate the process remains elusive. Using data from various airborne geophysical programmes such as Operation IceBridge and the NERC Institute ice stream survey, we discuss evidence from radio-echo sounding (RES) revealing continuously measured basal channels extending over 100 km from the Foundation ice stream, across the grounding line and beneath the ice shelf. Within the zone of grounding line ambiguity, a massive channel incised upwards into the ice is observed (∼800 m in height). This channel can be seen in numerous RES transects and, importantly, is manifested at the ice surface as a feature detected by MODIS. Convergence of this channel with another across the ice shelf is also consistent with RES observations. These data make it highly likely that basal water from the upstream grounded ice sheet is responsible for the channels. While the grounded channels are too large to be ‘le Brocqian’ bed channels (i.e. the flow of water necessary to solely maintain one of the channels is equivalent to the flow of the Amazon), their explanation as sediment-filled channels is challenging to rectify against the known glacial geomorphological record. We discuss that while the channels are undoubtedly associated with basal water, as required to form the ice shelf channels, the nature of the channels that feed water across the grounding line is not obvious.