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The evolution of a basal melt channel on the southern Filchner Ice Shelf

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Basal melt channels of ice shelves influence ice-ocean interaction and thus the current and future dynamics of ice sheets and ice shelves. Understanding their evolution is necessary to assess their influence on ice shelves' stability. In this study, we investigate the evolution of a basal channel, up to 330 m high, located in the southern Filchner Ice Shelf where the ice thickness is between 1150 and 1400 m. Observations with a phase-sensitive Radio Echo Sounder (pRES) reveal decreasing melt rates within the channel, from 1.8 m/a to freezing with increasing distance from the grounding line of Support Force Glacier. At a distance of 20 km from the grounding line, melt rates within the channel fall below those of the ambient ice and the height of the channel starts to decrease. Calculating the evolution of this channel over 250 years, under present-day melt rates, reveals a mismatch when compared with its present geometry: the melt rates would have needed to have been twice as high as those of the present day to form today's channel geometry. In contrast, the present-day melt rates result in a closure of the channel. These results were confirmed by simulations with a viscoelastic model: while the present-day melt rates led to a closure of the channel, higher melt rates reproduced the current channel geometry. The type of melt channel in this study diminishes with distance from the grounding line and is therefore not a destabilizing factor for ice shelves.