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Supraglacial and subglacial meltwater routing in Kongsfjord basin, Svalbard

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In tidewater glacier fjords, the amount, the spatial distribution, and the timing of meltwater entering the subglacial hydrological system play a key role in modulating ice flow dynamics, as well as in impacting adjacent marine ecosystems. This study aims to describe how meltwater journeys through the polythermal glaciers of Kongsfjord basin in Svalbard, Norway. Our methodology involves the use of a surface runoff timeseries (2003-2017) from a coupled surface-energy-balance-snow model forced by a regional climate model (HIRLAM). Using a program for flow pathways analysis in DEMs (TopoToolbox), we generate a map of surface meltwater streams and drainage catchment areas. Other supraglacial features such as melt lakes, moulins and crevasses are manually detected from satellite imagery. These serve as basis to create four different setups of water input to a subglacial drainage model (GlaDS): **(1)** a spatially continuous input that equals the surface runoff, **(2)** a discrete input where the total surface runoff over the whole Kongsfjord basin is equally distributed between moulins, **(3)** a discrete input where upstream catchment areas are taken into account to weight the runoff drained into each moulin, and **(4)** a hybrid configuration of (1) and (3) where in crevassed areas the input equals the surface runoff, while in non-crevasses areas moulins are fed by upstream catchment runoff. The subglacial drainage model, which allows for meltwater to flow through both an inefficient distributed network of linked cavities, and a more efficient channelized system, yields spatiotemporal information on basal water pressure, sheet discharge and channel discharge, as well as on channel location. Results for the four water input setups are compared, and we discuss the relevance of using a more realistic configuration of meltwater recharge when modeling hydrological systems underneath glaciers. Finally, based on our model outputs, we provide seasonal maps of Kongsfjord basin's subglacial hydrology that show the preferential flow path of basal water and through which glacier outlet meltwater is released into the fjord.