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An investigation of the influence of subglacial drainage system evolution on fluvial sediment availability, Storglaciären, northern Sweden

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Recent studies have shown subglacial drainage system configuration to be a key control on sediment transport pathways. This is especially important in the case of suspended sediment fluxes, as these require very little energy to transport once entrained. Analysis of such fluxes is therefore likely to reflect sediment source characteristics and the processes of entrainment, rather than reach-scale hydraulics, which are more likely to influence bedload transport. Changes in meltwater routing to the subglacial drainage system, as the seasonal snowline retreats up-glacier, allow meltwater to reach new areas of the bed and facilitate the tapping of new sediment sources. Combined with the gradual channelization of drainage at the bed, these processes can result in relative exhaustion of subglacial sediment and limit the delivery of fluvial sediment to the proglacial area as sediment availability is reduced.

However, whilst the concept of drainage system evolution is well established, the processes governing sediment availability and the implications for sediment supply exhaustion are poorly understood. This study aims to provide a greater understanding of the interaction between seasonal subglacial drainage system evolution, sediment availability and the delivery of proglacial sediment fluxes. Hydrological data were collected in the immediate proglacial area of Storglaciären, northern Sweden during the 2009 and 2010 melt seasons, using a combination of traditional hydrometric techniques and Acoustic Doppler Current Profiling (ADCP): ADCP allows the collection of continuous flow data at high spatial and temporal resolutions, and can provide acoustic backscatter as a proxy measurement for suspended sediment concentration. It therefore has the potential to be an important tool in the advancement of hydrometry, especially in dynamic environments such as glacially-fed streams.

Seasonal evolution of the drainage system will be inferred through hydrograph classification. This will allow periods of relative stability and discontinuities in the time series to be used as an indicator of expansion in subglacial drainage network. Changes to sediment sources and availability of sediment will be interpreted using diurnal hysteresis between discharge and suspended sediment concentration, which will allow the occurrence of sediment supply exhaustion to be detected. A first-order autoregression model (ARIMA [1,0,0]) will also be employed to further infer controls on variations of suspended sediment concentration. These data and analyses will allow the quantification of water and sediment fluxes at high temporal resolutions, and will provide us with a greater understanding of the significance of seasonal subglacial drainage system evolution in terms of sediment availability and delivery at Storglaciären and comparable glaciers.