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The impact of proglacial lakes on downstream sediment delivery

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This paper discusses the impact of proglacial lakes on sediment transport of three different glaciers: Nigardsbre, Engabre and Tunsbergdalsbre. All of these lakes were developed in modern time. The recession of the Nigardsbre uncovered a 1.8 km long and on average 15 m deep proglacial lake during the years 1937 to 1968. From that time the glacier front was situated entirely on land, and the sediment input and output to the lake were measured. Sediment samples were collected 2- 4 times a day and the water discharge was recorded. The sediment transport into and out of the lake was on average 10504 t yr^{-1} and 2340 t yr^{-1}during the years 1968 – 1981. Thus, 23% remained in suspension at the outlet. In 2011 an excessively high transport of 32356 t $yr^{-1}$was recorded, due to several large flash floods that year. A 1.9 km long and up to 90 m deep proglacial lake downstream from Engabre glacier was uncovered during the years 1930 – 1945. The average suspended sediment load delivered from the glacier during the years 1970 – 1981 amounted to 12375 t $yr^{-1}$and the transport out of the lake was 2021 t yr^{-1}, giving an average of 16% remaining in suspension. In 2000 the sediment transport into the lake amounted to 15450 t yr^{-1}.

For the Tunsbergdalsbre glacier, measurements in the early 1970s indicated that the suspended sediment transport was on average 44000 t yr^{-1}. From 1987 to 1993 the recession of the glacier uncovered a proglacial lake. Downstream from this 0.3 km long and around 9 m deep lake, the suspended sediment load was measured as 28 000 t yr^{-1}in 2009, indicating that as much as 64% remained in suspension. The various factors affecting the sedimentation rates in the proglacial lakes are discussed. The low sedimentation rate of the lake in front of the Tunsbergdalsbre was due to its limited length and depth. Hence the meltwater from the glacier maintains a high flow velocity. The lake will however increase its size as the glacier recedes. The two other lakes have gone through a similar development.

Keywords: sediment transport, proglacial lakes, sedimentation, glacier retreat