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Intensity and spatio-temporal variability of fluvial sediment transfers in an Arctic-oceanic periglacial environment in northernmost Swedish Lapland (Latnjavagge catchment)

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Abstract

Intensity and spatio-temporal variability of fluvial sediment transfers and mechanical fluvial denudation were analyzed in the periglacial Latnjavagge catchment (9 km^2; 950–1440 m a.s.l.; 68.20N, 18.30E) in Arctic-oceanic northernmost Swedish Lapland. The present-day rates of fluvial sediment transfer are low. The mean annual mechanical fluvial denudation rate at the inlet of lake Latnjajaure, as calculated after five years of process monitoring (2000–2004), and excluding a "rare rainfall event" which caused 3.2 times higher suspended sediment transport during one day as compared to the total mean annual suspended sediment transport, is 2.3 t km^{-2} yr^{-1}. In years without "rare rainfall events", most of the total annual sediment load is transported in a few days during annual snowmelt runoff. In the calculation of longer-term sediment budgets, rare rainfall events like the July 20th–21st, 2004 event have to be considered as essential components. Reliable estimation of the recurrence intervals of such events is problematic. The pattern of ice patches and snow fields within the valley, the steepness of streams and channels and the location of areas showing slushflow activity are the major factors controlling spatial variability of mechanical fluvial denudation in the drainage basin. The five lakes in Latnjavagge, especially lake Latnjajaure, are significant sediment traps and ground below 1300 m a.s.l. is protected by a very stable and closed vegetation cover and rhizosphere across the entire lower catchment.

Keywords: Fluvial sediment transport; Spatio-temporal variability; Rare events; Sediment budgets; Vegetation cover; Periglacial; Arctic-oceanic

1. Introduction

Quantitative data on fluvial sediment transfers in present-day periglacial environments are still rare, and more quantitative investigations on sediment sources, the intensity and spatio-temporal variability of fluvial sediment transport and on recent fluvial sediment budgets in periglacial drainage basins are urgently needed. The fluvial transport of solids in periglacial fluvial systems is normally confined to floods, generated by snowmelt, by rainfall, or by combinations of snowmelt and rainfall (Rapp and Strömquist, 1976; Clark, 1988; Barsch et al., 1994; Gintz and Schmidt, 1998; Jonasson and Nyberg, 1999; Gude and Scherer, 1999; Vedin et al., 1999; Beylich, 1999, 2000; Gintz and Schmidt, 2000; Beylich and Gintz, 2004; Beylich et al., 2005a).

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The investigation reported here is part of a monitoring programme that was initiated in 1999 in the Latnjavagge drainage basin (68°20′N, 18°30′E; 9 km^2; 950–1440 m a.s.l.) in northernmost Swedish Lapland (Beylich, 2003; Beylich et al., 2003; Beylich and Gintz, 2004; Beylich et al., 2004a,b, 2005a,b). Over a period of five years denudative processes were monitored and quantified. In this paper, the intensity and spatio-temporal variability of fluvial sediment transfers and mechanical fluvial denudation in this representative drainage basin in the higher Abisko mountain area, an Arctic-oceanic periglacial environment, are discussed. The main focus is on spatial variability of fluvial sediment transfers and on detection of sediment sources and source areas within the catchment. The importance of a "rare rainfall event" which happened on July 20th–21st, 2004, is compared to annual snowmelt-generated runoff peaks and mean annual denudation rates (Beylich and Gintz, 2004; Beylich and Sandberg, 2005). Results from the Arctic summer field seasons of 2000–2004 are presented.

2. Study area

The Latnjavagge drainage basin (68°20′N, 18°30′E; 9 km^2; 950–1440 m a.s.l.) is located in the Abisko mountain area in northernmost Swedish Lapland (Figs. 1 and 2). The mountain area of northernmost Swedish Lapland is situated close to the North Atlantic in a prevailing westerly wind regime. The northerly position of the area is climatologically partly counteracted by the influence of the Gulf Stream. The Arctic-oceanic climate in Latnjavagge (at the Latnjajaure Field Station, LFS, 981 m a.s.l.) is characterized by a mean annual temperature of −2.3 °C (1993–2001) and a mean annual precipitation of 818 mm yr^{-1} (1990–2001). July is the warmest month (mean 8.0 °C). The coldest month is February (mean −10.1 °C). About 2/3 of the annual precipitation is temporarily stored as snow during the winter. Snowmelt normally starts at the end of May/beginning of June. Stable freezing temperatures with little daily fluctuation at 10 cm above ground and autumn snow

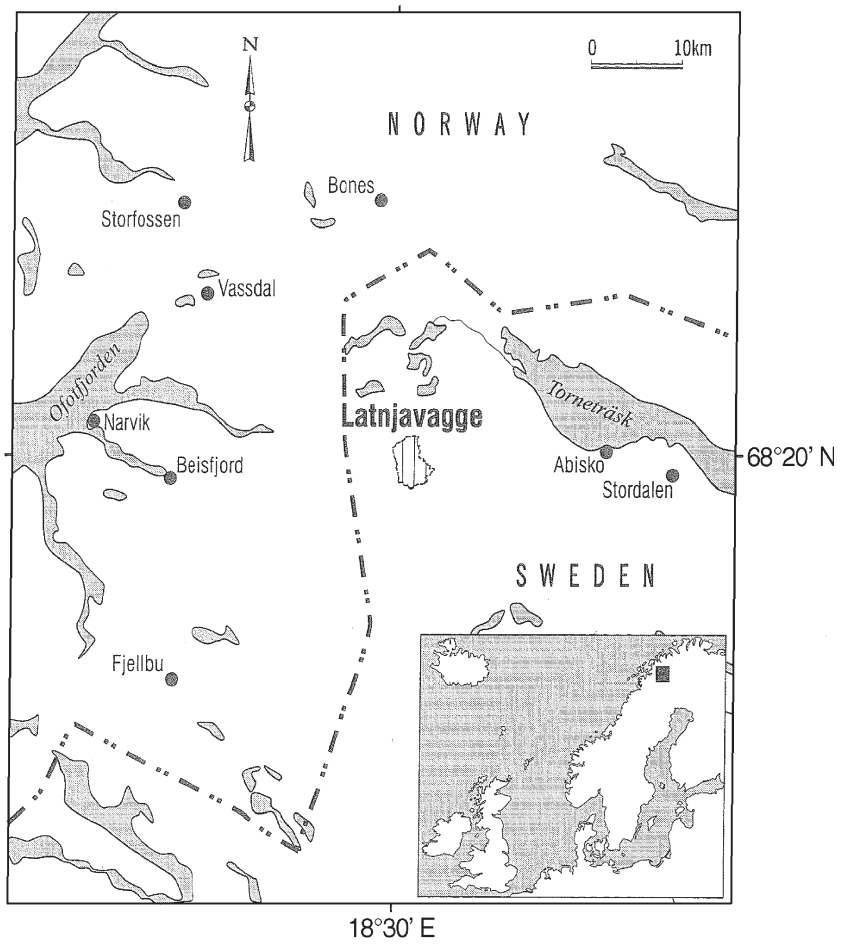

Fig. 1. Location map of Latnjavagge, northern Swedish Lapland.