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Detrital flux in glacial and peri-glacial domain: the example of the Bossons glacier (Haute Savoie, Mont-Blanc Massif)

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A better knowledge about erosion is needed to understand the relief evolution in glacial and peri-glacial context. In the Mont-Blanc area, Bossons Alpine glacier was choosen: to estimate 1) the part of glacial erosion versus peri-glacial denudation and 2) the total detrital sediment fluxes in this partially glaciated watershed in a context of glacial retreat.

1) The sediments come from two main reservoirs (the glacier and the lateral moraines) which interact with a third reservoir that corresponds to an alluvial zone: the subglacial Bossons stream flows through the alluvial zone whereas hillslope processes furnish sediments from lateral moraines. To distinguish the flux of the two reservoirs, we focus our study on: i) the granulometric and lithologic characteristics of the reservoirs; ii) the volume of sediment stored in the alluvial zone; iii) the transit time for the different granulometries through the alluvial zone; iiii) a comparison between the flux that enters in the alluvial zone and the released one.

i) To identify glacial erosion from peri-glacial denudation, the coupled study of the granulometric and lithologic characteristics of the reservoirs was led on 23 macro-granulometries and 37 micro-granulometries ($<$2mm) ; ii) The stored sediment volume is annually estimated from DGPS measurements of elevation evolution since 2006 at 1000 t.y^{-1}; iii) A comparison during one month between suspended fluxes measured in the two sampling sites located respectively on each side of the alluvial zone at the altitude of 1200 m (BOS 1200) and 1250 m (BOS 1250) shows that the transit time for the suspended load is less than 3 days; the monitoring by radio-frequency of the displacements of 185 pebbles and the granulometry of deposits in the alluvial zone show that the fraction $<$1 cm has a transit time around one year and those more coarse are trapped in the alluvial cone; iiii) The comparison of the suspended load concentration on BOS 1200 and BOS 1250 stations shows that most of the suspended load is provided from moraines during rainy extreme events.

2) The total detrital sediment flux was estimated in 2009 and 2010 by high frequency (every 10s) discharge measurements at the gauging station BOS 1200 and calibration curves (2 types: during the melting season 2009 suspended load was measured each hour allowing to build a curve suspended load/water discharge; during the melting season 2011 we performed a calibration curve between bedload and water discharge).

These results show that 75% of the sediments exported (3000 t.y^{-1}) is composed by fine grains (silts/sands) and are mainly mobilize during rainy extreme events. These suspended sediment dominantly resulting from the leaching of the peri-glacial domain (75%). The coarse fraction trapped into the alluvial plain corresponds to about 25% of the sediments exported (1000 t.y^{-1}). This detrital sediment mainly provides from hillslope debris flows processes of erosion in lateral moraines. Finally, both suspended and bedload data gives a minimal estimation of 4000 t.y^{-1}for the detrital sedimentary production.

The methodology applied to the Bossons glacial and peri-glacial watershed demonstrate that the major part of the erosion concerns the recent exposed peri-glacial morainic surfaces, and that glacial erosion contributes weakly to the total exported sediment flux.