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Impact of an extreme storm on the ^{10}Be signal in a mountainous catchment

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The impact of discrete extreme meteorological events on the long-term evolution of landscapes and sedimentary budget is poorly understood. We need quantitative estimates of the geomorphic change occurring during such events, of the sediment fluxes produced by landslides, flashfloods, and sediment remobilization. The frequency of such events at the geological and historical time scale and how they can be driven by climate change is also a major concern, especially for risk management. ^{10}Be concentrations measured in river sediments produced during extreme events may provide a powerful tool to quantitatively study the geomorphic impact of the event.

On October 2-3 2020, the Var catchment in the French Alps was struck by an extreme rainfall episode connected to the "Alex" storm (> 500 mm / 24h). This event resulted in flash floods in the Vésubie and Var valleys, mobilizing large volume of sediments and resulting in a 10 km long sedimentary plume at the Var outlet in the Mediterranean Sea. Fortunately, the Var catchment had been extensively studied before this event: ^{10}Be had been measured in sediments to derive sub-catchment denudation rates and interannual variability of the ^{10}Be signal (Mariotti et al., 2019). Moreover, paleo denudation rates over the last 75 ka for the whole catchment had also been measured using two sediments cores drilled in the Mediterranean Sea (Mariotti et al., 2021), providing a high-resolution record of past sedimentary dynamics. This extreme rainfall event of October 2020 and our previous ^{10}Be dataset offer the unique opportunity to assess the sensibility of a sedimentary system and its capacity to relay extreme events in a source-to-sink system. This is also a great opportunity to characterize the ^{10}Be geochemical signature of such events. This step is important to interpret paleo-^{10}Be signals in sedimentary archives, with the aim to better assess the frequency of extreme events at the geological time scale.

In order to characterize the response of the Var system to the Alex event, we compare ^{10}Be concentrations in samples taken in 2016, 2017 and 2018 with ^{10}Be concentrations in samples taken at the same locations after the 2020 storm at +7 days, +21 days, +4 months and +7 months.

We use also use samples taken within each sub-catchments to constrain the evolution of the ^{10}Be signal over time. This dataset permits to define the background of the ^{10}Be concentrations and compare these concentrations to the ones measured after the storm. The ^{10}Be concentrations measured at the outlet of the Var catchment at +7 days and +21 days are similar to those measured before the storm. However, the sample taken +4 months later shows a 20% decrease in ^{10}Be concentration from pre-storm values. The Vésubie sub-basin is the only one to exhibit a ^{10}Be decrease at +21 days. Hence, the delayed depletion observed at the outlet probably reflects the transfer of a ^{10}Be-depleted sediment-wave from the Vésubie valley, where most of the landslides and terraces reworking happened during the storm.