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10Be exposure dating of onset and timing of Neoglacial glacier advances in the Ecrins massif, French Alps

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Alpine glaciers are known to be highly sensitive to change in temperature and precipitation on decadal to centennial time scales. For two decades, numerous studies on Holocene climate revealed a period marked by abrupt cold reversals (e.g. 8.2 ka event) with increasing frequency and magnitude after the Holocene Climatic Optimum, during the so-called Neoglacial period (roughly the last 4 ka). State-of-the-art studies indicate that largest alpine glaciers failed to exceed their Little Ice Age (LIA) extent during these LIA Type-Events, unlike certain smaller glaciers.

In the French Alps, very few investigations were conducted to date on Holocene glacier variability. Almost all studies focused on the most glacierized area: the Mont Blanc massif, where suitable organic remains to apply radiocarbon dating and dendrochronology are available. Other glacierized massifs are poorly studied, without any Holocene/Neoglacial glacier chronology up to now.

Here, we present the results of a study focusing on six glacier forefields distributed in the Ecrins massif. Detailed geomorphological mapping and in-situ produced 10Be dating were carried on multi-crested so-called "LIA composite moraines". The targeted ridges are located in distal position with respect to late LIA drift in order to identify Holocene cold pulses that have led to (or slightly exceeded) LIA-like glacier extent.

The 35 10Be ages obtained revealed that the onset of Neoglacial occurred at ∼4.2 ka, and that at least two other advances were recorded at ∼3.3 ka and ∼0.85 ka. One site has yielded a nearly complete Neoglacial record as four discrete events have been dated. These results highlight the potential of lateral moraine ridge stratigraphy which could yield accurate record when sufficiently preserved, but also the different preservation of landforms along the glacier margin which could censor the record.