Quantifying the spatial summer precipitation variability in a highly glacierized catchment: the case study of the Arve catchment (Chamonix) in the French Alps

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Mountains play a critical role in the water cycle by storing snowfalls during winter and providing essential water resources downstream for different human needs and activities during the melting season. Due to their geomorphological properties and their role in capturing atmospheric moisture, they are also subject to flash flood events. In order to quantify the relative contribution of quickflow and baseflow to the total runoff over a highly glacierized catchment (the upper Arve catchment, 203 km2 33% of which is covered by glacier, with an elevation range from 1025 up to 4295 m a.s.l), a dense network of 10 in-situ rain gauges has been deployed since 2014. This network covers the bordering ranges of Aiguilles Rouges and Mont Blanc, at different elevations, and is adapted to quantify the spatio-temporal variability of summer precipitation. Results for the summers 2014 and 2015 evidence that a simple altitudinal gradient is not sufficient to represent the observed rainfall patterns, even at annual scale, and that these are function of more complex atmospheric circulation patterns. The dependence of precipitation on different weather patterns is discussed at seasonal and event scale and a comparison of in-situ observations with the SAFRAN reanalyses (which are the reference for the considered catchment provided by the french meteorological service) is proposed, showing important differences between the two. Consequences for meteorological and hydrological modelling are discussed.