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Glacier fluctuations in western and central Alps AD 1500-2050: an interdisciplinary approach using new historical data and neural network simulations

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Glacier fluctuations are sensitive indicators of climate variability. Although glacier length is an indirect and delayed signal of climate information, it is a useful tool for the examination of the glacier-climate relationship. As the time of the Little Ice Age is not documented by instrumental data, interdisciplinary approaches that contain both historical and physical methods are needed to reconstruct the behaviour of glaciers back in time. In the present study, we revise and refine the existing glacier length curve for the *Mer de Glace* (Mont Blanc area, France), made by P. Mougin, using new available documentary data. Documents containing historical pictorial information of the glacier terminus (e.g. paintings, photographs, maps) as well as texts were analysed and interpreted concerning former glacier extents. The new glacier length curve for the *Mer de Glace* dates back to 1570. The two major glacier advances occurred around 1644 and 1821, minor advances have been detected around 1600, 1720, 1778, and 1852. Since then, the glacier has retreated more than 2 km until present-day. A comparison of the *Mer de Glace* length curve with the curve of the *Unterer Grindelwaldgletscher* (Bernese Alps, Switzerland) yielded an astonishing simultaneity, despite the different settings of the glaciers in the western and central Alps. Finally, a non-linear back-propagation neural network model (NNM) has successfully been applied to the *Mer de Glace*, using the new length curve and multiproxy reconstructions of seasonal temperature and precipitation back to 1500. In the absence of glacier length data before 1570, the application of the NNM yielded qualitative plausible reconstructions of glacier fluctuations for the 16^{th} century. Furthermore, the NNM allowed making some predictions of future (i.e. 2000-2050 period) fluctuations of the *Mer de Glace*.