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A 9300 year series of extreme precipitation events under natural climate conditions recorded in the varved interglacial palaeolake sequence of Pianico (Southern Alps, Italy)

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The sediment sequence of the Piànico palaeolake (Southern Alps, Italy) includes a ca 9.5 m thick interval of varved sediments deposited under interglacial conditions ca 400 ka ago. The interglacial sediments are composed of a succession of ca 15,500 endogenic calcite varves. The floating varve chronology is tephrochronologically dated at 393 $\pm$ 12 ka ago. The calcite varves comprise two laminae: a light thicker spring/summer layer formed by up to 96% of endogenic calcite and a dark, thinner winter layer constituted by organic remains, diatom frustules and occasional detrital grains. The summer layer thickness is a proxy for lake productivity and δ^{18}O of endogenic calcite is a proxy for changes in temperature/atmospheric circulation.

Detrital layers mainly comprising Triassic dolomite from the catchment are intercalated within single varves and reflect extreme precipitation events. The microstratigraphical position of a detrital layer within a varve indicates the season of the extreme precipitation event: "spring-summer" detrital layers are located directly below or within the endogenic calcite layer and "autumn-winter" detrital layers are deposited above the summer layer or within the winter layer. Sediment microfacies data have been obtained for the upper 9300 years of the interglacial period. Overall, 766 detrital layers are intercalated in the study interval: 66% are spring-summer detrital layers and 34% are autumn-winter detrital layers. The mean recurrence time is ca 12 years. The distribution of the detrital layers, however, is not homogeneous, and two periods of higher detrital layer frequency (recurrence time ca 4 years) are observed during a 1000 year mid-interglacial cold period and during the last 500 years of the interglacial; in both periods the frequency of extreme summer floods is increased while the extreme winter events become less frequent. Lomb-Scargle Fourier transform (LSFT) and the weighted wavelet Z-transform (WWZ) were applied to the flood time series and reveals a periodicity of about 17 years in the summer and annual floods of the last 500 years of the interglacial. The same cycle was also identified in the second half of the mid-interglacial cooling period.

The two periods of increased flood frequency correspond to periods of colder climate as reflected by sudden drops in summer layer thickness, lowering of δ^{18}O values of endogenic calcite and vegetation changes from broad-leaved dominated to conifers. The increase of detrital fluxes indicates intensified surface runoff and soil erosion processes.