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Changes in flood seasonality in Northern Italy during the past 2000 years

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The hydro-climate of the Mediterranean area is expected to experience strong impacts with climate change, a prognosis that was corroborated by the cyclone Cleopatra and its devastating effects in November 2013. In order to investigate the occurrence and the controlling climatic factors of such extreme hydrological events in the past, we investigated the frequency and seasonality of floods in Northern Italy during the past 2000 years using an annually laminated (i.e. varved) lake-sediment record (Lake Ledro, Trentino). The past flood occurrence is traced by characteristic flood deposits intercalated within the regular lacustrine sediments. The seasonality information is retrieved from the stratigraphic position of these flood deposits within the annual sedimentary cycle.
Overall, the reconstructed flood signal reveals a dominance of summer (26.2%) and autumn (63.4%) events, while winter (3.7%) and spring (6.7%) events are rare, yet, the seasonal distribution varies over time. With regard to climatic forcing, periods of increased flood frequency, in particular in summer, correlate with solar minima (including Dalton, Maunder, Spörer). This correlation indicates a strong influence of variations in solar irradiance on the atmospheric circulation over the North Atlantic and thus on the latitudinal position of the westerly storm tracks. Furthermore, the comparison of our data with a sea-surface temperature (SST) reconstruction based on foraminiferal oxygen isotopes from the Mediterranean suggests that intense autumn floods more often occurred during periods of warm Mediterranean sea-surface temperature, in particular from 500 to 1000 AD. However, the intensity aspect of paleofloods requires more research, for instance by comparison with instrumental and historic data sets.
The outcome of this paleoclimate study agrees with modern weather patterns in the Southern Alps. On this basis, our data set thus supports the assessment of precipitation forcing on a timescale that cannot be captured by instrumental data records.