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A composite method for past events characterisation providing insights in past, present and future coastal flood hazards: Joining historical, statistical and modeling approaches

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The characterisation of past coastal flood events is crucial for risk prevention. However, it is limited by the partial character of historical information on flood events and the lack or limited quality of past hydro-meteorological data. In addition coastal flood processes are complex, driven by many hydro-meteorological processes, making mechanisms and probability analysis challenging. These issues are tackled by joining historical, statistical and modelling approaches. We focus on a macrotidal site (Gâvres, France) subject to overtopping and investigate the 1900-2010 period. A continuous hydro-meteorological database is built and a damage event database is set up based on archives, newspapers, maps and aerial photographs. Using together historic information, hindcasts and hydrodynamic models, we identified 9 flood events, among which 5 significant flood events (4 with high confidence: 1924, 1978, 2001, 2008; 1 with a lower confidence: 1904). These flood events are driven by the combination of sea-level rise, tide, atmospheric surge, offshore wave conditions and local wind. The critical conditions leading to flood are further analysed, including the effect of coastal defences, showing that the present coastal defences would not have allowed to face the hydro-meteorological conditions of 09/02/1924 for instance, whose bi-variate return periods of exceedance T_r (still water level relative to the mean sea level and significant wave height) is larger than 1000 y. In addition, T_r is expected to significantly decrease with the sea-level rise, reaching values smaller than 1 y, for 8 of the 9 historical events, for a sea-level rise of 0.63 m, which is equal to the median amount of sea-level rise projected by the 5th Assessment Report of the IPCC in this region for RCP8.5 in 2100.