Historical floods in the northern Adriatic Sea

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Extreme sea levels in the northern Adriatic usually occur during late Autumn and Winter, occasionally causing flooding and related coastal damage. We used sea-level records from tide-gauge station Bakar as a proxy for the northern Adriatic floods. We have found that when Bakar's hourly sea level rose 90 cm above the long-term mean, flooding was observed in our area of interest. Twenty-seven events were recognized in the period 1929-2022. Sea-level measurements, atmospheric reanalysis, and newspaper reports on flooding were analyzed for all these events. Regarding sea level, the contributions of five different sea-level processes (regional seiches, tide, synoptic processes, planetary-scale variability, and slow sea-level changes) to total sea level heights were studied. It was shown that storm surge was the dominant process in forming the extremes, while tide and planetary-scale variability played a secondary role. The flooding intensity and frequency became more substantial at the end of the studied period: since 2018, there has not been a single year without a flood, and the six strongest events have occurred in the last 15 years. Given that storm surge was recognized as the most critical flooding component, we also analyzed the atmospheric synoptic background of the events. Synoptic conditions causing a strong sea-level response at Bakar were characterized by a southeast-to-northwest pressure gradient over the Adriatic and nonuniform southeasterly Sirocco wind with maximum speeds closer to the eastern coastline. All the presented information will be publicly available within the Adriatic storm surge online catalog, which is currently being prepared.