Characteristics of joint heavy rain and high sea level events on the Finnish coast in 1961-2019

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The simultaneous occurrence of heavy precipitation and high sea level can lead to more severe impacts than if these hazards occur in isolation. In this study, the joint occurrence of heavy precipitation and high sea level (hereafter compound events) on the Finnish coast in 1961-2019 is investigated. We use tide gauge observations from nine Finnish tide gauges and FMI ClimGrid gridded precipitation data. Two levels for the extremeness of precipitation and sea level were considered: elevated and high, with elevated corresponding to 90 percentile and high to 98 percentile of daily precipitation and maximum sea level. Elevated compound events were defined as days when both sea level and precipitation reached elevated levels, and high compound events were defined as days when both sea level and precipitation reached high levels.

First, the climatology of precipitation, high sea level, and compound events are studied. This is done by analysing frequency distributions of these events. Then, the interannual variability and long-term trends of the compound events are presented, and finally the synoptic weather patterns and the atmospheric circulation indices promoting the compound events are analysed.

We found that compound events are most abundant in late autumn and early winter, and they are typically caused by passing extratropical cyclones. The frequency of compound events has increased during the study period, in particular in the Bothnian Bay. The increasing trend of these events was linked to the more positive phase of the North Atlantic Oscillation (NAO) index during the recent decades. When the total annual number of compound events is considered, the Scandinavian blocking pattern (SCAND) was found to be the most controlling atmospheric circulation pattern, with negative SCAND promoting more compound events and vice versa.

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