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The effect of decadal variability on the extreme sea levels on the west coast of Norway

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The highest sea levels are often a result of a combination of simultaneous occurring phenomena and dominated by short-lived events. At the Norwegian coast, extreme water levels are mainly caused by astronomical tides and storm surges. Despite the fact that Norway is rather well sheltered from the sea level rise due to land uplift, in the long-run climate change driven mean sea level rise will amplify future coastal flooding situations on the Norwegian coast. The rare flooding events are the most hazardous ones and evaluation of their origin and risk is crucial nevertheless demanding due to their unusual occurrence.

Normally, extreme value analysis (EVA) on the Norwegian coast is performed using the observed records of the sea level maxima at the tide gauges, and taking into account the astronomical tides that vary significantly within different regions. However, in addition to the short-term phenomena, there are processes unrelated to the special events, that make mean sea level (MSL) vary on seasonal to decadal time scales. These are not necessarily random processes, and they may even be predictable some years ahead. In particular, slow variations in heat content, overturning circulation, wind forcing and ocean currents, create decadal variability along the Norwegian coast.

In this study, we investigate how large-scale interannual and decadal sea level variability affects to the extreme sea level analysis on the Norwegian coast, focusing on the Bergen region located on the west coast of Norway. During the last decades (from 1980 forward) in Bergen, the amount of sea flooding situations with 20 year RWL (return water level) or more have increased compared to the period of 1958-1980. The aim of this study is to evaluate the magnitude of the variability. Moreover, we investigate how removing such a long-term variability from the records before executing EVA analysis, affects the results. In our study, the extreme value analysis is based on the probability distribution of the observed water level variations.

Understanding the influence of the decadal variability on coastal flooding events in the past will help to estimate the behavior of present extreme water levels on the Norwegian coast, and give a tool to asses flooding hazards more accurately also in the future climate.