# Estimating authoritative storm surge protection levels for a European capital region

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Copenhagen, the Capital region of Denmark, has been affected by storm surges through centuries and will be increasingly threatened in the decades to come due to a rise in sea levels. Its location is highly complex and storms can originate from both the north (North Sea/Kattegat) and south (Baltic Sea). Despite relative long time series, the major events occurred before official recordings, which makes the creation of robust estimates of recurrence statistics, as needed for adaptation design, highly challenging. The onset of this study, nevertheless, came about when municipal authorities in Denmark requested official an authoritative estimate of storm surge protection design levels for the physical maximum og storm surges. This study presents the statistical and model-based steps taken to bring about such design levels. In doing so, the 1872 storm surge was used as a proxy for a 'perfect storm' in immense storm surge modelling simulations undertaken by the Danish Meteorological Institute using the HBM storm surge model. As a part of the process, issues of pre-filling levels in the Baltic Sea, altered wind- speed and directions, wave setup and climate change induced sea level rise and wind speeds were simulated. As a result, the study succeeded in providing a fixed design level estimate towards municipalities and infrastructure owners. The study also includes aspects of the project phase where decision-makers were included decisions within the study design and execution phase in order to obtain a shared understanding of the steps taken and the uncertainties involved.