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Review and Assessment of gap-filling methods from tide-gauges: Maxima missing at the Esbjerg, Denmark station, before 1910.

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Information on extremes of the sea-level is obtained from tide-gauge records. Such records may have gaps.

Estimates of potential changes in the size and/or frequency of sea-level extremes are hampered by long gaps, or when just the high extremes are missing due, e.g. to equipment failure.

Methods used for filling such gaps can be based on having multiple records from gauges near each other; but what to do if there is only one record? This problem can typically occur when old tide-gauge records are used -- the use of multiple recorders at the same place is more wide-spread today. However, especially older and therefore longer records hold the key to obtaining long-baseline insights into the temporal evolution of extreme tides and thus impacts of e.g. climate change.

In this work, we review and assess methods for gap filling. We assess using the 'known truth' method, i.e. by applying realistic gaps to complete gauge records and reconstructing and then comparing errors calculated as the difference between modelled and actual values. We compare a simple harmonic model fit method to various spline methods as well as Neural network and deep learning approaches. We also test a hybrid method which uses not just tide-gauge data but also air pressure readings from a meteorological station near the tide-gauge.

We then attempt to fill in the missing maxima of the Esbjerg, Denmark hourly tide-gauge record since 1889. Particularly, before 1910 the maxima above 300 cm are missing (Bijl, et al., 1999), and we try to fill these in.

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