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Digitalizing historical high resolution water level data: Challenges and opportunities

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Historical tide-gauge data offer the opportunities for determining variations in key characteristics for water level data and the analyses of past extreme events (storm surges). These information are important for calculating future trends and scenarios. But there are challenges involved due to the extensive effort needed to digitalize gauge sheets and quality control the resulting historical data.
Based on these conditions, two main sources for inaccuracies in historical time series can be identified. First are several challenges due to the digitalization of the historical data, e.g. general quality of the sheets, multiple crossing lines of the observed water levels and additional comments on the sheet describing problems or additional information during the measurements. Second are problems during the measurements themselves. These can include the incorrect positioning of the sheets, trouble with the tide-gauge and maintenance. Errors resulting from these problems can be e.g. flat lines, discontinuities and outlier. Especially, the characterization of outliers has to be conducted carefully, to distinguish between real outliers and the appearance of extreme events.
Methods for the quality control process involve the use of statistics, machine learning and neural networks. These will be described and applied to three different time series from tide gauge stations at the cost of Lower Saxony, Germany. Resulting difficulties and outcomes of the quality control process will be presented and explained. Furthermore, we will present a first glance at analyses for these time series.