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Spatial patterns of linear and nonparametric long-term trends in Baltic sea-level variability

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The study of long-term trends in tide gauge data is important for understanding the present and future risk of changes in sea-level variability for coastal zones, particularly with respect to the ongoing debate on climate change impacts. Traditionally, most corresponding analyses have exclusively focused on trends in mean sea-level. However, such studies are not able to provide sufficient information about changes in the full probability distribution (especially in the more extreme quantiles). As an alternative, we apply quantile regression (QR) for studying changes in arbitrary quantiles of sea-level variability. For this purpose, we chose two different QR approaches and discuss the advantages and disadvantages of different settings. In particular, traditional linear QR poses very restrictive assumptions that are often not met in reality. For monthly data from 47 tide gauges from along the Baltic Sea coast, the spatial patterns of quantile trends obtained in a linear and nonparametric (spline-based) framework display marked differences, which need to be understood in order to fully assess the impact of future changes in sea-level variability on coastal areas. In general, QR demonstrates that the general variability of Baltic sea-level has increased over the last decades. Linear quantile trends estimated for sliding windows in time reveal a wide-spread acceleration of trends in the median, but only localised changes in the rates of lower and upper quantiles.