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Changes in design precipitation over the Nordic-Baltic region as given by convection-permitting climate simulations

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The increased risk of flooding due to global warming and subsequent heavy rainfall events in the Nordic-Baltic region call for recommendations directed at long-term planning. Climate change allowances are often based on expected changes in design precipitation as given by climate model simulations, and are used as a buffer on top of current design values to avoid a future increased damage potential as a consequence of climate change. We here compute expected changes in precipitation design values, so-called climate factors, for the Nordic-Baltic region, based on convection permitting simulations. These simulations have the advantage of explicitly resolving convection, which has been shown to be the main contributor to increased rainfall, and not explicitly resolving convection is a main source of error in modeled precipitation. We compute climate factors and assess their dependence on rainfall duration, return period, and geographical location, focusing on the summer (convective) season, short durations and the high emission scenario RCP8.5. We also compare these climate factors to those computed from a more conventional (not convection permitting) regional climate model ensemble.

We found higher climate factors for the longer return period, with only few exceptions, and distinctly higher climate factors going from daily to sub-daily durations. However, the different simulations give conflicting results for very short-duration rainfall (< 3 hours). The huge difference in the climate sensitivity of driving GCMs dominates the magnitude of estimated return levels. Our analysis is shaped by the high computational costs of running convection permitting models, resulting in a very limited ensemble representing a single emission scenario. The value lies in a holistic assessment of a combined dataset, with their different strengths and weaknesses, supporting the assessment of robust climate change allowances for heavy precipitation in the Nordic-Baltic region.

Reference: Dyrrdal et al., 2023. Submitted to Weather and Climate Extremes.