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# Convection-Permitting Climate Models: Present and Future Insights on daily and sub-daily Extreme Precipitation in Norway

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Convection-permitting climate models (CPMs) have demonstrated enhanced capability in capturing extreme precipitation compared to convection-parameterization models. Despite this, a comprehensive understanding of their added values in daily or sub-daily extremes, especially at local scale, remains limited. In this study, we conduct a thorough comparison of daily and sub-daily extreme precipitation from HCLIM3 and HCLIM12 across Norway, divided into eight regions, using gridded and in-suit observations. Our main focus is to investigate the added values of HCLIM3 compared to HCLIM12 for precipitation extreme indices at daily and sub-daily time-steps on both local and regional scales. We find that the HCLIM3 better captures the maximum 1-day precipitation (Rx1d) at most of the regions except south-western region. Notably, the performance of HCLIM3 in capturing Rx1d shows a notable coastal-inland division, overestimating along the coastal areas and underestimating in the inland regions. In general, HCLIM3 better matches observations than HCLIM12 for daily and sub-daily precipitation extreme indices at regional scale in Norway. However, at the local scale, neither HCLIM3 nor HCLIM12 can capture the temporal evolution of Rx1h during 10 years, except one station near Oslo (eastern region), where only HCLIM3 fits the observations. In general, HCLIM3 performs better than HCLIM12 on Rx1d and Rx1h in Norway with the mean of bias distribution closer to zero, although it varies a bit among regions (for example, HCLIM3 performs worse in the south-western region). In addition, the seasonality of Rx1h can be also better captured by HCLIM3 at both regional and local scales, while HCLIM12 tends to underestimate hourly extremes. In a future warming climate, HCLIM3 with higher Clausius-Clapeyron (CC) scaling, exhibits a higher increase than HCLIM12 in the Rx1h and Rx1d over most regions of Norway except southern and south-west regions. Under global warming, short-duration extreme events with greater CC scaling have a higher increase rate than long-lasting events. This study highlights the importance of more realistic convection-permitting regional climate predictions and projections in providing reliable insights into the characteristics of precipitation extremes and their future changes across Norway's eight regions. Such information is crucial for effective adaptation management to mitigate severe hydro-meteorological hazards, especially for the local extremes.