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Representation of extreme precipitation events in storm-resolving global climate models within the nextGEMS project

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The amplitude of precipitation extremes across Europe is expected to increase through the 21st century under most climate change scenarios. Current CMIP-style global climate models broadly project increased flooding and drought extremes; however, they often rely on parametrization schemes or downscaling methods for inferring about potential future extreme events. These methods often introduce errors leading to high levels of uncertainty for policymakers and infrastructure planning. The need for accurate extreme event projections became further evident after the July 2021 floods and summer 2022 record-breaking heatwaves and droughts across Western Europe.

The ongoing H2020 Next Generation Earth Modelling Systems (nextGEMS) project aims to address these issues with the development of storm-resolving, fully-coupled, Earth-system models. Using the latest Cycle 3 runs from the Integrated Forecast System from ECMWF and ICON from MPI-M, we examine the dynamical representation of extreme precipitation events across Europe and compare it against a suite of observations (station and satellite based), reanalysis datasets, and CESM2 simulations. Focusing on tail-end extremes, the results focus on the realism of high precipitation extremes, value of upscaling to CMIP6 resolution, representation of precipitation drivers, and dry extremes (dry day percentages and consecutive dry days). Overall, both ICON and IFS perform reasonably well in representing high precipitation extremes although issues related to the ICON non-parameterized, deep convection causes overly frequent precipitation events.