Dynamical representation of extreme precipitation events in storm resolving global climate models within the NextGEMS project

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The intensity of precipitation extremes across Europe is expected to increase through the 21st century under a warming climate. Current coarse-resolution global climate models broadly project increased variability of both wet and dry extremes; however, they rely on parametrizations schemes of crucial processes controlling extreme precipitation such as convection. These methods often introduce errors and thereby induced uncertainties in projections of extremes in the water cycle that are relevant for policy makers and infrastructure planning. The need for accurate extreme event information on such extremes became further evident after the July 2021 floods (Ibebuchi, 2022) and summer 2022 record-breaking heatwaves/drought across Western Europe.

The ongoing H2020 Next Generation Earth Modelling Systems (NextGEMS) project aims to address these issues with the development of fully-coupled storm-resolving Earth-System Models. Using some of the first runs of the Integrated Forecast System (IFS) from ECMWF and ICON from MPI-M at 4 km and 5 km horizontal resolution respectively, we examine individual extreme precipitation events across Europe and evaluate their representation against similar analogues in the Copernicus European Regional Reanalysis (CERRA) and observational datasets. The unprecedented high resolution of the fully-coupled Storm-Resolving Models and CERRA allows for an evaluation of precipitation characteristics in complex terrain like the Alps (Hughes et al., 2009) or complex coastlines. We first evaluate the spatial and temporal structure of the events, compare their representation to coarse-resolution GCMs and then examine the potential drivers such as atmospheric river using integrated moisture transport and vertical structure of the low-level jet (Swain et al., 2015).


