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Learning to love the rain in Bergen (Norway) and other lessons from a Climate Services neophyte

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A question that is often asked of regional climate modelers generally, and Climate Service providers specifically, is: "What is the added-value of regional climate simulations and how can I use this information?" The answer is, unsurprisingly, not straightforward and depends greatly on what one needs to know. In particular it is important for scientist to communicate directly with the users of this information to determine what kind of information is important for them to do their jobs. This study is part of the ECLISE project (Enabling Climate Information Services for Europe) and involves a user at the municipality of Bergen's (Norway) water and drainage administration and a provider from Uni Research and the Bjerknes Center for Climate Research. The water and drain administration is responsible for communicating potential future changes in extreme precipitation, particularly short-term high-intensity rainfall, which is common in Bergen and making recommendations to the engineering department for changes in design criteria. Thus, information that enables better decision-making is crucial. This study then actually has two relevant components for climate services: 1) is a scientific exercise to evaluate the performance of high resolution regional climate simulations and their ability to reproduce high intensity short duration precipitation and 2) an exercise in communication between a provider community and user community with different concerns, mandates, methodological approaches and even vocabularies.

A set of Weather Research and Forecasting (WRF) simulations was run at high resolution (8km) over a large domain covering much of Scandinavia and Northern Europe. One simulation was driven by so-called "perfect" boundary conditions taken from reanalysis data (ERA-interim, 1989-2010) the second and third simulations used Norway's global climate model as boundary forcing (NorESM) and were run for a historical period (1950-2005) and a 30yr. end of the century time slice under the rcp4.5 "middle of the road" emissions scenario (2071-2100). A unique feature of the WRF modeling system is the ability to write data for selected locations at every time step, thus creating time series of very high temporal resolution which can be compared to observations. This high temporal resolution also allowed us to directly calculate intensity-duration-frequency (IDF) curves for intense precipitation of short to long duration (5 minutes - 1 day) for a number of return periods (2-100 years) with out resorting to factors to calculate rainfall intensities at higher temporal resolutions, as is commonly done.

We investigated the IDF curves using a number of parametric and non-parametric approaches. Given the relatively short time periods of the modeled data the standard Gumble approach is presented here. This is also done to maintain consistency with previous calculations by the water and drain administration. Curves were also generated from observed time series at two locations in Bergen. Both the historical, GCM-driven simulation and the ERA-interim driven simulation closely match the observed IDF curves for all return periods up to durations of about 10 minutes where WRF then fails to reproduce the very short, very high intensity events. IDF curves under future conditions were also generated and the changes were compared with the current standard approach of applying climate change-factors to observed extreme precipitation in order to account for structural errors in global and regional climate models. Our investigation suggests that high-resolution regional simulations can capture many of the topographic features and dynamical processes necessary to accurately model extreme rainfall, even in at highly local scales and over complex terrain such as Bergen, Norway. The exercise also produced many lessons for climate service providers and users alike.