EGU24-5682, updated on 27 Jul 2024
https://doi.org/10.5194/egusphere-egu24-5682
EGU General Assembly 2024

A bottom-up regionalization approach for extreme rainfall events

Jannis Hoch[1], Izzy Probyn[1], Francesco Marra[2,3], Chris Lucas[1], James Savage[1], Oliver Wing[1,4], Chris Sampson[1], and Nans Addor[1,5]
[1]Fathom, Bristol, United Kingdom
[2]Department of Geosciences, University of Padova, Padova, Italy
[3]Institute of Atmospheric Sciences and Climate, National Research Council, Bologna, Italy
[4]School of Geographical Sciences, University of Bristol, Bristol, United Kingdom
[5]Department of Geography, University of Exeter, Exeter, United Kingdom

Intensity–duration–frequency (IDF) curves are representations of the probability that a given rainfall intensity over a given duration [GU1] will be exceeded [GU2] within a given period. To construct IDF curves, rainfall observations are required, ideally at the sub-daily temporal resolution. Unfortunately, such measurements are available only for a few locations world-wide. This poses a major challenge for simulations of global pluvial flood hazard and risk which require information of intensity, duration, and probability as boundary conditions.

As an alternative to global IDF curves created from remotely sensed rainfall, we here propose a bottom-up approach which departs at the gauge level and employs machine-learning for regionalizing information on IDF curves from gauged to ungauged areas.

To that end, we use available quality-controlled sub-daily precipitation data from the GSDR data set to derive Simplified Metastatistical Extreme Value (SMEV) parameters at around 10,000 locations world-wide. After combining these parameters with globally available data of precipitation drivers, a random forest regression model is applied. Results indicate that some SMEV parameters can be better regionalized than others. With globally available SMEV parameters, it is possible to obtain rainfall intensity for any combination of duration and frequency.

We then evaluated these IDF maps against analytical intensities derived at the GSDR stations directly. Results show overall good agreement, yet the tails of the distributions are not entirely represented in our simulated intensities. Additionally, we benchmarked our intensity maps against similar datasets such as PPDIST and GPEX. Last, we assessed practical implications by comparing flood maps created with the various datasets used as pluvial boundary condition. While there are fundamental differences in how each of the datasets is derived, our analysis indicates overall similar spatial patterns and distributions of rainfall intensities.

While such data-driven approaches clearly depend on the quality and quantity of available sub-daily rainfall observations, our proposed bottom-up approach seems to be able to scale local data to global data applicable in both flood risk research and practice.