Extreme precipitation simulations from Convection-Permitting climate Models. An analysis based on the Metastatistical Extreme Value distribution framework

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The emergence of convection-permitting models (CPMs) represents a significant advancement in climate simulations. By explicitly resolving convective processes, CPMs enhance spatial and temporal resolution while reducing uncertainties linked to convection parameterization. However, their high computational cost limits simulations to relatively short periods, typically around a decade, posing challenges for estimating return levels of extreme events, such as precipitation, that exceed the available record length by orders of magnitude. To address this, we leverage the Metastatistical Extreme Value (MEV) framework [1] to maximize the information extracted from limited data. Specifically, we propose a regionalized MEV approach to reduce estimation uncertainty when assessing extreme precipitation events from CPM outputs. We validate our method using long-term, high-resolution observational datasets. Finally, we derive robust spatial estimates of projected percentage changes in precipitation extremes between present and future climate scenarios. These findings offer crucial insights for guiding adaptation strategies to mitigate risks associated with changing precipitation extremes in a warming climate.

[1] M. Marani, M. Ignaccolo, Adv. Water Resour. **79**, 121–126 (2015).