EGU General Assembly 2022

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Differential orographic impact on sub-hourly, hourly, and daily extreme precipitation

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EGU General Assembly 2022 – May 24th, 2022

HS7.8: Hydrometeorologic stochastics for hydrologic applications: extremes, scales, probabilities

Motivations

- Extreme precipitation in mountainous regions is the main trigger of hydrological hazards such as flash floods and debris flows
- Increasing number of reported events and socio-economic impacts caused by flash flood, urban floods, and debris flow in the European Alps.

Research questions

- What is the impact of orography on both extreme precipitation statistics and on extreme return levels for durations ranging between 5 min and 24 h?
- How the interaction of multiple weather systems and complex terrain influence the precipitation extremes?

Methodology

Collecting and quality controlling high-resolution continuous rainfall time series

Exploiting the potential of the (Simplified) Metastatistical Extreme Value (SMEV) Marani and Ignaccolo, 2015 Marra et al 2019

Analise the effect of orography on SMEV parameters distribution and rainfall quantiles using linear regression models

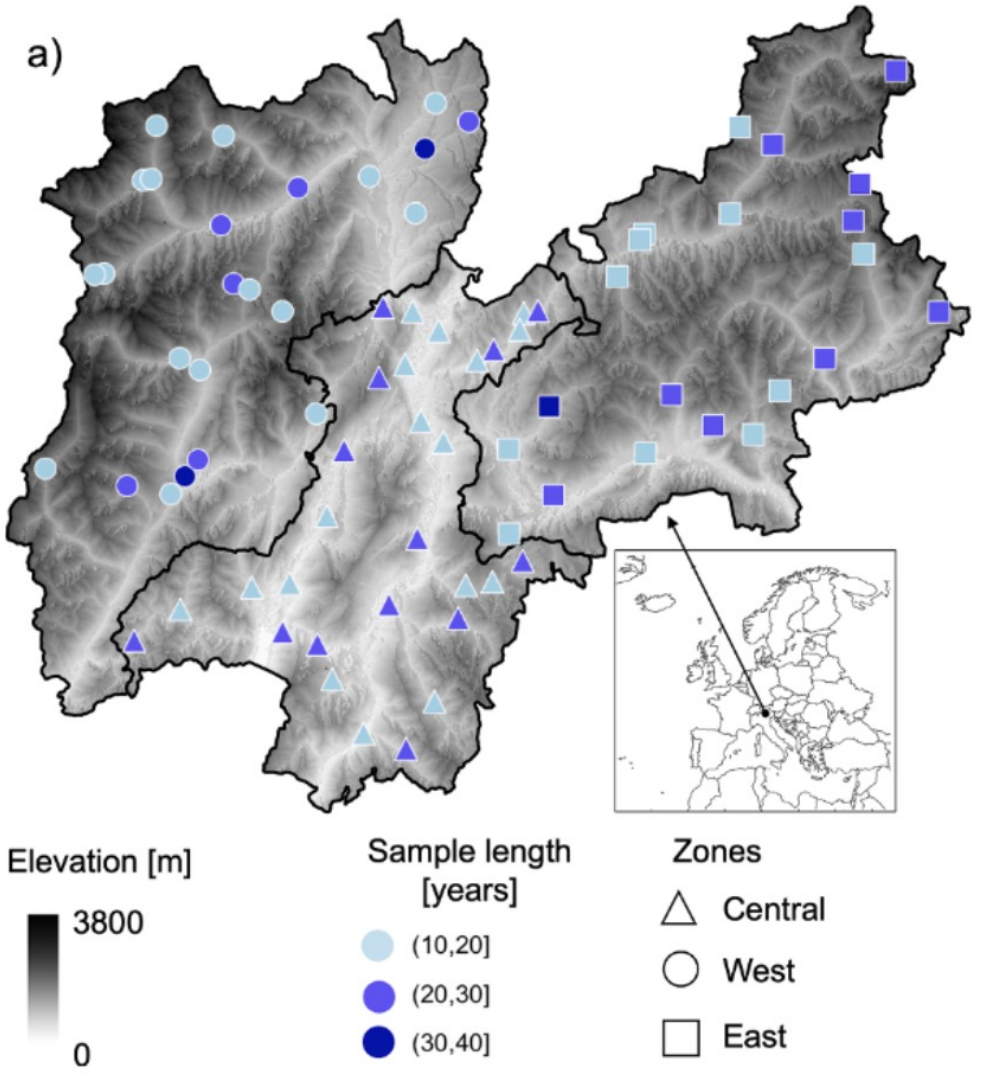
*Marani and Ignaccolo (2015), A metastatistical approach to rainfall extremes, AWR
**Marra, et al., (2019). A simplified MEV formulation to model extremes emerging from multiple nonstationary underlying processes, AWR

Study area: Trentino region, north-eastern Italian Alps

- Area: 6000 km2
- Elevation range: 150-3600 m a.s.l
- Mean annual rainfall: ~1100mm/yr

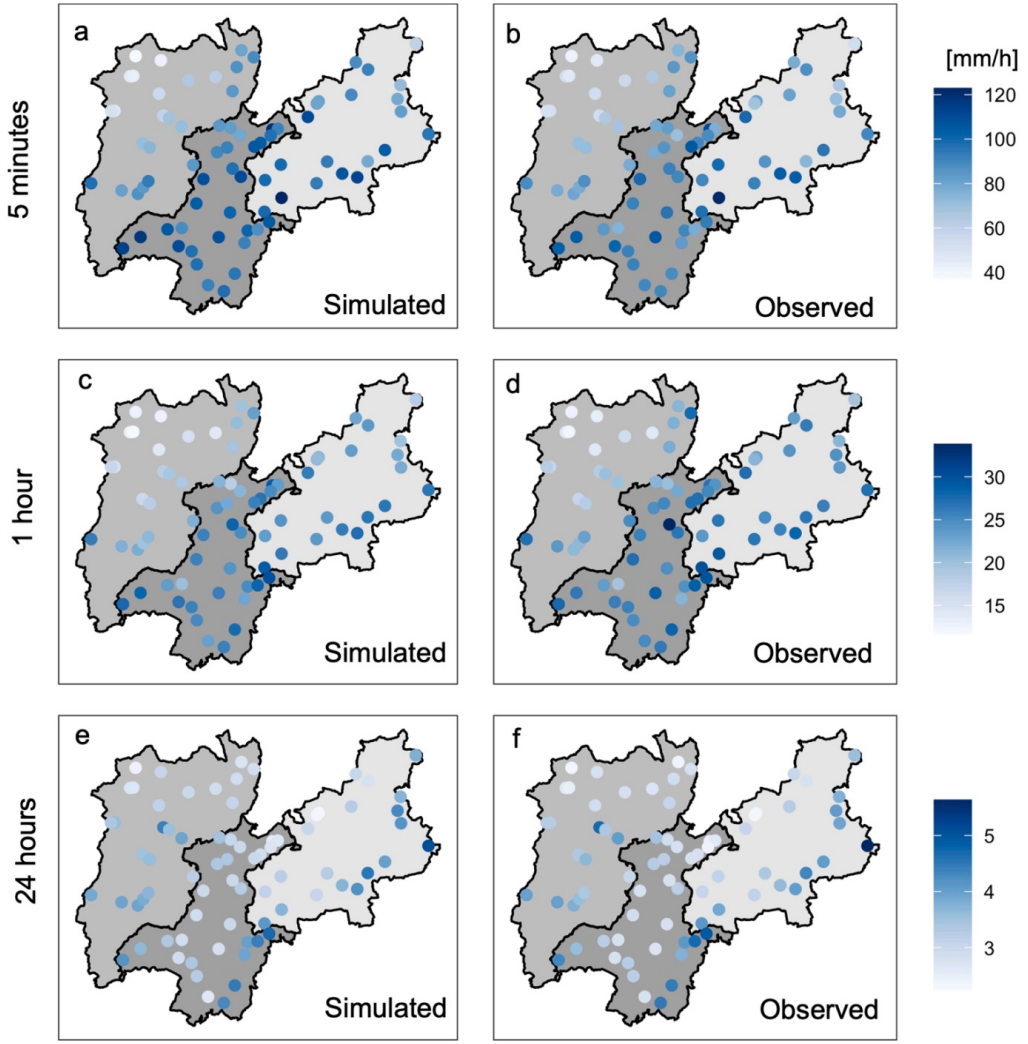
Data used:

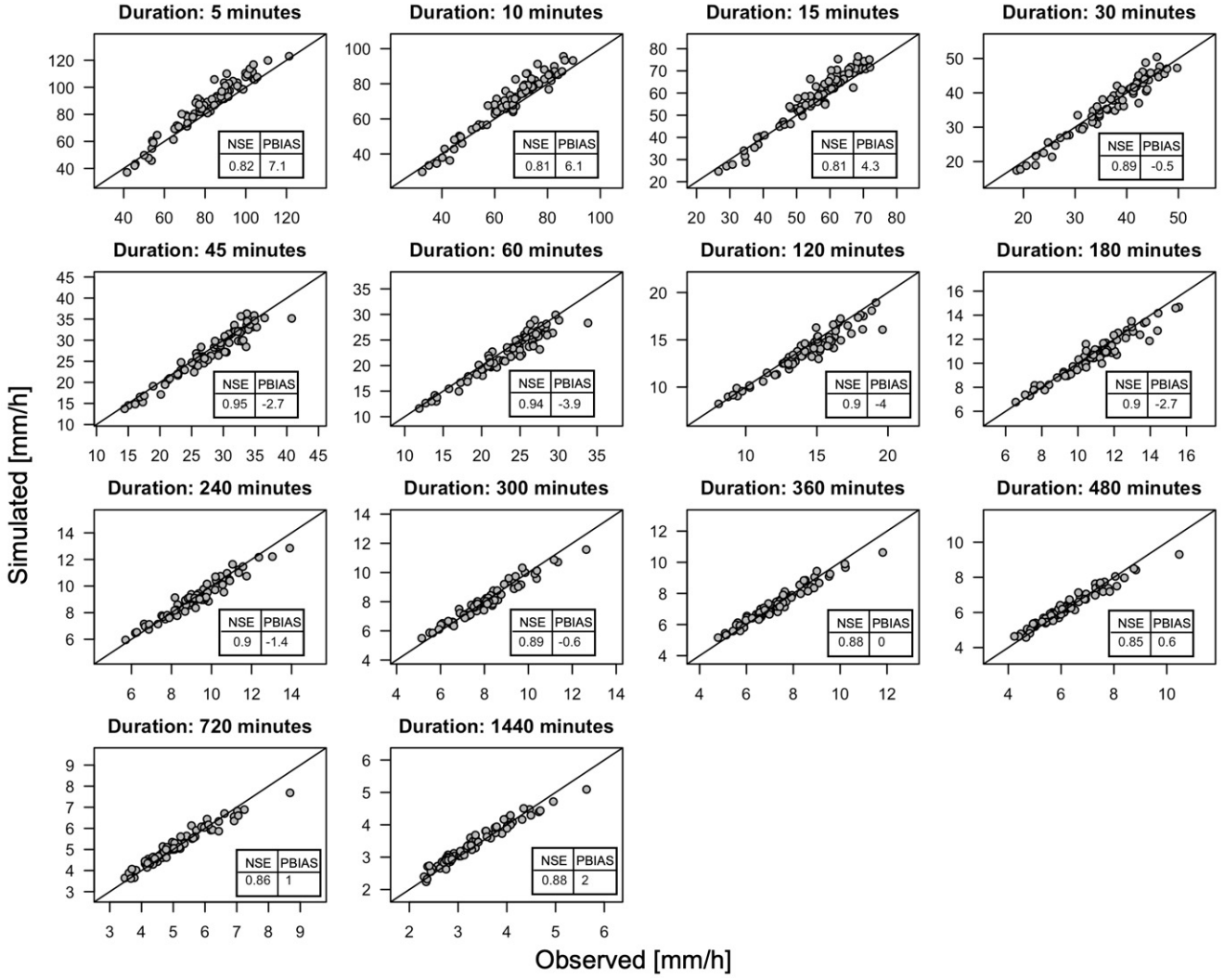
- 78 reheated rain gauges with 5-minute temporal resolution with at least 10 valid years per stations



Formetta et al., 2022. Differential orographic impact on sub-hourly, hourly, and daily extreme precipitation. *AWR*.

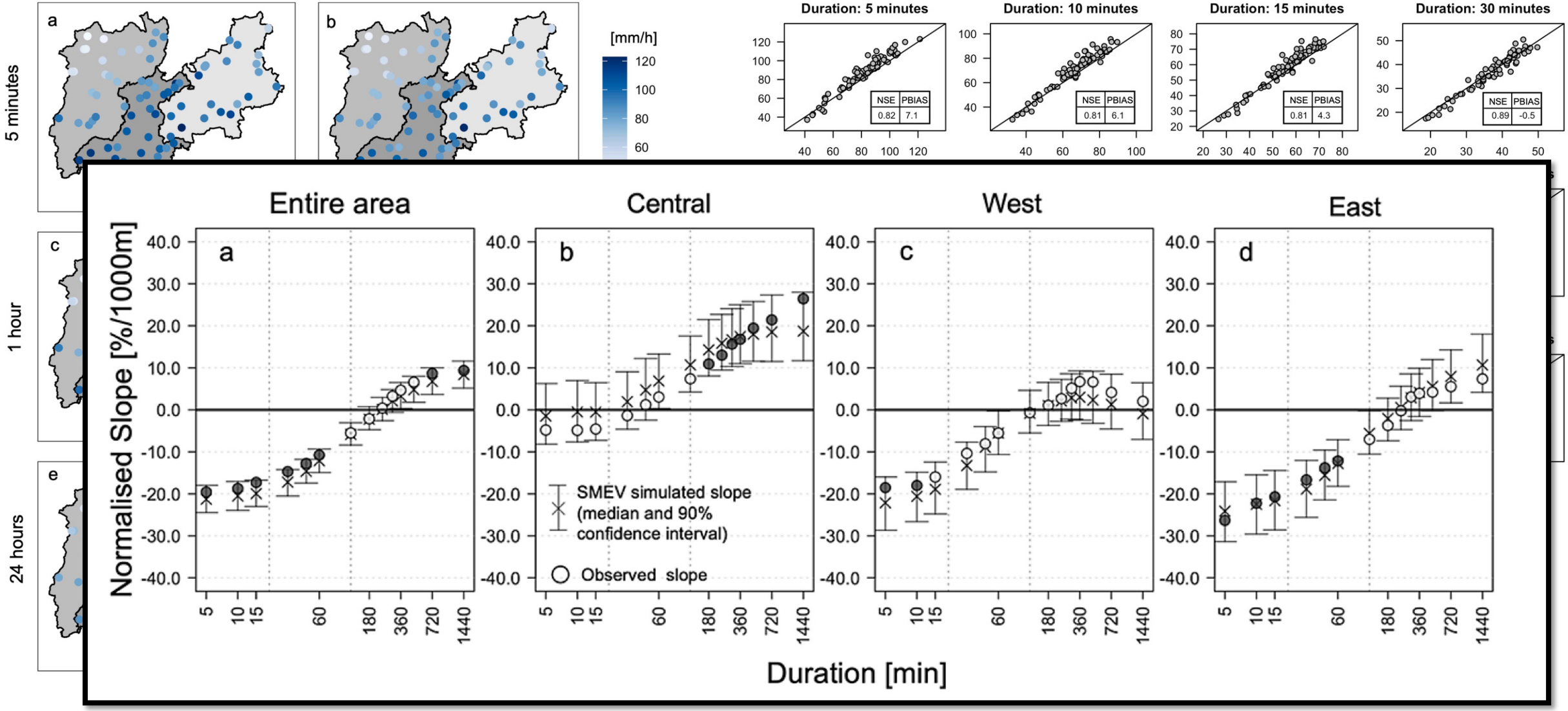
Results: Framework validation against long term observed annual maxima





Formetta et al., 2022. Differential orographic impact on sub-hourly, hourly, and daily extreme precipitation. *AWR*.

Results: Framework validation against observed orographic effect on observed annual maxima

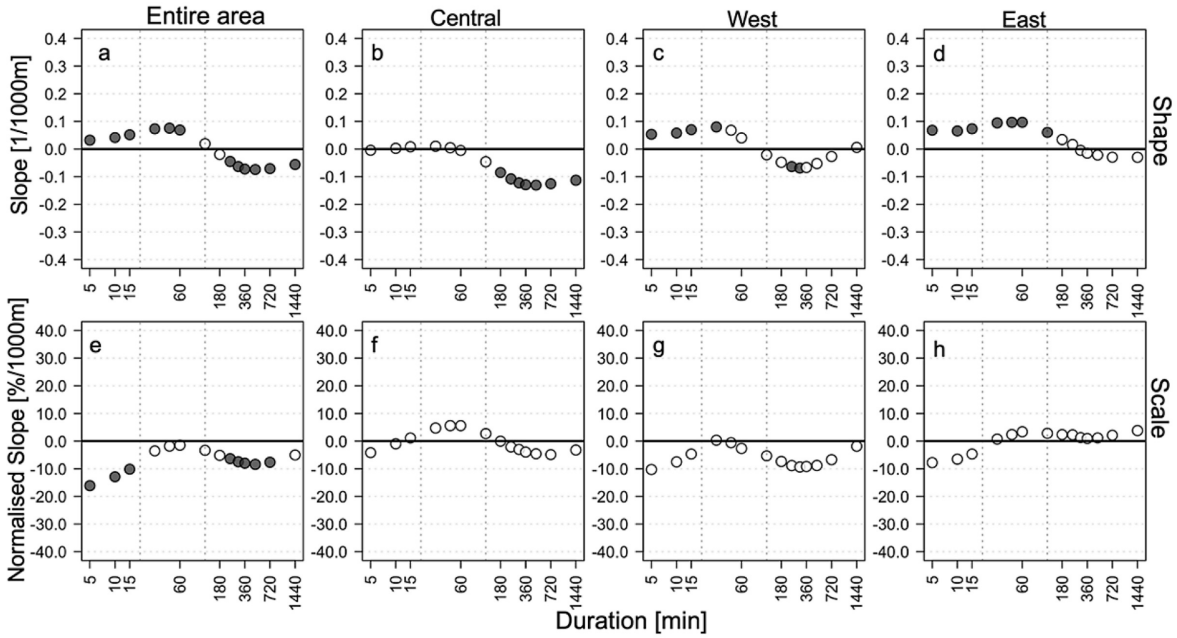


Results: Orographic influence on Weibull distribution parameters

Short durations: lighter-tailed distributions for locations at higher elevation

Long durations: heavier-tailed distributions for locations at higher elevation.

Mid durations: transitions regime between the previous two



Results: Orographic influence on Weibull distribution parameters and extreme rainfall quantiles

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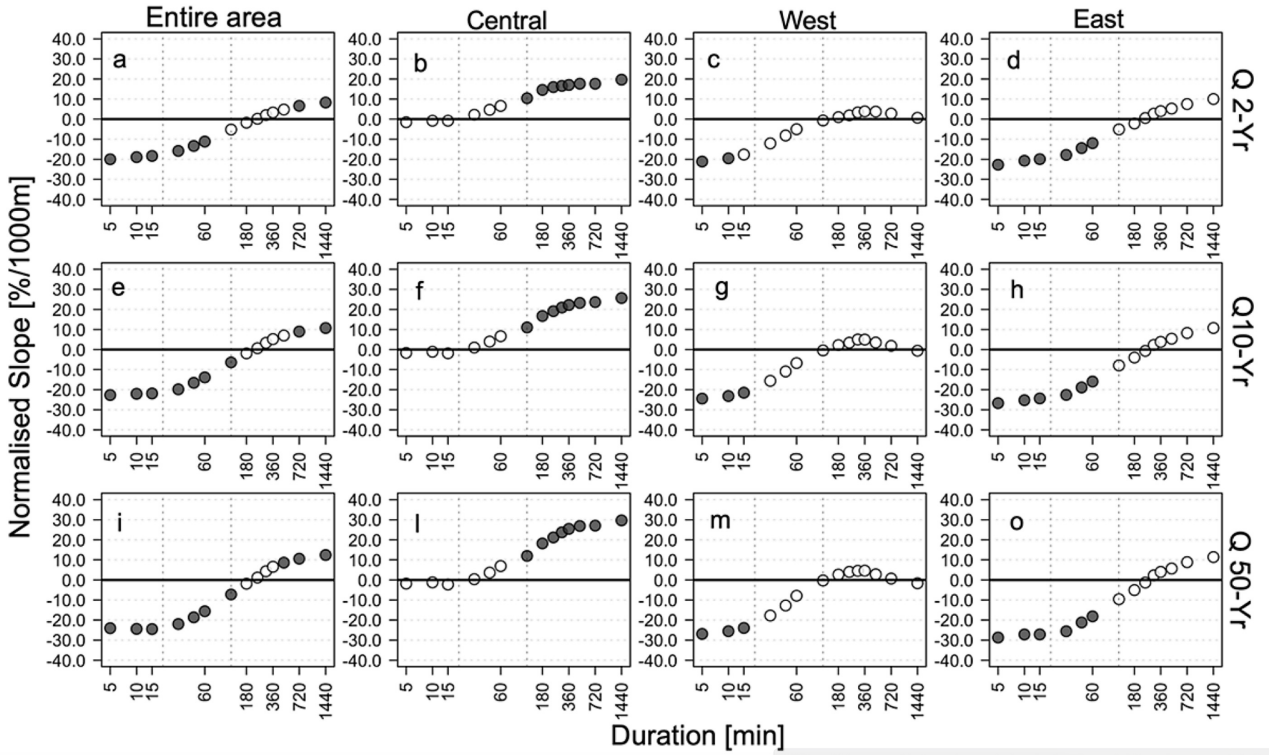

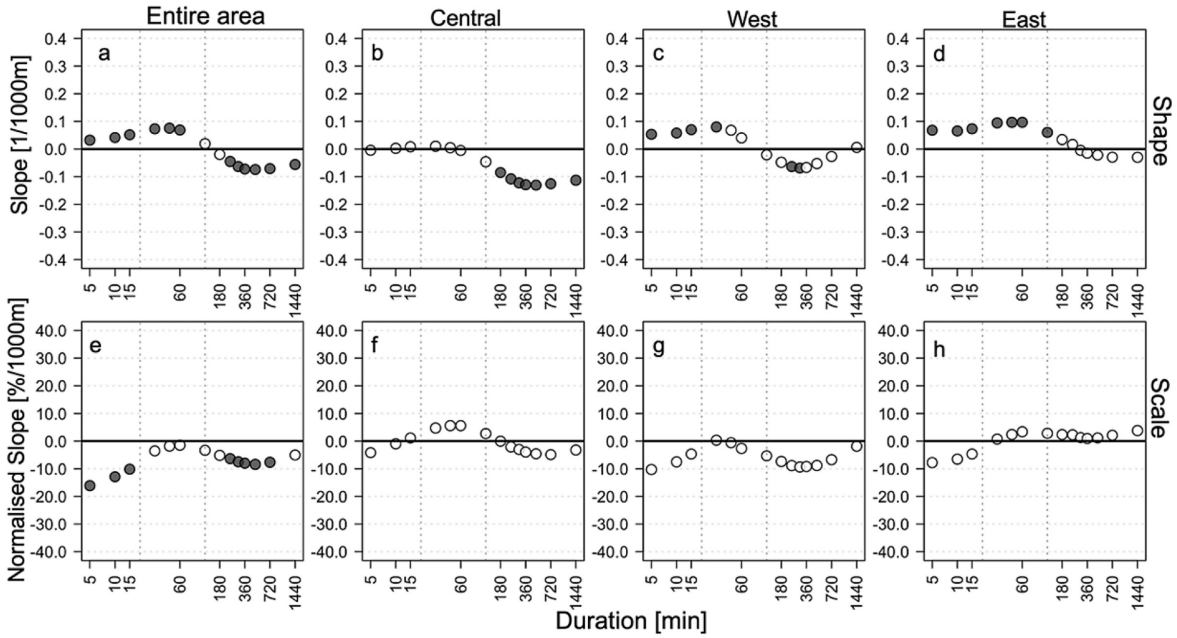

Rainfall return levels are decreased at short durations and intensified at long durations by orography.

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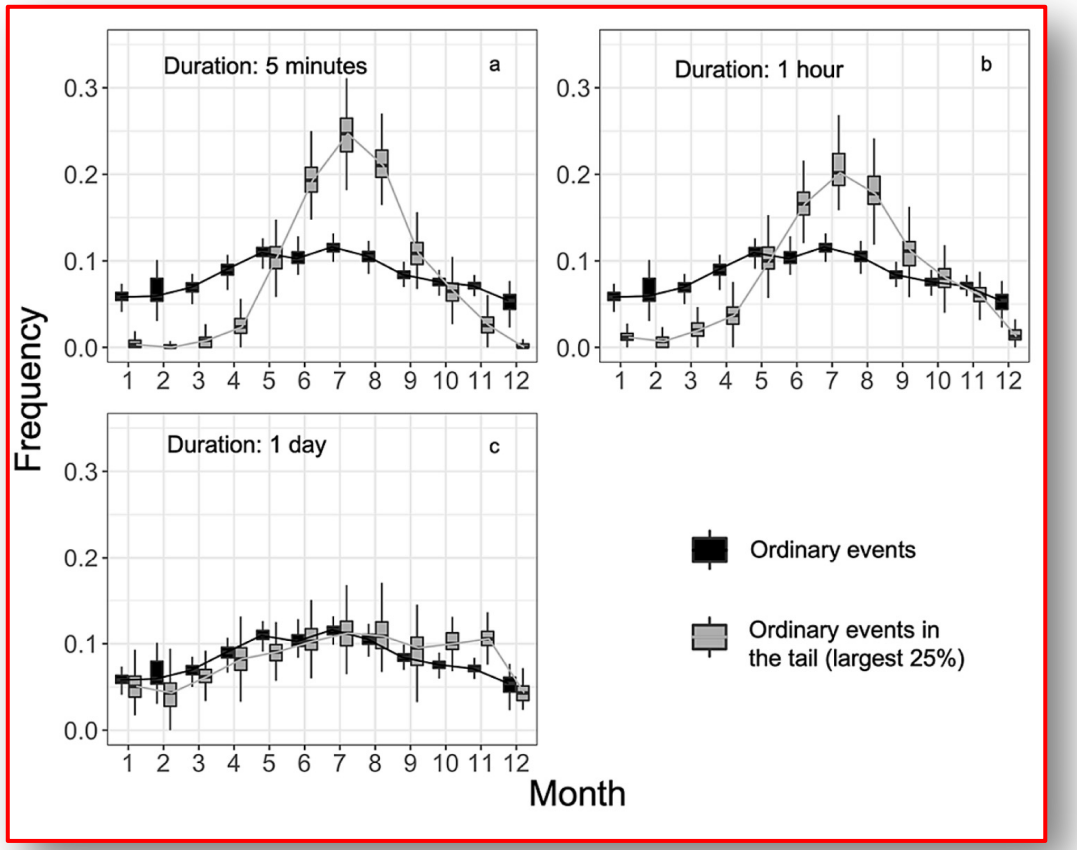

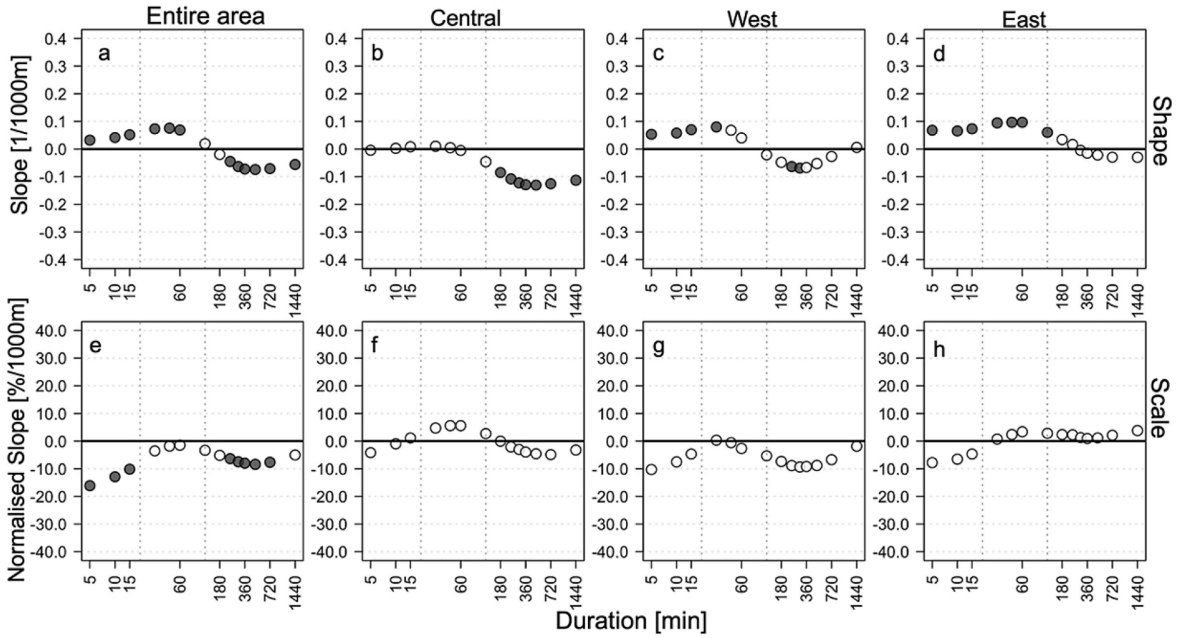

Rainfall return levels are decreased at short durations and intensified at long durations by orography.

Short durations: peak rain intensity of convective cores

Long durations: long-lasting stratiform processes, combination of stratiform and convective processes, snowfall

Mid durations: transitions regime between the previous

Thank you for the attention!!!

Give a look at:

EGU22-541 | Presentations | HS7.4

How well do convection-permitting climate models represent sub-daily precipitation upper tail in complex orography?

Eleonora Dallan, Francesco Marra, Formetta Giuseppe, Giorgia Fosser, Marco Marani, Christoph Schaer, and Marco Borga

Tue, 24 May, 08:58–09:05 Room L2

EGU22-5453 | Presentations | AS1.16

Impact of orography on current and future extreme sub-daily precipitation

Letizia Lusito, Francesco Marra, Eleonora Dallan, Mattia Zaramella, Alberto Troccoli, and Marco Borga

Tue, 24 May, 16:09–16:16 Room M1