Review of manuscript egusphere-2025-3455 submitted to Natural Hazards and Earth System Sciences (NHESS)

Event-based analysis of extreme precipitation trends in Italy using hourly convection-permitting reanalyses

by Francesco Cavalleri, et al.

General comments:

This manuscript presents an analysis of precipitation event properties (frequency, intensity, duration, and size) using a convection-permitting reanalysis dataset for Italy. The paper is well written, scientifically rigorous, and of clear interest to the NHESS community. That said, the manuscript would benefit from more cautious phrasing regarding the ability of the reanalysis to represent meso-beta scale processes, a more concise and focused introduction, and more consistent use of acronyms. These revisions would improve readability and balance some of the claims. I therefore recommend major revisions before the paper can be considered for publication.

Specific comment:

I find the manuscript highly relevant, as it combines two approaches that are still not very common in the community: the high-resolution reanalysis from ERA5 and WRF, and the event-based approach. This framework could be extended to other regions, which increases the value of the study. But the paper would benefit from addressing the following points:

- **Introduction:** The introduction is overly long. Please consider streamlining it to improve readability and focus on the main motivation and novelty of the study.

- **Section 2.1:** Here you present the MERIDA HRES reanalysis, but you do not describe the quality or limitations of the dataset. While some of this is discussed later, it would be more appropriate to include a clear description of dataset strengths and limitations already in this section.

- **Resolution:** The reanalysis resolution is reported as 4 km, presumably referring to the horizontal grid spacing. What about the vertical resolution? A more careful discussion of its role would be valuable. In addition, in the results you claim that the model can resolve meso-beta processes (2–20 km). In my view, a 4 km horizontal resolution may not be sufficient to adequately resolve the full meso-beta range, perhaps only processes above ~10 km. For example, at 4 km resolution, a 10 km feature would be represented by only a handful of grid points. I recommend revising this claim to reflect these limitations.

- **Acronyms:** The manuscript contains many acronyms, which makes it easy to lose track. I recommend reducing their use where possible and writing terms explicitly. I will provide examples in the technical corrections.

Technical corrections:

-Line 4: Please specify explicitly how many years of data are available.

-Line 25: Here you state that extreme precipitation changes are due to thermodynamics (CC scaling). What about the role of dynamics? For instance, see Pfahl et al. (2017):

Pfahl, S., O'Gorman, P. A., & Fischer, E. M. (2017). Understanding the regional pattern of projected future changes in extreme precipitation. Nature Climate Change, 7(6), 423-427.

- Line 51: Please, define ARCIS.

- Line 65: Please, define GRIPHO

-Lines 77-79: Please add supporting references.

-Line 147: How sensitive are your results to the choice of the 50th percentile threshold?

-Figure 2: Consider using a single colorbar and enlarging it for clarity.

-Table 1: Consider alternative acronyms instead of axis_maj or lon_wavg, lat_wavg, which are not very intuitive.

-Line 178: Have you considered that grid cell size decreases with latitude? This could affect your area-based results.

-Line 181-182: The acronyms here are difficult to follow, please consider spelling them out.

-Line 230: Please clarify whether this refers to a large quasi-stationary cyclone.

-Line 240: Be cautious with the claim that 4 km simulations can fully resolve these processes; please consider rephrasing.

-Line 374-377: It would be useful to mention dataset biases earlier (e.g. in the data section), and to quantify them explicitly as percentages relative to observations.

-Line 378: Please elaborate on the role of skin temperature in WRF biases.