General comments

This manuscript addresses the critical and timely topic of suspended sediment dynamics in a rapidly deglaciating Alpine catchment under the influence of increasing extreme rainfall events. This work is highly relevant to the scope of Hydrology and Earth System Sciences (HESS) as it provides quantitative insights into how climatic shifts are altering hydro-geomorphic processes in high-mountain environments. The study is well-conducted and presents a thorough analysis linking extreme precipitation characteristics to suspended sediment fluxes in the Tumpen-Ötztal and Vent-Rofental catchments in Austria. The methods are robust and clearly described, and the resulting data analysis is systematic. The manuscript is well-written, and the discussion is generally comprehensive. Overall, I recommend publication of the manuscript following minor revisions. Some comments are listed below.

Specific Comments

Antecedent Catchment Conditions. The discussion (lines 484–486) highlights the role of sediment availability for interpreting the year-to-year variability in SSY. In my opinion, authors should also consider the influence of antecedent catchment conditions, specifically factors like soil moisture, which might impact both overland flow generation and soil erosivity, the sequence of events, which dictates the depletion of readily available in-channel and hillslope sediment supply, and the presence/absence of snow cover, which might modulate the rainfall-SSY relationship. An event-based analysis of few targeted events could provide insights on these factors.

Snow and Ice Melt Processes. In general, little space is given in the discussion on the impact of snow and ice melt processes on sediment transport. I suggest the authors expand this discussion to address the temporal dynamics and potential overlap with rainfall extremes. Specifically: When does the peak ice melt happen? Is it overlapping with the period characterized by the highest short-duration convective rainfall? Could this interaction explain the higher SSF_{mean} observed for short-duration events? Furthermore, describing a typical pattern of snow cover duration in the catchment would add context. Again, by analyzing a few events with different characteristics, as they did for 2020, the authors would be able to incorporate these key cryospheric processes more fully into the discussion.

Event classification. I have a clarifying question regarding the event classification described in Lines 224–226. Does this methodology imply that a genuine long-duration event could be identified or partially characterized as a sub-daily extreme if it contains a single, very intense sub-daily peak? I am not sure I understood this and I wonder how potential mis-classification might influence the results showed in Figure 6 as well as the discussion in 5.2.2. and 5.2.3.

Increasing frequency of extreme precipitation – Stations. The finding of an increasing trend in the frequency of extremes derived from the INCA product is central to the study's context. Have the authors checked if a similar increasing trend is observable in the precipitation station data used for INCA development? Recognizing the already thorough nature of the analysis, I suggest the authors check if a similar increasing trend is observable in some targeted stations. This would enhance the robustness of the signal by ruling out the possibility of the trend being an artifact of the gridded product or its calibration process.

Technical Corrections

Figure 2. The font size is rather small. The figure could be a bit bigger.

Line 100-101, 108-109: In the sentence "The accuracy of INCA estimates can vary, particularly in complex terrain, with an average error of 50-100% in the 15-minute precipitation grids and 1.0 to 1.5 ◦C in the temperature grids (Haiden et al., 2011).", the 15-minutes precipitation grids confuses because in line 100-101 the authors describe the INCA datasets as "… hourly 1-km grids for all of Austria.". Perhaps just add "… and sub-hourly …" to the sentence in line 100-101.

Line 115-116: Please, provide a brief (few words) explanation of the rainfall/snowfall separation method used in openAMUNDSEN.

Line 120-123: As I understand here, you used hourly, 1-km grids, precipitation for the period 2004-2024, and rainfall for the period 2011-2024. Correct? Please, clarify.

Line 125. Figure 1 to Figure 1b.

Line 190: Please improve clarity by changing "Detection thresholds, u, for each …" to "Detection thresholds, u, for each DURATION d and spatial scale (i.e. GRID-SCALE It or CATCHMENT-AVERAGED Pt).

Line 210: I believe I understood what you did, but could you please write this iterative merging in a clearer way?

Line 265: Since you are talking about events with SSC larger than the 90^{th} percentile, I find $P_{90}(SSC_t)$ a confusing definition and would change it to SSC_{90}.

Figure 8. Font size rather too large. I suggest being more precise in the legend: from "extreme" to "extreme precipitation", from "non-extreme" to "non-extreme precipitation".