Dear Referee, thank you for your review of our manuscript and for your constructive comments. Below is a point-by-point response to the issues raised. Some responses are common to those given to RC1. Comments concerning the form are not addressed here but can be incorporated into the revised manuscript.

Major Comments

1. Clarify the Methods section

- It is not fully clear what is meant by: "rain events", "precipitation events", and "snow cover days" (line 277). Please define these terms and explain how they are calculated. In addition, please clarify why these variables are included in the analysis and what additional information they provide regarding ROS events.

Thank you for pointing out this lack of clarity. Rain events and precipitation events are defined in the same way as ROS events, but without the condition on snow cover, and, for precipitation events, without distinguishing the phase (rain or snow). Table I below compares the definitions of the three types of events, and will be included in the revised manuscript for clarity.

	ROS event	**Rain event**	**Precipitation event**
Snow condition	SD ≥ 10 cm at the beginning	-	-
Variable considered	Rainfall (RF)	Rainfall (RF)	Precipitation (PP)
Start condition	RF ≥ 3 mm over 12 h	RF ≥ 3 mm over 12 h	PP ≥ 3 mm over 12 h
End condition	RF < 3 mm over 12 h	RF < 3 mm over 12 h	PP < 3 mm over 12 h
Minimum total over the event	Total RF ≥ 5 mm	Total RF ≥ 5 mm	Total PP ≥ 5 mm
Minimum separation between events	12 h	12 h	12 h

Table I : Comparison of the definitions of ROS events, rain events and precipitation events. RF: rainfall; PP: precipitation (liquid and solid phases not distinguished); SD: snow depth.

These events are analysed because they help interpret the changes in ROS events and infer their probable causes. The comparison with rain events makes it possible to attribute the trends in ROS events to a change in snow cover or in rainfall. The comparison with precipitation events makes it possible to identify trends common to precipitation in general, which are not specific to ROS events.

- Please justify the choice of the 50% threshold (line 229).

Regarding the choice of the threshold, we are constrained by the results shown in Fig. 9b. It is not possible to exceed a proportion of impactful ROS events of about 70% based on total rainfall. The choice of 50% allows a very simple interpretation: at this threshold, one ROS event out of two is impactful. It can be inferred that a ROS event exceeding this threshold has a one-in-two chance of being impactful, i.e., of triggering natural hazard events. Furthermore, Fig. 9b shows a fairly linear relationship between the applied threshold and the proportion of impactful ROS events up to a proportion of about 50%. Beyond that, the increase in the proportion of impactful ROS events with the total rainfall threshold is smaller. The 50% value thus appears to be a good compromise between the ability to discriminate impactful ROS events (one ROS event out of two is impactful) and the sample size of heavy-rainfall ROS events, which must remain large enough to analyze their evolution in the remainder of the article. It is also an easily interpretable criterion. The revised manuscript will include a justification based on these elements.

- Please specify the method used for trend calculation.

What we refer to as trends in the article is the difference between the means of two 30-year periods (1959–1988 and 1995–2024). This choice was motivated by the strong interannual variability (which rules out any parametric modelling) and by the numerous zeros when results are broken down by elevation band and period of the year. The difference provides a non-parametric, quantitative result. The Mann–Kendall test does not provide this quantitative aspect, and the Theil–Sen estimator yields null results for heavy-rainfall ROS events because of the numerous zeros.

The statistical test used is a permutation test (also called re-randomization test or shuffle test), described in L237–240. It is applied to the annual values that make up the means of the two compared periods. This is a standard approach for comparing the means of two samples. This more detailed explanation of the statistical test will be included in the revised version of the manuscript.

- Please clarify why both SWE and SD were used to define ROS events (line 173).

Thank you for this question, which prompted us to check whether these two criteria are necessary. This dual criterion stems from an initial analysis of snow cover data from observation stations, with an optical sensor for SD and a cosmic-ray snow sensor for SWE. As SD values can be affected by an obstacle in the path of the optical sensor, we added a criterion on SWE to improve the reliability of snow cover detection. We subsequently kept the same dual criterion in the final study, which relies on S2M snow cover data. Upon verification, it turns out that in all detected ROS events, SD ≥ 10 cm

implies SWE ≥ 10 mm. The SWE criterion is therefore no longer useful and will be removed from the definition of snow cover in revised manuscript. To ease comparison with other studies that use a SWE threshold, we will add a statement that, for all ROS events, SD ≥ 10 cm implies SWE ≥ 10 mm.

2. The analysis period (1958-2024 and 2001-2024)

It is not clear which analyses were conducted for the period 1958-2024 and which were conducted for 2001-2024. In Sect. 3.3 (starting from line 207) and Sect. 3.4, you refer to the period 2001-2024, whereas in the Results (e.g. lines 274, 309, and 351) you refer to 1958-2024. I found this difficult to follow. Please clarify the rationale for using different analysis periods and indicate clearly which analyses correspond to each period.

Thank you for this comment. S2M covers the period 1958–2024, so ROS events can be defined and studied over this entire period. However, to link events to their impacts, we use the RTM database, which is reliable only from 2001, when the recording of natural hazard events became systematic (L148–150). The results on impactful ROS events (Sect. 4.2.2, from L315) are therefore computed over the 2001–2024 period. From this 2001–2024 analysis, we define heavy-rainfall ROS events, which are a proxy for impactful ROS events and allow their evolution to be analysed over the whole 1958–2024 period. Apart from Sect. 4.2.2, all the results presented cover the 1958–2024 period. This will be clarified in the revised manuscript.

3. Role of snowmelt

The manuscript states that snowmelt combined with liquid precipitation enhances flood hazards. However, the analysis focuses primarily on precipitation characteristics, while the role of snowmelt is not explicitly examined. Since snowmelt is highlighted as an important process, I encourage the authors to discuss its role more clearly. If snowmelt was not considered in the analysis, it would be helpful to explain this choice and discuss how it may affect the interpretation of the results. At a minimum, the potential contribution of snowmelt should be addressed in the Discussion section.

We agree that this aspect deserves to be addressed. Our study focuses on the meteorological occurrence of rain-on-snow, without accounting for the effect of snowmelt. Our input data are the hydrometeorological forcing, but hydrological analysis is beyond the scope of our study. This is indeed a limitation, and the effect of snowmelt may vary among impactful ROS events. However, from a risk-prevention perspective, we chose to keep the approach simple by relying on readily available and predictable variables (snow presence and rainfall accumulation).

To address this point, we carried out the suggested processing, dividing the daily ΔSWE by 24 h. Comparing SWE at the beginning and end of each event ($\Delta SWE = SWE_{end} - SWE_{start}$), the snowmelt contribution is highly variable, with many outliers and some events showing a positive ΔSWE (Fig I below). This variability could be explained by the state of the snowpack at the beginning of the event: an unsaturated snowpack can absorb a certain amount of liquid water, resulting in a positive ΔSWE. In addition, according to their definition (Section 3.1), ROS events may include snowfall between rainfall periods. For all ROS events, the median ΔSWE is -2 mm ($Q_1 = -10$ mm, $Q_3 = 3$ mm), and for impactful ROS events it is -13 mm ($Q_1 = -25$ mm, $Q_3 = -2$ mm). The snowmelt contribution for impactful ROS events remains much lower than the total rainfall (median of 56 mm). Although a few events show outliers reaching about 60 mm of snowmelt, rainfall thus remains the main contributor to discharge. Moreover, snowmelt is not the only hydrological role played by snow cover. Its antecedent presence may have wetted the watershed (hydrological yield being higher on a saturated watershed), and, depending on its structure, the snowpack may shorten the time of concentration (Brandt et al. 2022). These effects of snow cover are complex processes that are worth investigating at the watershed scale, but they are beyond the objective of this large-scale study. These elements will be included as a new section of the Discussion in the revised manuscript.

Brandt WT, Haleakala K, Hatchett BJ and Pan M (2022) A Review of the Hydrologic Response Mechanisms During Mountain Rain-on-Snow. Front. Earth Sci. 10:791760. doi: 10.3389/feart.2022.791760

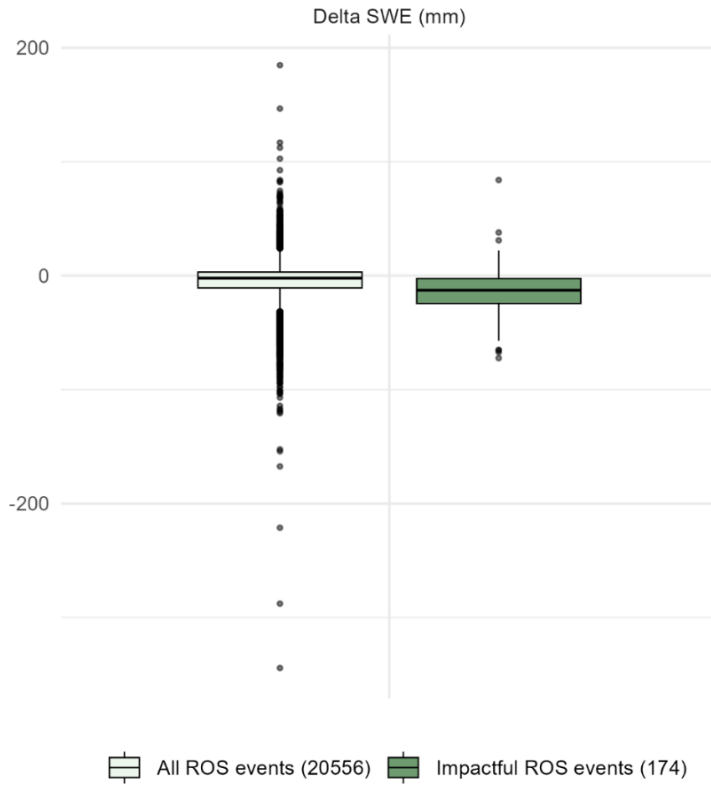

Figure I : Boxplots of ΔSWE per ROS event considering all events or restricting to impactful ones, over the 2001–2024

Minor Comments

Line 234: Do you mean the trends in number of ROS events? Please clarify.

Yes, only the trends in the number of events are calculated for both ROS events and heavy-rainfall ROS events.

For ROS events (as well as rain events and precipitation events), trends were calculated for the three variables studied (L179–181): number of events, total rainfall per event, and event duration. Trends in event duration are ultimately not presented because of a temporal bias (L267–271). For heavy-rainfall ROS events, only the trends in the number of events are calculated. Trends are also calculated for the number of snow cover days (Figs. 12d and 12c).

Line 198: It would be useful to briefly discuss avalanches in the Discussion section, even though they are not included in the analysis.

Thank you for this suggestion, avalanches are an interesting point. Without distinguishing natural avalanches from human-triggered ones, 467 avalanches are identified as caused by ROS events over the 1958–2024 period, i.e., 14.4% of the avalanches recorded over this period. This proportion is thus higher than for torrential floods (9.7%), floods (11.6%) and landslides (9.5%). According to the information fields in the RTM database, most avalanches caused by ROS events appear to be natural. Among natural avalanches, the proportion caused by ROS events is therefore potentially higher than 14.4%. These partial results will be included in the Discussion.

Please clarify what is the difference between “RTM” and “RTM-DB”?

Thank you for pointing out this ambiguity. “RTM” stands for *restauration des terrains en montagne* (mountain land restoration). It is the name of the service of the French National Forest Office that produces the event database used in our study, which we refer to as RTM-DB (RTM database) (L133–139). To lighten the text, events recorded in the RTM databse are loosely referred to as RTM events. To avoid confusion, we will not introduce the acronym RTM-DB in the revised manuscript, and will systematically write “RTM database”.