Snow Water Equivalent (SWE) is a key parameter in hydrological, climatological, and meteorological applications. New efforts for spaceborne radar-based SWE retrieval algorithms like the Lievens et al. (2022) method is promising for alpine snowpack. This paper presents a unique dataset of a tower-based C-band radar system experiment over an alpine snowpack. This dataset is unique and build on the understanding of the Lievens et al. (2019-2022) method. The paper is well presented, and results improved the conceptual understanding of the interactions between the radar waves and the snowpack at C-band.

I have mostly minor comments.

However, I think another analysis could be done to improve the understanding, but I think I will leave it to the authors to decide if they want to add it to the manuscript. This work is enough for publication. Here is what I'm proposing.

Like it is mentioned in the conclusion… Strozzi and Mätzler (1998) found that snow scattering was negligible compared to ground reflections. This brings the question of why the method is working? In a thesis by Jiyue Zhu (2021), they proposed a hypothesis based on radiative transfer modelling for why C-band in cross-pol is sensitive to volume scattering from deep snowpack. In figure 4.11, they show both the volume and background (rough surface scattering) in co and cross-pol as a function of snow depth. At a certain depth, the volume scattering becomes larger than the background scattering for cross-pol where the co-pol always has the background stronger than the volume. Also stated from Zhu (2021) "The volume scattering increases with thickness. Note that, for co-pol, surface scattering is larger than volume scattering. For cross-pol, volume scattering can be larger than surface scattering for large thickness (above 1 meter in the example)." The background contribution in cross-pol is significantly lower than co-pol because the ground does not depolarize the signal. The volume scattering in both co and cross-pol is similar but because the background is smaller, the cross-pol would be more sensitive to volume scattering. Perhaps this dataset would be able to show this.

I suggest, if possible, calculating the backscatter percentage due to snow and ground throughout the season. This would be done with equation 5 and finding an index (i) to separate both intensities (Easier said than done!!). Would be interesting to find the SWE at which the volume becomes stronger than the background. This could strengthen the theoretical hypothesis from Zhu that the Lievens method works.

Minor comments:

Line 64: I would add that the retrieval is only valid for deep snowpack which differs from previous studies mentioned previously.

Line 179: typo… should be timestep.

Line 261: The methodology of Lievens et al. (2022) works at lower resolution (100, 500, 1000). Here, the resolution is 5x20. Can you comment if or how this could influence the comparison?

Line 281: I think you can remove "s" in "figures" because it is the same figure. Also change to shows.

Line 350: typo… should be seasons.

Line 426: Can you quantify like you did for 2021-2022 so we can compare?

Line 471-472: This link to my point earlier and it would be great if you can add number to this. How much snow is necessary, so the snow contribution becomes more important than the background.

References:

Jiyue Zhu, Surface and Volume Scattering Model in Microwave Remote Sensing of Snow and Soil Moisture, 2021, Dissertations and Theses (Ph.D. and Master's), DOI https://dx.doi.org/10.7302/3871