Responds to the reviewer #2

Dear reviewer,

Special thanks to you for constructive comments concerning our manuscript entitled *Research on the evolution of snow crystal necks and effect on hardness during snowpack metamorphism (ID: water-2754056)*. Your comments are all valuable and very helpful for revising and improving our manuscript. All modified parts are marked in red font in the new version. Please see the resubmitted manuscript. Here are the responses for your comments and suggestions.

(1)

The paper titled "Research on the Evolution of Snow Crystal Necks and Their Effect on Hardness During Snowpack Metamorphism" presents a comprehensive investigation into the evolution of snow microstructure during varying metamorphism stages. The primary aim was to analyze the snow neck area and explore how temperature, solar radiation, snow density, and wind speed impact its characteristics, particularly in the context of global warming and its implications for the cryosphere as a key driver of climate change.

The paper is particularly relevant due to its focus on the cryosphere's significance in understanding climate change, aligning well with the journal's scope and relevance. The study conducted a controlled snow metamorphism experiment, maintaining a constant density of 200 kg/m^3, to comprehend the dynamics of the snow neck region. Findings highlighted that the neck area is notably affected by temperature, solar radiation, and snow density, while wind speed has minimal influence.

A noteworthy contribution of the paper is the development of a multiple linear regression equation denoted as "S = -1342T + 3E + 112ϱ + 8854V - 62339," where 'S' represents the neck area, incorporating solar radiation (E), temperature (T), snow density (ϱ), and wind speed (V). Impressively, these four factors collectively account for 87% of the variability affecting the neck area, underscoring their pivotal role in its evolution.

Furthermore, the study establishes a strong correlation between snow hardness and the neck area, reaching 71% in earlier metamorphic stages and potentially rising to 91% in later phases. Utilizing the neck area, the researchers derive a predictive equation for snow hardness: "H = 0.002764S + 67.922837."

Overall, this research delineates intricate growth patterns within the neck region of metamorphic snow cover. It elucidates the complex relationship between external environmental factors and the resulting microstructure and macroscopic physical characteristics of the snow cover. The findings not only deepen our comprehension of snow metamorphism but also offer valuable insights into predicting snow hardness based on identified influential factors.

The manuscript is exceptionally well-written, and the figures included are of high quality. The paper's comprehensive methodology, meticulous experimentation, and robust statistical

analyses significantly contribute to the field of snow science, carrying implications for environmental studies, climatology, and material science.

As a reviewer, I commend the authors for their thorough investigation and strongly recommend this paper for publication due to its scientific rigor, clear presentation, and substantial contribution to the field.

Response:
It is a great honor to receive your recognition of this work. Thank you very much.