Response to the Reviewer #1:

The authors would like to thank the reviewer for the time and valuable comments and suggestions. Below the reviewer comments are in blue, our responses are in black. All changes are highlighted in red in the revised manuscript.

Throughout the manuscript you use SD for Standard Deviation. Many snow papers use SD for snow depth, consider an alternative abbreviation (StDv/ SDv etc) or spelling it out every time for clarity! I found this confusing and had to reread multiple times when I thought the manuscript was referring to snow depth.
Response: Thanks for pointing out this issue. SD has been changed to StDv thorough the main manuscript, all figures and tables.

Line 67 - regional weather forecast models are recently used -> regional weather forecast models have been used recently.
Response: It has been corrected**.**

Line 69 - This line is not grammatically correct. Remove significantly.
Response: It has been removed**.**

Line 70 - remove global snow hydrology or explain what this means.
Response: It has been removed**.**

Line 107-08 - "high-resolution Weather Research and Forecasting (WRF) model run" -> Weather and Research Forecasting model run at various resolutions.
Response: It has been corrected**.**

Line 112 - "on the accurate estimation of peak SWE" -> rewrite this to be more grammatically correct.
Response: It has been corrected as: Particular attention is paid to investigate the role of the WRF model's grid cell size on the accurate estimation of peak SWE timing and value across the watershed.

Line 113-114 "This study can provide information related to the regional water management and hazard prevention. " Expand or remove this sentence.
Response: It has been removed**.**

Line 145 - Please rephrase to emphasize these are weather stations with snow pillows.
Response: It has been rephrased as: Nine weather stations, equipped with automated snow pillows, have been selected based on the availability of daily SWE data with minimal data gaps during the study period.

Line 241 - "The ERA5-L SWE at 9km resolution performs less well than the WRF9K simulation" Less well is not grammatically correct, please fix.
Response: It has been corrected**.**

Section 3-1. I am unsure what "SD - CanSWE SD" means. Is this the SD of each dataset minus the SD of the CANSWE dataset? If so, can you explain this in the text more directly. Also, if so, can you give

a better justification of why you showed this as opposed to just the standard deviation? I am not sure the Stdev of the mean time series makes sense as opposed to calculating the Stdev of the spatial distribution of SWE? It makes sense that the Stdev of the time series is strange as obviously SWE starts at zero and ends at zero, so we have a large distribution of possible SWE values over the series. Or did you calculate the Stdev for each day and then calculate the SD time series and then a total average over the time series? This section really needs more clarity. Also, if you keep the Stdev of this daily time series, please fix the caption, the last sentence doesn't make sense.

Response: Yes, "StDv - CanSWE StDv" refers to the standard deviation of each dataset minus the StDv of the CanSWE dataset. The text has been revised to clarify to avoid confusion. The rationale for using this approach was to highlight the relative variability of each dataset in comparison to the CanSWE dataset, which serves as a benchmark. The caption also has been revised.

Line 283 - Remove "obvious"

Response: It has been removed**.**

Line 287 - swap the order of "deposition" and "redistribution."

Response: It has been changed as suggested**.**

Table 2 - It might be nice to include the average/mean elevation bias for WRF9/3/1k.

Response: Average elevation bias (in percent) for WRF simulation at all three resolutions has been added to the table**.**

Figure 7 - Are you sure that the increased error in the melt season is not due to the incorrect temperature from lapse-rate correction of the elevation bias incorrectly influencing the melt timing?

Response: It is possible that the increased error during the melt season could be attributed to the incorrect temperature resulting from lapse-rate correction of elevation bias affecting melt timing, however, this aspect was not examined in the current study. However, it is an important factor that could be explored in future research

Table 5 - Clarify what the signs of the numbers mean. I mean have missed it, but I could not find. Is a negative number the peak SWE date is earlier than CanSWE or later?

Response: It has been clarified in the caption as: The anomaly shows the number of days that peak SWE occurs before (denoted by a minus sign) and after CanSWE.

Line 394-408 - In this section you start by saying that the elevation bias is correlated to mean bias error, but then later on in line 403 you say the "elevation bias is not significantly correlated with error metrics at any resolution" Please clarify this statement and rewrite this paragraph as necessary. Is mean bias not an error metric?

Response: It has been changed to “the other understudied error metrics”

Line 478 - Please rephrase, elevation bias does not affect RMSE MAE or SD, but it does impact MB. This in turn influences your RMSE and MAE Thus, you cannot conclude that elevation bias is not a factor in your error statistics.

Response: It has been rephrased for more clarification**.**

Response to the Reviewer #2:

The authors would like to thank the reviewer for the time and valuable comments and suggestions. Below the reviewer comments are in blue, our responses are in black. All changes are highlighted in red in the revised manuscript.

The study evaluates the Weather Research and Forecasting (WRF) model at three different resolutions (9km, 3km, 1km) for estimating Snow Water Equivalent (SWE) in Western Canada's South Saskatchewan River Basin (SSRB). It uses CanSWE dataset for validation during the 2017-2018 water year, Employs ERA5 reanalysis data for boundary conditions
Major Findings:
• Higher resolution (1km and 3km) WRF simulations significantly improve SWE estimates compared to coarser resolution (9km)
• The 9km resolution consistently underestimates SWE by about 31%
• Peak SWE timing is well captured across all resolutions, occurring in late April
• Strong correlation between elevation bias and SWE bias, particularly at coarser resolutions
Scientific Merit:
• The methodology is robust, using established models and validation techniques
• Results align with theoretical expectations about resolution impacts on mountainous precipitation
• Good use of statistical analysis to quantify model performance
Areas for Improvement:
From a climate modeling perspective:
• The study could benefit from analyzing more water years to ensure results are not year-specific
• Further investigation of physical mechanisms behind resolution-dependent biases would strengthen the findings
• Discussion of computational costs vs. benefits of higher resolution would be valuable
Certain sections could be rewritten for better clarity, here some examples:

1 - From Abstract:

Original: "All WRF simulations tend to underestimate annual SWE, with largest biases (up to 58 kg/m2, i.e. relatively 24%) found at higher elevations and in simulations at coarser horizontal resolution."

Can be improved: "All WRF simulations underestimated the annual SWE. The largest errors occurred in two conditions: at higher elevations and when using coarser horizontal resolution. These biases reached up to 58 kg/m2 (24% relative error)."

Response: It has been changed as suggested**.**

2 - From Introduction:

Original: "Spatiotemporal distribution of SWE, particularly within northern latitudes and higher elevations, shows the extent of spring and summer runoff (Barnet et al., 2005; King et al., 2020)."

Response: It has been changed as suggested**.**

Can be improved: "The distribution of SWE across space and time is especially important in northern regions and at high elevations. This distribution determines how much water will be available during spring and summer runoff periods (Barnet et al., 2005; King et al., 2020)."

3 - From Results:

Original: "Examining the role of these two forcings on simulated SWE at the three resolutions, we find very close agreement in temperature (Fig.3a), but a systematic low bias in accumulated precipitation at WRF9K (Fig.3b), indicating that lower total precipitation is the most likely cause of the SWE bias at the lowest resolution."

Can be improved: "We examined how temperature and precipitation affect SWE simulation at different resolutions. Temperature values were very similar across all three resolutions (Fig.3a). However, the WRF9K consistently showed lower precipitation values than expected (Fig.3b). This suggests that the underestimation of precipitation, rather than temperature differences, is the main cause of SWE bias in the lowest resolution model.

Response: It has been changed as suggested**.**

4 - From Discussion:

Original: "The large bias in the coarsest resolution also may be due to the incapability of the WRF9K to simulate the processes that are responsible for snow deposition and redistribution in mountainous areas that are characterized by heterogeneous snow distribution."

Can be improved: "The WRF9K model shows large errors primarily because of its resolution limitations. At 9km resolution, the model cannot accurately capture two key processes in mountainous areas: snow deposition and snow redistribution. These processes are especially important in mountains because snow distribution varies greatly over short distances."

Response: It has been changed as suggested**.**