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Interactive comment on "Precipitation Transition Regions over the Southern Canadian Cordillera during January–April 2010 and under a Pseudo-Global Warming Assumption" *by* Juris D. Almonte and Ronald E. Stewart

Anonymous Referee #2

Received and published: 28 March 2019

General Comments:

The study compares precipitation transition regions over Southern Canadian Cordillera during in January-April 2010 using high-resolution Weather Research Forecasting model simulations of retrospective and future climate. They identified regions and times of mixed-phase precipitation from the control and future simulations and group them into seven types of transition region based on constituent of precipitation. Area extent, distribution and elevation of transition regions are determined and compared between the historical and future simulations. They also investigate occurrence of each transi-

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tion region type and amount of precipitation from the two simulations to explore future change in transition region features. The study examines causes to the changes in future climate runs and suggests potential increase in avalanche risks at major ski resorts.

In general, the manuscript is very well written and focused. The objective of the study is clearly stated. Analysis techniques is well explained. Observational data, both point and gridded sources, are used to first validate model performance in simulating temperature, humidity, and precipitation in the study area which is essential for achieving the study goal to investigate future changes. It is interesting to find out how a warmer climate impact not only the elevation difference of where transition regions would typically occur but also spatial extent and distribution.

Some errors in the figures (see below) were found and some of them could use modifications.

I believe after minor revisions this manuscript may be accepted.

Specific Comments: Abstract, line 13: change “reanalysis” to “reanalysis-driven” or delete the word.

Sec. 2.2, first paragraph: I recommend specifically noting here that Thompson one-moment microphysics scheme was used in the WRF simulations and rain, snow, and graupel are produced from the scheme (i.e., no ice pellets). Here, the authors wrote accumulation at the lowest level was used. Could you clarify if mixing ration of graupel, rain, and snow (that are available as 3D data) were used in your study or surface graupel, rain, and snow. If the lowest model height mixing ratios were used, please indicate how far above the ground (in general) the level is.

Sec. 2.2, last paragraph: Ice pellets can exist in transition regions. Did you consider situations with ice pellets? If so how did you determine ice pellets from the model outputs? If it was explained in Sec. 2.2 that only rain, snow, and grauple categories

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are simulated in the mp scheme, then other readers may not wonder about how ice pellets were dealt with in this study.

Table 1: change “temperature criterion. . .” to “Wet bulb temperature criterion. . .”.

Sec. 3.1, line 156: Change “precipitation availability” to “precipitation observation availability”.

Figure 3: Panel (a) is said to be showing the simulation result mapped over a coarser 10km x 10km grid, but it looks like it is on a 4 km x 4 km grid space. Could you verify if a correct figure was used? The blue color scale makes it difficult to see where values are high/low. I would suggest using a different color scheme.

Sec. 3.2.1, line 202: It is good that the authors indicate issues with the gridded data product. However, should “>5mm” be “<5mm” according to Lespinas et al. (2015)? It may also be good to state that the density of observations used in generating CaPA drops significantly across US-Canada border as you go northward.

Sec. 3.2.2, line 220: Could you briefly explain how the data were adjusted by Mekis and Vincent (2011)?

Figure 4: correct “WRF CCTRL” to “WRF CTRL” in the legend.

Sec. 4, line 260: Sentence starting with “Of these, 93% (94%). . .” does not indicate which value is associated with the CTRL simulation. Correct the sentence accordingly.

Sec. 4-5: I may have missed it but there is no mention of how much relative humidity changed from CTRL to PGW simulations over the study area. This study does not mention about how change in cloud mixing ratio and vapor mixing ratio (in PGW) would impact evolution various hydrometeors. A short discussion on change in moisture (not only temperature) would be good.

Figure 10: The two panels are identical (western sub-region?). Please check.

Sec. 6.1, line 496: Correct “the order of precipitation occurrence be related to ..” to “. . .

occurrence can(is?) related to. . .”

Sec. 6.1, line 508: Change “This idealized . . . at Whistler Mid Station . . .” to “. . . at Whistler Mid Station CTRL . . . “

Sec. 6.2, Figure 14: It is unclear from this section and Fig. 14 that the future climate will increase avalanche risk. Figure 14 shows that less transition regions at ski resorts in PGW which contradicts Lines 471-477 and analysis given prior to this section where clearly states an increase in transition region in PGW. Please clarify. Also, Figure 14 may be modified with horizontal lines separating each ski resort so that CTRL vs PGW comparison at a site can be done easily. Also indicate which ski resorts are on the eastern / western sub-regions or use separate panel plot for each sub-region.

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