

Author Comments for Reviewer 1

General Comments:

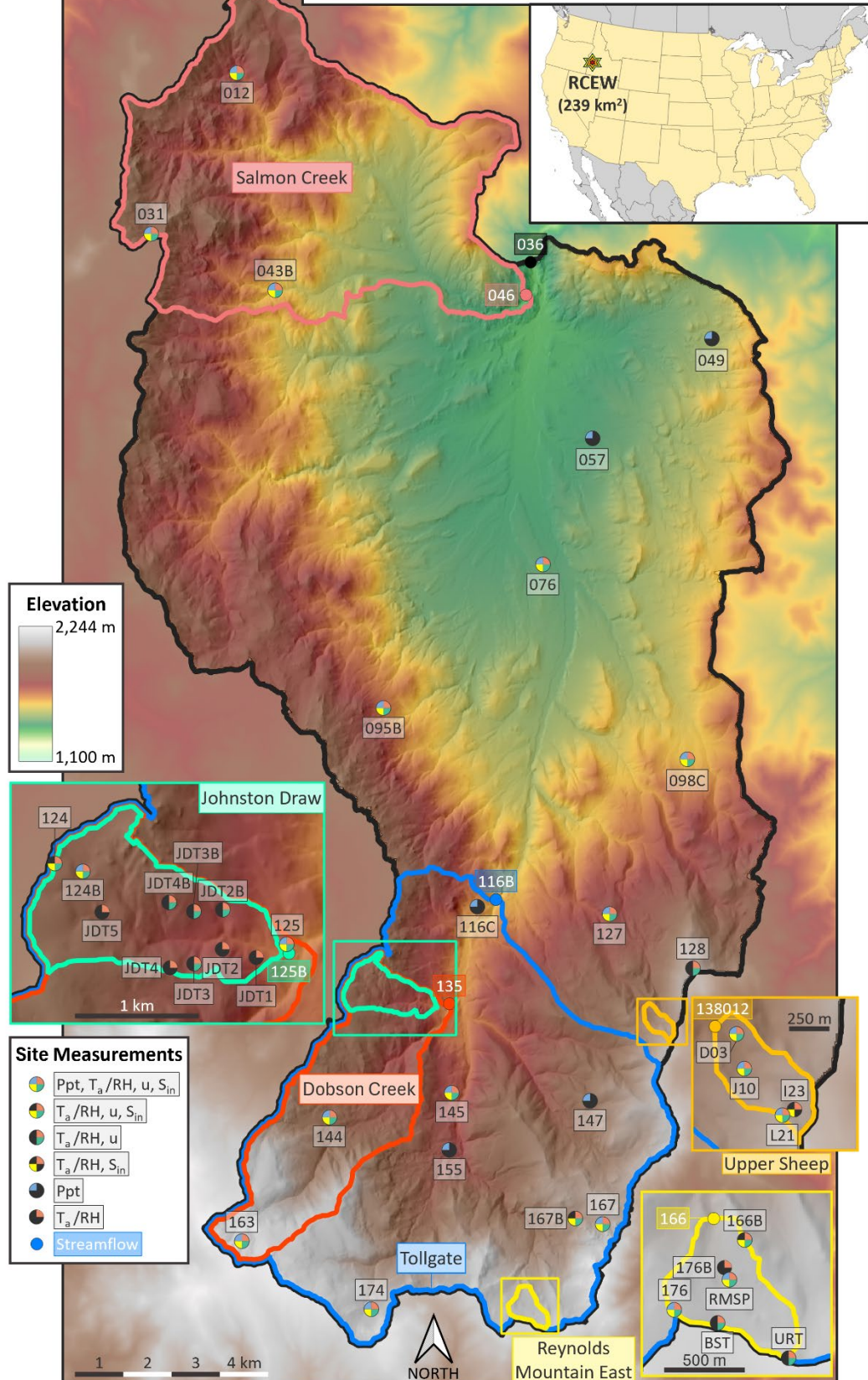
This manuscript presents a 40-year high-resolution gridded meteorological dataset for the Reynolds Creek Experimental Watershed in southwest Idaho, USA. This watershed is designated as a Critical Zone Observatory and is located in the rain-snow transition zone and snow-dominated semi-arid environments, which have experienced shifting due to climatic change. The manuscript describes how the high-resolution gridded dataset was developed from weather stations in this watershed. The presented dataset is extremely important to climate change, hydrology, and ecology related research and can make contribution to understanding climatic change response in the rain-snow transition zone. In addition, the dataset is valuable forcing data for hydrologic model benchmarking and development as well as validation data for atmospheric reanalysis model outputs. The dataset stored in the data repository mentioned in the manuscript meets the standard of usefulness and completeness and can be readily accessed and extracted in the methods described in the manuscript. Overall, the manuscript is well written and easy to follow and should be acceptable for publication with minor revisions. I have a number of specific comments and technical corrections below for authors to consider.

We appreciate your kind words for this data description paper and for taking the time to provide your thorough review. This manuscript will be strongly improved based on your comments. We have tried our best to incorporate all of the comments and suggestions and our responses are individually listed below.

Specific Comments:

1. In Figure 1, the red box weir number, i.e., 135 appears in the inset map of Johnston Draw sub-watershed, while the weir number 135 is for Dobson Creek sub-watershed. I suggest authors move the red box 135 out of that inset map and place it in the main map. **DONE**. In addition, use a thicker red color outline for the boundary of Dobson Creek sub-watershed, as it is barely visible with the thin outline. **DONE**. This is same for pink color outline for Salmon Creek sub-watershed, use a thicker outline to improve readability. **DONE**. Also, I suggest authors perhaps include an inset map showing the location of RCEW in USA for general readers who are not familiar with the watershed. **DONE**. We include here the revised Figure 1.

Reynolds Creek Experimental Watershed



2. In section 4.2, for the relative humidity (RH), is it corrected for saturation vapor pressure over ice when air temperature is below freezing? **Yes, the data logger programs in Reynolds Creek do correct for sub-zero air temperatures and super-cooled water vapor in the atmosphere.** Same comment for vapor pressure, the Eq. 1 shows vapor pressure estimation when air temperature is above freezing, does the vapor pressure estimation consider when air temperature is below freezing? **Yes, SMRF calculates vapor pressure differently for above and below freezing temperatures. We added the Magnus-Tetens equation for the below freezing case (new equation #2).** Air temperature can drop below freezing in the RCEW, and perhaps authors can add some clarification for this in this section. **Thank you for the catch and we have added a more explicit explanation.**
3. In section 5, the description for mean elevation of mixed phase precipitation (e.g. grid cells where $-1^{\circ}\text{C} < T_{\text{wb}} < 1^{\circ}\text{C}$), is this different from the definition of mixed precipitation shown on Line 216: “When time step precipitation temperatures fell between -0.5°C and $+0.5^{\circ}\text{C}$, the precipitation was defined as mixed phase,”? Please check this and use the consistent definition for mixed phase precipitation. **Thank you for pointing out this mistake. The mixed phase precipitation is defined to be between wet-bulb temperatures of -0.5 and $+0.5$ C. We have corrected this in Section 5.**

Technical Corrections:

1. Based on the notation for date and time by the journal, please use the following corrections:
 1. Line 7: please change “water years 1984 to 2023 (October 1st to September 30th)” to “water years from 1 October 1983 to 30 September 2023”.

Done

 2. Line 94: please change “for the time-period October 1, 1983 - September 30, 2023.” to “from 1 October 1983 to 30 September 2023”.

Done
2. Line 77: please change “(where a water year is defined to begin on 1 October and end on 30 September)” to “(a water year beginning from 1 October to 30 September of the following year)”.

Done

3. Based on the notation for hyphen by the journal (i.e., recommend not to hyphenate modifiers containing abbreviated units), please change “10-meter” to “10 m” for the following corrections where “10-meter” appears: Line 9, Line 45, Line 65, Line 83, Line 102, Line 112, Line 122, Line 138, Line 154, Line 155, Line 201, and Line 256.

We corrected all occurrences of ‘10-meter’ with ‘10 m’.

4. Please add hyphen between sub and watershed or watersheds, that is, use the “sub-watershed” or “sub-watersheds” for the following corrections: Line 68, Line 222, and Line 236.

Done

5. Line 16: please remove “and” before uncertainty analyses.

Done

6. Line 21, please add a comma before yet. Yet is used as conjunction.

Done

7. Line 31: please change “ranging between 1-4 km²” to “ranging between 1 and 4 km²”.

Done

8. Line 35: please remove “or” before due to.

Done

9. Line 49: please use “maximize” to have consistent English style (i.e., American English) used in the text.

Done

10. Line 54: please use lower case “southwest” to be consistent with ones used throughout the text.

Done

11. Line 57: please remove “exists”, the verb is not needed.

Done

12. Line 58 to 59: please change “from 228 mm at site RC.057 in the low northeast elevations to 1,086 mm at site RC.163 in the highest southwest elevations of the watershed” to “from 228 mm at site RC.057 in the lowest elevations to 1,086 mm at site RC.163 in the highest elevations of the watershed”. This is to improve clarity, as

lowest and highest are for entire watershed, not lowest in northeast and highest southwest.

Done

13. Line 61: please change “This dataset updates the gridded temperature, humidity, and precipitation dataset” to “This dataset updates the gridded air temperature, relative humidity, and precipitation dataset”.

Done

14. Line 62: please remove “of conditions” before (2015-2023).

Done

15. Line 73 to 74: please shorten “maintained by the USDA Agricultural Research Service (ARS) Northwest Watershed Research Center (NWRC)” to “maintained by the USDA-ARS-NWRC”. The organization abbreviation has already been described in section 2, so the abbreviation can be used in this section.

Done

16. Line 110: please use “in degrees Celsius”. The unit for air temperature in Tetens equation should be degrees Celsius.

Done. Thank you for catching.

17. Line 123: please combine references as “Winstral et al. (2002, 2009)”. Also, these two papers are not presented in the reference list, please add them.

Done and references added.

18. Please use consistent verb tense with other sections in the text and have the following correction:

1. Line 123: “the underlying digital elevation model (DEM) was” Done
2. Line 125: “resulting 72 layers of maxus grids were stored in a lookup library” Done
3. Line 126: “measured wind speed was adjusted to” Done
4. Line 128: “had been distributed across the entire grid using standard IDW, the distributed wind directions were used to find the maxus value” Done
5. Line 129: “the distributed ‘flatwind’ speeds were converted back to” Done

6. Line 135: “Gridded incoming shortwave radiation (S_{in}) was measured at 23 sites” **Done**
 7. Line 146: “Diffuse shortwave radiation under canopy (R_d) was computed by” **Done**
19. Please add a comma for better readability on Line 126 and Line 129, as the following:
1. Line 125 to 126: “for each station, the measured wind speed” **Done**
 2. Line 128 to 129: “the distributed wind directions were used to find the maxus value for each grid cell, and the distributed ‘flatwind’ speeds were converted back to actual wind speeds” **Done**
20. Line 138: for better readability, please change “Hourly clear sky atmospheric S_{in} was modeled, then corrected for surrounding terrain in each 10-meter grid cell following Dozier (1980) and Dubayah (1994), respectively.” to “Hourly clear sky atmospheric S_{in} was modeled following Dozier (1980) and then was corrected for surrounding terrain in each 10 m grid cell following Dubayah (1994).”
- Done**
21. Line 149: please remove “then” before the sum of.
- Done**
22. Line 153: please remove “the” before τ , μ .
- Done**
23. Line 156: please change “well-represented” to “well represented” based on the notation for hyphen by the journal.
- Done**
24. Line 171: please remove en dashes (–) before or instruments and before for periods.
- Done. Changed the wording from “– or instruments to measure thermal radiation – for periods during” to “for measuring thermal radiation during long periods throughout”.**
25. Line 179: please use lower case “the” before RCLT.
- Done**

26. Line 192 to 193: please change “the RCEW measurement network was initially planned to contain one gauge for every square mile of the watershed (n=110)” to “the RCEW measurement network was initially planned to contain one gauge for every square mile and 110 stations for the watershed”.

Done

27. Line 194 to 195: “used here to produce the hourly gridded precipitation fields (Figure 1).” Figure 1 does not show the precipitation fields, please refer to the correct figure if it is presented in the paper.

Reference to Figure 1 was removed. It is not clear why this figure reference was included.

28. Line 196 to 197: please change “was used for all but one of the sites in the RCEW” to “was used for all sites in the RCEW except for RC.124B”.

Done

29. Line 201 to 202: please change “using a Detrended Kriging interpolation method (Garen, 1995) identical to the approach by Kormos et al. (2018)” to “using a Detrended Kriging interpolation method (Garen, 1995), which is identical to the approach by Kormos et al. (2018)”

Done

30. Line 207 to 208: please change “Prior work has demonstrated that wet bulb temperature is the most suitable method for partitioning snow from rain in a semiarid watershed such as the RCEW (Marks et al., 2013).” to “Previous research has demonstrated that wet bulb temperature is the most suitable precipitation phase partitioning method in a semiarid watershed such as the RCEW (Marks et al., 2013).”

Done

31. Line 210: please remove “accumulated” before snow density.

Done

32. Line 217 to 2018: please change “and warmer temperatures were 100% rainfall” to “and warmer temperatures produced 100% rainfall”.

Done

33. Line 221: please change “For an example demonstrating the utility of this unique dataset we examine how the annual average storm-based” to “As an example of the utility of this unique dataset, we examined how the annual average storm-based”.

Done

34. Line 228: please change “The accumulation season was defined as the period prior to peak SWE accumulation” to “The accumulation season was defined as the period from 1 October to peak snow accumulation (SWE)”. This change also defines the SWE abbreviation used subsequently.

Done

35. Line 230 to 231: please change “the RS_z has risen from 1,830 meters in 1984 to 1,991 meters in 2023 and resulted in a decrease in snow-dominated basin area from 52% to 24%” to “the RS_z has risen from 1,830 meters in 1984 to 1,991 meters in 2023, resulting in a decrease in snow-dominated basin area from 52% to 24%”

Done

36. Line 236 to 237: please change “snow accumulation season (October 1 – peak SWE date)” to “snow accumulation season (from 1 October to peak SWE date)”.

Done

37. Line 247: please change “ snow dominated” to “snow-dominated”. This is to be consistent with style used throughout the text.

Done

38. In Figure 5a, the fit lines for trend analysis of rain/snow transition elevation are shown in orange line and navy blue line for all storms and accumulation season storms; also, there are two gray dot lines shown for the elevation ranges of Tollgate sub-watershed. Perhaps, to help readers, add these fit lines and dot line in the legend or describe them in the figure caption.

Done. We added text in the caption to refer to the lines of best fit and the dotted elevation lines.

Author Comments for Reviewer 2

General Comments:

This compact paper describes a rasterized dataset of meteorological variables with high spatial and temporal resolution for the Reynolds Creek Experimental Watershed (Idaho, USA). The dataset was derived from operational station measurements using various spatial interpolation and modeling techniques and is available for download. It provides a valuable basis for a wide range of potential quantitative investigations of processes in the atmospheric boundary layer and land surface hydrology, particularly snow hydrology, for which the dataset was originally developed.

The paper is written in very good English and is a pleasant read. I agree with all the comments and suggestions for improvement made by the first reviewer (RC1); these have obviously been incorporated into a second version of the manuscript (which, however, is not available to me). From my perspective, only a few minor points remain that I would address prior to publication of the manuscript.

Thank you for taking the time to review our manuscript and for your invaluable comments. We will address each comment below in red text.

What would be desirable is a paragraph about the code (which is also available) used to calculate the new dataset. Would it be possible to use this code to generate a comparable dataset with, for example, lower spatial (e.g., 100 m) and temporal (e.g., 3-hourly) resolution, or to apply it to a different area? Absolutely! A good deal of thought was put into deciding the optimal spatiotemporal resolution for RCLT dataset. Ultimately, we decided to produce the highest resolution we felt was possible from both disk storage/file access and scientific application perspectives. Coarsening the dataset could be achieved in two ways: (1) the simplest approach would be to resample the 10-meter, hourly grid to the desired coarser resolution using an appropriate method for each variable; (2) the more rigorous and accurate method would be to produce a new basin topo file (DEM, mask, vegetation parameters) at the coarser resolution and then alter a few options in the yearly SMRF configuration file. We are now including a sample configuration file in the supplementary materials based on this comment. It would be an additional benefit of your paper if you write a few explanatory sentences about this in a short dedicated paragraph. We have added a paragraph explaining how this dataset can be customized to various use cases in Section 7 (Data Availability).

Minor technical corrections and revisions for improvement:

86: “ ... differing levels of accuracy, which are not reported here”: Could you at least provide some basic experiences by the “full-time staff of technicians tasked with the calibration

and servicing of each sensor deployed in the RCEW” to give the user of the dataset an idea if the station recordings of a certain variable are less or more reliable?

Because the data record was so long and there were so many measurements, it became apparent that compiling a comprehensive list of sensors was going to be nearly impossible and would result in a very lengthy description. Furthermore, field notes on when sensors were serviced, calibrated, and replaced are sparse prior to the year 2000. We have added the text “but are available upon request” to the sentence on not reporting the levels of accuracy.

Are the types of sensors used documented somewhere (if yes, a reference would be helpful)

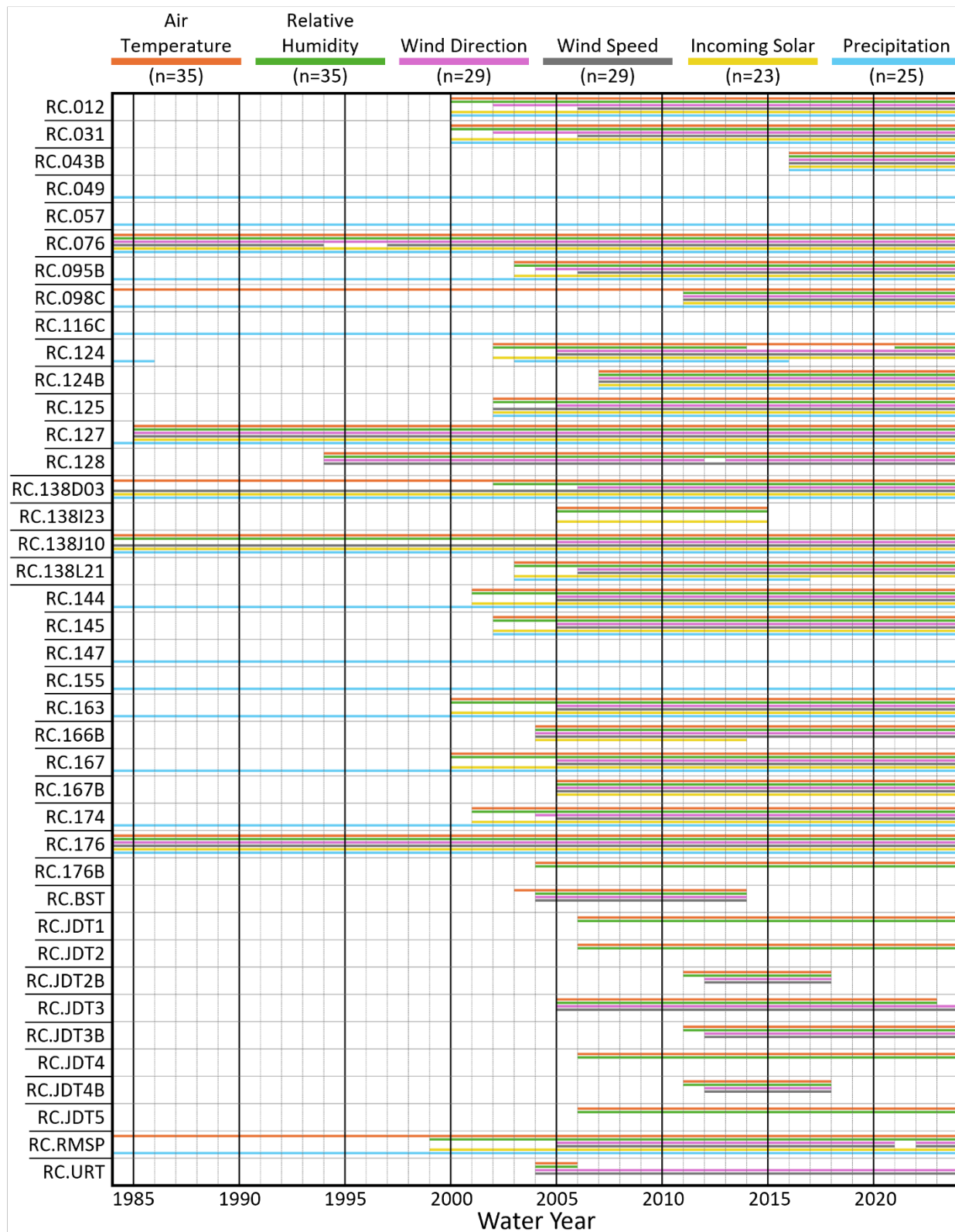
Yes, there is detailed documentation going back to the year 2000 on the different sensors located on our internal RCEW wiki page. Readers and dataset users that are interested in these details are encouraged to contact the Northwest Watershed Research Center to find more information on site-specific sensors. Unfortunately, US government policies prohibit us from publishing this wiki page publicly at this time.

Figure 2: I would recommend to extend this table with the units of the single variables and with their very basic statistics (e.g., annual min, mean, max for the 4 decades covered?)

Thank you for this suggestion. We have added units to this Figure, though rather than adding statistics to the figure, we opted to list them in the text towards the end of the Section 4 variable subsections.

Figure 3: the x-axis does not show the period covered by the data. Can you adjust it as true time line so that it correctly covers the time-period 1 October 1983 - 30 September 2023 with correct length of months and years, ticks positioned at the beginning/end of a year, and year inscriptions positioned between these ticks?

Thank you for your feedback on this figure. We went through iterations of how to best convey the measurement time series information succinctly. The figure x-axis label was misleading, and it now reads “Water Year” to convey that the tick marks coincide with the beginning of the water years (1 October). In other words, the minor grid lines depict the start (1 October) and end (30 September) of a water year.



Also, the caption was not clear on the measurement gaps for each station variable. The colored horizontal bars indicate individual water years that had over half of the hours in that year where station data was able to be used in the gridded interpolation (per variable). What it does not show is each individual data gap over the 40-year period. We initially plotted each data gap but found that it was too difficult to view when considering all station variables ($n=176$) and across 350,640 hours. The figure caption has been revised to read:

“Annual water year measurement record used in SMRF gridded interpolation from the 40 individual sites within RCEW from 1 October 1983 to 30 September 2023. The horizontal bars for each variable indicate station observation data present for over half of a water year, however smaller data gaps are not shown. Some sites measure all six variables required by SMRF to produce the twelve gridded hydrometeorological forcing variables, though many are instrumented to measure fewer variables. For example, five stations solely measure precipitation (RC.049, RC.057, RC.116C, RC.147, and RC.155).”

Figure 4: again, the x-axis should be a true time line and add the day to the given year/month

Because this figure only concerns a single sample water year (2009), we changed the tick labels on the x-axis to read “1-Oct, 1-Nov, etc.” We hope this resolves your comment.

Figure 4/caption: „... observed versus modeled maximum daily incoming solar radiation (S_{in}) at three sites ...“

Thank you. This was addressed.

4.6.3: Density of New Snow: can you at least say what new snow densities the lookup table approach produces for typical snowfall conditions in the RCEW?

Yes, snowfall in the RCEW typically occurs between -5°C and 0°C , so the new snow density falls between 75 kg/m^3 (at -5°C) and 250 kg/m^3 (at $+0.5^{\circ}\text{C}$) corresponding to the values presented in the table on page 2007 of Susong et al., 1999. We added these sentences to Section 4.6.3:

“These lookup table values are distributed in a stepwise fashion between -5°C and $+0.5^{\circ}\text{C}$ with values ranging between 75 kg/m^3 and 250 kg/m^3 , respectively. Snowfall occurring below -5°C , which rarely occurs in the RCEW, is assigned a new snow density of 75 kg/m^3 .”

4.6.4: does „mixed phase“ precipitation mean that certain fractions of snow/rain occur, depending on precipitation temperature between -0.5°C and $+0.5^{\circ}\text{C}$? How is the transition shaped?

Yes, mixed phase precipitation is defined linearly between -0.5°C and $+0.5^{\circ}\text{C}$. We have edited Section 4.6.4 to better describe this:

“The relationship between precipitation phase and wet bulb temperature is linear such that 0°C results in a 0.5 snow fraction, -0.5°C is 100% snow, and +0.5°C is 100% rain.”

Fig. 5a in the legend: „Accum season storms“: better do not abbreviate. Again, convert the x-axis to a true timeline (see comment to figure 3).

Thank you for this suggestion. We altered the figure legend to state “Accumulation season storms. As for the x-axis, the data points represent the water year average rain-snow transition elevations. Therefore, each plotted data point is assigned to a water year value (1984-2023) rather than a date. This is similar to Figure 3.