

Response to Reviewers:

Spatial and seasonal patterns of near-surface humidity in the foothills of the Canadian Rocky Mountains, 2005-2010

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We thank the managing Editor and the reviewers for their time and their constructive suggestions to improve this manuscript. We have incorporated most of the reviewers' suggestions, and are pleased to have the opportunity to submit a revised and improved manuscript. Our response to each point is detailed below, in blue.

Reviewer One

Overview: This manuscript introduces a detailed spatial dataset for surface humidity in the foothills east of the Canadian Rocky Mountains. Previously these authors have shared a dataset for surface temperatures for this same network. This manuscript explains the methods by which specific humidity and relative humidity data were quality-controlled and missing data were infilled. The authors provide some examples that illustrate the potential for this dataset to be used in further studies. This is an interesting dataset and the authors have presented sufficient information for it to be used by others.

Major Comments:

There are several places where the text is difficult to follow, and several places where the text could be shortened. I found the Abstract to be difficult to follow because of organization. There is quite a bit of repetitive text especially in the summary which should be edited for brevity. The examples provided in Figures can be improved. When providing figures illustrating seasonal and spatial patterns it would be preferable to use a consistent colour scale so the reader could more readily see the seasonal and spatial differences. I particularly object to the use of colour scales with three colours when two would be sufficient (Figures 4 and 7). I would encourage the authors to consider a different colour palette for Figures 5 and 6.

Thanks for these general suggestions. We have rewritten much of the manuscript to shorten it and avoid repetition. The Abstract has been reorganized and rewritten (see responses below).

We have adopted some of the colour palette suggestions here, while noting that this is purely online content, so colour comes at no expense and offers some variety to the eye.

There are several places where there are inconsistencies or missing information that is needed to properly describe the results. These are noted in the detailed comments below.

[See responses below.](#)

Detailed comments:

Page 1 line 11: The following sentence is unclear. "Hourly air pressure measurements at Calgary Airport are adjusted for elevation to calculate specific humidity from the vapour pressure." Do you mean

specific humidity was calculated from the vapour pressure and adjusted for elevation using hourly air pressure measurements at Calgary Airport.

Not exactly this. Vapour pressure can be calculated directly at each site, given the in situ T and RH data: $ev = es(T) * RH / 100$. The hourly air pressure from YYC is adjusted for elevation and used to calculate specific humidity from this: $qv = 0.622 * ev / (P - ev)$. This is too involved for an abstract, so we removed this to avoid confusion. Now explained clearly in the methods.

Line 16 neighbourhood instead of neighbourhoood.

Revised, thank you.

I think that the text in the abstract is awkwardly ordered. The following might be better. Near-surface humidity was monitored from 2005 to 2010 in a mesoscale network of 232 sites in the foothills of the Rocky Mountains in southwestern Alberta, Canada. Daily mean specific humidity, relative humidity, and vapour pressure from the multi-year study are available at <https://doi.pangaea.de/10.1594/PANGAEA.889435>. The monitoring network covers a range of elevations from 890 to 2880 m above sea level and an area of about 18,000 km², sampling a variety of topographic settings and surface environments with an average spatial density of one station per 78 km². This manuscript describes the processing methods used to quality-control and gap-fill the data. Overall data coverage for the study period is 89%. Inverse-distance weighting techniques are used to estimate the missing 11% of data, based on neighbourhood values of daily mean specific humidity. Hourly screen-level temperature and relative humidity were recorded over the study period, forming the basis for daily mean relative humidity and vapour pressure estimates. Specific humidity was calculated from the vapour pressure and adjusted for elevation using hourly air pressure measurements at Calgary Airport. We provide plots of seasonal and spatial humidity patterns for the dataset to illustrate the relations between humidity variables and temperature, elevation, and longitude in the region. We provide examples of monthly mean lapse rates of specific and relative humidity based upon this dataset as an illustration of one potential use.

We followed some of this suggestion, but some of the abstract content has now been removed, per the comment/confusion above about how specific humidity is calculated. We think that the Abstract is now concise and clear.

Page 2. I note that ESSD allows lists of references to be by importance, chronologically, or alphabetical. It appears the choice here is chronological and is consistent throughout.

No action required.

Line 21 Holden and July 2011 is cited but no reference provided.

Reference now provided, apologies.

Line 29 Segal et al 1992 is cited but no reference provided. Also Lengfeld and Ament 2012 is cited but no reference provided.

References now provided, apologies.

Page 3. Line 13. Consider changing “Here we present the mean daily values of relative humidity, specific humidity, and vapour pressure over the five-year study.” To: The dataset contains the mean daily values of relative humidity, specific humidity, and vapour pressure over the five-year study.

Revised as suggested.

Lines 10-18. Consider adding a statement that where erroneous or missing data were gap filled the data has a flag.

We note this twice later in the manuscript, where we present the methods and data in greater detail – we prefer not to add it to the introduction, which is more general and with the objective of avoiding repetition in the manuscript.

Page 4. Line 26. Consider changing Calculation of mean daily humidity values can be complicated, due to the fact that RH is a constructed variable that depends non-linearly on both temperature and actual humidity. To: Due to the fact that RH is a constructed variable that depends non-linearly on both temperature and actual humidity, calculation of mean daily humidity values is more complicated.

Revised as suggested, now at p.7, l.3.

Footnote 1: I do not understand the relevance of this footnote.

One can no longer find reference to Veriteq Instruments or the SP-2000 datalogger online, in case a reader wishes to acquire or investigate these sensors/loggers further – we found them to perform far, far better than comparable Hobo T/RH sensors, for instance.

Page 5. Line 11. In the abstract you refer to Calgary Airport and that should be retained here: For a site with elevation z (m) and absolute temperature TK , we estimate pressure based on the assumption of a standard atmosphere, using Environment Canada data from Calgary Airport which has a reference elevation of $z_0 = 1099$ m.

Retained as suggested and rewritten for clarity, p.6, ll.20-23.

Line 24. Delete “However,” as what follows is a statement of fact.

Revised as suggested, p.7, l.8.

Line 26. Change to wording: We anticipate that some applications of the data may require daily RH data and others may require actual humidity measures (ev or qv), so we include estimates of mean daily humidity derived from both methods in the dataset.

Revised discussion here, p.7, last paragraph.

Page 6 line 7. Change “The reference site” to This reference site”

Revised as suggested, p.4, l.25.

Page 7 line 15 insert “were” so “measures were calculated”

Rewritten, now n/a, p.8, l.13.

Line 23 “: : has been used by Nalder and Wein (1998); however, there is variable topography in the FCA area: : :

Revised as suggested, p.8, l.5.

Page 8 line 34. Here you say the optimal results are for 18 neighbours, but on page 15 line 2 you say 15. I would expect these to be the same number, or did I miss something?

Our carelessness - best results are with 18 neighbours. Now reported just once on p.9, l.25.

Page 9 line 18. There are problems with this sentence: This is also true for the percentage difference (Figure 2), where ΔT has a roughly relationship with both temperature and diurnal temperature amplitude across the full range of observed conditions (with exceptions to this behaviour). This is also true for the percentage difference (Figure 2c & d), where ΔT has a roughly linear relationship with both temperature and diurnal temperature amplitude across the full range of observed conditions (with exceptions to this behaviour).

Revised as suggested, p.7, ll.20-22.

Line 22. Delete “However,”

Revised as suggested, p.7, l.28.

Page 10 lines 12-21. There is something that I am missing about Figure 3. Panels a and b are the actual observations and panels c and d are the interpolated values. That would explain, based upon the method described for interpolation why the highs in a/c and lows in b/d are different. On page 7 line 15 it states that 89% of the values were complete, so when the interpolated values, which I assume to be about 11% of the total are plotted in Figure 3 the frequencies are about the same whereas I would expect the interpolated frequencies to total to a much smaller number than the actual data.

For these plots and uncertainty estimates, we use a jackknife (leave-one-out) approach to generate interpolated values for known points. This is applied to all known data (89%). Now clarified, p.9, ll.18-19.

Page 13. Line 7. Should be “classic example”

Revised as suggested, p.12, l.16.

Line 25. This is the very first mention of the fact that the interpolated values were accompanied by a flag. I think that this should have been mentioned earlier in the manuscript.

Now noted in the introduction, p.3, l.14-15.

Page 14. Summary. I found the nearly two page ‘summary’ to be very repetitive to the preceding text. And seems to diverge from the subject of the dataset itself.

We have rewritten and condensed this to minimize redundancy. Several paragraphs were shortened or removed, bringing it down to 1 page and 4 lines.

The second paragraph should be moved to page 4 after line 12.

Revised as part of the rewritten summary.

Paragraph 6 [page 15] is very similar to page 12 lines 9-16. It would be better if these two were combined into a single paragraph on page 6.

Revised as part of the rewritten summary.

Paragraphs 3-5 could be shortened in a summary.

Revised as part of the rewritten summary.

Page 15. Line 2. See my previous comment about the consistency of 15 or 18 neighbours.

Now n/a as part of the rewritten summary.

Page 16. Missing references: Segal et al 1992 Holden and Joly 2011 Lengfeld and Ament 2012

References added, apologies for this.

Page 19. Figure 1. This just might be the quality of the Figure in the pdf that may have been generated from a Word document but the resolution is not very good. I do not think that the inset 'b' is necessary since the location of the FCA is clear in 'a'. Inset c would need an elevation scale to be added.

We have kept the inset as there is room for it and it helps to show the outline of the city of Calgary and the Bow River in a regional context, as referenced in the text.

Figures 4 and 6. This is a personal perspective, but I find that the present colour scales and different scales between panels leave too much for the reader to interpret. I suggest that only a single colour scale be used i.e. white to red or white to blue and the same scale to be used in each sub-panel in the figure. Single colour [i.e. white to red] scales survive grayscale printing and are easier to interpret. Using a common scale for similar panels as in Figure 4 lets the reader see both the seasonal and spatial scale; this is not the case with Figure 4 or 7.

We understand this point, but there is little overlap between seasonal ranges. Therefore, using a single scale for all seasons does not show the seasonal spatial pattern effectively, e.g., winter becomes a single colour. We have re-drafted our figures to try to improve clarity, but continue with the variable scale bars in these figures.

In Figure 4 it is not immediately evident that summer has much higher specific humidity that fall because of the use of different scales and red-white-blue colour scales. In 'd' the blues are actually » than the reds in 'b'. Also, the ordering of panels in Figure 4 is odd. A more common order would be MAM, JJA, SON, DJF.

As noted above, using the same scale for all seasons does not show the spatial variability for each season, which is the primary purpose of the plot. Different scales for each season have been retained. The colour scheme has been changed (combining suggestions of the two reviewers), and the plots have been re-ordered to make a more logical seasonal sequence.

Figure 7 would be better with a single colour scale [with to red or white to blue] and common ranges for each of specific and relative humidity. This would allow the reader to readily see the differences between the four events. Here, you might use white to blue for one column and white to red for the other to distinguish between specific and relative humidity.

Per above, single scales obscure the spatial variability, which is the main point, but we did change the colours to a different scale that avoids some of the concerns with the temperature palette. As online (not print) content, we think the colours are effective in making our points about the spatial patterns.