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Hydrology and Earth System Sciences Discussions

Interactive comment on "Hydrological effects of the temporal variability of the multiscaling of snowfall on the Canadian prairies" *by* K. R. Shook and J. W. Pomeroy

K. R. Shook and J. W. Pomeroy

kevin.shook@usask.ca

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Anonymous Referee #2

1) The aim of this study is to downscale snowfall series that mimic the multifractal signature of the observed series, so that one can generate input to a hydrological model. Some sentences can be used to explain why the chosen strategy is the best, why the multifractal analysis is important and how the successful reproduction of multifractal features ensures a good downscaling. The paper have the appearance of being written in a hurry. As the topic is (still) strange to the community, one could use the opportunity to enlighten the colleagues. My feeling is that this paper is still not a complete

product and I would like the following to be adressed:

2)What are the implications of the huge uncertainty in the estimate of β?

The great degree of scatter shown in Figure 2 is caused, in part, by the temporal variability in the scaling present in the dataset. As shown in Fig. 3, the uncertainty in the value of β is relatively small, over each segment of the snowfall time series, compared to the changes in magnitude from segment to segment.

3) Why do you have section 3? how are the results used? Does figure 3 show that the data are not stationary? I am confused

The purpose of section 3 is to show (a) that the data are scaling (which is required for all further analyses) and (b) that the degree of scaling appears to vary over time. The overall purpose of these analyses is (a) to test the existence of trends in the (multi)fractality of the snowfall time series and (b) to determine the effects of those trends.

The figure shows that the degree of (multi)scaling appears to vary over time. This is independent of the question of whether or not the data are stationary (see below).

Specific comments: 1280-line 7 “shows”-show 1280 l 8 The sentence is way too long, and I think “timing and quantity of snow accumulation and melt” should be addressed at physical processes, not at multiscaling parameters. The abstract could me made more clear

These will be addressed.

1281 l 3 I thought the statistical properties did differ, but could be scaled

Yes. This will be rephrased.

1281 l 17. Both the terms “multifractal” and “multiscaling” are used. It would be nice if a decision could be made on which, or clearly explain the difference. The topic is elusive enough as it is without introducing further confusion trough terminology. The same goes for stationarity and (in)homogeneity, usually these two terms mean the same (in

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space and time). What is it here?

The terms are similar. A multifractal is a more general version of a fractal, while multiscaling is a property of multifractal data sets.

The term “stationarity” is used with respect to the frequency distribution of a time series, while “inhomogeneity” is used to refer to the distribution of the values in time. The two may or may not be related. For example, the short-term autocorrelation of a data set may be altered by moving values by small lags within a data set, without affecting the overall stationarity.

The multifractality is caused by the short-term temporal variation of the data over periods shorter than a month, as shown. Variation in this type of distribution (temporal) over the length of the dataset does not appear to affect the distribution of the mean.

1283-l 9. Mystifying sentence The time series are stationary, but the temporal distribution is not? How can this be?

See above. The “stationarity” referred to is the simplest sense: that the mean is unchanging over time. However, over the length of the time series, the short-term (i.e. less than one month, as described) temporal distribution (the intermittency) shows variation.

1284 l 3. A sentence can be added to explain intermittency. I think this (alpha) parameter is especially important to elaborate upon since it will probably change according to temporal scale and probably affect the other moments of the distribution (it is later shown to be correlated to the parameter of inhomogeneity). It would also be helpful is we could know what is “large” and “small” wrt these parameters. What is the relation between values of C1 and the claim that the series are stationary?

As the datasets are multifractal, the values of alpha and C1 are not expected to depend on temporal scale. However, the analyses in this paper are restricted to examination of multifractality over a very small range of scales (1 day to 1 month), so the question is

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really outside the scope of this investigation.

The magnitude of C1 could not be shown to have significant trends in the datasets, so it was not considered, except as it could be shown to relate to alpha.

It is probable that the values of alpha and C1 do affect the higher moments of the parameters. This is a useful avenue for future research.

1284 l 9 reformulate the sentence “The extreme: : :”

What is the problem? The extreme values of the distributions are of interest. Is it because this could be confused with the extreme-value distribution? It could simply be re-written as “the extremes”.

1285 l 6 the comment ”(32 being the closest power of 2)” is not very enlightening.

The value of lambda has to be an integer power of 2. This will be re-phrased.

1285 l 13 “tenths” ????

What would be a better term? Perhaps “sections”?.

1286 l 11. The PDF of cumulative snowfall and snow on ground. There may be many reasons to differences in PDF. Redistribution by wind, of course, but also perhaps melting events??

Melting is possible, but the prairie spring melt generally occurs well after March 1, and the mountain melt generally occurs well after April 1. These dates were selected from the available snow surveys (generally done once per month) as they show the greatest accumulations of snow. Furthermore (as shown in the figure) the median of the Banff snow on the ground is evidently greater than that of the snowfall, which is unlikely to be due to melt.

1287 l 16. “By varying the distribution of # : : :.“.Is it possible to elaborate somewhat more here, since this is the place where the entire multifractal business is linked to the

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downscaling.

The distributions will be described.

1288 l 27. The final part of the sentence starting with “To reduce: : :” is incomprehensible.

It will be re-written. The word “consisting” will be changed to “using”

1289 l 20. should it be “muliscaling analysis”

No. It is the multiscaling (i.e. the property of the time series), as indexed by the universal multifractal parameter alpha, which shows evidence of trends.

1295- Figure legend “Wave number”- should it be wave length?

“Wave number” (the default used by the statistical program R, which was used for these analyses) was thought to be more descriptive as it is dimensionless. The wave “length” would have dimensions of 1/days, which are not lengths. Perhaps the legend should read “Wave number (1/days)”.

1291 l 17. I do not find this reference in the text. True. This will be fixed.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 7, 1279, 2010.