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Discussions

Interactive comment on "Snow density climatology across the former USSR" *by* X. Zhong et al.

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Summary: In this work, the authors develop a climatology of snow density based on observational data recorded at 1259 sites across the former USSR between 1966 and 2008. Mean monthly snow density is shown to vary between 0.135 g cm-3 in October and 0.295 g cm-3 in June with an overall mean of 0.194 g cm-3. The spatial distribution of the climatology of snow density is presented along with results for different types of snow based on the classification scheme of Sturm et al. (1995). Long term trends in snow density are established using linear regressions and demonstrate declining snow densities across the former USSR, especially during autumn.

This paper is generally well written and illustrated and may be acceptable for publication in the journal following some revisions. My report provides guidance that the authors

may follow in revising their manuscript:

General Comments:

1) While the results of the snow density climatology are important and should be published, the present study provides little explanation as to the distribution and trends of snow density observed across the former USSR. What are the meteorological and surface conditions that result in the spatio-temporal distribution of snow density? For instance, is there any relationship between snow density and snow depth or air temperature? Further analyses on other hydrometeorological variables would be helpful in interpreting the results of the snow density climatology.

2) In relation to this, a climatology of observed air temperature, snowfall, wind speed and snow depth during winter across the former USSR would be helpful in assessing and interpreting the results of the snow density climatology.

3) Is there any information about the vertical profiles of snow density within the snow pack or are only bulk values available for each site of interest?

4) Some of the figures and their captions require modifications – my specific comments provide suggestions on how to improve these.

Specific Comments:

1) P. 3381, line 29: It appears there is a space missing in "to 1993".

2) P. 3382, line 16: Could you expand on what results Ma and Qin (2012) found for snow density across China?

3) P. 3384, line 4: This should read "points".

4) P. 3384, line 26: Insert the year of publication for Sturm et al.

5) P. 3387: Snow densities are reported here to three decimal figures whereas they were previously reported only to two decimal figures. Please be consistent with the

presentation of the results.

6) P. 3390, line 18: Insert "the" before "1990s".

7) P. 3393, line 5: Insert the appropriate units for the standard deviation of snow density.

8) P. 3394, lines 1-3: Are there relationships between snow density and other environmental factors (such as latitude, vegetation types, meteorological conditions, etc.)? Elevation appears to explain only a small fraction of the observed distribution of snow densities.

9) P. 3395, line 18: This should read "was affected".

10) P. 3396, line 4: Insert "the" before "1970s".

11) P. 3396, line 11: Insert "a" before "normal".

12) P. 3397, lines 21-22: Do you have the volume and page numbers for this reference?

13) P. 3403, Figure 2: Is it possible to have the legend "37%" below the top of the graph?

14) P. 3404, Figure 3 and others: There is no need to provide details about the axes in the caption as this is self-evident. The second sentence in the caption should start as "Dots represent the . . ."

15) P. 3405, Figure 4: Again, this should read "Dots represent. . ."

16) P. 3408, Figure 7: Why is there a sudden drop in snow density in the 2000s? What explains this regime shift in snow density and departure from the previous trend? Were different measurement techniques of snow density implemented at that time in the former USSR?

17) P. 3410, Figure 9: The last sentence of the caption should read: "Red circles represent decreasing trends while blue circles denote increasing trends in snow density."

18) PP. 3411-3413, Figures 10-12: Is the PDF of snow density based on daily or

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monthly values? The caption should clarify this point. The mean and standard deviation values shown on the plot should be given units. What do the arrows on the x-axis denote?

19) Pp. 3414-3415, Figures 13-14: Please insert the units for elevation on the x-axis label.