

## ***Interactive comment on “Snow depth on Arctic sea ice from historical in situ data” by Elena V. Shalina and Stein Sandven***

**Anonymous Referee #2**

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This paper incorporates a wealth of data measured from the Russian Sever expeditions to improve our historical knowledge of snow depth on sea ice, in particular in the marginal seas. The data used represent a massive effort spanning several decades and I am happy to see such a study done. The paper is thorough and generally well written, though I do have a few points I would like to see addressed.

An updated climatology to that produced by Warren et al., 1999 is one of the main results of the paper. However, in the Warren paper the Sever data were examined but not used for these reasons quoted in the paper:

“It is puzzling that the snow should be so much deeper around hummocks (45 cm) than behind ridges. The geographical patterns are also puzzling. Because some of the variation in average snow depth across the Arctic seen in Fig. 9 is probably due to different

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areal coverages of sastrugi, ridges, and hummocks, one would expect the geographical gradients of snow within these classifications to be smaller than those of Fig. 9. However, this is not the case. The snow depth behind ridges appears to decrease toward Canada, while the height of snow around hummocks increases. These strange patterns cause us to question the representativeness of the measurements made at the aircraft landing sites. We favor the measurements made at the NP stations that were conducted more systematically.”

I believe these points need to be addressed directly by the authors prior to publication.

In addition to the points raised in the Warren paper, I would like to see a better explanation for why the new climatology was produced using only the sastrugi and landing snow depth. The Warren climatology used data from snow lines which contains a mixture of snow depth from level ice as well as deformed ice, I'm not sure the snow depths produced from the Sever data would be equivalent. Perhaps a statistical analysis could be done to better relate data from the snow lines to that sampled in the Sever data.

Specific comments

P1 L23-24: In comparing to the Warren climatology it is necessary to state what is being compared: level ice snow or does it mix in snow from deformed ice too?

P3 L1-2: The Warren climatology gives a representation of the mean error in the form of the interannual variability, so I don't think this statement is correct here. The climatology did not have adequate sampling to provide information on the errors due to spatial variability, so I suggest this statement be revised to reflect this aspect.

P6 L20-34: In the W99 paper there is significant discussion about the representativeness of the sampling. While this section describes the sampling method, this important point has not been addressed. I note particular the analysis done with random samplings of the same population to see how the error for a given set of measurements changes with sample size and snow depth.

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P7 L15-16: This statement seems like it belongs more in the caption for Figure 4.

Figure 5: It would be easier to read if the figure panel with snow depth had the units labeled.

P9 L19: I don't understand the last sentence, particularly with regard to the word "implying". Were all snow measurements used or was the MY subset used?

P10 and throughout: "fastice" should be "fast ice"

P13 L4-8: I'm confused by this section as the regression equation implies the sastrugi height is simply a constant 15.5 cm higher than the undisturbed snow.

P20 L5-8: Why were only the snow on the landing area and sastrugi data used and not any of the others described?

P20 L15-18: Although the detail of the data is lost in the quadratic fit, an advantage of the W99 climatology is that the fit coefficients were provided such that others could easily reproduce the climatology values. I suggest the authors put the fit coefficients in here.

P25 L34-35: Petty et al., 2016 (The Cryosphere) found FY feature heights of around 1 m which might be a more thorough comparison to the Sever data.

A number of minor grammar errors are present throughout the text.

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Interactive comment on The Cryosphere Discuss., <https://doi.org/10.5194/tc-2017-278>, 2017.