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The Cryosphere Discussions

Interactive comment on "Spatiotemporal variation of snow depth in the Northern Hemisphere from 1992 to 2016" *by* Xiongxin Xiao et al.

Anonymous Referee #1

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In this manuscript, the authors use a support vector regression (SVR) algorithm that they developed in a previous paper to estimate snow depth from passive microwave observations. In addition to evaluating their estimates of snow depth against values from GlobSnow and ERA-Interim/Land, they also use snow density assumptions to estimate snow water equivalent (SWE) for the Northern Hemisphere. Their major conclusion is that SWE has been declining by ∼5 800 km3 a year, or approximately 139 200 km3 over their 24-year study period. The authors say this decline is equivalent to a 12.5% reduction of SWE over the study period, suggesting the initial amount of SWE was ∼1 113 600 km3.

I believe there is a fundamental flaw in how the authors are calculating annual snow accumulation in this manuscript. Their estimate of annual SWE is orders of magni-

tude larger than other global datasets suggest. Mudryk et al. (2015) show that the Northern Hemisphere has an average annual snow accumulation of 3500 km3 (see Figure 1a, taken from Figure 3 in that manuscript). Using four commonly used global datasets (ERA-Interim, GLDAS, MERRA2, and VIC), I estimate the long-term-average global snow storage to be ∼4000 km3 (see Figure 1b). Even if these global models/reanalyses are underestimating SWE, it is unlikely they are wrong by as much as this manuscript indicates. I believe the authors may be summing daily values of SWE when calculating their annual total SWE, as one would do when calculating annual precipitation from daily precipitation values. However, this is incorrect when working with SWE. Instead, the authors should consider comparing the annual maximum SWE over their period of record. This will not lead to such a dramatic value of SWE decline, but I think it would be interesting to see how their method compares to changes in SWE from GlobSnow, ERA-Interim/Land, and other global data products.

With this mistake, the manuscript is not ready for publication. But if the authors redo their SWE calculations and the following analyses, I would be interested to see the SWE results from their SVR method. Since this error is critical to the main conclusions of the manuscript, I do not include a review of the rest of the paper.

Reference: Mudryk, L. R., Derksen, C., Kushner, P. J., and Brown, R.: Characterization of Northern Hemisphere Snow Water Equivalent Datasets, 1981–2010, Journal of Climate, 28, 8037-8051.

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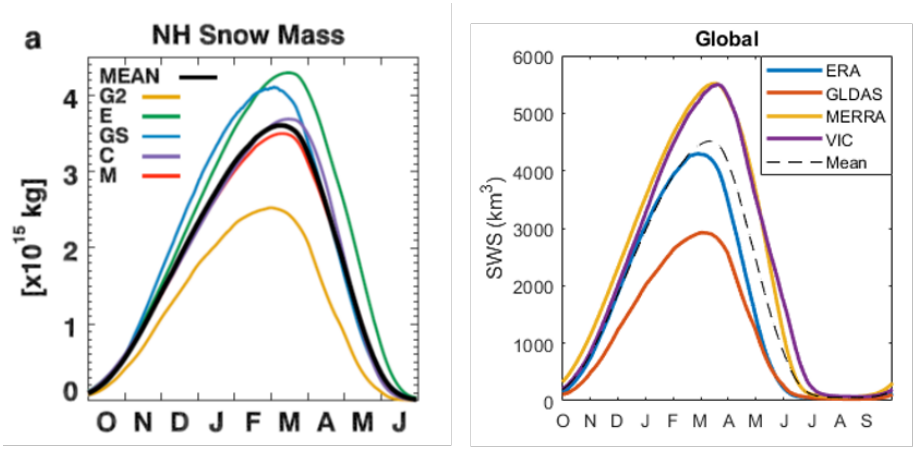

Figure 1. (a) Northern Hemisphere snow mass, in kg, from Mudryk et al. (2015). (b) Global snow water storage, in km3, from four global data products.

Fig. 1.