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Interactive comment on "Snow mass decrease in the Northern Hemisphere (1979/80–2010/11)" *by* Z. Li et al.

Anonymous Referee #3

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This study employs multiple satellite-derived snow water equivalent products to evaluate snow mass across Northern Hemisphere lands since the advent of passive microwave remote sensing over 30 years ago. The authors determined that the NOAA products (called NSIDC) were most accurate at SWE values below 30mm, while the GlobSnow product was best above 30mm. Employing these products led to the conclusion that there has been an overall loss of SWE during this portion of the satellite era. They attribute this loss to increasing surface air temperatures.

The use of multiple datasets in the analysis is an interesting and commendable approach. However the ground station data validation discussed in 2.2 is not tremendously convincing for any of the satellite SWE products. In essence the estimates are not being compared to "ground truth SWE" as they state. Rather they have generated

SWE based on snow depth measurements and the Sturm snow densities. I realize that there are far too few actual SWE observations available globally, so seemingly their approach may be the best available. However they should state this as such.

Given the innovative nature of the approach and the "first shot" at a hemispheric trend evaluation, I believe this manuscript is ultimately publishable. However it is not yet fully ready. Some of my reasoning is based on the writing style, which at times makes it difficult to follow. However there also are some fundamental items that need further attention prior to publication. They are listed below.

1. Intro: there are more recent publications than 2006 that speak to shrinking NH snow cover extents. They particularly address spring SCE losses (Brown and Robinson; Brown and Derksen) 2. Methods: in the first sentence mention that the radiometers are flown on polar orbiting satellites. 3. Methods: explain "the inversion algorithm" 4. Methods: overall, the authors don't set up the methodology well. More explanation and discussion is needed. 5. Methods: I suppose that the issue passive mw snow sensing has with thin covers isn't much of a problem when looking at large-scale SWE observations. However that associated with wet snow must certainly be a problem near the periphery of the pack in all seasons and pack-wide in spring. This should be addressed. 6. Results: the description of where snow lies in December and March is incorrect. For instance, in both months the average snowline in North America is close to the US/Canadian border, not nearly as far north as they mention in December or equivalent with the average in January and February as they state for March. 7. Results (line 16): are the drops statistically significant? If so, this must be state as such. 8. Results: a better comparison with SCE would be welcome. Overall (not just looking regionally) is the greatest impact on reduced SWE a loss in extent or a loss in SWE where the snow resides? 9. Discussions: with precipitation increasing and SWE decreasing might there be rain falling on the snowpack or perhaps the use of the Sturm densities can't be fully used (given density changes over time with warming)? This should be discussed further. 10. Discussions: I'm not sure how the discussion in

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the last two paragraphs fits within this section. Perhaps it should be in the Introduction (of course without starting off by mentioning the decrease found in this study. 11. Conclusions: the authors are quick to attribute the SWE loss to increasing temperatures (also mentioned at the end of the abstract. They should consider that the warming might in part be due to the loss of snow cover. At best they shouldn't be so certain in their assertion without looking into this further.

Interactive comment on The Cryosphere Discuss., 8, 5623, 2014.