Referee Report for Koenig *et al.*

Upon review of the authors' response to both reviews, it appears that they have been able to adequately respond to many of the concerns posed, leading to improved clarity of the manuscript. Therefore, I thank the authors for their careful evaluation of the reviewer comments. Specifically, the authors were able to clarify their methods to improve the reader's ability to understand all steps taken. At the same time, there were a few salient points brought up in the initial reviews that were not addressed in the author response, which I summarize below. **The authors should explicitly respond to the bolded comments.**

1. Error Analysis. The authors provided their error analysis in their response based on errors only in density and age, ignoring the range bin (or two-way travel time, *twtt*) error from layer picking. The authors state (Page 7, Line 7-8) that "layer picking" is a primary source of error in radar-derived depths, and further explain that they estimate this uncertainty as ±3 range bins (Page 7, Line 14). As shown in Eq. 3, *twtt* (which is calculated based on the range bin picked) directly impacts the accumulation rate calculation, yet it is not included in the error analysis. As shown in my initial review, this uncertainty is negligible for thicker layers (higher accumulation rates), but it becomes increasingly significant for thinner layers, becoming the dominant uncertainty below ~0.25 m w.e., which is conceptually and mathematically logical.

   Additionally, the authors state a few times that the largest uncertainty in the accumulation rate measurements is the uncertainty in density from the top 1 m, but according to their analysis in the author response [i.e., sqrt((12*0.6)^2 + 8^2) = sqrt(7.2^2 + 8^2)], the uncertainty from density and age are approximately equal, which is also in agreement with the plot presented in my initial review (red and blue lines in Fig. C2).

   These are valid issues that must be addressed prior to being published. **Specifically, the range bin uncertainty must be incorporated, and all references to a maximum error of 12% need to be changed, and the authors must carefully evaluate the relative importance of each uncertainty component (density, age, and picking), the latter of which varies depending on the accumulation rate.**

2. Age of the first layer. The authors provided additional description on selection of a 1 July date for each horizon, which helped give insight into their rationale. Somewhat related to the prior concern, however, I find the age of the first layer is not adequately accounted for the in the error. The IceBridge flights can range in collection during a given year by up to 2 months, yet a date of 30 April was selected to represent a common date. In 2010, the year of the biggest discrepancies with MAR, IceBridge data were collected over the Greenland Ice Sheet beginning on 24 March and ending on 26 May, a full 2 months. In 2011 and 2012, collection occurred over the ice sheet over 1.5 months, and in 2009, over a month. Assuming 30 April adds another source of uncertainty (which was not accounted for), but it does so unnecessarily since you already know the collection date for each survey and can measure accumulation rates according

to that date for comparison to MAR. **Either measure accumulation rates relative to each survey collection date, or please include the error in collection date in your age uncertainty.**

3. Most of the uncertainties in these accumulation calculations are autocorrelated in space (i.e., do not cancel out when averaged over large distances). The bias from using the wrong collection date varies by flight, which can either span the entire ice sheet or are clustered in a small region. The date of the end of melt (or melt maximum) varies largely by location, so that will introduce a spatial bias as well. Finally, density is dependent on the initial density of the snow as well as temperature and accumulation rate, so use of a constant density will also bias results. These biases are all largely uncertain, especially for the top layer, to the point where the usefulness of an evaluation of a regional climate model is largely tenuous. I realize the authors are in disagreement with that statement and will not ask for them to remove the evaluation; however, the language within is still quite strong: use of "over" and "underestimate" inherently assume that the measurements are correct and the model is wrong. **A paragraph in the discussion, perhaps building off of the final paragraph in the discussion, should explicitly define all the uncertainties and how they might impact the comparison with MAR (as I began to do in this response), so readers are made aware of the fact that the comparison is not "apples to apples" and is not entirely fair to the model. Furthermore, there was no discussion of whether the measurements and model fell within measurement error, as noted in the initial review. Ensure that the model evaluation is not based on comparisons where the model falls within the measurement error, and state that this is the case within the text.**

Finally, the authors should take ample time to read through the text in the entirety as several typographical and grammatical errors exist throughout the manuscript. Some of the more obvious mistakes are listed below.

Page 5, Line 22. This equation does not appear correct. There is no closed bracket.

Page 5, Line 25. This equation does not appear correct. The densification rate is displayed as dt/dz when it should actually be dz/dt. Furthermore, if z is depth, then this equation is thickness change (which is related to the densification rate), should this be dp/dt? Otherwise, it is not a densification rate, perhaps a compaction rate. Also, Brun et al. should be 1992, not 1989.

Page 6, Line 22. Remove "significantly". There is overlap of their standard deviations.

Page 7. Lines 15-27. Read this section carefully. Line 18, beginning with "Hence,.. " is a sentence fragment. Line 18, change "cumulated" to "average", Line 24. Speed of light units are wrong: "m s^{-3}".

Page 13, Line 2. "30 June – 1 July" should be "1 July – 30 June", I believe.