

## ***Interactive comment on “A 60 000 year Greenland stratigraphic ice core chronology” by K. K. Andersen et al.***

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The authors of this paper are to be congratulated on the tremendous effort that has gone into counting annual layers through to 60 ka. However, I am concerned that some aspects of the counting procedure and accuracy are being propagated through a series of papers, and appear to be assuming more certainty than they warrant in the process. Ice cores with layer counting form a very valuable resource for chronologists, but we should not claim a precision that we cannot justify.

The first issue is whether the presented uncertainties are really a 1-sigma error, as the text suggests. This designation was justified in the previous paper (Andersen et al., 2006) by some of the same authors using an argument about the distribution of the years that the authors considered uncertain. However, it is meaningless if the definition

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of what constitutes an uncertain year is subjective. The authors state that by definition a year is considered uncertain when the probability that it is really a year is between 25 and 75%. However, without providing the counting team with a training dataset in which the true years were known precisely, it is impossible to assess whether they are really using such a definition.

The problem is that the authors are stretching their ability to count into layers where the years are very poorly defined in all parameters. Sodium, conductivity and ECM appear to be too smoothed to give much useful information, especially in cold periods. It is acknowledged that ECM and visual stratigraphy (VS) can give more than one peak per year (Andersen et al., 2006). The difficulty is very clearly illustrated in Figs 1 and 2 of the present paper. If we look at the records and the layer marks in Figure 2, there are large sections in which it is clear that only the VS provided any real information to the layer counters. The authors identify 39 certain layers and 3 uncertain layers (which would therefore be represented as  $40.5 \pm 1.5$  years, and reported as a 1-sigma uncertainty of 0.75 years). But even if we accept that it is safe to assign years based on VS alone, it is hard to understand on what basis the uncertain layer at 2346.75 m is uncertain but the ones at 2346.63 m and at 2346.41 m are certain (>75% probability). Nor is it easy to see why VS peaks at 2346.48 m and at 2346.70 are ignored (implying <25% probability that they represent a year).

My point is not to argue about specific layers but to show that another set of layer counters using perfectly reasonable and defensible criteria would come up with a different number of layers, and with a much larger number of uncertain layers (i.e. a larger uncertainty).

The authors can reasonably point to the fact that their chronology is in good agreement with radiometric dates obtained in other media. This would indeed suggest an alternative way of defining the uncertainty, using a well-matched marker to pull the uncertainties back into line (in the same way as the uncertainty envelope in many radiocarbon dated records widens between  $^{14}\text{C}$  dates, and narrows at the location of

the dates). However, that would be a different procedure to that adopted here; I would suggest that the true uncertainties in this paper using the methods shown are much larger than stated, and this should be acknowledged.

Andersen, K. K., Svensson, A., Johnsen, S., Rasmussen, S. O., Bigler, M., Rothlisberger, R., Ruth, U., Siggaard-Andersen, M. L., Steffensen, J. P., Dahl-Jensen, D., Vinther, B. M. and Clausen, H. B.: The Greenland Ice Core Chronology 2005, 15-42 kyr. Part I: Constructing the time scale, *Quat. Sci. Rev.*, 25, 3246-3257, 2006.

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3, S705–S707, 2007

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