"A refined TALDICE-1a age scale from 55 to 112 ka before present for the Talos Dome ice core based on high-resolution methane measurements"
by S. Schüpbach et al. (cp-2011-46)

Response to Referee #2

In general, the paper reads fairly well and seems to be an improvement for the age model over the period covered.

As the core was drilled and measured by CFA between 2004 and 2009, it is unclear why the CFA CH_4 analyses were not included in the original age model for Talos Dome. Obviously the CFA data were available before the discrete CH_4 data were so why not use the CFA-CH_4 data in the original timescale development? This will cause confusion in future literature when referring to the "correct" age model for this interval.

It was our intention to provide the high-resolution CH_4 data to achieve the best possible time scale at that time. We have offered to the authors of the original timescale to implement our data to their work. However, these authors have elected to base their work on discrete CH_4 measurements. Therefore, we decided to refine this original age scale very soon, since the refinements shown here are considerable and contribute to better synchronization possibilities of TALDICE with other records. It was not our intention to cause confusion by publishing a refined age scale so soon after TALDICE-1 but to contribute to a better understanding when it comes to discussions of climate mechanisms at work at sub-millennial time scales.

One concern I had with the new technique is the question of solubility. From the Schupbach et al. 2009 paper, there is discussion of the influence as being the same as that for the ice core samples. I disagree strongly with this assumption. As I understand it, the standard air and degassed water are mixed and then treated as if it was a sample. Given the differing Henry's law solubility coefficients for CH_4 as compared with O_2 and N_2, the amount of time the bubbles spend in contact with the melt water is critical. So, the better way to determine solubility issues associated with gas/bubble interaction during transit would be to introduce the air/degassed water mixture at the melthead. The next step in this discussion is to determine whether the ice core bubble/water stream is in equilibrium at the melt head.

The reviewer is right in pointing out that the duration of the contact of air and water in our calibration system is critical. We tried to adjust this time during a standard run to the time during a sample run by adjusting the tubing length of our calibration system and by directing the artificial calibration flow the same way as the sample from the debubbler on, i.e. exactly by simulating an injection of the standard gas / degassed water mixture at the melter head as proposed by the reviewer and as described in Schüpbach et al. 2009 (page 5373, second paragraph of the right column). The goal of this procedure was to account for the different solubility coefficients for CH_4 as compared with O_2 and N_2. However, there is still an offset of the absolute values of the CFA-CH_4 record compared to discrete samples (as described in Schüpbach et al. 2009, and in this manuscript, discussion paper p. 1179 lines 2-14). As we stated in this section we are aware of this difficulty but, nevertheless, this dataset is still very well suited for dating/synchronization purposes.

Finally, there is an error in Table 1. When plotting EDC depth vs EDC3 gas age and comparing with similar values from the Buiron paper, the age assigned for 1105.55m is not the same in both publications. From my plot it seems that the error is in table 1 value (not Buiron). I have not investigated this further but a spreadsheet error like this may have propagated to other parameters. Please double check all the calculations and tabulated data.

Thanks for the careful inspection of table 1 by this reviewer. The error in the age assignment for 1105.55 and 1141.27 has been corrected. When examining table 1 carefully it has been discovered that not the latest version of the age uncertainties had been inserted in this table. Some uncertainties had been underestimated while others had been overestimated. These numbers are now updated.