Anonymous Referee #3 (response)
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General comments:

The authors present work that applies numerical modelling of ice temperatures in combination with an assessment of uncertainty in knowledge of geothermal heat flux datasets in order to identify potential locations of ancient ice in Antarctica. The work is scientifically well conceived and executed, and first applies a simplified model to assess thermal conditions in the ice divide regions, before applying a 3-dimensional thermomechanical model to enable assessments in regions where horizontal advection is more significant. Input geothermal heatflux datasets are corrected using available temperature profiles from ice core drill sites, surface temperatures and accumulation rates to result in modelled temperature profiles are as close to observed as possible.

A correction for the location of known subglacial lakes (and this basal melting conditions) is applied. The numerical models are then used to conduct sensitivity tests using the suite of data and corrections. The 3D model generates similar results to the simple model, providing a useful methodological comparison. Suitable potential areas for drilling to million year old ice are located in limited portions of the ice divide areas. The paper is clear in its presentation of this work, but in places could be improved by using slightly more precise language. Only minor changes need be made, and overall this work is thoroughly worthy of being published.

Specific comments:

The abstract doesn't actually say why you want to find 1 million year old ice (i.e. to investigate key climate transition).
We added a final sentence in the abstract: "The combination of both modeling approaches show that the most likely oldest-ice sites are situated near the divide areas (close to existing deep drilling sites, but in areas of smaller ice thickness) and across the Gamburtsev Subglacial Mountains."

In respect of the feedback mechanisms that drive the MPT, you neglect to mention any role for the ocean (e.g. McClymont et al., 2013, Earth Science Reviews). Furthermore, you don't quite finish off the introduction by bringing it full-circle to say that by extending an ice core record into the time of the MPT it will therefore enable the changes across this important boundary to be examined, helping the controls upon the MPT to be identified. I think you could make this more explicit before moving into your discussion (line 23) on the possibilities of finding such a long record by locating areas with no basal melting.
The purpose of our paper was not to give a comprehensive overview of why drilling for the oldest ice is important; the introduction on the MPT is kept briefly on purpose. A more comprehensive overview is given in Jouzel & Masson-Delmotte 2010, to which is referred at several instances. Nevertheless, to make the 'full-circle' we added a final sentence: "A deep ice core covering a time-span of more than one million years would shed a light on the mechanisms involved.".

There are a number of locations mentioned in the text. For clarity, I think a location map should be provided that is independent from your result maps. This could show the ice core locations, as well as locations that are discussed, including some of the lakes.

We made a new figure showing the locations of major sites that are cited throughout the text.

You correct for the locations of subglacial lakes, but do not do so for locations where subglacial melting and water-flow has been identified (e.g. Bell et al, 2011, Science; Wolovick et al., 2013, Journal of Geophysical Research: Earth Surface). Perhaps useful to check your results against locations where Wolovick et al identify water routing. **Subglacial lakes are large water bodies that have an impact on the local thermal conditions. When water in large quantity is present, the bed should be temperate. However, routing of water can occur over much smaller spatial scales, smaller than the nominal grid size of our model. This is the main reason why we refrained from adding such information. However, by carrying out sensitivity experiments with different sizes of influence zones around subglacial lakes, we did capture regions in which subglacial melting as well as subglacial water routing has been identified.**

The discussion and conclusions section is largely discussion. I would like to see the key results identified at the end of this section – e.g. re-iterate where the potential sites are, show you have improved geothermal heat flux boundary conditions, indicate that your models produce results that correspond well. Overall, make it easier to find the findings. Perhaps separate into 2 sections – discussion vs. conclusions.
We kept the section on Discussion and Conclusions as a whole. However, we added a paragraph at the end of the paper that briefly summarizes our main results. We wrote: "In summary, this paper gives an overview of the factors that influence the basal thermal conditions of the Antarctic Ice Sheet, which are useful to guide the search for potential deep drilling sites for IPICS oldest ice (more than one million year old) records. The two complementary thermal models that were employed virtually lead to similar results: most suitable sites are situated in the vicinity of the ice divides and close to areas where deep drillings have been carried out in the past. Another suitable area is in the vicinity of the Gamburtsev Subglacial Mountains. Ice thickness is found to be a major limiting factor, since too thick ice may lead to temperate basal conditions. This is the main reason why most of the current deep drillings have been found at or close to pressure melting point at the base."

Technical corrections:

P2860,L12 – basal conditions – do you mean 'basal thermal conditions'? Be specific.
We added "thermal"

P2861,L16 – change 'going back for more than 800000 yr' to 'which extends over 800 ka into the past'.
done

P2862,L1 – with sufficient – should be 'at sufficiently'
done

P2862,L3 – 'several' – say how many. Thermodynamic models – models of what? Ice flow?
We change this in : "In this paper we use two thermodynamic ice-sheet models to infer …"

P2862,L16 – 'bedrock should be at pressure melting point' – you mean 'basal ice should be at pressure melting point'. Also – add 'therefore destroying bottom layers' to the end of the sentence.
We changed the sentence as suggested

P2864,L4 – provide a citation for the low accumulation.
Done

P2864,L6 to L7 – rephrase/write out fully to remove the parentheses. Might need to break into 2 sentences.
We rewrote the sentence by: "Despite the simplicity of the model, it can be applied to central parts of the Antarctic Ice Sheet, where horizontal advection is absent or negligible, to explore suitable drill sites"

P2864,L9 – 'Uncertainties in Antarctic GHF and the oldest ice' –uncertainty in what specifically in relation to the oldest ice? Location of oldest ice? Also, doing what about uncertainties? Estimating Uncertaintes?
We added the word 'location' for clarity.

P2864,L12 – 'hence the vicinity of ice divides' – remove this as its repeated later in the paragraph anyway.
We kept the sentence but changed by "i.e. the vicinity of ice divides."

P2866,L16 to L19 – flip this around to describe the large difference first, and then indicate the that the rectangular area points to most suitable conditions.
This sentence has been altered in view of remarks of other referees.

P2866,L23 – Remove the sentence on colour scale and make sure it is in the figure caption instead. Its not required in the main text.
done

P2866,L24 – 'is obviously corresponding to' – change to 'corresponds to'.
done

P2867,L3 – 'accidented' – describe what you mean.
We changed by the word "uneven"

P2867,L8 – 'more acceptable' – replace with 'likely'.
done

P2867,L11 – remove the '-' dashes and insert commas.
done

P2867,L12 – 'In the next section we' – replace with 'We therefore extend the model that doesn't include horizontal flow and'. This will provide a better lead in.
done

P2868,L15 – do you mean 'observed ice surface velocities'?
We changed this in 'satellite-derived velocities'.

P2862,L19 – provide a reference for the error associated with slow flow.
Done

P2869,L14 to L19 – split into shorter sentences.
done

P2870,L8 – provide citations on the discrepancies.
Done

P2870,L11 – 'as close as possible the' change to 'as closely as possible with the'
done

P2870,L20 – 'sufficient' should be 'sufficiently'.
done

P2871,L8 – 'brought their number on 145' change to 'contained 145 lakes'.
Rewrote as suggested

P2871,L13 – 'corroborating' change to 'corresponding to' and remove the parentheses.
done

P2871,L14 – 'corroborating' change to 'which are the result of'.
We rewrote the sentence: "… such that at least 379 subglacial lakes of varying size are now known to exist (Wright and Siegert, 2012). Subglacial lakes are usually identified from radio-echo sounding (RES) in which they are characterized by a strong basal reflector and a constant echo strength corresponding to a smooth surface or have been identified through surface elevation changes using satellite altimetry, theorized to be the surface expression of rapid drainage or filling of subglacial lake-sites …"

P2871,L19 – 'spot' change to 'location'.
done

P2872,L24 to 25 – change to 'cold-based sites are not precisely situated at those locations, but lie nearby in locations where ice is thin enough to reduce basal ice temperatures.
We rewrote the sentence: "Since all three sites are at or close to pressure melting point at the base, suitable cold-based sites do not coincide exactly with the ice core locations, but lie nearby in locations where ice is thin enough to reduce basal ice temperatures."

P2772,L28 – 'larger spread of' change to 'wider'.
See previous comment

P2873,L5 to L6 – explain why you combine the dataset.
We added "in order to investigate common grounds"

P2873,L10 to L11 – change latter part of sentence to 'we apply a set of constraints to select the suitable sites for preservation of million year old ice'.
Done

P2873, L11 to L16 – explain your choices as at present they seem somewhat arbitrary.

The arbitrary choice has been explained in a previous section, according to the request of another Referee.

P2874,L8 – remove 'due to'
done

P2874,L14 – 'for a longer timespan' be specific about the timespan – how many kyrs? Also – are these supposed to represent mean conditions over glacial-interglacial cycles? If so, say so.
We wrote: "… time-span covering a glacial-interglacial cycle

P2874,L20 – 'one needs to keep in mind' change to 'we note'.
done

P2874,L23 – 'Nevertheless' doesn't work here. Can you simply say 'We suggest that the results presented here should not be used as a sole guide...
done

P2874,L26 – 'bedrock variability' – do you mean bedrock relief or bed roughness? Also, change 'well be suitable from a thermal point of view, the topographic variability' to 'be thermally conducive to the preservation of ancient ice, but the topographic variability...'
We changed as suggested and added "relief"

P2875,L4 to L6 – can you modify the language here to be more clear? Break it into 2 sentences and say ice that travels over hundreds of km before reaching the core sire introduces somplecity in the thermal history. Furthermore, ice divides shift over glacial-interglacial timescales (provide a reference – e.g. Pollard and DeConto 2009) and therefore also influence the direction of ice flow over time. In the regions identified in this analysis small shifts in ice divide could result in significant change, or even reversal, of ice flow direction.
We cut the sentence in two and added a reference to Huybrechts, P., O. Rybak, F. Pattyn, U. Ruth, and D. Steinhage (2007) Ice thinning, upstream advection, and non-climatic biases for the upper 89% of the EDML ice core from a nested model of the Antarctic ice sheet. Climate of the Past 3(4): 577-590.

P2875,L11 – 'overseen' change to 'not identified'.
We changed "overseen" by "overlooked"

Figures: In the map-based figures – should the eastings and northings be put into a polar projection (lat,long) rather than a rectangular grid. This would be a more standard approach.
We added an overview figure with the main sites. This figure has lat/lon marks, so that a comparison is easier. Adding Lat/lon marks to each of the figures would make them less easy to interpret in view of the grid lines potentially covering the sites of oldest ice.

Figure 5 figure caption – highlight that the cold areas are small, and tend to correspond to a higher RMSE.

Done