This study reports an ice-core dating method, based on a non-linear pairing transformation of H_2O_2 concentration data and a time series of estimated temperature, for the chronology of 113m deep borehole from Detroit Plateau at the Antarctic Peninsula. The thinning of annual firn layers is considered in this method. According to the chronology, combining with snow density, snow accumulation rate is determined during 1980-2010.

Ice core dating is a primary prerequisite for recovering climatic and environmental information using ice core records. The dating method presented here is new and important. The manuscript is well organized and well written. The figures are interesting. In my opinion, the manuscript should be accepted after addressing the following comments.

Main comments

1. **Despite the importance of the presented dating method, I think it is difficult to be widely used for other ice core dating over Antarctica, because the long-term temperature observations are too sparse. Therefore, its potential applications should be carefully clarified to add the value of this study.**

   Answer:

   We do agree temperature observations may not be widely available over Antarctica, but the algorithm can be used to synchronize distinct datasets, so be used in other contexts, like synchronizing distinct boreholes. Your comment is addressed on the Conclusions in a new last paragraph:

   Our goal was to demonstrate the effectiveness of our method on a dataset we have collected on PD. We believe the method may prove to be useful in other data where manual counting is more challenging than the present case. Moreover we draw the attention of the reader to the fact the algorithm showed to be effective in synchronizing distinct datasets, so it can be used in other contexts, like synchronizing distinct boreholes.

2. **The authors make so many efforts on the chronology, and seem to only obtain the important accumulation rate results, which are easily determined by layer counting. This greatly reduce the scientific value of the present manuscript. So it is necessary to clarify the priority of your method relative to layer counting after a comparison.**

   Answer:

   We do agree that simple layer counting is a great deal easier and that it would give somewhat similar results to our dataset, albeit not being possible to assure one is better than another. We did layer counting on the smoothed series as an internal check for our results.

   Purely mathematical procedures for annual layer counting are laborious compared to manual counting, nevertheless the latter has no other intrinsic

quality but easiness; quality or effectiveness cannot be technically guaranteed. Mathematical approaches are indisputably rigorous, disposition--free and, in our case, able to estimate efficiently the annual layering on the entire data section at once. It directly produces inter--annual layering and the annual accumulation rate. Notwithstanding being used in a particular dataset it the algorithm is not case—specific and so it can be used with other datasets and sites. It is not even bound to the dyad peroxide--temperature; it can deal with other kinds of annually laminated data, like from distinct wells. Moreover the algorithm may prove to be useful in other data where manual counting is more challenging than the present case.

Here is important to note that simple layer counting would give somewhat similar results to the ones presented here, but it is important to note the considerable noise content renders peak identification a considerable challenge, prone to disposition. Manual layer counting on the smoothed versions of the data series gives inter--annual accumulation figures that differ from the ones presented here up to 40%, being 17% on average.

Our goal was to demonstrate the effectiveness of our method on a dataset we have collected on PD. We believe the method may prove to be useful in other data where manual counting is more challenging than the present case. Moreover we draw the attention of the reader to the fact the algorithm showed to be effective in synchronizing distinct datasets, so it can be used in other contexts, like synchronizing distinct boreholes.

We have added the above to the end of the Conclusions.

3. **To further add the scientific values, interpretation of cause of the resulting snow accumulation rate changes since 1980 is required. I also would like to see further comparison of this time series with other previously published ice core snow accumulation over the Antarctic Peninsula.**

Answer:

We have added the following paragraph on that in the Conclusions section:

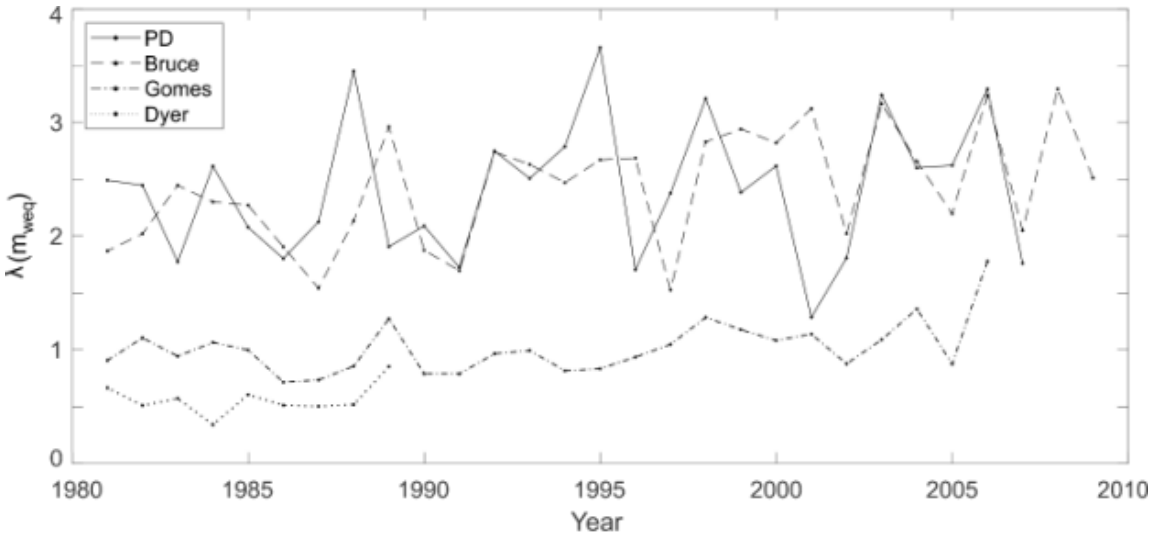
"Our results contribute to confirm the Antarctic Peninsula region of high snow accumulation, allowing a rapid sequestration of the seasonal deposition of chemical species, at least the H_2O_2. Conversely the high annual accumulation limits the temporal range of ice cores in this region, confining records to the second half of the twentieth century. The ice core accumulation figure may represent mass gain to the local ice sheet, an important component of the total Antarctic mass balance."

We have included a comparison of the interannual accumulation variability in our data with three other sites, Gomez, Dyer plateau and Bruce plateau. This discussion comes at the end of Section 3.2, just before the Conclusions. Your suggestion was greatly appreciated. It follows the material added to the manuscript.

"It is worthwhile to end this section comparing our estimated annual accumulation variability with data from the three ice cores listed in Table 1, all South of PD in the Antarctic Peninsula. Figure 6 shows that the accumulation rates at PD and Bruce Plateau are compatible throughout, an indication that both sites may have been subject to similar high accumulation regimes, twice as large as Gomez's. The Figure also suggests annual snow accumulation for the period 1980–2010 a stable accumulation for all four ice cores. Nevertheless the time period spanned by our data is too short to probe multi–decadal trends, it is reported that the Antarctic Peninsula has been experiencing an increased rate since 1900 (Thomas et al., 2017). In particular the Bruce plateau ice core suggests an increase in snow accumulation during the late twentieth century, increasing at a rate of 0.19 mm w.e./y since the 1950's (Goodwin et al., 2016)"

Table 1. Location of third party ice cores sites on the Antarctic Peninsula with their distances to PD ice core. z_{max} is the maximum depth and the time span ΔT, in years, is shown between square brackets.

Name	Latitude	Longitude	Elevation(m)	$z_{max}(m)[\Delta T]$	Distance(km)	Reference
Bruce plateau	-66.0	-64.1	1976	448[1750–2009]	302	(Goodwin et al., 2016)
Dyer plateau	-70.7	-64.9	2002	190[1504–1990]	767	(Thompson et al., 1994)
Gomez	-73.6	-70.4	1400	136[1858–2006]	1137	(Thomas et al., 2008)



NB: Both the Table and the Figure above are screen snips; they do not reproduce the manuscript's quality.

4. **This manuscript gives results, but not discuss them.**

Answer:

Agreed, it was a bit too descriptive. We have enlarged the Conclusions accordingly to include a discussion on our results.

Minor comments

Line 1 Change "peroxide, H_2O_2," to "peroxide (H_2O_2)"

Ans: *Done*

Line 11 "e.g. Masson-Delmotte et al. (2006)." should be "(e.g., Masson-Delmotte et al., 2006)"

Ans: *Done*

Line 29 Change "Plateau Detroit" to "Detroit Plateau", and check throughout the text.

Ans: *Done*

Line 93-97 Please give some discussion on the uncertainty of the interpolation.

Ans: *We have expanded the paragraph to two, to accommodate a discussion on the interpolation process. We cannot fathom the uncertainty on the temperature estimates but it is accepted that Delaunay triangulation minimizes interpolation errors (Chen, Long, and Jin-chao Xu. "Optimal delaunay triangulations." Journal of Computational Mathematics (2004): 299-308). Moreover the accuracy of a particular temperature estimate is not crucial to our results as we use only the location in time of a given summertime peak temperatures for synchronization, not the temperature values.*

Line 215-218, The determined snow accumulation time series is only 28 year, and 11-year moving average is statistical significance? Please explain this.

Ans: *You are right on this. The statistical significance of the 11-year moving average (period of a solar cycle) is rather limited. We have used that for the sake of comparison with other author's results, as it is frequently used. We have also changed to entire paragraph to address your comment.*

Figure 4, suggest to use full lines and dotted line to discriminate H_2O_2 and temperature more clearly.

Ans: *We've done that. It did improve the Figure. Thanks.*

Figure 5, the horizontal ordinate is vague.

Ans: *We have simplified the Figure 5, leaving only the interannual accumulation and the 11-year moving average at PD. We believe now the function of the horizontal axis became clearer. We have included the accumulation in other sites in a new Figure 6, as for your major comment 3.*