**MAJOR COMMENTS**

**l. 34: "surficial atmospheric temperature alone as a proxy for the solar irradiation" Why would the temperature be a good proxy for insolation? It is well known that the seasonal cycle in temperature lags that of insolation, especially in regions where horizontal advection is important and when open seas are nearby. Moreover, sea ice cover may influence the seasonality, depending on wind direction and time of year. Please provide more evidence that the used temperature record lines up well with (top-of-atmosphere) insolation, and how discarding the Bellingshausen record makes a difference. Another useful addition might be to select subsets of the four stations to study the dependency of the final result on station selection, and compare what happens if e.g. simple time series of top of atmosphere insolation is selected as a counter of the passing of the years.**

***Answer:***

*The selected text above is an unfortunate flaw in the manuscript. Please accept our apologies for it. We did not use "of the surficial atmospheric temperature alone as a proxy for the solar irradiation" at all in the paper. What we have done was to synchronize the peaks of the peroxide record to the summertime peaks in the temperature record, the latter acting as a time reference. Sure they do not necessarily occur at the same time on a given year, as the local surface temperature does not correlate perfectly with local insolation at a given instant. Nevertheless, the difference between the summertime peaks of the peroxide and the temperature is of the order of or less than 0.5 years. Our work deals with annual estimates therefore that discrepancy is less than the temporal resolution of our data.*

*We have made the following amendments in order to correct the manuscript.*

**Further to the above: what potential role does precipitation seasonality play in influencing the signal? And how sensitive are your results to the filtering applied to both time series?**

***Answer:***

*On this issue, we draw your attention to Figs. 2 and 3. Please note that the filter is very robust face the considerable noise content on both series, any eventual displacement either in depth, Fig. 2, or in time, Fig. 3, will remain within a fraction of a year thus less than the temporal resolution of our data. That considered we found your query should be properly addressed in the text, so we have enlarged the first paragraph of the Conclusions to:*

*"The $H_2O_2$ concentration record, C (z) has a considerable noise content throughout, which has to be minimized making its seasonal signal conspicuous. We produce a smooth data series* ***C (z)*** *by robust fitting on C (z) through a loess nonparametric method (Cleveland and Grosse, 1991). That filter is robust enough face of noise to render any eventual displacement in depth of a given concentration peak correspond to a fraction of a year, less than the temporal resolution of our data.*

*We have produced a time scale, an ice-core chronology z(t) for the 133m deep borehole DP-07-1 drilled in Detroit Plateau, Antarctic Peninsula, as a direct result of the process of warping a high resolution $H_2O_2$ concentration data series onto an estimated local temperature time series. The physical reliability of the procedure is rooted both on the* *robustness of $H_2O_2$ as a seasonal marker and on the local high accumulation rate, which brought the borehole depth span to within the operational life span of the Antarctic stations. The adopted numerical procedure, a non-linear warping of the concentration data onto the estimated temperature record, was performed aligning their respective summertime peaks, thus requiring a conspicuous seasonal signal throughout. Both series have a considerable noise content rendering peak identification a considerable challenge prone to disposition. We alleviated noise through a loess nonparametric filter, which produced clean smoothed versions of the data series albeit still retaining their complexity, as seen in Figures 2 and 3. Any eventual displacement in depth or time of a given concentration peak correspond to a fraction of a year, which is less than the temporal resolution of our data.*

*The application of the non-linear warping algorithm on the smoothed data series allowed for the correction of the thinning with depth of the firn annual layers due to the vertical strain, yielding an estimate of their thicknesses at the time of snow deposition, not considering the snow which was eventually displaced by the wind. The whole process is all based on numerical optimization, yielding the best match between the two series and a secular variation in local precipitation, characterized by the relatively large interannual accumulation rate variability easily seen in Figure 5"*

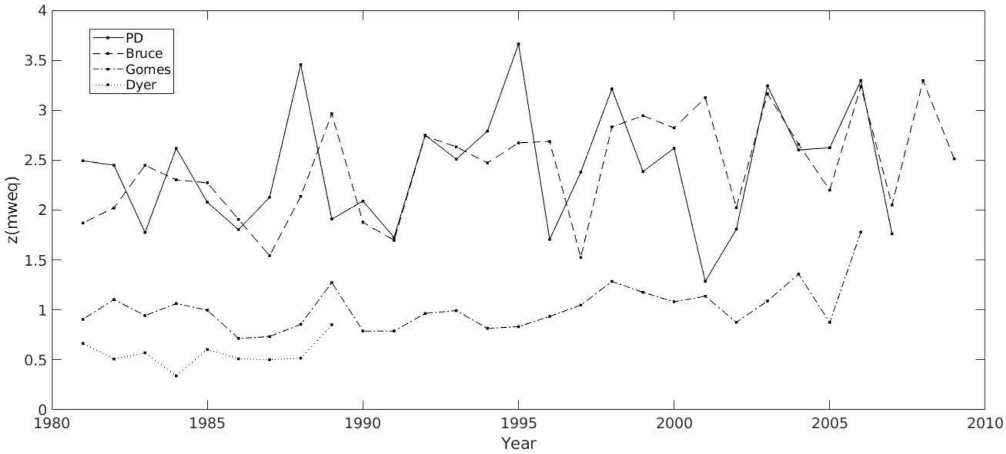
**An important outcome of this work is not only the average accumulation rate but also the interannual accumulation variability, which is very large (Fig. 5). To enhance the impact of the paper I would like to see a direct comparison of the annual accumulation time series as obtained from this study and as obtained from simple layer counting, as often done in glaciology.**

***Answer:***

*We do agree that simple layer counting would give similar results to our results. But the algorithm is able to determine the most likely annual layering in an entire data section at once, while being based on purely mathematical objective criteria. Our intention was to demonstrate the effectiveness of our method on a dataset we have collected. The method may prove to be useful in other data where manual counting is more challenging than the present case.*

*We have done the layer counting using the smoothed versions of the series but we don't agree we should present that in our paper. I believe one cannot say that one approach is better than the other, for sure the manual counting is quicker, but you may agree with us that using the algorithm is a safeguard against disposition.*

*But inspired by your observation on the interannual accumulation variability we decided to include a comparison of our data with three other sites: Gomez, Dyer Plateau and Bruce Plateau. You may agree this addition may enhance the impact of the paper. We found it useful, please see below.*




But we do agree your point should be addressed in the text, so we have changed the 2nd paragraph of the Conclusions

***From***

*The adopted numerical procedure, a non--linear warping of the concentration data onto the estimated temperature record, was performed aligning their respective summertime peaks, thus requiring a conspicuous seasonal signal throughout. Both series have a considerable noise content rendering peak identification a considerable challenge prone to disposition. We alleviated noise through a loess nonparametric filter, which produced clean smoothed versions of the data series albeit still retaining their complexity, as seen in Figures 2 and 3. Any eventual displacement in depth or time of a given concentration peak correspond to a fraction of a year, which is less than the temporal resolution of our data.*

***To***

*The adopted numerical procedure, a non-linear warping of the concentration data onto the estimated temperature record, was performed aligning their respective summertime peaks. Both series have a considerable noise content which renders peak identification a considerable challenge. We alleviated that noise through a loess nonparametric filter, which produced clean smoothed versions of the data series albeit still retaining their complexity, as seen in Figures 2 and 3.*

*Note that the summertime temperature and peroxide concentration peaks do not necessarily occur at the same time on a given year, as the local surface temperature does not correlate perfectly with local insolation. Nevertheless the expected difference between the summertime peaks of the two series are of the order of 0.5 year, less than the temporal resolution of our data which is one year.*

*Here it is important to say 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 interannual accumulation figures that may differ from the ones presented here up to 40%, 17% on average. The algorithm is able to determine the most likely annual layering in an entire data section at once, while being based on purely mathematical objective criteria.*

**Minor and textual comments**

*We have done all the suggested modifications. In some we felt we should clarify better or add comments of our own. Those are dealt with below.*

**l. 19: The H2O2 -> Hydrogen peroxide (H2O2)**

*Done*

**l. 19: "surficial and atmospheric" Do you refer to H2O2 or solar radiation? Unclear what you mean here, please reformulate**

***From:***

*"The reported strong seasonality on the production of* $H_2O_2$ *in Antarctica, allow us to concentrate on the yearly cycles of the surficial atmospheric temperature alone as a proxy for the solar irradiation."*

***To:***

*The maxima of* $H_2O_2$ *production and of surficial atmospheric temperature occur during the sunlit months of the austral summer, allowing us to seek a correlation between their respective maxima. Obviously they do not necessarily occur at the same time but they do during summertime, the time difference between them being a fraction of a year.*

**l. 26: Can it be briefly explained why the concentration ratios differ by an order of magnitude between atmosphere and snow? What about the diffusion of the signal in the ice core?**

*A:*

*The accumulation at Detroit Plateau is very high minimizing post--depositional losses from degassing, resulting in an excellent preservation of the record. In particular I could not trace the one order of magnitude difference between atmosphere and snow at a particular site in the literature I used; it seems to be a typo. In face of that we changed text*

***From:***

*"The* $H_2O_2$ *reportedly may reach a summer-to-winter ratio of 5 in high accumulation rate ice cores from atmospheric concentration ratios of ~ 50 (Sigg and Neftel, 1988; Hutterli et al., 2003; Frey et al., 2006). The* $H_2O_2$ *is a particularly robust marker for ice cores at high accumulation sites in Antarctica (Sigg and Neftel, 1988; Frey et al., 2006)."*

***To:***

*"The* $H_2O_2$ *is a particularly robust marker for ice cores at high accumulation sites in Antarctica (Sigg and Neftel, 1988; Frey et al., 2006) where post-depositional losses are minimized resulting in excellent preservation of the records, with summer-to-winter ratios in excess of ~ 50 (Sigg and Neftel, 1988; Hutterli et al., 2003; Frey et al., 2006)."*

**l. 29: Plateau Detroit -> Detroit Plateau (throughout, please)**

*Done*

**l. 34: surficial atmospheric temperature alone as a proxy for the solar irradiation -> near-surface (2 m) atmospheric temperature alone as a proxy for the solar irradiation**

*A: We have changed this part of the text.*

**l. 68: “conductivity measurements on ice cores down to 20m had a modal value of 40.4μS/cm” What is the added value of this information?**
*A: None, withdrawn.*

**l. 75: “along the 98m of ice cores” Earlier, ice core length was 133 m, with intact ice**
***Text changed accordingly,***
*from (1st paragraph of Section 2.1)*
*“concentration data has a high-resolution sampling, averaging to 36 samples/year along the 98m of ice cores.”*
***To***
*“concentration data was retrieved from the first $98\unit{m}$ of ice cores with high-resolution sampling, with an average of 36 samples/year.”*

**l. 84: “the first 100m” See above.**
*A: Corrected to 98m.*

**l. 94: “We have considered 95 only the maximum daily temperature reading at each station” Why? When was the reading taken at the station with one reading per day?**
*A: We don’t know when readings were taken. We just retained one, the maximum daily reading at each station. Obviously if a Station has one reading, we used it.*

**l. 96: “, using a conservative lapse rate for the decreasing of temperature with altitude of −0.55â–¦C/100m” Since you have a good estimate of the annual mean surface temperature at Detroit Plateau (being the 10 m firn temperature, assuming no meltwater refreezing), you can estimate the temperature lapse rate yourself, neglecting the temperature difference between surface and 2 m.**
*A: You are right on this. It is embarrassing we did not simply use that. Our estimated temperature lapse rate is -0.45C/100m. Using this would have implied a rise in the average temperature at 1937m of +1.940C. This difference does not impact our results.*

**l. 155: Begin this line with a small introductory remark, e.g.: “The analysis proceeds as follows: “**
*Done*

**l. 164: Typo “increasing”**
*Done*

**l. 196: Typo “As ice sheet”**
*Done*

**l. 216: Why was an 11-year moving average chosen?**
*A: It was a choice of ours, we have used the period of a solar cycle.*

**l. 222: Although both accumulation estimates are close, they still differ by more than 10%. Is this within the range of expectations?**

*A: We believe so. The two accumulation rate estimates are reasonably compatible considering the assumptions leading to Nye's time scale. This provides a weak check on our numerical procedure.*

**l. 234: Typo "equals"**
*Done*

**l. 238: Add "of" between "Peninsula" and "0.8"**
*Done*