***Response to the review comments of the anonymous referee#1***

*We would like to thank the referees for their constructive reviews. We accounted for each of the comments by either modifying the manuscript or, by arguing and explaining our choice. We give below answers to each comment and chose to write them in italic characters, first after the general comment, then after the specific comments.*

**Review of "Improved information about the vertical location and extent of cloud layers from POLDER3 measurements in the oxygen A band" by Desmons et al.**

**General comments**

This paper presents an extensive global statistical analysis of cloud top height and cloud vertical extent retrievals from POLDER O2 A-band passive remote sensing measurements. The POLDER retrievals are correlated with Cloudsat/CALIPSO active cloud profiling data. Since the data set under study is large, the comparison between oxygen pressure and actual cloud profile has a strong statistical significance, and the dependence of several parameters is being studied. This paper is a very useful followup of the earlier paper by Ferlay et al. (JAMC, 2010) in which the method of determining cloud vertical extent using the multi-view observations of oxygen absorption pressure by POLDER was proposed.

The main problem with this paper is its very poor presentation quality, which makes the paper difficult to read. The used English language is poor, and must be improved. The many spelling and syntax errors should be corrected. The text should be more compactly written; in this way the paper can be shortened. Furthermore, there are too many figures; the authors should be more selective in presenting their results. Suggestions are given below. The figure captions should be clearer. Some specific textual comments are given below, but are not extensive. The English style should be improved by the help of the senior co-authors of the paper

*We acknowledge that the first version of the manuscript contained too many errors of english language and style. We corrected them with care.*
*We also globally improve the manuscript to make it more concise and clearer. We did it by rewriting in particular section 2 in order to avoid redundancies, and by removing some figures.*
*Symbols used throughout the manuscript were re-defined and clarified. For exemple the cloud geometrical thickness is denoted by h, while H means the CPR/CALIOP cloud geometrical thickness. We made it clear that PO2 means with no ambiguity the angular average of POLDER directional oxygen pressures.*
*We chose to remove the figures that were not necessary. Thus, we removed two figures (Figure 11b and 15) and replaced one (Figure 10) by another one. We no more show the variability of the slope of the linear regression between sigmaP_O2 and H, but only the spatial variability (with histogram of values) and temporal evolution of the correlation coefficient. We think these changes make the paper easier to read and clearer.*

*However, we chose to keep Figure17 although reviewer#2 suggested to remove it. We not only decided to keep this figure but to add another panel showing the CTP-H diagram for liquid cloud over oceans. This figure shows that while our results are preliminary and can certainly be improved, we already obtain from a passive sensor some climatological feature about cloud covers*

*we think are interesting, with informations about their vertical occurrence, which is new.*

*Concerning the demand of the reviewer to add color scale for 2D plots and scale for some histograms, we chose not to follow the recommandation. We think that it would not add a very valuable information as we don't use quantitatively these plots but qualitatively. We added some texts to better explain the figures.*

**Specific comments**

p. 2533: title: vertical location and extent > cloud top and cloud vertical extent from POLDER3 . . .

p. 2534:
- l. 4: . . .from a better account . . .: unclear, please rephrase
- l. 15: . . .the most numerous ISCCP cases. . .: unclear, please rephrase

*done*

- l. 21-23: For liquid and ice clouds . . .: unclear sentence, please clarify

*We accounted for all these comments and clarified*

p. 2535:
- l. 4: (-12 m): what does that mean?

*We clarified the text. -12 m is the mean difference between the actual cloud vertical extent and the one retrieved from the difference of pressures for liquid water clouds above ocean in 2008.*

- l. 6: error of 20 percent . . .: error in what?

*We modified the text. 20% is the relative error of the estimate of h which corresponds to a confidence of 50% for ice clouds over ocean*

p. 2538:
- l. 15: the POLDER3 sensor. . .; plateform> platform
- l. 17: The PARASOL orbit. . .; for the first time . .
- l. 18: such that. . .? Please rephrase

p. 2540:
- l. 6: noted > denoted by (this occurs several times)
-l. 21: It has been observed several times with . . . > This has been observed with . . .

p. 2541:
- l. 4: . . . hangs on with. . .: what do you mean?
- l. 11: ie > i.e.
- l. 16: more > moreover

p. 2542: a 345 long vector?: rephrase

*We accounted for all these comments, by correcting or rephrasing.*

p. 2544
- l. 3: New POLDER Oxygen pressures: unclear title

*We changed the title of this section to "Definition of new POLDER oxygen pressures"*

- l. 4: analyze > analysis

*done.*

p. 2545:
- l. 13-15: unclear, please rephrase

*We rephrased.*

- l. 25 (Sect. 4.2): Please clarify the principle of getting unbiased cloud top pressure from POLDER. Which new information from POLDER observations is being used that was not used before?
- The first paragraph of Sect. 4.2 is very unclear.

p. 2547:
- l. 3-5: text on scores is unclear.

*We made it clearer.*

p. 2549, l. 2: . . . and H: is H from POLDER or CloudSat/Calipso?

*H comes from CloudSat/CALIPSO. In the revised article, we denote by h the cloud vertical extent in general, and by H the cloud vertical extent given by CALIPSO/CloudSat, so it should be clearer for the reader.*

p. 2551, l. 12: several values of H . .
*done*

- It is appreciated that a synthesis of the results is given here; this is necessary, since the paper is quite long.
- Why is H given in meters and not in pressure units, like cloud top pressure and cloud midpressure?

*The cloud geometrical thickness h is not a usual retrieved parameter. Thus, there is no rule or habit for the choice of h unit. However, we talk about cloud geometrical thickness, not cloud pressure depth. It is thus logical to use meters. Yang et al (2013, JQSRT) made also the choice to use meters.*

p. 2552:
- l. 11: the POLDER retrieved H for clouds . . .

*done.*

- l. 12: is H here from CloudSat/Calipso?

*We clarified, see the previous answer.*

- l. 21: much away from . . . > more deviating from . . .
- l. 25: in front of . . .?: as compared to . . .

p. 2553, l. 17-18: this type of clouds . . ..: unclear, please correct this sentence

p. 2559, l. 4: reference should be to: Koelemeijer, R. B. A., P. Stammes, J. W. Hovenier, and J. F. de Haan (2001), A fast method for retrieval of cloud parameters using oxygen A band measurements from the Global Ozone Monitoring Experiment, J. Geophys. Res., 106(D4), 3475–3490, doi:10.1029/2000JD900657.

p. 2564: caption:
- Statistics of the retrieval of cloud vertical extent H for liquid . . .
- MD, SD and DeltaH should be explained

*We accounted for these comments.*

Fig. 2:
- indicate in the graph the mean P_O2 with a horizontal line
- in fact, P_O2 was defined in Sect. 2.1 as the mean oxygen pressure over all viewing directions, so it is not consistent to say in this caption that P_O2 varies with the viewing direction.
- what does the negative viewing zenith angle mean? Please indicate the azimuth.

*We chose not to add another horizontal line. We think that the fact to give in the figure's caption the value of the angular mean of POLDER pressures is enough. We modified the label and introduced the relative azimuth \Delta \varphi as recommended. We also define more clearly P_O2.*

Fig. 3: which product is shown here? Which satellite instrument? Which algorithm?

*Data are from the CPR and CALIOP. The caption was modified.*

Fig. 4:
- Why is there a gap for clouds with H < 200 – 300 m in the lower plots (b)? Marine Sc clouds can be 100-200 m thick.

*We thank the reviewer for this comment, as we found an small error in the process of the data which leads to the production of the CTP-H diagram for liquid clouds. Histogram of cloud geometrical thickness coming from CloudSat/CALIPSO show a quick decrease of the population below 300m, while a local mode exists centered on 200m for very low level clouds. It is now apparent on the figure.*

- A color bar is missing.

*See the answer after the general comment.*

- Please give the two rows and columns of the plots the appropriate titles: ocean. land, ice, liquid.

- Caption: - Climatology of cloud top pressure versus cloud vertical extent of monolayer

*We corrected the caption.*

- Global data?

*It is indeed global data, we think that it is clear for the reader.*

Fig. 5: Caption: mention that P_O2 is the oxygen pressure averaged over all viewing directions (cf. comment on Fig. 2). Standard deviations are indicated by error bars.

*In the revised version, we took care that P_O2 means with no ambiguity the angular average of POLDER directional oxygen pressures.*

Fig. 6: in figure titles: make red text black. Please explain in caption the black and red line fits.

*Done,*

Fig. 7: Caption: explain what P_O2 – CTP is, and what sigma_O2 is. Global data?

*Done ; yes, they are global data again.*

Fig. 8: please explain the rows and columns of plots with titles. Explain the strange stripes in plots (c-d) in the caption. Caption: what do you mean with historical pressure?

*Done. Stripes come from the very discrete values taken by MODIS CTP. We commented. Historical pressure means the oxygen pressure before (mus-tau) corrections. We stop to use the word "historical".*

Fig. 9: Briefly explain what scores are in the caption. The curve "Histogram of CTP" is very confusing - please add a right-hand-side y-axis to the plots for this quantity.

*We better explained in the text what score means. Concerning histograms of CTP, we think that arbitrary units are enough, and that another y-axis would make the figure heavy.*

Fig. 10: please remove this figure. It does not contain relevant information which cannot be summarized in the text.

*We have replaced this figure by an histogram showing the spatial variability of the correlation coefficients above ocean and land. It shall be the panel (a) of Figure 10.*

Fig. 11: please consider removing this figure; at least (b) can be easily removed and summarized in the text.

*We removed panel (b), and kept panel (a) that shall be the panel (b) of Figure 10.*

Fig. 12: please consider removing this figure. It is very complicated for the reader. If kept, the curves should be numbered in the plot.

*We keep it as we think it is important. We modified it to make it clearer.*

Fig. 13: explain the symbols in the caption. Please use a different symbol for the retrieved H by POLDER and the H determined from CloudSat/Calipso. This holds for other figures as well (and in fact the entire manuscript).

*Done, see previously.*

Fig. 14: please make clearer lines in this figure. Caption: H_DP > H_sigma. Retrieved H: from POLDER. Please note a possibly decreasing trend in (b) for ocean.

*Done. the trend is commented in the text, not in the caption.*

Fig. 15: Which satellite (etc.)? Standard deviation: of what?

*We decided to remove Figure 15. It showed results that are, in the new version, given only in the text.*

Fig. 16: Which satellite (etc.)? Please consider removing this figure.

*We chose to keep it and we change the caption to clarify it. There are the scores obtained by POLDER estimate of the cloud vertical extent .*