

## ACP 2011-581 review report

« The comparison of MODIS-Aqua (C5) and CALIOP (V2&V3) aerosol optical depth»

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### General comments

The manuscript presents a comprehensive study of the difference between the aerosol optical depths (AOD) estimated from the two satellite based remote sensing sensors (Modis and Caliop). This comparative study is interesting and it can have a broad impact on the scientific community involved in atmospheric aerosol research. It is seldom to get useful information on sensor AOD data quality covering the whole earth atmosphere and this for different year periods and their evolution over two years. A huge work has been done to realize this data assessment. Moreover, the authors have defined and applied a rigorous methodology to ensure data quality, hence showing possible misuse of data from the different sensors based on different measurement techniques. The authors mainly focused their study on three important topics: the geometry of the data comparison, the criteria on the data quality assurance and finally, the statistical and geographical distribution of the AODs difference. To avoid readers' questions on the different manners to compare the two dataset, the broad technical description proposed by the authors seems to be adequate.

Such paper can be read on two levels. The first one is summarized in the previous paragraph. The second one can be more focused on the aerosols properties once the comparison and the optimization on data quality done. Sufficient material is there available to edit two different manuscripts.

According to me, the manuscript needs only minor improvements before publishing.

### Specific comments on minor improvements

1. P 22991, line 20. A short description of the screening method of Oo and Holz should be added. It will bring understanding to the method used in the manuscript. Are there other screening methodologies which could be applied?
2. P 22991, line 23. Technical description in the title of 2.1 section should be removed.
3. P 22991, line 26. What is the meaning of product MYD04\_L4?
4. P 22992, line 7. Why is this limit value set to 0.0025 ? Comment should be added on it because this criterion is often used in the study.
5. P 22992, line 16, MODIS AOD uncertainty and also CALIOP uncertainty should be given in a table with the evolution of these uncertainties where bigger analysis area is considered. It will help interpreting the statistics on the AOD difference (Fig 4) and the longitudinal distribution (fig. 5 and 6).
6. P 22993, line 18. The entire paragraph (up to page 22994 line 20) qualitatively describing the uncertainties of CALIOP and the improvement from V2 to V3 are not necessary. It doesn't help the reader. It should be summarized to essential quantitative values leading to build up the AOD comparison. See previous remark.
7. P 22995, line 18. The paragraph on the box size evaluation should be shortened giving the statistics on the chosen one and a small comment on the other size.
8. P 22996, line 23, the MODIS symbol colour explanation should be given in the legend. It will help the reader to understand the figure 1. Moreover this FMF differentiation is never discussed

in the text. Remove this FMF indication or add comments if it is a valuable parameter for the study.

9. P 22997, line 3 to line6. It should be checked if all of these statistical parameters are discussed in the paper. If not they should be removed from the list and from the tables or further discussed. Moreover the simple mathematical expression of each evaluated statistical parameter should be added in the text with the reason on the choice of these statistical parameters. It is convenient for the reader to have this information in order to better understand the results presented in the manuscript.
10. P 22997, line 26. “Mean difference from Modis AOD,... are smaller for V2 than V3”. A reasonable explanation on this behaviour should be given.
11. P 23001, line 1. Presenting the results in a figure (figure 3) is not the adequate format. A table will be more convenient to highlight the results. Moreover, information or values not discussed in the text should be removed. Otherwise each values presented in the table should be discussed or commented.
12. P 23002, line 13. “as well as differences in the aerosol type....”. How is this information linked to Caliop AOD evaluation? Is this sentence necessary?
13. P 23002, line 14. The figure 4 is an important issue of this study. Some supplementary analysis and remarks should be added on the bias difference between over land and over ocean AOD difference. This difference does not strongly depend of the period of the year. Comparison of the width of the distribution AOD difference with individual Modis (Caliop resp.) AOD evaluation for typical AOD values (low and high) and this for over land and over sea AOD evaluation will perhaps differently highlight the results. Comment on the bias of Caliop AOD evaluation based on optical extinction numerical integration procedure could also help interpreting the statistics. It is well known that different numerical integration procedures (trapeze, weighted,..) rise to different small errors, which can be in the range of the bias. Some of these comments could be added in the discussion section.
14. P 23002, line 20. Explanation on graphic line format should be in the graphic legend.
15. P 23003, line 11. A reference on the long range transport of biomass burning particles should be given.
16. P 23003, line 13. The title “discussion” is not appropriate because the section includes more conclusion remarks and outlook than discussion. Quantitative discussion should be added in this section and a new section summarizing the finding could be added in the manuscript.
17. P 23004, line 13. Example of the rms values should be given. It will perhaps help interpreting the systematic bias sensors AOD difference and give insight for future work on screening procedure.
18. P 23004, line 20. The conclusion seems to be severe because, as mentioned in the manuscript, the large width of AOD difference statistics is also related to Modis AOD evaluation. Moreover, this large rms difference is limited to AOD estimation over land. The discussion on this rms difference should be enhanced.
19. P 23005, line 15. As previously highlighted the discussion should be enhanced because the work presented in this manuscript is important for the scientific community. Elements of discussion could be better organised relating the different topics: methodology (sensors AOD evaluation, screening, statistics on the AOD difference, geographical distribution,...) and ending with a general statement.

### **Comments on graphics, tables and legends**

20. Fig.1. Explanation of the different colours of dots and boxes should be given. The size of each Modis, Caliop V2 and V3 screening box should be clearly indicated in the legend. It will render the figure more comprehensive. Only one Modis V2 box is necessary, the second one adds complexity in the figure.
21. Fig.2. The text in the figures should be minimized on indication of parameters discussed in the text. It is not a necessity to indicate the fitted parameters, which are summarized in the table. FMF should be defined in the legend.
22. Fig. 3. The content of this figure should be presented in a table.
23. Fig. 4. The legends of the different line type and colour are not correct or are not correctly assigned. The legend of the x-axis is scientifically not correct because a difference is plotted in state of sensors name difference. "AOD difference" will be more adequate. Same remarks for the other figures presenting the AOD difference.
24. Fig. 5. "and over-lean". It seems that "over-land" will be more adequate. Plotting the standard deviation of the AOD difference, if it is possible, will help the interpretation of the latitudinal distribution. Same remark for Fig. 6.
25. Fig.6: define "foc" and "flc" either in the legend or in the text.