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Interactive Comment

Interactive comment on "Characterization of aerosol pollution events in France using ground-based and POLDER-2 satellite data" *by* M. Kacenelenbogen et al.

M. Kacenelenbogen et al.

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We would like to thank Lorraine Remer for her positive review. We deeply appreciate her helping advices and are very interested by the issues she has emphasized. Although some points would need further studies, we have done our best to take into account most of the comments and improve the revised version of the paper.

1. The Chu et al. reference in regard to investigating AOT vs. PM relationships in Europe, as well as North America might be mentioned in the introduction.

We agree on the important contribution of the study by Chu et al. [2003] to our subject. The reason why it wasn't originally cited in our introduction is that, instead of directly investigating the relationship between satellite AOT and PM, these authors studied sep-

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arately the relation PM/ AERONET AOT and MODIS AOT/ AERONET AOT. However, it deserves to be mentioned since it is one of the first studies on the subject especially over Europe. In the revised text, the paper has been cited in the Introduction and added in the reference list.

2. There is a recent paper by Li et al. [2005; IEEE TGARS, 43 (11), 2650-2658] that demonstrates a better relationship between MODIS AOT and PM when the AOT is derived at finer spatial resolution than 10 km. Li et al. develop a 1 km product for the task. This is for the complex urban environment of Hong Kong. In general air quality forecasters have asked me for a finer resolution MODIS product, saying that 10 km is too coarse. Now, POLDER has even coarser resolution. Have the authors considered the effect that this coarse resolution has on their results?

It is true that it is important to assess the impact of spatial resolution on the relation between satellite derived AOT and PM. POLDER-2's coarser spatial resolution might, indeed, lead to major differences in some cases. We observed no significant changes in the regression line between PM and AOT (PM 2.5 = 24.14 AOTPOLDER (440 nm) + 12.00) when using the simple 21Km x 18Km resolution instead of averaging POLDER-2's data in a 60 km x 60 km size area. More over, the spatial resolution could be reduced down to 6x7 Km by modifying POLDER-2's algorithm like in Li et al. [2005] for MODIS at 1 Km. However, as this is a first study that assesses the standard POLDER product's capabilities to detect fine urban pollution aerosols, the matter wasn't to modify the algorithm yet. We have the intention, in further studies, to investigate the spatial resolution issue especially over complex areas.

3. The conclusions found here are based on April-October data. The authors point out that the winter produces more significant PM events, which may be linked to winter-time lowering of boundary layer heights. It is very possible that the AOT=0.17 threshold that divides AQCs may be very different in the winter, and the correlation between AOT and PM may be very different in the winter. I would state this caveat in the abstract and in the conclusions

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It is true that, due to the limited lifetime of the POLDER-2 instrument, our results, threshold and conclusions might not apply to the winter season. In the revised version, we have included a related comment in the final discussion and conclusion.

4. I found the regression equations between AOT and PM to be very interesting, but the authors do not elaborate on this point at all. In this study, the slope of the regression is about 25 ug/m3 per unit AOT. Right now, based on work that we've done with MODIS, the operational IDEA product is using a conversion number closer to 60 ug/m3 per unit AOT, with no offset. Chu et al. 2003 find a similar number in Italy, but regressed against PM10, not PM2.5..Wang and Christopher find it to be 70 for their local study in Alabama. Li et al. (2005) find a much higher number, 200-400 ug/m3 per unit AOT in Hong Kong. The 25 ug/m3 of this study appears to be low. However, Engel-Cox et al. published in 2004 a regression slope of 19 ug/m3 per unit AOT for daily values. There is much hidden in a simple regression. PM2.5 or PM10? AOT at 550 nm or at 440 nm? Forced through zero or allowed an offset? Still, I was surprised to see it as low as the Engel-Cox study. I would welcome any discussion on how this present study agrees with or disagrees with previous findings. For example, would we expect POLDER and MODIS to arrive at the same quantitative relationship between AOT and PM? Would POLDER's sensitivity to fine particles make a difference? Would the different spatial resolutions matter?

We agree that the regression between POLDER AOT and PM deserves more discussion than in the submitted version. As suggested by the reviewer, in the revised text of section 3, we have added a discussion comparing our results with previous findings. Several factors complicate the comparison of our regression with those previously established by using MODIS like i) the use of PM2.5 [Wang and Christopher, 2003 and Engel-Cox et al., 2004] or PM10 [Chu et al., 2003 and Li et al., 2005], ii) satellite AOT at different wavelengths and iii) alternative approaches forcing the offset of the PM/satellite relationship through 0.

i) We chose PM2.5 measurements instead of PM10 for our study since fine particles

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pose the most serious health risks [Al-Saadi et al., 2005]. In addition, we found that both measurements were highly correlated over North of France during year 2003 and that 70 % to 76 % in mass of the PM10 are also PM2.5. When using this last information, the conversion of PM2.5 into PM10 tends to increase the slope and offset of the regression.

ii) In most of the previous studies [Wang and Christopher, 2003, Engel-Cox et al., 2004, Chu et al., 2003 and Li et al., 2005], the authors use MODIS AOT at 550 nm. When using the AOT at 550 nm instead of 440 nm, we find an increase in the slope of our PM2.5/POLDER AOT relationship (up to 45μg/m3).

iii) In our case, the offset of 12 μg/m3 is significant, and consequently, we cannot force the linear regression through 0. As said in the text, this offset reveals that the satellite has a limited capacity for monitoring small amounts of particles

iv) It might be interesting to do the same study with MODIS AOT instead of POLDER AOT averaged at the same spatial resolution. However, we don't think that we can derive a same quantitative relationship between AOT and PM2.5 for POLDER and MODIS. Indeed, POLDER measures directly the fine mode AOT while MODIS gives the total AOT. Moreover, they both have a different surface representation leading to very different possible bias in the AOT.

5. Why 440 nm? Why extrapolate from 670 nm?

The standard POLDER AOT is derived at 865 nm. The AOT was computed at 440 nm since it improves the sensitivity to small pollution particles. 440 nm is also a standard wavelength for Sun photometer measurements.

6. Some minor comments. P. 6306, just above eqn (1). "the number of PM2.5 observations that overpass the 15.5 ug/m-3Eˇ " I would use the word "exceed" instead of the word "overpass". Table 1. In the caption, please explain the last column. Fig 1. The authors may want to label the bottom axis with English abbreviations of the months

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instead of French. Jan. , Mar. May, Jul, Sep., Nov.

Every comment above has been taken into account and the revised text has been modified in consequence.

Interactive comment on Atmos. Chem. Phys. Discuss., 6, 6299, 2006.