Atmos. Chem. Phys. Discuss.,
https://doi.org/10.5194/acp-2017-192-AC2, 2017

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Vertical distribution of aerosol optical properties in the Po Valley during the 2012 summer campaigns" *by* Silvia Bucci et al.

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Received and published: 22 December 2017

We would like to thanks the reviewers for the useful comments and insights that allowed us to better redefine the methods and presenting the results of this study.

Second reviewer:
" *[. . .]However, the main text of the manuscript needs to be more logically organized, and it is suggested to modify the logical structure of some sections to give clearer conclusions. For instance, the whole introduction part is in one large paragraph mentioning the characteristics of the Po river basin, previous studies over the Po Valley, mineral dust's adverse impact, and LiDAR observations, which is a little unclear.*

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It is recommended to re-organize some of the sentences or separate this part into more than one paragraph and provide a clearer logical sequence introducing your study focus. For the conclusion part, it is recommended to highlight a few key findings or conclusions using refined expression of the evidence."

We thanks the reviewer for the comment. We re-organized the manuscript introduction to have a clearer logical structure (presentation of the characteristics of the Po Valley, description on the possible sources of particulate over the region, goals, methods and focus of the study) and we introduced a sub-paragraph structure to separate the description of anthropogenic and natural PM sources.

Similarly, in the conclusions, we stressed the results in a clearer form. In particular:

We removed lines from (14,7) to (14,11).

From (14,21): "...carrying depolarizing aerosol.The study offered evidence of dust transport to the ground, showing clear dust layers intrusion in the PBL and rapid mixing with local pollution. We showed how this mixed layer, generally characterized by lower depolarization values, can reach the ground within few hours and we showed, by direct comparison with ground in situ instruments, the corresponding enhancement of particle volume size distribution in the 2-5 µm range (leading to values higher than 1 $\mu m^3 cm^{-3}$)."

We substituted lines (14,30-31) with "The study revealed moreover the presence of events of late afternoon particles resuspension from the soil, not related to Saharan dust transport, impacting on the PM concentration near the ground. The existence of. . ."

From (15,6): “The combination of depolarization profiles with meteorological and aerosol measurements allowed also to highlight the effects of the condition of high RH (typical for this region) on the particle processes. The analysis revealed how, in correspondence of a shallow layer near the ground (<500 m), in conditions of high relative humidity values (RH > 60 %), the aerosol linear depolarization ratio decreases respect to the above layer. Such effect is particularly visible when in presence of mineral dust particles near the ground (δ_a decrease ∼3.5 %). The temporal evolution and the high values of nitrates ion concentration (up to 18 µg m^{-3}) in the PM1 and PM10 channels during this period, suggest that the origin of such low depolarization particles can be related to processes of secondary organic aerosol formation and hygroscopic growth on mineral dust particles with nitrate-enriched surface.”

“ *Finally, some language mistakes have been noticed and revision of the language is needed to give clearer meaning of the sentences. For instance: Page 3, line 15: ‘. . .basing on the analyses of continuous and vertically resolved particles light scattering and depolarization. . .’ -> consider revising*”

We performed a revision of the manuscript to improve the clarity of the text as tracked in the revised version.

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