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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Source apportionment of fine PM and sub-micron particle number concentrations at a regional background site in the western Mediterranean: a 2.5 yr study" *by* M. Cusack et al.

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Authors' response

The authors would like to take this opportunity to thank the editor and reviewers for taking the time to read this publication and for their insightful corrections. We believe the manuscript has benefited greatly from the reviewers comments and corrections.

RC C285: Anonymous Referee #2, 28 Feb 2013

This is a very well written paper, and a well structured work, it provides useful infor-

mation about PM1 sources along with sub micron number concentrations. After the apportionment of SOA source was argued and clariïňĄed, i don't have any major comments. I do have a few minor comments which are going to be highlighted in the following paragraph.

Author's response: Thank you for taking the time to review our article and for your positive comments. Please find below a point by point response to your comments.

Reviewer: P3922: Please provide correlation coefficients (R2) for PM1, OC, Sulfate and Nitrate between modelled and measured concentrations.

Author's response:

Correlation coefficients have been included in the text for PM1, OC, Sulfate and Nitrate (r2 of 0.71, 0.97, 0.95 and 0.99 respectively).

Added: P3922, L 20: After a variety of factor numbers were tested, it was observed that a 6 factor solution provided the most meaningful results, with a correlation coefficient (R2) of 0.71 between the modelled and experimental PM1 concentrations, with Q values of 2816 (Robust) and 2833 (True). Correlation coefficients (r2) between modelled and measured concentrations for OC, sulphate and nitrate were 0.97, 0.95 and 0.99 respectively.

Reviewer: P3924: For Nitrate, it would be important to highlight the sampling artefacts which result in higher nitrate concentrations in winter compared to summer.

Author's response:

A more in-depth explanation of sampling artefacts associated with nitrate:

Added: P3924, L 16. "Nitrate concentrations are signiïňĄcantly elevated in winter and much lower in summer owing to its thermal instability (Harrison and Pio, 1983; Querol et al., 2004a). Ammonium nitrate can be volatilised in the atmosphere in warmer conditions associated with the Mediterranean climate, especially in summer. However, a

negative artefact may also account for the reduced concentrations measured in summer, due to the volatilisation of ammonium nitrate from the filter during and after sampling.

Reviewer: P3927: For the fuel oil combustion source characterised by V and Ni, in the source of profile we can also see non negligible contributions for Na and Mg. Can the authors of this article give more information about the influence of shipping emissions at MSY. Maybe giving some information about the meteorology and the marine aerosols influence in order to be more specific?

Author's response: The influence of shipping emissions on the fuel oil combustion source has been discussed in greater detail in the text. Specifically, the influence of shipping emissions is discussed in two sections:

Added: P 3928, L 9: The presence of Na and Mg, typical marine aerosols, in the fuel oil combustion source may indicate the influence of shipping emissions. A source apportionment study of PM10 and PM2.5 for the MSY site was performed by Pey et al. (2009). In that study, the secondary sulphate and fuel oil combustion sources were not separated, but correlation was observed for secondary sulphate and sea spray emissions, indicating some influence of shipping emissions. Furthermore, it was shown that sea spray concentrations were considerably higher in summer at MSY owing to the increased sea breeze circulation over the coastal area (25 km from MSY).

Added: P 3930, L19: Furthermore, as noted previously, sea breeze circulation is substantially more influential during the summer months (Pey et al., 2009). Therefore, shipping emissions are likely to be more influential owing to the enhanced sea breezes and may provide some explanation of the seasonality observed for the fuel oil combustion source.

Interactive comment on Atmos. Chem. Phys. Discuss., 13, 3915, 2013.