

Interactive comment on “Size-resolved aerosol pH over Europe during summer” by Maria Zakoura et al.

Anonymous Referee #1

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The paper describes results on size dependent pH in aerosol from the PMCAMx chemical transport model and analyses sensitivity of modeled pH with regard to non-volatile cations. Considering the importance of aerosol pH for aerosol public health, ecosystem and climate effects, the topic is relevant for this journal and this reviewer recommends publication after the following major comment have been addressed.

The paper focuses on May 2008 as the period during which online observations of PM1 composition are available through the EUCAARI intensive campaign at the sites discussed in more detail. While some of the model performance was evaluated in the paper cited (Fountoukis et al., 2011), aspects such as the representation of nitrate diurnal concentration (Figure 6) were not shown before. The diurnal variation of PM1 nitrate shown in figure 6 does not seem to be in accordance with observed diurnal

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variation (see e.g. Mensah et al., ACP 2012). Considering the link to aerosol pH, it is critical in the context of this paper to show in detail the performance of the model with respect to aerosol composition. This reviewer therefore requests a detailed analysis of the model ability to simulate particle composition, specifically particulate nitrate. Accounting for the high fraction of organic nitrate in PM1 across Europe (Kiendler-Scharr et al., 2016), this analysis should take into consideration organic nitrate.

Minor points in order of appearance:

The introductory summary of observed aerosol pH (page 2 line 62 – page 3 line 89) is not suitable to provide an overview as is. Switching between reported units (from pH to $[H^+]$ in $nmol\ m^{-3}$) and listing values without obvious systematic should be avoided and the material structured into e.g. a table or figure to provide an overview.

Page 5 Lines 148ff: When introducing abbreviated names for simulations, apply this to all including the simulation that neglects calcium.

Page 6 Lines 188: Are the two periods for Cabauw (summer 2013 and May 2008) similar in aerosol composition and source, i.e. should one expect the same pH value? If not, why make a comparison and state that PMCAMx under predicts PM2.5 pH by 0.8 units (line 190)?

Page 7 line 225: What does “both” refer to in this context?

Page 8 Line 246: Show comparison of observed and modeled size distribution of nitrate where available.

Page 8 Line 261: If kinetics of mass transfer is critical here, discuss for full size distribution. It is unclear why only the difference between two size ranges is discussed here.

Page 9 Line 264: Compare average diurnal profiles of nitrate with observed data (see also major point above).

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References

Fountoukis et al., *Atmos. Chem. Phys.*, 11, 10331 – 10347, 2011

Mensah et al., *Atmos. Chem. Phys.*, 12, 4723–4742, 2012

Kiendler-Scharr et al. (2016), *Geophys. Res. Lett.*, 43, 7735–7744,
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2020.