

Comment on acp-2021-970

Anonymous Referee #1

Referee comment on "Eurodelta multi-model simulated and observed particulate matter trends in Europe in the period of 1990–2010" by Svetlana Tsyro et al., Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2021-970-RC1>, 2021

Overarching comments:

The manuscript provides a comprehensive evaluation of modeled PM mass and species trends against observations for the 2000 – 2010 time period, with a more limited analysis of trends over the 1990 – 2010 time period. Evaluating whether models can capture historic trends resulting from changes in emissions is of key importance when using such models to predict future changes. The model simulations and analyses presented in the manuscript are sound and of good quality. The manuscript is well written and structured clearly, the presentation quality of all figures and tables is good, and references to other published studies on similar topics are provided where appropriate. My only major comment is that the impacts of not considering forest fire emissions in these simulations should be discussed more prominently in the description of results as well as the abstract and summary. In addition, the list below contains a number of minor comments that the authors may want to consider when revising their manuscript.

Specific comments:

Line 25: maybe mention that the exclusion of forest fire emissions and (in some models) windblown dust emissions may have contributed to a higher fraction of modeled trends being significant due to the lower amount of interannual variability being present in such model simulations

Line 61: suggest inserting "over the" before "last years"

Lines 80 – 83: as noted below, to more fully accomplish this goal, it would be beneficial to provide more information on the speciation of primary PM_{2.5} emissions (especially EC and

OC) and the representation of secondary organic aerosols in the models, and then reference this information when discussing speciated results in section 5.4

Line 96: insert "that" before "participated"

Line 109: insert "was" before "performed"

Lines 105 – 116: Please provide information how the ECLIPSE PM2.5 and PM10 emissions were speciated into different compounds. If this was handled differently for each model, please provide a summary of the approach for each model to better understand the results presented in section 5.4

Lines 113-114: Please provide more information on the temporal resolution the ECLIPSE inventories for the different sectors – are these all annual total emissions, and did each model then apply the same EMEP profiles to perform monthly, weekly, and diurnal allocation? Did the vertical distribution of emissions depend on the meteorology used by each model to account for the effects of meteorology on plume rise, or are these EMEP profiles static? Given the effects of atmospheric stability on near-source PM concentrations, uncertainties in representing plume rise may be an important factor of model error especially during wintertime.

Lines 126-127: The exclusion of forest fire emissions (and in some models dust emissions) may have important implications for the interpretation of modeled and observed trends, specifically the smaller amount of interannual variability the exclusion of such emissions causes in the models which in turn leads to a tendency for more significance in the trends estimated from the models. The current version of the manuscript does not reference the exclusion of fire emissions in any of the discussions in sections 4 – 7.

Section 2.1: It would be useful if this section also included a summary of the aerosol treatment of the different models (e.g. number of modeled species, sectional vs. modal size distribution representation, representation of biogenic and anthropogenic secondary organic aerosols, etc.) to help with the interpretation of results from individual models in subsequent sections.

Lines 136 – 146: Please clarify if the modeled annual mean values at the observation locations were computed by discarding any time periods for which observations were not available at that site. In other words, if a given site had 80% data completeness in a given year, was the corresponding model mean for that site and year computed over the same 80% of all modeled time periods in that year? Such temporal matching of observations and model values at the underlying temporal resolution and completeness of the observations would be the preferred approach for ensuring consistency between the observed and modeled annual means.

Lines 175 – 176: If possible, it might be interesting to discuss which meteorological and/or emission features (e.g. precipitation, dust or fire emissions) may have caused the elevated PM levels in 2003, 2006, and 2010

Line 226: consider changing “does not probably indicate” to “hardly indicates”

Line 254: change LOTOS to LOTO for consistency

Line 261: change “they are an underestimation” to “they are underestimated”

Lines 283 - 284: remove double parentheses

Lines 338 – 343: This essentially seems like a repeat of the results in lines 291 – 296. Both paragraphs discuss the results averaged over all sites.

Line 358: suggest changing “calculated” to “modeled”

Line 397: suggest inserting “between species” after “not the same”

Lines 399 – 400: I would suggest converting these results from ugN/m³ and ugS/m³ to ug/m³ for consistency with the analysis of total PM mass

Line 453: change “dependency of” to “dependency on”

Line 578 and 581: what is the estimated uncertainty of VOC and NH₃ emissions?

Lines 588 – 593: The authors may want to explicitly discuss that in the real world, these emissions are dependent on meteorology (higher on colder days) while this effect likely is not represented in the current models.

Line 589: year is missing for the Simpson et al. reference

Line 628: what is the authors' interpretation of this finding? Also see my earlier comments on fire and dust emissions.

Line 639: consider changing "downsized" to "partially masked"

Line 665: this section does not include an outlook, consider changing the section title to just "Summary"