

Atmos. Chem. Phys. Discuss., referee comment RC1  
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## Comment on acp-2021-496

Anonymous Referee #1

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Referee comment on "What caused a record high PM<sub>10</sub> episode in northern Europe in October 2020?" by Christine D. Groot Zwaaftink et al., Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2021-496-RC1>, 2021

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The paper by Groot Zwaaftink et al. investigates a recent (October 2020) record-breaking PM<sub>10</sub> episode in northern Europe with the aid of surface measurements, satellite observations, and modelling approaches. This is a very interesting and comprehensive in-depth analysis exploring the sources and mechanisms that resulted in several exceedances of the EU PM<sub>10</sub> limits over northern Europe. The paper is overall well written, and I really liked the sequence of analysis steps. As apart from local sources, long range transport is also responsible for PM standard exceedances, such studies unravel limitations of modeling and forecast systems, contributing to the direction of improving air quality management. Thus, I support publication of the paper after the following comments are considered by the authors.

Comments:

- Please use a), b), .. indexing for all Figures and modify accordingly the manuscript. This will be very helpful for the reader.
- P3 Figure 1: Since there is no distinct color separation for values > 50 µg/m<sup>3</sup> (left) and >25 µg/m<sup>3</sup> (right), the reader cannot distinguish the sites where the air quality limits are exceeded. I suggest to use less color levels in a way that colors from red and on are referring to air quality limit exceedances. Another option would be to plot station exceedances with another marker (instead of circle you can use + for example). Moreover, I suggest to provide 2 and 3 of October 2020 as separate Figures (4 in total) in order to have sense the visualization of exceedances.
- P17 Figure 5: I understand the choice of the dates. Yet, for a more comprehensive view of the event and to better unravel the pathways of BC and dust transport, apart from start (27/9) and end (02/10) of the episode the intermediate dates are also essential. I suggest to provide (maybe as Supplement) the respective maps from 27/9 to 02 or 03/10 with a 6-hour (or 12-hour) interval, as a Figure or animation. Also, I suggest using another color for coastlines, as it is difficult to distinguish from contour lines and color-shaded.
- As the state-of-the-art CAMS-global (IFS) forecast system provides aerosol species for both dust (3 bins) and black carbon, it would be interesting to investigate if it has an added value to the existing analysis.

Minor Comments:

- P1, L11-12: This sentence needs reconstruction. I guess on-line and off-line refers to transport model simulations and not to observations. Please make this clear.
- P1, L17: Better use surface measurements instead of high quality measurements.
- P1, L20: I suggest removing "During a two-day's episode" and start the sentence as "In early October ...".
- P1, L26: Is there a url for this reference? If yes, please include accordingly in the Reference Section.
- P2, L31: "by LRT PM" -> "by LRT of PM". Apply in other instances as well if applicable.
- P2, L36: "is the most likely based" -> "is the most likely reason based"
- P2, L38: "long-range transport", use LRT instead, and in other instances as well if applicable.
- P2, L45: "observed frequently" -> "frequently observed"
- P2, L48: "polyarometaic" -> "polycyclic aromatic"
- P3, L60: "respectively, the" -> "respectively, and the"
- P8, L216: "dry deposition" -> "dry deposition,"
- P8, L228-230: Are these meteorological data forecast or analyses?
- P8, L233: Replace "made" with "performed".
- P9, L243: This refers to radius or diameter?
- P9, L246: "dust emission," -> "dust emission, while"
- P9, L248: "for biomass burning." -> "for biomass burning FLEXPART simulations."
- P9, L249: Remove "will".
- P9, L251: The CAMS regional forecast product is for 4 days (96h) in advance.
- P9, L256: C-IFS is now simply called IFS.
- P9, L261: aerosol was -> aerosols were
- P9, L263: Replace the sentence with "Figure 2 presents an RGB composite of observed OCLI for 2 October 2020."
- P11, L304: Insert at the end of the sentence "(Table 1)".
- P11, L309: (Sect. 2.1.2) -> (Sect. 2.1.2),
- P12, L315: Hurdal and K arvatn -> Hurdal, and K arvatn,
- P15, L344: was missing -> were missing

- P16, L352: "on 27 September". The year should be also included. Please apply where applicable in the manuscript.
- P18, L392: a-b -> a-c
- P18, L396-397: Modify as "In Figure 7 we compare ...at Birkenes."
- P22, L480: Replace "figures Figure 8 and Figure 9. The measurements showed" with "Figures 8 and 9, indicating".
- P22, L488: does not show -> is not reproduced
- P23, L501: I think pink should be replaced with magenta.