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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Effects of marine fuel sulfur restrictions on particle number concentrations and size distributions in ship plumes at the Baltic Sea" *by* Sami Seppälä et al.

Anonymous Referee #2

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This manuscript presents a major data set of ship plumes, as observed at a fixed location downwind shipping lanes in a Baltic Sea. The analysis is based on measured particle number size distribution over a 10-year period, during which the sulfur content of the fuel used by marine ships decreased considerably. The paper is scientifically sound and original enough to warrant its publication. The text is well organized and clearly written. I have a few minor issues to be addressed before recommending the paper to be accepted for publication.

The authors should justify the selection of the size ranges 7-134 nm and 155-499 nm in their analysis. Why the border between these size ranges is well over 100 nm,

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including both Aitken mode and the lower tail of the accumulation mode? Furthermore, the given borders of the size ranges are incorrect, because the middle points of size bins do not determine the upper and lower limits of the size ranges. For example, the upper limit of the first size range and lower limit of the second size range should be the same (somewhere between 134 and 155 nm, probably close to geometric mean of these two diameters).

Too much emphasis is given to the role of coagulation in shaping the observed particle number size distributions. It is true that coagulation is able to decrease total particle number concentrations in aging shipping plumes, but the reported particle number concentrations are way too low to cause any significant growth of the particles between their emissions and observations (times scales for coagulation growth are simply too short in these cases). This is related to discussion on lines 232-233, 281 and lines 412-413 (on these last lines, the authors give an impression that particle chemical composition would affect coagulation, which does not sound correct).

Why to use the concept total particle number size distribution mentioned on lines 306-307 and Figure 11? I would understand the word "total" if the particle population would have been treated somehow (e.g heating to different temperatures) and then compared to the non-treated situation, but this seems not to be the case here. Would just talking about particle number size distribution be enough?

What are the authors referring to with dilution-related processes on line 233? Changes in gas-phase chemistry and/or gas-particle partitioning of condensable vapors? Dilution itself does not affect particle size by any means.

Line 401: arriving at

Lines 425-426: Writing like this, the authors give a somewhat incorrect impression on aerosol influences on clouds. Cloud formation tends to be dominated meteorological processes (cooling of air, often in updrafts driven by other met phenomena). While aerosols particles could affect this at high aerosol loading due to aerosol-radiation

interactions, their main role is to modify cloud microphysical properties via aerosol-cloud interactions.

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