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Interactive comment on “Real-case simulations of aerosol-cloud interactions in ship tracks over the Bay of Biscay” by A. Possner et al.

Anonymous Referee #1

Received and published: 19 November 2014

This paper presents the results of real-case simulations with the COSMO regional model of a prominent ship-track scene observed by MODIS over the Bay of Biscay. Aerosol-clouds interactions and feedbacks are analysed, considering also various sensitivities. The results help understanding the features and limitations of cloud parameterization, and interpreting the current estimates of global aerosol-cloud forcing.

The suggested approach is very interesting and the topic is of relevance, given the relatively low level of scientific understanding of the involved processes and their importance for climate. This paper therefore fits well to the scope of ACP and deserves publication.

The manuscript is generally well written, although more clear and precise formulations

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are desirable in some parts (please find detailed suggestions below).

I have only a few questions regarding the emission setup of the model (Sec. 2.1.1), namely:

1. The number-to-mass conversion is done using a measured radius of $0.04 \mu\text{m}$ from Hobbs et al. Does this assume that all the particles have the same radius or is a size distribution also assumed?
2. It is not immediately clear how the size distribution parameters of Righi et al. are used here. From the caption of Table 1, I understand that they are used for partitioning the mass emissions between the Aitken and accumulation modes, but this is not clear in the text.
3. It is also not clear why the authors use the measured radius by Hobbs et al. to convert number to mass, and then the radii of Righi et al. to assign the mass to the size modes. Although it is stated in Sec. 3.1 that this does not affect the results, why not consistently using the same values for both operations?
4. Using a measured number emission flux introduces further uncertainties, as this quantity varies quite rapidly with the plume age. Was there a specific reason for this choice? A better possibility would be to start from mass emissions (e.g., considering typical emission factors for the given ship class from the literature) and convert them to number using the same parameters used for mass partitioning. This conversion depends on plume age too, but the uncertainty can be quantified using two sets of parameters (as the authors actually did when considering a *fresh* and an *aged* distribution for the partitioning).

Minor remarks:

P26722, L14-15: if possible, please provide the corresponding relative changes in CDNC and radius.

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P26725, L26: please also specify the vertical resolution.

P26726, L11: was the entrainment rate parameter tuned? If yes, how?

P26727, L17: is the global ECHAM-HAM simulations using the same cloud scheme, parameterizations and emissions? Please specify.

P26728, L9: what about the hygroscopicity of ash? Is it also relevant in this context?

P26728, L21: I guess this is the median radius, not the mean.

P24729, L16: I wonder whether the ship emission update timestep (3 minutes) is dependent on the ship speed.

P24731, Eq. 1: I guess SFC means surface. I would write it explicitly, or better, just write 0 there.

P24731, L13: why is the cloud cover predominantly 0 or 1? Is it due to the high horizontal resolution?

P26737, L19: up to which altitude/pressure is the column integrated?

P26738, L7-13: this seems to contradict the results of the cited global model studies (Righi et. 2011, Peters et al. 2012), which found a quite high sensitivity to particle aging. I think this is worth a comment.

P26739, L10: here radiative effects are discussed, but Fig. 6c shows τ .

Text corrections:

P26722, L3: please replace “parameterisations” with “model parameterisations”.

P26722, L10-13: this sentence is long, rephrasing as “The simulations, which include moving ship emissions, show that...” may improve readability.

P26723: L15: remove comma.

L26726, L18: I would break the sentence after “dust” and start a new one.

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L26726, L23-24: replace the \geq symbol with \leq .

P26727, L24: put a comma after “monoxide”.

P26732, L25: for clarity, I would write “mass flux (ship10) or emissions size (ship10A)”.

P26736, L17: replace “as is consistent” with “consistently”.

P26738, L29: replace “Within the ship” with “In the ship”.

P26740, L10: replace “this” with “the one analysed in this study”.

P26740, L18: replace “on the order of” with “on a typical time-scale of the order of”.

P26741, L20: delete “within”.

Interactive comment on Atmos. Chem. Phys. Discuss., 14, 26721, 2014.

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