

Response to Referee #1

We would like to express our appreciation to the Referee for valuable suggestions and relevant question to the work presented. Our answers to the referee are given below.

Major comments:

Points that should be considered by the authors:

1. This is a long paper that I believe could be greatly improved by being made more concise, primarily by removing redundant material. In particular, Sections 2.1 and 2.2 could be removed without compromising the paper. Although most of this material is not important for this paper, some (for example a shortened discussion of previous model/observation comparisons of sea salt aerosol concentrations – Section 2.2) could be folded into Section 3.2, particularly to justify the use of the M&M source parameterization. Section 5.1 (including Figs 1&2) should also be removed as the results are not important for the stated aims of the paper and in the end this is simply an intercomparison of source functions without any recourse to measurements. The effects of changes in sea salt source function in the EMEP model itself are covered in Section 7.1 so what real additional and important information is contained Section 5.1?

Following the recommendations, the content of Sections 2.1 and 2.2 have been essentially cut down. We have chosen to keep Section 5.1, though it's also been considerably shortened. Only one figure, showing the wind dependence of size-resolved sea spray fluxes from different source functions, has been kept. We think the summary of main differences between the considered source functions with respect to sea spray production, droplets size distribution and dependence on wind speed are relevant and useful when analysing differences in sea salt concentrations calculated with the CTM, applying those parametrizations.

Other redundancies and repetitions:

Removed as suggested

Page 11176, lines 15-25 & page 11177, lines 1-9:

The list of findings from box-model tests has been removed, and one sentence has been included instead: “The box-model study allowed a better insight in the differences between the selected source function with respect to calculated sea spray fluxes and their wind speed dependence, and the size distribution of generated sea salt aerosols”

2. The last line of the abstract and the last sentence of the conclusions mention the improvement in insight gained with regard specifically to the EMEP model. If the results shown here are only relevant for the EMEP model then it is hard to justify their publication in an international journal like ACP. Although this paper is part of the EMEP modeling special issue, more emphasis should be placed on the contribution this work makes to regional sea salt aerosol modeling in general. This would then widen the group of interested readers and increase the paper's impact. I would like to see a greater emphasis placed on how these insights can be generalized to other, similar models which as discussed in Section 2.2, suffer from similar problems of inconsistent biases in sea salt concentrations (in air and precipitation). For example the sensitivity of the precipitation concentrations to the scavenging efficiency (in cloud and below) is interesting and I would anticipate this result is not specific to the EMEP model.

This is a very relevant remark. The authors agree that the formulation was rather unfortunate as we certainly agree that the findings and discussions presented in the paper could also be useful to other modellers. To our knowledge, most of regional models calculating sea salt experience pretty similar problems. In particular, overestimation of sodium in air and its overestimation in precipitation has been reported by Guelle et al. (2001) and Foltescu et al. (2004). Unfortunately not many other regional and global models look at (or at least, publish their results about) the accuracy of modelling of sea salt in precipitation. Therefore, it is difficult to see how generic this problem really

is. The reference to specifically EMEP model has been removed, and the text has been re-written in order to highlight the contribution of this work to regional sea salt modelling in general.

3. Instantaneously mixing emitted coarse mode aerosols through an approximately 90m layer may not be very realistic (e.g. Blanchard et al. Tellus B, 34, 118-125, 1984). This is a difficult modeling issue but given that you mention this point on Page 11155, line 14, should this also be discussed in Section 7.7?

The referee is quite right here. The assumption on immediate sea salt mixing within a 90m thick layer is not a very appropriate one. In the source areas, i.e. over sea, and in the proximity to coasts it would likely result in model underestimation of surface concentrations. On the other hand, being distributed within a layer closer to the ground, sea salt will more readily be deposited, which would shorten its lifetime and hamper the long-range transport ability. It is not so obvious to see how sea salt wet deposition would change. We could probably expect that more sea salt aerosols would reside at relatively lower levels and thus be less affected by in-cloud wet scavenging.

In fact, there have recently been initiated a work to study the effects of increasing vertical resolution on EMEP model results. Preliminary tests have been performed using three layers with height of. 18, 45 and 90m (instead of a 90 m layer in the standard model). Very first results for January 2008 show that sea salt concentrations are considerably (up to 50-100%) higher over the seas compared to standard runs. Compared with observations, Na⁺ concentrations are somewhat more overestimated at coastal sites, while more underestimated at in-land ones in the case of a fine vertical resolution in the surface layer. For all stations, the average bias goes up from -5% to 24% and the spatial correlation goes down from 0.79 to 0.70 for January 2008. More investigation is needed and envisaged to study the effect of a finer model resolution of the surface layer for all “classical” air pollutants and natural aerosols and will be subject of future publications. Brief discussion on the issue has been included in Section 7.7 of the paper.

General comments:

1. “Sea salt pollution” is changed to “sea salt concentrations”
2. The use of ”sea spray” has been checked through the paper

Specific comments:

Page 11145, lines 22-24: The sentence is re-written as “Since sea salt contributions can hardly (or not always) be determined from air quality measurements alone, model calculations can be used for this purpose, which requires a good confidence in model performance.”

Page 11153, line 4: Erroneous year 1996 is corrected to 2006

Page 11168, lines 15-17: The mentioned results on wind speed verification are from the on-going work and have not been published. Reference to “A. Benedictow, personal communication” is added.

Page 11169, lines 3-6: The indicated text has been found erroneous and thus deleted.

All other General and Specific comments concerning inaccuracies and typos in the text/tables have been attended to and the paper language has been refined.