Dear reviewer #2,

we thank you for your comments on our manuscript. Below we present our answers (black color) to your comments (grey color) accompanied by the changes we performed in the manuscript (blue color).

1) Abstract, line 17/18: "The pattern of the simulated distribution of volcanic ash particles shows an agreement with previous studies". Why not "good agreement" as for Bromoform and Dibrommethane?
   We adapted the wording for the volcanic ash:
   The pattern of the simulated distribution of volcanic ash particles shows a good agreement with previous studies.
2) p. 572, line 1 – 6: It might be interesting to know the approximate horizontal and vertical resolution. It is mentioned later in the text (about 40 km horizontal, and on p. 592, line 10 in the context of the discussion concerning the volcanic ash plume, a vertical resolution of 300 m is In the description of the run for bromocarbons (p.589, line 6) a number of 90 levels up to 75 km altitude, time step of 72 s is given. It might be helpful to clarify this point of horizontal and vertical grid spacing with respect to the different model runs which have been performed.
   The horizontal and vertical grid used for all examples presented in the manuscript is the same. We therefore relocated the statements that were previously within Section 6.1 to the introduction of Section 6.
   The forcing of dynamics and transport in these simulations was done by parameterized processes of the NWP version of ICON and namelist parameters were set accordingly. A R2B06 grid (about 40 km horizontal grid spacing) with no nested domain has been chosen with 90 non-equidistant vertical levels up to 75 km together with a time step of 72 s. The vertical thickness of the lowest model layer is 20 m, the maximum thickness of about 2600 m is reached at the top of the model domain.
3) Is the vertical grid spacing varying with altitude or is it constant? What is the upper boundary?
   The vertical grid spacing varies with altitude. We added 'non-equidistant vertical levels up to 75km' to the general setup description as stated at the beginning of Section 6.
   A R2B06 grid (about 40 km horizontal grid spacing) with no nested domain has been chosen with 90 non-equidistant vertical levels up to 75 km together with a time step of 72 s.
4) The authors mention the problems with computing time, what is the computing time e.g. for an annual run as performed for sea salt ? Or for the other applications shown?
   The example for the sea salt might not be the best example for a simple reason. As the goal was to obtain emission fluxes, we did not switch on advection. The VSLS simulations might give better insight. For the multi-month simulation of the very short-lived bromocarbons presented in chapter 6.1, 700 CPUh on 128 Intel Xeon processors E5-2670 (Sandy Bridge) with 2.6 GHz clock speed are needed to simulate the transport and simplified chemistry of in total 7 tracers for one month in a R02B06 resolution with 90 levels (in total 29491200 grid cells) and a time step of 72 s including a daily netcdf output on the native ICON as well as on a regular lat-lon grid with 0.5°x0.5° resolution.
   In general, our tests showed that ART does not impact the scalability of the ICON model.

Using 12 ART tracers for volcanic ash and sea salt aerosol lead to roughly a factor of 3 compared to an ICON simulation without ART. This test was performed with MPI parallelization only on different numbers of cores between 64 and 1024. We added a small passage concerning the scalability:

We performed tests with different numbers of cores (powers of two between 64 and 1024) and found roughly a factor of 3 for an ICON-ART simulation compared to an ICON simulation without ART. The ART simulation for this purpose was performed with volcanic ash and sea salt aerosol switched on. This shows that the scalability of ICON applies also to ICON-ART.

5) p. 586, line 11: The term VSLS is used before it is explained on p.588, line 6. Better to explain it with the first usage on page 586.

   VSLS is now explained at the first usage.

6) p.591, line 21: "after some tuning ..." Is the "tuning" performed in some systematic way or just by trying several factors and then take some which is just leading to reasonable results?

   The phrase tuning might be misleading. Although this parameter can be used as a tuning parameter for future simulations, no adjusting of this parameter has been performed for this work. It was rather chosen based on literature values. We added a paragraph which describes the physical background of this parameter and why 0.04 was chosen:

   The emission fluxes for the different size bins are calculated using Eq. (21). It is assumed that a significant fraction of the total emitted mass is deposited close to the source due to the gravitational settling of large particles, aggregation of small particles and organized downdrafts. Common values for the ash fraction available for long range transport lie between 1% and 10% (e.g. Witham et al. 2012). We chose an appropriate value of f_lrt = 0.04 in Eq. (21) which lies well in that range.

Bibliography:

Witham, C., H. Webster, M. Hort, A. Jones, and D. Thomson: Modelling concentrations of volcanic ash encountered by aircraft in past eruptions. Atmos. Environ., 48, 219-229, 2012.