Dear reviewer #1,

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) It would be nice if the authors explain in a bit more detail the reasons why a icosahedral approach was chosen to start with: what are its advantages in terms of computational cost/grid nesting or other?
   During the last decade, there is an obvious trend away from traditional latitude-longitude grids and series expansion methods, mainly because of their need for extensive global communication. Global models based on latitude-longitude grids suffer from the so called 'polar problem' because the meridians converge towards the poles. To maintain numerical stability near the poles, polar filters involving global communication are needed. Moreover, reasonable time steps can only be achieved with (semi-)-Lagrangian algorithms, which do not allow for exact mass conservation and tracer mass consistency. On the other hand, global series expansion/spectral transform methods involve Fourier and Legendre transforms every time step, which also require massive global communication and have a numerical complexity increasing more than quadratically with the number of resolved wavelengths.
   In view of the required scalability on today's and future massively parallel computing architectures, we decided to choose an icosahedral approach. Icosahedral grids provide a quasi-uniform tesselation of the sphere as well as obvious ways for achieving local mass conservation and tracer-mass consistency, which are of great importance for aerosol-chemistry-models. The main challenge of icosahedral grids, however, is to control their spurious computational modes, which either show up in the mass field (triangular grid) or in the vorticity field (hexagonal grid). Details on the specific measures undertaken for ICON can be found in Zängl et. al (2014).
   The decision to go with the icosahedral-triangular C grid rather than the icosahedral-hexagonal approach was mainly based on the fact that triangular grids provide a much more obvious way of implementing a hierarchical nesting-based mesh refinement.
2) The authors describe all of the components of the atmosphereic composition model, including some that are probably common with the meteorological model (I think of turbulent diffusion). A few physical processes were not included in this global description: microphysics, radiation and surface-atmosphere interface come to mind. It would be appreciated if the authors could rapidly introduce how these processes are taken into account in ICON-ART. As one of the stated objectives of ICON-ART is to model cloud and radiation interaction with aerosols, the microphysical and radiation parameterizations must be two critical components of the system, even though they don't formally belong to the "ART" part of ICON-ART.
   We mentioned turbulent diffusion (and also convection) parameterization because these have a direct impact on the spatiotemporal evolution of aerosol and trace gas concentrations.
   We agree that the coupling of aerosols to cloud and radiation parameterizations will be a crucial component of the full ICON-ART system. The objectives the reviewer refers to apply to the final stage of ICON-ART development as stated in the manuscript. In the model version

described in the manuscript, the coupling of ICON and ART is realized only in one direction. This means that our aerosol and gaseous tracers do not have a feedback on the atmospheric state so far.

Our plan is to couple the two-moment microphysic scheme by Seifert and Beheng (2006), which is a (non-operational) part of ICON, with parameterizations for the activation of aerosol particles (Fountoukis and Nenes, 2005) and a cirrus cloud formation scheme (Barahona and Nenes, 2009). For the interaction of aerosol with radiation, we plan to replace the aerosol optical depth (AOD) climatology that is used in the radiation scheme by an AOD that is calculated based on simulated aerosol distributions.

For the gaseous tracers the simplified lifetime approach will be supplemented by a full chemistry scheme for the troposphere and stratosphere. Therein, the photolysis rates will be calculated online using Fast-Jx (Bian and Prather, 2002) and the gas phase reactions via the kpp software (Sandu and Sander, 2006).

We added a statement that the physical parameterization package we use so far is the same as for NWP applications:

If not stated differently, physical parameterizations (e.g. radiation, microphysics) used for the simulations in this paper are the same as described in Zängl et al. (2014).

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