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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Aerosol pollution potential from major population centers" *by* D. Kunkel et al.

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1) Aerosol transport in models – frontal activities and coastal sea breeze

In general, aerosol transport is performed by four independent processes in the model: advection in the large-scale circulation, convective lifting, vertical diffusion, and gravitational settling (see also page 7, lines 22-25). In general, only the advective part is resolved in global circulation models, while the other three processes have to be parametrized due to their appearance on smaller scales. Synoptic scale phenomena such as frontal lifting and warm conveyor belt transport are considered as part of the large-scale circulation and as such are resolved in a reasonable way in a model with

a horizontal resolution of about 1.1° and a vertical resolution of at least 60 m. Hence, the aerosols can undergo these transport pathways, too. However, it has to be kept in mind that aerosol particles are efficiently removed from the atmosphere in these frontal lifting processes due to the presence of clouds. Moreover, not every frontal system can be resolved in its entire structure, since there are also processes operating on smaller scales in a frontal system, which can not be resolved in the applied horizontal resolution. Moreover, the model resolution limits the representation of a coastal sea breeze, which in most cases is a local circulation in the lowest layers of the atmosphere with horizontal extensions of about or smaller than the horizontal resolution. Thus, a coastal sea breeze is not explicitly resolved in a global model and the state of the atmosphere due to land-sea differences is changed only by modifications from the vertical diffusion and convection parametrizations. We will elucidate these aspects more clearly in the revised manuscript.

2) Comparison between models (EMAC-MATCH) and with observations

We compared the EMAC results to those from MATCH-MPIC to increase our confidence that we can interpret our results mainly in terms of tracer properties and emission source locations and do not have to consider model specific features of the transport processes which would exacerbate the interpretation of the results. Our setup was explicitly chosen not to represent real world emissions. We used an artificial and arbitrarily -chosen to be 1 kg/(s*grid-cell)- emission strength for each of the 460 tracer and apply it only at the locations of the MPCs. This allows us to study the potential pollution resulting from a unit mass release. Hence, our results are not well suited to directly compare them with real world observations. However, several other studies were conducted to compare EMAC results for gas-phase tracers with observations, e.g., Jöckel et al., 2006 and Pozzer et al., 2007 as well as for aerosols, e.g., Pringle et al., 2010, Tost et al., 2012. These studies have all been conducted using emission inventories for gas-phase species along with a comprehensive chemical mechanism and in case of aerosols for different aerosol types and an aerosol module to treat for

aerosol microphysics and thermodynamics.

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Pringle et al.: Description and evaluation of GMXe: a new aerosol submodel for global simulations (v1), Geosci. Model Dev., 3, 391-412, 2010

Tost and Pringle: Improvements of organic aerosol representations and their effects in large-scale atmospheric models, Atmos. Chem. Phys., 12, 8687-8709, 2012

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