

Responses to reviewers comments and revised version of „Value added by high-resolution regional simulations of climate-relevant aerosol properties“ by P. Crippa, R. C. Sullivan, A. Thota, S. C. Pryor

The responses to the reviews do not address the points made by the reviewers adequately, in particular the differences in meteorological variables at 12 km and 60 km horizontal resolution and the precipitation bias at 60 km resolution need to be understood (see below). Publication can only be recommended after major revisions.

General comment:

For a meaningful comparison of AOD between the simulations at 12 km and 60 km horizontal resolution the differences in meteorological variables and their impact on AOD need to be understood. The annual mean precipitation in the studied region should be around 800 -1200 mm with a standard deviation of about 180 - 260 mm (Groisman and Easterling, 1994). The precipitation of the 60 km simulation in Fig. S3 is significantly below these values in many areas. The reason for the difference between the 12km and 60 km simulations could be the different performance of parameterization at different resolutions or internal variability. The discussion of the cumulus scheme by the authors is very welcome and should be added to the main text. It remains to be checked if the difference between the 12 km and 60 km simulations is also due to internal variability. A 60 km simulation is significantly cheaper than a 12 km simulation. 60 km simulations with varying initial conditions can be used to explore the internal variability and if possible reduce the differences in meteorological variables, in particular reduce the precipitation bias.

Specific comments:

P6, L 152: Effects of the boundary conditions are clearly visible in some of the Figures e.g. Fig. 4, Fig. 6, Figs. S1-S3. It should be mentioned in the text that removing the cells at the boundary does not significantly affect the BSS results or the boundary cells should be excluded from the analysis. Otherwise a reader may be confused whether or not the cells at the boundary are included in the analysis and whether or not they affect the results.

P10, L273-L298: Using the BSS and its decomposition in Murphy and Epstein is useful to investigate which one of two simulations has the higher skill. But it would be interesting and within the scope of the paper to know also the skill of each simulation individually. Therefore it would be useful to compute in addition a BSS for each simulation (WRF60 and WRF12-remap) by using climatological values as the reference.

P17, L477-L485: Because wet scavenging by precipitation is removing most of the aerosol globally (Textor et al., 2006) a short discussion how wet scavenging by precipitation affects the comparison of the two resolutions should be added.

Technical corrections:

P6, L134: The Angstrom exponent α is the exponent for (λ_1/λ_2) , i.e. $(\lambda_1/\lambda_2)^\alpha$.

P6, L138: The natural logarithm is missing in the denominator.

P6, L141: Only 2π is below the square root, not σ_i . σ is the standard deviation, not the geometric standard deviation. r is not defined.

P6, L145: The variables in this equation depend on z. z is not defined.

P7, L167: There are words missing before representative.

Reference:

Textor, C., Schulz, M., Guibert, S., Kinne, S., Balkanski, Y., Bauer, S., Berntsen, T., Berglen, T., Boucher, O., Chin, M., Dentener, F., Diehl, T., Easter, R., Feichter, H., Fillmore, D., Ghan, S., Ginoux, P., Gong, S., Grini, A., Hendricks, J., Horowitz, L., Huang, P., Isaksen, I., Iversen, I., Kloster, S., Koch, D., Kirkevåg, A., Kristjansson, J. E., Krol, M., Lauer, A., Lamarque, J. F., Liu, X., Montanaro, V., Myhre, G., Penner, J., Pitari, G., Reddy, S., Seland, Ø., Stier, P., Takemura, T., and Tie, X.: Analysis and quantification of the diversities of aerosol life cycles within AeroCom, *Atmos. Chem. Phys.*, 6, 1777-1813, doi:10.5194/acp-6-1777-2006, 2006.