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The aerosol distribution in Europe derived with the Community Multiscale Air Quality (CMAQ) model: comparison to near surface in situ and sunphotometer measurements

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Abstract. The aerosol distribution in Europe was simulated with the Community Multiscale Air Quality (CMAQ) model system version 4.5 for the years 2000 and 2001. The results were compared with daily averages of PM₁₀ measurements taken in the framework of EMEP and with aerosol optical depth (AOD) values measured within AERONET. The modelled total aerosol mass is typically about 30–60% lower than the corresponding measurements. However a comparison of the chemical composition of the aerosol revealed a considerably better agreement between the modelled and the measured aerosol components for ammonium, nitrate and sulfate, which are on average only 15–20% underestimated. Slightly worse agreement was determined for sea salt, that was only available at two sites. The largest discrepancies result from the aerosol mass which was not chemically specified by the measurements. The agreement between measurements and model is better in winter than in summer. The modelled organic aerosol mass is higher in summer than in winter but it is significantly underestimated by the model. This could be one of the main reasons for the discrepancies between measurements and model results. The other is that primary coarse particles are underestimated in the emissions. The probability distribution function of the PM₁₀ measurements follows a log-normal distribution at most sites. The model is only able to reproduce this distribution function at non-coastal low altitude stations. The AOD derived from the model results is 20–70% lower than the values observed within AERONET. This is mainly attributed to the missing aerosol mass in the model. The day-to-day variability of the AOD and the log-normal distribution functions are quite well reproduced by the model. The seasonality on the other hand is underestimated by the model results because better agreement is achieved in winter.

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