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An integrated model study for Europe and North America using the Danish Eulerian Hemispheric Model with focus on intercontinental transport of air pollution

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The Danish Eulerian Hemispheric Model (DEHM) is a 3D long-range atmospheric chemistry-transport model with a horizontal domain covering the Northern Hemisphere. For the AQMEII (Air Quality Modelling Evaluation International Initiative) intercomparison exercise, the model was set up with two two-way nested domains simultaneously – one covering Europe and one covering North America. In this paper, the model configuration used in AQMEII will be described, including a discussion of model results and evaluation for the year 2006 against available measurements in Europe for different chemical species. The evaluation of DEHM for Europe shows that the model gives satisfying results for species such as ozone, nitrogen-dioxide, sulphur-dioxide and secondary inorganic aerosols. The evaluation also points to certain processes where DEHM can be improved, such as biogenic emissions of isoprene, mass closure for particulate matter, wet deposition, and description of vertical mixing during winter. Furthermore, special attention is given to the intercontinental transport of air pollution between North America (NA) and Europe (EU). We estimate the contributions to the total air pollution levels at continental scale from the anthropogenic emissions in the two areas, with a focus on ozone and particulate matter using a tagging method, taking into account the non-linear effects of atmospheric chemistry. We conclude that for this specific year, the intercontinental transport between NA and EU is small for the annual or seasonal mean values – for ozone the contributions are typically around 3% ($\sim$1 ppb) from NA to EU and around 1% ($\sim$0.3 ppb) from EU to NA. For particles the contributions from NA to EU is around 0.9% ($\sim$0.05 μg/m3) and from EU to NA around 1.4% ($\sim$0.05 μg/m3).