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Model initialization and validation with ground- and space-based lidar measurements and sun photometer measurements

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The regional model system COSMO-MUSCAT (COSMO: Consortium for Small-scale Modeling; MUSCAT: MultiScale Chemistry Model) was used to perform studies for the characterization of the European aerosol distribution. The influence of the distribution pattern of chemical compounds on meteorological parameters and dynamical processes can be determined. Main focus is the validation of the vertical distribution of chemical compounds especially at the lateral model boundaries. The description of these vertical profiles was realized by lidar profiles from ground- (EARLINET: European Aerosol Research Lidar NETwork) and space-based (CALIPSO: Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observation) measurements and sun photometer measurements at European AERONET (Aerosol Robotic Network) stations. The model simulations were performed for the period July 18-26, 2006. This period was characterized by an anticyclone that was situated over Europe for several days and which caused very low transport of atmospheric particles and chemical compounds from outside into the model area. To characterize the aerosol entering the model domain, three different vertical particle profiles were defined at the model boundaries. A climatological lidar profile (Case 1) was used to describe the vertical distribution of chemical compounds and aerosols. Aerosol distribution at all four lateral model boundaries was described by particle concentrations in three main layers. The second approach (Case 2) uses individual lidar profiles, measured at EARLINET stations on July 17, 2006 (Thessaloniki (Greece), Belsk (Poland) and Minsk (Belarus)). The particle load at all four lateral model boundaries was initialized based on the shape of these backscatter profiles. Between 2000 and 4000 m the particle load decreases and the lowest concentration occur above 4000 m. The third approach contains the daily measurements by CALIPSO. The difference to Case 1 and Case 2 is the individual description of vertical distribution at all four sides for every day, instead of using fixed layers. Sun photometer measurements, performed at AERONET stations, situated next to the lateral model boundaries, were used for all three cases to define weighting factors for the prescribed vertical profiles. With that additional information the load of chemical compounds and aerosol was determined. Results of these case studies will be presented, together with results from a further case study for a time period with stronger transport of atmospheric particles from outside into the model domain, where lateral transport across the model boundaries is expected to play a more important role compared to the July case.