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Ultrafine particles from power plants: Evaluation of WRF-Chem simulations with airborne measurements

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Ultrafine particles (UFP, particles with a diameter < 100 nm) are an acknowledged risk to human health and have a potential effect on climate as their presence affects the number concentration of cloud condensation nuclei. Despite of the possibly hazardous effects no regulations exist for this size class of ambient air pollution particles. While ground based continuous measurements of UFP are performed in Germany at several sites (e.g. the German Ultrafine Aerosol Network GUAN, Birmili et al. 2016, doi:10.5194/essd-8-355-2016) information about the vertical distribution of UFP within the atmospheric boundary layer is only scarce. This gap has been closed during the last years by regional-scale airborne surveys for UFP concentrations and size distributions over Germany (Junkermann et al., 2016, doi: 10.3402/tellusb.v68.29250) and Australia (Junkermann and Hacker, 2015, doi: 10.3402/tellusb.v67.25308). Power stations and refineries have been identified as a major source of UFP in Germany with observed particle concentrations > 50000 particles cm^{-3} downwind of these elevated point sources. Nested WRF-Chem simulations with 2 km grid width for the innermost domain are performed with UFP emission source strengths derived from the measurements in order to study the advection and vertical exchange of UFP from power plants near the Czech and Polish border and their impact on planetary boundary layer particle patterns. The simulations are evaluated against the airborne observations and the downward mixing of the UFP from the elevated sources is studied.