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Precipitation scavenging of aerosol particles at a rural site in the Czech Republic

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Wet deposition is an important removal mechanism of atmospheric aerosol (AA) in the troposphere, transferring AA to the Earth surface in an aqueous form (Seinfeld and Pandis, 1998). Deposition consists of in-cloud (ICS) and below-cloud (BCS) scavenging, both processes depending on the size, chemical composition and concentration of the AA particles (e.g. Laakso et al., 2003; Ladino et al., 2011). Due to the complexity of the processes and high instrumentation and time demands, a complete understanding is still a challenge, although both phenomena have been extensively studied recently (e.g. Andronache et al. 2006; Chate et al. 2011; Collett et al. 2008).

In this work, the influence of ICS and BCS, described by the obscurities (mist, fog and shallow fog) and precipitation (drizzle, rain, snow, rain with snow), on submicron atmospheric aerosol particle number size distributions (PNSD) was studied using 5 years of measurements at the rural background station Košetice. The typical PNSD during individual meteorological phenomena were compared, and the change in the concentrations before and after the beginning of the phenomenon, the scavenging coefficient lambda_s, and the rate of change of the AA concentrations with time were computed.

It was found that both obscurities and precipitation have a strong influence on the AA concentrations, both on the total number concentrations and on the particle number size distributions. The scavenging not only lowers the total AA concentrations, it even changes the number of modes on the PNSDs. The PNSD main mode is shifted to the larger particles, and the concentrations of particles smaller than 50 nm in diameter are considerably lower. In nucleation mode, however, wet scavenging does not seem to be the main process influencing the AA concentrations, although its considerable effect on the concentration was proved.

During obscurities, there is a typical PNSD to which the PNSD converge at any mist/fog/shallow fog event. The concentrations of AA particles smaller than 80 nm are lower than they are during periods without any phenomenon recorded. Also during liquid precipitation, PNSD are lower when compared to non-event periods, suggesting an effective AA deposition. Precipitation containing frozen hydrometeors behaves differently from liquid precipitation. Concentrations of AA particles larger than 200 nm during precipitation containing solid particles do not differ from non-event cases, suggesting insignificant scavenging.
The results of the observed size dependent changes in AA concentrations and PNSD could be used to assess the expected changes in atmosphere during transport and scavenging of AA not only during experimental campaigns, but during modelling as well.

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