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Identification and classification of the formation of intermediate ions measured in boreal forest

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Abstract. We have measured the size distributions of air ions (0.42–7.5 nm in diameter) with the Balanced Scanning Mobility Analyzer in boreal forest, in Southern Finland since spring 2003. The size range covers the size range of cluster ions (approximately 0.42–1.6 nm) and naturally charged nanometre aerosol particles (1.6–7.5 nm) or intermediate air ions. Based on the measurements from April 2003 to March 2006 we studied the characteristics of charged aerosol particle formation by classifying each day either as a particle formation event, undefined or non-event day. The principal of the classification, as well as the statistical description of the charged aerosol particle formation events are given. We found in total 270 (26% of the analysed days) and 226 (22% of the analysed days) particle formation days for negative and positive intermediate ions, respectively. For negatively charged particles we classified 411 (40% of the analysed days) undefined and 348 (34% of the analysed days) non-event days whereas for positively charged particles 343 (33% of the analysed days) undefined and 460 (45% of the analysed days) non-event days. The results were compared with the ordinary classification based on the Differential Mobility Particle Sizer (DMPS) measurements carried out at the same place. The above-presented values differed slightly from that found from the DMPS data, with a lower particle diameter of 3 nm. In addition, we have found the rain-induced intermediate ion bursts frequently. The rain effect was detected on 163 days by means of negative ions and on 105 days by positive ones. Another interesting phenomenon among the charged aerosol particles was the appearance and existence of intermediate ions during the snowfall. We observed this phenomenon 24 times with negatively charged particles and 21 times with positively charged ones during winter months (October–April). These intermediate air ions were seen during the snowfall and may be caused by ice crystals, although the origin of these intermediate ions is unclear at the moment.

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