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Waterfall-Related Aerosol Inventory

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The current study investigated the distributions of ionic-clusters and aerosols originating from waterfalls. The 10 day measurement campaign was performed with three portable Gerdien condensers (air-ion detectors) to monitor air-ion concentrations [1] and a Scanning Mobility Particle sizer (SMPS), along with an optical particle counter (OPC) to determine the size distribution of aerosols. The size spectra covered in each measurement ranged from 0.9 to 350nm for the negative ion concentration. Determination of negative charges using the SMPS covered the full range, whereas the positive complement was restricted to a size window of 0.9 to 2 nm and was determined by the detection principle of the SMPS. Using the fully-fitted SMPS (with the neutralizer attached to the DMA) made it possible to monitor aerosol distributions in the size window ranging from 5.5 to 350 nm. In combination with the OPC, it was possible to extend the upper threshold up to 2 µm.
The investigation revealed a distinct aerosol distribution in proximity to the falls along with a soaring concentration of negative ions in the lowest size range below 10 nm. As expected, off-site control measurements used to monitor background ion- and particle concentrations prompted significantly different signatures. The increased concentration of negative intermediate ions is assumed to be due to the so-called waterfall effect [2], in which auto-ionization due to friction, fragmentation and charge-separation mechanisms cause free charges inside water droplets. Fluctuation in charges and their mobility yield free ions when a droplet collides with an obstacle. Aerosol spectra on the other hand showed a distinct “wash-out-effect” of otherwise specific aerosol distribution in the absence of a waterfall, whereas aerosol concentrations – especially in the lower size range below 100nm – are elevated as condensation and agglomeration effects are suppressed due to the cooler microclimatic conditions near the falls.

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