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Experimental investigation of birch pollen emissions (MicroPoem) and the influence of sensor orientation and meteorological factors on the inlet sampling characteristics of volumetric bioaerosol samplers

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Diseases due to aeroallergens constantly increased over the last decades and affect more and more people. Adequate protective and pre-emptive measures require both reliable assessment of production and release of various pollen species, and the forecasting of their atmospheric dispersion. Pollen forecast models, which may be either based on statistical knowledge or full physical transport and dispersion modeling can provide pollen forecasts with full spatial coverage. Such models are currently being developed in many countries. The most important shortcoming in these pollen transport systems is the description of emissions, namely the dependence of the emission rate on physical processes such as turbulent exchange or mean transport and biological processes such as ripening (temperature) and preparedness for release. Thus the quantification of pollen emissions and determination of the governing mesoscale and micrometeorological factors are subject of the present project MicroPoem, which includes experimental field work as well as numerical modeling. The overall goal of the project is to derive an emission parameterization based on meteorological parameters, eventually leading to enhanced pollen forecasts.

In order to have a well-defined source location, an isolated birch pollen stand was chosen for the set-up of a 'natural tracer experiment', which was conducted during the birch pollen season in spring 2009. The site was located in a broad valley, where a mountain-plains wind system usually became effective during clear weather periods. This condition allowed to presume a rather persistent wind direction and considerable velocity during day- and nighttime. Several micrometeorological towers were operated up- and downwind of this reference source and an array of 26 pollen traps was laid out to observe the spatio-temporal variability of pollen concentrations. Additionally, the lower boundary layer was probed by means of a sodar and a tethered balloon system (also yielding a pollen concentration profile).

The concentration distribution downwind of the birch stand exhibts a significant spatial (and temporal) variability. Small-scale numerical dispersion modeling will be used to infer the emission characteristics that optimally explain the observed concentration patterns. In the present contribution a project overview on the emission experiment is given and first results are presented. An emphasis is put on the relative performance of different pollen sampling technologies. The field measurements indicated a significant impact of pollen sensor orientation (vertical and horizontal) and meteorological factors on the relative sampling efficiency. A corresponding relative calibration was constructed from the lab and field work, which considerably improves the performance of typically vertically oriented non-automatic systems under natural conditions.