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Ventilation scheme, room location and meteorological factors influence indoor birch pollen concentrations

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Allergenic pollen, often in co-occurrence with air pollutants from traffic and industries aggravating its pollen allergenicity, constitutes a major health risk for the urban population during the pollen season. Airborne pollen concentrations are traditionally monitored with fixed pollen traps mounted >10 m above ground on flat roof tops. However, the personal exposure of allergic people mostly depends on their main residences and the local emission patterns. Consequently, the assessment of indoor pollen is essential for human health since people stay most of the day inside buildings. In our study, hourly indoor birch pollen concentrations were measured on eight days in April 2015 with portable pollen traps in five rooms of a university building at Freising, Germany. A traditional pollen trap on the roof of the building provided the background birch pollen concentration which was compared to the respective outdoor values right in front of the rooms. The office and lab rooms were characterised by different aspects and window ventilation schemes. Meteorological data were equally measured at a nearby climate station and directly in front of the windows.

The observed flowering phenology of 56 birch trees in the nearer surrounding partly explained daily peaks in airborne pollen concentrations. As expected, outdoor pollen concentrations were larger than indoor concentrations: Mean indoor/outdoor (I/O) ratio was highest (0.75) in a south oriented room with fully opened window and additional mechanical ventilation, followed by two rooms with fully opened windows orientated to the west and north (0.35, 0.12) and lowest in east oriented neighbouring rooms with tilted window (0.19) and with windows only opened for short ventilation (0.07). The latter two rooms even had a birch tree directly flowering in front of the façade. Hourly I/O ratios depended on meteorology and increased with outside temperature and wind speed oriented perpendicular to the window opening. As also known from literature, indoor concentrations additionally depended on the previously measured concentrations, indicative of accumulation of pollen inside the rooms. Two follow-up studies on grass pollen at the TUM building in Freising (2015) and a KIT building in Garmisch-Partenkirchen (2016) largely confirmed these findings on indoor concentrations of allergenic pollen.