



Spatio-temporal investigations of flowering dates and pollen counts in the topographically complex Zugspitze area

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Flowering behaviour of the major allergenic species *Betula pendula* Roth, *Corylus avellana* L., *Dactylis glomerata* L. and *Alopecurus pratensis* L. - two tree species and two grass species, respectively - was examined by phenological observations in spring and summer 2009 along an altitudinal gradient (up to 1700 m a.s.l.) in the topographically complex Zugspitze area, Germany. The results were compared with meteorological data and pollen counts derived from pollen traps located on different altitudes (720 m, 1503 m and 2650 m a.s.l.).

Phenological onset dates showed a great dependence on altitude and on exposition: Altitudinal gradients of the two grass species varied between 6-7 d/100m. Results for birch confirmed a delay of 3 d/100m. Northern and western exposed birch individuals at the same altitudinal level showed even higher differences in flowering dates and fluctuated between 6 to 10 days. However, grass species did not equivalently show a distinct difference in flowering times induced by exposition.

The comparison of phenological and aerobiological data revealed a good accordance with respect to the start of the pollen season. Therefore, not long-range pollen transport but local emissions of grass and birch pollen remarkably accounted for the timing of the start of the pollen season, defined by aerobiology, in 2009. It could be statistically demonstrated that temperature increase and dry conditions support the release of pollen from anthers; however, precipitation interrupted the release.

More pronounced altitudinal responses for the analysed grass species point toward a marked temperature sensitivity and suggest that changes in temperature due to recent climate change could imply a discernible earlier grass pollen season and in turn lead to major consequences regarding allergic diseases and human health.

Keywords: phenology, aerobiology, pollen, allergy, microclimate, topography, exposition, altitude, Zugspitze, Limestone Alps.