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Analysis of meteorological conditions during maximum pollen concentrations in Zagreb, Croatia

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Back-trajectories, in conjunction with measured meteorological data, were used to examine the ragweed pollen concentration maximums that occurred during the first week of September in years 2002 and 2003 in Zagreb. Based on the maximum ragweed pollen concentration occurrence, two periods of research were defined, period A (3rd and 4th September 2002) and period B (6th and 7th September 2003). According to the two-hour pollen measurements, besides very high daytime maximum concentrations that exceeded 600 grains/m3, the night-time concentrations were unusually high as well. Prognostic charts show that synoptic conditions in both periods were very similar, with a slow eastward moving high pressure system over the south-eastern Europe.
The mesoscale WRF numerical model results demonstrated a successful multi-day simulation in Zagreb reproducing (i) the local topography influence on local wind flow as well as (ii) the formation of an urban heat island over the city and (iii) reasonable agreement with the available observations. The model indicated that in the first period, the moderate synoptic flow was predominantly from the east, while during period B, a weaker (than in period A) easterly synoptic wind allowed a more significant local thermal circulation development over Zagreb.
Hourly back-trajectories, based on the wind field obtained by the WRF model, indicated the most probable reasons for high nightly two-hour concentration peaks recorded in Zagreb. The long-range transport of pollen grains from the Pannonian Plain was the presumable cause of the rather high pollen concentrations during period A, especially during its night-time part. During period B, the westward long-range transport, suggested by trajectories, was significantly supplemented by the horizontal recirculation of the pollen grains within diurnal local thermal circulation over the city, causing the higher late evening concentration increase.