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Modelling climate change effects in urban and peri-urban forest areas of the City of Vienna

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Although the role of urban and peri-urban forests, i.e. the inner-city trees and parks as well as the surrounding green belts around densely populated areas has raised scrutiny during the past decade, little is known about potential impacts of climate change (CC) on the provision of forest services in urban and peri-urban areas. Following the current general prognoses of climate models shifts both in temperature and precipitation regimes are projected while abundance and duration of dry seasons are expected to significantly increase in Austria.
To render analysis of climatic conditions more spatially specific and with a stronger focus on urban and peri-urban forests, we apply eco-physiological modelling (Biome- BGC) for forest areas in Vienna and in the biosphere reserve surrounding the city using past and current climate data as well CC scenario projections to assess the vulnerability of urban and peri-urban forests to changes in water and nutrient cycles due to changes in temperature and precipitation.
The Austrian version of DAYMET allows climate interpolations for each location in Austria using daily minimum and maximum temperature (Tmin, Tmax) and daily precipitation from more than 400 climate stations all over Austria. It yields interpolated Tmin, Tmax, Prcp and, derived from these three variables with the help of a digital terrain model and algorithms validated for Austria, daily solar radiation (SR) and vapour pressure deficit (VPD). All of which serve as Biome-BGC model drivers. For the simulation of the future development of the forests we run an advanced Biome-BGC model with daily weather data created by a regional climate model (Tmin, Tmax, Prcp) and with daily SR and VPD again derived with DAYMET.
From the past climate data we could deduce a maximum urban heat island effect for the mean daily average temperature for Vienna for the 1990s and the 2000s of about 0.6 °C. A closer look into the climate data records reveals trends in the heat island effect, along with artefacts owing to changes in climate station availability. The analysis of the eco-physiological modelling results give insight into vulnerability of urban and peri-urban forests to CC effects and supports the derivation of hotspots of needed intervention as well as future management recommendations with respect to the provision of forest services.

Key words: climate change, eco-physiological modelling, forest services, forest vulnerability, Vienna