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Forecasting the weather
- ensemble techniques
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LWF meteorological observations in Switzerland: a comparison between open-site and below-canopy climatic conditions

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Meteorological data have been collected since 1997 in 17 LWF (Long-term Forest Ecosystem Research) plots in Switzerland, 14 of which were used for the present research. They represent different locations, orientations and elevations, composed of deciduous, coniferous and mixed forests. We compared below-canopy and open-site climatic conditions for these 14 sites and analyzed the forest influence on local summer and winter climate according to the forest type (coniferous, mixed, deciduous), soil type, slope orientation and topography.

We found clear differences between below-canopy and open-field temperatures, humidity, wind speed and PAR and could relate them to the specific site conditions. We specifically analyzed air temperature during summer 2003, in connection with the exceptionally high temperatures measured during that summer and during the 11-day August heat wave. Results show that maximum temperatures were on average up to 5.2 K cooler under the canopy during the 11-day heat-wave episode. The forest influence on PAR and maximum temperature is clearly determined by the forest type, whereas the influence on minimum temperature is affected by both forest type and slope orientation and impact on humidity depends on the soil type. The wind speed is most impacted by topography. The intensity of the effect of the forest on climate parameters greatly depends on the season.

In summer, deciduous and mixed forests generally have the strongest impact on daytime temperatures, cooler under the canopy, with a higher RH. Coniferous forests have a moderating effect on night temperatures, warmer below-canopy, and on RH, less humid under the canopy.

In winter, all forest types lowered the day-time temperatures and the RH. The forest generally increased night-time temperatures, especially in north-oriented conifer sites. The forest impact on day-time RH was enhanced in all forest types, except in a Scots pine forest. In deciduous and mixed stands, the forest impact on microclimate is generally towards less extreme values, but it can also bring more extreme values during some winters in the beech and beech-silver fir stands. There was a significant correlation between the absolute value of temperature and the difference between open-site and below-canopy temperature: the warmer the temperature, the stronger the impact of the forest.

Our results quantify the role of forests in providing a cool shelter during heat waves. The results are of particular value to urban areas, where forested parks could provide an important source of relief during heat waves. Within a central European context, the most efficient ecosystems for this purpose appear to be beech, beech–silver fir and oak–silver fir forests. The opposite effect was seen in mugo pine and Scots pine forests, with warmer temperatures under the canopy compared to open-site.