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Observed response of vulnerable forest ecosystems to ongoing site condition changes

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In the last decades, several symptoms of drought damages have been observed in the Hungarian forests (e.g. sparse canopy, leaf drop, top drying, fungal diseases). Forest responses are also influenced by other factors beyond climate (e.g. available water content, soil conditions, biotic damages, adaptive capacity, etc.).
Our aim was to prepare a complex analysis of the change of all site conditions, that could lead to the observed health status decline of the forest tree species. For a case study region in Hungary (Keszthely Mountains, near to Lake Balaton) precipitation and temperature tendencies as well as the frequency of extreme dry summers have been determined for the period 1961-2100. Soil conditions have been investigated in 9 profiles and soil mapping analysis has been carried out including 100 sites with hand soil auger. For the investigation of the water-balance we used the modified Thornthwaite-type monthly model and determined water stress when the relative extractable water (REW) decreased below 40% (Granier et al., 1999).
In the last 30 years three severe droughts have been detected when duration of extremely dry and hot periods exceeded 3-4 years. Not only orographic and microclimate conditions but also soil types show a large diversity within a relatively small distance in the case study area. On rendzina with shallow topsoil layer thickness, low water holding capacity, black pine was planted. Brown earth with medium and brown forest soils with deep topsoil layer thickness is favourable for oak (sessile or Turkey) and beech. These microscale differences between the three site condition types resulted different available water contents quantified by the modified Thornthwaite-type monthly water-balance model. Our results show the different sensitivity of the studied sites to water stress. It means that the local scale orographic and soil conditions can enhance the projected drought risk of the region. However, the favourable microclimatic effects of the existing forest stands are still a knowledge gap and the topic of the ongoing research.

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