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A modelling approach to adaptive management of water protection forests under climate change scenarios

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Intact forest stands in humid climate zones are considered to have favourable effects on ground water supply by moderating peak flows and by their ability to filter, buffer or transform pollutants. These functions may be temporarily lost in case of disturbances. The water supply and storage capacity of a forest site is a determinant of both species composition and leaf area. Changing climate, can increase the severity and duration of drought stress events, putting a current forest stand or water supply at risk of deterioration. In such situations, particularly in mountainous areas with shallow soils, adaptive forest management is necessary to maintain optimal ecosystem functionality under changing conditions.

To aid management decisions for this purpose, the hydrological model Brook90 has been applied to determine leaf area carrying capacities under future climate scenarios for dominant tree species, at various development stages, on forested sites at various elevations, with various soil types, in the Northern Limestone Alps. Brook90 was parameterized for the City of Vienna's water protection forests and calibrated using climate records for the area. Stress events were identified from model output and used to project leaf area under climate scenarios. Using stand development scenarios, in combination with future climate scenarios for the region, specific leaf area carrying capacities were determined for each unique combination of tree species, forest development stage, elevation and soil type.

The model results were used to create a decision support tool for forest managers. The tool is a booklet of charts, which enable forest managers to look up the optimal species combination and leaf area according to the carrying capacity of any given site by using the appropriate chart. Adaptive forest management can be carried out by regenerating a forest stand with tolerant tree species best suited to the site, and by keeping stand density below critical thresholds.

The modelling approach allows better understanding of hydrological processes in forests of the Limestone Alps, while the decision support tool aids forest management decisions leading to protection of water supplies.