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Supplementary file S2. Using the models in simulation

The model set presented in this study is used in simulations as explained below. Simulation is based on a list of trees where the breast height diameter and number of trees per hectare (frequency) are known for all trees. The trees of the list may represent diameter classes or individual trees measured on a sample plot. In addition, the age and dominant height of the initial stand must be known.

1. The site index model (Equation 10) is used to calculate the site index of the stand from stand age (T_1) and dominant height (H_1) using 40 years as index age (T_2).
2. Tree heights are calculated from dominant height and tree diameters using Equation 3.
3. Stand age is incremented by one year.
4. Dominant height after one year is calculated from Equation 10. Now, index age (40 years) is used as T_1 and site index is used as H_1. T_2 is the incremented age of the stand.
5. Survival probabilities of trees are calculated by Equation 12 and the tree frequencies are multiplied by the survival probabilities.
6. Diameter increments of trees are calculated from Equation 11 and added to the diameters of trees.
7. Tree heights are calculated from updated dominant height and updated tree diameters (Equation 3).
8. The total stand basal area, total number of trees per hectare and quadratic mean diameter are calculated.
9. Number of trees per hectare and stand basal area are compared to the self-thinning limits (Equations 13 and 14). If the self-thinning limit is exceeded, tree frequencies are reduced until the stand density is on the self-thinning limit. This additional mortality is distributed into different diameter classes according to the survival probabilities calculated from Equation 12
10. Steps 3–9 are repeated to simulate additional years.

The above simulation assumes that dominant height does not change in thinning treatments, which means that only thinning from below can be used. When simulating treatment schedules where thinning is from above, the dominant height of the stand is reduced, and Equation 10 can no longer be used to simulate dominant height development. In these kind of simulations, the following alternative height model can be used:

$$\hat{h} = 1.3 + (-29.472 + 9.944 \ln T + 0.516\mathrm{SI}) \exp\left[\frac{-(23.645 - 3.948 \ln T - 0.383\mathrm{SI})}{d}\right] \qquad \text{(A1)}$$

where h is tree height (m), d is diameter at breast height (cm), T is stand age (years) and SI is site index (m). In this case, the site index model is used only for calculating the site index of the stand, after which Equation A1 is used to simulate height development. Dominant height is calculated as the average height of 100 largest trees per hectare.

Equation A1 was fitted using the same data as for Equation 3. The RMSE of Equation A1 is 1.219 m with 16401 degrees of freedom.