

Calibration of the 3D Hi-sAFe agroforestry model for hybrid walnut

Wolz K. J. (wolzkevin@gmail.com), Dupraz C., Lecomte I., Gosme M., Reyes F.

UMR-SYSTEM, INRA, Montpellier, France

Hi-sAFe is a 3D biophysical model designed to explore the interactions between trees and crops in agroforestry systems. Utilization of any tree species within Hi-sAFe requires parameterization and calibration of the model for that tree species. We carried out these three steps for hybrid walnut (*Juglans regia x nigra*). Data used for parameterization and calibration came from the literature and long-term experimental plots at the Restinclières Estate near Montpellier in Southern France (Inurreta-Aguirre et al. 2018). The three plots included two alley cropping systems of hybrid walnut and durum wheat (*Triticum durum*) and a pure forestry system of hybrid walnut with a natural ground cover. A total of 21 Hi-sAFe tree inputs were unable to be parameterized directly and were included in the model calibration. Optimal parameter values were searched for using a multi-objective evolutionary algorithm (MOEA) similar to the NSGA-II algorithm (Deb et al. 2002). The root mean square errors of the measured vs. modeled diameter at breast height (DBH) in each plot were used as objective functions to minimize. The final Pareto optimal front of the MOEA contained a diversity of tree parameter sets. Accuracy of modeled crop relative yield in the A2 plot was used as a final criterion to select the best parameter set. These calibrated Hi-sAFe parameters for hybrid walnut can be used to confidently explore hybrid walnut agroforestry systems across pedoclimatic and management conditions.

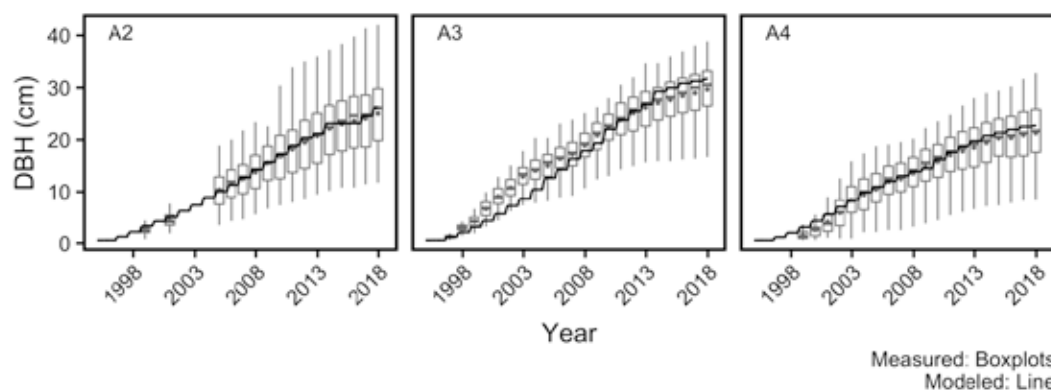


Fig. 1 Measured vs. modeled DBH of hybrid walnut in two agroforestry systems (A2 and A3) and one pure forestry system (A4) in Southern France. Boxplots show the range of measured data for individual trees each year. Lines show Hi-sAFe model predications after model calibration.

Keywords: alley cropping, silvoarable, model, genetic algorithm, optimization.

References:

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