

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

Kevin J Wolz*, Christian Dupraz, Isabelle Lecomte, Marie Gosme, Francesco Reyes
INRA (UMR-SYSTEM), University of Montpellier, Montpellier, France. *kevin@SavannaInstitute.org

OBJECTIVE

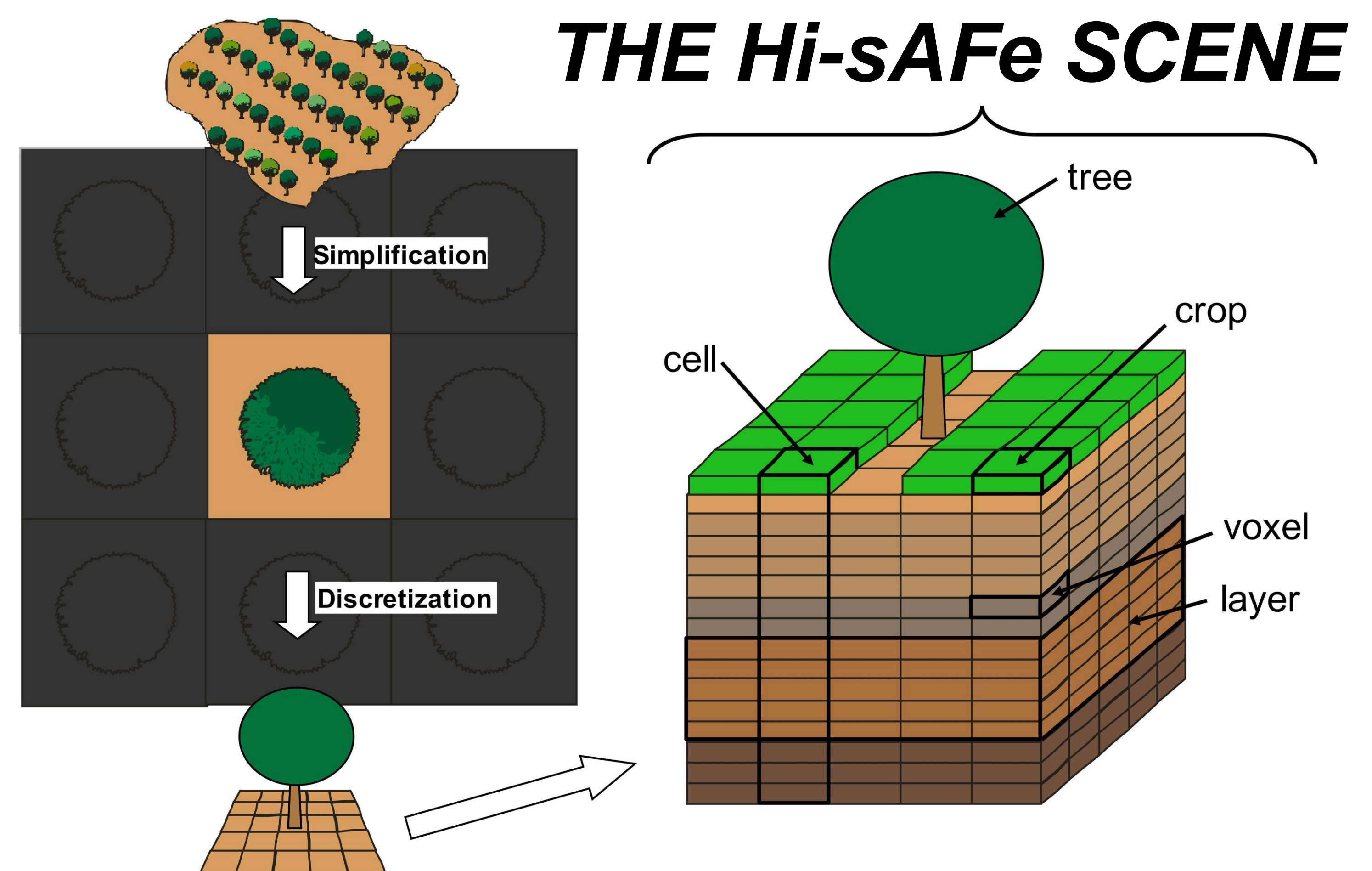
Hi-sAFe is a 3D biophysical model designed to explore the interactions between trees and crops in agroforestry systems. Utilization of any tree species within Hi-sAFe requires parameterization and calibration of the model for that tree species. We carried out these three steps for hybrid walnut (*Juglans regia x nigra*).

FIELD & LITERATURE DATA

Data used for parameterization and calibration came from the literature and long-term experimental plots at the Restinclières Estate near Montpellier, France. The three plots included two alley cropping systems of hybrid walnut and durum wheat (*Triticum durum*) and a forestry system of hybrid walnut with a natural ground cover.

21 tree inputs were unable to be parameterized directly and were included in the model calibration.

Restinclières Estate



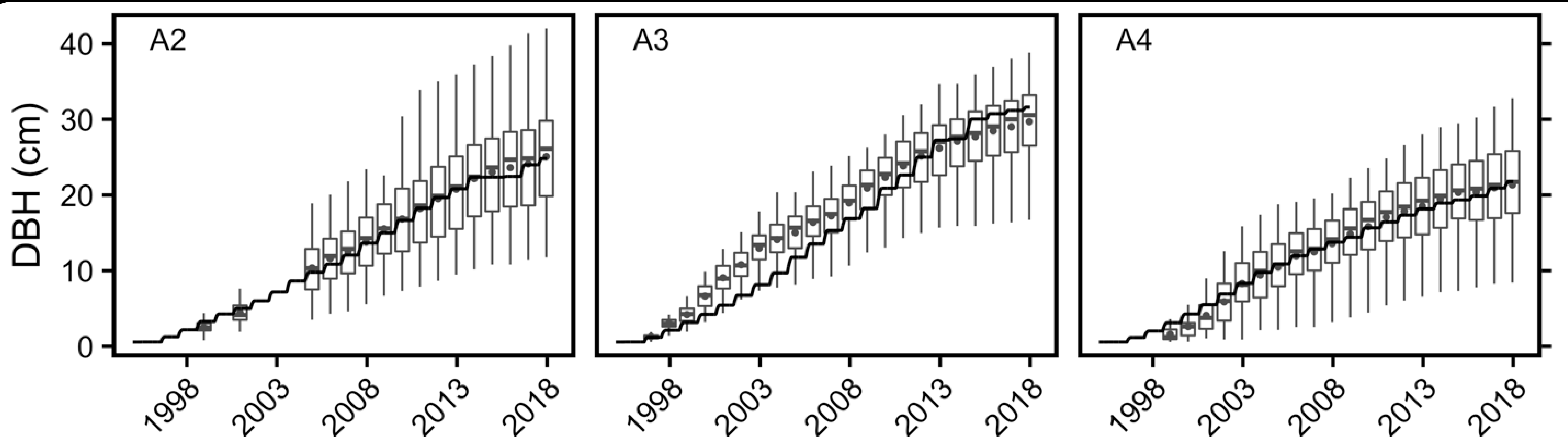
CALIBRATION

Optimal parameter values were searched for using a multi-objective evolutionary algorithm (MOEA) similar to the NSGA-II algorithm. 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.

Most Sensitive Calibrated Parameters

- *lueMax*
- *transpirationCoefficient*
- *targetNCoefficient*
- *cRAreaToFRLengthRatio*
- *colonisationThreshold*
- *horizontalPreference*
- *maxTargetLfrRatio*
- *initialTargetLfrRatio*
- *maxTargetLfrRatioDailyVariation*



Measured (boxplots) vs. modeled (lines) DBH of hybrid walnut in two agroforestry systems (A2 and A3) and one pure forestry system (A4) near Montpellier, France after model calibration.

CONCLUSIONS

These calibrated Hi-sAFe parameters for hybrid walnut can be used to confidently explore hybrid walnut agroforestry systems across pedoclimatic and management conditions.