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On the role of intraspecific variability of plant hydraulic traits when modelling plant water use strategies at different forested sites in Europe

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The drought resilience of forest ecosystems depends on the water use strategies and the degree of vulnerability to hydraulic failure of individual tree species. The coordination between hydraulic and allocation traits along with stomatal control determines the tree water-use strategy, ranging from acquisitive to conservative tree species. This work explores the role of different plant hydraulic traits (Ψ_{P50}, c_k, and k_{max} in the Community Land Model 5.0) on the simulated plant water use dynamics. We selected two broadleaved tree species (*Quercus ilex* L. and *Fagus sylvatica* L.) at four SAPFLUXNET experimental sites having contrasting climate conditions. From the range of plant hydraulic traits reported for each species in the Xylem Functional Traits (XFT) database and other literature, the most vulnerable and most resistant parameter combination was chosen as extreme cases. Four sets of experiments were carried out that include modification of the shape of the plant vulnerability curve changing only Ψ_{P50} and c_k (CS-experiment), changing only k_{max} (k-experiment), changing the three parameters of the vulnerability equation (FC-experiment), and changing gradually k_{max} (KS-experiment) to test the model sensitivity to k_{max}. The stand transpiration obtained from SAPFLUXNET was used as a benchmark for the model comparisons. The CS-experiment revealed that a vulnerable configuration increases the modeled transpiration during conditions with ample water supply, and causes severe water stress and reduced transpiration during dry periods as compared to a resistant configuration. This indicates that transpiration is hydraulically limited even at ample water supply in the model so that the more negative Ψ_{P50} enables increased transpiration. Although a more negative Ψ_{P50} allows the vegetation to access more soil water than would be the case for vulnerable configurations, the difference in actual plant available water is small at this dry end of the water retention curve, and hence the dry period water stress is mainly determined by early-season transpiration. The K- and KS- experiments illustrate the role of k_{max} to effectively scale up/down the transpiration response. Finally, the FC-experiments revealed the potential of plant hydraulic traits to mimic either conservative or acquisitive water-use strategies, allowing the vegetation to manage more efficiently the soil water resources. This work underlines the importance of selecting a suitable plant hydraulic parametrization contemplating the diversity of plant water use strategies.