Refining the outputs of a dynamic vegetation model (CARAIB): the importance of plant traits to improve prediction accuracy at tree species level.

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Dynamic vegetation models (DVMs) are process-based models combining the inputs and the outputs of sub-models, possibly in feedback loops, to simulate the plant functions. The sub-models compute conditions outside and inside the plant and physiological reactions from the environmental data (climate, light intensity, air CO_2 concentration, soil properties). DVMs are tools of choice to predict the future and the past of the vegetation taking into account climatic variations. The emergence of new questions in the context of climate change, particularly on threatened species or on commercial species, compels to apply DVMs to species while the information to parameterize and validate them is largely lacking. Of particular importance are the morpho-physiological traits. These were intensively studied within the hypothesis that they could be used to predict plant performances. This hypothesis finally revealed not very suitable, but it brought to light that important traits controlling photosynthesis and water relationships could strongly vary within each species in response to environmental conditions.

We studied the Atlas cedar (*Cedrus atlantica* (Endl.) Manetti ex Carrière), in Morocco (northern Africa). It is a threatened tree species of important economic value. We also studied the English oak (*Quercus robur* L.) and the sessile oak (*Quercus petraea* (Matt.) Liebl.) in eastern Belgium. In a series of localities, we determined several traits (specific leaf area, leaf C/N, sapwood C/N, as well as for the cedar, leaf longevity) and we assessed biomass and net primary productivity as validation data, thanks to forest inventories, dendrochronology analyses and allometric equations combined with leaf area index estimations. We compared the model simulations of the CARAIB DVM when varying the set of traits (direct site estimates or default values) to the field estimates of biomass and net primary productivity. We found that trait default values provide sufficient information for the DVM to compute mean output values but low ability to reproduce between site variations. On the contrary, the in situ traits improve drastically this ability, which indicates that the plant performances are the results of acclimation to the evolving local environmental conditions.