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Mechanistic trait-based model predicts fitness of evergreen and deciduous trees

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The global distribution of leaf life span, as associated to evergreen and deciduous leaf habits, is poorly understood. Although these two leafing strategies show a different phenology, they co-occur frequently in many ecosystems. This co-occurrence therefore implies that there is a continuous trait spectrum with multiple optimal trait combinations in which different strategies may operate with the same fitness.

The aim of this study was to mechanistically evaluate strategy differences between evergreen and deciduous trees, using a trait-based model to optimize fitness in response to a range of environmental conditions.
We have developed a model, EVDEC, which optimizes plant allocation of carbon and nitrogen to maximize fitness using current knowledge on trait-trait coordination and trait-environment relationships. The leaf traits used in the model are Specific Leaf Area, nitrogen per area, Leaf Dry Matter Content and Leaf Thickness. Results of the optimization over a range of temperatures for both leafing strategies shows that both evergreen and deciduous trees are able to cope with a large range of environments, using different combinations of traits in this multidimensional spectrum. Furthermore, evergreen trees appear to be much more dynamic in leaf traits compared to deciduous trees.

Our model demonstrates for the first time that it is possible to explain variation in plant traits driving plant fitness across environmental gradients, including the seasonal dynamic of these traits, using optimized allocation parameters.