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Simulating the success of plant hydraulic strategies within a global vegetation model

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Today's forest carbon stocks are threatened by climate change through many types of disturbances, including drought. State-of-the-art Dynamic Global Vegetation Models (DGVMs) have hitherto not been able to explicitly simulate the response of tree hydraulic systems to drought, which are ultimately important determinants of tree resilience during drought events. Increasingly, more detailed representations of plant hydraulics, including death by cavitation, are being included in DGVMs, but simulations at the global level have been challenging, partially due to the lack of data for parameterisation. To overcome these issues, we compiled a large dataset of hydraulics-relevant plant traits from the literature (including TRY). To overcome the sparseness of the available trait data, we used literature on the functional relationships between traits to create a hypothesis framework that functionally links multiple traits and their trade-offs together in a network. From this network of traits we can sample parameter sets that reflect coherent plant strategies. We applied these strategies in the plant-hydraulics-enabled DGVM LPJ-GUESS and show how they can be used to provide model-based hypotheses of how both strategies and individual trait values vary across different forest environments. These results provide a basis for global-scale hydraulic model parameterisation, as well as providing verifiable hypotheses for testing in the field.