Drought-forced tree morphological changes facilitate trubs in a semiarid region

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Semiarid forests characterized by the presence of “trub” species, which have short heights but large canopy sizes, can maintain a high carbon sequestration rate. By integrating terrestrial laser scanning (TLS), we quantified drought-forced tree morphological variation along a precipitation gradient; annual precipitation (MAP) explained 70.3% of variation in tree height (Height) but did not explain the variation in canopy area (CA). Theoretical CA-Height relationships widely adopted by dynamic global vegetation models (DGVMs) matched only the 5th percentile of our results, which is problematic for simulating carbon sequestration of open forests in semiarid regions. The trend toward “trubs” under a drying climate implies two decoupled functions of stems, mechanical stability and hydraulic efficiency, and can be an important strategy for trees to balance water and carbon. Our results demonstrate the importance of tree morphological studies for both tree environment-acclimation strategies and the improvement of DGVMs.