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Patterns in leaf morphological traits of Chinese woody plants and the application for paleoclimate reconstruction

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Leaf morphological traits (LMTs) directly influence carbon-uptake and water-loss of plants in different habitats, and hence can be sensitive indicators of plant interaction with climate. The relationships between community-aggregated LMTs and their surrounding climate have been used to reconstruct paleoclimate. However, the uncertainties in its application remain poorly explored.

Using distribution maps and LMTs data (leaf margin states, leaf length, leaf width, and length-width product/ratio) of 10480 Chinese woody dicots and dated family-level phylogenies, we demonstrated the variations of LMTs in geographical patterns, and analyzed their relationships with climate across different life-forms (evergreen and deciduous; trees, shrubs and lianas) and species quartiles with different family-ages.

Results showed that from southern to northern China, leaves became shorter and narrower, while leaf length-width ratio increased and toothed-margin percentage decreased. Our results revealed great uncertainties in leaf margin-temperature relationships induced by life-form, precipitation and evolutionary history, and suggested that the widely-used method, leaf margin analysis, should be applied cautiously on paleotemperature reconstruction. Differently, mean leaf size responded tightly to spatial variations in annual evapotranspiration (AET) and primary productivity (GPP and NPP), and these relationships remained constant across different life-forms and evolutionary history, suggesting that leaf size could be a useful surrogate for paleo primary productivity.