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Moisture availability constraints on the leaf area to sapwood area ratio: analysis of measurements on Australian evergreen angiosperm trees

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The leaf area to sapwood area ratio (LA:SA) is a key plant trait that links photosynthesis to transpiration. Pipe model theory states that the sapwood cross-sectional area of a stem or branch at any point should scale isometrically with the area of leaves distal to that point. Optimization theory further suggests that LA:SA should decrease towards drier climates. Although acclimation of LA:SA to climate has been reported within species, much less is known about the scaling of this trait with climate among species. We compiled LA:SA measurements from 184 species of Australian evergreen angiosperm trees. The pipe model was broadly confirmed, based on measurements on branches and trunks of trees from one to 27 years old. We found considerable scatter in LA:SA among species. However quantile regression showed strong ($0.2<R1<0.65$) positive relationships between decadal averages of two climatic moisture indices and the lowermost (5%) and uppermost (5-15%) quantiles of log LA:SA, suggesting that moisture availability constrains the envelope of minimum and maximum values of LA:SA typical for any given climate. Interspecific differences in plant hydraulic conductivity are probably responsible for the large scatter of values in the mid quantile-range, and may be an important determinant of tree morphology.