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Quantitative prediction of leaf economics

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The 'leaf economics spectrum' (LES) relating leaf longevity (LL) to leaf mass per area (LMA) has been known for 15 years, but it has not been shown from first principles how these are quantitatively related, nor how climate should influence their relationship. Combining three elements (Kikuzawa's optimality hypothesis, Xu et al.'s empirical rules, and the coordination hypothesis) we develop a theoretical framework for the LES, which we show to be consistent with two independent trait data sets. In evergreen species, LL increases in proportion to LMA but decreases in proportion to leaf-level irradiance and the square root of growing-season length. LMA has limited predictability from environment alone, because many alternative LL-LMA combinations are viable. In deciduous species, LL is constrained by growing-season length; community-mean LMA is predictable from light, growing-season length and temperature. An additional positive effect of aridity on LMA was also found in both evergreen and deciduous plants.