The marginal water cost of carbon gain: Patterns of emergence in the Ball-Berry slope parameter by plant functional type

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Abstract. Plant leaves are key factors in the global water exchange cycle - leaves affect the land surface water and energy budgets by controlling the passage of water vapor and carbon dioxide through the aperture or conductance stomata -small orifices on the leaf surface. A common approach for estimating fluxes of CO_2 and water in leaf and canopy models is to couple a mechanistic model of photosynthesis (P_n) to a semi-empirical model of stomatal conductance (g_s) by utilizing an observed linear relationship between net photosynthesis (A_{net}) and g_s. In contrast to the generally good understanding of how key parameters in the biochemical model of A_{net} vary by species and plant functional type (PFT), much less is known about how a key and influential parameter (*m)* of the g_s model varies by PFT. This parameter represents the marginal water cost of carbon gain, and has a large influence on transpiration estimates. However, the range of reported values is highly variable among species, PFTs, and studies. Additionally, sparse attention has been given to whether this parameter acclimates to environmental conditions such as moisture stress, with disparate results reported in the literature. The overarching objective of this work is to extract and compile a robust historical compilation of reported parameter value for *m,* as well as examine patterns of parameter response to fluctuations in environmental conditions such as soil moisture and elevated atmospheric CO_2. The compiled results are utilized to group patterns of environmental response by PFT, and further build on and refine recently reported patterns of emergence in this parameter.