Mountain landscapes have complex and rugged topographies, with abrupt spatial and temporal changes in microclimate and soil properties, factors that directly affect tree growthand canopy processes. These may alter functional relationships over short spatial scales, rendering the use of allometry in scaling tree water use (TWU) from single trees to stand level less accurate. On the other hand, canopy processes, especially stomatal conductanceare sensitive to the environmental conditions prevailing above the canopy. Given that these also change rapidly in a mountain landscape, we speculate that patterns of water use in a complex landscape are determined by the interaction between stand structure and canopy conductance. We examined forest stand structure, microclimate and sap flux density (Js) in two forest stands distributed at 50 m and 330 m elevations of the Dinghushan Mountain in south China to determine how they influence tree functional allometry for scaling up stand water use. Tree sapwood area (SA) was correlated with the diameter at breast height (DBH) irrespective of species and location within the forest catchment. The maximum sap flux density (Js) on a clear sunny day ranged from 18 ± 9 to 48 ± 12 and 25 ± 8 to 64 ± 11 g m^{-2} s^{-1} in the 330 m and 50 m forest stands, respectively. Differences among trees and between forest stands were significant ($p < 0.05$). Daily maximum tree water use (TWU) ranged from 2 ± 4 to 36 ± 12 kg d^{-1} and 4 ± 3 to 42 ± 11 kg d^{-1} in the 330 and 50 m, respectively. Differences between the stands were significant. Within a stand, TWU was correlated with DBH irrespective of species. This functional relationship was, however, different between the forest stands, resulting in different E estimates for the respective stands. Cross-site variations were due to differences in vapor pressure deficit (VPD), photosynthetic photon flux density (PPFD) and leaf specific canopy conductance (g_t). While trees responded in a similar manner to the microclimatic environment, between-site differences in stand characteristics shifted the functional relationships. Thus, in this complex mountain terrain, using a universal, site-specific allometric equation in scaling up sap flow from single trees to catchment-scale can lead up to 30% inaccuracy.