As a general trend species with high wood density as adults are tolerant to water inundation. These species may have the plasticity to grow into these high wood density values and be enabled to do and we provide some evidence that this could be a result of internal carbon budgeting, whereby species with the plasticity to grow high wood density convergence on adult values. High wood density species are present across the elevation gradient, the ability to exist on a low carbon budget is useful along the entire gradient from drought, shading, water inundation – thus we may not expect to see variable distributions. Nevertheless, the quality of inundation sensitivity can be allowed through another mechanisms (here not stated) as some low wood density species also are able to withstand inundation episodes. Co-occurrence of low- and high-density species is possible in low elevation flooded areas if they include micro-topographical refuges from waterlogging (Fig. 1) where, we conjecture, fast growing low-density species have a competitive advantage over slower growing high-density species3. Thus, in the absence of a flooding regime, species are expected to segregate along gradients of wood density associated with soil water and nutrient responses, but where lower elevations are bounded by floodplains, a triangular relationship is observed (Fig. 3d).

Our understanding of species partitioning across the soil water gradient in tropical forests has been driven almost exclusively from the perspective of species being restricted by limited water availability associated with higher elevations2,4,6–8. We can interpret this as a result of species sorting among seedlings across the soil water gradient that ultimately determines adult spatial distributions. It has been suggested that tropical saplings have developed distribution patterns similar to that exhibited by their adults on reaching a size of 1 cm diameter26. Alternatively, these patterns might be explained as the result of evolved differential adaptations to soil water conditions acting on later (post-seedling) life history stages, which happen to be ontogenetically reflected in seedling populations. Thus, while species sorting among seedlings appears to occur along the soil water gradient, we cannot attribute the distribution of adult populations solely to this process. Nonetheless, there is remarkable congruence between differential seedling responses to inundation at micro-topographical scales and the macro-topographical distribution of adults.

Our results suggest a soil water balance trade-off among dipterocarp species expressed from small-scale micro-topographical differences of a few centimetres that affect seedling survival, to larger scale distributions of adult trees over topographical ranges of tens or hundreds of metres. Yet high wood density species occur across the entire soil water gradient. Thus, a direct trade-off among species may not be forthcoming, as high wood density provides species with some tolerance to both drought16 and, as we show here, water inundation.

Given the increasing evidence that soil water availability constrains species distributions, altered precipitation patterns11 could have an extensive impact on tropical tree communities. The implications of climate change for the vegetation of the lowland tropics of Southeast Asia are poorly understood27, but current understanding suggests that some reorganisation of tree communities is likely as a result of the increasingly variable precipitation predicted for the region.