environment of 10,000 pixels, wherein 50 breeding trials of the same genotypes (i.e. eucalyptus clones) are randomly allocated. We used 100 non-related genotypes expressing a low heritability quantitative trait that mimics yield. GIS-GE uses spatial interpolation to environmental data, referring either to climatic and landscape variables, to define Environmental Indexes (EI) by their relationship to the phenotypic data, totaling 1 million of envirotypic markers (100 envirotypes * 10,000 pixels). For this envirome, we used advanced genetic modeling to estimate the EI effects across the whole set of pixels. We show that GIS-GE presents advantages in breeding, including matching of genotypes to their most appropriate sites; definition of breeding areas of highest genetic correlation to genotypes; and indication of the locations that maximize the capture of lost phenotypic heritability in trials.

Full-rotation carbon, water and energy fluxes in a tropical eucalypt plantation

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Eucalyptus plantations in Brazil are among the most productive forests of the world, reaching mean annual increments of about 50 m^3 ha^{-1} yr^{-1} over short (6 - 7 yrs) rotations. We continuously monitored water vapor, CO_2 and energy flux through the eddy-covariance method over a 9 year-period in southeastern Brazil. Tree growth, Leaf Area Index (LAI), water table depth, and soil water content (SWC) down to 10 m depth were also monitored. Rooting depth and vertical fine root distribution were assessed at various ages. Mean annual evapotranspiration (AET; 1383 mm yr^{-1}) represented 90% of the annual precipitations (P; 1539 mm yr^{-1}). AET reached maximum values (1598 mm yr^{-1}) about 2-3 years after planting (a.p) when LAI peaked and when deep rooting (about 15 m deep 2.5 yrs a.p) provided access to the large amount of water stored in deep soil layers during the first months after clear-cutting and replanting. Most (88%) of the available energy (3852 MJ yr^{-1}) was partitioned to the evaporation process (latent heat fluxes), with very low sensible heat fluxes over the rotation, except after harvesting and replanting when LAI was low, and later in the rotation during dry events. Deep drainage after harvest of the first stand allowed the water table to rise from -18 to -12 m over the first 2 years after replanting. Both measurements of SWC and model simulations showed that deep water storage and subsequent uptake played a major role in supporting the very high wood production and dampening seasonal droughts.

Light use efficiency and productivity of 16 genotypes of *Eucalyptus* along a 6-year rotation in Brazil

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Forest stemwood productivity depends on the amount of absorbed light and on the Light Use Efficiency (LUE), i.e. the amount of stemwood produced per amount of absorbed light. Other growth limiting factors than absorbed light are for instance water and nutrients, carbohydrates allocation processes, and management practices. In fertilized eucalyptus plantations in Brazil, a shift in the main factor limiting growth is expected, from light at the beginning of the rotation (not limited by water because soil has been recharged during the interval between rotation) to other factors such as water in the subsequent years. Changes of allocation patterns and foliar traits also occur along the rotation. These trends may differ between genotypes. These hypotheses were tested along a 6-year rotation, with 16 contrasted genotypes planted in 10 randomized repetitions in São Paulo Region, Brazil. Absorbed light was estimated using the MAESTRA 3D model precisely parameterized at tree scale for each plot. Stand growth was computed based on allometric relationships calibrated on regular destructive biomass measurements. Results at stand scale showed that 1) LUE increased with stand age for all genotypes, from 0.15 to 0.70 g_{dry_matter}r/MJ on average; 2) light was the main limiting factor during the first year of growth (R^2 between 0.5 and 0.95). Subsequently, the variability of wood production explained by light was variable among genotypes (R^2 of 0.25 on average; 3) The effect of genotype on stemwood production remains high and significant along the rotation. These results and their implications for plantation management are discussed.

Unraveling drivers of growth dominance and its impact on stand growth of *Eucalyptus* plantations across Brazil

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Growth dominance (GD) occurs when trees grow disproportionally to their size compared to other trees. High growth dominance indicates that stand growth is concentrated in larger trees, leading to further increase in size heterogeneity in stand structure. Growth dominance increases have been associated with lower productivity in tree monocultures, especially in monoclonal stands such as the eucalypt plantations in Brazil. Understanding how GD develops for different eucalypt genotypes and the effects of site and age are fundamental to understand the link between stand structure and productivity. We used data from the TECHS-IPEF cooperative research program, a continental experimental platform, in which different genotypes were planted in sites ranging from north Brazil to Uruguay. We chose four contrasting sites regarding soil water deficit, in which 18 genotypes were planted in monoclonal plots at 3 m × 3 m spacing (genotype differed among sites). Two adjacent plots were established for each genotype, one treated with 30% throughfall exclusion. We investigated whether there was difference in the development of GD among genotypes; whether water stress (represented by the contrasting sites and by throughfall exclusion within site) affects GD; and whether GD is associated with decreasing plot volume increment. We found significant differences in GD, as well as in its development throughout time, among genotypes. GD increased with age and tended to be lower with slowest development for the drier sites as well as for the throughfall exclusion plots. After other factors were accounted for, increasing GD was associated with decreasing plot volume increment.