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Can forests organize regular tree growth trends at the aggregate level ?

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Abstract

Individual trees in natural forests often exhibit complex, inconsistent, and variable growth trajectories influenced by genetics, climate change, and uneven stand structure. These growth divergences pose a challenge in predicting the overall growth trend of trees. Here, we propose a radius-driven metabolic growth model (IGMR) to examine the radial growth of trees, thereby addressing this problem on a global scale. The IGMR suggests that tree ring growth pattern is determined by tree maximum radius and total growth time and can vary over some predictable range. Our results show that the best radial growth trajectory (BGT) at the aggregate level follows the IGMR, and its half also constrains the overall growth trend. Further analysis shows that climate change and uneven stand structure may cause the overall growth trajectory to undergo more growth drifts (changes in growth rate only) than adaptations (changes in maximum size). These results not only extend metabolic growth theory, but also imply that climate change is more likely to affect forest maximum carbon sequestration through community shifts than through changes in tree growth.

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