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Climate sensitivity and carbon dynamics of *Eucalyptus obliqua* within wet and dry Tasmanian forests: Implications for future growth under climate change

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The eucalyptus forests of Tasmania, Australia are some of the most productive and carbon dense in the world. Of the eucalypt species that are native to Tasmania, messmate stringybark (*Eucalyptus obliqua, Euob*) dominates 20% of the forested landscape. Moreover, *Euob* is distributed across both dry and wet forests that exhibit vastly different microclimates and subdominant vegetation communities. However, warming temperatures and increasingly stochastic precipitation events threaten their fate. Here, we reconstruct historical growth and physiology to characterize the sensitivity and timing of *Euob* tree responses to climate in two contrasting forest types (i.e. wet versus dry). We then combine these data with stand-level surveys and total carbon inventories to scale our findings within their respective geographical footprints. Finally, we develop a novel modeling framework to contextualize differences in the growth potential of trees in each environment under current and future projected environmental conditions. We found *Euob* tree growth in dry forests is highly sensitive to climate in the late spring, while growth in wet forests is more complacent and driven to a greater extent by mean climate over the course of a growing season. Moreover, intrinsic water use efficiency, the ratio of net photosynthesis to stomatal conductance to water, remains constant across a range of soil moisture in wet *Euob* forests, but declines with increasing water availability in dry forests. Our data suggest *Euob* growth, and subsequently carbon uptake and allocation to stem wood, is energy-limited in wet forests and water-limited in dry forests. Growth modeling revealed that, even under ideal conditions (i.e. maximum realized growth potential), stand-level carbon stocks in dry *Euob* forests achieve only 90% of those currently observed in wet forests. Our results suggest *Euob* trees in energy-limited wet forests could benefit under future climate, as Tasmania is expected to become warmer in most regions, while dry forests may be particularly vulnerable.