EGU22-13194
https://doi.org/10.5194/egusphere-egu22-13194
EGU General Assembly 2022

Differential climate memory drives tree growth in ongoing forest dieback

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Changing climatic conditions suggest that forests will be altered at unprecedented rates over the course of this century. In forests experiencing drought-induced dieback, declining trees may exhibit altered climate memory, likely reflecting their lower buffering capacity and shorter leaf lifespan. This study evaluates the effects of past climate conditions on tree growth in forests dominated either by gymnosperms or angiosperms showing different levels of vigor (crown defoliation). We applied the stochastic antecedent modeling (SAM) framework to understand the role of past climate on tree growth in declining and non-declining trees. The model allows us to elucidate the importance of past temperature and precipitation conditions for tree growth and the predisposition for forest dieback. Our results identified lower growth rates, reduced sensitivity to antecedent climate, and shifts in the seasonal importance of climate in declining compared to non-declining trees. We found that declining trees of some tree species were sensitive to recent temperature and precipitation conditions, whilst climatic conditions further into the past were more important for non-declining trees. Both vigor classes were also coupled to climate conditions during markedly different seasons, with dry summer conditions particularly affecting declining trees. Our results point to the importance of climatic sensitivity and memory on growth for understanding and forecasting forest dieback.