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A novel dendroecological method finds a non-linear relationship between elevation and seasonal growth continuity on an island with trade wind-influenced water availability

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Climatic seasonality drives ecosystem processes (e.g. productivity) and influences plant species distribution. However, it is poorly understood how different aspects of seasonality (especially regarding temperature and precipitation) affect growth continuity of trees in climates with low seasonality because seasonality is often only crudely measured. On islands, exceptionally wide elevational species distribution ranges allow the use of tree rings to identify how growth continuity and climate–growth relationships change with elevation. Here, we present a novel dendroecological method to measure stem growth continuity based on annual density fluctuations (ADFs) in tree rings of Pinus canariensis to indicate low climatic seasonality. The species ranges from 300 to >2000 m a.s.l. on the trade wind-influenced island of La Palma (Canary Islands), where we measured three decades of tree-ring data of 100 individuals distributed over 10 sites along the entire elevational range. The successfully implemented ADF approach revealed a major shift of stem growth continuity across the elevational gradient. In a remarkably clear pattern, stem growth continuity (percentage of ADFs) showed a hump-shaped relationship with elevation reaching a maximum at around 1000 m a.s.l. Low- to mid-elevation tree growth was positively correlated with the Palmer Drought Severity Index (PDSI; indicating aridity) and sea surface temperature (indicating trade wind-influenced moderation of water supply), while high-elevation tree growth was positively correlated with winter temperature (indicating a cold-induced dormancy period). We conclude that ADFs are a useful method to measure stem growth continuity in low-seasonality climates. Growth of P. canariensis on the Canary Islands is more frequently interrupted by winter cold at high elevations and by summer drought at low elevations than in the trade wind-influenced mid elevations, where growth sometimes continues throughout the year. Climate change-associated alterations in trade wind cloud formation might cause non-analogue growth limitations for many unique island species.

Weigel R, Irl SDH, Treydte K, Beierkuhnlein C, Berels J, Field R, Miranda JC, Steinbauer A, Steinbauer MJ, Jentsch A. 2018. A novel dendroecological method finds a non-linear relationship between elevation and seasonal growth continuity on an island with trade wind-influenced water availability. AoB PLANTS 10: ply070; doi: 10.1093/aobpla/ply070