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Refining the standardized growth change method for pointer year detection: bias-adjustment and definition of the recovery period

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Detecting pointer years in tree-ring data is a central aspect of extreme-event ecology. Pointer years usually represent extraordinary secondary tree growth, which can often be interpreted as response to extraordinary environmental conditions such as late-frosts or droughts. Identifying pointer-years in larger tree-ring networks and relating those to specific climatic conditions may allow for a deeper understanding of how trees perform under extreme climate and consequently, under anticipated climate change (Meyer et al., 2020; Rehschuh et al., 2017).

Recently, Buras et al. (2020) demonstrated how frequently used pointer-year detection methods are suboptimal for such large-scale analyses due to an either too low or sometimes too high sensitivity in detecting extraordinary growth. In their study, Buras et al. (2020) proposed a novel approach for detecting pointer years – the standardized growth change (SGC) method. Despite a higher success rate with regards to identifying artificially introduced pointer years in simulated tree-ring data, Buras et al. (2020) concluded that the SGC method could be further refined to capture pointer years following a gradual growth decline. Moreover, they discussed the possibility to incorporate growth changes at higher lags, thereby allowing the duration of the recovery period following a pointer year to be estimated.

Under this framework, we here present a refined version of the SGC-method – the bias-adjusted standardized growth change method (BSGC). The methodological adjustment to the SGC approach incorporates conflated probabilities of time-step specific growth changes with probabilities of time-step independent growth changes. Application of BSGC to simulated and measured tree-ring data indicated a successful bias adjustment which now allows for the identification of pointer years following years of successive growth decline. Moreover, the length of simulated recovery periods was well reproduced and revealed plausible results for existing tree-ring data. Based on these validations, BSGC can be considered a further refinement of pointer-year detection, allowing for a more precise detection and consequently better understanding of the radial growth response of trees to extreme events.

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