# INSTITUTE OF LOWLAND FORESTRY AND ENVIRONMENT

Early-warning signals of individual tree mortality based on annual radial growth, Frontiers in plant science, 9, 2019, p. 1964

Scientific paper

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Tree mortality is a key driver of forest dynamics and its occurrence is projected to increase in the future due to climate change. Despite recent advances in our understanding of the physiological mechanisms leading to death, we still lack robust indicators of mortality risk that could be applied at the individual tree scale.

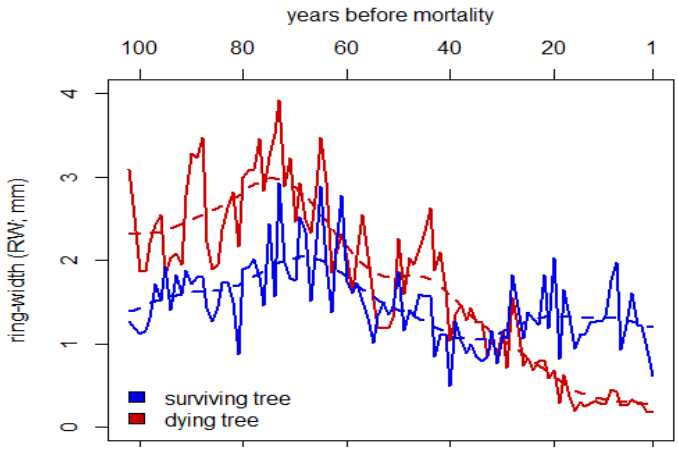


Figure 1: Mean chronology of 4389 surviving and 3605 dying trees

Taking advantage of a unique global ring-width database of 3065 dead trees and 4389 living trees growing together at 198 sites (belonging to 36 gymnosperm and angiosperm species) (Figure 1 and 2), we analyzed temporal changes in autocorrelation, variance, and synchrony before tree death (diachronic analysis), and also compared these metrics between trees that died and trees that survived a given mortality event (synchronic analysis). Changes in autocorrelation were a poor indicator of mortality risk. However, we found a gradual increase in inter-annual growth variability and a decrease in growth

synchrony in the last ~20 years before mortality of gymnosperms, irrespective of the cause of mortality. These changes could be associated with drought-induced alterations in carbon economy and allocation patterns. In angiosperms, we did not find any consistent changes in any metric. Such lack of any signal might be explained by the relatively high capacity of angiosperms to recover after a stress-induced growth decline. Our analysis provides a robust method for estimating early-warning signals of tree mortality based on annual growth data. In addition to the frequently reported decrease in growth rates, an increase in inter-annual growth variability and a decrease in growth synchrony may be powerful predictors of gymnosperm mortality risk, but not necessarily so for angiosperms.

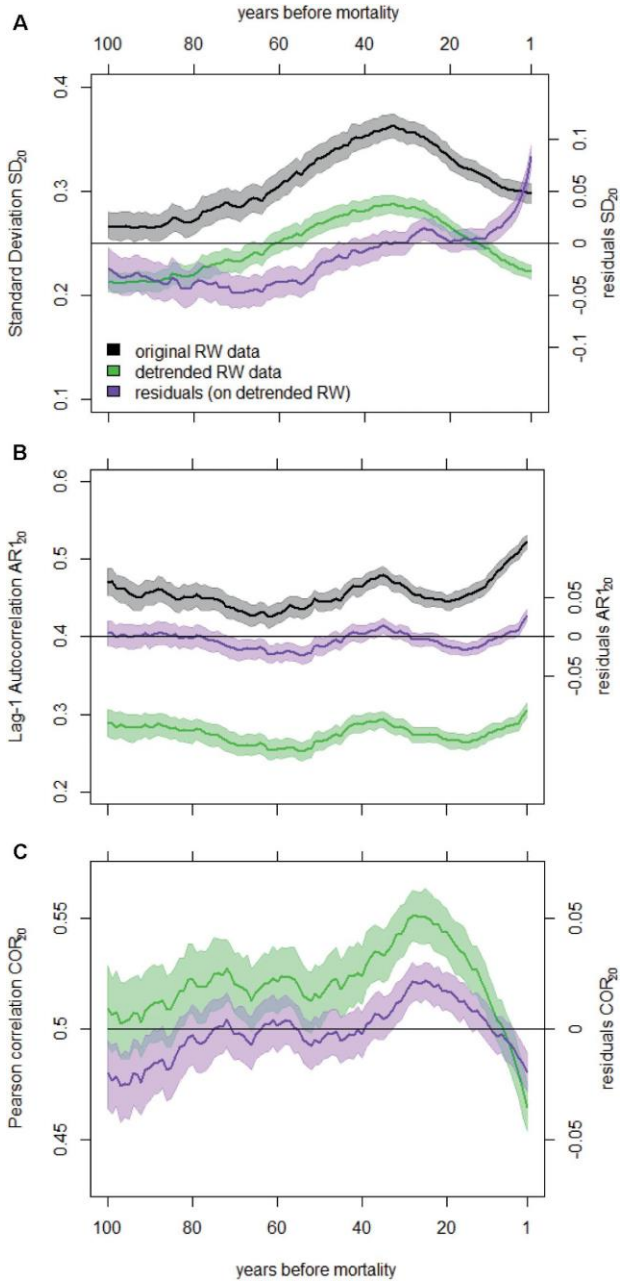


Figure 2. Temporal change before death different statistical parameters averaged for all dying trees and calculated on the original and detrended data.