A Bicentennial Reconstruction of Tropical Cyclone Rainfall Variability Derived from Longleaf Pine (*Pinus palustris* Mill.)

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■ Records of tropical cyclone precipitation (TCP) in the USA are insufficiently long to fully understand the natural range of TCP variability.

■ We used longleaf pine (*Pinus palustris* Mill.) latewood chronologies from two study sites in North Carolina and a combined chronology as a proxy for TCP during AD 1771–2014 as the latewood growth period of June 1–October 15 coincides with 93% of annual TCP.

■ We correlated latewood radial growth with TCP during 1953–2014 based on days when tropical cyclones tracked within a 223 km rain field: (r = 0.71, p <0.01).

■ We created three radial-growth groups (low, near-average, high) and found that corresponding TCP values were significantly different (p <0.05) between groups. Low radial-growth values were a strong marker (91% occurrence) of below-average TCP years, with high radial-growth years (73% occurrence) also being good indicators of above-average TCP years.

■ The high fidelity between longleaf pine latewood growth and TCP coupled with the geographic distribution of the species throughout the southeastern USA where tropical cyclones are common suggests the utility of this species to help better understand the temporal variability of precipitation delivered via tropical cyclones.

Figure 1. Typical open-canopy conditions for longleaf pine at the study sites. Note gradual slope typical of bay ridges.

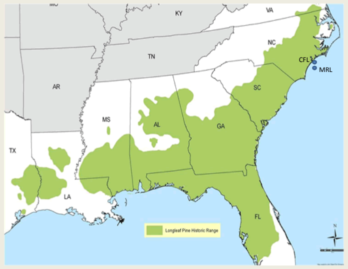

Figure 2. Location of two study sites in North Carolina and range of longleaf pine.

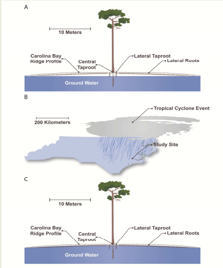

Figure 3. Hypothesized relationship between latewood growth and TCP. A) cross section of a longleaf pine on Carolina bay ridge with root structure shown; B) TCP over North Carolina coastal plain; and, 3) rise in water table post-storm to the height of lateral roots, which we posit triggers a latewood growth flush.

Figure 4. Remnant stumps extend tree-ring data to the 1600s.

Figure 5. Working on relict longleaf pine sites is a lot of fun!

Figure 6. Core sampled at the MRL site (Figure 2). Latewood variations are closely related to variations in TCP. Pronounced suppressed growth occurred during 1843–1877 (center).

■ We postulate the high fidelity between latewood growth and tropical cyclone precipitation is a result of oscillating water tables, with tropical cyclones creating a basin-wide recharge of the water table to the height of the longleaf pine taproots (Figure 3).

■ Five significant (p < 0.05) latewood growth regime shifts were identified (Figure 7), with the most prominent regime of 1836–1877 corresponding to a distinct period of reduced TCP. This period of reduced latewood growth was present in *all* cores, suggesting a pronounced and severe period of low TCP (Figure 8).

■ The 1815 Tambora eruption is coincident with the onset of a multidecadal period of below-average TCP (Figure 9).

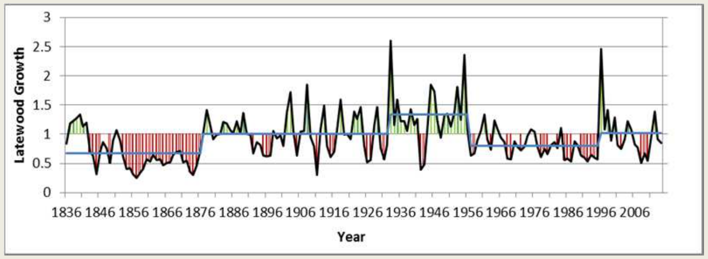

Figure 7. Occurrence of dry (red lines, radial growth ≤ .76) and wet (green lines, radial growth ≥ 1.1) TCP years for the combined chronology. Classification of dry or wet TCP years inferred from standardized latewood radial-growth widths (black line). Regime shifts (p =0.05) from one stable growth period to another are shown by the blue line.

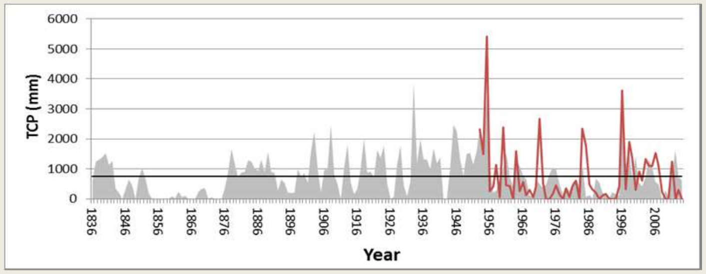

Figure 8. Time series of reconstructed TCP from the combined standardized tree-ring chronology (gray shaded) and the observed TCP (red line). Mean TCP (740 mm) during 1953–2014 is also shown (black line).

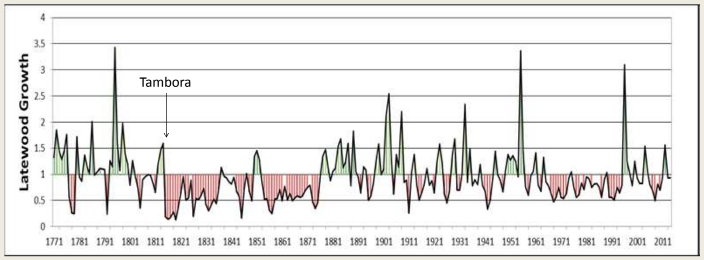

Figure 9. Period of marked TCP decrease (red) at site CFL is coincident with the 1815 Tambora explosion and consistent with the idea of reduced TC activity following major volcanic eruptions.

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