An examination of tropical cyclone precipitation regimes along coastal North Carolina, USA during 1750-2015 using a longleaf pine tree-ring record

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- Based on samples collected from live and remnant wood (Figs. 1–3) along coastal North Carolina, we examined relationships between longleaf pine latewood widths and tropical cyclone precipitation (TCP) during 1750–2015 to determine the temporal variability of multidecadal wet and dry phases.
- We hypothesized that wet and dry phases were caused by synoptic controls that affected the steering currents of the tropical cyclones blocking their westward migration.
- We found:
    1) six phases of alternating wet and dry periods during the 266-year period ranging from 17 to 62 years with the 1843–1876 dry phase (i.e., the Great Suppression) unmatched in its severity (Table 1, Figures 4 a–b);
    2) the Great Suppression was concurrent with a period of anomalously low pressure (500 hPa height) centered over the southeastern U.S.A. coastline that served as a “steering low” that blocked the onshore advancement (Figure 5a); and
    3) that each dry phase coincided with the persistence of steering lows including the most recent (2006–2016) period marked by the absence of major landfalling tropical cyclones (Figures 5 b–d).
- We conclude that variability in TCP and inferred tropical cyclone activity along the North Carolina coast exhibits significantly greater variability than documented by historical records and that periods of unusually dry (wet) phases are caused by the presence (absence) of steering lows along the coast (Figures 6 a–b).

Figure 1. Old-growth longleaf pine savanna near New Bern, NC. Live trees at this site date to the mid-1700s with remnant wood having interior dates to the 1600s.

Figure 2. Remnant wood samples dating to the 1600s are common in longleaf savannas because of the rot resistance of the species.

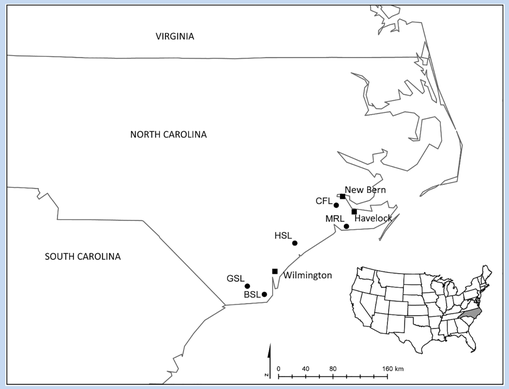

Figure 3. Location of study sites (circles) and three climate stations (squares).

RSA Phase	Regime Length (Years)		Regime Groupings by TCP 1 = driest, 4= wettest		
		1	2	3	4
1764–1780	17			111.7	111.7
1781–1842	62		83.4	83.4	
1843–1876	34	17.6			
1877–1932	56		65.8		
1933–1964	32				127.8
1965–2014	50		58		

Table 1. Six phases of wet and dry conditions during 1750–2014 with mean TCP values (mm) during each phase. Only the 1843–1876 phase was significantly different based on ANOVA with a Tukey HSD test.

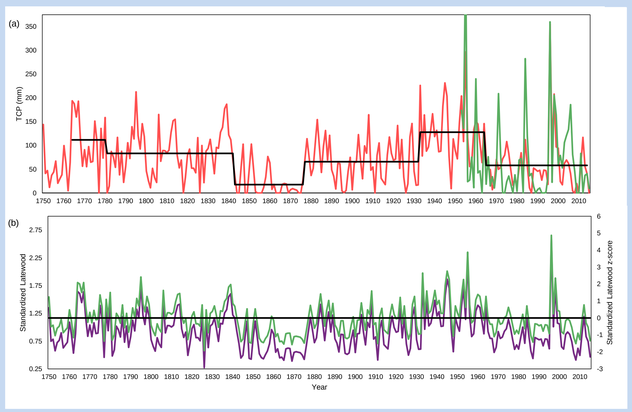

Figure 4. Top: Reconstructed (rose) and actual TCP (green) with wet and dry phases shown by black line. Bottom, standardized (purple) and z-scores of latewood (green) and with mean z score (flat line).

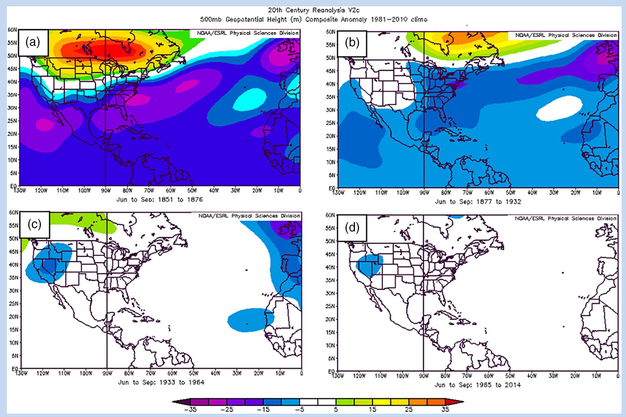

Figure 5. The mean 500 hPa height anomalies during TCP phases of 1851–2014: (a) 1843–1876, (b) 1877–1932, (c) 1933–1964, and (d) 1965–2014. The 1843–1876 phase is truncated by lack of data prior to 1851.

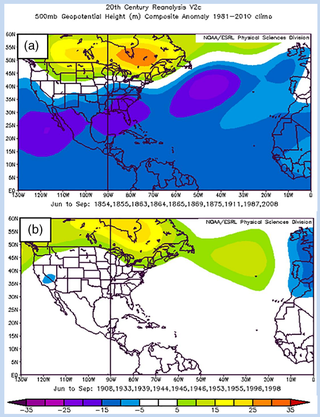

Figure 6. The mean 500 hPa height anomalies during: (a) the 10 driest and (b) the 10 wettest reconstructed TCP years during 1851–2015.

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