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RECONSTRUCTING SOUTH CAROLINA TROPICAL CYCLONES BACK TO THE MID EIGHTEENTH CENTURY

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1. Introduction

Tropical cyclones are commonly recurring hazards in South Carolina. The Atlantic tropical cyclone database since 1886 indicates significant tropical storm impacts on the region occurring about every 1.8-2 years, and at least category 1 hurricane impact about every 8-10 years (e.g., Purvis and McNab 1985). However, the record since 1886 has limitations in assessing a longer temporal perspective on tropical cyclone activity over the Atlantic Basin at longer timescales and when different climatic forcing was prevalent. Historical records enable reconstructions of tropical cyclones that extend back to the eighteenth century (Chenoweth 2003). We provide a detailed and continuous reconstruction at daily resolution back to the late 1770s for South Carolina tropical storms, to 1769 for minimal hurricanes, and back to 1752 for major hurricanes. A detailed reanalysis was also conducted on each potential major South Carolina hurricane for the 1871-1911 period.

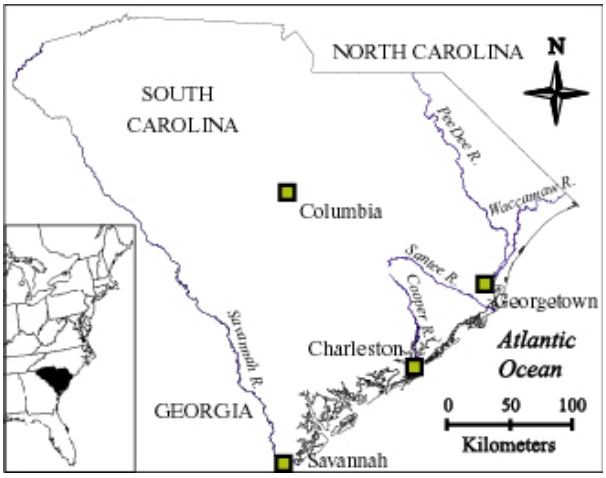

Fig. 1. South Carolina and some coastal features.

2. Historical Data

We examined historical data for the entire South Carolina coast (Fig. 1). Historical data consists of three different types: plantation diaries, early newspapers, and early instrumental records. These three data types supplement one another with different characteristics of information (Mock, in press). Plantation diaries have been proven very useful for hurricane reconstructions, as plantations were a commercial enterprise, thus careful record-keeping was essential and often detailed. Plantation diaries provide consistent daily weather records that are useful for monitoring the existence of tropical cyclones, particularly weaker storms striking less populated regions. Newspapers, such as the *Charleston Courier* and *Winyah Observer*, generally provide more detailed information on the intensity and damage from tropical cyclones than plantation diaries, including detailed descriptions of wind direction and intensity, storm surge, tree damage, and building damage (Ludlum 1963). Newspapers are generally better sources for stronger storms and contain information reported from both rural and populated areas. Early instrumental records, such as from the Charleston Board of Health and Army Surgeon General, contain verbal weather information as well as valuable numerical data of barometric pressure, temperature, wind direction and intensity, and precipitation data.

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3. Methods

This study classified tropical cyclones into three intensity categories: tropical storm, minimal hurricane, and major (category 3) hurricane (e.g., Dunn and Miller 1960). First, tropical cyclone frequencies were compiled for each year from the HURDAT database from 1851-2003, counting each tropical storm when it was centered within 100 miles of the South Carolina coastline and each hurricane within 60 miles (Chenoweth 2003). Newspaper, diary, and early instrumental data were collated for reconstructing tropical cyclones, mostly dealing with the pre-1871 period. All available sources of historical data were used to identify potential storms. In order to conclusively add a storm in the reconstruction, the data must show the classic signs of tropical systems which include sustained strong winds for quite longer than several hours, specific wind directions that indicate the motion of tropical systems, and descriptions of damage (Mock, in press). Inconsistent reports of the same event by reliable sources led to the exclusion of a candidate storm from the final list. Temperature and pressure data provide valuable information to verify tropical characteristics and estimate intensity. The intensity of each storm was classified based on conservative characteristics of the Saffir-Simpson scale (e.g., tree damage) and details of the storm surge. Generally, most storms after the early nineteenth century were described in at least ten different records, thus the results are quite conclusive. Some storms prior to 1800, however, are based on scarcer data amounts.

4. Results

Results from our reconstruction provide new specific information on over 75 storms from 1752-1868 (Fig. 2). Temporal analysis of the tropical cyclone record, smoothed by 10-year running frequencies, indicate

decadal variability in the 1830s at a level that is unprecedented when compared with the modern record. In particular, 1837-1838 was the most active year for the entire period, with four tropical cyclones affecting South Carolina for each year. The 1840-1870 period was relatively inactive in hurricane activity. It was followed by a very active period from 1870-1910 and another inactive period from 1910-1950. Return-intervals of minimal hurricane impact generally remained about the same as the twentieth century. The Western Atlantic trough was located west of today's position until the late nineteenth century (Lamb 1977), which may relate with variations of hurricane activity.

Major hurricane impact on South Carolina is clearly evident for 1752, 1804, 1813, and 1822, suggesting highly anomalous behavior in major hurricane activity in the early 19th century. Detailed analyses of the 1854 and 1885 hurricanes, which include reliable barometric pressure and copious documentary data, suggest that they were clearly below major hurricane status over South Carolina, reinforcing the importance of critical examination of primary historical data. The approaches used in this reconstruction offer a useful methodological framework for extending landfalling tropical cyclone reconstructions for other locations of the Atlantic and Gulf coasts, and for supplementing other historical data sources such as from ship logs, and comparisons with tree-ring, coral, and sediment core reconstructions.

5. Acknowledgements

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6. References

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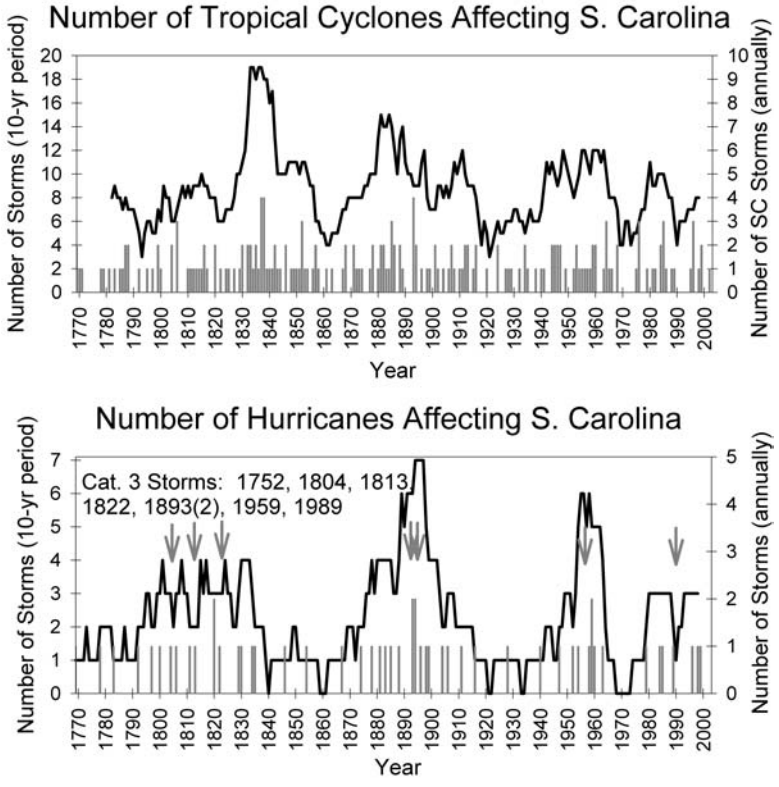

Fig. 2. Tropical cyclone frequencies (top) and hurricane frequencies (bottom) for South Carolina (top) from 1769-2003. Thick lines represent centered 10-year running frequencies. Vertical dark gray bars represent annual frequencies with respect to the right axes. In the bottom graph, category 3 hurricanes are represented by arrows and the years listed.