Appendix

Bathymetric data source and profiling methods

Bathymetry data used in this paper are from the NOAA NGDC Coastal Relief Model, available online at http://www.ngdc.noaa.gov/mgg/coastal/crm.html. The bathymetric profiles shown in Figure 2 were created using Fledermaus 3D data visualization software (http://www.ivs3d.com/products/fledermaus/).

Description of the Horton et al. (2009) sea-level database

The sea-level database presented by Horton et al. (2009) represents the most complete and best quality-controlled compilation available for the study area. Horton et al. (2009) provide a detailed description of the data sources and evaluation of age-dated materials for their suitability as sea-level index points, or as marine- or fresh-water limiting points. The gray shaded area shown in Figure 3 indicates the approximate proposed duration of the cape feature described here.

Horton et al. (2009) divided the North Carolina sea-level data into northern and southern regions, approximately through the location of the captured cape described here. Thus, we consider the Horton et al. (2009) data in aggregate.

The sea-level index points (black crosses), when combined with the limiting points (red and green), provide an envelope of sea-level elevations through the 9-4 cal kyr B.P. time period that is consistent with our inferred time-history of cape establishment and subsequent capture. For all data, horizontal bars indicate calibrated age range at 1 sigma. Vertical bars indicate most probable depth range.

Description of the coastline evolution model

The shoreline evolution modeling results presented in Figure 4 were generated using the coastline evolution model presented in detail by Ashton and Murray (2006a). The model discretizes the plan-view domain into cells that contain a fractional value representing the plan-view shoreline extension; the partially filled line of cells between empty and entirely full cells represents the shoreline. The shoreline cells are evolved using upon cross-shore conservation of mass based upon gradients in alongshore sediment transport computed using the CERC formula (e.g. Rosati et al., 2002):

$$Q_s = K H_b^{5/2} \cos\alpha \sin\alpha , \qquad (1)$$

where we use a typical value of 0.34 $m^{1/2}s^{-1}$ for the constant K (which typically depends on sediment characteristics), and the breaking wave height, H_b, and relative angle, α, are determined by taking offshore waves (with given height and approach angle) and refracting them over assumed shore-parallel contours using Snell's law.

The simulation results presented here use geometric variables and wave climate conditions approximating those of the modern Carolina coast. Simulations use a constant deep-water wave period of 8s and wave height of 1.7m, representing the weighted time average contributions to alongshore sediment transport ($\left\langle H^{12/5} \right\rangle^{5/12}$) from Wave Information Study hindcast data from 1980-1999 (http://frf.usace.army.mil/wis2010/wis.shtml). Cells are 1000m wide and a time step of 60 days is used (note that sensitivity analyses show that general model results are not affected by time step and cell size). Each time step, the wave approach angle is selected from a PDF weighted with 55% of the waves approaching from the left, looking offshore, and 60% of the waves approaching from angles > 45 degrees. This distribution resembles that experienced along the modern Carolina coast (Ashton and Murray, 2006b).

The active shoreface depth is 10m, with a shoreface slope of 0.01, and a shelf slope of 0.001 extending from the initial offshore shoreface toe (from 10m and deeper). During progradation, cross-shore mass is balanced using local shelf depth (based upon the shelf slope). Erosion extends to the shoreface depth, *D* m. Generally, the morphology, including aspect ratio, of the capes depends on characteristics of the wave angle climate (Ashton and Murray, 2006a), and the temporal scaling of model results to different driving conditions depends on the input variables according to:

$$\Delta t \propto D_{sf} K_1^{-1} H_0^{-12/5} T^{-1/5} \Delta x^2, \tag{2}$$

where Δt represents the characteristic timescale and Δx represents the characteristic spatial scale. The simulation results presented here begin with a straight coast with assumed initial white noise perturbations with a total magnitude of one cell width. The results in Fig. 4 represent a snapshot of model evolution beginning at 19,726 years until 24,657 years illustrating the characteristic timescale of cape capture along a coast with preexisting cuspate cape features.

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